CO-382

AIRE, AN INTERACTIVE ATLAS FOR DECISION MAKING SUPPORT

TOBELEM ZANIN C.
UNIVERSITE PARIS DIDEROT PARIS 7, PARIS, FRANCE

On-line Geographic Information Systems and cartography-related sites, be they dynamic and/or interactive, have been developed quite a lot recently; they can be reference tools for teaching geography but they can also be decision-making support tools for local governments or for politicians: the political and scientific struggle is going on to try to convince all actors about the validity and superiority of this or that tool. In general, one can recognize among these tools, two differentiated kinds: tools that are exploratory, where users carry their search through a set of benchmarks that are possible to visualize on a map or graphic, and visualization tools for maps in general.

Unlike quite a few exploratory sites, generally GIS oriented, Interactive Atlas of European Region (IAER)[1] is an Atlas including a compendium of geographic maps. This paper presents an explorative research work about a visualization and decision-making support tool through a multi representation of same benchmark in accordance with several analytical scales: to allow for visualizing same phenomenon through different viewpoints. First, we try to specify the background and clarify the scientific contribution of our research work for territorial analysis. Then, we try to focus on web atlases as effective tool for territorial management. Finally, we present our website tool, IEAR, as an innovative and highly effective tool for decision-making support that allows for analyzing and understanding any kind of regional data.

1. TERRITORIAL ANALYSIS AND MAPPING

Any territory is a space with a population organizing its space for a living, provide for its basic needs and move around. This space –or territory—is to be considered as a living space structured so as to allow for creating favorable conditions considering people's activities. Such a structured space creates clear challenges that must be identified so as to manage them as efficiently as possible. Generally, this includes six categories of leading challenges: a specific population grouping, ways of life, organization structures and management processes, spatial organization, technical shapes, and the environment (F.Leurent & al., 2007). Study themes related to these topics have to do with structures (natural, institutional, financial, scientific, and technical), infrastructures (networks), and people acting with each other at every level. Their viewpoints are shaped by economics, management, demography, sociology, laws, or geography. However, only a multisectoral approach allows for a comprehensive territorial analysis necessary to design a specific territorial public policy aimed defining strategies for implementing development objectives.

1.1 Territorial management

It is increasingly necessary to understand how territories function for more and more interested actors. This is because first, geographical information is available more than ever and our relationship to such information is evolving substantially and rapidly.

Territory management, wherever it is, requires previous diagnosis. Such an analysis should allow reveal natural and human factors as well as driving forces for such actors get hold of the related territory with a common vision of its current features and of its future. One should prepare a comprehensive description of the situation, a process that can be called « territorial capital analysis » (Martinais, 2007). Consequently, it should be participatory and presented in an integrated and prospective manner. It should be a real strategy and not a simple description. What are the related territories' resources? What natural, economic, environmental, and administrative/institutional resources do we get to help figure out a territorial strategy? What kind of challenges do we face, what issues for what prospective? Territorial analysis logic looks like a bottom-up logic reflecting the reality of the land and allow institutional actors or other actors, to become the change engine for future available evolutions. Therefore, any territorial diagnosis should describe precisely spatial dynamic and make it clear what the complementarities and interdependent factors are so has to describe them by order of importance. Beyond the simple static description, the territorial analysis challenge remains to identify development alternatives that will allow for classify hierarchically, actions to be undertaken or political choices to be made.

Any territorial diagnosis will fine tune and stress its internal organization and links with its close environment and beyond. It allows for an accurate spatial analysis that describes the related territory's complexity and its regional, national, and international context. The description is organizational as well as political and administrative. It includes a socio-analysis of its various elements and a thorough diagnosis of the environment. Therefore, it is not limited to just know of its existence but a technical tool and a method

that will be used for project identification and preparation. It should be a tool helping in the decision-making process with a strong political challenge connotation because it can induce to select some priorities rather than others and lead to make major strategic choices. A successful diagnosis is a strategic diagnosis which makes the decision-making process easier towards transforming existing conditions (Yengo P., 2005)

Analytical synthesis is carried out through a detailed description of challenges at stake by « layers ». A specific mapping of each layer helps summarize the related challenges (noise mapping, unsafe road systems mapping, population mapping….) but it is quite often necessary to criss-cross analytical elements, scales and representation modalities. Then, it can be interesting to use a multi-thematic map (for instance, environment related constraints, interactive map…) or a multi-scale vision or representation (stocks, densities, smoothing, potentials, anamorphosis, and discontinuities). Thus maps become analytical tools as well as a synthesis tool for territory diagnosis.

