New Tools and Technologies to Manage Operational Data and Help in Decision-Making Concerning Shoreline Pollution

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Abstract

When an accidental oil spill occurs, it is necessary to collect and organize all the data concerning the pollution itself as well as in relation to all the response operations. Lessons learnt from *Erika* and *Prestige* (Cabioch et al., 2005) have allowed us to build a secure and user-friendly tool allowing response teams and decision-makers to access, capture and use data (shoreline landings, collected waste, workforce and equipment, evolution of cleaning) using innovative web technologies and interactive cartography. The chosen tools and technologies were selected to allow maximum flexibility regarding the connections and possible adaptations to other systems, in particular foreign ones. The prototype was then tested and validated by simulating an exercise involving the POLMAR* response teams. Improvements are still in progress and regular updates are planned in order to keep this tool in use in the long term as well as to provide an immediate launch when needed.

1 Introduction/Background

In the case of an accident, it is important to use outstanding tools with the aim of collecting information about the pollution itself as well as about the response operations that follow (Gouriou et al., 2005). The gathered information should give an overview of the evolution of the pollution on shore in real time, and allow cleanup site data to be used at different levels of organization (cleanup operations, manpower

* POLMAR (MARine POLlution): specialised intervention plans to be applied to major accidental marine pollutions. It allows the mobilisation and coordination of the fighting means of the state. The on land Polmar plan is directed by the department Prefects.

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resources, equipment requirements, collected waste, disposed waste, date of pollutant stranding, etc.) (Juhel et al., 2002). This aims at being able to define response strategies (Le Berre et al., 2005), and it is also necessary to post-incident analysis (Poupon and Gouriou, 2002). Moreover, this information can be used as a possible support for cleanup cost claims (Mauseth et al., 2003).

It is in this particular and significant context that ARGEPOL has been developed (ARchivage et GEstion de données lors d'une POLlution dans le cadre de la lutte à terre/data management and storage for shoreline pollution to help in decision-making). This project has been in operation since December 2003 and is carried out by the *Cedre*, Western Civil Defence Area (ZDO), Le Floch Depollution, Atlantide and Nasca Géosystèmes within the framework of a RITMER project (Croquette et al., 2005) funded by the French Ministry for Youth, National Education and also financed by DDSC (Civil Security) and DAM (Maritime Affairs Authority).

This project gave birth to an internet tool which captures pollution data (shoreline landings, collected waste, human and material resources needed, evolution of cleanup operations) from every headquarters (handling local cleanup). This is possible thanks to an easy and user-friendly tool which allows homogeneous capture of data from the whole polluted area. If an accident occurs, all data is transferred to a single server. Various forms of pre-processed information (charts, mapping, and graphics) are accessible by internet login.

2 Methodology

2.1 Return of Experience and Inquiry

The aim of this first phase was to draw up an inventory of similar systems in order to determine the current state of knowledge as regards the issue to be treated through the Argepol project (Laflamme and Percy, 2003). In addition, an inquiry was carried out at the level of the main actors involved in the *Prestige* incident (Gouriou et al., 2004). On the one hand, this inquiry aimed at evaluating the computer skills of the users and the material and software available, and on the other hand, it aimed at gathering the experience and impressions at several levels in the decision-making process. The results of the inquiry underlined the necessity for a user-friendly, interactive, compatible and reactive tool.

These results allowed us to define the specifications of the future tool, which concern the data capture, the nature of data and its exploitation, and also the definition of human and material constraints. This first phase was followed by the development of a prototype.

2.2 Prototype Development

Given the specifications established in the first phase, several technological choices have been analyzed. The best solution turned out to be the use of a Web application based on free software and technologies, because of its ability to evolve and adapt to multiple users. The chosen technologies are Linux for operating system, Apache for server, Mapserver for cartographic module, and PostgreSQL/PosGIS for spatial database. Development uses Php and JavaScript.

The GIS is interactive and communicates with a database. GIS data can be created or instantly modified by users. All data is located on a single server so data updates are easy. All the processing work (capture and data exploitation) is carried out on the server which returns information to users through their browsers (Internet

Explorer); no software is required on the client site (apart from Internet Explorer and High debit internet).

The improvements made proved to be innovative thanks to their general ergonomy (e.g. the elaboration of the charts and maps) and for their purely technical aspects (e.g. interactivity between GIS and data management).

The tools and technologies were chosen to allow the greatest flexibility in terms of connections to other systems and possible adaptation for foreign use. In this way, the tool can be used by a foreign country with its own territorial organization without additional costly material needed. This application was also created to adapt to the user's language (data management resources specific to the language).

3 Deliverables (Description of the Tool)

The information recorded in the database represents a major stake from both an ecological and an economic point of view; therefore access to the website is secured and requires a login and password. The ARGEPOL application is divided into two parts as shown in Figure 1, the cartographic part and the data management part.

