International Cartographic Association
Association Cartographique Internationale

Cartography beyond the ordinary world

Joint ICA Symposium

Event organized within the activities previous to the 27th International Cartographic Conference

21–22 August 2015
Fluminense Federal University, Brazil

Participating ICA Commissions:

• Commission on Cartography and Children
• Commission on Maps and Graphics for Blind and Partially Sighted People
• Commission on Planetary Cartography
• Commission on Cartography for Early Warning and Crisis Management

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ISBN 978-1-907075-08-7

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FOREWORD

The International Cartographic Association (ICA) organizes its most important conference for cartographers all over the world, the International Cartographic Conference every two years. The organization of pre-conference events (joint meetings, symposia and workshops) became a tradition for the ICA Commissions in the last years. Their common characteristic is that commissions working on themes related each to other organize together a short (one or two days) event to give their members the opportunity of exchanging their professional experiences and results of latest research.

In 2005, before the 23rd International Cartographic Conference in A Coruña (Spain), five commissions had a Joint ICA Seminar organized at the Technical University of Madrid. Later, in 2011 four commissions and a working group organized the Joint ICA Symposium entitled "Maps for the Future: Children, Education and Internet" at the University of Orléans in France. It was followed by the Joint Symposium entitled „Sharing Knowledge" at Dresden University of Technology in 2013, which was organized by four commissions.

In 2015 four ICA commissions organized other joint event, entitled "Joint ICA Symposium on Cartography beyond the ordinary world". The participating commissions are Cartography and Children, Maps for Blind and Partially Sighted People, Planetary Cartography as well as Cartography for Early Warning and Crisis Management. Four commissions with apparently dissimilar themes, but in fact connected by a common property of their research: their members are working to find answers for cartographic questions motivated by "special" map users or situations. Children, blind or visually impaired people, natural or man-made disasters and discovering of other planets: all of them are themes "beyond" the "daily" cartography, requiring in many cases individually planned and developed solutions for all these specific cases within the actual cartography.

This event constitutes a valuable opportunity for all the participating colleagues to present the results of their research in the last two years in five thematic sessions. A special workshop is dedicated to the cartography for blind and partially sighted people, offering a general idea about the development of this area in Brazil.

The success of an event is first of all assured by the presented papers and posters, but it could not be possible without the logistic support of local organizers. Participant ICA Commissions wish to thank for the valuable help given by the Brazilian members of the Local Organ-

izing Committee and in special the efforts developed by colleagues and students from the Institute of Geosciences at the Fluminense Federal University, headed by Prof. Angelica Carvalho Di Maio.

Organizers would like to thank to commission chairs for their collaboration, as well as the participation of members of our Commissions or just participants interested in our research activities. With joining our professional experiences we contribute to make ICA and first of all Cartography a stronger factor in a wider spectrum of scientific activities involving our "special" research fields…

Budapest, 2 July 2015

László Zentai
ICA Secretary General

Jesús Reyes
Chair, ICA Commission on
Cartography and Children

I CARTOGRAPHY AND CHILDREN

Barbara Petchenik Children Map Competition – National Organization and Development

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Abstract. Barbara Petchenik map competition (BPC) has already more than twenty years history and eleventh exhibition will be held in Rio de Janeiro in August 2015 during the 27th International Cartographic Conference (ICC). A poster was designed for the both jubilees of the competition by a girl, who was a former participant. The poster is sponsored by the ICA and distributed to the national children's map competition coordinators (*Figure 1*). The national members and ICA representatives received a copy in Paris during the General Assembly (Bandrova & Reyes Nunez 2011). In this period three volumes of books with the children drawings have been published (Anderson J. M. et al. 2005, Bandrova T. et al. 2010, R. G. de Sena et al. 2015) and one more is expected this year.

Bulgaria started to organize national competition in 1999 and first participation of Bulgarian drawings was in Ottawa during ICC. Two calendars have been published using the children drawings: for 2008 and for 2015-2016 within the International Map Year. School Atlases have been designed using children drawings. The benefits of the competition are arising during its development.

The paper describes how the national competition was started and developed in the time. Several questions will find their response: what is the reason that children like to participate; what are the reasons for arising numbers of children participated in the competition; what is the usefulness for both sides from the competitions: map-makers and children. Some suggestions will be made on the base of organizational experience in Bulgaria and as well as on the base of interviews made with participants in the competition.

Figure 1. Barbara Petchenik Competition Poster.

Keywords: Children maps, Drawing competition, organization of BPC

1. Introduction

International Cartographic Association (ICA) is the only one international and professional association that organizes regularly (every two years) a map competition for children. The number of participants and participating nations in the competition are growing up from 1993 to 2015. During last competitions about 30 countries participate with more than 170 drawings. Other nations, which at present are not ICA members, also ask to participate in the competition. It is visible the great international interest is growing up because of educational aspect of the competition. Bulgaria has participated in BPC since 1999 with a great success: a price in category for the youngest children, Bulgarian drawing was chosen for the cover of the first volume of books „Children Map the World“ (Anderson et al 2005) and later 5 awards in different children groups have been received during the years to now.

The main aim of the Barbara Petchenik Children's Map Competition is to promote the creative representation of the world in graphic form by chil-

dren. Participants, children less than 16 years of age are encouraged to draw a world map on a general theme which is changed, generally every four years. There are two levels to the competition. The first level is the national one where country organizers select five (now six) maps to represent their country at the second level - the international competition (Reyes Nunez 2008).

The Barbara Petchenik Children's Map Award was created by the Executive Committee of the ICA in 1993 as a memorial to Barbara Petchenik, the first woman elected as an ICA vice-president. Barbara Petchenik's early research related to children and much of her work as a cartographer was dedicated to creating maps for children.

2. National organization and children understanding of the competition

First competitions have been organized with many personal contacts and explanations of many details were done to all participants: teachers and students. The theme for drawing a map of the world was new one for art society and many children afraid to start. After first attempts they understood that this activity will bring them not only to new drawing but also to new knowledge. This fact happened because participants started to use cartographic sources (atlases, maps) and thought on a given territory by different way than before. In interview with one of the children, she responded on a question "How you got the idea for your map and what you learned while creating it?" like this: „I wanted to draw not only a picture but a message". Another child responded that the most important thing is to love the earth – Mother Nature – and to take care of it (Bandrova et al 2010). All these responses show that children understood that we can make communications with our users by maps. This fact leads to success in the competition and better understanding of geo-space and environment around us.

One of the most important points in competition organization is media support. From first competition we had support of national radio. The support was made also by newspapers three times but after checking the results it was visible that the radio as a media is much stronger in this case. The last competitions were supported also by all available virtual media like Internet pages, Face book, LinkedIn, Tweeter, etc. One very interesting media support came also last years by National Geographic KIDS Bulgaria. They published articles about last three Bulgarian competitions within the Children's World Map contest with a lot of photos taken during the award ceremony (Bandrova 2011).

Nine National competitions were organized with results Bulgarian participation at International Exhibitions and multiple profits. The achievement of children' creative representation of the world with a theme and clear indicated rules could be one of the profits. Children begin to understand that maps are design and drawn element by element and the objects and phenomena location is connected to their quality and quantity representation. All this theoretical aspect of map creation is not clear for children in the beginning of map drawing but they use it intuitively for better drawing of their pictures. The teacher's role is very important during the entire process of the competition. Teacher should explain and lead all steps of the competition:

1. Idea of the competition;
2. Information about previous competition and clear rules indications;
3. Connections between common competition title and map title of every student;
4. Choosing of cartographic base suitable for the title;
5. Way of mapping and presentation of thematic contents;
6. Design and art presentation of the drawing.

Examples available in Internet could be used for comments in every one of above-mentioned steps. Children' drawings show the following map elements: title, legend, scale, projection, and data visualization. The complexity and difficulty of map creation is understandable by children and teachers. Even blank maps do not put in the table so many questions like this competition. If the teachers are clearly familiar of the competition's rules and aims, they will use it in geography and cartography lessons (Bandrova 2005). In addition to promoting aspects of mapping, the competition provides children with an opportunity to think about their national identity and its place within the world community (Anderson & Bandrova 2009). One of results as winner drawing could be seen in *Figure 2* where the child combines a world map with map of Bulgaria.

Additionally to these ones, teachers and children should indicate in the final product "a map" all elements described by Castner (2006): 1) THINKING about the world and some aspect of it or of a phenomenon in it; 2) DETERMINING the essential characteristics of that aspect or phenomenon; 3) ESTABLISHING a communication goal, i.e., the use(s) to which a representation will be put; 4) CONSIDERING the various forms and modes of representation that can speak to that goal; and only then 5) EXECUTING some representation that best addresses that communication goal.

Figure 2. An example from the 4th National competition "Many nations – one world", 2005.

Some of older children have a talent to express all above theoretically described elements without reading and looking other maps from different competition. This conclusion is made after conversation with the winner of our national level last competition in 2015 (see her map in *Figure 3*).

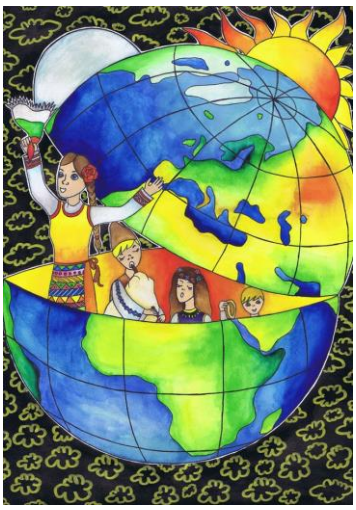

Figure 3. The winner drawing in National Competition made by Dessislava Dimitrova, 12 years old; title "The magic of Bulgarian folklore".

3. Competition levels and themes

Castner (2006) expressed that the Competition theme is perhaps the best way to focus students and teachers to address the communication role of maps. To do this the theme must pose a question or ask to consider some geographic proposition or perspective. Every new theme was highly emphasized to teachers and children. Cartographers know how it is important if the map title correspond to the map content. This fact was explained to participants in the national competitions.

Children had to draw during the years on different titles:

2013- 2015 "My place in today's world"

2009-2011 “Living in a globalized world”

2005-2007 “Many nations – one world”

2001-2003 „Safe the Earth“

1999 „A World Map“

The competition has two levels: the first one is a national level, when the local organizers select five (now six) winner maps to represent their country in the second level - the international one (Reyes Nunez 2008).

The last year Bulgarian national competition was very successful and regional versions of it were organized. On this way the competition (BPC) had tree levels. The teacher on geography Rada Miteva from Varna city described all processes of the organization and later presentations, exhibitions and prices were given (see *Figure 4*). The experience of all kind of organization, weakness and strong part of the national competition are described. The results could be good or bad examples for other organizers in national and international level.

4. Evaluation and jury

The evaluation procedure in national level was created for the first competition and it is kept the same one to now. All procedures have an idea to make the final decision more objective and less subjective. This was estimated as one of very positive element of the competition from art teachers and later from the International jury. Similar procedures exchanged the existing ones and in the moment the idea is working in International level.

Figure 4. Presentation and one of computer generated drawings from the regional competition in Varna school "Cyril and Methodius".

5. Applications and use of children drawings

The main usage of children drawings is making exhibitions for different occasions. The last one was a retrospective exhibition of Barbara Petchenic local entries during FIG Working Week in Sofia, May, 2015.

Another usage is done in designing process of school atlases. The example is an Atlas on geography and history of Bulgaria for school years 3 and 4 (ages 9-11, respectively) of Bulgarian schools. A key feature of the design is the use of children's drawings, some derived from local entries to the Barbara Petchenik map competition. Additional pictures were created by a professional artist in a complementary style (Bandrova 2003).

The promotional children drawings calendars are also available. The last one was made on occasion of International Map Year, designed by Bulgarian Cartographic Association and published by Military Geographic Service (*Figure 5*).

6. Conclusions

Having more than 15 years experience in organization of national and international levels of the competition I can declare that one of the most important point of the competition is the evaluation process. The participants could believe and know that this is one of the most objective evaluated competitions. Subject influencing is minimized by 2 aspects: including bigger number of jury members and no communication between them during the evaluation. Final decision is taken on common meeting after clear calculation of the individual results.

Figure 5. Atlas and Calendar designed by children drawings from Bulgarian entries to the Barbara Petchenik competition.

Another important point is the personal work of the organizers with teachers and children. The professional explanation about maps and mapping help the participants in clarification of many ideas they have about their drawings.

Keeping the rules is one of the points that should be underlined during the entire process of the competition. Very often the teachers neglected the rules and this make a lot of troubles to children. Such unpleasant situations could be avoided because they demotivated children to participate in the competition next time.

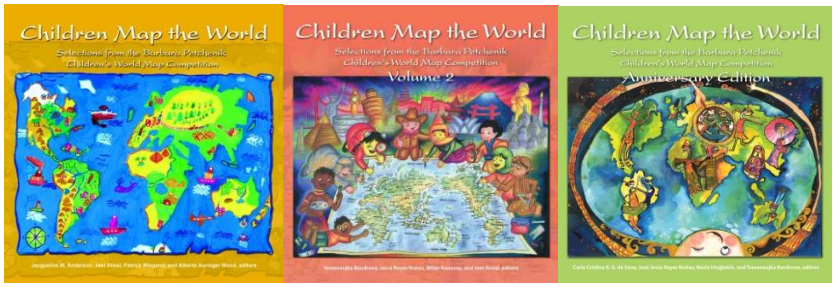

Figure 6. Three volumes of Children Map the World, published by ICA and ESRI Press.

Media performance and advertisement is the most important for including more children in the competition. Another motivation is to announce very good price for the winners. Our last price for the winner was a tablet, which provoke 100 children more to participate in comparison to previous compe-

tition. More supports and sponsors could be involved in the competition. In Bulgarian competition cartographical companies award winners by maps and atlases, as well as by books published by ESRI "Children Map the World" (*Figure 6*).

Cartographers and ICA Commission on Cartography and Children need to find more applications and way of usage of so many talented children from all over the world drawing maps and giving us unbelievable ideas for cartographical needs.

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Geoinformation tools in school: From Google Earth to TerraView

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Abstract. This paper is a reflection result of a pedagogic project for cartography education developed by the author during the year 2014. At this paper we try to reflect about the school-technology relationship and the Geo-information role at cartography education. We show the results of the project and its course through the year, bringing reflections and difficulties of its achievement through association of an experiences report and the theories about technology and school. We are especially dedicated to distinguish technical instruments and technology. We tried to think how the technology expansion and diffusion modifies what we think about the world, and how it can be absorbed by the school as way to provide the students the instruments to read the world and turn themselves subjects of knowledge, able to elaborate their own maps and space conceptions. Therefore, a dialog of scholar cartography and new technologies was developed, culminating in GIS tools role in cartography education, with much more accessible and intuitive software, providing new ways to teaching-learning and interpretation to geographic space.

Keywords: scholar cartography, new technologies, GIS in school

1. Introduction

The relationship with students and daily treatment with them provides us indicatives of their necessities and of which challenges we need to overcome to help them to improve social integration and their space activities. Thinking as a Geography teacher, understanding that the students need to know the space to act on it, is an essential element for a teaching practice (Lacoste, 2012). GIS tools and geolocalization are part of daily life with a growing importance and they influence many aspects of life: GPS, Map Tools

software and some video-games shows interfaces that needs cartographic knowledge to understand. Despite its importance and attendance, the map is still involved in mysteries and nescience about its basic elements. This ignorance makes difficult to understand issues that need multiscale space analysis and make the students feel displacement from their own place and to not associate small scale dynamics with daily event.

On the other hand, it is common to see students confused in essential questions for space comprehension such as: scale, coordinates and contour. There is also a sub-representation where the map is every space of "the other" it generates a distance that makes the students to not associate a small scale event, because just the biggest scale is perceptible for them. Only the immediately visible and perceived is designed like real and intelligible. We highlight that position is responsible, many times, for the distance between Geography Education and student experience (Lacoste, 2012: 53).

Otherwise, it is common between the students to understand the cartographic representation like a real space. Thus, an education based in local spatial clippings helps the students to understand the cartography like a partial and incomplete representation of the world, which purposes are specifics and certain. It occurs because the cartographic alphabetization is not full but not contextualized of student reality being necessary to develop a cartographic education based in "*reading*" maps (Katuta, 1997:42). This way, the students are placed in a passive position when in front of the symbols and locations learning of map, but are necessary for them to know how to read the map as representation and, by mapping, to become able to understand the signals impregnated at those.

During year 2014, it was held a cartography project which objective was to develop in students their own recognition as subject of space, able to register their mark in space. Adopting the sentences of Katuta (1997),

(...) by mapping that the student will be to conscientious about the importance of representations used in geography e will can use, therefore, to can use in a more conscientious form. However, for maps lectures, just mapping is not enough, it's necessary to domain a skill sets, notions, concepts and information so really this lecture will be meaningful. (Katuta, 1997: 43) (*free translation*)

We add these sayings that do not enough mapping and domain the set of notions, conceptions and information, it is important to the student to have clear the mapping objectives. By mapping we choose and value space as-

pects instead others aspects. Therefore, we understand that the students may be authors of their own maps. By making field research and direct observation and by selecting indicators according their objectives they can elaborate and use maps with information that they consider relevant.

From these premises, I began the work with the students. The project usually occurs at the Computer Lab and its objective was to develop the cartographic techniques and knowledge which culmination would be thematic maps of the city of Rio de Janeiro.

This project was directed at students of 7th at 9th scholar years, with ages between twelve and fifteen years old. This was intended to improve the cartographic abilities development in 6th scholar year in Geography lessons with computer lessons. Therewith, I tried to build new ways for the students to understand map and improve motivation to map production. This process allowed the students to access a plural vision about maps, specially scale and colors. According to Angélica Di Maio & Alberto W. Setzer (2011): "the computer isn't just a tool to accelerate the paper map creations: it represents a different way to visualize and to interact with maps and to rethink how these maps are showed." (2011: 216) (free translation).

The computers were prepared to classes and received the following software: Google Earth free edition, Terra View Brazilian free GIS software - and Libre Office, a document editor for data tabulation. The data were obtained at the Internet, at the IBGE website for geographic information and news webpages for popular information.

The project was divided in two steps: the first realized until the middle-year vacation (in June, because of the Soccer World Cup FIFA 2014) and the other realized at the end of classes, in December. At the first moment I taught cartographic concepts, symbols and how to elaborate sketches and thematic maps. At a second moment, I dedicate totally to the use of GIS program and elaboration of city maps.

In this paper, I relate the results and reflections raised by interaction with the students throughout the project trying to seek the relationship between school and technology and the role of Geography in this process.

2. Technology and School: Possibilities and challenges

The challenge of bringing new technologies to school is constant and is increasingly inserted into political agendas and discourses to "improve education". However, it is important to mention that despite the ordinary use of

the term technology as technological innovation or technical instrument, more than the simply presence of a computer or its software, technology is a system of knowledge which combine technical products and the ability to use and understand them.

The technology must be understood as the use of scientific knowledge to satisfy the authentic material needs of a commonwealth. Therefore, it would be part of their culture and could not be considered as mere commodity that is bought or sold as ownership. The technology would be something that is acquired by living, learning, researching, questioning and discussing. (Vargas, 2011: 52). (*free translation*)

Thereby, technology is put eminently as a specifically located social knowledge, established by science and a way of doing which is consolidated from the exchanges and needs that finds its fundamentals at determined spheres of reality.

This insertion allows us to understand technology as the systematization of a certain kind of "*know-how*" that, by being configured as science, is validated through standardized and practiced procedures (Oliveira, 2008: 3-8). This understanding allows us to understand that the school itself is a technical instrument focused on a particular purpose, the education. Thus, the debate about technologies cannot be based on a polarized issue in which the dichotomy between School and Technology is made. However, the new Information and Communications Technologies (ICT) insert a new problem for the school, by providing a quicker and more complex access to the various issues that affect both the scientific community as the daily affairs. (Silva, 2001: 839). Likewise, the requirements made no longer require a simply "*connoiseur*" of the world, but needs a formation of subjects capable of intervening and interpreting the most varied issues raised by the society and nature.

According to Milton Santos (2006), each society uses and develops a specific technical system able to respond their needs which, by being a system, works in an integrated way until it be replaced by another technical system.

The life of the techniques is systemic and so its evolution is. Groups of techniques appear at a given moment, remain hegemonic during a certain period constituting the material basis of the society's life, until another system of techniques takes its place. This is the logic of its existence and its evolution. (Santos, 2006: 114) (*free translation*)

The society adaptation to new techniques and its insertion, demands today a new commitment of the school. In a world that the diffusion and the communication are increasingly faster, the school, an element that appears at the first stage of knowledge diffusion, needs to adapt and use new strate-

gies to justify its maintenance, as shown at the documentary "Schooling the World: The White Man's Last Burden" (Black, USA and India, 2010). In a scenario in which the colonizing desire was to shape society to serve as workforce and consumption, destroying its way of life and instituting "Eurocentric" civilizing standards, schooling is imposed and replace the time ruled by the quotidian for a time ruled by the clock. Michel Foucault (1987) presents a similar review by introducing the school as an element to make "docile bodies" and drawing attention to the "standardizer" role of the school. With its structure closed, sequenced and lined up that organizes the space in order to situate each individual in their position, the school is turned into a "teaching machine" (Foucault, 1987: 125-126).

If the school technology as machine allowed its expansion, its class and knowledge hierarchy model collides, today, with the speed of the information traffic and the way of knowledge production, from contacts and relationships. The need of speed and, specially, the transformation of the subject into "full time consumer" collide with the school structure that needs exclusiveness and "arrest" the subject into a specific and strict routine. Furthermore, by not having the information monopoly anymore, the school becomes an accessory space which we do not recognize as authentic space of knowledge production. (Pretto, 1999).

Nelson Pretto (1999) shows that for the school is not enough the simple insertion of technological resources without a transformation on its way of dealing with knowledge, simply understanding it as a resource to the already established education methods. However, it's important to understand that technology is more than a simple resource. Today the world is "high-tech", in other words, the world works with a logic that is centralized at the information networks and from devices that comprise this world, the internet, as way, having centrality in this process, and the computers and, increasingly, the cellphones as way of being connected.

However, by talking about technologies, we cannot forget the fundamental, the technical instruments needed; here we find the school's great bottleneck and the need for investments. Despite the several trials, the possibility of using computers at school is still far away, either because of the lack of computers, the huge amount of students and, in many cases, even because of inappropriate power grid, as in the school of this article. At the studied school we find this scenario, the computer lab has only twenty computers and, a large part of the year, only ten were working. It causes operational difficulties and a limitation at the use of the room that is many times unavailable and cannot hold a complete class, with approximately forty students.

Thereby, by working daily with the needed instruments for the new technology, we bump into technical order problems (internet limitations and few devices). But we also bump into problems related to the legislation (at this work, conducted at a municipal school in Rio de Janeiro, during the 2014), as the prohibition of mobile phones and tablets at the classroom, devices with increasingly powerful software, capable of processing images that are more and more common for the students.

Lastly, there is no space at the teaching time to teach the use of the technique and the contents, increasingly run over and with a restricted period at the Geography subject, beyond the separation into school subjects and the absence of a school subject focused at the communication technologies. That, at this author's opinion, demonstrates a mismatch of the school with the present times. It has configured the need of a model that could enable students to experience technical instruments, to strengthen of their cartographic literacy, all of this by the use of mapping software by the students themselves.

In a time when the information and communication technologies become increasingly present and multidirectional, it is necessary to understand that the map, the techniques and languages used configure, more and more, instruments routinely used at the virtual information.

3. Sketch Cartography: First steps

The Cartography is the challenge of geography in school, but how exactly the map acts for the knowledge production in school? For a long time, the map appears as a visual resource and a text approaching (Francischett, 2008). This is a limitation of map uses. The map is a complex language that communicates, through representations and symbols, information about proportion, distance and specifics space events. To know how these events are configured in space we need to recognize the existent symbols in map. To know how to represent the lived space and read information from a map requires, this way, to understand how a map is organized.

Thereby, the project begun with exercises with students to develop the abilities of expressing information through the maps and to comprehend information existent in many maps. The activities was oriented to start the development of the ability to represent space in cartography form. The first activity was a formulation of the home-school route when I analyzed how the students noticed the space around them.

This activity was addressed to analyze the stage of students' spatial representation and their degrees of space comprehension as well as their hori-

zontal view to vertical view transposition abilities (Nedochetko & Mello, 2012). I realized that students don't draw with many details, streets and that the path is shortened or elongated without reference of metric distances, but the visual and walking perception are very important in their constructions of space. Climbs, crossings, traditional buildings and long roads are significant in their sketches (these are places that attract the eye and move the body in other direction).

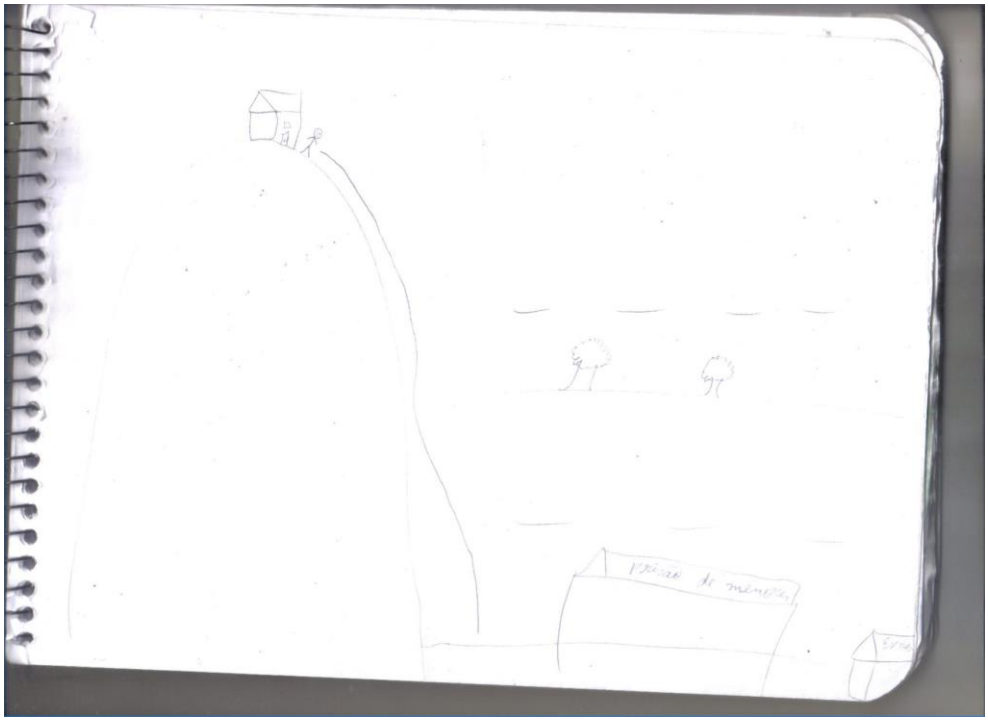

Figure 1. Example of draw of house-school route: In that the students represent as their received the space when walk for the rout, their down the climb at the school.

After the elaboration of the paths, it was shown to the students the Google Maps tool (https://maps.google.com.br), a website that allows us to view online maps and make routes. In this website each student made a home-school route. This activity mixed the horizontal view shown in "Google Street View", Google Maps' tool that allows us to make a virtual walking through street photo sequences, and the satellite view when shown through the vertical view. For this activity I intended to demonstrate the difference between both views, essential notion to understand a map and the Cartography.

The vertical view was more developed at the following activity, which the objective was mapping the school neighborhoods. This work was made

without computer at the following week; I predicted that the students would appropriate the cartography notions and develop their vertical view, resulting in a closer drawing of a map. I expressed this for the students to not repeat the same drawing the previous week. The result of this activity showed that the students were already able to represent the space with more acuity and proportionality, creating a better drawing.

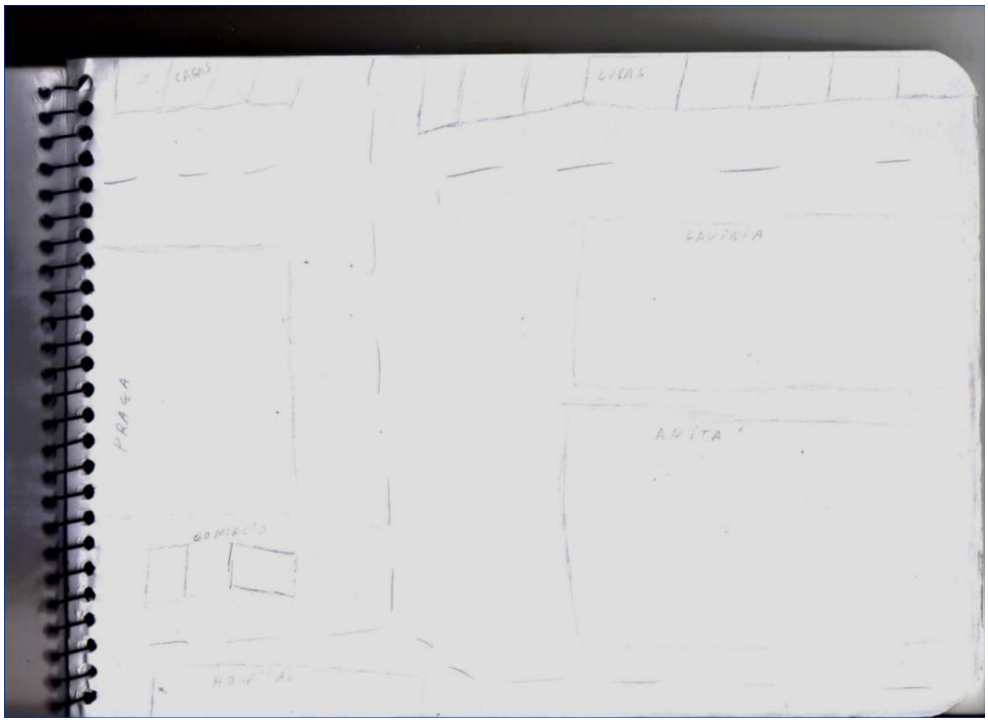

Figure 2. Neighborhood school by student vertical view: The student represented a square (named praça) and the schools (Lavinia e Anita). Although imprecise is close to real map.

At the third activity, elaborated as a bridge to students' map confection, we worked with cartography symbols. Using the Google Earth, software of Earth representation, I had demonstrated how to use scale and compass rose in map, with exercises made at the computer (with zoom tools) and exercises in the book, when the students understood the reduction scale and the orientation of compass rose.

After the students had understood the cartography basis, the first step of the project was closed. They were ready to start to elaborate maps and now the maps read could be more complex, using other elements and inserting notions as dot maps and zone maps.

4. Reading Maps: Using thematic maps

When the students understood the maps, we began to work with the information contained on the map. We started to work with zone maps and dot maps and to understand how the information can be communicated through these representations. Therefore, at this moment, we developed abilities to overcome techniques conceptions about map and allow an interpretation from the subtitles and symbols in map. We agree with Katuta when she says,

We understand that reading maps are much more that decoding of cartography conventions. It is beyond decoding the "cartography alphabet" also create meanings to that reality being or have been mapped is try know specific reality of indirect form. For this, is not enough just read the mapped facts, much less development the decoding skill. It is necessary a number of concepts, information, data and analyze categories and, most important, a world understanding logic or thinking structure, so that it can be understood minimally certain conflicting realities, but in the process of differential spatiality affect each other, making a certain territoriality. (Katuta, 1997: 44) (*free translation*).

The objective in production of zone maps and dot maps was to reveal meanings at the space as well as demonstrate what is hidden and explicit at the map production. Besides, we made the option, in that moment, to change the map scale, working with smaller scales and, consequently, working with a range of perception. Such transposition was intended to notice if the students had learned the scale notions and for them to make works with their country scale for this know this locations and orientations.

After this exhibition of a number of zone maps (climate maps, vegetation, events areas and politic maps), I asked the students to group the Brazilian states using Human Development Index (HDI) in each state. For this activity I had indicated the Internet search engine to obtain tables of HDI (under teacher supervision to check data tips) and I provided a blank map of Brazil territory with a state division. The students inserted compass rose and colors to taste, producing slightly different results, but they allowed themselves to analyze the maps and then perceived a difference in HDI in Brazil, largest in South while in Northeast and North feature lower indicators. The students developed theories and their experience in which relatives who came to Rio de Janeiro as a way to live better (the school serves the neighborhood of the Galeão, especially the Vila Juaniza community, whose origin is due to migration Northeastern). Their conclusions point the South states with more money and the North and Northeast with less money, during the class the inequality process was working and placing from personal condi-

tions of living. We highlight that the smaller scale occult internal differences, making homogeneous some areas with biggest difference in large scale. I explained that is not an error, but a scale limitation.

For more effective comprehension, to the dot mapping, we returned the use of Google Earth. I showed many dot maps (web urban maps, economic activities maps and location maps). After that, I asked to students an activity where they needed to indicate the host cities of FIFA Football World Cup 2014 realized in Brazil in the year of realization of this project. For this task, the students typed the cities names and found references to allow mark them at the map.

Some students showed more difficult in locate the cities, however most students demonstrate quite easily and could quickly locate. One student in particular marked the points in each football stadium. This fact was quite useful to explanation, because we saw the banality of that accuracy because with the scale reduction is impossible to distinguish even the host cities of the Cup.

These activities demonstrated to students that they are capable to make maps and to generate information themselves. The students felt motivated and happy with the results so far. However, we used just commons software to obtain trivial information. The next step was the use of Geoinformation software to obtain information that is more complex.

5. Reading Maps: Using thematic maps

The final activity evolved TerraView software; this propitiated new possibilities of mapping to students. In this step, we felt it more difficult in the beginning, but the students learned quickly with terms and software operations.

The proceedings initially taught were (1) table selection and map selection; and (2) generation theme from theme. With these mechanisms, they created a shape file of Rio de Janeiro city and, through the “group” command; they built the district shape files from sectors polygons (*Figure 3*).

Figure 3. District map of city of Rio de Janeiro.

After this, I asked the tables insertion for thematic maps creation. Using "Legend Edit" tool to elaborate thematic map, the students began to create maps to "carioca atlas". The first choice was an education map. Using IBGE information that were tabulated and georeferenced, the students were capable to create their first map.

This map allows the view of locals with more and less education in Rio de Janeiro city. The students perceived a raised education in South Zone while in West Zone is substantially less. When invited to reflect about it, the students elaborated an answer based in access condition of better schools and possibly a college.

The next map complicated the analysis, the students elaborated a *per capita* income map and comparing these maps and the education map, the students realized that the higher education areas were the same when occur the high-income area. This information confirms the relation between education and income. With this information, they understood the inequality in the city of Rio de Janeiro and how the IDH works in the city.

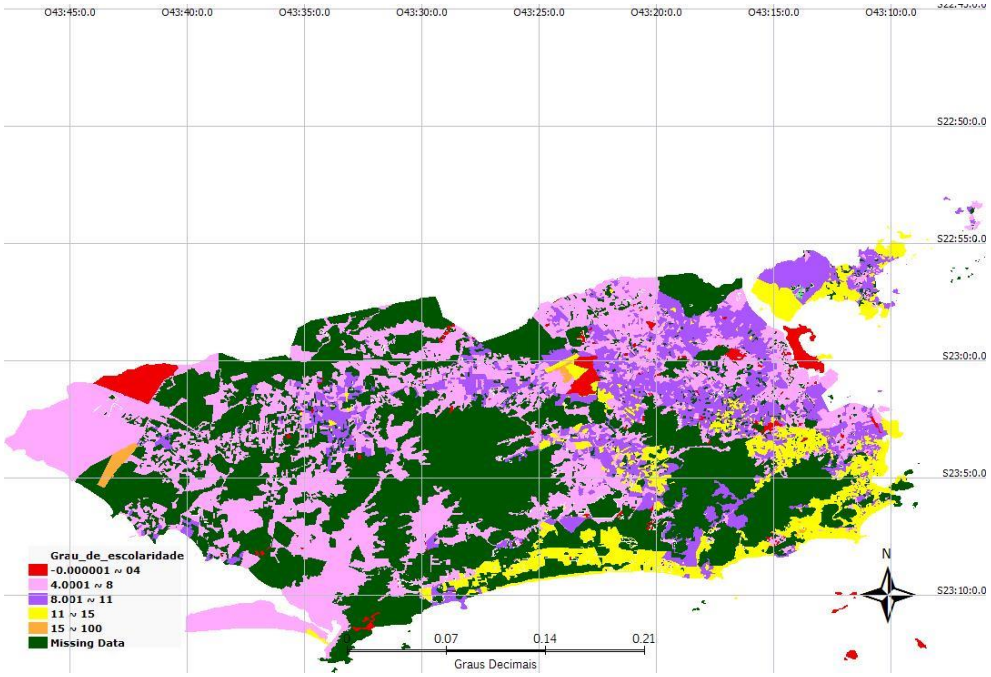

Figure 4. First student digital map. Education in city of Rio de Janeiro.

With this work the students was capable to make draw analysis from what they made on the maps they produced themselves. When the students create maps, it allows a better perception of details and the map lecture. The students questioned about the “not data” areas, stating that not simple forest areas, but areas where occurs slums. In mapping process, some city areas (and sometimes the living area of students disappeared of the map). Being capable to read and elaborate maps allows students for these elements and asks them.

6. The right of mapping yourself. Cartography as a tool to read the world.

Helping students in the process of becoming a space author, being able to read it and act on it is some of Geography objectives in basic education. Therefore, the right of mapping yourself is a chance to students realizes the differences on the map and invisibilities. Each step: distinct forms of mapping, choices made and even colors were understood like appreciation or depreciation of elements and aspects of information.

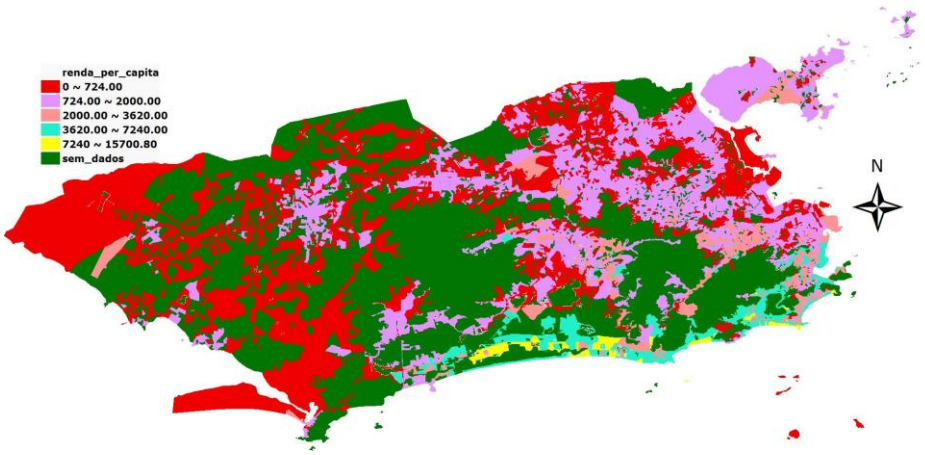

Figure 5. Income in city Rio de Janeiro map. Less polluted visually.

Technology insertion in school is necessary when we think in recent society transformations and it associates challenges. The students are immersed such that they deal easily with shown software and are able to give a high quality answer to proposed challenge. The understanding and analyzing level after the course allows understanding the software taught not only as a strict capacitation like an early professionalization, but an analytic tool for the student to become able to connect information about the space differently and deeply to become just not an information decoder, but an information generator.

It was not a simple process and was not flowers in way, difficulties were found and some were not overcome. The programs needed a special authorization to installation at the teacher's PC and were uninstalled at the students' PC, because of the configuration of the machines at the Computer Lab. It turned the knowledge slower, because needed an individual lesson with students caster at the teacher's PC. Besides the pieces broken recurrently and a small periodicity slowed the course and, the initial, namely the students' development a municipal scholar atlas was not made. These difficulties are not perennial, but circumstantial so it is not an impossible obstacle, but a challenge to overcome to insertion new subjects in reflection space.

At this paper the question raised is a need to amplify the critical analysis capacity of citizens using technological resources, teaching how to use the

available tools and software to amplify the mechanisms of countercharge and propose presentation to space use. This is a long way, but I understand how needed the association between local knowledge, academic knowledge and access to technical tools are, to allow the subjects to give a critical participation in social living, whether through intervention or the response of hegemonic discourse.

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Analysis of socioenvironmental perception on 7th grade students from Elementary School: mental maps as an educational tool in the teaching Cartography

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Abstract. Spatial practices, actions, beliefs, values and cultural habits assign subjective meaning to place´s images, even though there are traces in common that are highlighted by a group of people. A mental map is a spatial representation without rigor in the cartographic process that allows the teacher to realize students perception regarding living space through daily experiences, personal or group interpretations, perceptions and feelings. The main goal of this paper was to analyze students' mental representations from two classes of 7th grade of Escola Municipal Raul Veiga in the city of São Gonçalo, in Brazil, about their socio-environmental perception of Alcântara River from one of its river channel that runs a few meters from the school. The analysis was based on Humanistic Geography supported by the phenomenology contemplated by Gould and White, Kozel, Teixeira and Nogueira's theories. The methodology considered students' representations in two classifications, the first being related to the mental map and nature "untouched" by men and the second related to the mental map and proximity the socio-environmental "reality" of Alcântara River river channel. The purpose was analyze, interpret and identify in the drawings the level of cartographic literacy that had been acquired in the previous school years about the spatial perception of students regarding one of the river channel of the Alcântara River that runs by the students' way from the school to their homes; it is underlined that these mental maps have been analyzed and interpreted separately in each class. Results have shown a concern regarding the perception of geographic space from the student's living space and most mental maps have been restricted to the margin of the river channel of Alcântara River proposed for this spatial representation. Furthermore, it was found disproportionality among objects represented next to the river channel were noted, and difficulties regarding scale,

absence of relation between natural and artificial objects. Spatial organization surrounding the river channel was not considered, as well as relating the main factors responsible for the current environmental state of Alcântara River. Results have shown a significant deficit in the cartographic and geographic reading of these students on 7th grade of Elementary School. The use of mental maps is an important educational tool to perform diagnosis on cartographic literacy, as well as the student's spatial perception. It is underlined that the proposition for the use of mental maps in this research was to learn about students' perception regarding the socioenvironmental state of Alcântara River while considering the student as a subject of spatial representation for the study of the environment before the performance of cartographic activities through the use of geotechnologies and multimedia resources to support the teaching cartography in Geography classes by using some material available on the Internet named Mapeando Meu Rio. These mental maps are available at <http://www.mapeandomeusrios.com.br>.

Keywords: Mental map, Teaching Cartography, Socio-environmental perception

1. Introduction

Spatial practices, actions, beliefs, values and cultural habits assign subjective meaning to place´s images that according to (Lussault, 2003, p. 1), "[...] whether material or mental and whether it refers an objective reality of the physical world or an abstract ideality" shows a great variability of mental image from one individual to another, although Capel (1973) adds that there are common traces in a group of people.