1.2 The map as a territorial management tool

Cartographic tools should contribute to territorial management systematically. In all phases of carrying out territorial analysis, cartography documents are used in different ways with several specific functions: information support, communication tools, and validation instruments for propositions of action or simple description of reality (Bulcon & Gaio, 2002).

In here, map contribution is not necessarily to get an accurate or objective representation but only to facilitate public action. It remains a simplification tool to make it easier to understand reality, a basis for actors' debates about what decision and collective action to take. Under the apparent neutrality of cartography, a map is always a political power tool (Bailly & Gould, 1995; Lacoste, 1976) and its preparation conditions and usages (Lussault, 1995) allow for appreciating assets and limits, in particular within the territorial management context (Debardieux, 2002).

Maps and plans have been for long among usual tools for graphic representation of any space elements and their management. But practices show a wide diversity of viewpoints and know-how and nothing is absolute here. Rulings and practices are blurred. We can mention the example of risk management : related maps help define risky sectors such as regions with potential flooding that allow the public sector decide where to deliver construction permits and where not (Urban Local Planning). Major risks policy of the 1980s as well as recent modifications within the legislative and administrative rulings (Law of July 23, 2003 following AZF disaster of 2001) largely contributed to turn cartographic documents more useful and give them a key role in trying to respond to major risks as an information/knowledge tool and a tool for social arbitration. Indeed, French law introduces new prevention principles and more participative procedures when informing the public, in providing help and support, or in controlling urban development (Martinais E., 2007). Here, the mapping role is wider and from its purpose of allowing for locating risky infrastructures, maps are now used to help experts better define the territory for designing diagnoses, provide information of potential risks and their potential impacts, thus helping local actors organizing for the related prevention and protection and taking new actions.

Such cartographic documents are now usual at every step of diagnosing from the outset up to the definition of actions to take and areas to reconfigure and the related information to local population. Every step is subject to specific cartography: risks, administrative authorization, public information, urban development surveillance, environmental management, etc… These maps become the main element for putting together actors coming from various social origins even though the cartography writing can influence the way situations are read and can bias the conclusions and recommended actions. Such an influence can be strong as the map content is not objected. Its capacity and efficiency to show regrouped elements or oppositions by simple representations strengthen the apparent truth of the map. It becomes a tool for legitimating actions (Martinais, 2007), a very efficient one as it can figure out the very object of what is discussed.

Information sources and available data grow significantly and modify the meaning and use of the generated documents. To become able to stock, manage, and get the required information that can interest users among such information flows has become a priority. It is important to help public action actors to generate analytical documents so as to allow them make the right decisions, operational documents facilitating performance. Analytical work and results obtained are achieved through using and criss-crossing competencies coming from various origins through differentiated documents and tools (texts, maps, images, quantitative or qualitative data…). Therefore, creating tools and not specifically electronic atlas can help improve the efficiency of any territorial analysis.

2. WEB ATLASES FOR TERRITORIAL ANALYSIS

Geographical atlas is an object among the most familiar and representative of geography. Whether at schools or at home, everyone has been able, at least once, to look at an atlas. It is principally a compendium of maps defined as the possible graphical representation of a geographical space. Such a set of maps are aimed at reaching different objectives: to see a localization, or a relative position and scope of represented spaces. It allows also mapping specific phenomena which will give some meaning to some specific spatial configuration.

