IMPLEMENTATION OF A SYSTEM TACTILE SYMBOLS FOR MAPPING OF IMPACTS ASSOCIATED WITH GLOBAL WARMING

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Introduction

The increase of greenhouse gases not only cause changes in temperature but also on global climate, such as changes in precipitation patterns, increased desertification, the agricultural cycles and melting ice, which would raise sea level causing flooding and possibly a direct effect on many coastal cities.
A global climate change extent and rate that is providing cause significant alterations in the biosphere that could lead to migrations and extinctions of many species. These changes also affect in general human activities and, particularly, those that are critically dependent on climate and agriculture. In addition, they will cause adverse effects on human health due to displacement of some disease vectors.

Several of the mentioned effects have spatial and territorial impacts, some of which are showing already in large parts of our planet, so monitoring and cartographic record of such events constitutes a challenge and task for the present generation of scientists and cartographers.

At the same time, it is essential to disseminate this problem, as well as progress in knowledge regarding the processes and impacts, beyond the scientific community, namely at the level of students and in particular to those who shape special educational needs (SEN), such as blind and deaf, for which we have designed a project that seeks to highlight the global warming problem while developing a tactile system map symbols that can be used in the implementation of models or maps that allow these students to know the geographic location of those places that have been impacted or are currently suffering directly some of the changes associated with global warming, in several countries in the Americas.

Finally, it is important to note that geographical and environmental education work is with humans, with their intellect, values, passion and commitment to cause positive actions with the environment. The blind and deaf people must learn about global

warming and thereby contribute to greater awareness about the measures that are suggested by the different actors involved in Environmental issues.

Background

Visual impairment with the hearing totaled nearly 170 million people worldwide, of which a significant percentage is distributed in Latin American countries. Visually impaired people, on the one hand, and hearing disabilities, on the other, although considered different people are equally capable of sustaining development in their knowledge, which are faced with a reality different from that experienced by those that no disability.

These minority sectors of society, they desire a better quality of life and governments expect to provide more and better expectations. To help meet these two conditions, it is important for disabilities people have access to education and information in different formats and this should gradually help to integrate the disabled into society, going so gradually reaching greater autonomy (Barrientos, Coll and Vidal, 2007). In this context, the problems that affect human development, including poverty, hunger, natural disasters should be known by society and by each of the inhabitants of this planet, without exception, and the education system of each country must be prepared to transfer this knowledge, geographic reach all students including those who have some form of disability.

Scholars and teachers of universities and colleges in Latin America have begun to develop a project funded and supported by PAIGH / OAS (American Institute of Geography and History) and led by CECAT (Tactile Mapping Center of the Universidad Tecnológica Metropolitana) that aims implement systems of representation of geographical issues, particularly associated with global warming, which affects the territories of each Latin American countries and for which the search for forms of graphic expression patterns of territory in three dimensions and other related media tools informational, considered "Orientation and Mobility Systems" and defined by Pino (2001) and Huentelemu, (2007), will enable the development of cartographic products that deliver spatial information to disabilities people.

In this sense, we must not forget that users typically use mapping are sighted people that relate to the world of science and researchers in the field of earth sciences, natural resources and education. However, each day there is a significant increase in users with more everyday purposes and scientific less need to consult about the location and spatial distribution of different subjects, objects and elements in the Earth's surface. In this sense the hearing and visually impaired users, children and youth are a special population who require access to data and information to enable them to structure their own mental maps (Coll, and Barrientos, 2003), regarding the effects and impacts arising Global Warming.

Because of the importance of cartographic modeling currently in the teaching of geography, particularly in the case of children, is that the International Cartographic Association (ICA) created a committee dedicated to "Cartography and Children" which

studied the way that children have about the world through maps that they produce. Its activities include that of "Barbara Petchenic Competition" that displays maps produced by children around the world in the biannual conference of the International Association cited, some of which account for concerns about the issue of natural disasters associated with global warming and hope for a better and safer world.