Cartography instruction should not reduce the Euclidean metric that according to Levy research (2008, p. 156) *" ... it is based on Cartesian vision by extension about the idea of abstract space, independent of the objects that have on it*"; there are different forms of graphical the environment representation that can express subjectivities, values, concepts and their student´s affective relationships with the place.

For Castellar (2005), the mental maps enable students to represent the geographic space in many different spatial and temporal scales according to their interests and needs making it possible to improve the perception and representation of geographic phenomena.

The Environmental Education should include a interdisciplinary perspective that involves historical, economics, ecological and, therefore contribute to "*[...] student education prepared to understand the interdependencies*

that have been connected to their lives to a place to live" as describes Debesse-Arviset (1974, p.17). Thus, the environmental study contributes to the construction of socio-environmental perception, whose natural and social dimension are treated in a integrated manner in a holistic concept allowing changes in behavior and attitude of the students and consequently the development of environmental rationality advocated by Leff (2011).

The main goal of this paper was to analyze students' mental representations from two classes for 7th grade of Escola Municipal Raul Veiga in the city of São Gonçalo, in Brazil, about their socio-environmental perception of Alcântara River from one of its river channel that runs a few meters from the school.

The methodology considered students' representations in two classifications, the first being related to the mental map and nature "untouched" by men and the second related to the mental map and proximity the socio-environmental "reality" of Alcântara River channel; these mental maps are available at <http://www.mapeandomeusrios.com.br>. The analysis was based on Humanistic Geography supported by the phenomenology contemplated by Gould and White, Kozel, Teixeira and Nogueira's theories.

Thus, the main goal of this work is to show the contributions of mental maps as a pedagogical instrument to analyze the social and environmental perception from the student´s in cartography teaching.

2. The mental maps as pedagogical instrument in cartography teaching

Mental map is a form of graphic language that represents the perception from the individual´s about the environment through *"[...] subjective elements that [...] become more effective this representation by theirselves to include contexts that can become much better to understand the geographic space*" as describes Richter (2011, p. 125).

Gould and White (2002) describes that mental image can be formed by the contact with the place through of utilization digital media obtained on television and radio or through dialogue with another person.

In Humanistic Geography, mental map represents social, cultural and multiple senses (touch, hear, smell, taste) of everyday experience of the places.

Furthermore, it´s represents a world vision and shows an interpretation of environmental understood as a natural, cultural, historical and social landscapes. The phenomenology provides subsidies to understand the socio-environmental relations that occurred in space from everyday experi-

ence as described by Gomes (1996, p. 124), "*The lived world is therefore, source of all knowledge and legitimacy of whole conscience*".

Gould and White (2002) argue that mental maps create possibilities for an individual represents the real world through satisfactions, dissatisfactions, needs, values and actions that involves their experiences. This form of representation of spatial perception allows teachers to identify mental images from the student´s formed by their experience and direct information and immediately with environment.

Mental maps are representations of spatial perception without rigor of cartographic processes, but allows communication and reconstitution of information of the real world and so on teacher can get to know the perceptions from student´s in relation to geographic space in accordance with Richter (2011, p. 128) allows *"[...] include their subjective interpretations and/or collective*", their perceptions, concerns, feelings becoming part of spatial geographic represented by cartography are not submitted to the cartographic rules of projection, scale or precision, but spatial representations from human mind that can be read as mapping process and not as static products.

The use of mental map allows to geography teacher works to environmental education from the research and interpretation of socio-environmental perception as analyze Nogueira (2010, p. 129) and to know what everyone brings and what is obtained in relation to life with the place"; thus, cartographic activities can be developed in a way to make awareness and thus to create awareness and develop a critical vision on the students about the socio-environment conditions and to suggest reflections about their actions and attitudes on behalf of the sustainable environment.

The paper published by Teixeira e Nogueira (1999) about perception and representation of spatial contributes to research in relation to mental maps in cartography teaching to investigate an mental image formed from graduate students of third period in Geography at the Federal University of Paraná about of the campus where they did this graduation. In this sense, researchers show that mental map is a result of mental image built from experience and perception of space that investigate the perception of space and understand the geographic knowledge level from the student.

Staszak (2003) argue mental map as a form of cartographic language to understand interrelationships among individuals with environment through their relation cognitive of individual with geographic space.

Thus, mental maps allows student to change the significance to significant and so on represent environmental issues from life space and to encode e decode the spatial information. Finally to understand geographic phenomena scale that they are perceived and not from reasoning mathematical as Castro (2000) states. According to Kozel (2010, p. 2) "*mental maps as constructions with signs require an interpretation/decoding, remembering that are inserted in social, spatial and historical contexts with reference to subjective and singularities*".

According to Gaspar and Marian (1975), mental map is an image that every one of us has in relation to geographic space and to be applied in Environmental Education allows student to represent the environmental from our everyday lives and thus to express geographic knowledge.

3. Methodology

This paper consists to analyze mental maps drawn up by two classes in seventh grade groups of Elementary Education at Escola Municipal Raul Veiga about socio-environmental perception of Alcântara/RJ River.

The choice by Alcântara River as cutting spatial was related to one of the river channel of the Alcântara River that runs by the students' way from the school to their homes. According to Brazil (1998), the National Curriculums Parameters of Geography describes that place is an important concept to understand Geography as a discipline that reveals nature of places and the world as man´s habitat.

Based on Humanistic Geography were performed analyzes about mental maps that were supported on phenomenology through Kozel´s (2007) and Teixeira and Nogueira´s (1999) theories.

This study with the mental maps aims to identify levels of basic knowledge of cartography based on the assumption that the students had already learned the basic elements of Cartography (spatial orientation, legend, scale and geographical coordinates) contents from the third cycle syllabus (6th and 7th grades) of Elementary Education in Brazil, the methodology was applied in seventh-grade classes.

The methodology employed consisted of two parts: preparation and evaluation of mental maps separately in two classes for 7th-grade students in public schools, in São Gonçalo city, Rio de Janeiro State, Brazil. The practice was performed in a Geography class with two classes and so on getting 55 mental maps.

In order to discuss the importance of understanding mental maps by socio-environmental perception of environmental from the student´s in relation to Alcantara River were chose four mental maps divided into two groups, according to the specifications below: mental map and the nature "untouched" by man; mental map and the proximity to "reality" of socio-environmental channel of Alcântara River.

The mental maps were scanned and insert into in module 2: Exploring the Alcântara River in São Gonçalo/RJ on the net, named "*Mapeando Meu Rio"*, in English Mapping My River, (MMR), which is available on the net in the following electronic address: <http://www.mapeandomeusrios.com.br>. This material focuses on the socio-environmental perception of the Alcântara River, located in São Gonçalo city, Rio de Janeiro State, Brazil.

4. Results

In the search, four mental maps were selected, interpreted and analyzed in two groups in which mental map and the nature "untouched" by man and mental map and the proximity to "reality" of socio-environmental channel of Alcântara River.

The mental maps that represented the nature "untouched" by man with a feeling to the idealized nature (River with its clear waters, trees, without air pollutants) can be verified in *Figure 1*.

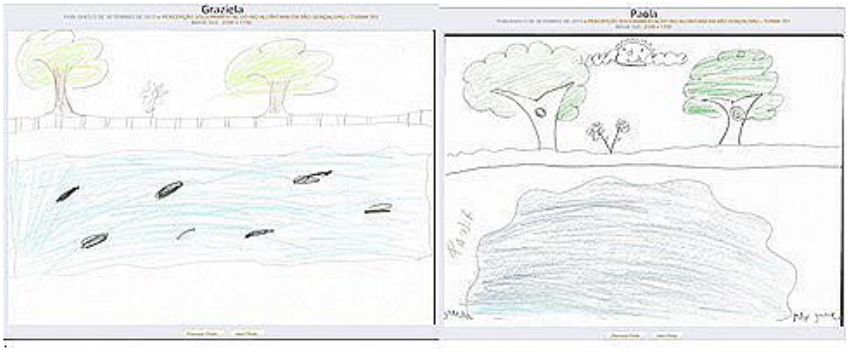

Figure 1. Mental maps that represented the nature "untouched" by man

Students´ imagery is formed by mythical conception of the nature as if around of Alcântara River was a protected natural area like a uninhabited space in which the nature remains untouched by man and as describes Diegues (2001).

Therefore, there is a geographic reading in a low level in relation to around of Alcântara River channel represented in a mental map for these students.

Archela, Gratão and Trostdorf (2004) added that mental maps allows to establish relationship between each person´s perceive your lived space. On this scope, students perceive the Alcântara River channel as a natural resource with its clear water with life since it was not represented human elements and landscape built on the channel banks like if there isn´t a conception of geographic space as shown in *Figure 2*.

Figure 2. Mental maps the Alcântara River channel as a natural resource with its clear water

Mental maps shown below represented the proximity with the "reality" of socio-environmental Alcântara River channel. There was the representation to nearest Alcântara River channel with its polluted waters, as shown in *Figure 3*.

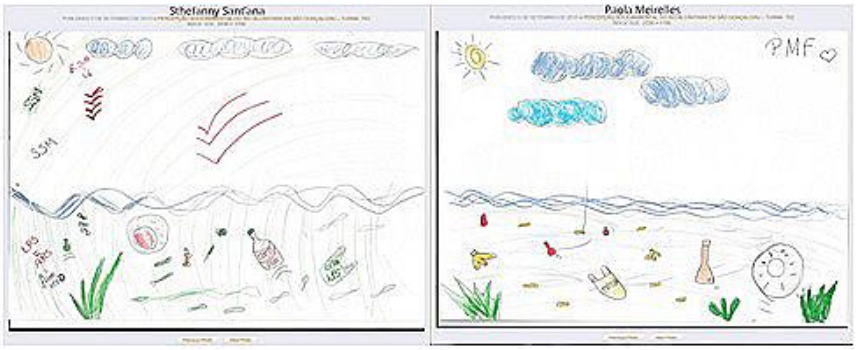

Figure 3. Representation to nearest Alcântara River channel with its polluted waters

The mental map on the left, it was observed that the vertical notions of channel banks with a reduced space, but uninhabited space and without life; there was a concern to legitimize the power of authorities to avoid attitudes and actions polluting the river channel; while, in mental map right, it

was also observed a vertical view of the channel and front view of their margins, but the spatial objects are without connecting the space re-by derogation from.

When analyze and interpret mental maps of the 701 class was detected conformity of the students in relation to water pollution of Alcântara River channel, because the spatial representations not showed in their majority, prospects of programs and actions to clean up this water resource; however, the pollution water of this River was identified, but without color relations of processes that contributed to current environmental situation of this water resource.

According to Richter (2010, p . 167), " ... *map is not reflection of reality, it passes through filters, in peculiar readings that modified its size general-to- specific*". On this scope, mental maps of *Figure 4* represent the perception of River channel as "it really shows" with its dark waters because objects were thrown out along its course.

However, mental maps above represented pollution waters of the river channel without the concern with the margins of rivers and spatial objects around it, such as houses, stores and workshops without relate as agents producers of urban space responsible for current environmental situation of this channel.

In the mental maps of 702 classes, it was found that the majority of students did not represent correlations between pollution and factors in the natural and environmental order responsible for waters degradation of the channel that became not so good for use and consumption.

Therefore, in both classes there were some difficulties in relation to basic cartographic notions such as proportionality between the channel represented or even the main course of Alcântara River and spatial objects around this water resource, in relation to the orientation of spatial objects, such as residences, trade, streets that in many spatial representations were placed without correlation with the surroundings of this channel. However, channel or the main course of this River was represented as objects more significant on the map.

5. Final Considerations

The main goal of mental maps in Cartography teaching shows an important form of graphical representation because allows teachers to analyze, interpret, understand and to know readings and geographic space perception also to check the knowledge about the main elements of cartography.

The results of mental maps showed a great concern in relation to geographic space perception from the student to place lived; the majority of mental maps were restricted to view side of Alcântara River channel. There was not concern to consider spatial organization around the river channel also to correlate the main factors responsible for waters pollution. It showed a lived space with few meaning, experience and affectivity.

To sum up, the use of mental maps shows an important instrument to work not only the basic elements of Cartography, as well as the social production of space and environmental issues of lived space. The main goal of mental maps in this research was to understand how the students perceived the Alcantara River before the activities proposed with geotechnologies and multimedia resources.

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First Brazilian Cartographic Olympiad

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Abstract. An Olympiad is an incentive to improve the academic performance of students who can be encouraged to study, in this case, to study spatial representation, orienteering and the use of maps. The I Brazilian Cartographic Olympiad (OBRAC) has national coverage and is focused on high school students, aged between 14 and 18 years, from public and private schools. Among the objectives of the event stands out: stimulating school interest in science, especially in mapping science; provide teachers with the knowledge and tools for dynamic and participatory teaching areas covering the cartographic content; providing socialization of teachers and students through group activities and foster the training of human resources to work in the field of cartography and geotechnologies. The first Brazilian Cartographic Olympiad meets a worldwide celebration, the International Map year 2015/16, which aims to provide opportunities to engage people the in art, science and technology of maps' construction and use.

Each participating school must form a team of 4 students and a teacher. The Olympics activities will be executed in four stages: first and second stages will be done at distance learning platforms. All the mapping related activities shall be prepared and will be available to subscribers on the site www.olimpidadecartografia.uff.br. Each team must perform the proposed activities and submit to the Olympic evaluation committee. The evaluation committee will select the top three teams. In the third and fourth stages these three teams will be, in the final steps, in Rio de Janeiro, where a series of practical activities will be held, including participation in an orienteering running. After the final steps the winning team will be declared the champion of the I Brazilian Cartographic Olympiad. More than 1000 teams have done the registration, this means that around 5000 students are studying, discussing and talking about cartography at the same time during the event.

It is expected that the Cartographic Olympiad, in its first edition, works as the basis for the continuity of the event and contributes to the learning and dissemination of cartography, fundamental science in the development of countries. It is also expected that the Brazilian Olympiad format, serves as an incentive for other countries.

Keywords: Cartographic Olympiad, Orienteering in School, Scientific Olympiad

Viewing Children's experience of Distance due to School Closure in Swedish rural areas

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Abstract. Living in the countryside can be complex and is often a matter of daily movements in order to make all activities fit into one's life. The structure of everyday life is also about the interplay between political decisions and physical structures. This study shows the consequences of change to the rural landscape for daily life. In this case, the change was brought about by the closure of two rural schools in Ydre, Sweden. The aim is to analyse the meaning of rural schools in the development of local society and identity, and how such meaning is based on children's time-spatial everyday stories. The study focuses on how children interpret change and the problems that arise from the closure of rural schools. Studying this is accomplished through interviews and drawings of mental maps with 28 schoolchildren of varying ages and is based on a time-geographical perspective. The study investigates local circumstances, how children adapt to structural changes, how this creates patterns in their everyday lives and activities, and how schools and private life are connected. One conclusion is that a school is not just a place for teaching; it is also an important place where children can meet; it is a part of social life; and it is a place where social networks are created and decisions about everyday life are made. It is a hub in the local society. When the local school shuts down and the children have to travel further away to another school the travel patterns, activity patterns and social networks are affected. In their drawings, children's experience of place, time and distance are expressed. This study shows that way of travel and frequency of travel is crucial for their distance assessment in both time and space. Through studies of the school closures and children's experiences, some of the complexities of countryside life and problems appear in a more human-centred and everyday perspective.

Keywords: school closure, distance assessment, time-geography

Some questions about how children and teachers learn scales on maps in Geography teaching

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Abstract. This work aims at discussing the use of scales in the teaching practice of Geography. It secondarily aims at analyzing Geography teachers' speeches in order to suggest that maps can be used as an instrument for mediation which contributes for a modification in their practices. Among the readings carried out, we have the analysis of classical references concerning the question of scales, such as Oliveira (1978), Castro (1996), Martinelli (1999) and Correa (2000) as well as other contemporary studies, which are directed to conceive a methodological and cognitive study of maps in articulation with cartography in Geography teaching. In order to formulate a new theory for the formation of Geography teachers in Brazil, these studies are articulated within certain theoretical boundaries – such as the Philosophy of Language (Bakhtin), the contributions of Learning Psychology (Piaget/Vygotsky/Feuerstein), and, eventually, the relink of knowledge (Morin) in the school. The methodology and techniques used in the development of this work focus on the implementation of several mediated learning workshops for the development of cognitive functions through the resolution of scale exercises, having Reuven Feuerstein's Mediated Learning Experience as basis. The use of this theory to promote a renewal in Geography teaching is justified by the importance given to the teacher's role in the teaching of this subject at schools, since the question of scales is both dealt with in a superficial and fragmented way and considered a problem, representing a fear for both teachers and students. In other words, we approach the question of scales searching for approximations, interfaces, continuities and discontinuities evidenced by a lot of studies concerned about the teaching of cartography at schools. This study consists of a contribution for us to reflect that the teaching of maps at schools as a language is not enough when our real necessity concerns the mediation of the spoken words, since thoughts appear to be, here, the forerunners of language acquisition, not the op-

posite. The students are finally understood as subjects and authors of scientific knowledge, in a dialogic relationship with teachers.

Keywords: Geography teaching, maps, scales, Mediated Learning.

The Guardians: Understanding historical cartography of the Bay of Guanabara

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Abstract. The project consists in the preparation of an educational game as an efficient tool supporting the process of teaching and learning. As all tools, it must be practical and efficient in its utilization. We believe that the ludic interaction, obtained by a combination of playability, well established rules, perception of patterns and also the mechanics and all the experience that an electronic game can provide, give us a strong tool to stimulate the interest for knowledge and the apprenticeship inside and outside the classroom.

The historical cartography and the records of old maps of the entry of the Bay of Guanabara during the period from 1700 to 1900 favour an interpretative analysis of the strategic importance of this place in the colonization history of the country. We therefore present the educational game "The Guardians", which is a 3D action game in the style of "Tower Defence", with the intention of highlighting the dynamics and the importance of the fortifications of the oriental side of the bay of Guanabara, through an enjoyable way of understanding. It is the pleasure of learning by playing. The game is primarily intended to schoolchildren of the district of Jurujuba but it can also be proposed to the entire population of Niterói, RJ. It is a new way of learning history. With the reading of maps, we intend to give more precision to the elaboration of the game. The confidence in this information allows and stimulates in the players a new point of view of the district and of its role in the history of Brazil. The exploration and the access of the bay of Guanabara during the considered period return us to the great navigation times and access to the town. The garrisons of the entry of the bay, with their fortifications on both sides of the bay were important. But we give more importance to the oriental side.

Using the "*Game Engine Unity*", one of the mostly used engines by independent game creators, accessible even in its *free* version, the game is designed for mobile devices with systems Android and Windows Phone. The

distribution and dissemination through mobile devices is due to the facility of getting to the targeted public, as they are used daily. The background of the game is the region of the creek of Jurujuba in the bay of Guanabara, presented in a 3D model created through 3D modelling software like Autodesk Maya and Zbrush.

Keywords: Educational game, historical cartography, local identity

Cartographical Problems for Teaching Landforms in Geography: A Brazilian Perspective

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Abstract. This paper shows part of the results of a doctorate research developed by the author, where is testified the ineffectiveness of the actual cartographical material available in most part of schoolbooks, and consequently the teaching of Brazilian landforms in Geography. Were applied some exercises in 4 schools, with pupils that are between 10-12 years old, and from different socioeconomic realities in Belo Horizonte/MG, Brazil, tracking down the way the pupils have been learning this important subject. These preliminary results show that they have very little capacity to identify the 3 different Brazilian landforms in 2D perspective maps. Some discussion about the cognitive development in this age group helps to sustain the need of a new way to produce physical maps destined to the pupils in elementary school.

Keywords: Cartography, Landforms, Physical Geography

1. Introduction

Physical geographical studies in elementary school are very important not only for the continuity of the educational processes on the Geography during the studies in the basic education, but to increase the comprehension of the wide relationships between physical spatial dynamic and anthropic actions. These relationships can be observed also in other disciplines, and in multidisciplinary studies, especially the disciplines that is related to the environment.

Studies of landforms under a Brazilian perspective have been a great challenge for all scholar community. The complexity of the physical processes that involves the formation and the dynamic of the landforms are object of many studies, but mainly directed for undergraduate students. Nevertheless, since 1996, when the last classification of Brazilian landforms was published definitely, there are no significant changes in cartographical data or in approach of this theme in schoolbooks or geoatlas for the basic education as a whole. And the maps produced to support the spatialization of these phenomena are published only in 2D perspective, being embarrass for the full comprehension of this important subject. In the last 6-7 years some satellite images were insert in a few quantity of didactic materials, but not with the clear intention of improving maps of landforms, or adopted maps considering the different cognitive stage of students. Other studies with the same problem in different countries testify many of the problems related in this paper. Michaelidou et al (2004) assert that maps with physical themes, both in Greece and in Cyprus, have been used mainly for recording things in place. There are problems with the teaching of physical Geography also in Canada, UK and USA (Day 2012).

Although it is consensual among Geography teachers that the Cartography and teaching are very important for a best comprehension of the pupil, the Cartography, not just for studies of landforms but in general lines, continue as a problem for pupils and teachers (Francischett 2002).

Interpreting and analyzing scholar maps with physical themes requires different abilities. When the themes are geology, climate, vegetation or hydrography, a map made in 2D perspective can attend many possibilities of analysis, because these themes do not requires a more accurate vision for the purposes of the studies developed in elementary school. When a study of landforms is needed, a map in a 3D perspective can improve the comprehension of many processes that has contributed to show the actual forms. Michaelidou et. al. (2004) certified that when a 3D map is used (or shading map, like they did in their studies), the comprehension of a landforms becomes better. Nevertheless, when the subject of the map involves some knowledge of hydrological dynamic associated with landforms, not always a map make in 2D perspective can attend all the possibilities of interpretation.

The problem of comprehension of inner and upper factors that contributes for the modelling Brazilian landforms starts early, when pupils that are 10-12 years old must understand themes that involve a great capacity of abstraction. Besides, some notions of scale must be consolidated, because the landforms comprehend great areas, and in this age there are some pupils that do not have this ability consolidated yet.

The cartographical language can and must be an important support for the comprehension of this complex theme, but there are serious problems with the language adopted in maps. Since early times, the cartographical language used to show the superficial forms of the Brazilian relief do not suffer significant changes. In addition, the cartographical language used with pupils in high school in most of the cases is the same used with the pupils in elementary school. Moreover, there are many studies that demonstrate that the reading of some maps requires different cognitive levels. Piaget and Inhelder (1967) argue that by the age of seven or eight, at the beginning of the concrete operational stage (approximately 7 to 12 years), children have already acquired most projective relationships and some Euclidean relationships. Therefore, they are capable of conservation (numerical), classification, ordering, and spatial reasoning tasks, but they cannot yet solve abstract problems. Another studies suggests that the concrete operational stage could happen earlier (Michaelidou et. al. 2004), but it is anyway important to reexamine the Brazilian official documents that put this matters in this stage of elementary school.

Santos (1978) reinforce that a map, in his traditional format, must be rejected. According to him, there are a secular lag among the phenomena that the geographer works, and the maps that are enforced to them. The obsolete maps (as he calls maps without meaningful information) contribute for an excessive highlight for historical and physical phenomena, even that this data do not explain well many things. Thus, the Cartography that was inherits for Geography is inconvenient for the practices of a contemporary Geography (Fonseca 2004).

2. A Very Brief Historic of Brazilian Landform Studies

The problem mentioned previously also could be explained through the antiquity of the Brazilian relief studies. There are many studies about the Brazilian relief, but in Brazilian schoolbooks three of them get special highlight. In few lines, and without make a deep analysis of each study developed so far, the first important study about Brazilian landforms was made in the decade of 1940, by the professor Aroldo de Azevedo, which has used as basic criteria the altimetry. So, he has divided the Brazilian territory in two great forms: the plains, which altitudes varies between 0 and 200 meters, and the plateaus, that have altitudes in general higher than 200 meters and in general is undulated. These great forms were subdivided by the author in 7 units. Many teachers, as a bad interpretation of this study, teach plains as a "low plan" and plateaus as a "high plan", but probably they have the intention to make these studies easier. Another important study was made by the professor Aziz Ab'Saber, which in the decade of 1950 has used

as criteria the processes of erosion and sedimentation. He also includes the morphology and climate in their analysis. So, he has considered the simultaneous acting of inner and upper factors, associating tectonics, climate, soil, hydrography, vegetation, and other physical events. Nevertheless, in this perspective he gave some special attention to paleoclimates associated with internal forces of the Earth that has contributed for the actual forms. Therefore, in their study there are two forms (plateaus and plains), but 10 units. Finally, the most actual study, made by the professor Jurandyr Ross initially in 1989, consider a wide vision about the structures that sustains the relief, as well the erosive processes that occurred during the Cenozoic Period. He used data of a project called Radam Brasil[1]. This criterion divides the Brazilian territory in three great groups of relief forms, which are plateaus, plains and depressions. Due the antiquity of the Brazilian relief (most part was formed during the Precambrian), there is no mountains, because tend to a wastage relief, having only some sierras. The Brazilian sierras have no more than 3000 meters of altitude. So, in this classification, plateaus and sierras - that have the same attribute of loss of sediments - are classified as almost the same. Concerning his common geological and time origins, this forms were raised during the Precambrian, and since then lost sediments and reduces the altitude, promoting the planning of some areas (like Central Plateau – "Planalto Central"), and reduction of the ancient mountains, forming some sierras and other residual reliefs. Then, it constitutes to the more raised forms in Brazil. On the other side, the plains received great part of the sediments that was lost for the plateaus and depressions, so it constitutes to the lower parts of Brazilian relief. The depressions have the attributes of loss and gain of sediments, but it is enclosure by areas more raised (Ross 2005[2]).

Despite the two first authors have given important contributions to the relief studies in Brazil, the study of Ross is the most prominent, because explain with more details the importance of each physical element in the modeling of the Brazilian relief, and the geological time where the most important events have occurred. Is important to mention that when studies like these are inserting in schoolbooks, some simplifications must be done, what can provoke some mutilations.

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[1] The project Radam Brasil was developed among 1970-1985, through covering of all brazilian territory by aerial images, inferred by plane. This project was very important for knowledge of natural resources and land use in Brazil.

[2] The first edition of this book was published in 1996, but in next editions maps do not suffer changes in the way of make them.

3. Material and Methods

This research was developed with 205 pupils, scattered in 4 elementary schools in the city of Belo Horizonte, Brazil. These schools were choosing considering two basic elements, which are two public and two private schools, and the families that it attends is scattered for all the city and part of metropolitan region. In all of these schools and the classes studied, it is possible to find some pupils that have apprenticeship problems. The schoolbooks that are used in all of these schools have a national reach, that is, in all the Country there are pupils that use these books or equivalent maps.

Brief Characterization of the Schools Studied

The first public school is the Pedagogical Center of UFMG (Federal University of Minas Gerais). Its origin is linked to the idea of a college of application, that is, is an elementary school that many researchers (teachers and undergraduate students of the most different sciences that are involved directly or indirectly in a scholar routine) can do his studies with its pupils. The other public school is the Military School, which have an elementary and high school and is recognized nationally as having great quality of teaching. Both schools received pupils that come from different points of the city, and have different socioeconomic realities.

The first private school is the Baptist School, which has pupils in all ages of the basic education. Although it is located in a neighborhood of middle class, it attends pupils of all social classes, especially coming of middle and high class. This school is recognized for the quality of teaching and his tradition (it has almost 100 years of history). And the other is the Christian College Grow Up that is located in the periphery of the city, and attends pupils of different classes, but mainly poor communities.

Methodology

In classes, were presented to the pupils the same traditional map with the landforms of Brazil that they have in their schoolbooks, and which was worked by the respective teachers during the last 3 months of the school-year of 2014 (year where this data survey were realized). The names of the 27 subclasses of landforms were maintained, but some keywords were removed. This was made with the objective to analyze if pupils could identify the landforms with the name of subclasses. We requested to the pupils that they read the map and after place the correct name of the landform in the correspondent space (*Figures 1 and 2*). Another important situation to relate here is the maintenance of the way the classes were organized, that is, if the pupils commonly sit in line, in duo, in U format, or other way.

Figure 1. Original map

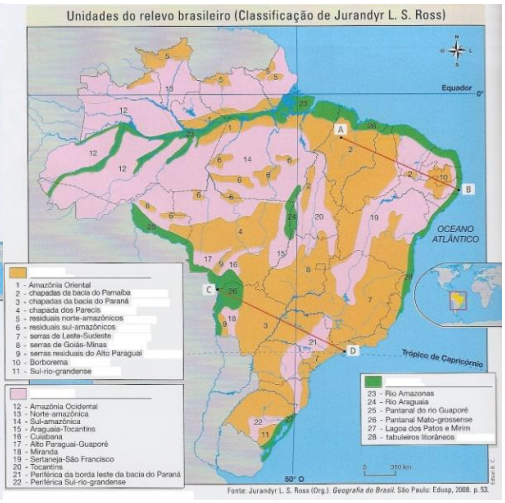

Figure 2. Map worked with the pupils

3. Results and Discussions

The results of the general and specific performance of the pupils can be analyzed in the tables 1 and 2. During the application of this test, many pupils have demonstrated some insecurity and difficulty, but they were stimulated to try to accomplish it anyway. So, the insecurity of the pupils in accomplishing the activity with success, associated with their low performance, shows that the teaching of landforms in Belo Horizonte, and also in Brazil, are in crisis. The schoolbooks that are used in two of these four schools are different, but in all of them there are maps with the same information, and texts with simple but good explanations.

Comparing the performance of pupils that study in public or private schools, we noticed that there are no significant differences. The main concern about the performance is that, considering the global performance, there are no any landforms with more than 50% of correct identification. In all of the schools studied, many pupils demonstrate to know that in Brazil there are 3 different landforms, and their names. But they could not identify them successfully in the map. Some pupils have some facility in identify plains, because this landform has some association with low areas. The same can occur with the plateaus, that have some association with high areas, but in this case many pupils make confusion with mountains (that do not exist in Brazil), that is, in imaginary of many of them, do not have plateaus that could have attributes of plans surfaces. Is important remember that sierras, under a Brazilian perspective, is part of ancient mountains erode for some inner and upper factors that occurred especially from the

Proterozoic, they have a similar shape of mountains, but not the same age, height and other actual tectonic processes. And when the subject is depressions, it is clear that there are few pupils that can understand well the dynamic of formation and evolution of this landform, especially because - considering that a depression do not fit clearly in low or high areas - the comprehension of the complexity formation process of this landform requires a great degree of abstraction. Thus, this low performance suggests that, beyond the cartographical language used, the comprehension of some physical processes is incompatible for the cognitive age stage studied in this paper. But is not clear yet what is the participation of each in these results.

Analyzing the individual performances of the public schools, only the Military School had more than 50% of correct identification in plains and plateaus - considering not just the public schools, but in all studied in this research. But their performance was low too. The Pedagogical Center has low results, but in class namely in this study as 2, most part of the pupils have identified plains correctly. This fact can be attributed to the way the pupils were organized in class, that is, in U format, and not in alignment. This organization did not occur in the class namely as 1. So, it is easier for the pupils to change information during the test with this organization. In one side the plains were identified easily, but in the other side we notice that the other landforms cannot be correctly identified with the same success, even though the change of information was occurring all the time.

In the private schools, the performance was low as well. In most part of the cases there was at least one answer made correctly, some pupils can identify plains or plateaus with more security, due to the reasons already mentioned. But the identification of depressions was under the expectation, because the initial expectation was about similar results for all landforms. It is interesting the great quantity of pupils that do not answer the questions, or had no correct answers, especially at Baptist College. If summed, almost 50% cannot identify any landforms using the maps like confectioned nowadays.

4. Conclusion

This study shows a little part of the crisis of landform teaching of and in a Brazilian perspective. In intention to increase the studies of landforms in Geography, it is highly necessary to think in two possibilities that not necessarily are complementary. One of them it is about the adoption of a new cartographical language, especially developed for the representation of landforms in a Brazilian perspective. The doctorate research that the author is developing is also looking for that. Therefore, it is important that the

schoolbooks contain maps of Brazilian landforms in 3D perspective, and the way of teaching this important matter suffer some changes. These productions and applications, as well as changes in didactic procedures in classes, must be necessary, and must be occur for support complementary studies in other areas. In addition, teachers must be producer of maps, and not just the pupils. Many efforts has been made in the sense of promoting a way to the pupils become map producers, but there are no significant efforts to prepare teachers to be map producers, as a way to complement their teaching needs in class (Almeida 2007).

The other possibility is to think in the need of develop another studies in a sense to reconsider the teaching of Brazilian landforms in a sixth year of an elementary school. These studies are necessary and must be occurring in parallel – with the important help of Psychology and Pedagogy - considering the fact that there are strong evidences that the pupils aged between 10-12 years old do not reach the adequate cognitive condition to understand, interpret and analyze subjects that demands high degree of abstraction. Therefore, for significant changes in curricular structure, beyond the consistent studies in these areas, it is necessary some political forces to make it happen.

So, considering the wide texture of processes and knowledge areas that involves an adequate relation between the teaching of landforms in Geography and an adequate cartographical language is highly necessary to think more deeply about the didactic ways for teaching landforms in Geography. There is a long way to walk in the direction of an efficient teaching of this important matter.

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Representation and scale: an introduction of Cartography in Pre-primary Education

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Abstract. All knowledge is developed by long process and does not occur by a simple transmission between people. This allows us to question the presence of principles that could introduce concepts of Geography and Cartography since Childhood Education. We think the relation between geography, cartography and spatial reasoning is important to develop geographical concepts and our studies have theoretical support on the reasoning processes studies and about the importance of the good questions for mobilize this thought. In this paper, we present an activity developed with 4 to 5 years children, who were participants of the PhD research (The relationship space-time and the School Cartography in Childhood). We relate to this the appreciation of space reasoning also in activities with undergraduate student of Pedagogy. We concluded that the use of materials and the development of activities can mobilize the thought processes to develop spatial reasoning and the representation of space in the pre-primary.

Keywords: Spatial Reasoning, Pre-primary, scale

1. Introduction

We know that all knowledge is developed by long process and does not occur by a simple transmission between people. Unlike this, the knowledge occurs through the development of concepts that support each other and the individual is the subject of learning. Based on this, some activities which involve principles of mathematics are common in early childhood education, for example, the use of Logical Blocks to the development of some notions such as form, size, color and thickness.

This allows us to question the presence of principles that could introduce concepts of Geography and Cartography. In this sense, are there possibilities of cartography be used as a language for understanding geographical concepts?

This question has been common in our research and some conclusions have been published. From one of our results, we conclude that early childhood education can perform the first approaches of geographical knowledge, which is scientific knowledge. This allowed us to prepare the PhD research (The relationship space-time and the School Cartography in Childhood)[3] and the research about the ideas of places, town and urban in the initial training of undergraduate students of Pedagogy[4], both developed at the University of São Paulo (USP).

The PhD research aims to establish a theoretical and methodological framework about school cartography for the first stage of Brazilian education: pre-primary.

For this, we have developed activities in two pre-primary school and produced data about how children solve problems, argue and elaborate their conclusions. In this article, we present the first activities in this study, which aims to promote the recognition of the space of the body and some possibilities of representation.

The other mentioned research aims to analyze how Pedagogy students think the geographical concepts, as this knowledge will be part of their teaching practice with children.

At school, geography develops learning of cartography, because it is in a language embodying spatial reasoning. It aims to develop the geographic and cartographic concepts, promoting spatial reasoning in a dialectical sense. This conception and our studies at school and university are guided by a theoretical support, which will be presented following.

2. Geography, Cartography and Spatial Reasoning

Geography's study object is the earthly space and all relationships in a space-time relationship from logical principles. The development of these geographic principles and their representations through cartography, either by drawings, maps, models or other representations, mobilizes spatial reasoning which mobilizes to think the representation and language (cartography) how its concepts (Geography). Based on this, we developed the following diagram dialectically (*Figure 1*).

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[3] Research conducted by Paula Cristiane Strina Juliasz, funded funded from The State of São Paulo Research Foundation - FAPESP. Process number: 2013 / 22654-2

[4] Coordinated by Sonia Maria Vanzella Castellar (CNPq researcher) – Process number:. 302366 / 2012-1

Cartography is a language, embodying the spatial thinking, imbued with geographic knowledge such as location, distance and connection. It is important to state that we understand that the children live and experience the space, and then are able to represent it, involving several cognitive processes related to the concepts of space and time. In this sense, we understand that the development of cartographic language occurs by cartographic education and the representation is the result of intellectual relationship with the reality.

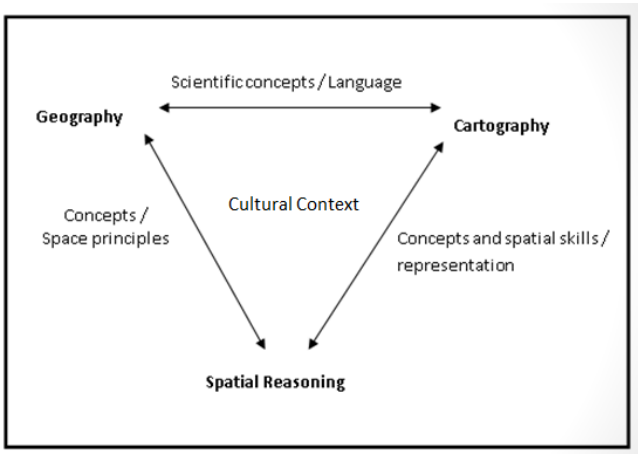

Figure 1. Relationship between Cartography, Geography and Spatial Reasoning.

We know that the cartography consists of a language and geography in a science that deals with studying the Earth's surface with all its relations. So how can we define spatial reasoning? This kind of thinking refers to the knowledge, skills and habits of mind related to the three elements: concepts of space, tools of representation, and processes of reasoning. (National Research Council, 2006).

Based on this definition the researchers Jo et al. (2010) have developed a taxonomy Spatial Reasoning, establishing that there are three components: (1) concepts of space, (2), representation tools, and (3) processes of reasoning.

The taxonomy of spatial thinking is composed of four types of spatial concepts: primitive space, simple space, complex spatial and non-spatial. Space primitive concepts are related to the basic and fundamental characteristics of an existence in space: specific identity of the place, location and magnitude.

The simple spatial concept is established by space primitive and it is composed of: distance, direction, connection, link, movement, transition, boundary, area, shape, frame, arrangement, adjacency and involvement.

The complex-space is derived from the simple spatial concepts. The authors state that "hierarchy" is developed by the combination of "location" and "magnitude" with other "linkage". Thus, combinations of simple primitive and spatial primitive produce more complex and abstract concepts. The complex-space are: distribution, standard, dispersion and cluster, density, distribution, dominance, hierarchy and network, spatial association covering layer, slope, profile, relief, scale and map projection.

Non-spatial concepts are those that do not represent any characteristic of an existence in space, such as population.

For these authors, there are three cognitive processes in the Spatial Reasoning: input, processing and output. The first consists of cognitive processes in which the person gathers information from memory. The cognitive process at this level is not responsible for spatial reasoning, but provides the basis for acquiring the knowledge necessary for it to occur.

At the second level there is a cognitive process associated with spatial reasoning, because it requires the establishment of meaning of information collected, in a superior manner.

The third level of thought refers to the generation of new knowledge or products from the information obtained from the first and second levels through the evaluation process, generalization and creation. These processes require reasoning and are considered the highest level of difficulty and complexity.

According to the authors, the three components of spatial reasoning are represented in the three-dimensional structure formed by 24 cells taxonomy. Each cell is unique, for example, the cell 1 is a non-spatial concept that does not use one representation and has the input level of cognitive processing. On the other hand, the cell 24 is a complex concept, uses a representation of cognitive process, and presents output level. Thus, the cell 1 is not related to spatial reasoning whereas the cell 24 is associated with spatial reasoning top level (*Figure 2*).

Jo et al (2010) state that spatial reasoning taxonomy (Jo & Bednarz 2009) consists of a tool to help teachers to prepare and select issues involving spatial reasoning more effectively. This is important because students can learn to think spatially by questions related to reasoning components (Jo et al. 2010).

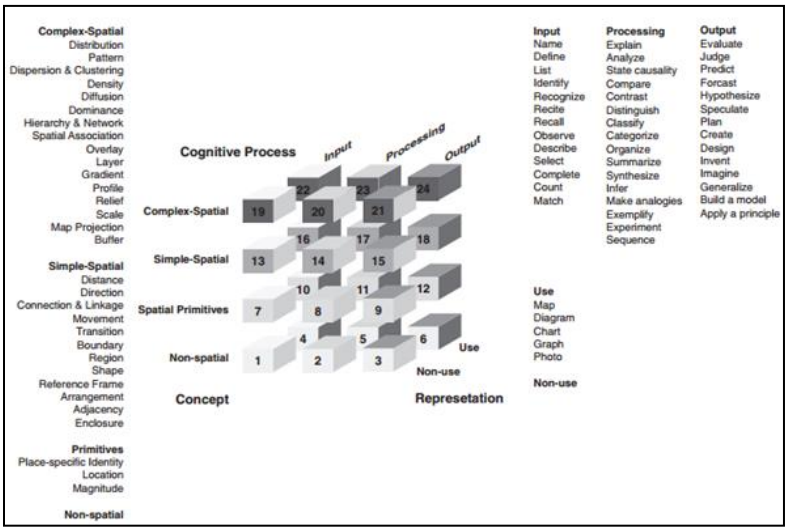

Figure 2. Taxonomy of Spatial Reasoning (Jo & Bednarz 2009)

This way of thinking the development of spatial reasoning is in line with our researches as an issue uses terms related to space, it promotes the thinking in relation to the problem in a class. Therefore it is possible to verify the role of language as a mediation of knowledge.

2.1. Spatial reasoning in Pre-Primary

To investigate how children 4 to 6 years establish spatial reasoning, we have elaborated activities. In this paper, we will discuss the first activities which had the objective to develop a concept used in cartography: the scale. Understand that a representation is not the object itself and its size can be increased or reduced involving the concept of scale. The concept of scale involves understanding that a representation is not the object itself and its size can be increased or reduced.

Thus, we chose the book “Open this little book” written by Jesse Klausmeier (2013) because children's literature can be a way to understand spatial relationships. This book begins with the phrase “Open this little book” and reveals many other books inside it.

The activity had the following sequence: a) Read and talk about the story. At this stage, the temporal concepts are developed by notions of sequence and simultaneity (a book opens the other and the reader opens the book with the character), and special concepts also are developed by notions of scale and involvement (a book is inside the other, from smallest to largest);

b) Body map in the scale 1:1. We did the body contour of a child from his body in real size; c) Body's Sculpture at a reduced size. Each child made a three-dimensional small human body and placed in a role where he or she made its outline.

In the second stage, when we asked if the outline had been equal, more or less, there was no consensus, some children said smaller, others larger and equal. So we ask for the child back into the outline, in order to verify the relationship between drawing and child. In this sense, we proposed a common action in science: the verification. Some children said that the hand was bigger, because the contour has not been done very close to the body, because of details and size, there was an exaggeration. Another factor that may explain the word "bigger" said by children is the fact that the line be done "out" of the body, which increases the size in the fact.