2.1 Paper and electronic atlases

The first Atlas is Mercator and Ortelius' in 1570 (Theatrum Orbis Terrarum). Since then, an important variety of atlases were created: general atlases to help figure places or more thematic atlases (demography, politics, geology, environment for such or such town or country) are nowadays editorial products. Every public has its own atlas in accordance with its object, theme, or time.

Any atlas organizes precisely a logical map reading in accordance with a purpose and a political or ideological viewpoint (Kraak and Omeling, 1996). It reveals a specific choice giving more or less importance to a theme or a region, showing or hiding given features or entities. Today, paper atlases are complemented by CD-Rom or interactive on-line atlases. Paper atlases, while following a specific problematic aimed at specific objectives in a linear manner, just as a demonstration with a structure defined by map scales and a selected scenario, a unique lay-out, a table of contents showing successive maps, and an index of maps shown while on-line atlases allow for differentiated readings offering an logical order, letting the user more flexibility. It is possible to select the level of detail as required, and because of existing links, it is possible to highlight a given image, specific statistics, and so on. First on-line atlases were offered back in the 1990s. They were no more than a gathering of static maps, a copy of paper maps (Peterson, 2007). At the beginning of the 2000s, interactive road atlases and dynamic cartography started to be offered on the web as technologies developed and Internet has become a more intense communication tool. The number of accessible maps (Peterson, 2007, P.41) on the web is growing constantly and probably more than grows the number of users.

Five main families of atlases can be found (Kraak M.J., 2001): general or reference atlases, school atlases, topographic atlases, national atlases, and thematic atlases. Only general, national, and thematic atlases can be found on the web.

General atlases present places and geographical objects located exhaustively on the world globe. The Times World Atlas is one of the best examples of this category on paper with a corresponding web version the Microsoft Encarta which allows consulting eight times as many items. On the Web[2] , these atlases are more and more issued by commercial companies, by universities, and by national states. They often offer reference maps, national and thematic maps with various interrelated and interactive items. Very often, publishers have only put on line their paper atlases (one of the first example is the National Geographic Atlas of the World or the Encyclopaedia Universalis one).

National atlases offer complementary maps, general, topographic and thematic of every country. They are often organized precisely along the lines of an almost identical scenario: first, a set of physical geography maps (topography, climate, environment, etc) followed by a set of socio-economic maps. National atlases are often disaggregated into regional atlases along same principle of showing a territory. The electronic version of national atlases is not yet at the same level of paper atlases. Only the USA or Canada cases reach the same outstanding quality. France does not have an on-line national atlas while regional atlases are more complete. On the Web, these atlases start offering more dynamic maps with some specifics functionality. Topographic atlases show same principles.

School atlases most often follow academic programs imposed by ministries of education, but zooming more precisely on the national case with some general introductory world pages. This is not one of the best represented on line. However, many historical and geography internet sites show also academic maps[3] .

Finally thematic atlases try to deal with one topic only that they approach in an exhaustive manner from different viewpoints (geology, demography, country, environment, forests, religions, history, elections, etc…). On the Web these atlases are many more and enjoy most of technological innovations (animation, interactivity, personal maps, semiological innovations, etc…).

2.2 Web atlases for spatial planning

For the last few years, many countries, regions, and local territories have produced interactive electronic atlases. Many geographic or cartographic international organizations organized some groups specifically aimed at working at this question. We can give, as an example, the International Cartographic Association (http://www.icaci.org/) with many specific commissions working at it, in particular to study on-line atlases

(Maps and the Internet Commission created in 1999) and another one on national and regional atlases (National and Regional Atlases Commission).

In France, teams working on electronic atlases are not many. We can mention the Working Group « Cartactive » of the « Système d'Information Géographique, Methodologies etApplications –SIGMA» (http://www-1sr.imag.fr/Les.Personnes/Jerome.Gensel/Cartactive/).

We also can mention the work carried out by UMR ESPACE with one of its research teams about Spatial Analysis and Society which deals with interactive atlases to communicate about the territory and its dynamism: interactive atlases challenges such as "The Mediterranean region" (C.Helle, S.Robert, G.Sillère : http://www.umrespace.org/IS-AtlasInteractifs.htm. In Europe, one can mention the work of AGILE Association of Geographic Information Laboratories in Europe (http://www.agile-online.org/).