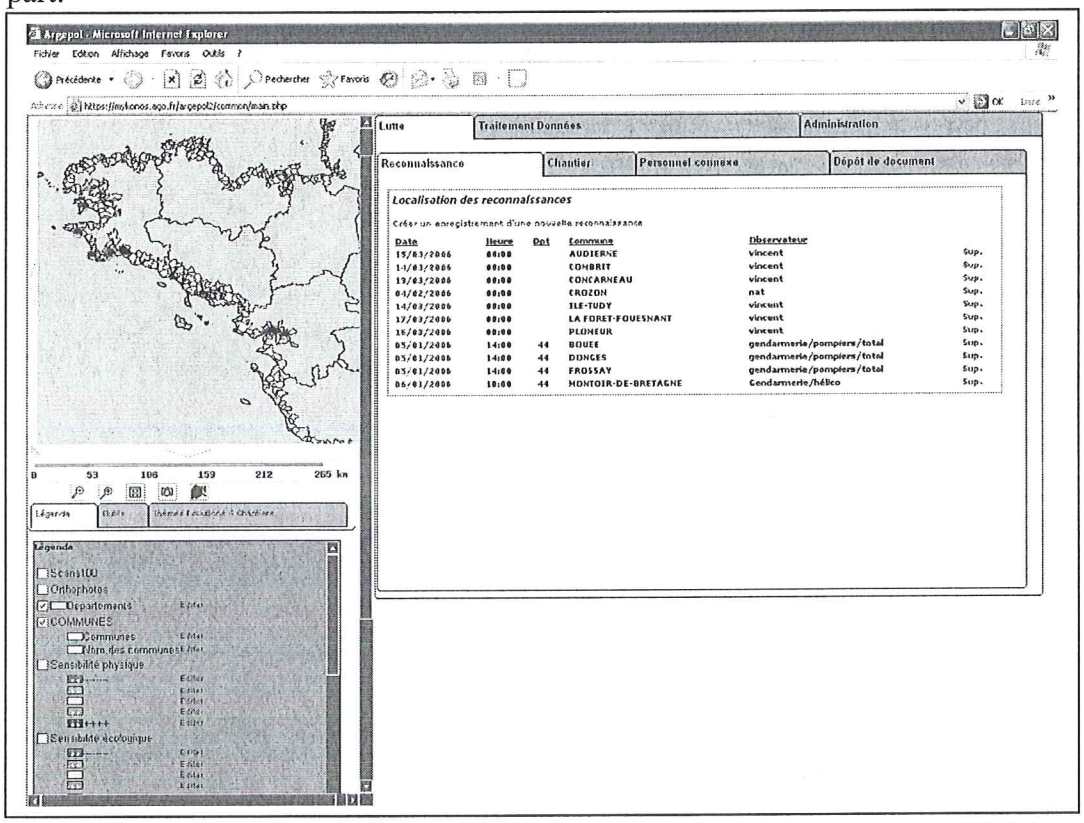

Figure 1 Cartographic part with GIS functions (left) and data management (right)

3.1 Cartography

This system allows thematic layers to be displayed (Figure 2) on pollution data, cleanup sites, raster maps, orthophoto (Lamarche and Gundlach, 2003), sensitivity maps (e.g. ecological or economic sensitivity) (Kerambrun et al., 1997) or operational data (e.g. access to shoreline). With an open-architecture concept, the web-mapping system can be remotely modified; users are able to digitize online and to update their own shared databases on the system.

The GIS owns a panel of different functions as research for the site localization, and features calculation such as length of shoreline or area affected. The user has the option to display data relative to the quantity or the quality of waste, manpower and pollution, and can also generate synthetic maps.