During the second stage, we talked about body size and their representation in paper and made the question: "If we wanted to draw the KAU[5] in this sheet (A4), how could we do it?". DAV said we could draw and this response shows hypothesis formulation.

In the third stage, some children noticed that were missing some elements that are part of the human body and they gave some solutions such as DAN who said, "I will put the modeling clay in the eye and make the outline." And LAR also noted the absence of some parts and designed the hair up and said it was like the KAU's hair, child who was previously drawn.

After drawing the sculpture, we could compare the different representations of the body, by the question: "Is this outline made by you higher or lower than this drawing (map in the scale 1:1)?" In response obtained "minor", with all the kids talking together.

When children perceive meaning in the activity, they propose solutions to problems such as the absence of element in sculpture and drawing. Therefore the activities in which children are involved and participate actively are important.

Although our aim was to understand the comparison of the size and the study of scale, we classify the graphic production of the children into four groups: a) form without much defined elements; b) contour; c) contour and face element; d) outline, face elements and inferior and superior limbs.

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[5] The children's names were abbreviated, because our aim is omit their identity.

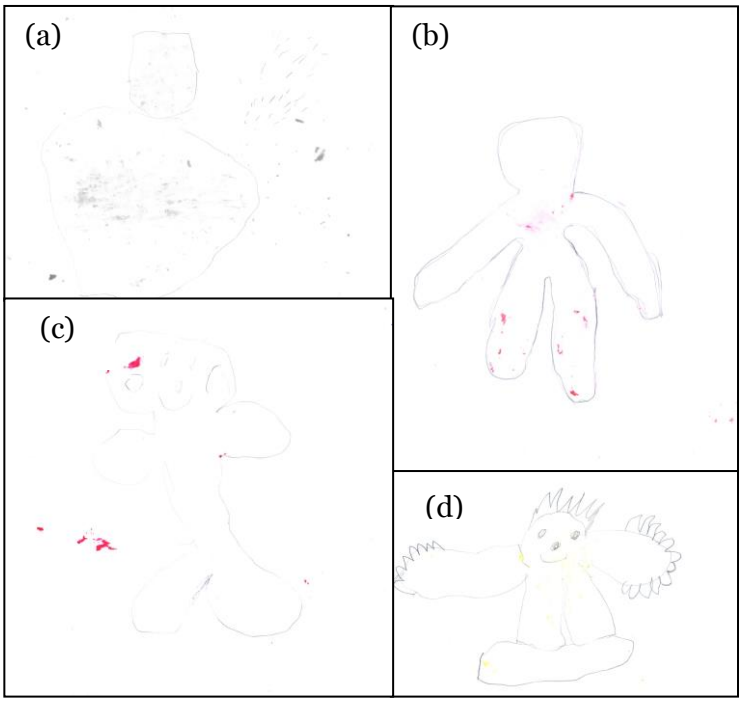

Figure 3. Doll drawings

In summary, in this activity, the children produced representations of the human body in two different ways: one full size and reduced. All these steps were based on spatial reasoning theories and education by research and argumentation. This type of activity introduces important spatial concepts such as vertical vision, mapping and scale.

2.2. Spatial Reasoning in Pedagogy Classes

From the conception of Spatial Reasoning as a process that can be developed since childhood, we began to study how would the thought of the future teacher, i.e. Pedagogy student who develop activities with the focus on geographical concepts and principles in schools.

When the cognitive dimension is involved in educational activities by the representation of a path (cognitive or mental map) or reading a thematic map, spatial relations start to guide the development process of the Spatial Reasoning. When children participate in activities, they interact with the concepts of area, size, and distance and also organize the thinking for the construction of the concept of scale and notion of proportion. In this sense, when we elaborate maps, we perform actions such as choosing and priori-

tizing the phenomena and for this we should select, group and sort the symbols to be used in the legend.

However, there have been frequent verify certain mistakes of these students in relation to the cartographic concepts, for example those related to point of view, the elementary factor for mapping an area. So, how will the teacher develop spatial reasoning?

When students developed the models of places in the city of São Paulo, after a class on reasoning processes proposed by Jo & Bednarz, we could verify the difficulty in differentiating plan view map, oblique and front view and also problems to determine the location and distance places in the mental map.

We note the importance of developing activities that involve principles such as that the parts compound a whole, i.e. the adjacency principle. In the case of the model and the map, the student mobilizes the distance and localization processes to compose the surroundings from a reference point.

We think that these activities provide us data to continue investigating and proposing alternatives in order to establish benchmarks to articulate the cartography with geography aiming to develop the Spatial Reasoning.

3. Conclusion

From our studies, we recommend the importance of understanding how children can develop their spatial skills, because this type of knowledge is also related to social knowledge, such as compare, analyze, locate places and think in hierarchies. These skills are essential for life in society. Furthermore, we emphasize that the spatial reasoning shall be present during initial teacher education because they will mobilize the children's spatial thinking at school.

If our intention is to establish references which involve spatial reasoning since pre-primary education we think it is also necessary to educate professionals of this.

We know that international studies suggest that children 3-6 years old can already start identifying places on maps, landscape features on the maps and landscapes as well as locate familiar places on maps. Children this age are able to identify the size of objects (bigger and smaller), but they can confuse the scale of an object with the number of objects therefore indicaing that at this age the concept scale shall consist on development of elementary principle such as increase or decrease an object.

When we asked the children if the representation in modeling clay is bigger or smaller than the one made in the paper on the floor, the children mobilize thought to compare elements that occupy a given space, from the notion of scale, yet to be built. We emphasize that this notion is developed by principles that should be treated in pre-primary education: bigger, smaller, big, small, extended and reduced.

We emphasize that we understand the importance of the integrated relationship Geography, Cartography and Spatial Reasoning, because in the activity presented in this paper, the scale (cartography) as a language embodies the mental representation that the child has the body of space, i.e. spatial reasoning, locating it in a another space, the sheet.

So, the question “Does this drawing have the KAU’ size?” promotes analysis of the data, while the questions “If we wanted to draw this child in A4 sheet, what would we need to do? The drawing would be bigger or smaller?” are exploratory questions about the process, instigates make predictions. When we aim to a greater reflection, we asked “Is this drawing bigger, smaller or equal to the KAU’s size?”, some children answered “Bigger” and refuted with a factor used in science called verification: “Why is it that got bigger? Let's try to prove it? KAU, please return to the contour, let's compare. - after that, we asked them - and now?”

When asked “Do this contour that you made have smaller or bigger size than this (the first, the map 1: 1)”, we aim to establish a relationship between two ideas and then to understand how children establish temporal notions of order and sequence. Other question was elaborated and we asked “what do we need to do to get this smaller size?”. This question was important to systematize the process of representation of a real object in a smaller space.

Therefore, spatial reasoning was approached in our analysis because it have involved the concepts of space, we use representation tools inserted in childhood cultures and understand the reasoning processes. The reasoning process involved in this activity consist in the spatial primitive because it refers to the basic and fundamental characteristics of an existence in space, the size, and the simple space because it treated of the shape of the object, the body and its parts and its adjancies.

In this sense, the children could see that changed the size of the representation of the human body but kept the shape and thought about the arrangement, for example what is the adjacency of the parts which compouded the whole. We note that the space complex concept is also involved in this activity because we introduce the scale concept.

We observed that children worked on the second level, the processing because the cognitive process was associated with spatial reasoning, establishing meaning of information collected. Thus, children have established a comparison and deduction to conclude that the doll drawing was smaller than the contour of the student's real size.

Another concept involved in the activity is representation, because the child may realize that even we reduce the human figure it continues to be the representation of a human body, with arms, legs, head and torso, or a whole composed of parts.

In this regard, we think the use of materials and the development of activities can mobilize the thought processes to develop spatial reasoning and the representation of space. We have stated that the Childhood Education school can be a space where enables the development of spatial ability in a systematic way and the university can promote appreciation and construction of the geographical concepts in the degree courses.

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II EDUCATION AND MAPS

Creation of new Localization Map for the University Federal of Bahia – A New Vision from Standard Thematic Mapping

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Abstract. The thematic mapping has become one of the main ways to transmit spatial information. It depends on the systematic mapping the quality of the information on thematic maps. Based on this idea, the undergraduate students from the Federal University of Bahia, were directed to create a new location thematic map purpose in order to attend the needs of all University students. Researches done with students of different courses, employees and teachers, revealed the inefficiency of the current maps of the campuses, since these maps have not fulfilled its function as a spatial information transmitter. A lot of people do not know about the existence of these maps, and to get to a unknown place they ask to another students about its location. Not to mention that these maps do not have information about the new buildings, which are part of the campuses expansion project. Given this need, the class was divided in little groups to collect remarkable points by using GPS C/A code and photographs to update the maps. Then, they used a topographic map from the Urban Development Company – CONDER as cartographic base, a georeferenced Geoglobe satellite image from Google, and the software ArcGIS to create the thematic map. The creation of the map was based on the analysis of the use of symbology and cartographic variables on maps of universities of Brazil and abroad. This article aims to transmit the need for cartography in the daily life of different people, and propose the implementation of cartographic culture in the Brazilians life.

Keywords: Thematic Map, Spatial Information, Cartography

1. Introduction

The expansion of the college education has the “Program of Support for the Restructuring and Expansion of Federal Universities” and aims to expand the access and permanence in college education. Established by Decree No. 6096 of April 24, 2007, and is one of the actions that are part of the Education Development Plan (PDE). The program actions include the increase in vacancies in undergraduate courses, expanding the supply of evening classes, promoting pedagogical innovations and the fight against tax evasion, among other goals that are intended to reduce social inequalities in the country.

In recent years, the federal government held an important recovery movement of federal universities budgets and began a vigorous process of expansion with the deployment of 49 new academic units distributed throughout the country, and the establishment of ten new universities. This required a better use of geographic space, causing noticeable changes in the visual field. Due the need to reshape these spatial transformations, represented through maps, and due to constant updates on the physical campus environment.

Serving from support for campus planning and the recognition of the different roles played in different locations, in this case to the permanent users as students, servants and teachers, or as a means for information to find something of particular interest from an audience that sporadically come to the campus (attendants of tertiary services, event participants, courses and others), the many maps found did not characterized the physical-spatial reality of campus. Based on the study of other university maps researched, sought to learn how were represented and arranged on the maps selected objects and if they satisfy the needs and location map of the user guidance, in addition to observing the representation of symbols and codes used in the language cartographic. Subsequently, within the university community, there was a perceptual test, which, according Suchan and Brewer (2000), as a method of qualitative research, is the most suitable for research in Cartography and aims to obtain solutions to generate more efficient cartographic products, based on analysis of the responses of respondents. You can promote an open and unrestricted environment in which it allows the interviewee freely express their ideas, directed through the questionnaire, but also allows them to be made comments, thoughts, opinions or suggestions unpublished. Field work included also the lifting of notable points on the ground with the use of GPS navigation, and was then represented in a GIS software.

Methods for production of maps as well as cartographic update gradually evolved with the advent of new technological processes, particularly in IT, with digital mapping, the use of Global Positioning Systems (GPS), digital imaging and System Geographic Information System (GIS). The main objective was laboring a new proposal, updated and georeferenced, themed campus map UFBA-Ondina / Federation, using digital technology for the preparation and/or updating of available cartographic base.

2. Methodology

2.1. Thematic Mapping

Cartography is divided, as Martinelli (2007) stated, in two distinct branches: Topographic Mapping and Thematic Cartography. The purpose of the Thematic Cartography is the best way to proceed so that the map expresses the facts and phenomena object of study related to the topic. The relevant science to a particular topic to gain knowledge of the truth of these facts and phenomena and it is up to the Thematic Cartography show them graphically, and therefore an aid in areas such as geology, geomorphology, meteorology, geography, demographics, among others.

The thematic mapping addresses the cartography as an instrument of expression of the results acquired by geography and by other sciences who need to express themselves in graphical form. Rosa (1996) points out that the thematic cartography is primarily concern with the preparation and the use of thematic maps, including the collection, analysis, interpretation and representation of information on a letter basis. Map maker should care more with the content that will be represented on the map than with the accuracy of the contours or the parallels and meridians network.

2.2. Mandatory Elements of a Map

A map should consist of some elements containing information like:

• Title: name that indicates what the map is representing, containing information such as the spatial area, the time and the issue in general;

• Scale: information on how many times the actual ground (if the Earth or part of it) was reduced in relation to the map, and can be numeric or graphical;

• Legend: identifies the symbols and colors used on the map;

• Orientation: points on the map the course of rose of winds;

• Projection and coordinates: the distortion is made to draw the spherical surface of the Earth for a representative plan;

• Source: author or entity responsible for map production.

The plot is based on the assumptions of graphic semiology and includes the production of maps, graphs, and networks, which are forms of representation intended in sight except for, of course, those figurative representations were, like posters, photographs, paintings, evocative drawings.

2.3. *Campi* Process Mapping

This project can be considered as a pilot project for the University as not encompassed other campuses due to the limited time for the project. However, the need for this update is mainly that most students do not know the existence of several campuses of the University. Based on this idea would be very important the extension of the project to the Canela and Piedade neighborhoods.

Action steps

Before carrying out the action steps of the upgrade project, it was necessary to carry out a survey among students, faculty and staff of various courses in the region present in the chosen region: Ondina-Federação. So were the questions asked about their knowledge regarding the existence of the current map position, and if they use it. But, according to this survey, it was noticeable lack of information due to poor quality of the existing product. And even the bad disposition of them on campus since most people did not even know of the existence of these maps. In addition to the poor quality of the maps appearing in a web environment so that web surfers can position themselves around the campuses.

During the elapsed period of the project, the team had access to topographic plan of Ondina campus-Federation, which was raised in 2010, and served as cartographic basis for the creation of the new map of the campus proposal. However, the university has undergone a renovation, and construction of new educational facilities and libraries, as well as new roads, and creating gardens and not on those things in this topographic plan. You also need to conduct a new survey to update new features now present in the region.

Procedures to Update the Campus of Surveying Plan Ondina-Federação

The procedures for this update were based, first, on a critical analysis of maps from other universities according to certain rules cartographic proposed by Nogueira (2008). Soon after it was conducted the interviews so

that they could get a sense of the public to which the map attend. Then the campus was divided into regions, where each team was responsible for updating to the collection of notable points using GPS navigation model GARMIN, new buildings, unchanging places, the process of registration on campus, and modifications to reform . The points were downloaded in the laboratory and were the junction and standardization of data in the table in Excel. The topographic base was filtered to stay with the information that met the team's needs. It was also used Google Earth tool to extract some important features and updated, since the topographical base was lagged. Polygons were generated there, based on satellite image features and exported in KML format. Then they were transformed into Shapefile format using the Quantum GIS software. These shapes were edited in Quantum GIS and the preparation of the final map layout was done in ArcGIS software.

Elements of the thematic map – proposal

The topic map consists of the following features / shapes:

- Green area - Tree;
- Green area - Grasses;
- Buildings - UFBA;
- Buildings - surrounding regions;
- Road System;
- Soccer Fields;
- Notable points.

The symbolism is: copier, bus stops, banks, food access, and concierge. Pavilions for classes have the appropriate acronyms related to them.

Map Layout

The map was drawn on the scale 1/2000 and tax on the sheet A1 (as well as the map of the current campus, available at the Federal University of Bahia site), and the selected information that would be important to represent this scale. The colors represented by each feature, form of representation of the notable points, map title, legend, graphic and numerical scale, fountains, north, are based on the concepts of thematic cartography in order to be harmony between the elements that compose it. Several tests were conducted to find a good representation, including distribution of colors, representing the noteworthy points and the position of the items that make up the layout.

3. Results

The current University map and the Proposal Map are annexed -by which are in A1 format, so that the details view you can - and have the following observations:

• **Current Map University - Campus Federation - Ondina**:

- The map shows information overload, of which his first sight there is difficulty discerning between the polygons to present overlap;
- The update of new buildings and constructions are in an unbalanced way compared to others because obey proposal used for ex .: color representation The color blue is proposal units, and the recommendation is for representation of hydrography; The red color represents units under construction, whereas the recommendation is to represent ways (depending on type)
- Some polygons have sizes that do not allow visual perception of the reader.
- The acronyms to name the buildings have no meaning or legend, making it impossible to identify the true unity nomenclature.
- Small Legend, containing little information about the basic elements: roads, follow naming and other buildings off campus that stand out because they are represented by different colors,
- It has no way of name inside and outside the campus.
- Do not have relevant information for a student like: Restaurants, Medical Services, Xerox, Internal playgrounds, and bus stop.

• **Map proposal**:

- It presents a model more "clean" writing: buildings with greater flow of people are highlighted with font size.
- Ordinances - external access to University
- Places most sought by the public university are represented: Banks, Stops Public Transport, Copiers and University Restaurants.
- It was considered the table of colors for representation of each item that makes up the map.

PS: All Maps are attached out on paper, because of scale and size – A1 format 1:2000. It allows the reader to view the details.

4. Conclusion

The results gained from this comparison demonstrates the importance of targeting the cartographer proposed by the thematic cartography, for help in interpreting the final product clearly and objectively in order to avoid visual clutter with too much information (or lack of information), and facilitates user understanding. Portrays the importance of recognizing the mapping to University, so that it establishes a relationship with the related areas, for the purpose of executing projects improved form, aligned the rules and cartographic conventions.

As there is no legislation in Brazil to Thematic Cartography, there is no universal rule, final products aim to get as close to the right following the cartographic conventions, with the aim of approaching the standard, therefore, maps that are were either very discrepant this reality, has some type of problem in interpretation.

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Map-based Geovisualization course at São Paulo State University (Brazil)

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Abstract. Geovisualization (and specifically the map-based geovisualization) is one of the scientific fields that have been growing faster and more dynamically during the last 20 years. From a pure technological point of view, two interrelated reasons can be considered the starting point of this intensive development: the use of computer-based graphic solutions and the determinant role that is playing the Web-based visualization in the representation of data.

The teaching of map-based geovisualization has become a basic topic to be taught for students in areas related not only to cartography, geoinformatics or geography among others, but also for those future specialists in other scientific areas who should use geographic information and maps in their daily activities, e.g. history, biology, etc.

The organization of the course on this topic constitutes a real challenge for the educators, because they should find a balance in the presentation of themes mainly related to data visualization and thematic cartography, as well as should decide which of the latest solutions for map-based geovisualization will be presented.

In our course we wished to give a general theoretical background and to develop some practical activities related to the most relevant current topics on Geovisualization. Each student made a project on a topic freely selected by them, making their own thematic map using one of the applications presented during the course. A selection of these works is also included in the current paper.

Keywords: geovisualization, cartography, education

1. Introduction

Cartography, geoinformatics, geovisualization: three very interrelated definitions that have become the corner stone of modern data visualization in a common and popular media, the World Wide Web. The graphic solutions developed during the common use of them have trespassed the traditional frontiers between the rigorous scientific publications for a limited community and the more general publications for all interested people, allowing the international scientific community to have faster access to specific results and at the same time simpler versions of these results can also be published for the general public.

In recent years the cartographic or map-based geovisualization can be considered one of the areas of great development due to the increasingly massive use of computational devices that integrate remote sensing images, GNSS-based positioning and mobile-based applications (apps) across the Internet. The continuing evolution of mobile phones permits the access of any user to the modern geotechnologies. Those professionals teaching Cartography and Geography need to acquire knowledge on these technologies by combining them with the study of at least basics of thematic cartography, in order to ensure the quality of produced products.

By this reason, they are unavoidable themes in the training of specialists on Geography, GIS, Cartography and related sciences. Numerous universities and other higher educational institutions have introduced the theoretical and practical teaching of these topics in their curricula. However, the dynamic development of cartography, geoinformatics and geovisualization requires professors to keep constantly updated the content of these subjects. Sometimes it is needed to organize special courses oriented to refresh the knowledge acquired a few years ago, or to complete it with the most current novelties. It was the main idea of the “Thematic geovisualization in Cartography” course organized by the School of Geosciences at São Paulo State University.

The course entitled “Special Topics: Thematic Geovisualization in Cartography” (40 hours) was offered by Prof. Dr. José Jesús Reyes Nunez during his postdoctoral visit to the Campus Rio Claro at São Paulo State University, from 15 to 18 September 2014. It counted with the participation of 22 professionals and students from different institutions in the country: São Paulo University (USP), São Paulo State University (UNESP) and School of Technology of São Paulo (FATEC-SP), Fluminense Federal University (UFF) of Niterói and Pontifical Catholic University (PUC) of Belo Horizonte, among teachers of Higher Education, Primary and Secondary Schools, graduate

students and students of the last years of the degree on Geography at UNESP (Figure 1).

Figure 1. Practical lesson during the course.

2. Thematic structure and content of the course

2.1. Structure of the course

According to our contacts with local organizers, the course was planned to have 20 hours of teaching activities (combining theoretical presentations and practices) and 20 hours of independent work for the final evaluation. The determination of topics and content to be presented in a course addressing fields like cartography, geovisualization and web-based applications constitutes a real challenge for the educators. Two premises should be filled: finding a balance in the presentation of themes mainly related to geovisualization and thematic cartography, as well as deciding which of the latest solutions for map-based geovisualization should be presented, which practical examples should be selected and explained in a limited period of time. Our decision was to divide equally the time available, preparing materials for 10 hours of theoretical teaching and 10 hours of practices.

2.2. Selection of themes

The current course is based on the “Thematic Cartography III” subject given in the fourth semester of the MSc degree on Cartography and Geoinformatics at Eötvös Loránd University. It is not only a selection of themes and a

resume of the content included in that subject, but at same time it was updated with the latest theoretical and practical knowledge, including the use of the newest web-based applications for map making.

Theoretical themes:

- Introduction: Brief history of data visualization
- Thematic Cartography I: Introduction to the French, German (including the Austrian and Swiss) and North American cartographic schools. Classification of the methods of thematic representation in the different schools.
- Thematic Cartography II: Types of thematic maps, methods of thematic representation more frequently used in each type.
- Alternative methods of representation: Cartograms, the Chernoff faces method and its use in Cartography
- Current solutions for the geovisualization of data I: web-based applications
- Current solutions for the geovisualization of data II: solutions for mobiles devices

Practical themes:

- Presentation and analysis of interactive websites for the geovisualization of data and making of thematic maps (cloud-based thematic mapping applications). Use of Google Fusion Tables to make thematic maps.
- Newest solutions in cartography: Using the "tag clouds" (word clouds and data clouds), examples of websites for the interactive making of them. Combination of different (carto)graphic methods for the representation of data.
- Introduction to the use of software to make area cartograms.

2.3. Remarks about the presented themes

Brief history of data visualization

The main aim of the introduction was to give a general background about the development of data visualization in general and specifically of map-based geovisualization beginning from 950 A.C. to nowadays. The history of the more general data visualization is important for cartography, because the graphic solutions applied for data visualization were later (or simultaneously) adapted for their use on maps too. By this reason data visualization can be considered the previous stage for the cartographic representation of data. Some examples of the specific topics presented in this part:

John Graunt as the author of the first book with demographic statistics (*Natural and Political observations…made upon the Bills of Mortality*, 1662), Edmund Halley' works (1686-1701), chats created by William Playfair (18th century), maps of Valentin Seaman (1798) and John Snow (1855), Humboldt's works (19th century), Berghaus atlas (19th century), Charles Minard's cartographic chart of Napoleon's Russian campaign of 1812 and other previous works, Otto Neurath and his Isotype method for the iconographic representation of data, Jacques Bertin's Graphic Semiology, the first computer-based maps as well as GIS- and Web-based cartography.

Thematic Cartography I & II: Introduction to the French, German (including the Austrian and Swiss) and North American cartographic schools. Types of thematic maps, methods of thematic representation more frequently used in each type.

In this topic was given a brief history of the term *Thematic Cartography* and previous denominations of this specific field within cartography. It was followed by an introduction to the main cartographic schools, presenting their most important personalities and their works, trying to resume the main characteristics of each school. A more detailed introduction to the German school was also given, followed by the classification of maps and methods of representation defined by this school. The theme was finished with a practical example about the correct and incorrect use of thematic maps.

Alternative methods of representation: Cartograms, the Chernoff faces method and its use in Cartography

This theme was dedicated to two methods of representation that were and are matters of discussion within the international cartographic community. The first one was the cartograms, presenting an introduction with the history of the method and the better known specialists, who researched on this topic (e.g. Erwin Raisz, Waldo Tobler, Daniel Dorling). It was followed by the definitions and differences between the denominations of the method in different languages, including also a discussion on its advantages and disadvantages. Other themes were: the classification of cartograms, examples of cartograms and international research projects (Reyes 2014).

Chernoff faces can be considered a special case within cartography, because it is a purely statistical method, originally not created to be used on maps. It was adapted for cartography in the second half of the 70s, but its use was not always correctly based on cartographic and graphic principles. During the presentation was briefly introduced the original method created by Chernoff and its use in Statistics, as well as were showed the first maps made using this method. Special emphasis was placed on presenting the

proposals for the use of method in School Cartography, which is based on the results of international research. A special topic was the adaptation of the Chernoff principle for its use with pictograms, showing different examples of maps made by MSc students. Finally, the results obtained during school surveys organized in two international research projects were also showed (Reyes 2010).

Current solutions for the geovisualization of data I: web-based applications

This is a theme constantly updated because of the fast and dynamic development of this field on the Web. The topic was introduced with the definitions related to data visualization and geovisualization. Different examples downloaded from the Web were used to explain solutions developed during the last years for the map-based visualization of data or to complete geovisualization with others graphic solutions. Other topic was the role of cartographic software in the development of geovisualization, more specifically of GIS-based geovisualization with a better graphic quality. Furthermore, graphic solutions less used in cartography were also introduced for the students, e.g. the possible use of tag clouds, more specifically of data clouds on maps. A significant topic was the introduction to the "Google World" and the map-based applications developed by them during the last years, as well as the Google-based applications developed by other companies, institutes, etc. Some 3D thematic mapping applications based on Google Maps and Earth were also presented (e.g. DataAppeal), together with the newest research projects developed on this theme all over the world (e.g The Copenhagen Wheel project of the Massachusetts Institute of Technology, MIT).

Current solutions for the geovisualization of data II: solutions for mobiles devices

The previous topic was an introduction to the last one, dedicated to the geovisualization on mobile devices, making special emphasis on the solutions to be used for the map-based visualization of data in Mobile School Atlases. This particular field within Cartography has not yet experienced the development that other fields (such as LBS-based navigation) have in the mobile market. By this reason, still there are open questions about how to take advantage of mobile technology in these atlases: How to use options like the positioning in space and time, the context awareness or the adaptive representation in school atlases? Can be the school atlases (or at least some of the maps in the atlas) redefined to be considered a context-aware adaptive system? Can be these atlases being developed to convert them into map-based educative applications? How to make use of geo engines for geo-exercises created for these materials? (Reyes 2013)

2.4. Practical exercises developed by the students

Cloud-based thematic mapping applications

It is a theme that cannot be eluded during the teaching of specialists related to Geography, Cartography and GIS. This field has developed considerably since 2005, when the first version of Google Maps was accessible on the Web. Today the cloud-based mapping is a tool available for and used by anyone, becoming a powerful media for the quick publication e.g. of results obtained in a research project. At same time, a powerful or limited tool cannot convert its users into cartographers, not all the maps created with these tools can reproduce the cartographic traditions developed during centuries by specialists. By these reasons is our obligation to teach our colleagues how to use these tools to make their own, cartographically correct maps.

There are different tools to make thematic maps in the cloud. Because of the limitation of time, in this course was presented one of the members of the Google "family", the Google Fusion Tables. Students had the opportunity to practice how to create their own thematic maps using this tool.

Use of tag clouds (word clouds and data clouds) on maps, examples of websites for the interactive making of these clouds.

Tag clouds are a graphic solution that became very popular on the Web in the last years. It was not originally created to be used on maps, but one of its variants gives us the option of creating a cloud based not only on words, but also on data. This variant was discussed in the classroom and some websites for the creation of tag clouds were also showed. Finally, the Tagul website was selected to practice the use of data clouds on maps.

Introduction to the use of software to make area cartograms

There are different applications and extensions for the making of area cartograms, including some free, open-sourced applications. Our choice fell on Scape Toad, cartogram software developed by the Choros Laboratory within an international project in 2005, which can be downloaded freely on the Web (scapetoad.choros.ch). The main reason of our selection was that this software is based on the Gastner-Newman algorithm (called diffusion-based method by its authors), one of the most popular methods to create the continuous area cartograms currently.

3. Course evaluations

Finishing the teaching activities, students were asked to make their own final project using any of the applications taught during the course: Google

Fusion Tables, Tagul website and ScapeToad. The theme of the work could be selected freely, according to the interests and research field of each participant. Some of the topics developed by the students:

- Description of mapping activities for the representation of São Paulo society's behavior in the context of the current water crisis
- Web-based map representing the risk of flooding for urbanized watersheds in the city of Jahú (São Paulo)
- Mapping chemicals accidents occurred in the state of São Paulo (1980-2009)
- The possible use of Chernoff faces in school atlases
- Geovisualization and Thematic Cartography: an exercise using data of the VIII Symposium on Cartography for Schools and Children
- Using Google Fusion Tables for the visualization of geographic data: Population and literacy rate in Mozambique in 2013

Some of the maps made by the students are showed on Figure 2.

The selection of themes and making of the final projects agreed to the aims proposed during the organization of the discipline and indicated the good income that had the group of participants, even in the restricted time available to carry out the activities. A common characteristic of the submitted projects is the diversity of alternatives used by the participants to solve cartographic problems involving map-based geovisualization techniques and methodologies of thematic cartography.

4. Opinions given by the students

Organizers made a questionnaire to be answered voluntarily by the participants after finishing the course. 22 participants considered the course as good, while their 50% (11 participants) considered that the course exceeded their expectations and other 50% reviewed that the course reached the expected aims. Lessons and its contents were considered good or great. All participants who evaluated the course recommend it to other people. Between the students' suggestions can be mentioned those that asked for the increase of the course load, as well as a greater detailing of theoretical and practical aspects, as well as the increasing of practical classes. An overall assessment of the participants was that they considered successful the course, having reached the initial aims, with good income and regular participation of all those involved in the activities, whether teachers as students.

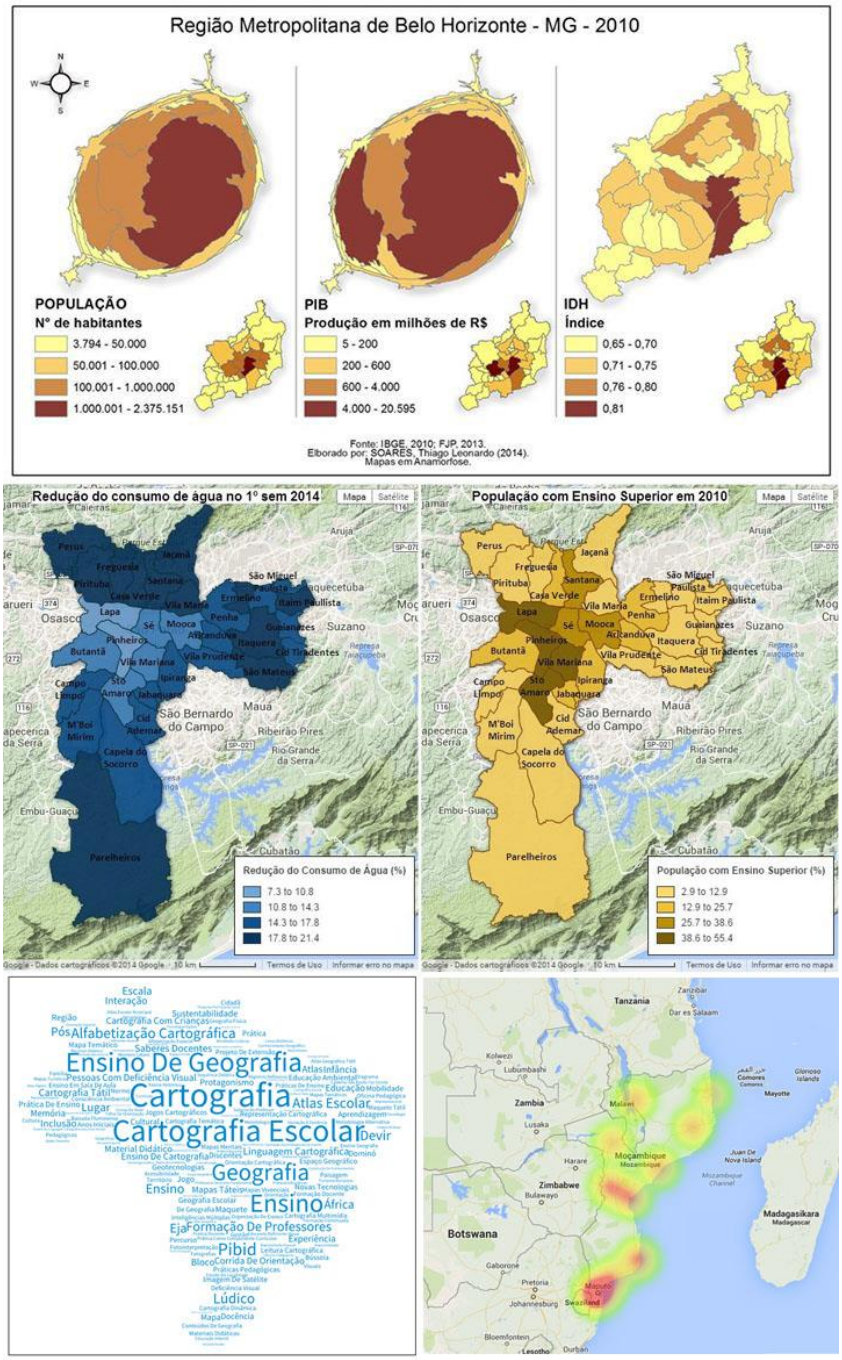

Figure 2. Selection of maps made by the students for their final projects.

5. Conclusions

The interest and enthusiasm shown by students and teachers who participated in the course, together with the results obtained by them during the making of final projects, confirmed that the aims planned during the preparation of the course were reached. In a relatively short period of time we had the opportunity to offer a general background about this theme and to focus on some practical activities that can be useful for the future specialists and teachers working on these fields. According to the conversations with the students and participating teachers they remained interested to know more about some specific themes, e.g. 3D based geovisualization and Google applications. Other international courses also reported similar experiences on the importance of these two topics: in Bulgaria, their Cartographic Association together with the Laboratory on Cartography at the University of Architecture, Civil Engineering and Geodesy (Sofia) also organized a 40hours special course dedicated exclusively to 3D Urban Visualization – Open Web technologies (Bandrova 2013). The number of courses dedicated to the teaching of different map-based Google apps has increased significantly in the last one year in Brazil, making accessible for every interested colleague the different materials and tutorials of these courses on scientific community sites like Academia.edu (Meneguette 2014). These are areas of knowledge that should be included or be presented in more detail and up-to-date in courses to organize at the future.

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III MAPS FOR BLIND AND PARTIALLY SIGHTED PEOPLE

LabTATE: The contribution of Tactile Cartography in Geography Education using accessible teaching materials

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Abstract. This text brings considerations about the trajectory of research conducted on Tactile Cartography Laboratory and School (LabTATE), under the Geography course at the Federal University of Santa Catarina, Brazil. Route that arises in a reality in which education still faces significant challenges, especially when it comes from teaching students with disabilities in regular schools. There are approximately nine years comes the LabTATE with the objective to elaborate tactile cartographic materials, especially maps, which could potentially contribute to the teaching of Geography and Cartography, and also as a result of this work, work in the continuing education of teachers. For this, in this article the projects developed by the team of teachers and researchers in the laboratory, linked to undergraduate and graduate in Geography, bringing an overview of studies, research and resources that have been created in this nearly a decade of work. In this trajectory studies and recent findings, we highlight the cartographic standards proposed for tactile maps, the LabTATE methodology for making maps, models and tactile graphics and the creation of LabTATE portal as a source of research and collection of tactile maps for education for each and every user that interest. In a brief review, the results of projects to demonstrate positive, especially when it comes from the integration of visually impaired people in formal education and the urban environment, the expansion of the communication facilities in addition to the oral and written language, but for graficacia allowing reading maps for visually impaired people, which tends to expand the horizons of spatial knowledge.

Keywords: LabTATE, Tactile Cartography, Geography Teaching

1. Introduction

In 2000 we started the first studies on the issue of education of cartography at the Federal University of Santa Catarina, these studies originated some articles that were presented at the First Ibero-American Symposium on Cartography, held in Rio de Janeiro in 2001. from that event, started the project "Cartographic Language ..." which lasted five years and the collaboration of three fellows. Meanwhile, there were extension projects, courses for teachers of the network state and municipal education. These works, in 2006, created the School Cartography discipline in the new curriculum of Geography and a line of research with the subject Geography in Educational Processes in Post-graduation in Geography.

To meet the need of the public schools of the state of Santa Catarina, Santa Catarina Special Education Foundation, requested technical support for transcription of the maps of the textbooks used in schools for maps for the visually impaired. Until that moment all the maps used by visually impaired students from public schools in the state of Santa Catarina were only figures, without any care with the elements and cartographic standard. From that first contact, the extension project that originated the first tactile map of the city center of Florianopolis emerged in 2005.

Since then, arises the project "tactile maps as inclusion of the visually impaired instrument" in order to develop standards of cartographic tactile products on a small scale to meet the teaching of geography in primary and secondary education, and also develop tactile cartographic standards for the preparation of products on a large scale. In 2006 comes the second project "The maps: they are produced and used" prepared in order to create a library of tactile maps for use by the Special Education Foundation of Santa Catarina with playback array of maps for schools in the state of Santa Catarina, the development of an educational site on tactile cartography and also a digital collection of tactile maps that can be downloaded and the organization and publication of a book divulging the results of research and extensions developed by the laboratory, the areas of School mapping and tactile.

Thus the LabTATE arises, created in 2006, with the support of funding agencies FINEP and CNPq, which finance projects creating a space that today has a collection of cartographic materials: maps, atlas, models, globes, charts, and also has a Web page intended for teaching Cartography, both tactile version, such as school Cartography.

The portal www.labtate.ufsc.br has two approaches that Internet users can access. One is on the cartography, and was thought to be used by students and teachers as learning object, ie a source of research on cartography and

production technologies maps, appropriate to the school public. The goal is to provide answers to key questions of teachers and students about the cartographic science and its main product is the map. The other approach is on Tactile Cartography and is geared to a specific audience: the visually impaired. That site the browser will find information about the tactile mapping; cartographic products and standards, finding also images of tactile and low vision maps and other products that have been developed by researchers at LabTATE, and are available to users.

It emphasizes the contribution that teaching and learning resources produced LabTATE, products of research and studies conducted, can provide students with visual impairment, as it shows as effective tools in minimizing distances and overcoming differences within the contest school.

2. Trajectories and achievements: possibilities of Tactile Cartography

2.1 Tactile Cartography and emergence of LabTATE: the theory applied to practice

For the development of maps and tactile models, as with conventional resources which have visual information, the process of preparing and cooking should exercise caution and follow a standard, which becomes a condition for the symbols and conventions cartographic are also learned and known for visually impaired users (Oka, 1999; Vasconcelos, 1993, 1996; Nogueira, 2009, 2013).

It is understood that the process of developing a tactile map or a tactile model from a printed map base ink, is not only transform what is visual in touch, we must seek to know how reading occurs the sense of touch and understand the cognitive process visually impaired happens in a different way, because only then can create maps and models that are accessible to the visually impaired.

Based on the method created from research developed by LabTATE that control with investments tests and evaluation, it was possible to prove that a visually impaired distinguish a linear feature, such as a river or a road, the smaller size is around 1 , 3 cm thickness less than this can be interpreted as a timely symbol. Thus, the development of a tactile map is not simply a transcription of visual symbols for tactile symbols, but rather a reworking of the visual variables, in order to enable the reading and interpretation of them by the visually impaired.

For the representation of what is conceived as a way in visual variables, it is necessary to escape the usual upon the common presented primarily by geometric shapes, and employing the various forms with, for example, using letters and symbols of the zodiac Greek alphabet as possible alternatives and positive interpretation by the visually impaired. As the representative areas, the test were proven that the shape, size and orientation different textures are composed on a same map, thereby differentiating tactile discrimination. See *Figure 1* with examples of the use of the symbols that we use to replace the name of the Oceans on the maps, and for some imaginary lines such as the Equator and the tropics.

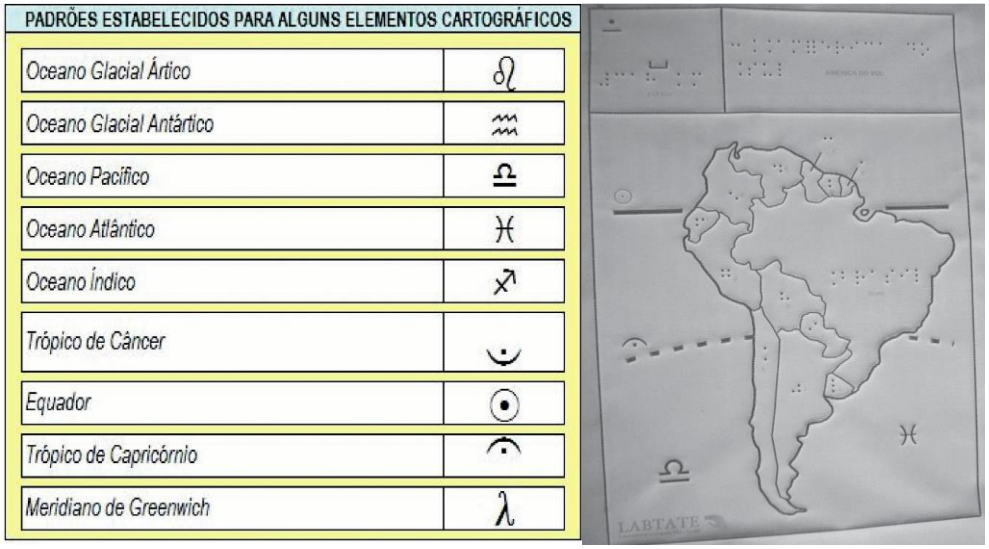

Figure 1. Some standard symbols for tactile maps on a small scale. The map was produced in automatically if microcapsule paper in A4 sheet.

During the tests and assessments carried out, it was found that people with visual disabilities discriminate the different classes presented in the areas Braille identifier, using the legend to decode it. Another key element in developing a tactile map is the layout and text on the map as a map should be understood from the arrangement of elements and texts brought in body and legend, as well as in conventional cartography. The geographical orientation, besides demonstrating the map orientation aids the positioning reading tactile map. The map scale should be preferably graphical, as it is from the reference bead size as the visually impaired person can understand the dimensions or extensions in reality.

Consider the amount of attributes or classes that a map can contain, in tests it was found that to be understood the map should not have more than two attributes in a physical thematic map, if textures are used. A solution to the

problem of many attributes would be a collection of maps, but it was found that the blind have difficulty join them mentally to understand their spatial distribution and compose the analysis of the whole.