Geoclip is the main site to mention for interactive cartography, used by many public or private institutions, in France as abroad. This paying tool is a cartographic representation tool aimed at helping find solutions to design geographical intuitive and intelligent applications, and illustrate any kind of data geographically located. It allows for intervene on the map in different ways: choice of themes, scales, value thresholds, canvases, colors, from statistical data that are many quite often. Such a tool allows for exploring many countries: France, UK, Spain, USA, and Russia….

Another France interactive cartographical site is the DIACT's Territorial Observatory [4]. It provides for a selection of territorial information generated by the public sector. It offers three options: one per benchmark; second by territory, where three analytical scales are proposed: the EU, France and the French Regions; third by zoning, which a way of find out about the complexity of territorial development devices in France. This tool also uses the Geoclip technology. At the EU level, this Internet site offer two kinds of representation (choropleth maps and proportional circles) and only two analytical levels scale (NUTS1 and NUTS2).

Tools, GIS-related on line, are also available They are less user friendly, linked with huge data bases, with more than a simple visualization purpose. In this category, one can find, for instance, the Ile-de-France Region (IAURIF)[5] or the Regional SIG on environment and regional risks (CARMEN)[6] . The thematic offer is important. Interactive functions, scale changes, browsing, selection and use of information, are relatively intuitive. A drawing tool is also offered that allow for adding graphical elements to the proposed map. But these tools are heavy and the visualization quality not good enough.

Other innovative tools can be mentioned: the exploratory tool Gapminder[7] , the interactive OECD Atlas or Hypercarte Group's hyperatlas. Gapminder is a non-profit company promoting UN programs for sustainable development (UN Millenium Development Goals) through an increased use and better understanding of statistics and other information on social, economic, and environmental development at the local, national and world levels. The proposed software aims at showing the beauty of statistical time periods translating dull numbers into pleasant graphics, animated and interactive. The current version is available since 2006. Michael Jern, from the National Center for Visual analytics of Linköping University (Sweden) is one of the founding fathers of UNIRAS, one of the first cartography software (1980) who worked with OECD. They propose today an exploration tool of OECD Regional Studies freely accessible online. The tool clearly aims at establishing interactivity between maps, tables and statistical analysis. Overtime, this tool should offer above 50 benchmarks to be explored in different manners: working on the map (changing the scales, working locally with Google Maps, etc) and on the semiology but also on a graphic in particular for following time indicators. The use of such a site is relatively easy even though one might need some item to fully take advantage of the its potential. The tool is attractive but may lead to interpretative errors such as series of flat numbers which do not mean much in accordance with the graphic semiology. This tool seems to be more of an exploration tool than an atlas.

The HyperAtlas tool is a piece of software for territorial exploration of data with multi-level spatial analysis. This application allow for carrying out the analysis and visualization of spatial phenomena in the perspective of contexts localization. Practically, it is possible to show various benchmarks based on combining two of them in accordance with various global (UE29, UE27, and UE15), mid- (NUTS 0, 1, 2, 2&3 and 3) and local (contiguity analysis) territorial contexts.. Deviation maps for a given region can be established at every one of these three levels. The tool has been combined for different geographical areas such as Europe (ESPON HyperAtlas or European Parliament Hyperatlas), Cameroon, Tunisia, Rumania and the Rhône-Alpes French Region.

