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MAPPING THE LIMITS OF INFORMATION - A PROTOTYPE FOR DIFFUSING LARGE FLOOD EVENTS DATA ON THE INTERNET

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1. INTRODUCTION

Maps are usually presented/perceived as a mirror of the reality. Maps produced with GIS claim optimal objectivity by increasing technical processing and reducing human choices. Maps produced with satellite images increase this objective dimension by representing "visible" phenomena. When these maps are shared for free on the Internet, this objective dimension can be perceived by a very large number of potential users. Although mapmakers are often aware of the particular limits and the subjective dimension of the map they disseminate, most of the final users are not. Misunderstanding the limits of mapped information can have some important consequences on the decisions made with these maps. The responsibility of the mapmaker is to show the limits and the subjectivity of the information presented, and to reduce the potential negative consequences of these limits. Some prior research concerns the representation of data quality in the GIS, but there has been less attention directed to the representation of limits and subjectivity on maps designed for wide dissemination. This question will be developed in this paper, through a concrete case study: the publication of a world wide floods events database through the Internet. This database will be presented first. Then we will describe the potential and the constraints of the Internet in representing and sharing map accuracy limits. Based on these potentials and constraints we designed a map prototype. This prototype will be described in the third part. We conclude with different perspectives opened by this research to produce maps better dedicated to the users needs and not only to the data producers.

2. THE PRODUCTION, REPRESENTATION AND MAPPING OF LARGE FLOOD EVENTS WORLD-WIDE

The Dartmouth Flood Observatory[1] provides a database concerning large floods throughout the world. The database is composed of two kinds of information: (1) news provided by major news wires concerning floods, and (2) satellite images data. The satellite data are provided by NASA' Terra and Aqua satellites. Both satellites host MODIS (the moderate resolution imaging spectometer). Although MODIS had not been designed specifically for flood remote sensing or hazard mitigation, its data are very useful for this purpose: two spectral bands are included with maximum spatial resolution of 250 km, these data are provided free of charge, and are available immediately and internationally by ftp computer-to-computer delivery. Furthermore, the MODIS data stream is routinely bundled with very accurate ground control points. Transformation of MODIS images into accurate image-maps, in a variety of user-selected map projections, is thus almost entirely automatic and requires no final operator assisted geocoding step. Finally, the two high resolution bands are very good for water/land discrimation when used together. MODIS is, currently, the best available remote sensing tool for international monitoring of floods, and day-to-day

[1] http://www.dartmouth.edu/~floods/

updating of inundation maps. Almost daily, MODIS images are processed at Dartmouth Flood Observatory to generate vector files of the major flood events all over the world.

This information can be very useful for flood hazard mitigation (including planning and preparing for floods) and for flood response. Particular lands and settlements are then known to be subject to flooding. "Known" must mean "known to the public": there is little purpose in acquiring information for the purpose of protecting citizens, and then not making such information available to the same. It is important to archive and publish them. For this purpose, all these data are available for free on the Internet. This access generates a lot of different uses, including non-governmental organizations such as Red Cross or Red Crescent, as well as national or local governments (in November 2002, more than 2500 web pages had a link to this website). But even if the essential first step is to accurately record where floods have been experienced, and to make that information public knowledge, such need not be the end result; it does not supply information clearly dedicated to the different users.

Despite their potential, MODIS data contain some specific limits for flood hazard mitigation and flood response: (1) as an optical sensor, MODIS can not provide any information under cloud cover, which is often a constraint during flood events; (2) even if MODIS scenes cover large areas, the limits of major flood events do not always fit in one scene; (3) as with every mapping process, the production of flood information is associate with different human subjective choices: these might include the choice of images processed, land/water discrimation methods, semiological representation, etc. To mitigate this situation the "classical/scientific" solution is to reduce the uncertainty of maps and to make them more accurate and more objective. In this case, it can be done by the use of complementary sensors (radar and optical), by the improvement of the classification method and/or by a more systematic way to represent the information. Even if these solutions can help to produce "better" maps, they will never eliminate the subjectivity of the multiple choices necessary to synthesize and represent spatial-temporal phenomenon. Unfortunately, these different choices generally do not appear on the final representation. Maps have not been designed to show the choices of the mapmaker or the limits of its information, but to make this information seems to be accurate, objective and scientific. The end user usually perceives the final map as a mirror of reality. This situation may have some real consequence on the decision made (Wood 1992). For this reason, the subjective dimension should be integrated systematically on each map, to make them designed for decision making. In this perspective, a better map is not necessarily a more accurate map, but a map that shows better its level of accuracy.

3. MAPS ON THE INTERNET: TO REPRESENT THE ACCURACY OF THE DATA

Maps on the Internet are different than conventional maps because ideally, any user is able to access any map available, but also because these maps can integrate animated, interactive or multimedia functions. In our perspective, these functions might be used to clearly acknowledge the level of accuracy of the information mapped as well as making the information easier to understand (cf. Caquard Forthcoming). These interactive functions should also be designed keeping in mind the technical limitations of the Internet and the needs of the Dartmouth Flood Observatory with regards to updating information.