The maps in very large scale plants and have the function of assisting in orientation and mobility are maps that use little symbols, which can assist in reading and use by the user. For these types of tactile map it is necessary to adapt specific symbols to mark important places in movement and orientation in space.

With the help of the portal LabTATE, design product that originated the LabTATE, available to all users, including the visually impaired, maps and all products were developed in the laboratory, in addition to the necessary information for making the user materials anywhere in the country.

The maps available on the site are those used in school from the first to the ninth year of elementary school; Guests maps some public places and Florianopolis streets; and maps that are part of a school atlas that was developed in tactile version and low vision.

Information on how to prepare the maps and the material needed for making them are also available on site. From the explanatory sequence the user has access to step-by-step production of a tactile map and knows the necessary materials.

It was developed and is also available on site, a catalogue of cartographic symbols drawn up by researchers and which were used on maps. This symbology was developed in order to be a proposal of signs standards for tactile maps, considering the lack of standardization, both nationally and globally.

There is also the portal, the model of a tactile globe, with the necessary information for making, explanatory content on tactile maps and models and the work and research carried out during the years of laboratory team's performance. All the resources are available to be downloaded and used by users.

The content on Tactile Cartography is available on the Internet seven years ago, and the results have been extremely rewarding. Through the site itself, users come into contact with the laboratory staff and from the received e-mails almost daily, it is possible to know how the resources available on the site are helping people accessing the page. Thus, it is considered that the site has achieved one of the objects that motivated the creation of the portal, which is to take the knowledge that have been developed by the research team LabTATE to every corner of the country, providing access to

people who would not have other ways of knowing and access similar content and materials.

2.2 LabTATE: a research laboratory in Tactile Cartography and School

In the field of tactile cartography, from the initial design, other studies have been and are being conducted by the research team of LabTATE, where cartographic products are the object of study or reference resource for the research. In 2009 the project entitled "Contribution to security and autonomy of the visually impaired in the urban space and buildings: conceptions of standardized maps" and aimed to expand the study of standards for tactile maps through a partnership with researchers from other Brazilian cities, to jointly define these standards, aided by the blind community. The project had sequence in the years 2006/2007, during which were performed cognitive tests. Based on the results of this evaluation, new standards for tactile maps from the perspective of the blind were created, considering the urban center and indoor public environments with wide circulation. Thus, it became possible to aid blind or teach to read maps to locate and locomotion using a map previously

Also in 2009, there was the extension project "Creating the tactile map of UFSC", with the proposal to revamp the maps of the campus of UFSC, as the previous model did not meet the needs of users. This project also resulted in the making of the University tactile map.

In 2010, the lab team developed a research project resulting from a partnership between researchers in the field of geography, cartography and Psychology. The project aimed to investigate the process of developing geographical concepts in students with visual impairments, with the contribution of tactile mapping. This research resulted in a master's thesis and articles published in events, books and journals in the area Geography and Psychology.

In the same year came the extension project "geographic education: complementary approaches to building a meaningful learning" in order to conduct a interdisciplinary work from the Geography discipline in school Florianópolis city's public network. The project activities were carried out through observations 'in situ' with the aid of maps, in which children were instructed to observe the environment and identify the elements contained in the maps. For activity didactic materials were used that in addition to working within the project remained in school so they can be used in future practical activities. In this way, students can better know the importance of

environmental preservation, as well as get acquainted with the cartographic language.

In 2011, work began on the project "Cooperating for educational inclusion of visually impaired: tactile geographic atlas and low vision of Portuguese-speaking countries", aimed to develop and make available on the site LabTATE a school geographical mini-atlas of Mozambique for the blind, from the perspective of universal design and accessibility for all. It began in the same year, and is still developing the extension project "Mini Atlas of states" which is to create an atlas for the blind in the states of Brazil and make available models on the internet and to the central library accessibility sector UFSC. This project will end result in a tactile mini-atlas, with representation of 17 Brazilian states. A fact to highlight is the possibility Atlas use by people with impaired vision through the use of low vision map.

In 2012, a master's research was carried out "Tactile Graphics to teach Geography" which proposed to apply and analyse a methodology to teach geography based on drafting, reading and interpreting graphs, produced from the reality experienced in data an inclusive classroom. As proposed goal, the project had the participation and interaction of students in data collection precession, production, reading and interpretation of graphs made. With this research, we took up the opportunity to bring a classroom that had the presence of a student with visual impairments an inclusive methodology, which relied on the help of teaching resources and incentives for socialization among students. This was a pioneering year LabTATE research, given that the production of tactile graphics, up to then had been ignorant.

Also in 2012, there was the project "Construction and adaptation of educational resources for the visually impaired in higher education undergraduate degree in Geography". This was a project that aimed at the construction or adaptation of teaching materials such as charts, diagrams, graphs, maps, images, models and others to provide support to school of geography teachers of the course who rely on the presence of a student blind. In this project, the LABTATE had the support of informational accessibility Environment Service - AAI located in the UFSC Central Library.

In 2014, he began a master's research linked Graduate Program in Geography UFSC, in which a blind student intends to investigate the choice of urban routes for disabled and proposes a discussion beyond the visual landscape, contemplating other references sensory used by the visually impaired. Therefore, the students use technical support and material produced by LabTATE.

It is currently developing another master's research, research that began in 2013 with the completion of course work in geography, and proposes the creation of tactile atlas of the city of Florianópiolis / SC, which also brings the tactile and cartographic material in link, plans to hold a discussion on how these maps can be developed for people with and without visual restrictions, which cartographic elements must be present and how the resource can be exploited by teachers and school.

The following projects were also begun in 2014: "Atlas tactile and tactile computer model. Continuity and advances in LabTATE", "Tactile Atlas and low vision of Portuguese speaking countries: Angola", which is the second country of the Portuguese language to receive our atlas. Unlike the mini state atlas having 7 themes, the Portuguese language atlas is resource with a larger number of subjects, and different titles. This project aims to fabricate an atlas by year; however, points out the difficulty in obtaining base maps that can be used for making of tactile maps.

In time still stand out the PhD project, "cartographic literacy of visually impaired people: a methodology of tactile mapping." This study aims to understand how blind children learn the geographic space, from the development of an alternative methodology support of tactile teaching materials and tactile maps for cartographic literacy and building spatial concepts. And the search for "The school as space of minorities: the teaching of Geography returned to living with diversity." This is a job you want to open the approach range of studies returned by LabTATE, seeking foundations of inclusive education to think about teaching and learning geography, but also bring evidence for establishing and preparation of cartographic products tactile.

3. Conclusion

In this article we tried to emphasize part of the trajectory, experiences and initiatives developed by the team of researchers LabTATE. Teachers and students have as a research focus teaching of cartography and geography that can overcome the existing barriers in the process of teaching and learning is to psychics or people with visual impairments.

Due to the needs of a deficient education was born LabTATE and its internet portal, which today are configured as spaces, one real and one virtual, socialization skills, that may contribute to the realization of actions aimed at minimizing inequalities experienced by the society and meet the need for education.

As a legacy, the LabTATE today has a collection of about 200 maps divided between tactile maps and low vision available on their website, which also includes the publications of the latest research and developed with dissertations and theses.

Expresses here the feeling of self-realization in order to develop projects, which like these bring positive results and reach the goal of providing resources that can provide support to students and teachers, contributing to the proposed overcome the barriers that impede access to cartographic and geographic knowledge.

The records and testimony that has been received from all parts of the country, people who access and use the site, motivate us to continue both with regard to the expansion and continuity of LabTATE portal that every project undertaken offers new content, as developing new proposals, as the other projects are always designed with the intention that people can overcome barriers and minimize differences.

In the course of carrying out the projects rely on the collaboration of some people and institutions that have contributed significantly to research. Thus, it is necessary to acknowledge the collaboration of the people of Santa Catarina Foundation for Special Education, Santa Catarina Association for the blind integration, teachers, students and scholars who participated in the preparation process of tactile maps and evaluation of the site, contributing much with the development of projects.

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Tactile Cartography: Development of Teaching Materials for blind students

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Abstract. The aim of this work is to report the study about Tactile Cartography that was developed by an association between researchers from three Institutions of Higher Education (IHE), Universidade Estadual Paulista – UNESP, Campus de Rio Claro, Universidade Federal do Rio de Janeiro - UFRJ and Universidade Federal de São João del-Rei – UFSJ. The purpose of the project is to develop strategies and tactile teaching material to spread the Tactile Cartography around cities from Minas Gerais State in order to give both, blind students and teachers support during the learning process. The study takes place in Belo Horizonte City - MG, at São Rafael Institute. There are 36 blind students from primary school and education for young people and adults, and 2 teachers taking part on it. The methodological approach is based on the historic-cultural aspects and the previous experience of UNESP Tactile Cartography group. The procedures are: a) collecting data by using a questionnaire; b) manipulation of textured materials by blind students; c) development of tactile maps and miniatures with and without sound resources; d) Workshop involving researchers from the three IHE; e) promotion of extension course; f) Website development. The experience gained at São Rafael Institute guides the development of procedures and teaching material, and influences the research dissemination. The result of the project proves that there is a lack of materials and resources concerning teaching Geography to visually impaired or blind students at the Institute, and it also show how important it is to hear the experience and feelings from people who are involved in the learning process in order to establish a rapport and guarantee people's right.

Keywords: Tactile Teaching Material, Blind Student, Teaching Geography

1. Introduction

According to Brazilian law, all students shall have equal access to education, including the ones who have special educational needs (SEN). As reported by Salamanca Statement (1994, p.3) SEN students are:

Disabled and gifted children, street and working children, children from remote or nomadic populations, children from linguistic, ethnic or cultural minorities and children from other disadvantaged or marginalized areas or groups.

Integrating a SEN student involves promoting his/her participation during the learning process and the school routine. When the learner is a blind one, it is important to provide him/her aids that help to explore the school environment. Furthermore, pedagogical support and development of tactile material are essential to integrate this student (Silva et al. 2014).

There are few Tactile Cartography representations available in schools. It happens because of many aspects, for example, the lack of materials and equipment, high cost of production, and others (Carmo 2009).

Almeida (2011) talks about how the lack of tactile materials makes it difficult to teach geographical topics for blind students. According to the author, this kind of material supplies students with abstract and structured spatial awareness, and because of this, it is crucial on Geography teaching.

This means that there is a requirement around the development of tactile material concerning Geography teaching for blind learners (Silva et al. 2014).

Regarding the international research about Tactile Cartography, that has been researching for more than a century, it is found the Tactile Atlas by Samuel Gridley published in 1837 and the book “Geography Practical” by Clara Pratt published in 1937 (Freitas, Ventorini 2011). In Brazil, the first defence of a doctoral thesis about this topic happened in 1993 at Universidade Federal de São Paulo (USP), and was conducted by Regina Almeida Vasconcellos. This study was important because stimulated others researchers and helped to spread Tactile Cartography around the country.

Nowadays, the Institutions of Higher Education (IHE) that have a consolidate research on the area in Brazil are: Departamento de Geografia da Faculdade de Filosofia, Letras e Ciências Humanas da Universidade São Paulo - USP; Centro de Análise e Planejamento Ambiental – CEAPLA - of Instituto de Geociências e Ciências Exatas - IGCE - of Universidade Estadual Paulista Júlio de Mesquita Filho - UNESP – Campus de Rio Claro; and Departamento de Geociências da Universidade Federal de Santa Catarina – UFSC (Freitas, Ventorini, 2011). São Paulo and Santa Catarina

are the states where it is found the highest concentration of studies in this field. But, on the other hand, it is found a slight progress in the researches in other Brazilian states.

In 2013, it started a Project called "Cartografia tátil: geração de material didático e práticas pedagógicas como apoio ao ensino de geografia para alunos com deficiência visual". Its main aim is to develop actions and material to spread the Tactile Cartography around cities from Minas Gerais state in order to support teachers and benefit blind students. The coordinator of the study is the professor Ph.D Sílvia Elena Ventorini from Geoscience department of Universidade Federal de São João del Rei (UFSJ). It was developed in association with Universidade Estadual Paulista (UNESP), Universidade Federal do Rio de Janeiro and São Rafael Institute from Belo Horizonte city – MG. the aim of this article is to present the research.

2. Considerations concerning Tactile Cartography and Teaching

The spatial awareness takes part of human activity, i.e. during daily movement like going to a place from another or territory defense and attack strategies. The basic knowledge of reading a map is a skill that everyone should have (Silva, Escanilla 2010).

In Brazil, like almost all countries, maps contribute to teaching and they are an important tool for researchers. The studies around spatial awareness, teaching cartography concepts, and teaching maps started in 70's. The first relevant publication was Oliveira (1978) thesis, named "Estudo Metodológico e Congnitivo do Mapa". One of the most important aim of this work is to emphasize the necessity to prepare learners to read maps (Almeida 2007).

Oliveira (1978) considered works from American and European authors, which were not available to Brazilian professors, to develop her work. Her reflections stimulated other researchers, like Paganelli (1982), Simielli (1986), Passini (1994) Almeida (1994), and others, to study this field. During the late 80's and early 90's, the discussion about teaching cartography and production of tactile maps emerged in academic studies. Vasconcellos (1993) presented issues about maps for blind students that helped to increase Tactile Cartography in Brazil.

The Tactile Cartography is a specific filed of Cartography studies, and its main aim is to develop theoretical and methodological procedures in order to formulate tactile material (Loch 2008; Ventorini, Freitas 2011). The tactile material helps blind students to understand the spatial awareness and arise their world comprehension. Tactile maps and models develop the au-

tonomy of students, which facilitate their mobility, i.e. when they go to parks, squares, schools, buildings, bus stations, banks and others (Nogueira 2009).

However, there are some countries, including Brazil, where it is difficult to find Tactile Cartography representations. It happens because of the lack of professionals who are able to develop material and teacher who are prepared to deliver a lesson using this kind of material. According to Silva and Aranha (2005, p.377):

The school just become an inclusive one when it takes into considerations the diversity of the students and attend all of them with pedagogic efficiency. In order to adapt the educational needs of each student, essential condition for an inclusive education, it has to adapt the different curriculum issues to each and all students.

In Brazil, the studies are not conclusive. It is still difficult to understand the needs of blind students and visually impaired students, as well as it is difficult to provide teachers support to work with these students. The data of population census in 2010 shows that 36,881,412 people (19.60% of Brazilian population) have low visual acuity. Moreover, 3.46% are severe visually impaired and 1,6% are blind (IBGE 2010).

In Minas Gerais state, there are 47,073 blind people, 591,179 severe visually impaired and 2,701,621 people with sight problems (IBGE 2010). It is important to mention that these numbers are preliminary data, so the number of people can be higher. More than quantitative, these data shows that

[...] *the preservation of blind people rights has to attend the universal rights and the specific groups' rights, and its purpose is to minimize or eliminate the chasm between disable people and non-disable people* (Oliveira, 2012).

As means to settle the problem about Tactile Cartography in Minas Gerais state, as told before, it was started this study, which methodological procedures in going to be described in this article.

3. Methodological Procedures

An association between researchers from Universidade Federal de São João Del rei (UFSJ), Universidade Estadual Paulista (UNESP), and Universidade do Rio de Janeiro (UFRJ) develops the study described in this article. The methodological approach is based on the historic-cultural aspects and the previous experience of UNESP Tactile Cartography group. The study takes place in Belo Horizonte city – MG at São Rafael Institute. There are 36

blind students from primary school and education for young people and adults, and 2 teachers taking part on it.

The methodological procedures of making and using tactile material are based on students' testimonials and opinions suggested by students and teachers. The target group has to approve each material. Considering each student's specificity, the work tries to develop flexible materials that can be modified by the learners (Ventorini 2007).

Based on the procedures described before, it was developed maps and models with and without sound resources, Workshops were realized involving researchers from the three IHE, extension courses were prepared and delivered and, finally, a website was developed.

The Tactile maps without sound resources represent Brazil, Minas Gerais state and Belo Horizonte city (*Figure 1*). The materials used to make the maps were suede paper, tracing paper, ink relief and laid paper. The keys to the maps were written in both, conventional way and braille.

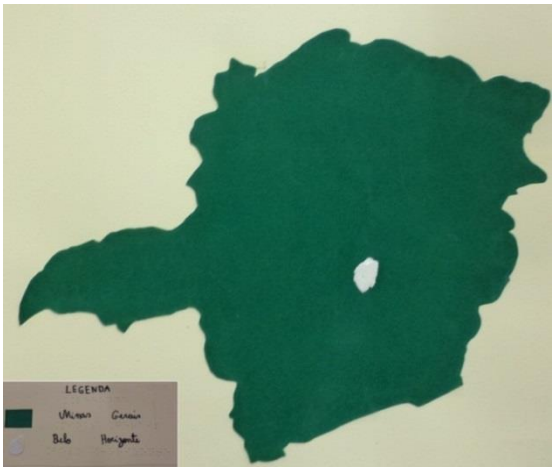

Figure 1. Example of a Tactile Map without sound resource. (Authors collection)

The model without sound resource (*Figure 2*) represents São José Mountain Range and the towns called São João del Rei, Santa Cruz de Minas and Tiradentes. The materials used to make the model were polystyrene, spackling paste, ink relief and fabric. The basic cartographic material adopted was a topographic map with scale of 1: 25,000, Army issue.

Figure 2. Making the model without sound resource. (Authors collection)

The maps with sound resources (*Figure 3*) represent the Brazilian relief, and for their preparation were used polystyrene, spackling paste, hot glue and Styrofoam glue, ink relief and microchips. There are information about São Francisco river basin, Amazonas river plain, the Pantanal, Gaúcha Mountain Range, Mantiqueira Mountain Range, Espinhaço Mountain Range and Roraima hill. The sound resources were recorded on the microchips. The Penfriend (*Figure 4*), an electronic that helps visually impaired people to distinguish things which have the same shape, was used to record the sounds.

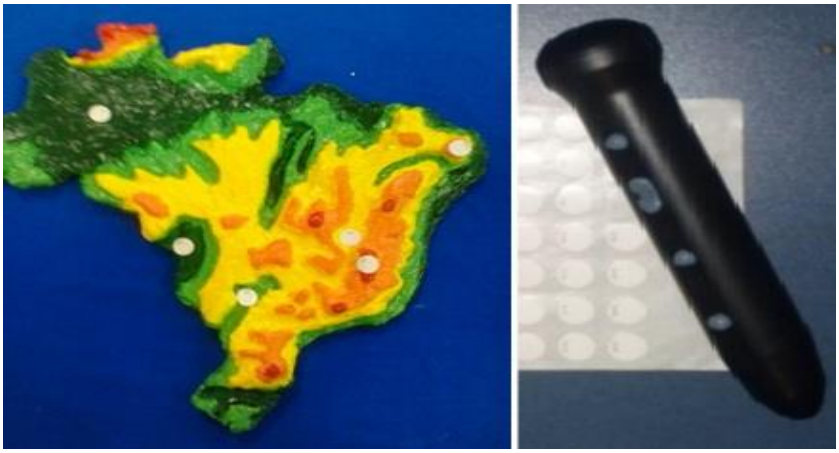

Figure 3. Tactile map with sound resource. (Authors collection)

Figure 4. Penfriend. (Authors collection)

The model with sound resources (*Figure 5*) represents São Rafael Institute and was made with scale of 1:300. The model was based on an image from Google maps satellite. The material used to make the model was 50mm and 5mm polystyrene, tarpaulin, cardboard, corrugated cardboard, ink relief, puff, hot glue and Styrofoam glue, adhesive tape, box cutter, brush, ruler,

scissors, pliers, network cable, solder paste, solder, soldering iron and micro-switch. The Tactile Model Mapavox[6] Software inserted the sound resources.

Figure 5. Model with sound resources. (Authors' collection)

Six workshops were realized by now, twice at UFSJ, twice at UNESP and twice at UFRJ. The purposes of the workshops were to discuss about the practical and theoretical procedures realized in each IHE, to share experience and to plain the work steps.

The association between the three IHE enabled the transfer of The Tactile Model Mapavox System technology to UFSJ. Moreover, it allowed the generation of actions consistent with the reality in Minas Gerais. From the discussions between the teams, it was proposed the ArduMap system for automation of tactile models.

The professor Ph.D. Eduardo Bento Pereira developed the ArduMap (*Figure 6*). The system is based on The Tactile Model Mapavox System technology and its main aim is to replace the computer task of automating the audio generation system for tactile models from the drive of tactile switches by visually impaired people.

It was delivered two short-term courses and two lectures. The first short-term course happened during "I Simpósio Mineiro de Geografia" at Universidade Federal de Alfenas, from May 26th to May 30th, 2014 and it lasted 8 hours. The second one happened during "III Encontro de Geografia do Campo das Vertentes" at UFSJ, from October 22nd to October 24th, 2014. Fourteen people participated in the two courses, including two professors

[6] This system is made by a group of micro-switch, the Mapavox software and Tactile materials (VENTORINI, 2007, BORGES et. al., 2011).

from Universidade Federal de Ouro Preto who taught a blind student in the Geography course in the distance learning modality. The participants evaluated the course by answering a questionnaire.

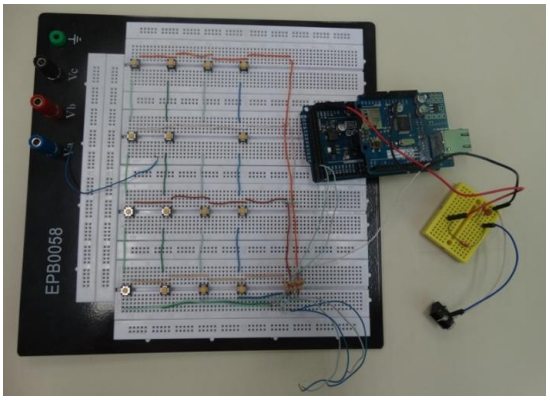

Figure 6. prototype with ArduMap. (Authors' collection)

A website was developed in order to disseminate the research not only in cities from Minas Gearis state but also in other states. The web hosting is a free one, but there are basic tools which it is possible to publish photos, texts and videos about the study and the work developed with the target group. The website is http://catografiadigitalu.wix.com/cartografiatatilufsj and its access has been available since August 2014.

4. Results

The manipulation of textured materials made by the blind students showed that it is essential to develop Tactile Cartography using materials that are pleasant to the touch, colourful and easy to handle.

The tactile maps and models without sound resources are pleasant to the touch and their colours are helpful for people who have low visual acuity. According to the teachers who took part in the research, the model is an important material to use during Physical Geography classes because it allows students do connect theory and practice about relief morphology. For students, the material was essential because they could explore the relief and relate it to Belo Horizonte relief. The model and the maps were donated to the Institute after teachers' request.

The tactile maps with sound resources are pleasant to the touch. It was the first time that these students had contact with the Penfriend.

The model with sound resources represented Euclidean distance between objects and, according to Ventorini (2007, 2012) experience, it was antici-

pated that students would have problems to recognize the area for the reason that the functional distance was not represented (Silva, Ventorini, Mata, 2014). During the model manipulation, students reported that it did not correspond to reality because it did not represent the steepness of the terrain, principally the ramps and stairs they went up and down while moving from one point to another.

The workshops enable the development in the sound resources used in tactile material. The ArduMap is being tested. It is expected that this resource can be exploited in order to provide students better use of the material.

The short-term courses proved that there is a scarcity of information about this field, which confirms the need for further actions. The questionnaire answered by the participants indicated that just two of them (25%) had knowledge of Tactile Cartography. One learned about it by reading, the other one by producing Tactile Material. About the course, 7 people (50%) said that their expectations were exceeded and 7 people (50%) said that their expectations were satisfied. They pointed that the course length was not enough and more examples that are practical should be covered.

The website brings an abstract about the Tactile Cartography team from Universidade Federal de São João del Rei and some materials that was developed by the group. This is the first website which aim is to disseminate Tactile Cartography made in Minas Gerais State. The team attempts to expand and create more resources to improve the website keeping it updated. People also can send their opinion and suggestion by the website in order to contribute for the improvement of the project.

5. Conclusion

The idea to spread Tactile Cartography in Minas Gerais emerged by noticing the lack of research and scientific publications on this topic. More than that, it was noticed the high number of visually impaired people living in the state. The association between the three IHE have had a good result. Sharing information, technology and knowledge provides a solid base to develop a study group about this field at UFSJ.

The experience at São Rafael Institute has been directing the research. As told before, there is a lack of material and studies on this area and it could be noticed during the practice at the Institute. It also shows the importance of "giving voice and hear" the experiences of those involved in this process, as well as establish partnerships for ensuring the rights of all. Both in evaluating the Brazilian relief tactile map and in the model representing the Institute it was found that students' difficulties were generated by the way

that the representations were prepared, not by absence, by the students, of knowledge.

Acknowledgments

We thank the “Fundação de Amparo a Pesquisa do Estado de Minas Gerais (FAPEMIG)”, “Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)”, “Programa de Extensão Universitária (PROEXT) MEC/SESu/2014 e 2015” and “Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq” for financial support for this research.

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Tactile models and Geography teaching for visually-impaired persons: Experiences in a Service Center for Blind People in Rio Claro SP, Brazil

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Abstract. Since the beginning of the decade of 2000 we have been developing studies for the Project Tactile Cartography and Mapavox: An alternative to the construction of tactile maps, models and games, at the Center of Analysis and Environmental Planning (CEAPLA) at IGCE/UNESP-Rio Claro SP, Brazil. In the year 2014 we worked in partnership with the Municipal Service Center for Blind People of Rio Claro (CMAC), which deals with the rehabilitation of blind and low vision people. The purpose of this article is to present didactical experiences in Tactile Cartography, including the preparation of cartographic material, practical Geography activities and their application in classes in order to stimulate the participation of visually impaired persons. Among the eight educational activities conducted fortnightly at CMAC, two of them are presented in this article, namely the results concerning the handling of the tactile model of both the Urca hill and the Sugar Loaf Mountain - Rio de Janeiro RJ and the guidance by the Sun and tactile compass rose activities. Among the final considerations, we highlight the value of cartographic representations, such as tactile models, concerning to attractive themes to stimulate learning in Geography of visually-impaired persons.

Keywords: Tactile models, visually-impaired persons, Geography teaching

1. Introduction

The fact that the issues relating to spatial organization involve, directly or indirectly, all human beings whether disabled or not, unfortunately affects them in an uneven and segregated way. The perception of the world that

surrounds blind people becomes restricted due to the low availability of bibliographic references and materials as well as adequate preparing of teachers on educational activities to visually impaired persons.

Thus, a group of researchers from UNESP-Rio Claro, linked to the Geography course, promotes academic interdisciplinary actions aiming to developing, disseminating and applying learning materials able to include blind and low vision persons in the teaching-learning process of geographical science integrated with other disciplines. The aim of the project is to develop in the participants the understanding of the space concept and to introduce the basics of location and geographical orientation adequate to their particular conditions. In this article we present aspects to be considered while devising teaching materials such as tactile texture, size and shape and also the materials and methodological procedures adopted for the preparation of didactic materials and classroom applications, followed by the main results.

2. The Municipal Center of Services to the visually impaired (CMAC)

The Municipal Center of Services to the Visually Impaired (CMAC), associated to Municipal Government of Rio Claro – SP – Brazil, is an organ maintained by the City Hall aimed at the rehabilitation of blind and low vision adults of both sexes. The line of work followed by the entity is humanist, in which the whole process is centred on making the therapeutic relationship its main working tool. In this context, the professionals linked to the Center act in such a way in which the main characteristic of the process of therapy is the participation of all, meaning each person in the group is responsible for it.

The entity attends people with visual impairments, offering Braille literacy, walking stick training, written and spoken Braille library, psychological support, music, physical education, as well as several courses in order to rehabilitate and professionalize them. The service is performed both in full time and outpatient basis. Among the participants of the survey are 24 people, 19 blind, and 5 with low vision, with age ranges from 18 to 80. Among the blind 1 has Alzheimer's, 2 are mentally retarded and 2 suffer from depression and receive counselling. In the group there is no case of congenital blindness, having all participants acquired blindness in different stages of life, the majority as adults. Due to the quantity of participants, people of low vision have important role in practical activities, contributing to the monitoring of blind people when manipulating tactile materials, as well as in the practical activities.

3. Tactile Material: Texture, size and shape

For the development of tactile materials it is necessary to take into account three major characteristics of the objects that will be explored with the tact: texture, shape and size.

In the case of texture, soft, plush, velvety or rubberized materials are required, allowing comfort and exploratory stimulus. The size of the objects (models, maps) is essential so that the student has the notion of "all" without losing details. It is therefore necessary that the materials are within reach of both hands during their exploration.

The care with the shape is also key and in the preparation of materials we should ensure them not to be too complex as to discourage their exploration. In this sense we must avoid objects with various breakdowns, pointed, with many distinct parts together, among others. Therefore, for the object to be suitable for holding it should present appropriate size, shape and texture, as any change in these features could disrupt and inhibit the tact.

The choice of materials capable of representing the objects contained in the environment has been perhaps the most difficult task. The overall structure and internal details were made with materials like EVA, buttons, plastic parts of children's games, various types of paper as cardboard, corrugated cardboard, Styrofoam plates, paper with multiple textures, recyclable materials and miniatures always pleasant to the touch, not pointed, to ensure proper tactile exploration.

At this moment we will present the procedure to elaborate tactile maps, models or maquettes.

Using an original map we trace on the basic materials of the models and, after, the step of cutting and pasting is conducted. Then, regular glue is used to fix the base, parts of the models and their illustrative objects. Usually, small details, symbols and texts can be inserted in the material by means of colourful glue relief. After the assembling, we proceed to the introduction of texts relating to the title, details of orientation and caption both in Portuguese and in Braille. For the preparation of texts in Braille we use strips of plastic material and a Braille labeller.

We should point out that in all products is recommended to adopt elaborate tactile convention of colours, size and texture to characterize objects. As in Brazil there is no universal standard adopted for such materials, as a rule, the group of participating researchers, blind people and people with low vision contribute, according to their experience in the evaluation of the adopted materials. Our experience as well as of those who are references to our studies, points to the need for standardization of materials, procedures

and symbols adopted in the production of teaching materials, which guarantees better assimilation of its contents, on the part of people with visual impairment. The production of maps, models and maquettes enables the tactile understanding of the space and the integration of blind and low vision persons in regular schools.

4. Methodology

Our relationship with the CMAC started during a visit that the regulars from the Center conducted in CEAPLA/Unesp in the year 2013, which involved a visit to the weather station and the laboratory for production of didactic material with submission of maquettes and tactile maps. In this occasion there was great interest in the group by materials produced at Unesp, which allowed an approximation between the CEAPLA team and the CMAC, resulting in a partnership for the realization of didactic activities at the Center from 2014. The meetings are biweekly and, according to the demands of the group, which is quite heterogeneous, practical activities focused on Geography are developed having an interdisciplinary character, also considering other areas of knowledge for instance, Mathematics, Geology and Palaeontology. Due to the large number of participants, the lessons are held alternately, by dividing the class into 2 groups of, approximately, 12 people.

The project developed considers the elaboration of didactic materials and procedures that promotes the inclusion of people with visual disabilities focused on qualitative methodology, based on theories about the object of study, mainly in Huerta et al. (1993), Amiralian (1997), Caiado (2006), Ventorini (2009), who consider the perspective of the blind or with low vision person in mobility and orientation activities, in the area of his/her living space for learning school concepts and understanding the world based on visual impairment.

The methodological procedures that guide the design and development of the models are based on the non-comparative perspective of results i.e., the results obtained are analysed from the blindness itself, seeking to set aside the visuocentrism. Therefore, we seek to fit methodological practices and the tactile models into the critical point of view of their own individuals with visual impairment.

Having the cited authors as reference, the research procedures and the active participation of the individuals with visual impairments in the preparation of learning materials developed were structured. Over the years the extension project has always been attended by visually-impaired persons in all its stages, beginning with the planning of the maps, maquettes and mod-

els, as well as with the issues of geographical sciences to be worked. In this way, aiming at the development of themes relating to the geographical sciences, the contributions of Ventorini (2009), Freitas et al. (2006), Freitas & Ventorini (2011) and Freitas (2013) were used as a basis. Such authors present procedures for the elaboration of didactic tactile materials, considering them as facilitation tools for teaching and learning.

The activities described here, developed in the CMAC in 2014, considered the following methodological procedures:

a) Historical survey and review of topics of interest in Geography: In this step we conduct a search by the CMAC in the quest to meet the profile of its regulars, their characteristics, abilities, limitations and interests in order to list the didactic possibilities in the area of Geography and related fields, which were of interest to the group.

b) Maquette of the Sugar Loaf Mountain and Urca Hill - preparation of the material and practical lessons: In the planning of practical activity an internet search was conducted in order to rescue the history of occupation of this sector of the city of Rio de Janeiro, as well as the installation of the tram tour. In addition, a survey of geological aspects of the area and the formation of rocks on Earth, finding in the Geological Eras, was considered in an introductory form. With the use of an existing didactic model set of the "Sugar Loaf" from the Laboratory of Continuing Education and Didactic Material production of CEAPLA-IGCE, as well as a model of a volcano from the Didactic Laboratory of Geography and a tactile globe, the activity was conduct in the classroom. While drafting the model of the Sugar Loaf Mountain and the Urca Hill it was necessary the use of an altimetric map with the information of level curves and quoted points of the area, Styrofoam, spackle, glue for Styrofoam, gouache paint of various colours, craft material like leaves and branches of various sizes to illustrate the areas of vegetation, folding paperboard, cardboard and plastic miniatures to illustrate the constructions and string to illustrate the tourist tram steel cable (Gadotti & Alves 2014).

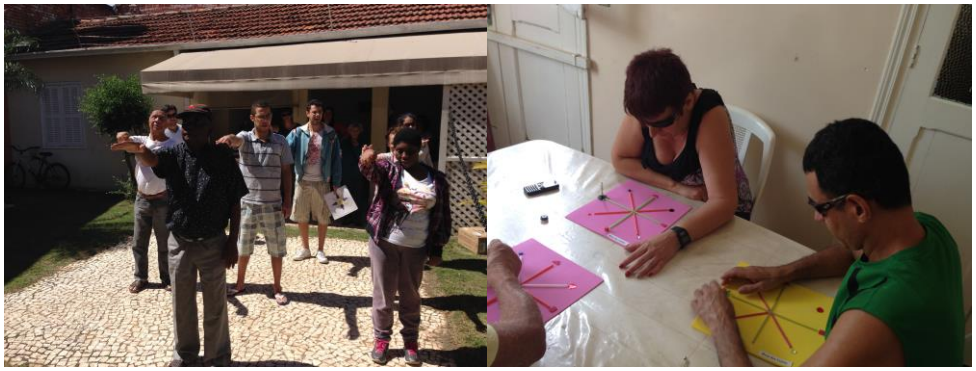
Initially in the classroom practice, a tactile globe was used to work out the distribution of the continents and oceans on Earth. With the use of the model of the "Sugar Loaf", it was possible to explain the endogenous and the exogenous dynamics of the Planet in the formation of mountains using as material support the model of a volcano. In the sequence, a sample of granite (volcanic-magmatic rock) was used to explain the existing rock type in the Sugar Loaf. A text with enlarged letters was delivered to people with low vision to read and monitor the activity.

Figure 1 presents the teaching materials used in the practice with the model of the Sugar Loaf.

(a) (b)

Figure 1. (a) Tactile globe and (b) Sugar Loaf Mountain maquette used in the practice at the CMAC.

c) Guidance by the Sun - preparation of the material and practical lessons: For the activity of Guidance by the Sun we made use of an elaborate tactile compass rose in square format, with the following materials: EVA from different colours, glue, colourful glue relief, plastic straw, tape for indication of the cardinal and collateral points in Braille. *Figure 2* presents the guidance by the Sun and tactile compass rose activities.



(a) (b)

Figure 2. (a) Guidance by the Sun and (b) tactile compass rose activities.

In the case of the guidance by Sun activity we started it in the CMAC backyard seeking the guidance by the Sun of the participants, followed by the exploration, in the classroom, of the tactile compass rose.

Initially, we explained to them the importance and the need for the human beings to guide themselves in the "geographic space" and what are the existing means of guidance. Later on, exposed to the morning Sun (around 9:00 a.m.), we found the East cardinal direction through the warm feeling coming from sunlight. After that, it was possible to perform the activity of guidance by the Sun, explaining the concepts of the cardinal and collateral point from the compass rose. We practiced with arm movements an indication of different directions, always trying to associate them with regions of the city. After that activity, organised in the classroom at tables with 4 seats, the participants handled previously elaborated tactile compass roses trying again to establish the concepts of cardinal and collateral points.

We were supported by questions and answers that should stimulate the participants to indicate directions of regions and significant points of the city of Rio Claro, aiming at their orientation and fixation of the cardinal and collateral points, always having as a reference centre the building of the CMAC.

d) Evaluation of results, adjustments to the methodological improvement: In the results evaluation the participants' performances in the fulfilment of the stages of the practical activity, considering their interaction with the teaching materials and proposed activities have been observed. Questions pertaining to the topic were formulated to the group, always seeking free and spontaneous answers, so as not to inhibit them in their manifestations. All the answers, both correct and incorrect, were commented on and discussed collectively, valuing individual manifestation, fostering a relaxed and informal environment.

5. Results

5.1. Tactile model of both the Urca Hill and the Sugar Loaf Mountain - Rio de Janeiro RJ

Initially, with the support of the tactile globe, it was possible for the class to understand the distribution of the continents and oceans of the Planet. The globe used in the activity is available for purchase on the internet and basically corresponds to a globe whose common boundaries of the countries received the application of colourful glue relief. Globe tactile exploration, as well as each of the tactile models, was held on an individual basis.

In this procedure we observed the participants' difficulty in understanding the model as a whole. Although the globe is within reach of the two hands, fundamental requirement for a blind person exploring a tactile material, we noted the difficulty in differentiation of continental and ocean areas that

have both the same level and the same texture, only separated by the contours in relief. We observed that individuals in the group with previous experience with this type of material in their educational background had better assimilation and suitable exploration of the tactile material.

As for the original model of the Sugar Loaf Mountain and the Urca Hill it allowed to explain the dynamics of the Planet functioning in the formation of mountains, besides presenting explanations concerning the dimensions of these features, using comparative elements, aiming to contribute to the awareness and understanding of the dimension of a real mountain and, in this case, the dimensions of the Sugar Loaf Mountain and the Urca Hill. In such comparative studies for understanding the size of objects by blind people, it is very common the association with the height of each individual.

In this way, we used the resource of comparing the height of the Sugar Loaf Mountain and the Urca Hill with the height of each individual, to imagine how many replicas of the same individual should be aligned and overlapped in order to reproduce the size of the Hills.

Following the activity, with the help of a model of a volcano and a granite fragment we dealt with the three existing rock types: sedimentary, magmatic and metamorphic rocks as well as the characteristics of magmatic rocks. While conducting the activity we observed that most participants could get a sense of the size of the hills in the study, as well as the type of use and vegetation that make up its surroundings. Testimonials from some of the participants, who had had the experience of visiting Rio de Janeiro and the region of Urca, when they still had the vision, facilitated the programmed explanations. The proposed student activity handling the rock, realizing its texture, hardness and weight allowed a greater stimulus to the group in understanding the dimensions of the hills and being surprised when comparing them with the buildings in its surroundings.

Those who had already been to Rio de Janeiro told their experiences and recalled the sensations and discoveries in the exploration of its tourist spots, collaborating with the understanding of the city, its natural beauty and its contrasts.

5.2. Guidance by the Sun and the tactile compass rose activities

On the analysis of the activity we can consider that the initial part in the CMAC backyard, seeking the guidance by the Sun, and the participants had a good performance with the practical experience, which encouraged learning.

All participants performed the orientation of the directions and the cardinal points in a playful way, with the active participation of individuals with low

vision, who often corrected blind colleagues in their movements. The subsequent activity, in the classroom, with participants individually handling tactile compass roses allowed the resumption of what was experienced in the backyard, allowing very positive observations about the guidance from the North.

A fact that deserves to be highlighted was that some of the participants with low vision felt confused while handling the model, because they were sitting around their desks, and the North of the model of one of them was in the opposite direction to the one of a colleague who sat in front of him, and was exploring his own tactile compass rose in the opposite position. This caused conflicting conclusions about the directions in the group, which led us to reformulate the activity, making the entire class successfully explore the compass rose in two phases: firstly considering directions in the educational material per se, and then with all the compass roses of the room oriented to the true North.

6. Conclusion

As conclusions of the paper we highlight the following:

a) Tactile maquettes and models are fundamental materials for the stimulation of learning by visually-impaired persons.

b) The size of these models should be such that one can handle it with both hands. However, elaborate models with different textures in larger areas are better suited than the use of glue relief to differentiate objects, as we have seen in the use of the tactile globe;

c) The experience in the understanding of the true dimensions of the Sugar Loaf Mountain indicates how blind people need the spatial reference data of their own body or their daily life environments for understanding the scale of objects and the phenomena of great proportions, such as the size of a hill and the emergence of a mountain;

d) Long oral presentations are not recommended to be performed with groups of heterogeneous educational background, as in the case of participants in the research. It is more appropriate to work with simple concepts, well explained and associated with their everyday life.

Acknowledgments

The authors need to acknowledge FAPESP for financing our participation at the Joint ICA Symposium and ICC Rio 2015 as well as the CEAPLA / Unesp

and the professionals and regulars of CMAC for giving us the conditions and the partnership to carry out this study.

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The Tactile Cartography and Geography at Elementary School in the state of São Paulo

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Abstract. The Tactile Cartography is an interface branch between Cartography and Geography, since it contributes to the citizen's mobility and orientation, as well as to the teaching process of geographical contents to students, including those with visual impairment. This field of study is still not broadly widespread through the country and it relies mostly on handcraft techniques. Therefore, the choice of a tactile material by the State Government, specially in the State of São Paulo, is a delicate matter. The Educational Inclusion has inflamed the existing challenges in and outside the classroom and, although the educational legislation is of national scope, the states and municipalities possess autonomy to adopt their own actions to carry it out. Among the actions that the Secretary of Education of the State of São Paulo has adopted is the program "São Paulo Faz Escola" which focuses on the unification of the scholarly curriculum to all of the more of five thousand state schools. The program is responsible for the implementation of the Oficial Curriculum of the State of São Paulo, formatted as documents which constitute guidelines to the teacher's work inside the classroom and ensures a common base of knowledge and skills to all teachers and students. Through the program "São Paulo Faz Escola", teachers and senior students of the elementary and high school receive supporting materials, containing teacher and student's workbooks (Caderno do Professor e do Aluno), which are organized by subject, year and semester. In the adapted version of the workbooks available to students with visual impairment – increasingly more frequent inside the common classrooms nowadays – there are the braille and the magnification of images as the most used techniques. However, when it comes to the teaching of phenomena occurred in the geographical space, these two techniques allied to the teacher and classmates' audiodescription are not always satisfactorily adequate. In order to figure out in what and how the Tactile Cartography can contribute to expand not only the educational, but also the social inclusion, eliminating

the physical and the attitudinal barriers, we have produced an adapted workbook that takes into consideration the specific concepts of this science branch. The entire production was based on the specific bibliography about the subject matter, on the surveys and on the interviews held with the teachers and students who, somehow, experience the confrontation between the adoption of a material that is common to all students and the specificities of the beings on their daily life. As philosophical results we have reached the reflection about the reality of the maps and about the policy adopted by the State Government. In practice, we have achieved not only a Geography and Cartography teaching that was meaningful to the visual impaired students, the other students and the teachers, but also to the socialization of the acquired knowledge. There is still a lot to be done and we hope that this work would serve as an incentive so that the inclusion can be perpetuated in the heart of society and school.

