3D geovisualizations for flood mitigation planning : a tool to enhance collaboration between praticioners, elected representatives and citizens

Géovisualisations 3D pour la prévention du risque d'inondation : un outil au service de la collaboration entre gestionnaires, élus et citoyens

Florence JACQUINOD[1],[2]

[1] UMR CNRS 5600 Environnement, Ville et Société (EVS) – ISTHME Université de Saint-Etienne, 6 rue basses des rives, 42 023 Saint-Etienne Cedex 2
[2] Ecole des ingénieurs de la Ville de Paris (EIVP), 80 rue Rébeval, 75 019 Paris

RÉSUMÉ

Le développement des technologies d'acquisition d'information géographique et des outils pour les exploiter, notamment en 3D, offre des perspectives en matière de modélisation et de visualisation en 3D des territoires inondables et de leur vulnérabilité. L'automatisation que permet le recours à des bases de données géoréférencées rend ces modèles attractifs et aisés à réaliser sur l'ensemble des territoires inondés. Des projets de recherche-action menées depuis 2009 à l'Université de Saint-Etienne (UMR CNRS 5600 EVS-ISTHME) en collaboration avec la Direction régionale de l'environnement, de l'aménagement et du logement (DREAL) Rhône-Alpes, ont montré l'intérêt de tels documents visuels tant pour améliorer la compréhension et la connaissance du risque que pour sensibiliser les citoyens à sa prise en compte. A condition d'utiliser ces visuels avec précaution, c'est-à-dire en donnant à leur public le temps et les informations nécessaires à leur compréhension, les représentations 3D géoréférencées peuvent constituer des documents fournissant aux élus et aux citoyens des éléments de connaissance et des supports d'expression individuelle et de discusssion collective.

ABSTRACT

Recent developments in georeferenced data acquisition have broadened the spectrum of opportunities in terms of 3D modelling and visualization of risk areas and their vulnerability. The use of georeferenced data and tools allows to develop automatic processes to produce schematics 3D models of flooded territories, hence providing practitioners with accessible tools. Action-research projects led by the University of Saint-Etienne together with a local government agency have shed light on the efficiency of those schematics 3D models as to how hydraulic data are comprehended. 3D geovisualizations have also helped to foster discussions about risk management and have been a valuable visual support for citizen to express their own experience and opinions. As long as elected representatives and citizens are given both detailed explanations on the models and time to decipher them, 3D georeferenced models can be useful in order to foster participation of citizens and interrested parties to flood management.

KEYWORDS

3D geovisualization, consultation, flood mitigation planning, geographical information system, virtual reality

1 INTRODUCTION

Given the increasing number of catastrophic flooding and the damages they inflict on people and territories, flood mitigation policies are to be strengthen in Europe. It is widely considered that those policies are all the more efficient when they are collectively conceived and implemented, i.e. together with elected representatives, citizens and any other interested parties. Both european and french legislations insist on this participatory aspect, so that flood risk is better taken into account by planners as well as by citizens and organisations in their spatial and social practices, calling for the use of « *'best available technologies' not entailing excessive costs in the field of flood risk management* » (EU Floods Directive 2007/60/EC). In this regard, the fact that acquisition of georeferenced data, and particularly of topographic data covering potentially flooded areas, is becoming standard, opens stimulating opportunities. Indeed, those data, used in conjunction with other datasets, provide for the production of analysis and representations of flooded territories and their vulnerabilities. Notwithstanding those opportunities, these ressources are rarely used as much as they could be, and are mainly reduced to the display of catastrophic scenarios or dedicated to the communication of basic information about flood risk over the internet.

In this context, three consecutive action-research projects have been initiated since 2009 so as to develop methodologies fostering automacity in the production, presentation and diffusion of 3D geovisualisation of flood risk. On a technical level, those projects are focusing on exploiting available georeferenced datasets (*Base de données topographique Rhône* and *BD TOPO®* produced by the IGN) and tools for the qualification of flood risk and territorial vulnerabilities as well as its representation through 3D geovisualization, often considered as easier to decipher by non-experts. From a sociological point of view, the main goal is to observe those 3D models in practice, both during their production and their uses in collaborative settings, in order to document and assess their utility in various settings. Indeed, few experiments or studies have been conducted on the use of those technologies in the field of risk mitigation, although the stakes of public awareness are particularly high in such a context.

2 METHODOLOGY

Those action-research projects are conducted by a researcher working together with civil servants in order to « co-design » 3D georeferenced tools which can then be used in ongoing procedures (for instance during the elaboration of flood mitigation plans). Those tools have been tested in context with various actors and their benefits have been assesed through direct and participative observation. Concretely, 3D geovisualizations have been produced on seven flood mitigation plans, covering thirty localities. Their production and uses have been observed during more than twenty-five gatherings of various actors, including twelve consultation meetings with elected representative and citizens. The researcher have thus gained significant knowledge of the roles 3D geovisualisations can play during consultation and of various actor's reaction to those tools. Civil servants, on the other hand, have benefited from the researcher' skills and expertise on how to use 3D models and what to expect from their use with elected representatives and citizens.