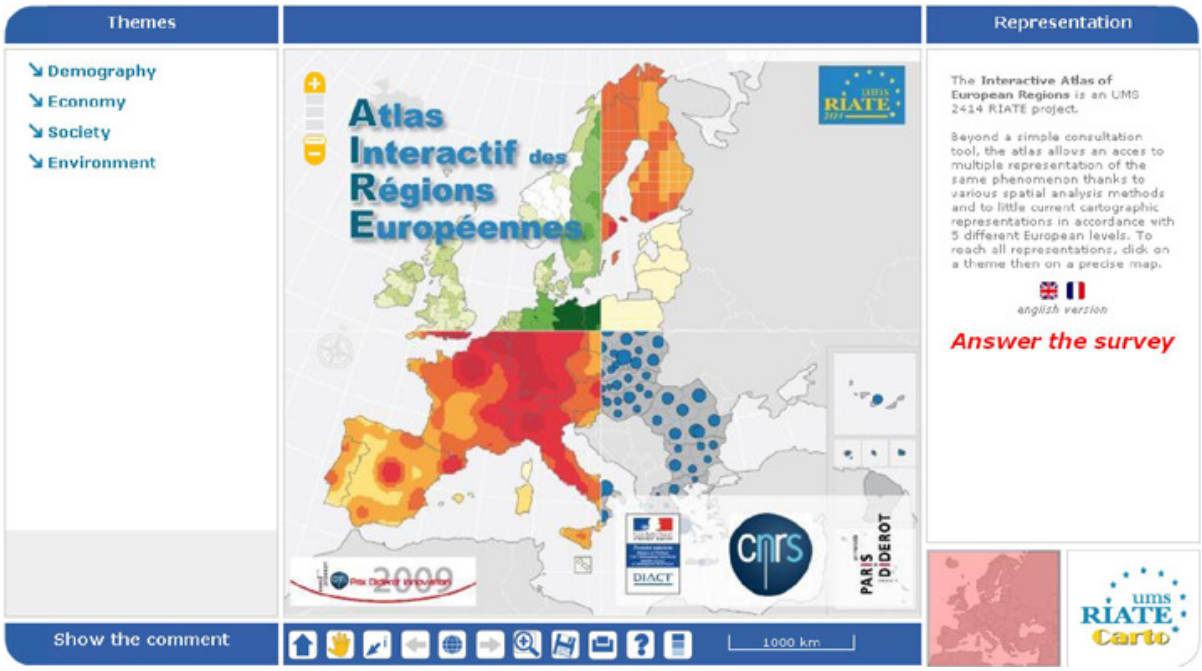
3. AIRE, A MULTI REPRESENTATION TOOL FOR SPATIAL PLANNING

As we showed it above, electronic atlases can be a possible answer. These atlases show territorial analysis from the local to the international levels through maps, images, texts, providing data and benchmarks of

organized synthesis. They show and help understand different realities. Paper atlases used to do this and continue doing it. The electronic atlas adds permanent updating, massive data stocking and paths for transversal consultation to the classical linear reading.