The modeling process that is being designed and implemented in this project to account for global warming and its territorial effects, is based on the tactile maps construction and a symbols system and signs for translating geographic phenomena graphically. These symbols must have the ability to be equivalent to reality, understanding that this is much more complex, hence it requires a great capacity for abstraction to achieve, by a single symbol, represent the same regularities and recurrences than the same support to geographic phenomena (Benoit et. al, 1993).

It is important to consider when developing tactile symbols that tactile mapping, unlike the visual mapping, is a sequential communication form, as is writing. While a sighted person discovers all the information instantly (as it reaches your brain), the visually impaired map readers must discover the information through a sequential scan of the map (Master I, 2004).

Finally, the challenge of implementing new visual communication proposals must not forget that the "mapping" historically considered as a science of visual communication that delivers solutions in the representation of the tangible and intangible phenomena that develop in space contributes to information systems in a very important and although currently the use of GIS was carried out essentially by those who have the ability to view, it is remarkable that at present there are interesting efforts to develop interfaces and devices that facilitate the reading of symbols directly on the screen, making the reading of maps for persons with disabilities and consulted remotely via the Internet, a world of possibilities open to people with special educational needs (SEN), (Pino and Coll, 2005) and in the future provide an easier and friendly approach to understanding complex problems such as those associated with global warming.

The material objects or concepts and facts related to the problem of Global Warming, registered in the geographical area they move to the maps using graphics, pictures or symbols. Material objects and the actual forms are represented by exact contours and projected in its true light, but the scale normally requires a reduction in size of the objects represented, so we must resort to a distorted representation and thickened.

Is called a symbol, a graphic representation of an object or event in evocatively, simplified or schematic, without rigorous implementation. The symbol translates visually the phenomenon and may be figurative or abstract. Therefore, the symbolism is to provide mapping signals located by an implementation point-line or zone and in this particular case tactile form (Perez, 2004).

Objectives

To facilitate the teaching-learning of the problem of global warming on students with SEN, through the teaching of geography using tactile map material and strengthening the monitoring and capturing the environment from a sensory point of view through the images, text and decoding the language of cartography. Develop a proposal for a

system of tactile map symbols for blind and deaf students which becomes an optimization of maps and educational material to the problem of Global Warming.

Methodology

The special mapping to represent the complexity of the phenomena associated with global warming and analysis of cartographic symbols used and tested in projects for the American Institute of Geography and History (PAIGH) and the Organization of American States (OAS) , serve as a reference for designing and constructing tactile maps and conceptual models that will allow a deeper understanding of the students toward more complex issues, their causes and impacts on the environment. The methodology used considers that blind people acquire information through touch, especially when recognizing objects, textures, sizes, thicknesses, temperatures and of course read Braille, so the development of tactile symbols to identify the impacts associated with global warming should make a proposal to generate symbols for easy recognition so as to facilitate comparison and integration of information.

These superimposed symbols on a tri-and two-dimensional material, will concretize concepts and information that would otherwise be difficult to grasp just by listening to the blind and the deaf to read. The latter will replace rote learning by developing one that allows real space structures. Whereas the work will be aimed at blind and deaf, the methodology considers the integration of visual variable in the same three dimensions model. Tactile map will be used to color models, supplemented with visual images, tactile variable being shared by the blind and deaf.

Material is built based on small and large scales, depending on the phenomenon size to represent, will be use textures and colors for areal representations, point and line. The printing of 3D models is made in PVC plastic by thermoform process. Finally, is necesary to evaluated the prototypes using a assessment tool for each of the materials developed. After evaluation of material , we proceed to the construction of the final models.

Results

He hopes to implement a system of tactile symbols that allow adequately represent processes associated with global warming and its regional impacts. The research will provide students with SEN a set of maps at different scales, which may be considered as a tool to facilitate understanding on the territorial dimension of the impacts associated with global warming. Besides the design of symbols and mapping as key products to impart the knowledge of the problems associated with global warming, is working on the design of conceptual diagrams that explain in a didactic way certain natural physical processes associated with the problem and to be used as a complement to the maps in the teaching learning process. Below is an initial proposal for classification of symbols from the definition of consequences associated with global warming (Table 1.). For the representation of the effects or impacts on mapping products will be necessary to define the way in which they will be represented as their introduction and is linear, areal or point, where the scale factor will play an important role.