Keywords: Geography teaching, Tactile Cartography, visual impaired students, workbooks of the State of São Paulo.

1. Introduction

Any analisis that pervades themes which involve power, inequalitiy and society must necessarily take education into account. It is the foundation of the social life and it can be responsible for the permanence of or change in the current systems. The school is a priviledged space to the comprehension of the world, efficient in the process of democracy and citizenship. In this sense, the school should seek a teaching that provides not only the school knowledge, but above all values and attitudes. It is also a political, social and ideological scenario of the current capitalistic socioeconomic system. It is exactly this school supremacy that is aimed by the public policies.

This article intends to discuss the didactical material of Geography distributed by the Government of the State of São Paulo to students with visual impairment at public schools. However, in order to this discussion be coherent, it is necessary that we understand how the process of educational inclusion in Brazil happened and how this material came to schools in replacement of the didactical book.

As a reflex of the post 1990s changes which transformed the educational structure in many countries, searching for a common teaching that was both globalized and conceived for the Labour Market, the Secretary of Education of the State of São Paulo (Secretaria da Educação do Estado de São Paulo) implemented changes, which are until today very polemic, in the public schools curricula administrated by the state. Among these changes is the option for the production of its own didactical material.

At that moment the number os school enrollments for the visual impaired public increased. The education of São Paulo, as in the rest of the world, faces the challenge of providing a quality teaching to all people at the commom school, including those which have some sort of impairment. This text will discuss the materials adapted to the visual impaired students. There is no intention to devalue other sorts of impairments, however this article will foccus on a public that presents many difficulties learning Geography.

According to the Fundação Dorina Nowill (Dorina Nowill Foundation) and the Associação Brasileira de Assistência à Pessoa com Deficiência Visual Laramara (Brazilian Association of Assistance to People with Visual Impairment Laramara), it is estimated that there are 6 million visual impaired Brazilians. Althought the policies developed to the visual impaired are mostly national, the states and the municipalities also develop complementary policies and execute the actions of the federal programs.

The Southeast region of Brazil has the largest number of visual impaired people and the State of São Paulo the greatest concentration of these individuals. Nationally, from the 197 thousand schools, only 85 thousand assist students who have all kinds of impairment.

The public education system at the State of São Paulo is formed by over 5300 schools and distributes, since 2014, two Cadernos do Aluno (student's workbooks) per school years – one for each semester – totaling up 16 workbooks per discipline during the 8 school years (here it is considered the four years of the Ensino Fundamental II (Elementary School II) and three years of Ensino Médio (High School)). These workbooks contain the whole semestral content and the student's version can be taken home. The workbooks only present exercises which are called Situação de Aprendizagem (Learning Situation) and they are divided by theme.

The sight has great representativity to human beings. It is responsible for outlining the space through time. Without it, the spacial perception gets compromised. Together with hearing, sight is a sense of distance which enables handeling informations external to the body (Masini 2013).

2. Objective

The main objective of this article is to present the first results of the research developed with the intent to use the theoretical and methodological principles of the Tactile Cartography in the production of an alternative version of one of the student's workbooks distributed to visual impaired students, contributing to the improvement of the teaching qualitity to this public and intending the elimination of barries in order to achieve an actually inclusive education.

3. Methodology

We have opted for the qualitative comprehension of the phenomena that will be presented, following the postulates of Thomas Kuhn (1975), which consider that the cientific research is oriented not only by theories, but also by paradigms. In this research the reached bias fits the phenomenological universe. By working with the human dynamics – individual and abstract – we searched for a project that were based in dynamic relationships as is the case of the teaching-learning process and the cognitive process of the visual impaired facing Geography. For that, the research-action comprehends that the individuals are the objects of this article and that, in turn, they cannot be translated into numbers.

The bibliographical research was based in the Brazilian legislation about impairments and inclusion, principles of cartography, tactile cartography and the teaching of Geography.

From the production of the adapted materials and its analysis, the results were interpreted and analised. The data gathering was made after visits to public schools and to specialized institutions, through observation, surveys, meetings and interviews.

Teachers of Educação Especial (Special Education), teachers of the public education system, visual impaired students (blind or with low sight) of the common school, students of post-graduation in Special Education who have low sight or blindness were interviewed. In all cases, the experience of each individual with adapted materials and the expecience of teachers who work with visual impaired students were also taken into account.

The tecniques of production of tactile graphical representations to the workbook's adaptations are based in the literature about production of materials to the blind (Vasconcellos 1993, Sena 2008, Carmo 2010, Jordão 2011), low sight and daltonics, as well as the suggestion of other materials and models of presentation suggested by the participants.

4. Tactile Cartography and its contribution to the teaching of Geography

The development of an individual involves, among other things, the spacial reasoning skills. Geography – at school above all – uses the cartographical language to implement this process. Cartography facilitates the construction of abilities that reflect the relationship between the individual with his place and should, therefore, be accessible to everyone.

The work with Cartography enables the development of reading abilities and of representation of the geographical space. Consequently, it subsidizes

the acting of the students in the environment. The absense or limitation of sight interferes in the relationship of the visual impaired individual and his living space, which, in its turn, influences the comprehension of the spacial reasoning skills and hinders the appropriation and the autonomous and independent interaction of this individual with the environment.

The contribution of the models in three dimensions has come from the production of rustic maps, like the ones produced in 2.500 B.C. by the Sumerians. On those maps, the natural resources have become instruments to produce the representations of the space, such as: vegetable fibers, shells, buff and the already mentioned baked clay plate among other materials which are sensible to the touch.

Although the use of touchable materials in the production of a map is something inherent to the Cartography, this kind of production did not become popular and only a few priviledged people were able to adapt them to their use.

When handeling the teaching to impaired people, the awareness about the target public is fundamental, in order for them to have their abilities and other senses stimulated.

The Tactile Cartography is an specific area of the Cartography which is concerned initially in researching on methodological procedures and in manufacturing maps and cartographical and/or multisensorial instruments for people with visual impairment (Vasconcelos 1993), however, it also demonstrates positive results when inserted in a context of students with other impairments or none of them. The tactile maps can be used not only to the school education but also to orientation and mobility, helping promoting the independency of an impaired person. In Brazil, most of the maps that are destined to the school education use handcraft materials such as embossed glue, beads and aluminium in a process that tries to destabilize the current homogenization in the education by the paper maps.

When adapting the graphical symbology to the tactile one, the generalizations and simplifications receive more attention, because the language changes. Because this is a tactile resolution, specific modalities of representation must be taken into account, since it is a sequencial perception and not of sintesis, like in the case of sight. As a fundamental instrument in this process of transcription of information, the braille is used for titles, captions and complementary information to the maps.

The thesis of Almeida (Vasconcelos 1993) is a theoretical reference in the field of Tactile Cartography, because it quotes the researchers which contributed the most to the theme through researches since 1950 until the end of her thesis. The author proposes an adaptation of the visual variables

from the Graphic Semiology of Bertin (1967), which talks about signs and abstract marks that build the cartographical representation. It can express any phenomenon of the surface of the Earth in a logical and aesthetical way.

The information variable – the two dimensions of the plain in the visual Cartography are three in the tactile expression: the two components of location X and Y and the third dimension which gives the proportion to the map to help the tactile comprehension. The latter replaces the color, which is understandable when a representation intends to attend blind students. The represented phenomenon is the fourth dimension perceived through tact. When a map is destined to people with low sight, the color also should be part of the representation. In reality, when we search for a material that can handle the process of inclusion, we incentive that the maps are colored, even to blind students, because it will facilitate the use with another person, like a collegue, or family members, for example, who not necessarily have any impairment.

5. Results

With regard to the production of the adapted workbooks the first identified problem refers to the consultation to authors of the original version of those materials. Since the processes of production of the printed and the adapted for visual impairment workbooks do not happen simultaneously, some of the authors have detached themselves from the Secretaria da Educação (Secretary of Education). The enlarged and braille versions are produced after the printed version. The Fundação Dorina Nowill (Dorina Nowill Foundation) has the responsability of adjusting the presentation to visual impaired people. This fact compromises, above all, the goals of the presented cartographical resources.

Because the Foundation does not understand the intent of the original authors, many times the activity looses its purpose when adapted.

On the other hand, there is a lack of knowledge about adaptation, inclusion and accessibility of the geographers hired by the Foundation, who try to supply the lack of contact with the authors of the printed version.

Since there is a fusion of Geography and accessibility knowledge, that are compartimentalized in the adaptation of the material, the workbooks also present many problems concerning the activities with maps.

It is necessary to find solutions so that the adaptions have the same effect as the printed version.

This could have been reached by the Foundation through the consultation of the authors of the paper version, in order to find a way to present the content that could be worked in a comfortable way by the teacher and that it was not exclusive of the visual impairment, like the braile is.

During the interviews it was made clear that the delay in the delivery of the workbooks by the Secretary of Education of the State of São Paulo – an average of 2 months – compromises the attempt of the visual impaired student to follow the classes, even when a questionable material like this is already being used.

When asked about the teaching of Geography, the respondants agreed that the major difficulty were the maps. Most part of the adaptation of Geography materials emerge in specialized institutions which those students attend and some others at the public school when teachers, who get touched by their students situation, decide to produce some materials on their own.

Regarding the quality of the enlarged materials there are serious problems concerning the resolution of the images presented in the workbook. The low resolution of the pictures and the colors lacking contrast do not allow them to identify the represented phenomenon (*Figure 1*). Besides that, on the enlarged workbooks, that were analised, the pictures were stretched out with no concern with the proportion of the maps, which makes impossible to use the scale or the comprehension of the adopted cartographical projection.

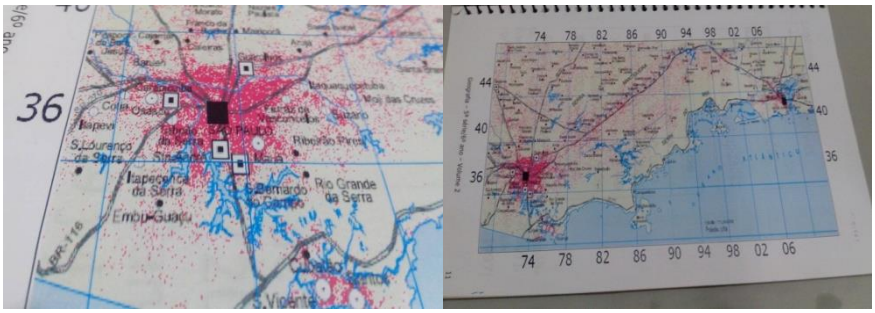

Figure 1. Map on page 7 of the enlarged version of the Caderno do Aluno (Student's Workbook), Geography, vol. 2.

The initiative of the tactile map to the same exercise was well received, because it has made possible the identification and comprehension of the represented objects (*Figure 2*).

Figure 2. Tactile map on page 7 of the Caderno do Aluno(Student's Workbook), Geography, vol. 2.

Regarding the braille workbook, it is very little used – even when they are actually delivered in time to follow the activities of the semester – because the Geography teachers do not know braille and the student makes all activities in an isolated way. Many classes keep being based on the oral description made by the teacher.

The braille workbook brings horizontal and vertical maps in the same material, using points to represent the graphical information. Because there is no sense of orientation for the reading of the pictures, the student takes more time to position himself for the correct way of reading.

The usage of points to all maps limitates the quantity of information to be represented, since it has only one layer of texture and high, which does not allow the differentiation, for example between the political limits of a country and the Equatorial Line.

Regarding the captions, in both workbooks – enlarged and in braille – they are located in the previous or subsequent pages to the map. This makes the foccus of his reading to loose track by every turn of the page and so the student has to search the information again.

Modifying the map and including the caption on the same page allow the student to maintain the foccus on the represented information in a way that the student goes from the map to the caption faster and without missing information (*Figure 3*).

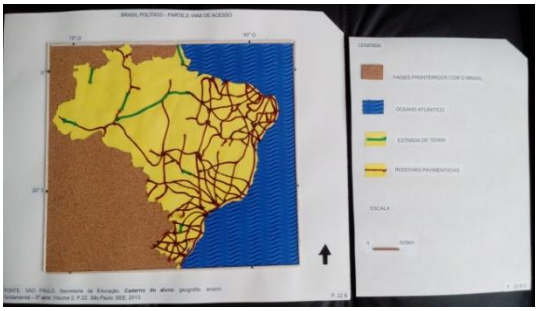

Figure 3. Tactile Map and its caption.

The respondants affirmed that Geography is better understood outside the classroom, with real daily experiences. They also affirmed that the images should bring this realism to the classroom and spark the curiosity, that the images should "show more the outside of the school". However, the impaired student has this opportunity denied; limiting his knowledge to what is offered by the Government of the State.

The Tactile Cartography is a cheap and effective alternative to those materials. One of the most nationally widespread tecniques for its accessibility in the aquisition of materials to the manufacturing and to the price is the handcraft and the collage tecniques. By allying textures and colors the materials become more attractive. Furthermore, one of the most important characteristics of the tactile cartography is that it promotes the social inclusion, because it enables the interaction between the visual impaired student, his classmates and his teachers. In this scenario, the Tactile Cartography, when inserted in the regular school, reinforces itself.

It is important to consider that the tactile map must me carefully made in order to serve to its purposes; otherwise it runs the risk of loosing its meaning, becoming only a pile of different textures, serving as a material that stimulates tact and not a Geography material.

It is possible to notice by the interviews that the mere disposition of the material will not assure the teaching of Geography or any other subject. Besides the adaptation of the Geography materials through the bias of Tactile Cartography, it is necessary that the faculty be sensitive and follows the whole process.

The size, the presentation and the content that will be taught must be taken into account. Even the curriculum can be modified or adapted in order to make up for these lacunae.

6. Conclusion

In the State of São Paulo there is a paradox. This paradox concerns the relation between the increase of the number of enrolled students and the inclusion policy adopted. Many times visual impaired students end up being neglected and isolated, because of different factors: from the barries of the way from home to school to the educational background of the teachers. The constraints are physical, systemical and of attitude. This contributes to the maintenance of the segregation situation, reflecting in the development of the impaired students, as well as constraining the exchange of experiences among them, their classmates and their teachers.

It is possible to affirm that the production of a coherent material, a material that takes their needs and opinions into account could promote an unrestricted learning process.

Unlike European countries, the United States and Japan, in Brazil the use of tactile maps is still incipient when it comes to mobility and when they exist; they were produced systematically and without the proper knowledge. Only 5 of the respondants affirmed to know or have attended a tactile cartography course, i.e. it is still barely widespread and distant of its field of action. Therefore, the difusion of this research line is important in order for more improved materials and methodologies to be produced, not only to the Geography teaching, but also to the other sciences.

It was noticed that the absense of these materials at schools was due to the lack of specialized people for the production of the materials, unpreparedness of the teachers in order to use this material in the classroom (Carmo 2009), time and cost of the production, lack of appropriate equipments and machinery for the production and reproduction of the materials, lack of financial support in the area – even the need of a cartographical initiation – and finally, lack of governamental assistance, so that a inclusion policy could be effective, not only for the Educação Especial (Special Education) but beyond it.

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IV CARTOGRAPHY ON EARLY WARNING AND CRISIS MANAGEMENT

Morphometric Characteristic of Ribeirão Anicuns Basin, Goiânia

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Abstract. The objective of this paper was study the morphometric characteristics of the Ribeirão Anicuns basin, located in Goiânia – GO, Brazil. The drainage area was 230 km² and perimeter 63.87 km. belonging to urban area accounts for 70% of the drainage of the county. The morphometric analysis was performed using a Digital Elevation Model (DEM). The DEM was generated with LIDAR data, scale 1:1000. Morphometric analyzes presented in this paper can contribute to management actions and planning, where it aims to minimize environmental problems. For the calculation of the morphometric characteristics of the basin was essential to have knowledge of the area, perimeter, compactness coefficient 1.163 (Kc), form factor 0.348 (Kf), circularity index 0.73 (Ic), drainage density 0.681 km/km² (Dd), length of main river of 24km and the hierarchical order of channels (Strahler). It was found that the study area has circular where the value is shown next to the unit stream watershed Anicuns belongs to 4th order, considering that is a basin with few branches, so. For an average density of drainage density drainage median value was presented. These parameters have influence on the runoff, therefore, on the erosion process. With morphometric analysis presented is possible that can be used to aid in management actions, occupation and land use.

Keywords: watershed, morphometric, DEM

1. Introduction

Through management measures concerning the land use and occupancy, the aim is to also watersheds preservation that depends on how these are data uses and activities in all their extension. In urban areas, the trend is to expand and with it come together several environmental changes, including changes in the hydrological cycle. In Brazil there is a highly cultured of waterproofing. The waterproofing means that cities show themselves fragile

during rainfall events, watercourses do not support the entire volume of water, flooding will become larger. Besides having much of municipal waterproof, the sluice gates cannot meet the entire volume of rainwater, while also not clogged by trash. The waterproofing, creeks and rivers canalization are some factors that influence urban flooding. In this urban context it is inserted the city of Goiânia, capital of Goias, with its construction planned for 50,000 inhabitants today that number is close to 2 million.

There was a fast growth, a population contingent that was not provided for territorial occupation. That way the quality of life has been compromised and therefore the environmental depreciation increased dramatically and with that comes the importance of knowing and plan the management of river basins inserted in urban areas, thus demonstrating the importance of knowing the morphometric parameters and how they influence the environmental balance and maintenance of the watershed. According Borsato and Marconi (2004) watershed (BH) is defined as an area where a watershed demarcates its boundary that separates it from neighboring basins and serving uptake of precipitation through surface aspects.

According to the Federal Law 9.433 / 97 which deal with the national water resources policy, watershed is the implementation unit of water resource management.

Tucci (1997) says it is a set of surfaces strands and a network of drainage formed by streams that converge to originate in a single riverbed. Clarify the issues of local environmental dynamics; morphometric characterization is one of the earliest and most frequent cases of hydrological and environmental analysis. The morphometric characterization of a watershed consists of the characterization of physiographic parameters, which are physical indicators of the basin. It is important instrument to prevent events such as floods, erodibility among others. It is possible using this type of study to systematically analyze the physical aspects of a basin and its dynamic operation, so that they can be considered as an important tool based on environmental vulnerability studies. Thus, this paper aims to carry out morphometric analysis Basin of Ribeirão Anicuns.

According Tonello et al. (2006), the physical and biotic characteristics of a basin is very important in the processes of the hydrological cycle, influencing onin filtration, the amount of water produced as runoff, evapotranspiration and surface runoff and subsurface. To Christofoletti (1999) morphometric analysis of watersheds is the quantitative analysis of the adjustment of the surface model elements which generates expression and spatial configuration – all the aspects and channels that form the relief, and the measured values corresponding to the attributes of these elements. Through GIS (Geographic Information System) software that characterization will be

extracted via a DTM (Digital Terrain Model). Silva (2010) states that GIS is a georeferenced database, which must be located spatially and operates a toolkit on special entities. The aim of the paper is the analysis of morphometric characteristics of Ribeirão Anicuns basin.

2. Materials and methods

2.1. Study area

The study area of this paper is the watershed of Ribeirão Anicuns, located in the urban area the city of Goiânia, Goiás state. The Basin of Ribeirão Anicuns has an area of 230 km² and is located west-center of the municipality of Goiânia. Their sources are the municipal border regions of Goiânia, Trindade, Aparecida de Goiânia, Anicuns e Abadia de Goiás.

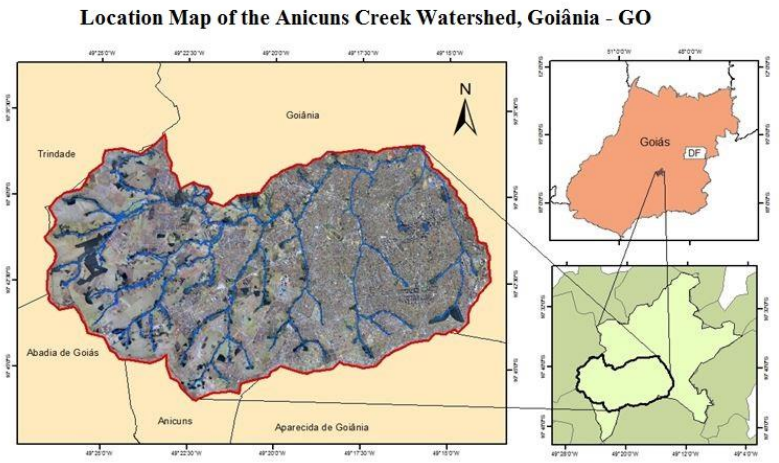

Figure 1. Location map of the study area.

2.2. Methodological procedures

The initial stage of the research was the literature review to raise the theoretical basis of morphometric characterization from various literature sources. The initial cartographic data was collected from Goiania Prefecture the shape files are available on the Mapa Urbano Básico Digital de Goiânia (MUBDG), the orthophoto and Digital Elevation Model (DEM). The cartographic data were incorporated into a GIS via ArcMap 10 software, which can manage and treat geographical information, and perform spatial analysis. The GIS is a computer system that allows the user to collect and analyze

large volumes of spatially referenced attributes and the associated data (Federal Interagency Coordinating Committe 1988). The GIS integrates in a single database of spatial information data coming from sources such as digital terrain model data, satellite imagery, census data, cartographic data, urban and rural cadaster (Corseuil 2006).

The Digital Elevation Model was created from LiDAR data (Light Detection And Ranging) made in Goiânia It is a high precision DEM whose spatial resolution is 1 meter. Hypsometry: to build the hypsometric curve of the basin the DEM was reclassified in several elevation bands, where its altitude ranged from 693 to 904 meters. Slope: the slope of the basin was obtained by the DEM generated previously. For identification and analysis of morphometric characteristic of Ribeirão Anicuns basin has used morphological watershed proposed by Horton and modified by Christofoletti and the Strahler channel order (1957).

The following are in summarized form the parameters used for morphometric characterization Basin of Ribeirão Anicuns. Hierarchy: the classification establishing certain watercourse or area he drained a total set of the watershed in which he is.

Basin area (A): The entire area drained by the whole river system, designed in the horizontal plane.

Perimeter of the basin (P): As the line length of the watershed that delimits the basin area.

Main channel length (mcl): This is the length of the main channel of the basin

Total length of channel (C): the sum of length of all the channels of the basin. Total number of channels (n) adopting the Strahler ordination, is the amount of first order channels

The following are the parameters for the quantification of the bowl shape and components of the hydrographic and combined parameters.
Compactness coefficient: It is associated with susceptibility to flooding in the basin, and was obtained based on equation1.

$$K_c = 0{,}28\frac{P}{\sqrt{A}} \qquad (1)$$

Kc: Compaction coefficient;

P: perimeter (m);

A: drainage area (m2)

Circularity ratio: as the compactness coefficient tends to the unit when the shape of the basin is close to circular and decreases when the basins are elongated. The roundness index (tc) was obtained by equation 2.

$$I_c = 12{,}57\frac{A}{p^2} \quad (2)$$

I_c: Circularity ratio;
P: perimeter (m);
A: drainage area (m²).

Form Factor: This index should be used in comparing similar areas basins. It is also indicative of the possibility of flooding.

$$K_f = \frac{A}{L^2} \quad (3)$$

K_f: form factor;
P: perimeter (m);
L: length of the main course of the basin (m).

Drainage density: This index is a very important indicator of runoff water, which reflects a greater or lesser degree of erosion in sculpting the channels.

$$D_d = \frac{L_t}{A} \quad (4)$$

D_d: drainage density (m/m²);
L: total length of waterways (m);
A: drainage area (m²).

Time of concentration: Obtained from two direct methods employment, explicitly calculating all flow times in all patterns of the basin. Tsuchiya method (1978)

$$t_c = 0{,}83\frac{L}{S^{0{,}6}} \quad (5)$$

Tc: time of concentration (min);
S: slope (m/m);
L: length (km).

2.3. Order

The order of the watercourses can be determined based on criteria presented by Horton, Shreve and Strahler. The classification used in this work was to Strahler, where no tributary channels without the tributary channels are called first order. The second-order channels are the ones that come from the confluence of two first-order channels. The third-order channels originate in the confluence of two second-order channels and can receive tributaries of first and second order, and so on Silveira (2001).

3. Results

3.1. Hierarchy of the River Channels and Morphometric Parameters

According to Strahler the hierarchy of the watershed of Ribeirão Anicuns has branching fourth-order, as shown in *Figure 2*. The results obtained for the Horton laws (1945) are shown in table 1. The coefficient bifurcation ratio (Rb) has its values ranging from 1.72 to 3.62, the mean value is 2.44. This value is consistently high, considering that the expected result should be between 3 and 5. The average length rate (RL) is 0.50 to Ribeirao Anicuns basin are thus within acceptable parameters.

Order (w)	Nw	Log10Nw	R_b	Lw media m	Log10 Lw	R_L	R_{lb}
1	50	1,69	1,72	80,6	1,90	0,66	0,38
2	29	1,46	3,62	53,85	1,73	0,31	0,08
3	8	0,90	2,0	17	1,23	0,55	0,27
4	4	0,60	-	9,5	0,97		
		média	2,44		média	0,50	0,24

Table 1. Results of Horton law.

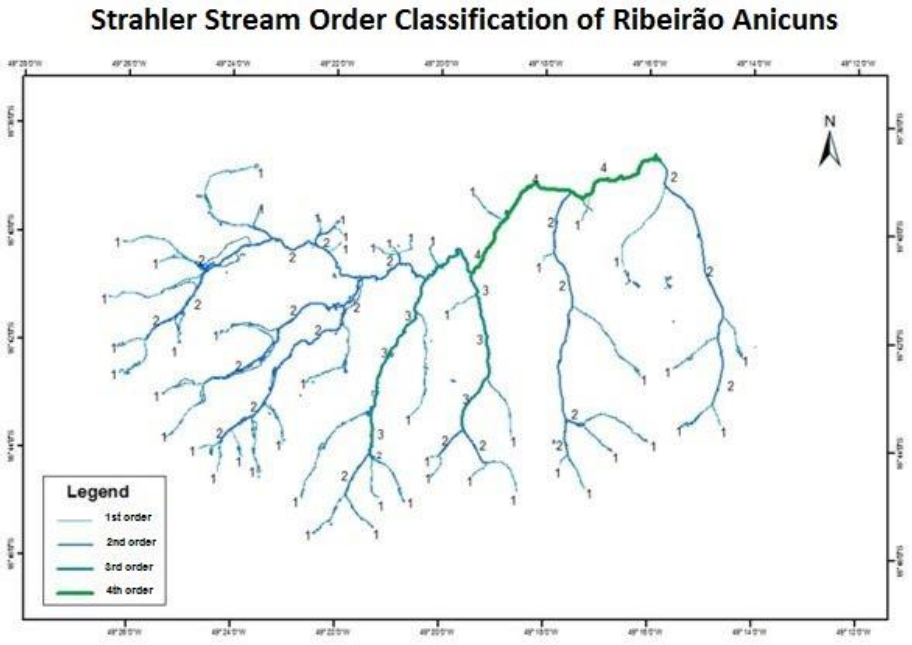

Figure 2. Channels ordering

Basin parameters	Results
Area (km²)	236.27
Perimeter	63.87
basin length (km)	26.05
Form factor	0.348
Compactness index	1.163
Total length of the channels (km)	83.75
Drainage density km/km²	0.681
Time of concentration tc	3,87
Circularity ratio	0,73

Table 2. Morphometric characterization of the river basin number.

The main measures of the watershed of Ribeirão Anicuns are its drainage area of 236.27 square kilometers, perimeter 63.87 and axial length 26,05km.The results show that the basin of Ribeirão Anicuns shown susceptible to flooding because the value of compactness index is close to unity (1.163).According to Vilela and Matos (1975) the form factor signals a basin-shaped lower factor has less flood of chances than another basin of the same size, but with the larger form factor. The result showed that the form factor of the creek Anicuns basin has an average value (0.348).The roundness index shows that the basin has a tendency to be circular because its value is close to unity. The circular basins contain higher concentrations in runoff. According to Beltrame (1994) drainage density of the basin (0.681 km / km²) is classified as average. The drainage density has great importance in the development of the drainage system of a bowl.

The hypsometric map was generated using the triangular grid structure, also known as TIN "Triangular Irregular Network", which is a vector type structure of the type with arc-node topology allowing a surface represented by a set of triangular faces interconnected. The hypsometric map allows a better assessment of raised signage behavior, observe the limits and the occurrence of major mountain ranges found within the basin (*Figure 4*).

The altitude ranges from 693 to 904 meters with a predominance of elevations between 693 and 749 meters and 817-853 metros with the largest located in the southeast, southwest and northwest of the city of Goiania, as well as a sharp peak in the northwest with an approximate altitude 904 m. Through the slicing image was taken in five divisions of the dimensions, in order to generate an image that represents the altitude of the region, identifying the highest peaks and downloaded.

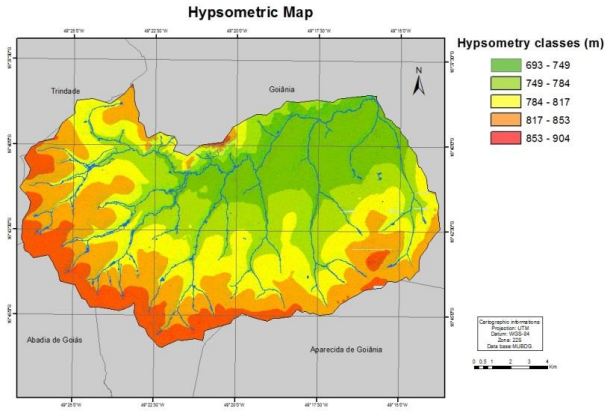

Figure 3. Hypsometric map.

To characterize the study area was used the image of shaded relief, *Figure 4*, which enabled the visualization of the highest areas and the outline of the raised signage of the basin. It is a heavily used technique because it highlights the subtle variations in topography, thus allowing a closer interpretation of the real in the study area; it is a technique that depends on the direction of the light source.

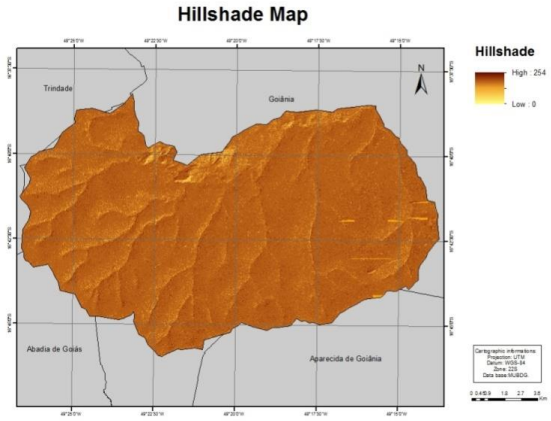

Figure 4. Hill shade map.

The slope may be defined as the inclination of the terrain relative to a horizontal plane may be submitted in percent or in degrees. It is calculated by varying the altitude of the land between two points in relation to the distance that separates them. In *Figure 5* we can observe the image, which was sliced based on the proposal of the Embrapa (2006) ranging between six slope classes: flat relief (0 to 2.9%); Smooth Wavy (3 to 7.9%); Wavy (8 to 19.9%); Wavy strong (20 to 44.9%); Mountainous (45 to 74.9%); and steep (> 75%).

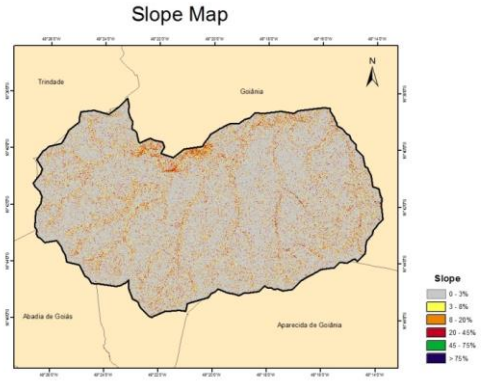

Figure 5. Slope map.

4. Conclusion

It is essential to know the morphometric characterization, it describes on the river system and raised signage with it identifies the changes that went by human activities occurring in the environment. With the results presented we can conclude that is a more circular basin, proven by the circularity index, where the value is shown near the unit. The drainage density presented an average value. The river watershed belongs to 4th order, showing that it is a basin that there are few branching, with several streams of the first order. Based on the results found in the morphometric characterization of the river basin of Ribeirão Anicuns it concludes that is an area that deserves attention and monitoring, mainly because he is in an urban area where the waterproofing rate is high.

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Relationship between the geotechnical Safety Factor and the presence of risk areas: Case Study of Barro Branco, Salvador/BA

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Abstract. The risk is the combined result of several factors in the physical and human dimensions, which result from extreme events occurrences in areas occupied by human settlements and can generate catastrophic events with several social, physical and economic losses. Considering the physical/natural and anthropic components associated with risk events, the soil is one of the most important structures, whether under the geographical approach or geotechnical approach as substrate. Study the soil behavior and interaction with the environment can help to promote actions that allow us to adapt the land use and land cover in ways that can minimize the occurrence of disasters associated with risk events. To best determining the nature of the soil masses movement, the calculation of the Security Factor (FS) is an effective tool. The FS means the numerical value of the relationship established between the shear strength available from the soil to ensure the balance of the body slider ($s = c + (\sigma-u) tg\varphi '$) and the shear stress mobilized, under the effect of the active efforts. This study analyzed the relationship between the FS, understood as the geotechnical variable, which allows, through the mathematical model; determine the stability of the slope. During the development of this experiment was used the calculated safety factor by geostatistics methods for the Barro Branco neighborhood, in Salvador city. It aimed to compare the effectiveness of the FS in the detection of susceptible areas to landslide. Considering the existent map of known risk events points in the study area, the results discuss the importance of this type of analysis for monitoring the instability in areas with steep slope and soil structure with a tendency to landslide. Add to that the dense urban occupation exists on site and its geomorphology associated with soil movement events in the city of Salvador/BA.

Keywords: Landslide, Risk Areas, Safety Factor

1. Introduction

The city of Salvador is one of the oldest cities of the country. Containing nearly three million inhabitants is considered the third largest capital of Brazil, behind only to the cities of Sao Paulo and Rio de Janeiro. In the 2010 census, Salvador boasted a population of about 2.6 million inhabitants (IBGE, 2010). In estimating held in 2013, the number had grown to just over 2.8 million. Since last year until July of this year, municipality won 19,245 new inhabitants. As shown in the comparative table below, between the data of 2010, 2013 and 2014:

Province	Population (IBGE 2010)	Population (IBGE predicted for 2013)	Population (IBGE predicted for 2014)
Salvador	2 675 656	2 883 682	2 902 927

Table 1. Population evolution in Salvador (Source: http://www.rms.ba.gov.br/regiao-metropolitana-de-salvador-e-a-6a-mais-populosa-do-pais-diz-ibge/)

The hillside areas began to be occupied in the 17th century, as can be noticed in the work "Perfil da cidade de Salvador: Salvador da Bahia de Todos os Santos" that shows her sea height, whose original manuscript is in the Algemeen Rijksarcjief, the Hague, from 1609-1612.

According to Muñoz (2010), the increase of the buildings on the slopes of Salvador starts in the late 17TH century, as shown in the iconography of the season – Vista St. Saviour, the engineer Froger, designed in 1695.

Figures 1 and *2* are two enlarged fragments: the first will do Carmo to the Mercy, and the second comprising the sight of Mercy to Santa Teresa. The observed increase of the buildings on the slopes of mercy and laziness and an incipient occupation on current Ladeira do Taboão.

Figures 1 and 2. First and second illustration of the Vista of San Salvador (Froger 1965 & Muñoz 2010), from Reis (2000, pp. 35-36).

Over time this situation intensified, because the actions of planning for urbanization of the city were still scarce, thus they were built earthen houses

and townhouses up to five floors on the slopes and surrounding the Hill (Muñoz 2010).

1.1. Legislation for Land Use in Brazil

The most important current legal framework when it comes to planning the use and occupation of land is Law No. 6,766, of December 19, 1979, which establishes minimum requirements for sanitation and infrastructure for the use and installment soil, equally important it indicates actions required to those that has been precariously occupied, which largely are associated with occupying slopes.

According to the Article 3 of the Law States, only will be accepted the division of land for urban purposes in urban areas, urban expansion or specific urbanization, as defined by the director or approved by municipal law plan, and won't be allowed the division of soil in wetlands and subject to flooding before taken steps to ensure the flow of water; on lands that have been grounded with harmful material to public health, without being previously sanitized; on land with slopes less than 30% (thirty percent), unless met specific requirements of the competent authorities; on land where geological conditions don't advise the building; in areas of ecological preservation or those where pollution prevents tolerable sanitary conditions, until their fix. (Law No. 6,766, of December 19, 1979, as amended by Law No. 9785 of January 20, 1999).

The sessions highlighted above in the text translate one of the biggest problems of land use and occupation reality in Salvador because the city has occupations in areas with slopes above 30% (without special conditions). Associated with this phenomenon, the increased amount of works such as bridges, condominiums and other soil waterproofing factors have contributed to the problems of drainage and water absorption from the soil by rainfall

1.2. From Risk definition to Risk assessment

The concept of "Risk" is defined as the "perception of a possible danger, more or less predictable, for a social group or by an individual who has been exposed to it" (Veyret, 2009).

The international strategy for disaster reduction (UNISDR, 2009) defines risk as the combination of probability of occurrence of an event and its negative consequences, mathematically:

$R = (P * V) / Re$

Where R is the risk, P is the danger, V is the vulnerability and Re is the answer.

The overall risk assessments are possible from mathematical modeling and laboratory testing. In risk analysis, the study proceeds from the "levels of risk", namely: (1) non-tolerable risks; (2) manageable risks; (3) negligible risks.

Tolerable risks can "transform" into manageable risks through the laws (Engineering Magazine 2010), as the law No. 6,766 of December 19, 1979, being distributed:

1) Non-tolerable Risks: this type of risk requires that you take serious measures to reduce their degree or become a manageable type.

2) Manageable Risks: they are the types of risks where we are prepared to receive them, however measures are better to reduce their degree.

3) Negligible Risks: no need to take measures to reduce or soothing for this type.

2. Occupation of hillsides, mass movements and the risks

Generally, these risks are consequences of the use and occupation of the soil unsuitable for half of the population. Normally, it is common for the low-income population to peripheral areas, by the fact of being low-cost areas (or zero cost). These areas are characterized by low-quality land of geotechnical viewpoint, lack of basic sanitation, associated with higher declivities and environmentally degraded areas.

The occurrence of mass movements are natural and recurring processes, however, the allies irregular occupations of these localities, generate has generated deaths, and tragedies in various locations, such as the city of Salvador. The city boasts a rugged geomorphology with few lowland regions, high proportion of low-income population, resulting in a dangerous combination when these mass movements occur.

2. Objectives and methodology

Between the months of April and May 2015 Salvador rainfall indices had atypical behavior for the rainy season, with an increase historical series and occurrence of extreme events concentrated in this period. As a consequence, the occurred mass movement events that resulted in property damage and a total of 11 deaths during the period.

Face of this of events, this paper aims a correlation the of the disaster localization in the factor of safety map (calculated from Geostatistics) and risk area, pointed from Salvador director plan of slope (data bank of risk areas on the Salvador City) to Fazenda Grande do Retiro neighborhood, Barro Branco locality.

3. Study area: the community of Barro Branco

The community of Barro Branco suffered with the rains accounted for 11 people deaths on 4/27/2015. In 40 years, the neighborhood is the third tragedy, in consequence between occupations of risk areas and rain. Second Campos (1996) the last similar tragedy to the current, happened in April 21, 1996 leaving 13 deads and more than 300 homeless.

The tragedy left hundreds homeless, with the slipping of 3 buildings that buried five houses and damaged other fifteen (according to A Tarde newspaper). *Figures 3* and *4* show this situation.

Figures 3 and 4. Images from the landslide area, Salvador. Source: Edmundo L (UFBA)

The Barro Branco community is part of Fazenda Grande do Retiro neighborhood and it is inserted in one of the largest urban city site slope, that achieve more levels above 40%. It also has in its perimeter the demarcation of risk areas with four levels (by PDE-Level maximum risk to be considered).

3.1. Technical procedures: Infinite Slope Method and calculation of safety factor

Slope is defined as a slanted surface that delimits a massive earthy or stony (Andrea Sell Dyminski 2010). Normally its geometry is of 45° or 1/1, and is not advisable for your inclination is greater not to influence its stability. The structure of the slope is represented in *Figure 5*.

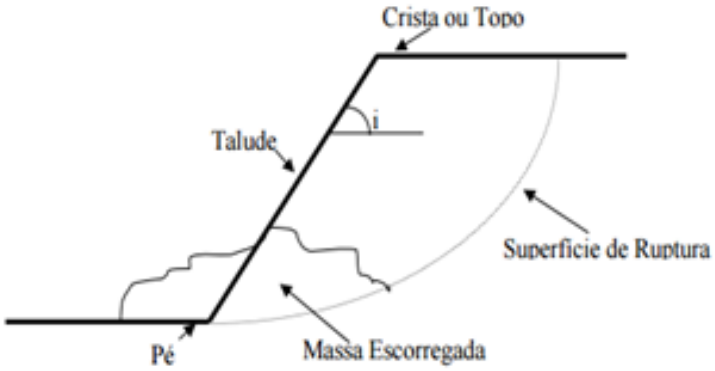

Figure 5. Slope Structure (Source: Dyminski AS, Slope Stability)

The slopes are characterized by its instability due to its relation with the natural formation and the external factors that Act on it. This imbalance causes from problems of large scale as land sliding (mass movements).

Land sliding can be defined by the reduction of the internal resistance of the soil who oppose the sliding movement. Usually the rupture takes place on the surface of least resistance. The slope stability analysis is carried through the calculation of safety coefficients against the propping. The factor of security is given by the coefficient between the resistant forces and the forces acting on a system (slope). The same may vary over time, once the slope can spend years without slipping and from any force (already defined in the previous paragraphs) may lose their stability.

There are a variety of methods for the calculation of the security factor (FS). But in this case it was used the method of infinite slope, as best fits the example worked.

3.2. Infinite Slope Method

Slope is named infinity when the extension between their dimensions, are very large. These magnitudes are geometric, long or thick. In these cases the rupture line is parallel to the surface of the ground. And these can be homogeneous mass or laminated, according to *Figure 6*.