Technically, models have all been produced with georeferenced databases using geographical information system (GIS) oriented softwares and a simple enough methodology so that other local government agencies working on flooding issues on the river Rhône (and thus having access to the same databases) could themselves produce similar models. Only a few aspects remain too complex technically to be reproduced locally (i.e. use of detailed and textured buildings and volumic modelling of water heights, see figure 1 below, last picture on the right).

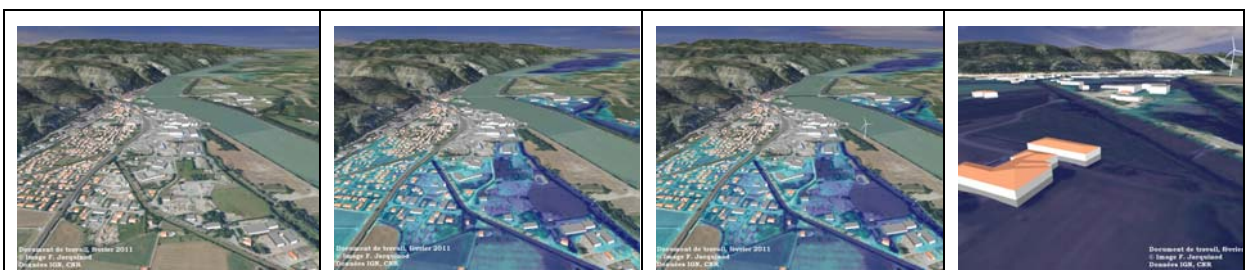

Figure 1 : the making of a 3D geovisualization thanks to georeferenced databases.
The first two steps are easily realized through automatic processes. Then details can be added for more clarity.

3 RESULTS AND DISCUSSION

Various reactions have been observed when 3D models were presented to elected representatives and citizens. The most striking one was the ability of 3D models to captivate every one's attention when presented, thus allowing civil servants to focus discussions on flood risk assessment (i.e. the technical data displayed representing water heights) instead of peripheral issues like debates over how a previous crisis had been managed. Several times, presenting a 3D model has triggered meaningful dialogues, inhabitants instinctively commenting on the images and providing civil servants with valuable information about past events. Civil servants have also been able to use 3D models as visual support for explaining flood risk and its characteristics. Inhabitants reactions have shown that they were able to combine their previous knowledge of flood risk and the technical information provided by civil servants in order to expand their understanding of hydraulic phenomenon. Most of the times, elected representatives have wanted to keep a copy of the visuals in order to watch them again and show them during city councils and to citizens on various occasions.

However observations have also put forward that the use of 3D models of hydraulic data is hardly sufficient to ensure the collaboration of all parties to a common deliberation. Indeed, those abstract data, even when displayed within 3D models of territory, are only fully comprehended when their public is given time to decipher them, along with necessary explanations on how data have been modeled. Contrary to common belief, 3D models are not « naturally » easy to grasp. Their efficiency lies in the many landmarks and markers they provide for orientation (compared to official 2D maps) as well as in the ability they provide to view, in « real time », a scene from many different viewpoints. In this regard, their use is efficient only if they are cautiously manipulated (giving enough time to the public to understand them) and thoroughly described, advocating for their use in meetings where enough time can be dedicated to their manipulation to ensure that they can both foster people's awareness of flood risk and increase their understanding of this phenomenon.

4 CONCLUSION

Finally, 3D geovisualisations of flood risk can be considered as an efficient technology to support discussion and collaborative thinking on the management of flood risk on a territory, as long as everyone is given the time and explanations needed to fully comprehend them. Available technologies and tools allow to produce schematic visualizations quite straightforwardly, meeting the criteria for « *technologies not entailing excessive costs* » put forward in the EU Floods Directive. Action-research projects on the river Rhône have proven the efficiency of such visual documents during consultation, underlying how comprehension of flood risk and discussion on how to handle it can be deepened through their use. As a consequence, the development of the use of such 3D georeferenced visualization tools could be profitable when collaboration among various actors, including citizens, is sought. 3D georeferenced models of potentially flooded territory can also be further employed. For instance, 3D models can be produced to support collective vulnerability assessment and to enroll various actors in the process of diminishing a territory's overall vulnerability to flood risk. Those types of representations are now experimented along the river Rhône, as shown in the pictures below (figure 2). Crisis management is also an area where those tools could be tested, along with other fields.

Figure 2. 3D geovisualisations for vulnerability assessment (current test versions) : visualization of building vulnerability (left) and of a locality's crisis management facilities and their exposure to flood risk (right).

This research is funded by the European Union and the Plan Rhône.