CLASSIFICATION MATRIX FOR TACTILE SYMBOLS TO REPRESENT IMPACTS ASSOCIATED

WITH GLOBAL WARMING

Implementation Effects Consequences	**Point**	**Line**	**Areal**
1. Effect on the vegetation and wildlife distribution.	X	X	X
2. Increased average temperatures		X	X
3. Reduction area in temperate Zones			X
4. Decreased yields of some crops (eg. corn)			X
5. Increase in food prices (mainly agricultural)		X	
6. Increased number of people with food and agriculture problems (especially in third world countries)	X		X
7. Changes in rainfall and distribution patterns (spatial and temporal)		X	X
8. Increased melting of ice sheets and glaciers			X
9. Gradual increase in mean sea level (likely effect on coastal cities)			X
10. Increased in frequency and intensity of storms and hurricanes	X		X
11. Increased type of illness "Dengue" in South America.	X	X	X
12. Increase in	X		X

frequency and intensity of floods.			
13. Increase in frequency and intensity of droughts.			X
14. Increased in wildfires risk and the negative impact on production forests and hence the economy of forest countries.		X	X

Table 1. Proposed classification of symbols to be used in accordance with the spatial characteristics of the processes.

From this classification symbols are built tactile symbols for which it is necessary to define texture and materiality of symbols to use in mapping models. Some of them can be seen in the accompanying figures (figures 1 to 4) . At the same time defined textures to use in circular graphs type and histogram for those variables that can not be represented on maps.

Figure N° 1. Point symbols

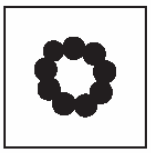
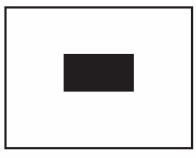
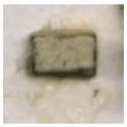
Graphic Symbol	**Tactil Symbol**
	
	
	