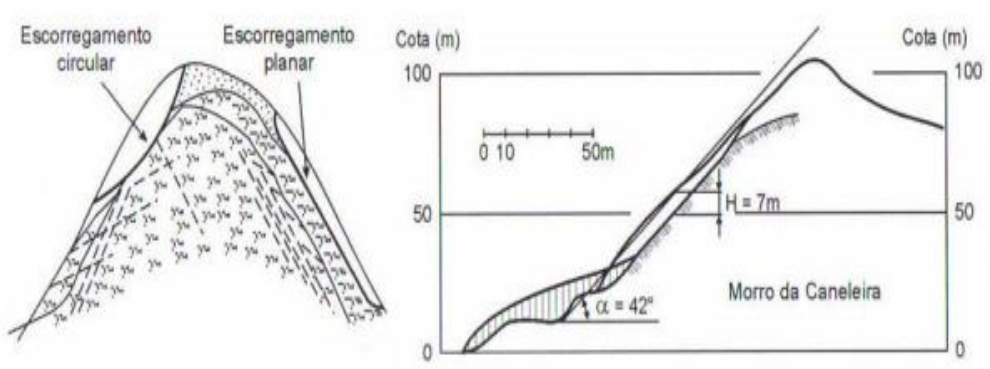

Figure 6. Infinity Method (Massad 2003).

Mathematically, the method is described below (*Figure 7*):

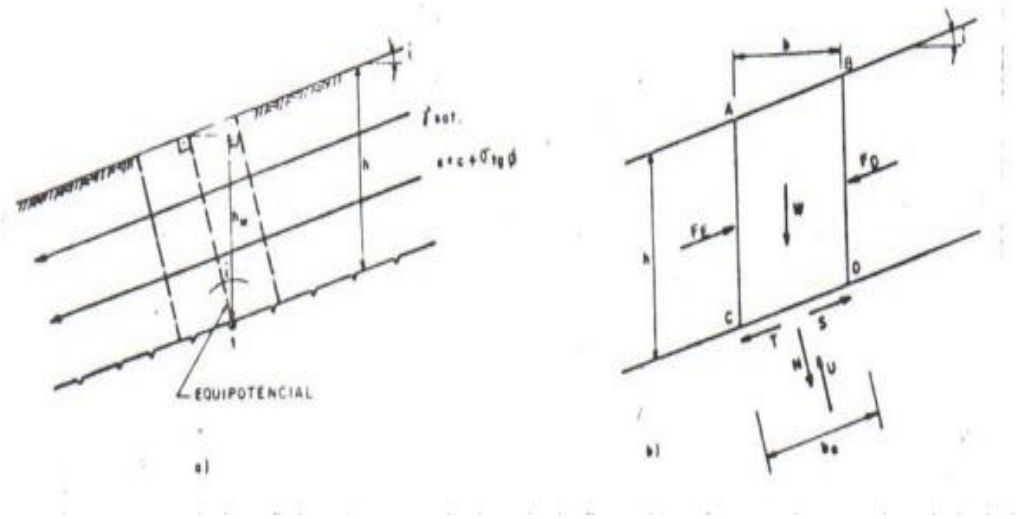

Figure 7. Infinity Slope method (Marangon 2009).

The capital letter represents the tensions, so:

Pressão neutra U: $\frac{u}{\gamma_W} = hw = h.\cos^2 i \; ou \; u = \gamma_W \,.\, h \,.\, \cos^2 i$

$U = u.b_0 = \gamma_W \,.\, b_0 \,.\, h\cos^2 i$

Peso da lamela W: $W = \gamma_{sat} \,.\, b \,.\, h \qquad sendo \;\; b = b_0 \,.\, \cos i$

$N = W \,.\, \cos i = \gamma_{sat} \,.\, b \,.\, h \,.\, \cos i$

$T = W \,.\, \text{sen}\, i = \gamma_{sat} \,.\, b \,.\, h \,.\, \text{sen}\, i$

$\sigma = N / b_0 = \gamma_{sat} \,.\, h \,.\, \cos^2 i$

$\tau = T / b_0 = \gamma_{sat} \,.\, h \,.\, \text{sen}\, i \,.\, \cos i$

And the factor of safety is calculated between the mathematical relationship (quotient) between the shear tensions above, resulting in the following equation

$$FS = \frac{c + \gamma' h.\cos^2 i.tg\phi}{\gamma_{sat}.h.\text{sen}i.\cos i}$$

Where c = is the soil cohesion (obtained through analysis of soil in the laboratory); γ_{sat} = Specific weight of the soil; i= inclination (slope); ϕ = angle of friction.

3.3. Geographic Information System – GIS

Geostatistics

Based on the mathematical model and the data were judiciously chosen: from the region-level curves obtained by CONDER Urban development company of Bahia – year of 2003. Cohesion, the specific weight and the friction angle, were obtained by data from surveys made in the year 2006, and the points of risk areas, were removed from the master plan of Slopes of Salvador (data Base).

In 10.1 version of the ArcGIS software, the first step was to interpolate levels curves using the *"Topo to the Raster" from Spatial Analyst*, outputing a new Raster. After, was extracted the slope (degree) using the "Slope" tool from Spatial Analyst. Cohesion, the specific weight and the angle of friction were interpolated using *"Ordinary Kriging"* tool from *Spatial Analyst*. These entire tools are inside the Arctoolbox.

Each variable that are part of the safety factor was entered in the new tool created. It is necessary to convert each data input under appropriate units - as example of the angle of friction and slope degree was converted to radians for which the calculation is performed correctly. In addition, each variable was converted TIFF format, with the intention that all pixels have the same dimension 5x5m. After these procedures, each raster was uploaded as

input to the tool FS, at Arctoolbox and resulted in a final raster containing variations, as shown in the *Figure 8* below.

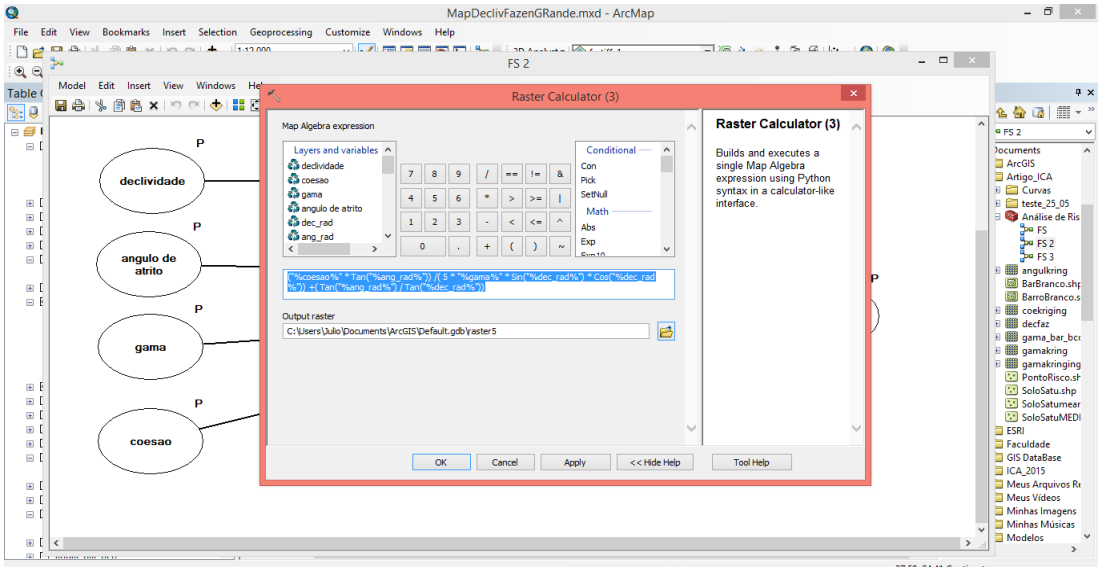

Figure 8. Model construction.

4. Results and Discussions

The result is a Map of safety factor with the overlapping points of risk areas containing the information of the safety factor for the entire district of Fazenda Grande del Retiro, with highlighting Barro Branco area, following settings:

Reference Vallues	Slope Stability
< 1	High Risk (unstable)
1 – 1,5	Midle Risk
> 1,5	Low Risk (stable)

Table 2. Interval Vales of Results Factor of Safety.

By changing the values of depth from the rupture surface, it is possible to estimate different scenarios for values between 1 and 5 meters.

These changes, combined with the degree of saturation of the soil represent the possibility of triggering a landslide. The maps of variation of the safety factor as a function of depth from the surface of rupture are presented in Figure 9 below:

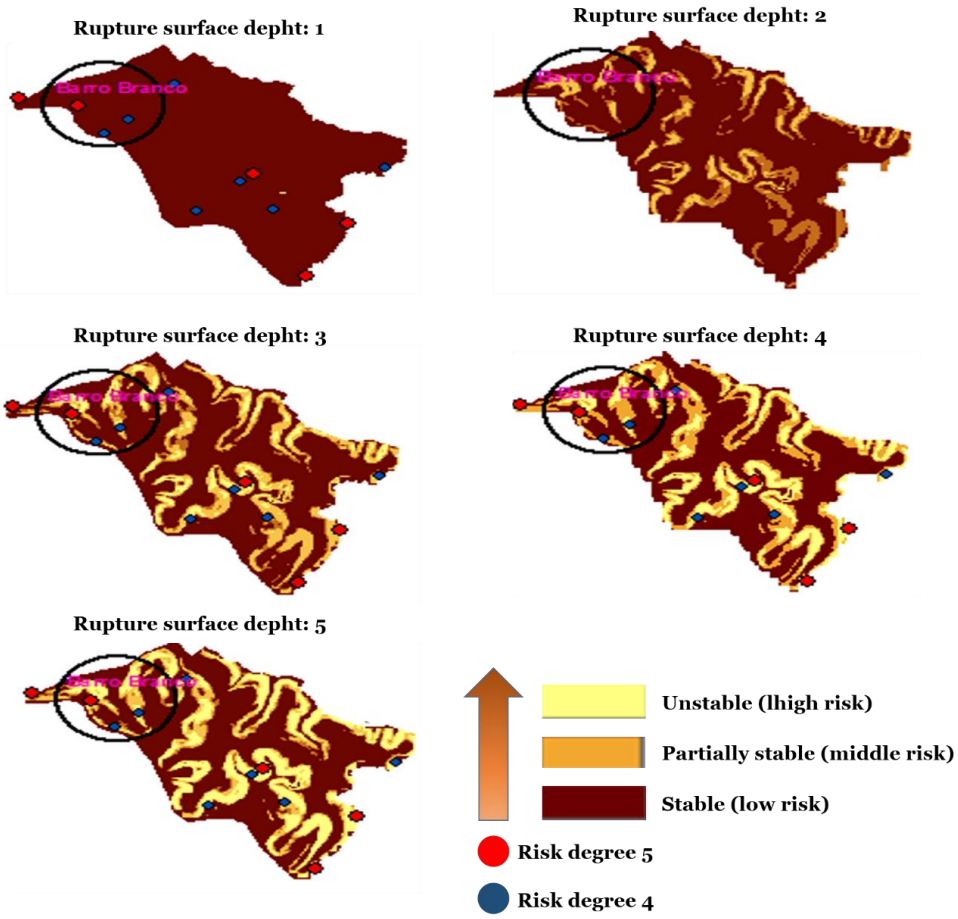

Figure 9. Factor of safety for different rupture depths.

The first map collection shows the safety factor and the risk areas that it covers. The second map (*Figure 9*) depicts that buildings occupy areas with medium and higher risk of slipping. As well as the location of white clay that is included in this region with values for up to 1 safety factor.

5. Conclusion

The calculation of factor of safety is an effective method for the delimitation of areas subject to land slippage, proven by the locality of white clay, where was the disaster that killed 11 people on April 28. This method can be used for local prevention that there is a tendency to washout of lands. The input data can be improved to be a refinement in the output product.

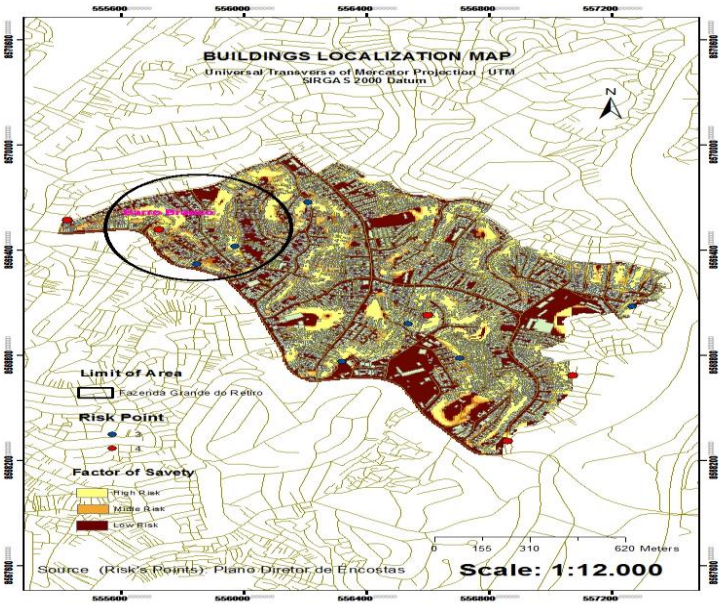

Figure 9. Buildings and factor of safety.

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Real-Time Hydrological Maps based on Data Interoperability Web-Services

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Abstract. In order to take appropriate countermeasures before and during flood events, decision makers, crisis committees, and the public need fast, secure and easy access to real-time hydrological data. In order to meet the increased needs and expectations of internal and external parties, new tools for real-time data analysis, data collation, interoperability, and interactive visualization have been introduced, and further developed by the Swiss Canton of Aargau. More customizable tools for hydrological data analysis and cartographic publication are now available, tailored to a diverse group of users.

At the heart of the new data infrastructure is on the one hand a client-server data management tool which allows role-based data access on the Desktop, including a variety of time series data analysis, visualization options, and data processing batches. On the other hand, a Web-based data interoperability Web-Service allows customizing and collating various sets of real-time hydrological measurement data, geometry data, and metadata from the Canton's productive real-time database. Heterogeneous dataset are easily converted and standardized using well-known standards such as Open Geospatial Consortium's WaterML 2.0 and Sensor Observation Service (SOS). These often large data sets may then easily be combined, distributed and served over the Web, for further use by further applications, or third-party users.

This contribution not only focuses on the capabilities and functions of the mentioned Web-Service, but also highlights features of the newly launched Cantonal real-time map portal *HydroWeb*, which is entirely based on this Web-Service.

Keywords: real-time cartography, big data, data interoperability, Web-services, hydrology, environment

1. Introduction

1.1. Big Data

Real-time information and visualization, as well as the buzzword "big data" are no longer mere concepts, but realities with which data suppliers, analysts, modelers, as well as cartographers and GI-scientist have to deal with. It is estimated that about 90% of all the data in the world has been generated over the past two years (SINTEF 2015). The bulk of these vast amounts of data results mainly from the environmental domain, such as computer simulation, in-situ monitoring and measurement, remote sensing activities, and volunteered geographic information collections (Buytaert et al. 2012). However, telecommunication connections, radio-frequency identification systems, web-cameras, online social networks, as well as data feeds, also play a major role in the context of "big data". Standing primarily for the processing and visualization of large, complex (multi-type, multi-source, multi-dimensional), rapidly changing data, big data constitute great challenges and potentials alike.

The first mention of the term dates back to Laney (2001), who characterized big data as data requiring high management capabilities, attributed to volume, velocity, and variety. In science, big data denotes the combination and statistical processing of large data amounts which may lead to new insights and scientific knowledge. Technically speaking, big data processing involves various aspects, such as:

- processing of a multitude of data sets
- processing of a multitude of columns in a data set
- fast import and export of large bulks of data
- real-time processing
- short response times, even for complex queries
- concurrent queries
- multi-type and multi-media analysis (numbers, text, images, films, etc.)

Classical relational database management systems (RDBMS), such as PostGreSQL or MySQL, which use standardized structure query language (SQL) and eXtensible Markup Language (XML) standards to store such big data, have many limitations, particularly when handling complex data formats (Vitolo et al. 2015). With the growth of data availability and its increased heterogeneity, problems of data scalability and flexibility become more prevalent. Large volumes of unstructured or semi-structured data are stored in multidimensional arrays, irregular meshes and graphs, no longer representable by classical relationships propagated by RDBMS. As Nativi et al. (2015) discuss, the next generation of large databases tackling the challange of big data will be based on NoSLQ-technology (Not Only SQL Data

Base). This requires the capabilities to read, modify and update unstructured data sources without making copies, but by versioning (spatial) data and keeping track of data provenance.

Aside from these mentioned technical challenges, further challenges arise dealing with big data in order to meet user needs and expectations. Regardless of the quantity of data, users expect fast processing and customized output. Whether it is subsequent processing steps, data delivery to third party applications, or end-users who operate some sort of decision-support system. Buytaert et al. (2012) argue that in the environmental domain there is an increasing need of end-users, particularly decision makers, for common platforms and infrastructures that help integrate environmental data, models, and decision support systems. On the global scale, these efforts are reflected by initiatives such as the *Earth Cube*, or the *Global Earth Observation System of Systems GEOSS*. GEOSS is designed as global and customizable network of content providers allowing decision makers to access an extraordinary range of data and information in their daily business (Nativi et al. 2015). Even on the regional or local scale, there is a growing need for achieving higher levels of data integration and interoperable data and information exchange. They all aim at providing environmental simulations and predictions that result from advanced integration of climatic, hydrological, ecological, social and other data, in order to support management and policy decisions (e.g., Fienen & Lowry 2012; Stakhiev & Stewart 2010).

1.2. Interoperable, standardized Web-Services

Basis for any decision support system are data sources, data processing, and their subsequent presentation to the user. Integrated workflows and Web-Services are widely used in the environmental domain, allowing distributed models, data, and sensors to be accessed through Web Services (e.g., Yue et al. 2015). Various Web-services may not only be used separately, but also chained together to support environmental monitoring and integrated modelling. In the geospatial domain, the Open Geospatial Consortium (OGC) is the major organization engaged with the development of interoperable geospatial Web Services standards by adapting or extending Web Service standards. Examples of OGC Web Service standards include Web Feature Service (WFS), Web Map Service (WMS), Web Coverage Service (WCS), Sensor Observation Service (SOS), and Web Processing Service (WPS).

Web-Services follow the principle of reusability, loose coupling and modularity. They are essential in the design and implementation of internet-based workflows. In essence, a web service is an application that enables access to its functions using established internet standards. As such, they

provide seamless cross-platform interoperability between different loosely coupled systems. Currently, two main architectural styles are most commonly used: SOAP and REST. SOAP services use remote procedure calls to invoke functions, parameters, or return values on remote systems. Data sent over the network is structured in XML format, making it machine-readable and platform-independent. REST, or Representational State Transfer, uses Uniform Resource Identifiers (URI) to address and obtain the requested resource. In REST, interaction with the Web service is based upon stateless transfer between different resource representations. REST is therefore loosely coupled to applications and rather resource-based than transaction-based. REST Web services handle organizations' firewalls without particular configuration and are easier to develop.

1.3. Background, Motivations and Outline

In 2012, the Swiss Canton of Aargau has launched to two-years project "Introduction WISKI", during which it purchased a commercial water information system software. It replaced its old software for better management of large archive and real-time hydrological data, for enhanced hydrological and GIS-based analysis, and for better interface management with Web-based publication and visualization interfaces.

After thorough evaluation, the decision of the Canton of Aargau fell on the WISKI system which is developed, marketed, and delivered by the German company Kisters Inc. One of the world's market leader in this segment, Kisters Inc. early teamed up with the American Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) and its subgroup Hydrologic Information System, to be up front with the developments of the Observations Data Model, its Web-based distribution and standardization (Goodall et al. 2008; Horsburgh et al. 2009). These developed concepts for Web-based, standardized and interoperable distribution of hydrological (and other environmental) data have reached market maturity and have entered the portfolio of the software vendor Kisters Inc, branded as Kisters Web Interoperability Solution KiWIS. Furthermore, the company still actively participates in the development of OGC's WaterML and TimeSeriesML standards, making sure that their Web-service products comply with international data standards. The offered Web-Service KiWIS allows customers – such as the Canton of Aargau – to tap the full potential of their hydrological database in cooperating with third parties and linking third party applications (see remainder of this paper). In fact, the availability of Web-Services was one of the main evaluation criteria for the new water information system purchase.

Similar projects that also discuss hydrological real-time systems, Web-service-based concepts, hydrological data exchange and data interoperability, data analysis, and visualization interfaces are described, among others, in Demir & Krajewski (2013), Lienert et al. (2011), Walker & Chapra (2014), Blower et al. (2014), or Kanwar et al. (2010).

2. Architecture, Data and Web-Service

2.1. Data Sources and Measurement Networks

Two main distinctions are made as to data sources and measurement network: 1) data sources where the Canton of Aargau holds data ownership 2) third-party data from other public authorities, such as several Federal Offices, other neighboring Cantons, one German state (neighboring the Canton of Aargau across the river Rhine), several research institutes, and private measurement network operators. Further distinction are made between a) real-time vs. archive, b) enduring vs. temporary (i.e., project) time series, c) original vs productive time series, d) persistent vs. on-the-fly calculated time series.

The following measuring parameters are stored in the Cantonal WISKI database: precipitation, soil moisture, soil temperature, water temperature, air temperature, groundwater height, pumping volumes, river discharge, various drinking water quality parameters, and various bathwater quality parameters. Further environmental parameters will be integrated in the near future. In the following, the focus is on the four measuring parameters river discharge, water level, water temperature, and precipitation.

2.2. Architecture

The entire system architecture of the Cantonal hydrological data management system is based on a client-server architecture with various middle ware and several server components. The architecture is shown in Fig. 1.

The grey background indicates (one of) the internal security zones for the server responsible for synchronic online data fetching (SODA) , the MSSQL-based database Server SQLA-WISKI-PROD, and the Windows-server based application server SVWAF009 (APPserver). On the latter, several core applications are running, such as the WISKI-Software, and the Distributed Service Manager KiDSM, responsible for tasks and jobs such as data import from external sources, or the controlling of data processing.

Two more servers are situated in an outer server zone, in order that some components are reachable over the Internet. The Linux-based server SVUAS90003 (FTPserver) is responsible for the bulk of the data transfer

and data conversion. This server also runs programs to create HTML-output and PDF-based graphics. The Linux-based server SVUIN705 (WEB-server) hosts programs that provide important Web-interfaces, among them is the discussed Web-Service program KiWIS. KiWIS uses the Web Data Provider (WDP) component of the APPserver, shown in Figure 1. More details on KiWIS and its outputs are discussed below. More technical information on vendor-specific server or component interfaces may be obtained from technical documents delivered by the vendor (www.kisters.eu).

About one time per year, an updated version of the WISKI system is available. For testing, integration, and eventually updating purposes, there is a replica of the entire operational architecture shown in Fig. 1. With this test architecture, safe operations are ensured on the operational system, while newly delivered or newly developed architecture component are tested and reviewed in parallel.

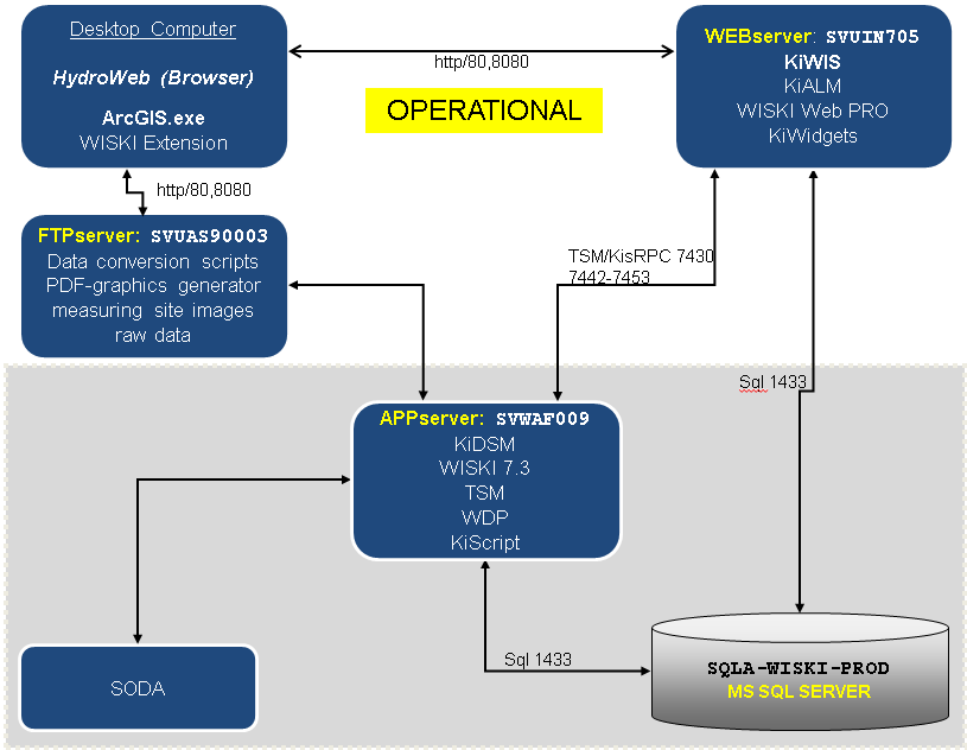

Figure 1. Overall operational system architecture of the hydrological and environmental data management and publication system of the Canton of Aargau.

2.3. Basic Data Model

A cascade of seven steps describes and determines the basics of the overall WISKI data model operated by the Canton of Aargau (it should be noted that the underlying, generic WISKI data model marketed by the vendor is not part of the discussion):

data owner (e.g., Canton of Aargau = AG)

organization (e.g. Division Landscape and Waters = ALG)

gauging site (e.g., City of Rheinfelden, and gauge Nr. 0374)

station type (e.g. Flowing Waters = FG)

measuring parameter (e.g., Water Temperature = WTemp)

time series (e.g., original series with raw data = Cmd.O)

agents (e.g., agent to import raw, unverified data)

This tabulating cascade is a simplified, descriptive form of the overall data model in the "vertical" direction (top-down). Each of the above mentioned steps has up to a dozen different manifestations in the "horizontal" direction. There are more interrelations on each cascading steps and further attributes with data is attached to them. For example, on each *gauging site* level, information is stored concerning identification, location (geo-coordinates), elevation, history, measuring parameter, and – depending on the station type – further statistical measures and aggregated values. Apart from these linked information on each step, the cascade also determines how deriving products (such as PDF-files containing updated time-series graphs) are stored, named, and accessed and the Web, since parts of the naming of a file and its path on the Web-server are served out of the database by the Web-Service KiWIS. Thus, by analogy to the above cascade, a PDF-file showing a graph of a certain station for the past 7 days may be accessed as: AG_ALG_FG_0374_7d_WTemp.pdf.

2.4. The Web-Service Interface KiWIS

Technically speaking, KiWIS is a Web-Service based on "REST Level 0", which makes it a "HTTP-based Web-Service". With the integration of KiWIS, the Canton of Aargau has established a basis to considerably facilitate online collation and publication of various hydrological data in real time. Data requests and data distribution are handled by this service while it is also convenient for providing large volumes of hydrological data to the cloud, and to make it available to third parties, or for further processing –

for example to publish them in real-time maps, as will be discussed in the next sections of this paper.

The Web-Service considerably simplifies working with a variety of data sets and formats by generating a homogeneous view of all available data. As mentioned above, the software implements hydrological open standards, e.g., OGC's WaterML 2.0. Summarizing, KiWIS may be characterized as a tool that:

- allows for the publication of large amounts of time series data
- supports authorities to perform their legal data publication tasks
- helps foster cooperation with third-parties
- distributes specific data and information to assigned user groups
- enables customers build customized Web-applications and data-hubs, in order to use data across applications.

In order to leverage the capabilities of the Web-Service, two specific data services were designed to deliver real-time data, so that it could be processed and combined with GIS-data in another environment, and ultimately be visualized on the cartographic user interface as real-time maps. The following two main types of Web-service request are formulated and applied for feeding the real-time data lists and the real-time maps:

1. *getTimeSeriesValueLayer*-request: get the last (most current) values of all activated time series. Activating a time series is done by assigning it to a specific group in the software. Such a group may be looked at as a database view. The first part of the URL reads:

https://www.ag.ch/app/hydrometrie/kiwis/KiWIS?datasource=0&service=kisters&type=queryServices&request=getTimeseriesValueLayer&format=objson&crs=local&timeseriesgroup_id=39016

The Kisters QueryService (KiQS) is used and the mentioned request *getTimeSeriesValueLayer* is applied. Available return format range from Google's KLM format to ASCII or HTML, but for our purpose, a JSON format that reflect object structure (Objson) is returned. A local coordinate reference system (crs) is used, and the time-series group with ID 39016 is retrieved, which is the mentioned database view with all activated time series stored in it.

2. *getTimeSeriesValues*-request: get the data of the past 72 (or another amount of) hours for a specific gauge. Time series must not be activated extra, but will be addressed with the assignment of the gauge to the time series group (see *getTimeSeriesValueLayer*-request above). The first part of this URL reads:

https://www.ag.ch/app/hydrometrie/kiwis/KiWIS?datasource=0&service=kisters&type=queryServices&request=getTimeseriesValues&format=html&dateformat=yyyy-MM-dd%20HH:mm:ss&ts_id=24956042&from=2015-05-29

Again, the KiQS is used with the request *getTimeSeriesValues*. As an example, the return formal HTML is used, and a date format and a starting date for the time series with the ID 24956042 is spedified, which is an ID that has been created by the WISKI system upon manual creation of the time series.

The two discussed Web-Service requests *getTimeSeriesValueLayer* and *getTimeSeriesValues* are called several times within one hour. Particularly during flood events, when the public retrieves real-time data, even concurrent processing requests may be evoked through the Web-Service. Extreme situation with large numbers of visitors and requests have been thoroughly tested and optimized with the Cantonal IT department. KiWIS also offers a configurable caching mechanism, which is applied for the *getTimeSeriesValues* request. For the *getTimeSeriesValueLayer* request, however, another type of cashing has been installed: the Web-Service is called every 5 minutes by a batch job and the result is stored as a file on the applicable server location. The map application then accesses just this file. This way, any possible, unforeseen bottlenecks are avoided and only one client (the batch job) evokes the Web-Service, therefore sparing it from excess loads.

More information on the Web-Service KiWIS and its specifications may be obtained from the specifications of the installed service on the IT-infrastructure of the Canton of Aargau (KiWIS-Specification 2015).

3. Resulting Maps and other Deliverables

3.1. Linking to the WebGIS

As mentioned at the beginning, within the frame of the overall project "Introduction WISKI", the sub-project named *HydroWeb* was carried out. The goal was to leverage the Web-Service KiWIS in order to visualize real-time data cartographically and interactively on the Web. The question was how to combine the real-time data served by the Web-Service with the Cantonal spatial data infrastructure and its publication utility AGIS*viewer*. This question was, somewhat later, addressed not only with hydrological, but also more generally, with environmental data (Lienert & Meier 2014).

Thus, for the success of the sub-project *HydroWeb*, the AGIS*viewer* framework had, for the first time, to meet the requirement of handling real-time data. So far, predominantly static, pre-processed products have been, and still are being, published in this framework. The choice to realize real-time maps in this framework, as opposed to work in other, external frameworks, was based on the arguments that not only would data be stored on internal databases, but also visualization would be provided by internal service providers (i.e., the Cantonal IT department, division GIS). Other advantages outweighed external visualization solutions, since many functional libraries such as navigation, search and filter, as well as base maps, and additional map layers are ready to be reused. Also, questions around corporate design and accessibility were solved quickly by choosing this internal way.

3.2. Data Access using Real-Time Lists

Apart from data access through interactive maps (see next section), the most current data are also accessible through lists. Such lists are optimized for mobile devices and comply with corporate design guidelines. Since maps are not yet accessible via mobile devices, users are automatically redirected to the real-time data list as shown in Figure 2 when trying to retrieve the map with a mobile phone.

The list is derived from the *getTimeSeriesValueLayer* request of the Web-Service and is further processed on the server for better readability. The user may choose one of the measured parameters (river discharge, water level, water temperatures, precipitation) using drop down functionality. The list is immediately reloaded when the parameter is changed, or when the browser is refreshed. For river discharge, the current values are related to different warning levels. Depending on whether and what warning levels are reached, automatic colorization of the row takes place. Warning levels have also been stored and linked with gauge information in WISKI and are served by KiWIS.

A single row of the real-time data list shown in Figure 2 consist of maximum 7 attributes: 1) river name, 2) station/location name, 3) date, 4) time, 5) measured value, 6) unit, and 7) link to constantly updated PDF containing the graphics of the time series. The real-time data list is accessible at www.ag.ch/hydrometrie/liste.

Figure 2. Screenshot of the list of real-time data. It is based on the *getTimeSeriesValueLayer* request and is optimized for mobile devices. Top left, either river discharge (German: *Abfluss*, shown here), water levels, water temperatures or precipitation data may be chosen to view in real-time. Depending on whether discharge values reach a pre-defined warning levels, the specific data row is colored yellow, orange, red or dark red.

3.3. Data Access using Hydrological Real-Time Maps

As described above, the real-time data are served through KiWIS in a JavaScript object notation structure, better known as JSON. Map integration was accomplished with the ESRI Application Programming Interface (API) for Javascript (JS). The framework for the entire AGIS*viewer* and time series charts in the widgets (see Figs. 3, 4 and 5) is provided by ExtJS. The map symbolization, particularly its interactive control, is realized by Cascade Style Sheets (CSS). The real-time map may be accessible at www.ag.ch/hydrometrie/karte

In Figure 3, the real-time hydrological map is shown on the scale 1:360'000. The dark shape represents the Canton of Aargau. It is a composite map consisting of a base map (streets, forests, city names, water bodies) and an orthophoto map. Additional Webmap-Services of the AGIS*viewer* framework provide, in dependence of the map scale, different levels of de-

tails of the base map information, as well as the river geometry and river name annotations.

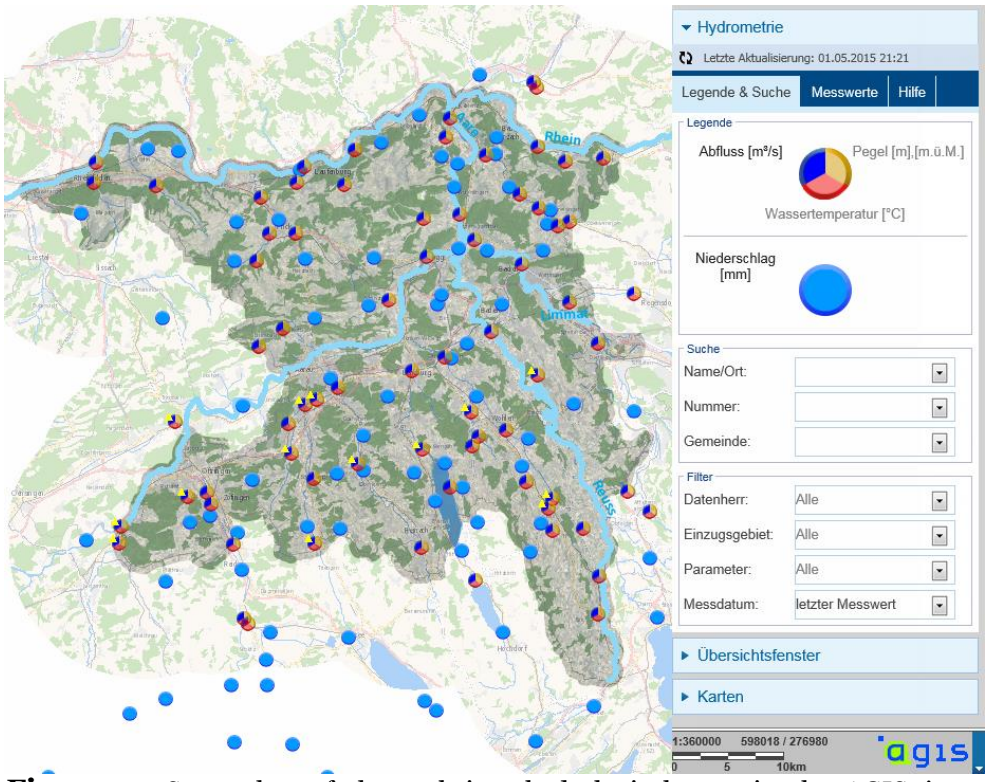

Figure 3. Screenshot of the real-time hydrological map in the AGIS*viewer* framework. On this scale, information about the gauge only appears when moving with the mouse over a gauge symbol. Also on this scale, additional yellow triangles on respective map symbols indicate that warning levels have been reached.

The map in Figure 3 comprises the measured parameters river discharge, water levels, water temperature, and precipitation. Gauging locations of precipitation are represented by a full blue circle. The former three mentioned parameters are measured at the same gauge location (multi-parameter gauge), thus the symbol to represent the location of these data is a circle with three equal slices (blue for discharge, red for water temperature, and green for water levels). On the map, depending on the chosen scale, specific interactivity and responses are provided. Clicking on the map symbols in the legend on the right either activates or deactivates the functionality that map symbol return information when they are being hovered by the computer mouse. Depending on the scale, information about the gauge (current measured value, gauge location, time of measurement) is

either provided only if the mouse is moved over the symbol, or it is already attached to the symbol and therefore visible right away, like a little flag.

Zoom-in into smaller map scales results in adjusted (i.e., enlarged) map symbol sizes and, in some specific cases, in the visibility of further map symbols which are not visible on the larger map scale. This mechanism is needed to address space conflicts of map symbols on larger map scales. These space conflicts and problems of map symbolization clutter have been solved pragmatically. When there was a space conflict on a specific scale, usually only between two two gauges, one gauge location was given priority over the other. The priority of a gauge was determined arbitrary, depending on its overall significance, measuring network affiliation, measuring quality, and representativity. The prioritization is controllable using a configuration file. Overall, five space conflict issues are solved this way, when the less prioritized gauge becomes only visible one or two zoom levels further down.

For the new hydrological real-time maps of the Canton of Aargau, so-called interactive data widgets were developed, shown in the center of Figure 4. Yet another new feature is the interactive search and filter functionality. These functionalities are shown in Figure 4 on the right side. A user may search for:

- gauge / location name
- gauge number
- name of the municipality

The search mask is provided with a so-called type-ahead function, making it easier for the user to not only search, but also find the desired gauge object. Likewise, there is a filter option that automatically excludes gauges, making these gauges invisible. The following filter criteria are available:

- data ownership
- catchment area
- measuring parameter
- date of measurement (latest available value, regardless of the timestamp, or last available in the past hour)

Search objects and filter criteria are all part of the data served by the KiWIS Web-Service. These data are part of the data model discussed above and have been entered in the WISKI Software beforehand.

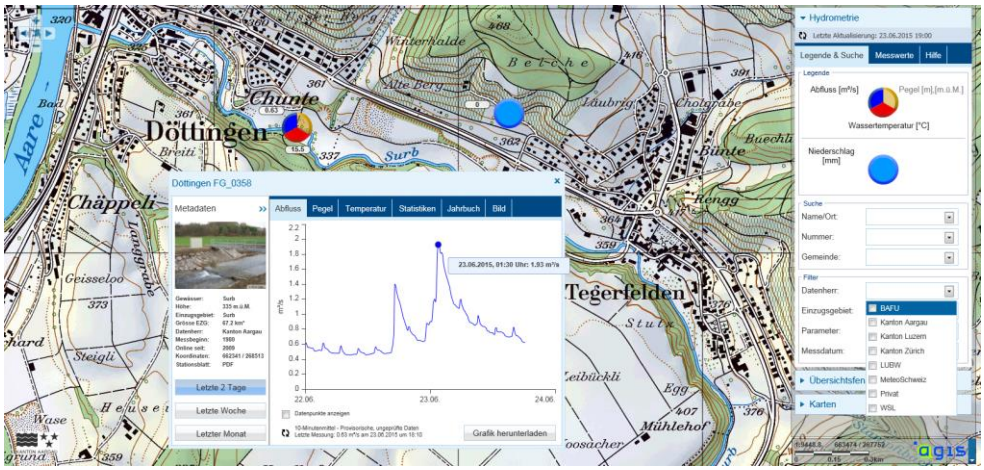

Figure 4. Screenshot of the real-time hydrological map in the AGIS*viewer* framework. A topographic base map is loaded in the background and a widget is shown in the center of the map. The widget provides time series information on different aggregation levels (10min, 1h, 1d aggregation levels), and different retrospects (2d, 7d, and 31d). The graphs are interactive and show measured values when being moved over by the mouse. A direct link to the respective PDF-based graphs is also available in the widget.

Beside the list product shown in Figure 2, the entire list of available time series is available on the cartographic user interface as well. It is also provided on the right side in the navigation, but on another tab (Figure 5, right side). The list may be sorted as to station name, parameter name, measuring value, or time of last measurement. Clicking on a list item leads to an automatic zoom to the chosen gauge.

In Figure 5, small flags next to the gauge symbols are shown. Some of them are colored yellow, as these have reached this specific warning level. When clicking on such a gauge, the widget shows the time series graph, plus the warning level and its corresponding color with a horizontal line. The widgets are movable and resizable, and they display basic metadata information (such as data owner, starting date of measurement, starting date of online operations, geographic coordinates, etc.) on the left side, and time series information, as well as statistics on the right side. On the right side, they are organized by tabs, which are named as follows and which contain the following information:

- discharge with time series graphs, and link to PDF
- water level with time series graphs, and link to PDF
- water temperature with time series graphs, and link to PDF
- precipitation with bar graphs, cumulative curves, and link to PDF

- statistics with extreme values (for river discharge), and link to PDF
- or intensity, sum, and event analysis (for precipitation), and link to PDF
- annuals with verified data of the past year(s), and direct link to PDF
- gauge images

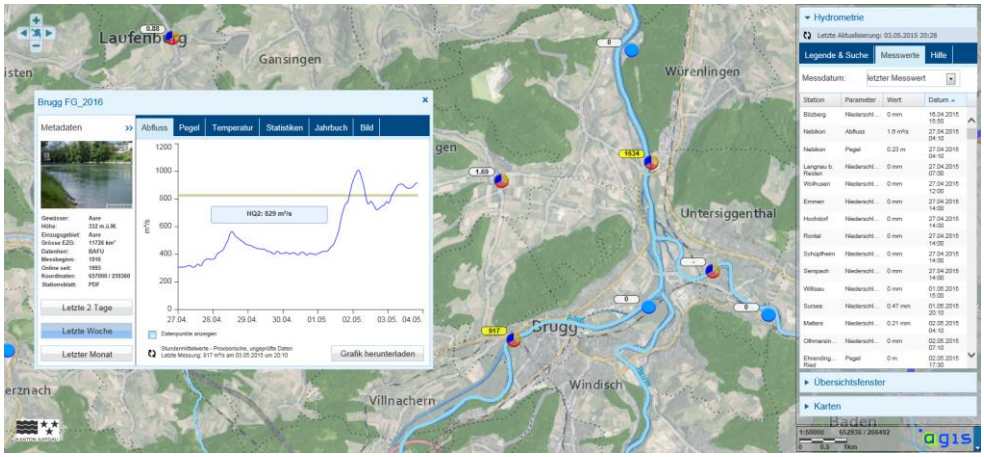

Figure 5. Screenshot of the real-time hydrological map in the AGIS*viewer* framework. On the right side, the overall time series list is activated. On this scale (as opposed to Fig. 3) yellow value flags next to the respective map symbol indicate the warning levels have been reached. In the widget, the graph is visualized together with the warning threshold.