As Jacob (1992) points out, the creation of new kinds of maps should always be based on the previous representations in order to be understood and not rejected by the users. On the other hand, conventional map communication needs to be improved. There is still a lot of potential map users who have difficulties in correctly understanding the information mapped. Carver et al. (2001, p.917) consider that this problem should be resolved by itself with the Internet, because “more and more people become familiar with using maps through work, leisure, or education.” This “passive” improvement in cartographic communication can be accentuated with dynamic functions. Interactivity provides a formidable way of adjusting the map to the needs and capabilities of each user, especially for novices and occasional users. It is also important to enable the user to create their own path within the data, and therefore, not to necessarily follow the path imposed by the mapmaker. Interactivity gives the user the possibility of choosing the representation s/he prefers, among all those available. It also gives the opportunity to create maps that acknowledge their own subjectivity and limits. The user can access a regular map, then add or remove some elements as limits of the information. Finally, multiple representations of the same phenomenon give a comparative framework that could be more ethical than presenting the information in only one form (Monmonier 1991). In a situation where multiple possibilities for the visualization of the information become possible, the subjectivity of the map becomes more obvious by giving the users the possibility to examine what Peterson (1999, p.32) calls “the cartographic lie”.

If, in theory, such potential is ideal for representing map level accuracy, in practice it must be put into perspective for different reasons. In a general aspect, the computer monitor is not the perfect support for maps: it is small, it varies from one place to another in terms of colors, definition, etc. The Internet is also limited in terms of access. Besides the fact that everybody does not have access to the Internet, many of the end users do not have a fast connection, which constrain the display of big and complex maps. In a more specific perspective, the Dartmouth Flood Observatory has its own constraints. Data must be updated on a daily basis at a low cost. This means that the large amount of data should be easily updatable with basic software. Despite these limits and constraints, the combination of maps and the Internet offer real potential to better represent map level accuracy.

4. A PROTOTYPE FOR REPRESENTING THE ACCURACY OF THE INFORMATION MAPPED

To evaluate the real potential of the Internet to represent the accuracy of the information mapped, we designed a prototype. This prototype concerned a specific area: the Tisza river watershed located primarily in Hungary and Romania. The maps presented on this prototype are interactive.

The interactivity gives the opportunity to visualize the information in different ways. The base map that the user accesses at first, looks like a “classical” map: a composite of all the flood events detected. However, some of the older floods events are hidden under the more recent ones. To improve the visibility of this information, the user can interactively view each flood independently of the others. The information becomes easier to read and to understand. To represent the accuracy of the information, some other interactive functions are available. For example, the borders of each satellite scene used to detect the floods are represented with a black box. Thus the user can see that the limits of a flood event representation might be related to the limits of the satellite scene used. S/he can also visualize the holes in the database by representing the flood events that were not detected with MODIS images but reported in the news. This information should help them to understand that the available database is not exhaustive. These different kinds of representation should allow the user to be more critical with regard to the information mapped, to better understand the limits of this information and to use it with care for flood hazard mitigation and flood response.

In more practical terms, this prototype must fit with Internet limitations. It has been designed in a SWG (Flash) format because the files produced are relatively light, the Flash player is free and maps fit the screen size. Furthermore, the maps are easy to update because of the direct link with the MapInfo files which is the format of the Dartmouth Flood Observatory database.

This prototype is a first step for diffusing better adapted information to the end users. As a prototype it contains a lot of imperfections. To improve this prototype, we need to understand better the end users needs. This objective will be reached by the evaluation that is presently made of this prototype by some end users in Romania. Their critiques will be very helpful to improve the prototype and to design a world interactive atlas of the large floods. At the same time, we are working on a survey to understand the different needs in terms of flood information and map representation from the users of the database all over the world. This survey will be available soon on the Dartmouth Flood Observatory website. The results of these different researches will lead us to design a map tool dedicated to improving flood data for disseminating and use. This work is a part of a larger project that should lead us to use maps and the Internet in a way really dedicated to help people better understanding the information mapped.

5. CONCLUSION

The map conception developed in this paper goes against the classical approach to the spread of geographic information. Most geographic information producers are more interested in improving the accuracy (or hiding the lack of accuracy) of their products than in acknowledging their limits and integrating it in the representations. But if we really want our maps to be effective tools for decision making, this dimension should be systematically integrated into each map. Beyond the acknowledgment of the information mapped, this perspective shows the limits of the expert/mapmaker and then reduces their influence in the final decision. It is probably at this level that the changes will be the more difficult, because it involves a reorganization of the place and the status of the expert in the decision making. By integrating practical and theoretical questions, this research opens multiple perspectives. It is important to think about a fundamental evolution in the way that we create and share technological maps; one that integrates not only the technical constraints but also theoretical and ethical dimensions.

6. ACKNOWLEDGEMENT

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