Figure N° 2. Example of linear symbol

Graphic Symbol	**Tactil Symbol**

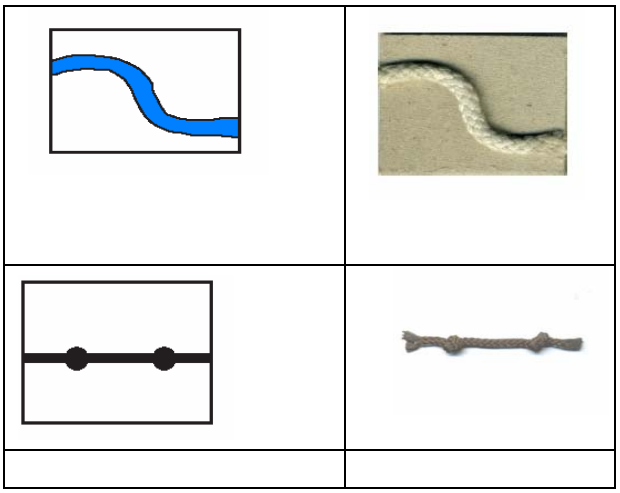


Figure N°. 3. Areal symbols

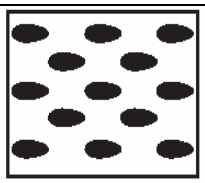
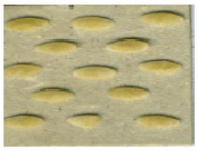
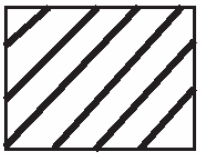
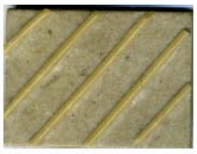
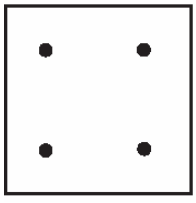
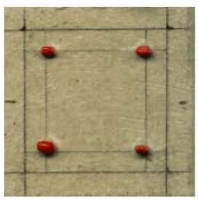
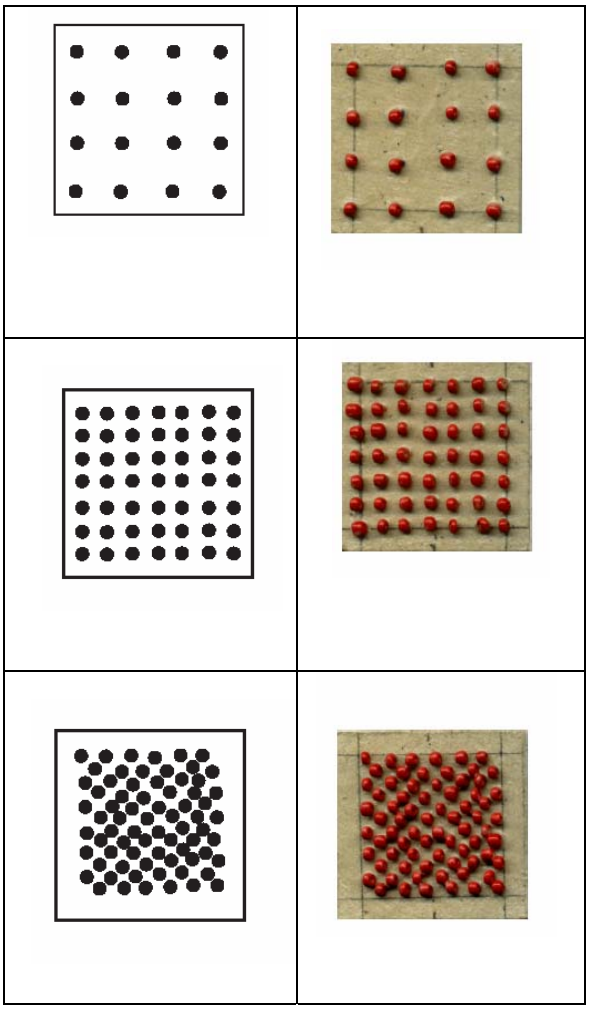
Graphic Symbol	Tactil Symbol
	
	
	

Figure No. 4.textures to represent a quantitative variable, eg rainfall intensity

Graphic Symbol	Tactil Symbol
	



Conclusions

The production of special maps designed to represent complex phenomena and dynamic processes is currently a challenge for cartographers and geographers who study the occurrence and spatial effects of impacts related to Global Warming.

The adverse impacts associated with global warming problem currently affecting most countries, shows visible manifestations in Latin America and it is necessary that the sooner people aware of what is happening. The delivery of knowledge on this subject, the visualization of geographic distribution and intensity of some of these processes must be part of teaching and learning processes of all students including those with disabilities. The proposed symbols that comes this time in an elementary stage still represents a joint effort of specialists in different subjects of education, mapping, design and geography that seek to generate dynamic maps that allow students to begin to size the future challenges that later generations will face more friendly to our habitat.

The use of special textures for the development of prototypes and models that were subsequently used in the production of final maps, the different materials that are being used to build these textures represent only a few steps in moving towards developing a system Tactile symbols that could potentially have a more conventional nature. Below are shown in Figure N° 5, a thermoformed model whit tactile special textures.

Figure N° 5, 3D map with special textures thermoformed

After the evaluation phase of the proposal is expected to improve the design of symbols and cartographic models, so that minimize the difficulties that are sure to present some of symbols proposed in the decoding and reading stage of children with special educational needs (SEN). Finally the generated material by project will reinforce geographic concepts related with the Global Warming problem , achieving integration of blind and deaf people who attend the regular system, since the models are drawn in ink and Braille, which enables for an attractive material to the touch, thus facilitating the transfer of information and knowledge through interactive learning.

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