3.4. Further Deliverables

The real-time maps are available in all major browsers and do not require any plug-in installation. Load time of the maps is usually fast, particularly those components depending on the KiWIS Web-Service. In case some problems occur during the loading of the libraries and additional services of the AGIS*viewer* framework, an automatic redirect lead users to the real-time data list (see Fig. 2). This list is not dependent on any AGIS*viewer* components. This redirect also occurs, when the map is being accessed with a mobile fone, as no mobile real-time map product is yet available.

Further deliverables comprise the statistics of the thorough load test that have been performed on the real-time maps before rollout of the entire project "Introduction WISKI", and its sub-project *HydroWeb*. For this purpose, various tools such as JLoader have been applied and statistics were calculated. Findings of theses test were that the system is capable of handling 5000+ concurrent visitors without noticeable compromises. Even more visitors may lead to load times that are in the order of few seconds, thus still acceptable.

In order to calculate and analyze visitor statistics, especially during flood events, the well-known Google Analytics tool has been integrated in both the real-time list and real-time maps.

Last but not least, the Cantonal IT Department offered and implemented an additional application monitoring service for safe operations of the entire WISKI architecture. Each component shown in Figure 1 is regularly checked by another server for their availability. A dashboard specifically built for monitoring purposes allows for a quick view and check of the performance. In case some component is (repeatedly) underperforming, emails are dispatched to those staff responsible in the Cantonal IT department.

4. Conclusion and Outlook

In the present paper, the development of hydrological real-time maps, based on interoperable data Web-Services are discussed. The Swiss Canton of Aargau has evaluated, purchased, and launched an entirely new hydrological data management software, in order to modernize and optimize its legal duties and tasks (monitoring the state of surface waters, data exchange with other authorities, publication of data to the public). Within the frame of two-years, the project "Introduction WISKI" (new Cantonal Desktop-software) and its sub-project "*HydroWeb*" (new Cantonal real-time map portal) have been realized. The overall project was rolled out in September 2014.

Within the software WISKI, the time series are arranged so as to provide an internal interface for the data interoperability Web-Service KiWIS. The service provides the data in a standardized format. In further processing steps fully JSON-based, interactive Web-maps are automatically created that allow users to search, filter, zoom, highlight, list, and map real-time measurement data, based on various temporal and spatial criteria. Both a level-of-detail concept for gauging stations and river systems, and interactive map symbol controls, avoid cluttering of the map at any zoom level. Multi-source and multi-parameter gauges are considered in the map with an adaptive symbolization. When real-time values of gauges reach pre-defined warning thresholds map symbolizations turn into more salient map objects.

The commercial software WISKI and its Web-Service module KiWIS, greatly facilitate data exchange in standardized format to external parties and internal visualization applications. With the integration of KiWIS, new interactive real-time maps are available on the Web to the public. Thanks to WISKI and KiWIS, multi-source and multi-format data from own and third party measuring networks has formed a better basis for the Canton of Aargau to process, exchange and visualize their environmental data. The dis-

cussed hydrological real-time maps combine a multitude of multi-source, multi-parameter and multi-format data in a harmonized, interactive, and fast way.

Further developments, such the retrofitting of the entire AGIS*viewer* framework towards a responsive design may be mentioned as an outlook. Access by mobile phones, not only to hydrological real-time maps, but any other GIS-data, is imperative. The responsibility for these profound developments, however, lies with the Cantonal IT department. Another technical development is the integration of real-time raster data. Presently, a project is carried out that deals with the integration and visualization of raster-based precipitation radar data in WISKI, and its interface through KiWIS for interactive visualization in the Cantonal *HydroWeb*.

The mentioned real-time data list and real-time maps may be accessed at www.ag.ch/hydrometrie/liste and www.ag.ch/hydrometrie/karte, respectively.

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Research and Prospect on Multi-source Geospatial Data Integration for Emergency Services

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Abstract. Emergency services are supposed to demonstrate the higher capacity of serving to ensure public safety compared with normal services. Since spatial data play an important role in decision-making during the response phase of an emergency situation, emergency geospatial information services could provide more efficient tools to meet the demand of emergency management information. This paper focuses on the spatial integration of emergency geospatial information. The critical approaches of multi-source spatial data integration and analysis are proposed. Meanwhile, the typical application results prove the feasibility of the proposed technologies and the alignment with widely established practices and standards, while the reaction of potential users who evaluated the system is quite positive. The opportunities and challenges of emergency geospatial information services are also outlined.

Keywords: Multi-source Geospatial Data Integration, Emergency geospatial information services, GIS, Spatial Analysis

1. Introduction

There are many public emergencies occurring every year. Nepal earthquake in 2015, Typhoon Haiyan in the Philippines in 2013, Hurricane Irene at peak intensity over the southern Bahamas in 2011 and Yushu earthquake in 2010 caused enormous losses, which have again shown the indispensable need of emergency services in reliable systems to help rescue operations. Emergency geospatial information services are necessary not only for rescue teams but also for ordinary people in/around the area with emergency occurrences (Jafarpour et al.,2011; Sagl et al.,2012; Fan,2014). Emergency geospatial information services are very important to various fields, such as

emergency management, emergency rescue, city planning, and environment monitoring. It is urgent to provide the integrated emergency information in early warning and crisis management.

The Federal Emergency Management Agency, USA divides emergency management into four phases namely: Mitigation, Preparedness, Response and Recovery (Elwood et al. 2012, Trilles et al. 2013). Data integration can be applied to any of the phases. Many researchers have investigated the application of spatial information integration technology in emergency systems. Elwood et al. introduced spatial mashup technology and real time data integration in geo-web application using open source GIS and was successfully demonstrated for disaster management in the Assam State of India during the floods in 2010 (Karnatak et al. 2012). Due to rapid urban growth and technological advancements, Lee et al. proposed an integrated approach to intelligent urban facilities management for real-time emergency response based on the integration of facilities-related information and the integration of management functions (Lee et al. 2013). Tsai et al. described the integrating geographical information and augmented reality techniques for mobile escape guidelines on nuclear accident sites (Tsai et al. 2012). Since a lot of different departments involved in disaster mitigation, there are mass, multi-source and different types information, how to effectively integrate the emergency information resources according to the needs of the emergency practical application, which managed by all levels of government and professional department, is the main issues of emergency information construction (Peng et al. 2011, Le 2012, Lee et al. 2013).

This paper studies the spatial integration of emergency geospatial information, which is organized as follows. The second section introduces multi-source spatial data integration and analysis. The third section mainly explains two typical applications. The fourth section presents the opportunities and challenges for the emergency services. The fifth section discusses and concludes the results of the paper.

2. Multi-source spatial data integration and analysis

In most cases it is difficult to attain a unified dataset of emergency information from different departments due to data protection, different standards and other reasons. So data integration of multi-scale, multi-temporal, multi-source, multi-type, multi-resolution and dynamic geospatial information is of most importance. With the help of multi-source spatial data integration and analysis we can provide a consistent, continuous geospatial information support for the emergency management and service.

2.1. Multi-scale geospatial data integration

As the data sources are different, the geospatial data must be unified into a common basis. Through the unified projection, scale matching, coordinate matching, we can integrate raster data with vectors. Through geocoding technology, fast coordinate transformation and projection transformation of spatial data, the connection of spatial data and geo-information integration can be realized quickly.

The procedure of multi-scale geospatial data integration is shown in *Figure 1*. For the purpose of multi-scale spatial data integration, first of all, the same objects from the database of different scales in the same area are identified by the space target geometry, topology and semantic similarity measure, and then through the inspection, comparison, analysis and identification, the changes of the same objects in two different scale database are judged, and then the objects are integrated and tested to establish the relationship of multi-scale spatial database. These methods could integrate geospatial data with the thematic data, such as natural disasters data, economic data, demographic data, resources and environment data, foreign affairs data, and foreign economic infrastructure data et al.

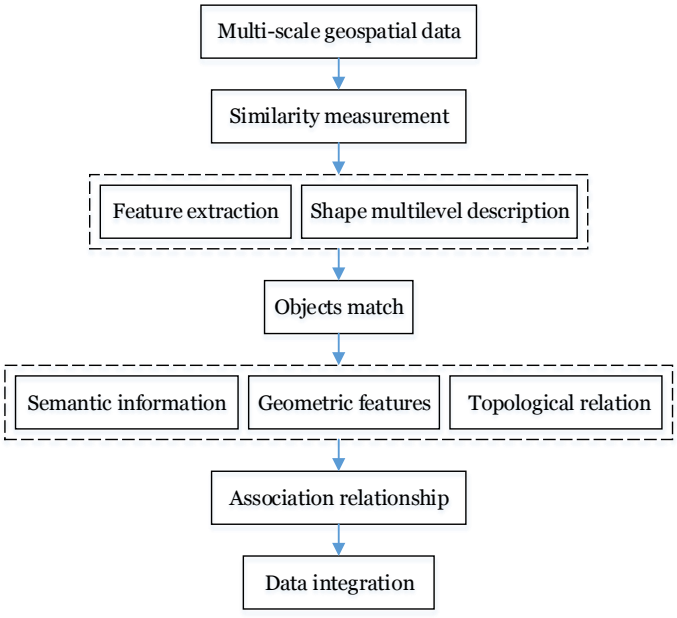


Figure 1. The procedure of multi-scale geospatial data integration.

2.2. Socio-economic data and demographic data integration with geospatial data based on the associated model

Socio-economic and demographic data are the most direct indicators in all human activities, and thus their statistics would be an important support for - emergency services. However, spatial orientation of traditional statistics based on administrative units is unstable, inaccurate and non-unified. Moreover, the problems of quantification and spatial distribution of these socio-economic and demographic data make it difficult to do integrated analysis with natural factors. This bottleneck has seriously hampered the emergency relief and early warning process of medical health risks, earthquakes, floods, landslides and other natural disasters. Use the methods of associated modelling based on statistics, geographical and gridded statistical data, we can get associated geographical factors atlas about main statistical indicators of socio-economic and demographic data and convert the statistics into spatial data. By this means, the quantitative distribution in the space grid cells and integration with natural data of statistics can be realized.

The procedure of socio-economic data and demographic data integration is shown in *Figure 2*. Considering the spatial association of multi-source data, the socio-economic and demographic data in space are reallocated according to the spatial correlation coefficient on the basis of the socio-economic and demographic development on the consistency of the partition and the socio-economic and spatial pattern of demographic data are reproduced objectively. This method can improve the spatial resolution of socio-economic and demographic data, solve spatial orientation instability of socio-economic and demographic data, and achieve the integration and consolidation of spatial, socio-economic and demographic data in any spatial statistical unit.

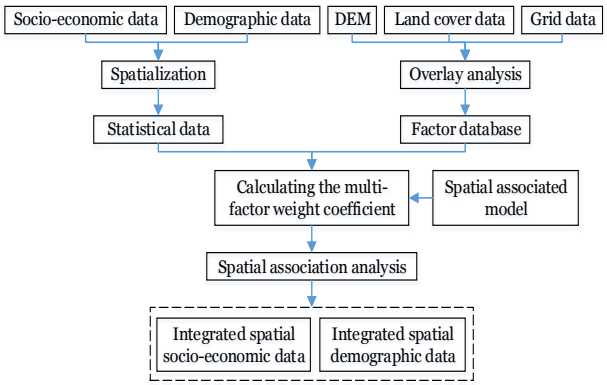
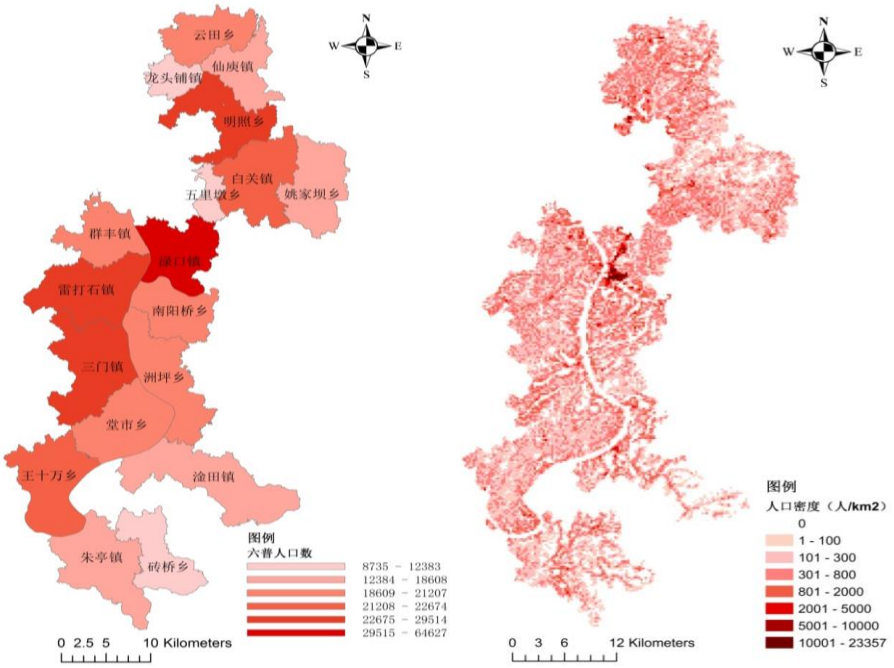


Figure 2. The procedure of socio-economic data and demographic data integration.



(a)Population density of Administrative Region (b)Population density of 250m*250m grid

Figure 3. Population data integration of Zhuzhou City.

2.3. Organization data integration with spatial data based on the fuzzy mathematics

The organization data record the basic information of enterprises, institutions or other organizations in detail. The information contains name, address, registered capital, number of employees etc. The organization data and geospatial information provide important information and support decision-making for the emergency service. When emergency events lead to gas diffusion and/or oil spill, the dangerous sources can be locked to guide the surrounding personnel evacuation by spatial analysis. After emergency incident, according to the school location and school enrolment, the rescue plans including the rescue route, the number of rescue personnel, and the distribution of relief supplies are made. The organizations need to be located on a map. Geocoding is the process of establishing the geographical coordinates and the consistency of a given address. The complex Chinese address description and Chinese segmentation affect the accuracy of geocoding. In order to improve the matching rate and matching accuracy, the address matching method is necessary through the establishment of geographic elements recognition mechanism and the fuzzy mathematics principle. Generally the more same of the address elements in two address

strings, the closer they are on the distance in the spatial location. Under the above assumptions, fuzzy Chinese-Geocoding method applies the principle of fuzzy mathematics to match address. An address element is a unit. Calculating the address strings' matching indicators produces the accurate results.

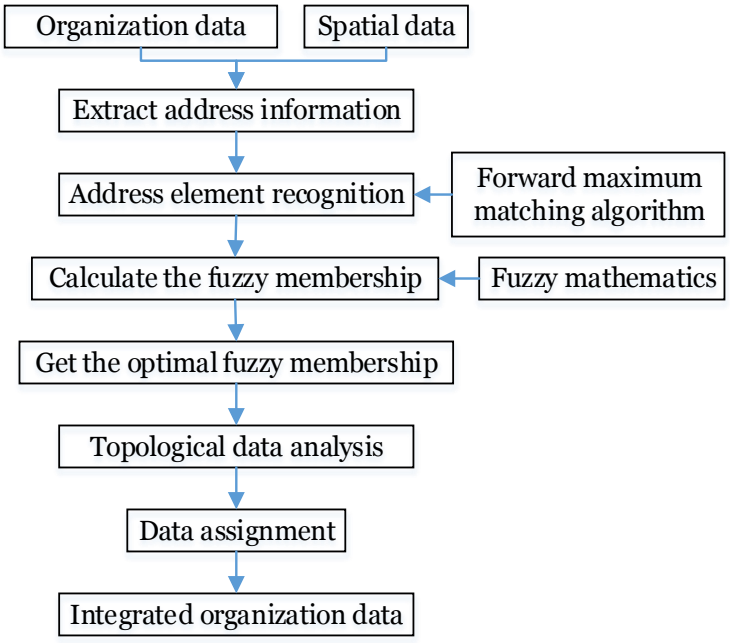


Figure 4. The procedure of organization data integration.

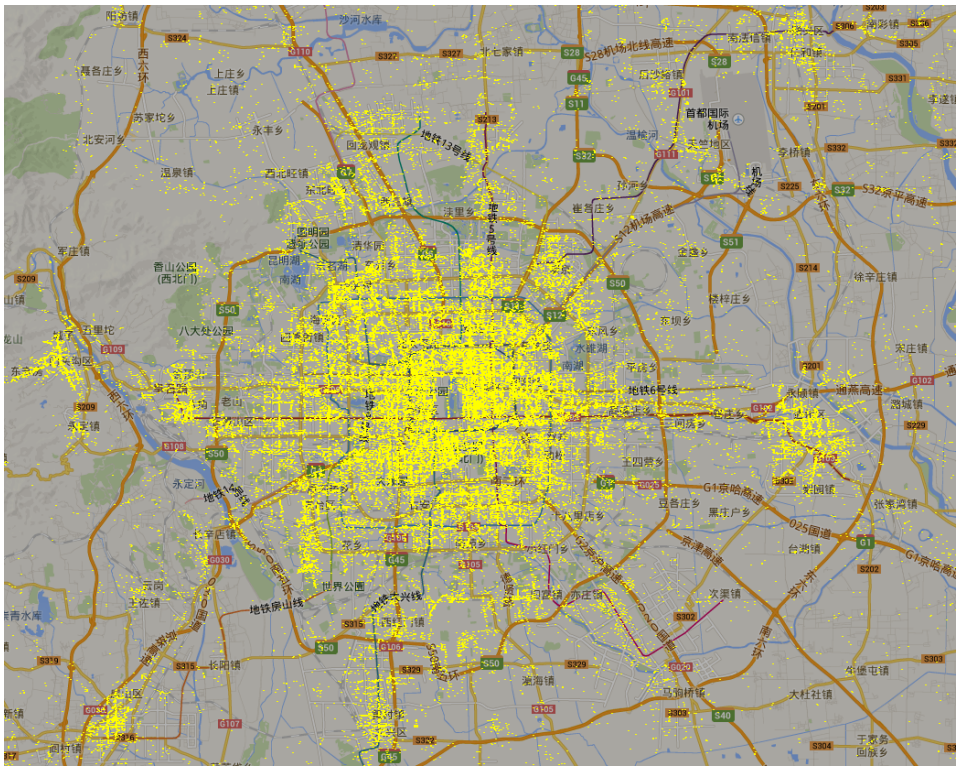


Figure 5. Map of organization data.

2.4. Web emergency geospatial information acquisition and integration

The explosion of the web information resources, including a large number of emergency geospatial information resources has yet to be excavated. How to obtain the geographic information data effectively from the web data and provide information services for emergency management and decision-making is our research focus in recent years. The procedure of web emergency geospatial information integration is shown in *Figure 6*. Based on the database of the feature words and website lists relative to disasters, webpage vertical crawler method is used to obtain the emergency web information. Through the event recognition engine, geographic entity extraction engine and address coding engine, the disasters and emergencies are mined automatically. By establishing specialized crawlers, some high-resolution satellite remote sensing images, photos and text introduction information of relevant areas from the web around the places are acquired. The geographic entities, satellite remote sensing images can be automatically displayed in the map. According to the disaster types, occurring time and location, the disaster information can be inquired and displayed by the he-

matic map, heat map or statistical map, and the results can be output online.

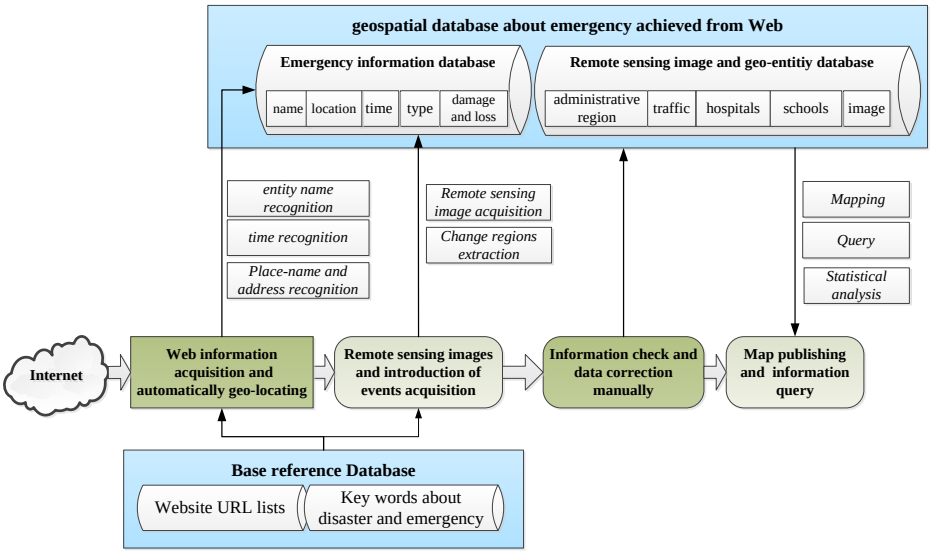


Figure 6. The procedure of web information integration.

(a) The spatial distribution information (b) The statistical information

Figure 7. Web emergency geographic information integration.

3. Application of emergency geospatial information integration

Emergency geospatial information integration can be extended to some important emergency services domain. The integration is based on the spatial data and helpful with decisions about the degree of hazard posed by the incident and the information could draw emergency response plans in order to prevent the incident.

3.1. Yushu Earthquake Information System

Aiming at disaster relief of the Yushu Earthquake, Yushu Earthquake Information System (YEIS) is developed based on the national fundamental geospatial information data and high resolution satellite remote sensing image. YEIS with fast 3-D reconstruction of terrain can integrate multi-source RS images and disaster information (such as barrier lake, slide areas, mud-rock flow, broken roads, broken houses and so on) from the Ministry of Land and Resources, State Bureau of Surveying and Mapping. Through data transformation, projection transformation, data resample, geographical association, space-time consistence processing, spatial index generation, earthquake disaster situation information of collapsed houses, collapsed schools, broken bridges, damaged power facilities, damaged rivers, damaged dams, landslides, population, and earthquake intensity, is seamlessly integrated with multi-scale spatial information. In Yushu earthquake YEIS provides information support and technical assistance for the leaders to explore the geographic environment, find out the disaster situation and evaluate the damage assessment. The integration of earthquake intensity information and spatial information is shown in *Figure 8*. The sensible radius is 83.6807 Km.

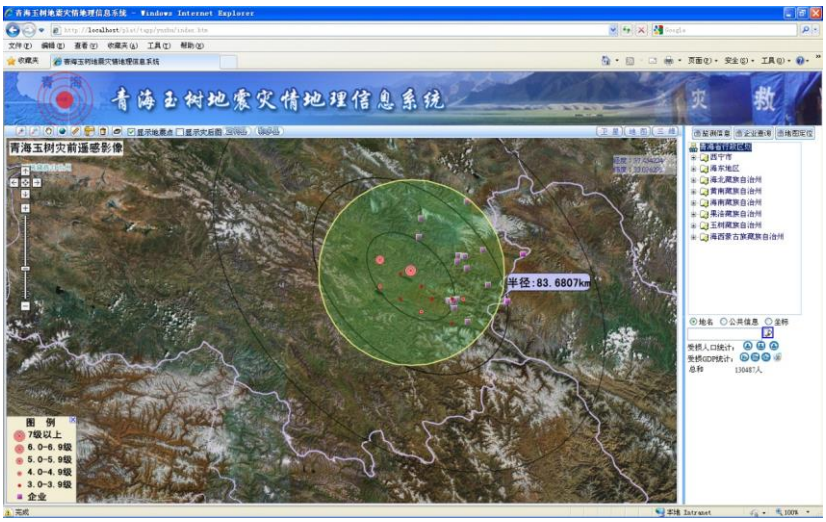


Figure 8. The integration of the earthquake intensity information and spatial information.

3.2. Xinjiang emergency geospatial information service platform

Xinjiang emergency geospatial information service platform is established based on the emergency geospatial information frame, which includes the high resolution remote sensing image of key urban and areas and the large

scale emergency geospatial information data. The platform integrates the emergency thematic information resources from the public security, health, safety, environmental protection, meteorology, earthquake and other departments. The platform provides the display of the geological hazard point distribution, the display and query of the history of disaster information, the management of geological disaster monitoring in important areas, the geological disaster warning services, the geological disaster relief services, the geological disaster information release and so on by integrating the thematic information from the department of land and resources and the department of meteorological. Through the integration with the meteorological information, the risk assessment of geological disasters can be achieved. Xinjiang emergency geospatial information service platform can provide the authority and convenient support of geospatial information services.

Figure 9. The integration of the geological disaster information and spatial information.

4. Opportunities and challenges of emergency geospatial information services

The convergence of the internet, cloud computing, big data and smart earth technologies is both an opportunity and a challenge (Chen et al. 2012, Dinh et al. 2013, Gubbi et al. 2013, Kitchin 2014). These technologies give us the engine for a powerful new generation of emergency geospatial information services and applications (Al-Bakri et al. 2012).

4.1. Real time emergency data integration and analysis based on parallel computing

In the field of Emergency rescue, the early warning of the spread of environmental pollution, the Geological disaster emergency treatment, etc., the rapid development of the various high precision sensors and the high bandwidth interconnect devices have enabled the fast acquisition ability of the emergency spatial data. In order to make strategic decisions and reasonable deployment for emergency events, high performance computational system is capable of delivering complex spatial decision support services in a timely fashion.

The high performance computational system for emergency response service has the ability to process real-time environmental information, weather, and traffic information. It can receive emergency calls from the event places and allocate evacuating team to respond to the requests. These challenges demand the high performance computing capabilities to deliver real-time services for both decision makers and the public. The system is composed of two kernel parts, the geovisualization module and the HPC geo-computation module. The geovisualization module is capable of visualizing the static background geospatial information and dynamic emergency events with real time interactivity. The HPC geo-computation module is responsible of decomposing the time consuming spatial tasks into relatively small tasks that can be concurrently performed in the multiple computing nodes.

4.2. Big geospatial data analysis for emergency services

During disasters or public events, a good master of up to date situation information is most essential to emergency rescue. Owing to lack of timely and comprehensive data about the situation, traditional the disaster emulation model cannot be so accurate and emergency rescue cannot be so efficient to save lives and properties. In recent years, with the development and popularization of mobile devices (such as personal digital assistance, cellphones), mobile internet, social network, various types of mobile device based location data, GPS trajectory data and social network data are explosively generated. Together with remote sensing images and traditional GIS data, those data constitute “big geospatial data”, and they play an increasingly crucial role in the process of decision-making to react to disasters and social events. Big geospatial data may be easy to come by, but analysing, mining and presenting those data in a useful form can be challenging but meaningful.

During the disaster, the usual used roads cannot be used anymore, then finding a road to evacuate is very import. Through mining the trajectories

of people in the disaster area, an available escape road can be quickly found and recommended to the public. Traditional rescue model is not accurate enough to guide the rescue efficiently. By mining the behaviours of people based on trajectories during the disaster or accident events, emergency rescue optimization model could be optimized, then providing an important guide for the rescue of other similar disasters.

4.3. The online early warning service for emergency geospatial information

The early warning emergency geospatial information service will be "online", including the progress of information collection, processing, geolocating of various disasters. Its goal is to help the government and the public to meet the challenge of emergency decision-making, providing more reliable and richer information. Therefore, the priority is to provide accurate, reliable and up-to-date emergency early warning of geospatial information for decision makers and the related public, so that before the arrival of possible disasters, they can realize the orderly response.

In order to achieve the above purpose, two main tasks for emergency geospatial information online early warning service can be depicted as: to establish the early warning models for all kinds of emergency events; to publish the online early warning services and to provide supports for the decision-making departments. The early warning models are based on the emergency geospatial information, according to the different types of disasters, and extract background information for the incident, integrated deciphering of remote sensing for disaster information and emergency project information, comprehensive disaster geographical environment, infrastructure and social development. Then, the different disaster early warning model is established, i.e., flood control early warning model, the meteorological early warning model, geological disaster early warning model, etc. Online warning services are in accordance with different periods, different types, and different areas of the disasters' early warning models, using different inputs to get the early warning analysis results, and comprehensive display the early warning of the space distribution of the possible disasters, generated the disaster evaluation charts and other information.

5. Conclusion

Geospatial information technologies are proved useful in emergency geospatial information services. Emergency geospatial information integration will be one of the most important techniques for GIS and emergency management in a very long period. In this paper we present our methods for

emergency geospatial information integration. Our practices indicate that emergency geospatial information integrations have potential to contribute in significant ways to quick emergency response. The opportunities and challenges of emergency geospatial information services are outlined. With the development of geospatial information integration technologies, more and more emergency information will be integrated to enhance the capabilities of disaster prevention and reduction.

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V PLANETARY CARTOGRAPHY

Country Movers – an Extraterrestrial Geographical Application

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Abstract. Building on the geographical knowledge on the users' home country or state, users can move countries' and states' outlines to extraterrestrial planets and moons, discover the extraterrestrial surface features and compare their sizes and positions to their countries' or states' geographical already known landmarks. This way users will have a better sense of distances and sizes on other planets and moons and can select an optimal (or worst) "landing site" for their country (or settling region for future astronauts), giving endless opportunities for further educational games at all levels and age groups.

The application, based on Google Maps Javascript API, uses Google's maps of Mars and the Moon, and additional planetary maps specifically designed for this purpose as background map. Country and state outlines are from open source geodata. Polygon coordinates are recalculated with respect to the radius of the current planetary body to keep original spherical distances.

Displacing the country's outlines to another location on the Earth is also possible, which can be used as a comparative geographical tool remaining on Earth as well as to demonstrate shape distortions of Mercator projection.

Keywords: planetary, geography, education, web cartography

1. Introduction

Estimating sizes on planetary surfaces is a difficult task because of the lack of familiar landmarks. It is so on a meter-scale and also on regional scale. We have developed an application that can help visualize the sizes of map-scale features. The application we call Country Movers overlays a selected country or US state onto a user-defined part of a planetary body – currently the Moon, Mars, Venus, Io or Titan.

2. Aims

2.1. A tool for professionals

It is often needed to characterize the size of a region of interest or a feature on Mars or another planet or moon. Publications compare the sizes of large features to countries on Earth. This application can be used to determine the approximate area of a region on a planetary body by comparing it to a feature with familiar size – a country, state or a part of it. Planetary objects laid over a familiar country or state can help in building a cognitive map, by replacing well known regions or physiographic provinces with the unknown planetary features. Authors of professional papers can easily chose from the best fitted regions that are also best known for their target audience, when they describe a region on another planetary body. This comparison can also be used very quickly and interactively in public presentations.

2.2. A tool for educators

The same tool can be used in formal education and outreach. Planetary sciences can be connected to lessons in geography. It would be an important step from the old school approach, in which the Solar System is discussed within the frameworks of physics or astrophysics, and not within the Geosciences despite considerable developments during the last five decades in exploring planetary surfaces with geographical methods. This tool clearly shows planetary surfaces as maps, where geographical features can be located. The aim is that students compare their country or US state to a location on another planet. This way, knowing correct sized, they could describe this “new” country using the same basic vocabulary as they would describe the physical geography of any terrestrial region.

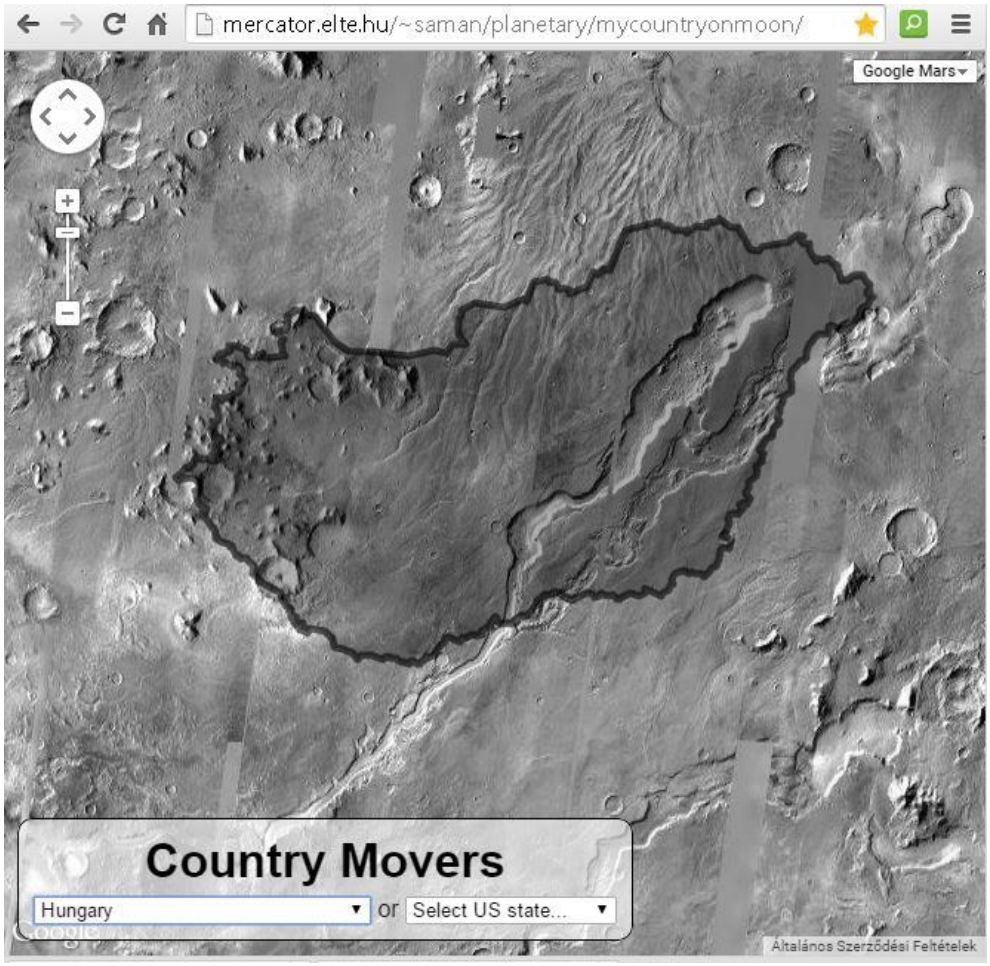

Figure 1. Hungary placed onto the Dao Vallis region on Mars. Map is from Google Mars infrared THEMIS mosaic.

A typical assignment would be to ask the student to imagine that they move their country or state to a new world. They should choose an optimal "landing site" for the country or state which is better than others from a given perspective. They should discuss why they chose that particular landing site. Afterwards, they can start exploring the new country as if they were settlers who explore their new country. They can be asked to describe the physical geography of the new territory and then start building infrastructure, settlements, roads, etc. in a logical way. Road plans can be easily transformed to traverse plans with real scientific objectives. They can also play with naming the new elements.

This is just one of the many possible uses of this tool. We encourage educators to develop actual exercises for this tool that can be included in its website.

3. Model for the tool

The model for the tool was developed as a static wall display for the Kemenes Vulkán Park museum's Solar System room (in Celldömölk, Hungary) (Karátson 2014), to illustrate the scales on Mars (Olympus Mons) and Io (Pele diffuse deposit ring). In this case, the continuous outlines of central European countries were overlaid on the image mosaics.

4. Technical background

The website is based on Google Maps Javascript API (Google 2015). This framework was mainly chosen because it supports the use of draggable polygons even in "geodesic" mode which means that although the map is shown in Mercator projection, the vertex coordinates of the dragged polygon are calculated with respect to the spherical surface. The API also supports easy addition of custom map types – in this case maps of the Moon and other extraterrestrial bodies. These features considerably reduced programming work.

The country data is stored in KML format, which facilitates further addition of polygons. The tile sets of map layers for extraterrestrial bodies were generated by Global Mapper from globe maps from the International Planetary Cartographic Database (IPCD 2015), except Google Mars and Google Moon layers that are using the respective Google tile sets.

When a polygon is depicted on another planet, its geographic coordinates are recalculated with respect to the radius of the given planetary body in the following way: first, the centroid of the polygon is calculated; then, the spherical distance and angle of each vertices from the centroid are calculated and their new coordinates will be a point that is in the same angle and distance but on a sphere with different radius.

5. Conclusion

The web cartographic tool "Country Movers" can be used by both professional planetary scientists and educators, for visually comparing the sizes of countries and US states and regions on planetary surfaces. The preliminary

version of the tool can be accessed from the following web address: *http://mercator.elte.hu/~saman/countymovers*

Acknowledgement

This project was supported by the Hungarian Scientific Research Fund (Grant no. PD 111737).

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Cartographic requirements for Mars GNSS FATIMA

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Abstract. Current planetary research and future steps of Solar System exploration will require precise positioning and navigation services. These services will be especially very welcome on planet Mars, as this planet is our next possible target after Moon. In Faculty of Aeronautics of Technical University of Kosice, we are working on a theoretical concept of global navigation satellite system for planet Mars. The proposed name of this system is **FATIMA**, which is an acronym of **F**ix **A**nd **TI**me provisioning system for **MA**rs. This GNSS system will be able to provide precise positioning fix, continuous navigation service and global time service for Mars – especially for surface planetary rovers, static probes (landers), orbital probes or future human missions. This global navigation satellite system will be also suitable for future geodetic measurements, for monitoring and research of any crustal activity on Mars and for monitoring of the seasonal surface changes within longer time periods. Design of the concept of GNSS FATIMA requires a determination of precise cartographic values and constants and use of exact reference ellipsoid of planet Mars. We need to set the planetary cartographic system and also to specify the cartographic grid which will be used for calculating of precise position. We are focusing on two standardized models – planetocentric and/or planetographic. The most suitable one will be then used for a design of the concept of Mars GNSS FATIMA. In this paper we will focus on specification of the cartographic requirements, we will specify the most relevant and important ones and then we will describe the reasons why these were selected. As the last part of the paper we will try to propose the possibilities of use of current Martian map systems and grids, in case the GNSS will be used for positioning.

Keywords: Mars GNSS, Mars, FATIMA, Martian cartography, planetary cartography

1. Introduction

Precise positioning, navigation services and timing on Mars, is one of the key aspects of wider exploration of this planet. Planning of safe routes of surface probes or possible flying probes in Martian atmosphere in the future is very important part of any mission. Robotic exploration of our planetary neighbor in Solar System has come to one of the most advanced steps in science and technology. We currently know a lot about Mars and we are focusing on deeper science on the surface of this planet. For all of this, we need to know our precise location at any given time, at any weather conditions or at any position of the planetary body. We must consider our current possibilities in cartographic area and new challenges standing in front of us.

2. Global navigation satellite system FATIMA

At present there is no global navigation satellite system or service on Mars. In our home planet Earth we use several such GNSS systems – well known GPS, Glonass or future European Galileo global navigation satellite system. We cannot imagine many aspects of economy or life on Earth without these services. But what about the other planetary bodies in Solar System, especially those where we are aiming with our exploration in the near future? Is there a need for such system or is there any vision of designing a concept of such system? The answer is simple. Yes, we need such system and yes, there are some concepts elaborated. One of these concepts is the Theoretical concept of satellite navigation system for Mars, better known under its name – FATIMA[7]. This concept is part of the scientific research at the Faculty of Aeronautics of TUKE[8]. The research of this concept of GNSS is currently in its advanced stage, where we are examining the natural conditions of Mars for possible use of GNSS. We are working on determination of suitable orbital parameters of constellation of satellites of this system and on the calculation of the most suitable frequencies for a GNSS on Mars. We are expecting the first final results of the simulations and calculations in the early months of 2016. At present we can say that we are in the ¾ of the research work. One of the most important steps of the research is the determination of suitable planetary cartographic parameters and constants, which will be used by the GNSS FATIMA for positioning and navigation services.

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[7] FATIMA – Fix And TIme provisioning system for MArs.

[8] TUKE – Technical University of Kosice, Slovakia, EU

3. Martian cartographic requirements

Precise maps of Martian surface based on the precise measurements and created on the basis of unified, internationally recognized constants and standards, are basic condition for any precise scientific research of such large areas and regions on Mars. It is necessary even for small areas. Same as on the Earth, the cartography on Mars comes from the three basic parameters – prime meridian, equator and the zero altitude. The other important constants are the rotation period of planet, the angle of axis of rotation of planet and the orientation in the epoch.

3.1. Parameters describing the rotation of Mars

The parameters describing the rotation of Mars were derived from the values, which were determined on basis of tracking[9] of Mars Pathfinder and Viking 1 and Viking 2 landers (Duxbury et al. 2002). The right ascension[10] α and declination δ in the given time t are expressed as

$$\alpha = 317.68143^{\circ} - 0{,}1061^{\circ}/\text{ century} * T$$

$$\delta = 52.88650^{\circ} - 0{,}0609^{\circ}/\text{ century} * T$$

where T is the number of Julian centuries from the time t from the standard epoch J2000.0. (Folkner et al. 1997)

3.2. The zero altitude on Mars

Mars does not have any oceans or seas, thus it may seem to be problematic to determine the zero altitude. In case of Mars was the zero altitude determined as the constant atmospheric pressure 610.5 Pa (6.105 mbar). It was calculated from the fact that the water cannot exist in its stable form (triple point of water). This value is only 0.6% of the atmospheric pressure on Earth's sea level. Later was the value of the zero altitude determined according to the measurements of Mars Orbiter Laser Altimeter experiment (MOLA)[11] in 2001. The zero altitude was calculated as the average value which is equal to the middle radius of the planet on its equator. So it was used the gravitational and rotational value of equipotential surface on equator in this middle radius of Mars. (Smith et al. 2001) These values are the

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[9] Tracking –projection of the trajectory of some surface probe (rover) or orbital probe on the reference surface of the planet, in our case Mars.

[10] Right ascension – the angular distance measured eastward along the celestial equator from the vernal equinox to the hour circle of the point in question.

[11] MOLA (Mars Orbiter Laser Altimeter) is the experiment of Mars Global Surveyor (NASA).

basic parameters of projection of the mosaic maps of Martian surface. (Duxbury et al. 2002) These standards were then used as the international unified standards for creation of surface maps of Mars.

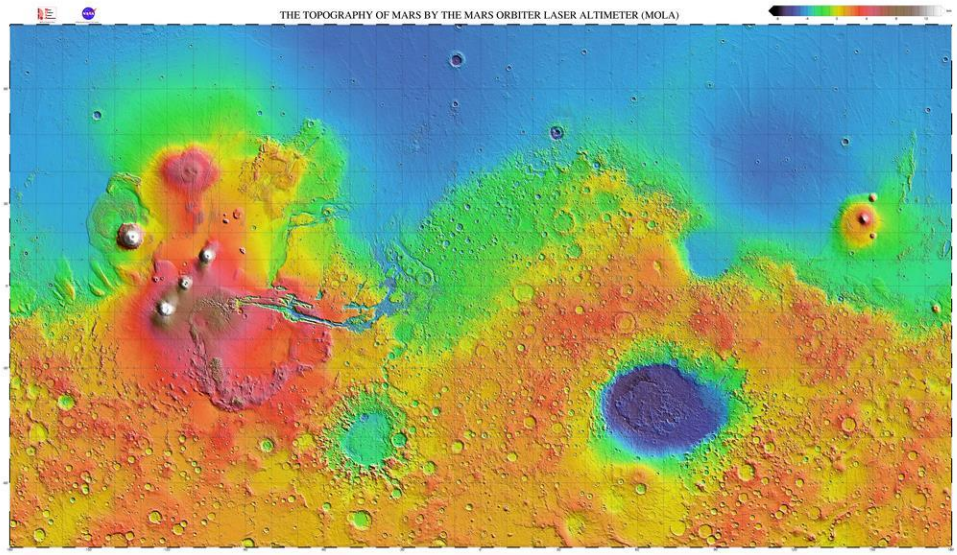

Figure 1. Topographic map of Mars created by MOLA experiment. Credit: NASA.