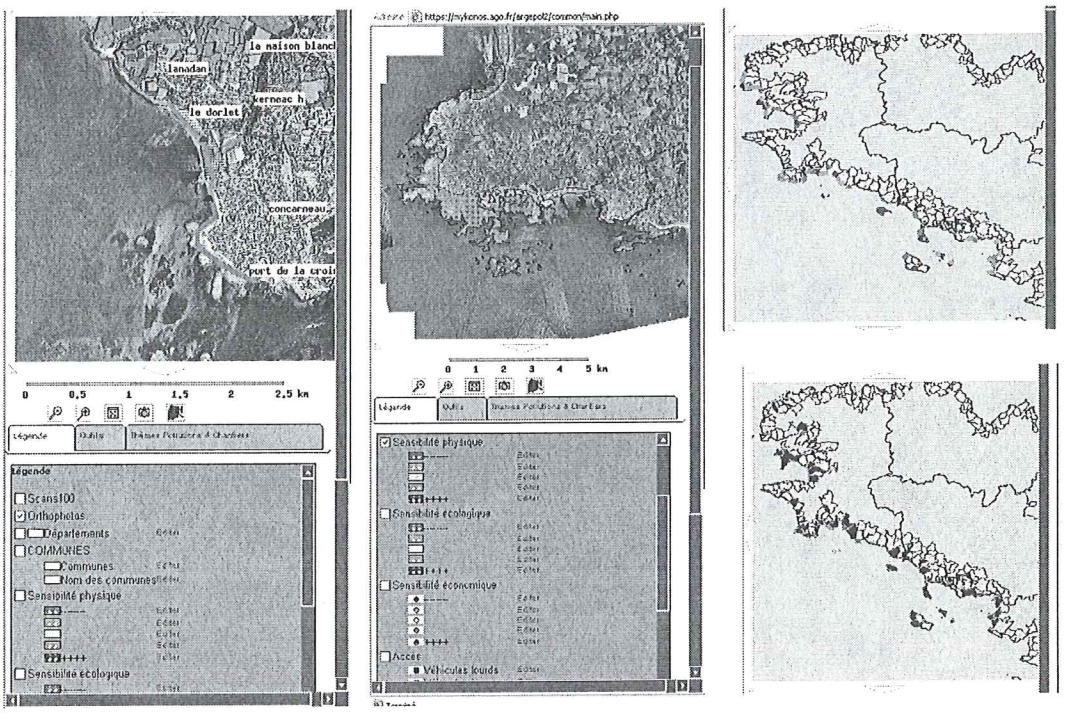

Figure 2 Localization of shoreline landings and cleanup sites (left), physical sensitivity (middle), synthetic maps of landings, type of pollution range by colour (right/top) and synthetic maps of municipality affected by pollution (right/bottom)

3.2 Data Management

This module is divided into three forms: administration, data capture, and data exploitation

3.2.1 Administration

This form allows the administration of users' profiles.

3.2.2 Data Capture

Through this interface (Figure 3), all the information about sites, i.e., shoreline survey (description and localization), cleanup sites (localization, manpower involved, work in progress, collected waste) can be securely collected. Moreover, related documents can be uploaded (photography, videos and any other digital document).

3.2.3 Data Exploitation

This form which is shown in Figure 4, gives access to specific data according to the user's profile and needs. Once the user has filled in the form with information such as date, area, theme (manpower, waste, cleanup sites, shoreline survey, etc.), this system semi-automatically generates synthetic outputs (charts, maps, graphics, areas,

histograms, cumulated histograms). This is shown in Figure 5.

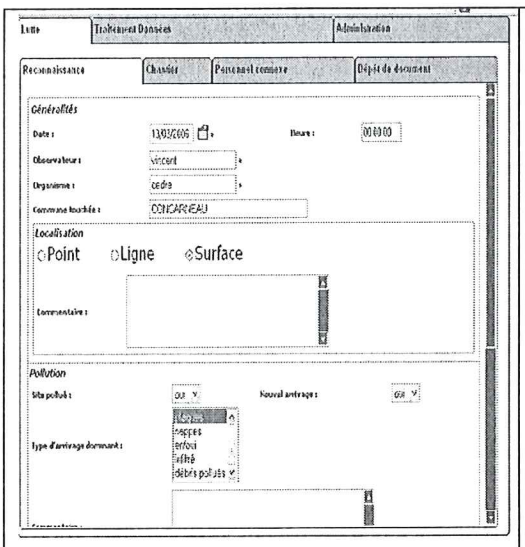

Figure 3 Data capture - shoreline survey capture

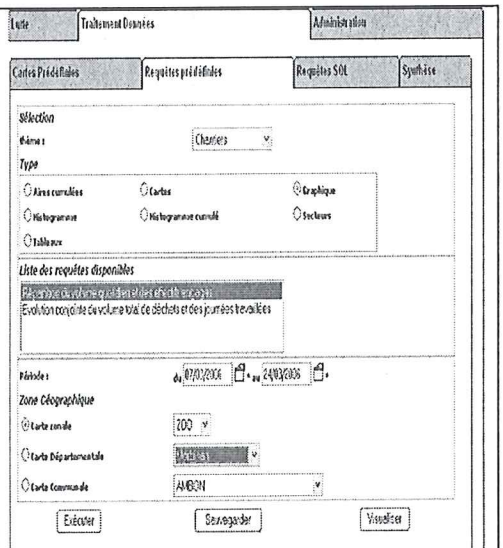

Figure 4 Data exploitation - predefined request

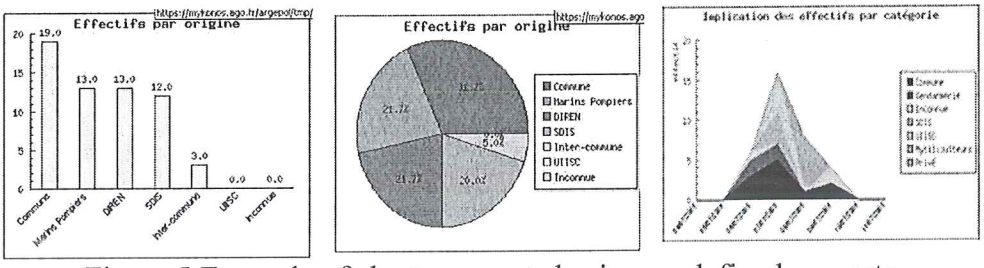

Figure 5 Example of charts generated using predefined requests

When the Argepol users cannot generate the necessary graphics through predefined requests, they can use the SQL request folder. Needless to say, this implies knowledge of the SQL and of the database structure. They can then use the results in Excel thanks to the CSV export format.

Once the maps and graphics have been created, the user can organize and display them on a summary page, add titles and comments, and generate a PDF document. This is shown in Figure 6.

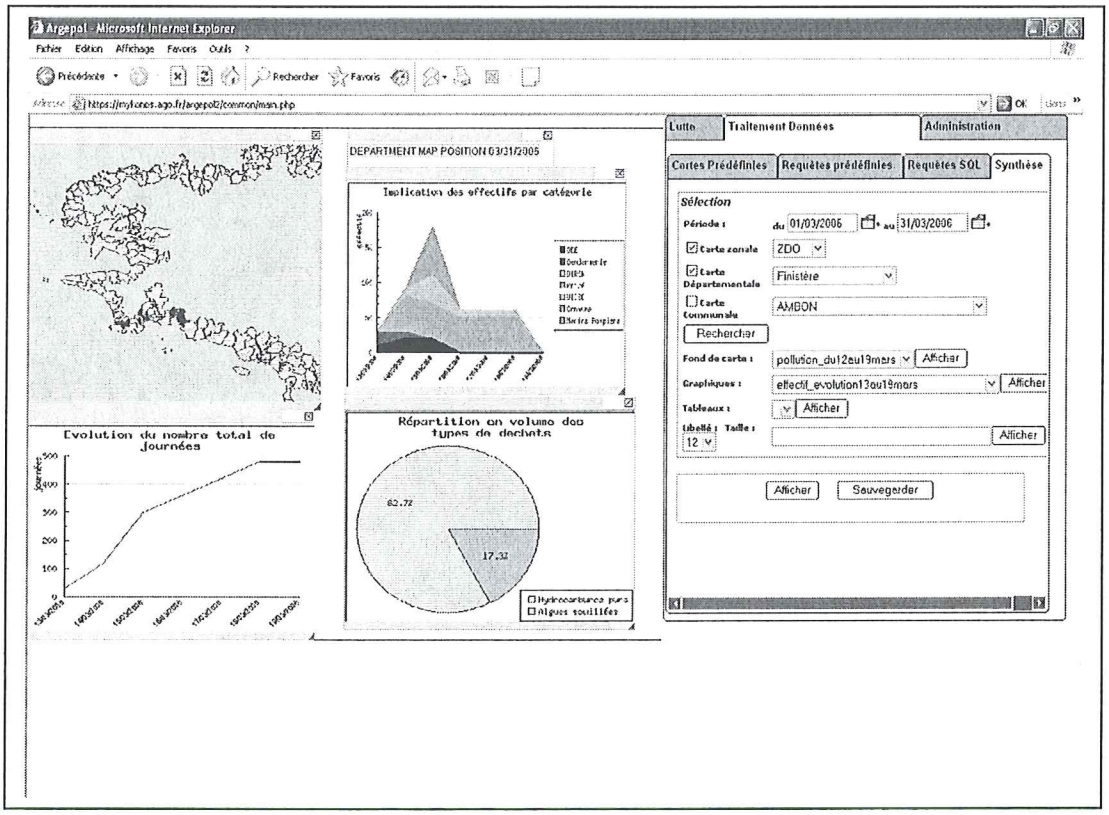

Figure 6 Example of a summary document generated directly on the Internet

4 Discussion and Conclusion

The feedback from the *Prestige* and the ongoing collaboration with POLMAR response teams throughout this project led to the development of certain functionalities in Argepol as well as improvements still under development. With this new tool, users can now create and edit geographical information online, modify databases and share information with other people using only a web browser.

The prototype was tested and validated on one hand to present the tool and underline its interest to people concerned with the different levels of decision-making and action in times of future crisis (Civil Defence Area, Land authorities, etc.) and on the other hand, to define the modifications and improvements needed.

As the prototype must be an operational tool, it must constantly evolve. Work still has to be done even after the research is completed. Information meetings are planned with the authorities (maritime authorities, public security, etc.) and training sessions will be organized once the tool is operational.

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