With the use of all necessary cartographic constants was determined the unified coordinate system for Mars. The International Astronomical Union on its annual meeting in 1970 formalized two types of coordinate systems for planets of the Solar System. These two are planetocentric and the planetographic systems. In the period between 1970-1999 it was used mostly the planetographic system in Mars exploration. The main change came during the MOLA experiment. Since this experiment the planetocentric system is widely used. The planetocentric coordinate system of Mars uses the positive coordinates in direction from the west to the east. This change came from the practical purposes. The precise map created by the use of this system is based on a grid of squares and its precision is ~100 m in horizontal direction. (Neumann et al. 2001)

3.3. Prime meridian and equator on Mars

Important values of the coordinate systems in any planet are the prime meridian and the equator. In case of Mars was the prime meridian determined as the meridian crossing the crater Airy-0. This crater is located in the area of Sinus Meridiani and its size is 0.5 km in diameter (middle diameter). The equator was determined as the zero parallel projected on the surface of rotational ellipsoid by the plane crossing the exact center of the ellipsoid. The

most suitable planetary parameters of the rotational ellipsoid in case of Mars are

$$A = 3396.19 \text{ km}$$

$$B = 3376.20 \text{ km}$$

The A value represents the middle equatorial axis and the B value represents the middle polar axis of ellipsoid. The most suitable center of the ellipsoid with minimal deviation from the center of the planetary body is calculated according the gravitational force. The exact center was calculated as the center of the ellipsoid with a radius R = 3389.50 ± 0.2 km (Duxbury et al. 2002).

4. Planetocentric or planetographic?

The global navigation satellite systems need to use one standard coordinate system based the on the unified cartographic constants and standards. It is necessary to focus on this, because we must avoid any possible mistakes in calculation process of the position on the surface of the planet. In the simulation and research of GNSS FATIMA we will use the results from the MOLA experiment and we will use the map of Mars created by this experiment. The system FATIMA will thus use the planetocentric system. If it will be necessary to refine the individual graphical outputs, then we will use the markings “W” for the western longitudes and the “E” for the eastern longitudes.

5. Conclusion

The global navigation satellite system FATIMA will need to use the standardized values of cartographic constants on Mars. The result of our research determines that we will need to focus on use of the planetocentric system which will enable us the most simplified calculation results of the positioning on the surface or at any altitude on this planet. The basic calculation formula for the positioning will use the rotational ellipsoid with above mentioned parameters. The positioning results will be displayed in accordance with the grid maps created by the MOLA experiment. This solution will allow the use of the system FATIMA not only by the new planetary exploration systems in the future, by possible human mission in the future, but also by the older systems already present on Mars. The system FATIMA will open the new era of Mars exploration, and will allow the people to make the next giant leap in human exploration of the Solar System.

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VI POSTERS

Cartography and technological advances: implications in the way of making and dealing with maps at School

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Abstract. The objective of this work was to discuss the innovations in cartography and to give examples of possible uses or even the incorporation of new technologies associated with spatial representation in schools, especially in Geography lessons. At the same time indicates the challenges for schools and teachers to the incorporation of new resources involving information technology, such as the geographic information systems, web maps, Virtual Globes and **GNSS**, which favour the spatial representation in the context of geography and the students' everyday life. Innovations in school environment bring positive effects to the processes of teaching and learning and also in communication, which allow more than the diffusion and socialization of information among people, but increase students 'chances of understanding the world and interfering in it. Education, as a collective construction, requires interaction between student, teacher and source of knowledge, and it has been strengthened in recent decades, being enhanced with the expansion of information networks.

Keywords: Cartography and New Technologies, Geotechnologies in Teaching

1. Introduction

Cartography, the basis for understanding spatial distribution of phenomena, is very important for students, since spatial thinking helps to find solutions for everyday problems, especially the ones related to spatial organization. Today, we live a very rich moment in the dissemination of geospatial knowledge. Thanks to Internet, the students have access to a huge amount of geographic space representations, which have now become part of our

daily lives, such as the material provided by Google Maps and Google Earth applications.

These technological advances in cartographic science, among others in the past 30 years, associated to advances in communication such as the World Wide Web (WWW), allowed a mass distribution of geospatial information. Regardless of objectives for the information's distribution, this new moment contributes largely to the emergence of spatial information developers and readers (or consumers), around the world.

Cartography teaching should meet students' needs in their daily lives, that is, it should contribute so that they can understand the environment they live in, revealing, as stated by Alves (2011), the physical, economic and social characteristics of the environment and its transformations. And this meets the official Geography National Curriculum Parameters (BRAZIL 1999) for basic education, which emphasizes that Cartography teaching is important not only for understanding the geographical space, but also to make the students critical readers about the relations present on this space.

Maps are as old as human history and are present in all societies. And the requirement for understanding the complexity of modern society is great and there are few disciplines such as cartography that respond to this demand, since maps are a means of navigation, of fundamental importance in a turbulent sea of data and information from a wide range of topics (Taylor 1991). Even before the invention of writing men already created maps to represent the places where they lived and passed, and knowing where they had to go was a matter of survival in tough times. As today, the location of situations ranging from the simple need to find a 24-hour pharmacy to environmental monitoring (Cunha 2011). Finding where places are located is part of the human essence and the popularization and the benefits of geospatial data even through the use of simple tools can cause big impacts on people's everyday lives.

Contemporary cartography seeks to meet the various branches of human activity, aiming for mass production in the shortest possible time and with increasing accuracy. For this, it counts on modern technologies such as remote sensing, GNSS (Global Navigation Satellite System) and GIS (Geographic Information Systems). The school of the twenty-first century must contribute to build citizenship and it does not mean preparing consumers only. "*It means empowering people for decision-making and informed choices about all aspects of life in society that affect them ...*" (Takahashi 2000, p. 45). The broadband providers in the early twenty-first century, and the improvement of hardware and software technologies dramatically transformed the way to find information and to communicate worldwide. Associated to this, the popularity and cheapening of technologies has ena-

bled more users to access the Internet from different locations such as home, school, work and a cyber cafe. Added to this, a wider participation or interaction was possible by Web 2.0.

With this new moment in technological history, the devices linked to geotechnologies passed through a popularization process with cheaper access. The cost of a satellite image (many are for free) and a GPS receiver has become smaller over time and accessible to users from school and people interested in mapping.

2. Cartography, new technologies and social issues

Computer programs as the GIS, and other geotechnologies, like GNSS and remote sensing techniques are not in themselves the solution to the issues of modern education or social problems, but the information they can mobilize encourage new forms of knowledge and actions (Di Maio et al. 2011) and their inclusion would have positive impacts on school teaching practices, even in favor of citizenship, in view of the large amount of data available with free access on the web. In other words, the spread of geoinformation provides tools that serve to think spatially and to consolidate the social use of spatial information.

In the context of social interactions, mediated by cartography and new technologies, it is necessary to work the concepts for different potential users in an easily understandable way in order to encourage participation and decision-making in the society's issues, as it is understood that the knowledge of space is essential for the full practice of citizen rights. Therefore, it is a necessary effort to raise the discussion of the role of geospatial knowledge in the school environment. In the context of social interactions, mediated by cartography, the Social Cartography emerges, and uses representations of people's daily lives to identify and represent the elements and relationships that characterize their territory. These representations provides a better understanding of the problems and potential conflicts, risks, threats, strengths and opportunities in their places of living. Social cartography is an alternative spatial representation, an opportunity to internalize elements of the area and the active participation of members of a group or community, through the development of maps and including the use of participatory GIS. For Taylor (2013), they are "*maps beyond their traditional roles*".

About two decades before, Taylor (1991) had suggested a revision of the traditional concept of cartography on the basis of scientific and technological innovations; cartography should be seen as the organization, presentation, communication and use of geo-information in a graphic, digital or

tactile form. Recently, came new other concepts in the graphical language in face of increasing technological innovations in cartography; according to Field and Cartwright (2013), GIS brought a very wide range of possibilities to be incorporated "to the cartographer's toolbox." For the authors, democratized cartography and cloud computing have increased the possibilities of working with maps, helping to create "a probable new golden age of cartography."

The popularization of geospatial information includes 3D visualization techniques in cartography, Chilton (2007) points out that,

"... Many people have difficulty reading and understanding paper maps, with its complicated system of symbols, language and orientation. I have no empirical evidence for this, but I suspect that seeing something with 3D images may be more recognizable to the viewer than a traditional map, and when covered with some other data, has a much better chance of being assimilated and understood - especially when the ability to zoom, rotate and tilt the resulting image is taken into account..."

3. Cartography in school and the democratic internet-space in the twenty-first century

The virtual map does have its value, as it is available in a free (or almost free) and easy way, the spatial representation tends to be more democratic. According to Damiani (2002),

"The notion of citizenship involves the sense one has of place and space, since it is the materialization of relations of all orders, both near and far. Knowing the space is knowing the network of relationships to which it is subject, from which it is subject. Alienation of space and citizenship constitute an antagonism to consider. "

The emergence of several services that provide maps like Wikimapia, Maptube, Google Maps, Open Streetmaps and others, and distributes free geographic information, reiterates the democratic argument that this kind of service has fostered the birth of communities of so-called neogeographers (Goodchild 2007). These neogeographers, are amateurs of an exercise of building a representation of the space; a "community" interested in maps.

The Google company, in the wake of this new period of dissemination of maps on the Internet, turned available web maps tools for solidarity projects undertaken by non-profit organizations and public benefit, desiring to disseminate their causes through Google Maps and Google Earth (available at: http://earth.google.com/intl/pt-BR/outreach/). Using the slogan "Do

you want to change the world? We want to help". There is a division in areas such as the environment, diseases, humanitarian areas, education, culture and etc. The service offers tutorials that teach to build and share maps, plus a forum, which enables the exchange of information between users. Among the projects available are maps from Greenpeace, World Wildlife Fund, earthquakes, water shortage, the magnitude of tsunamis and etc.

The Volunteered Geographic Information (VGI) refers to web as a democratic environment of geographical information; there are many examples as the Project that is mapping Manguinhos in Rio de Janeiro city, a very poor community. The people who lives there is putting their community in the map, they are mapping schools, cultural centers, bars, shops and passing the information to the Participatory Map of Rio de Janeiro application. They intend to draw up a portrait of little-known parts of the city from the perception of the citizens themselves, the expectation is that by 2016 all communities with Pacifying Police Unit (UPP) in Rio de Janeiro receive the project[12].

Meng (2013) mentions that "*the big data phenomenon forces cartographers to re-think the mapmaking procedure...*" there is a new cartography emerging, called neocartography.

And does this imply abandoning the traditional cartography? Of course not, but in a society permeated with technological resources where students are skilled manipulators, teachers are called to accept challenge new approaches to treat geospatial data. Many of these approaches already appear in textbooks and are still little explored in the context of Geography/Cartography lessons.

4. Technology and cartography: some examples with potential use in teaching

The web maps

Web Maps, via Google Maps for instance, provide tools to create interactive maps in a Web environment. It is possible to do some basic mapping operations as: measuring the distance between two points, recognition of geographical coordinates at each point, recognition of the features from the images and photographs, use of the zoom function for changing scale. The Web Map allows, for example, tracing the easier route to get from your

[12] http://www.riomaissocial.org/2014/08/ipp-lanca-mapeamento-participativo-da-cidade-do-rio-de-janeiro-em-manguinhos-3/

home, work or school to a chosen destination, with the view of public transport available and their stopping points.

Participatory mapping

Volunteered Geographic Information- VGI (geocollaboration, crowdsourcing)

The register of trajectories through GPS, for example, of passenger vehicles or travel cars, can help confirm the geometries of certain routes and detect a movement pattern. The social value of VGI largely reflects people´s capacity of spatial perception. The VGI mappers are able to use geospatial location information technologies as a means to activate their spatial skills, make more informed decisions and disseminate their knowledge to others (Williamson et al. 2010, cited by Meng 2013).

OpenStreetMap - The OSM is a collaborative project of a free editable map of the world. As an example, the Humanitarium OSM map[13] team, helped workers in Haiti, after the earthquake, to map the entire affected area in only 2 days.

RIsO Project (**Solidarity Network Information for Rio de Janeiro**)- (Duba and Di Maio 2014) - This project is a website with free georeferenced information available and aims to operationalize actions to consolidate the social use of geoinformation. The service for building and hosting sites on Google is free and allowed the building of the RIsO page integrated with Web Maps. The project has access on: https://sites.google.com/site/risouff/ or using the GEODEN (www.geoden.uff.br) website (Di Maio, 2004). The following participatory maps are available:

- *Solidary Map for Education (Routes for Education)*[14] - It locates educational activity sites (such as free preparatory courses for the universities), cultural and sports in the metropolitan region of Rio de Janeiro (*Figure 1*).

- *Solidary Map for Animals*[15] - It provides a service, with the location and disclosure of local dog and cat adoption organizations as well as veterinary hospitals.

- *Solidary Map for Recycling of Trash*[16] - This map shows the path of the truck that collects recyclables in the municipalities of Rio de Janeiro, able to map the delivery points of recyclable materials (Delpupo 2013).

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[13] http://hot.openstreetmap.org/projects

[14] https://sites.google.com/site/risouff/t

[15] https://sites.google.com/site/risouff/hospitais-e-clinicas-veterinarias

- *Solidary Map for Conservation Units*[17] - It shows the contact information of Conservation Units in Rio de Janeiro, to facilitate scheduling school visits and show the location of units, in proximity to schools.

- *Solidary Map of ideas* (MIGoogle)[18] -This map shows papers that used the Google Earth or Google Maps tools in educational activities. It functions as an archive of ideas, which are positioned on the map according to the address of the schools or institutions where they were developed. In this map focused on disseminating good ideas in Portuguese language countries.

Figure 1. RIsO Website Screenshots.
Source: https://sites.google.com/site/risouff/

Geographic Information Systems

A major advantage of GIS in school is the possibility of using digital material from different regions of the country; the databases can be developed for each application area. GIS offers interactivity to students, they can build their own maps by setting the scale, projection, legend; according to a set of conditions students can do spatial analysis by crossing layers. The ability to create their own maps on GIS meets the principles of the National Curriculum Parameters (PCN), which places as one of the goals of Geography learning, educating students as a conscious mapper (Brazil 1998).

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[16] https://sites.google.com/site/risouff/coletaseletiva

[17] https://sites.google.com/site/risouff/unidades-de-conservacao

[18] https://sites.google.com/site/risouff/artigos

The GEODEN Project (Digital Geotechnologies in Education) (Di Maio 2004) – This website can be accessed through the Internet at: http://www.geoden.uff.br. This educational site was structured in modules, with texts, exercises, curiosities, suggestions for further reading and for websites for more interaction. The GEODEN is divided into GEODEM (secondary school) and GEODEF (elementary school), which addresses issues related to Geography, Cartography, remote sensing and environmental spatial analysis (*Figure 2*).

To perform the proposed exercises, the GIS (Geographic Information System) of public domain EduSPRING is used. The EduSPRING (SPRING for Education) is a free GIS built for school use, it is a customized version of SPRING GIS (Câmara et al. 1986) developed by INPE (National Institute for Space Research).

The GEOIDEA Project (Geotechnology for Digital Inclusion and as Instrument for Environmental Education) (Di Maio et al. 2009; Peixoto et al. 2014) – with content and activities focused on biomes, health and rural areas in Brazil, for secondary and primary school. It also addresses issues related to cartography, spatial technology and environment focusing on Brazilian watersheds and nature conservation units. The activities proposed use EduSPRING GIS. The GEOIDEA (*Figure 2*) can be accessed via CD-ROM or GEODEN website at http://www.geoden.uff.br/index.php/geoidea.

Figure 2. Projects involving GIS and geospatial data in school education (Di Maio 2007; Di Maio et al. 2009).

In GEOIDEA's cartographic exercises, students can practice concepts of cartography like geographic coordinates, orientation and scale. The student finds the biomes within the Brazilian territory through regions and states.

The students get closer to the places, they can identify the National Parks and Indigenous Lands, and they can make correlations using thematic maps of climate and hydrology, for example. Using satellite images, they can identify land use, human settlement, deforestation, agricultural and urban areas, perform area and distance calculations. The students can make correlations and find explanations.

There are free and available GIS on the web, it is relevant to know how they work and what the possibilities of their use in school are. Several applications have been developed in schools, for example, Passos et al. (2013) developed a WEB GIS for Geography classes with activities for the State of Espírito Santo, Brazil. Albuquerque et al. (2012) developed a WEB GIS[19] for Ceará State, in Brazil, as a tool for mapping activities in Geography classes.

Virtual Globes

Google Earth is an application that provides many possibilities for exploring cartographic topics. The application provides the user with geographic information and allows distance and routes calculations.

Saranti and Silva (2009) presented a proposal, for elementary school, to use the Google Earth application in geography lessons about watershed (*Figure 3*).

The Solidary Map of ideas - MIGoogle can be accessed at https://sites.google.com/site/risouff/artigos and shows a database of good ideas for activities in the school, based on Google Earth and Google Maps tools.

GNSS and Mobile Cartography

The satellite positioning system has great potential to contribute to teaching and learning of geographical coordinates. The technology brings the student closer to the perception that coordinates change by materializing the changes on the receiver.

[19] http://mapas.ipece.ce.gov.br

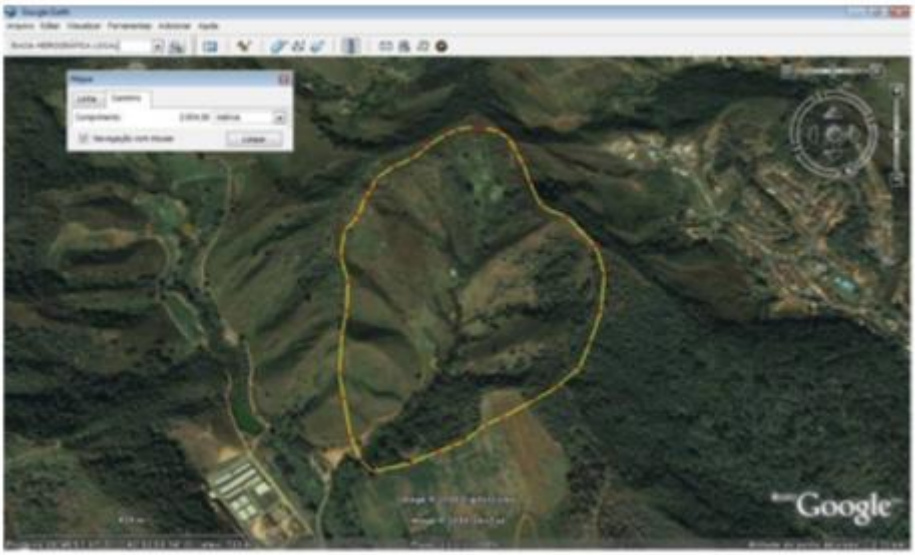

Figure 3. The Watershed close to the School in Viçosa Municipality - MG. (Saranti & Silva 2009).

Baker (2001) pointed out the GPS as a strong tool to use with students involved in solving environmental problems, which can be treated in an interdisciplinary way. And although the GPS can be used in biology and geography classes, its inclusion in school is not systematic. The author cited some examples of practical applications such as this one: students collected chemical, biological and visual data of a stream near the school, in association with the latitude and longitude data of points obtained with a GPS. Students later spatialized these data on a topographic map. In the coming seasons, students would return to the same points and then compare the water quality in the seasonal aspect.

The LBS (location-based service) make it possible to mapping the location of objects in real time, today even a child can map the way to school using a cell phone.

The world of maps is changing with the Internet that has expanded the distribution of maps for computers, mobile phones and tablets. According to Gartner et al. (2007), most web search applications have the ability to produce spatial maps and routes between specific origins and destinations in response to consultations. These advances in computing technology, including mobile computing, provide access to maps everywhere on Earth's surface. The maps and cartography have become ubiquitous, and this phenomenon requires reflection by those who use maps and teach cartography.

There is still a lot to discuss about the pros and cons when we choose the introduction of new technologies in everyday school life. On one hand, technology is part of our daily lives, brings convenience and information, but on the other hand, it can mean distance and in some cases even alienation. Still, common sense prevails, and we should take the best of what technology can provide us and avoid the exaggerations and see also the deficiencies in technology.

5. Final Considerations

On the Internet, there is a large volume of geospatial data and free programs available, but there are two major challenges to be overcome, especially in Brazilian public schools, the proper implementation and operation of computer labs in schools and the lack of investment in training teachers to use new technologies. Despite the difficulties, instigating spatial thinking enables logical reasoning routes to understand problems from the space where students are inserted, which can lead to more involved students making suggestions and finding solutions to the problems of geographical space, and acting as citizen or as geocitizen, as refers Julião (1999). For this author, 80% to 90% of existing information can have a geographical reference, that is, for the author "the Information Society is actually a Geographic Information Society".

It does not mean that only the school with all technological, digital and interactive paraphernalia is good, because we still have old challenges of the past century. The Geotechnologies are not in themselves the solutions to social problems, but the information they can mobilize encourage new forms of knowledge and actions and their inclusion would bring positive impacts on school teaching practices. But it is observed that in current education, in general, still prevails the under-utilization of computational resources and geoinformation, but this is a new culture in the education's world, and it requires changes in teaching practice, since, gradually and irreversibly, computing has permeated almost all human activities.

To Hasse (1999), schools today must match the stimuli of technological and scientific progress and be stimulating and attractive for young people, and emphasizes that,

"*we cannot think of poor schools for the poor. We have to think of a school that allows both: on one hand, the appropriation of knowledge and skills that are independent of computers, and on the other hand, we must think of a school that allows the use of this and other instruments that are meaningful and important for people's life*"(Luckesi 1988, p.41, cited by Hasse 1999, p.128).

For Almeida and Fonseca Jr. (2000), innovations in school environments bring positive effects to the processes of teaching and learning and this would be enough to justify the inclusion of new resources in class, moreover "*the advancement of science and technology matches people's cognitive advances and their research strategies*". What is reinforced by Hasse (1999), when she says that all this revolution in communication allows much more than the diffusion and socialization of information among people, since the knowledge we have, not just about the place we live, increases our chances of understanding the world and interfering in it. However, some schools resist about innovations or at least are not in the same synchronization, a problem that is aggravated by factors such as laboratory infrastructure and excessive working hours for teachers, and this situation turns the technological innovation in education, especially in cartography classes, in a challenge for educational systems.

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Cartographic games in Remote Sensing teaching: examples and discussions starting with applications in school of Rio Claro City/São Paulo, Brazil

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Abstract. Front of difficulties observed by teachers – teaching mediators in classroom – to insert the Remote Sensing containing, especially the satellite's images, in pedagogical practice, the research group called Geotechnologies and Cartography applied to Geography (GEOCART), founded in Universidade Estadual Paulista "Júlio de Mesquita Filho" (UNESP), located in Rio Claro city, São Paulo - Brasil, has been developing para-didactic materials, with cartographic games, on the perspective to give, through ludic activities, didactic alternatives which contributes to more dynamic classes, built by challenges, besides they result, overall, in the efficiency of competencies and abilities developments of cartography concepts, by the teacher, among the programmatic containing fixed to Geography discipline, in school environment. Set the challenge, this Course Conclusion work shows the application in class, the correction and adequacy of the prototype cartographic games, developed by Sarmiento (2014), about the themes aforementioned. To achieve its aim, it had been developed activities of literature review, outstanding the analyses of geography curriculum - the National Curriculum Parameters (PCNs, 1998), the São Paulo State curricular proposal (PCESP, 2008) and the Teacher's Notebook (2014) - and the books related to School Cartography, games in teaching, cognitive developing and psychology of children and School Geography. The methods and technics had based in participant research and containing analyses, to give structure to the methodology used for the developing of the research. As results, first, it had been showed some appointments about the importance of satellite's images using in Brazilian Geography curriculum, once, which even the PCNs (1998), and in PCESP (2008) it is possible to find containing about Remote Sensing, geo technologies and satellite's images. Topics that lead many teachers to find difficulties to work the contents with students in school environment, because they have no domain of these modalities. Reality, increasingly, in which the teachers need methodological alternatives

that help them in this process, for them keeping studying their students in different possible spatial readings by the cartographic documents generated by new technologies which, nowadays it is part of everyday society, for example, the satellite's images. In a second moment, it also shows the application of games elaborated in classroom, as well as their necessary adequacy. Fundamental stage to identify the problems for possible corrections, once that in the act of application is the possible time to cast the positive and negative points for then enhance the para-didactic material elaborated. And at last, it brings a proposal of a Support Teacher's Notebook, developed as an handout which is made: a) by the rules and instructions for each game; b) small instructions and hints of how to dispose the class to develop the pedagogical practices showed in the para-didactic material; c) apart from class plans indicating each containing, competency and ability to be developed each of these Satellite's images cartographic games.

Keywords: School Cartography, Cartographic games and Satellite images

Cartography at School - A practical application

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Abstract. The school cartography comes over time, conquering space in academic debates in general, but did not have his contents framed as a priority in Geography practiced in elementary and secondary education. In the process of apprentice education, cartographic literacy becomes essential as too.

The basic cartography has always been a challenge for Geography teachers. By several factors, there is great difficulty on the part of students and teachers to work it, making it the dreaded in the early grades of high school.

From this need arises the idea of a project, which counted on the support of other disciplines, to facilitate learning, increase interest and remove the stigma of the subject.

The Cartography at School Project is a work among teachers Geography, History and Biology and had the support of teachers of Mathematics and Physical Education. This is the development of practical classes mapping culminating in a special activity in which students use real location means within the district in which the school is located.

The objectives are to understand the issues of Basic Cartography, improved learning, interdisciplinarity between History, Mathematics, Biology, Geography and Physical Education and the school community participation in the activity.

The methodology begins with a diagnostic activity to identify the main difficulties of the students.

Developed steps were: determination of cartographic coordinates on the 1: 500 scaled chart of Village Residential Mambucaba, neighborhood where the school is located, as well as to define and locate the points of activity. With the above definitions, we disclose the activity at school and in the neighborhood and we have the permission of the management agents.

The result of this work was satisfactory, since most of the students correctly developed the activity applied for verification of learning.

Keywords: School Cartography, Cartographic Literacy, Geography Teaching

Navigating through School Cartography in Jurujuba – Promoting the value of the district through cartographic workshops for children

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Abstract. This article presents the results of one of the activities developed in project "Navigating in the Bay of Guanabara" from the Geo-environmental Analysis Department of the Fluminense Federal University. It refers to School Cartography actions developed with schoolchildren of fundamental 4th grade (ages between 8 and 10) of a municipal school of the district of Jurujuba (Niterói, State of Rio de Janeiro, Brazil) where they live. The activities were developed through cartographic workshops focusing the theme of valuing local identity. In the workshops, the schoolchildren draw imaginative sketches indicating the path taken from their home to school, highlighting special references in the landscape and the stories that these images inspired them. We also used satellite images focusing the district, giving the schoolchildren a new perspective where they were able to recognize local flora, degraded and occupied areas, beaches, and also their homes, allowing them to draw their own maps. With the utilization of maps, satellite images, games and interactive videos, it was possible to work also on cartographic orientation. At this stage of the workshop, the schoolchildren learned about the cardinal points, means of orientation and instruments used for localization, which taught them about the localization of their homes, their school and the tourist places of the district. The present document presents the methodology used in the workshops and the results attained. All the workshops focused on connecting school cartography with the reality lived by the schoolchildren, having the district of Jurujuba as main space. As a final result of the workshops, with the lived experience of the school and of the district, we began the construction of a story, created together with the children in order to promote a more effective relationship with the district and also to value the local identity.

Keywords: School cartography, valuing identity, geographic workshop

From Thematic Maps to GIS – in School Cartography

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Abstract. Despite of prosperity of digital devices and applications, paper print maps, atlases and wall maps still dominate school cartography in the most countries. In real life, GIS have already turned common tools and the most industrial fields are in constant development. This global progress makes basic GIS education necessary at the lowest possible age groups but the conceptual complexity of GIS raises new pedagogical and methodological questions.

The role of maps in education varies by age groups. First maps familiarize pupils with the object itself and with the 2D graphic representation of the environment. Besides the concepts of relief, scales, directions and distances, these maps also teach the basics of „(carto)graphic language" ie abstraction and symbology of objects. At higher age groups, development of general conceptual thinking lets coordinates, projections and other abstract contents to show up in the form of thematic and historical maps.

Teaching GIS in public education meets two fundamental difficulties.

1. Learning strategies of generation Z, those who were born between 1995 and 2012, strikingly differ from those that are (still) required in traditional education. While previous generations received and learned information linearly and regarded teachers the primary sources of information, generation Z has been accommodated to the unlimited flow of information of Internet and to the impulsive visuality of digital applications. These aspects dramatically changed children's mental functions of attention, understanding and memorizing. In linear education, they focus on objects only for short time periods and quickly loose attention. They acquire information on scattered paths by clicking and leaving web pages without deepening into the matter. These facts pose a serious question for educators: to follow (if yes, in what form) or to resist the trend.

2. Understanding GIS requires cartographic, statistical and mathematical knowledge and the ability of understanding relations at high level of information network, in other words overseeing all the components, issues and problematic points in a complex system.

Educators have to find the best way to prepare students to become attuned to the system logic, the structure and the tools of GIS through a set of age appropriate (and generation specific) tasks. The most adequate period to start GIS education is age 12 to 14, when students have already learned the main cartographic concepts and general map use. Lessons focus on the components (eg. relief maps, aerial photographs, satellite images, content of base map types), on basic functions (eg. navigating, gathering and interpreting information from simple data layers) and on thematic map types.

Structure and characteristics of databases (eg. data types and basic functions of data managing) and basic statistical methods should be introduced in secondary school (age 15 to 18). In practice, students learn the basics of vectorizing map features, building simple data bases and creating own data layers in a simplified GIS environment.

Behavior of generation Z members is characterized by the contradictory duality of individualism and team orientation. In a task like creating a GIS project in small groups, students can benefit from both of these characteristics.

Keywords: teaching cartography, teaching GIS, generation Z

Interactive Thematic Maps for Students: a proposal for Geovisualization

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Abstract. This article provides some thoughts about school mapping and multimedia cartography applied to the development of the Municipal School Atlas Ourinhos / SP (Brazil), in the digital version, the students from 6th to 9th grade of elementary school. The goal is to expose the scenario that allowed the development of teaching materials, which in its genesis ambivalent explains the methodological meeting of two structural approaches, the Municipal School Atlas and geovisualization. About the Atlas Municipal School, it can be said that in Brazil the official documents such as the National Curriculum Standards of Geography and the Curriculum Proposal of the State of São Paulo, encourage their development by emphasizing the importance of exposing the space experienced by the students, taking the reading world from the local to the global scale, adding to the knowledge of the place for the world. While the geovisualization is guided as a technological device able to streamline the communication of geoinformation by embedding concepts related to multimedia, such as interactivity, on maps. So, leads to expansion of the map itself, because, in this view, there are changes since the procedures for their preparation even in the purpose of use, focused more on exploration than in the disclosure of information. The focus has moved from cartographic communication whose function is linked almost exclusively to the storage and communication of spatial information, the cartographic visualization or, in the term used more recently, Geovisualization. Geovisualization is interactive process

that includes the operation and the simulation of events and phenomena that reveal heterogeneities and space relationships enable discoveries and, therefore, gives the map another sense reaffirming the need and the potential of the development and use in this perspective in Geography. This paradigm therefore induces development of the latent its analog to digital mapping means. With the Geovisualization there is a kind of refinement of the transmission of spatial information and, consequently, a greater socialization of information. The partial results are derived from this methodological union between the study proposal of the place and computational techniques that allow interactivity to the map, leading to achievement of the goal of developing a teaching material, the Atlas, for students and working the implications of the place of living, Ourinhos, by digital means. They were developed in all 15 pages with multimedia animation effects like cartographic showing different types of soil, geology, cloud formation, three-dimensional aspects of the relief, etc. Maps with clickable areas that open boxes with explanatory text, images and videos about certain points, with interactive legend, adaptable scale, viewing various device through an adaptive layout, etc. Possibility of temporal simulations, which allows the exploration of information, a case of urban development map, among other maps that will be presented in this paper. Besides the result achieved and the technical / methodological challenges in preparing these pages, will be presented also discussions about what they can offer teaching issues locality, central focus of Municipal School Atlas.

Keywords: Geovisualization, Cartography for children, Interactive Maps

Construction Solid Waste Destination on Cáscavel creek sub-watershed, Goiânia – Go.

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Abstract. The issue of construction waste is present in the major centers, where their growth is a constant. It is the responsibility of the generator to give a correct disposal of waste generated. But there are generators that do not want to be responsible for the waste produced; either for financial reasons or other reasons, here presents one of the challenges for decision makers in land management. Thus this paper conducted a survey along the Cascavel creek, in Goiania - GO, municipality to identify points of improper disposal of construction Waste using geoprocessing tools. For this paper a visit to the camp, where the authors carrying a GNSS (Global Navegation Satellite System) appliance was collected the coordinates of the points where the wastes, Goiânia orthophoto with spatial resolution of 10 cm and the shapefile were water body. GPS Track Maker was the software using to import the points collected in the field and ArcMap 9.3 software for spatial data, the points of the sites were launched for analysis on Cascavel creek. As a result it was possible to identify the locations of discharges of construction waste. The geoinformation generated in this work are for that decision makers are able to monitor and preserve the water bodies of the municipality.

Keywords: Construction waste, Cáscavel stream, GNSS

Risk of coastal flooding: What will be the effects on municipalities bordering the Atlantic Ocean in Rio de Janeiro?

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Abstract. Several studies in coastal areas talk about the line variation mapping coast, global warming and its effects and vulnerability of the coast to rising sea level. Some authors suggest that to have an idea of what can happen to a possible rise in sea level is necessary past the coast changes over Holocene for understanding how these areas behaved and with that thinking about future impacts with a super elevation as announces the IPCC. The intention here is to survey sea level variation indicators using biological, archaeological and geological-geomorphological evidence in the coastal plain between the Una and St. John rivers. Through literature surveys and photo-interpretation indicators will be specialized and a map will be constructed showing that the distances reached by marine waters. ArcGIS software will be used for mapping, orthophotos the IBGE scale of 1: 25,000 and scientific articles in the field. It is expected then confronts the layout of the urban area and the marine paleolevels indicators to give you an idea of the areas that could be impacted if these altitudes are repeated in such a short space of time.

Keywords: line variation mapping coast, global warming, vulnerability of the coast

Lowell Meets MOLA: A Merged Atlas of Mars

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Abstract. A thirty-section atlas of Mars is presented. Using the Mars Orbiter Laser Altimeter atlas as a basis, a redrawing of Lowell's 1905 map is overlaid. Additionally, the atlas overlays place names from numerous works of science fiction, and from the work of Beer and Mädler. The purpose of the overlays is to provide to researchers a resource for applying names to geographic features on Mars.

Keywords: Mars Orbiter Laser Altimeter, Percival Lowell, Mars atlas

3. The Illusionary Past, the Imaged Present, the Imagined Future

A planetary cartographer recalls that "canals and [their] nomenclature [are] like playing with fire, and [in] the early 1970s scientists wanted to forget [them] -- probably because it was too much shocking that they could not find any on the surface after making the famous Silpher map." Yet it is an indisputable fact that fully fifty of the approved names for Mars surface features in the database of the International Astronomical Union and the United States Geological Survey appeared on Giovanni Schiaparelli's 1888 map as canali, although is has been long understood that the *canali* were optical illusions. Furthermore, fifteen "canal" names have been carried forward into the official database that were original with Percival Lowell's 1895 map, as well as nine that were original with Eugène Antoniadi's 1901 map and ten that were original with Lowell's 1905 map. These 84 names are strong evidence that the scientific community has not had an overwhelming aversion to utilizing names whose genesis is in the illusions of the past.

What is striking, however, is the tremendous discrepancy in the survival rates of the names proposed by these early observers as a function of their complete lists of names (Gangale and Dudley-Flores 2013). All told, 48 percent of the *canale* names proposed by Schiaparelli and Antoniadi exist today in the official nomenclature; in stark contrast, only 12 percent of Low-

ell's names have received official blessing (see Table 1). Is this a mere statistical anomaly that is easily brushed aside? Not if one believes in repeatable results. The same bias is evident when examining the names that these observers proposed for other nonexistent cartographic features; proportional to these proposed names, more than three times as many have been approved from Schiaparelli and Antoniadi as from Lowell (see Table 2). This is not to suggest that there has been any official effort, or even an unofficial but collectively conscious effort, to give Lowell short shrift; nevertheless, the data exposes a glaring bias against Lowell's names, even if only an unconscious one.

Observer	Approved Names	Proposed Names	Percent Approved
1888 Schiaparelli	50	97	52%
1895 Lowell	15	118	13%
1901 Antoniadi	9	27	33%
1905 Lowell	10	85	12%
Schiaparelli/Antoniadi Total	59	124	48%
Lowell Total	25	203	12%

Table 1: Names of Canals

Observer	Approved Names	Proposed Names	Percent Approved
1888 Schiaparelli	22	25	88%
1895 Lowell	10	49	20%
1901 Antoniadi	12	23	52%
190 Lowell	10	42	24%
Schiaparelli/Antoniadi Total	36	52	69%
Lowell Total	20	91	22%

Table 2: Names of Seas, Bays, Straits, Oases. Springs, Forests, and Groves

This is understandable, given Lowell's eloquent popularization of his conviction that the canals were the magnificent engineering achievements of a

Martian civilization in its valiant struggle to survive on a dying world, whereas Schiaparelli and Antoniadi were far more reserved in their speculations. This powerful Lowellian vision of Mars survived in the popular imagination throughout most of the 20th century, fueled principally by the works of Edgar Rice Burroughs, Robert Heinlein, Ray Bradbury, and Leigh Brackett, but also by dozens of others, in the face of mounting evidence that Mars was unlikely to harbor any complex forms of life, much less a civilization of sentient beings. Thus, it is forgivable that planetary scientists may have tended to shy away from any whiff of the taint of Lowellianism and the concomitant peril of delegitimizing their own work. The bias in the scientific community has not been against the use of canal names *per se,* and certainly not against Greco-Roman names from antiquity (Schiaparelli's nomenclatural schema was the first to be widely accepted by the scientific community); rather, it has been against the idea of the illusionary canals being artificial constructions versus natural formations. The unfortunate result may have been a Martian "political correctness" that has done a great disservice to Lowell's classical scholarship and has robbed Martian cartography of the rich legacy of names that Lowell bequeathed to future generations by extending Schiaparelli's classical schema.

We are well into the 21st century, when much of the public understands that it will be little short of a miracle if we discover so much as microbes on Mars. There is no longer any danger of mainstream scientists being associated with "little green men," and so we can well afford to indulge the harmless quaintness of Lowellian Mars. Very bluntly, comrades, it is high time to politically rehabilitate Percival Lowell. There is not a dry streambed on Mars that will care that its name derives from Earth's cartographic antiquity by way of the misperception of a Martian canal. Also, there are presently few people on Earth who are able, much less care, to discriminate between an ancient cartographic name used by Schiaparelli and Antoniadi versus one used by Lowell; since all of these names were drawn from the same source, what can it matter that different observers transported them to Mars? On the other hand, in future centuries the human inhabitants of Mars will find it rather curious, and perhaps not a little distasteful, that the work of one observer was so evidently suppressed.

In all, the atlas appended to this paper displays approximately 150 names from Lowell's 1905 map that currently do not appear in the approved database. It is suggested that they may be used to name natural formations nearby. Also included in the atlas are the tropic circles of Mars as named by Wilhelm Beer and Johann Mädler in 1830.

4. Martian Cartography in Science Fiction

Another underutilized source of Martian place names is a century of fiction. It has been claimed that names from fantasy and science fiction are not used in the IAU/USGS database. Indeed? Where did the name Utopia come from? Sir Thomas More's work is often cited as an early work of science fiction. Additionally, names from the works of Frank Herbert and J. R. R. Tolkien are in the database. It is not necessary for the scientific community to ignore fiction as a source of cartographic names, for it has been used on Earth; indeed, it would be altogether fitting to make use of it, given the location of the Jet Propulsion Laboratory in a fantastic land, along with numerous universities and aerospace firms that are involved in the exploration of Mars:

> Know ye that at the right hand of the Indies there is an island called California, very close to that part of the Terrestrial Paradise, which was inhabited by black women without a single man among them, and they lived in the manner of Amazons. They were robust of body with strong passionate hearts and great virtue.
>
> --Garci Rodríguez de Montalvo, *The Adventures of Esplandián,* 1510

The 43 million inhabitants of one American and two Mexican states are quite comfortable with this entirely fictional origin of the name of their land.

The authors have identified about 100 names from fiction that can be approximately located on Mars. These are displayed in the appended atlas.

5. Things to Come

Future papers are planned to overlay Schiaparelli's 1888 map and Lowell's 1895 map on the MOLA atlas.

References

Gangale, Thomas, and Marilyn Dudley-Flores. Proposed Additions to the Cartographic Database of Mars. Presented at the 26th International Cartographic Conference. 25-30 August 2013, Dresden, Germany.

Additional resources are available at:
http://ops-alaska.com/projects/Cartography.html

Mapping channel belt fluvial deposits on Mars

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Abstract. Valley networks, outflow channels, smaller gullies, and deltaic deposits have been mapped in several previous studies on Mars. However, there are only a few papers that describe intra-valley fluvial deposits in non-terminal settings. A mapping procedure using the available image, topographic and compositional data should be able to distinguish fluvial deposits from erosional features, such as remnant islands, especially when taking into account where they are located spatially within the fluvial system. The morphology of both erosional remnants and depositional bars may be similar, and pendant bars may contain both erosional and depositional materials. We are building a GIS database in ArcMap that contains possible in-channel deposits and other islands and bar-like features in selected regions, focusing on East Hellas, but containing all major fluvial valleys and channels on Mars. We are looking for morphological and other features which make it possible to differentiate bedrock valleys from alluvial reaches, using terrestrial analogs, HiRISE, CTX and HRSC image and stereo data, thermal inertia data from THEMIS, and compositional data from CRISM. The database will be published as a public GIS that can be integrated with any existing similar valley network database or global geological map.

Keywords: planetary, Mars, fluvial

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