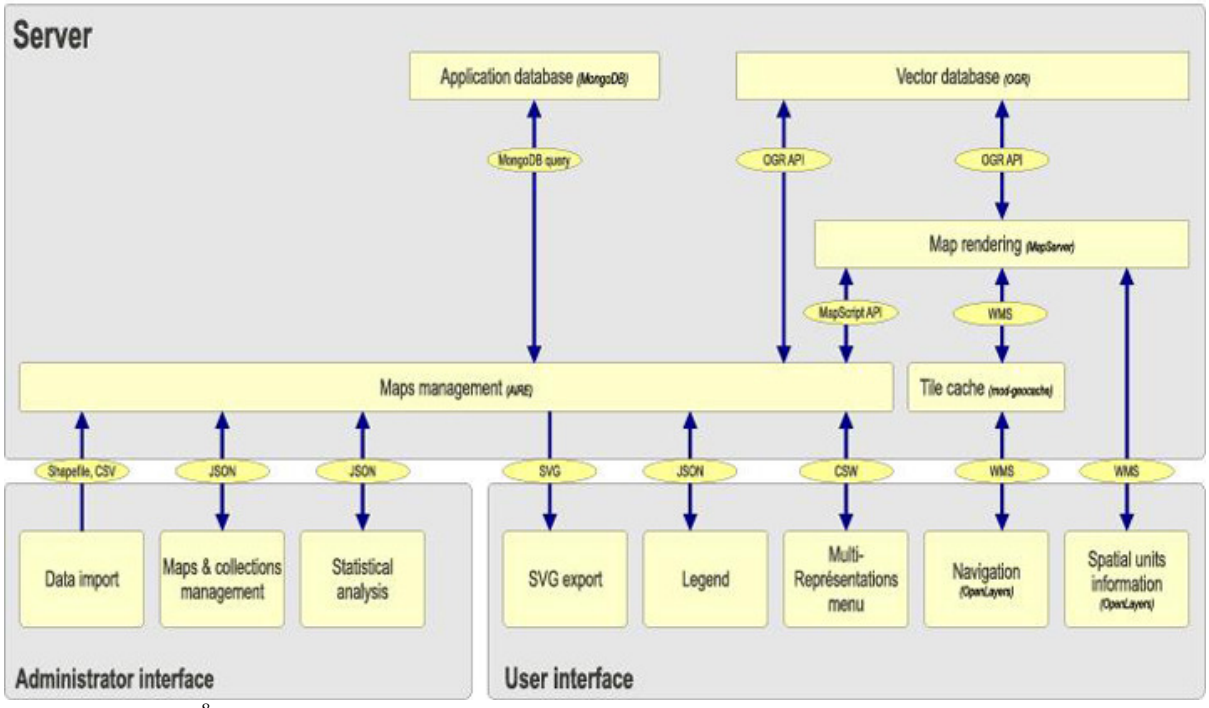
The functioning of electronic atlases provides for better describe territorial realities diversity and evolution. Zooming on a small entity or envisaging wider sets become possible. The objective is to provide the users with a better understanding as well as a tool that they can adapt to their needs. The question here is about the shape of such an electronic interactive and dynamic atlas not any longer as a simple presentation of a static map collection but as a real tool helping understanding and analysis a territory so as to facilitate the political decision-making process. The Figure 1 shows the first screen of the IAER application.

Figure 1: IAER , a web interactive atlas



Different from the set of presented sites, IAER is not an exploratory tool but a real atlas; this is a compendium of geographical maps. Maps proposed are « objects » conceived and implemented upriver without losing track of the multi-representation principle in accordance with different analytical scales and levels. IAER is written. Figure 2 shows how the application is organized; the IAER application is written in PHP language and uses 100% Open Source technologies such as MapServer (it renders maps from provided styles and data sources), OpenLayers (it manages the interactive navigation on maps), GDAL (Geospatial Data Abstraction Library, it's a library for accessing raster and vector data sources), MongoDB (it's a database engine), Dojo (it's a client side javascript framework),and Symfony (it's a PHP framework) for publishing spatial data and interactive mapping applications to the web. Open source code is made available free of charge to the general public, making IAER totally independent from any proprietary software. The rationale for this is that a large community of developers who are not concerned with proprietary ownership will produce more useful and bug-free product for everyone's benefit. We based our application on this concept which relies on community members to find and eliminate bugs in the program code. Between version one and two, the IAER application leveraged the technologies improvements contributed by the web community to these projects.

Figure 2: IAER Functional organization of the application



IAER uses OGC[8] standards extensively. For example, map tiles and feature information are requested using Web Map Service protocol (WMS). Now we are working on using the Catalogue Service standard (CSW) for the client server communication of map series. This will let other map viewers (such as IGN Geoportail or QGIS) access to the IAER maps collection and will be an advantage for the future users. They will be able to display the IAER maps with any tool of visualization and cross them with quite other images or maps. It's very useful for the territorial management process.

Another two strong points must be stressed: the possibility to obtain high-quality maps in vector format and the interactive module for commentaries. These advantages deal with the capability of the application to be a specific tool in the territorial reflexive process. How can I visualize my territory? What are the characteristics of my territory itself even but also with regard to the others? The basic idea of the IAER project is that there is not one cartographic representation of any spatial phenomenon but many of them, related to the map designer's hypotheses, in accordance with objectives, requirements, or cartographic information final users' practices (Andrienko, 2001). Web-related technologies evolve offering a great potential for this kind of approach, in particular because of the flexibility provided by an intense interactivity. The challenge therefore, is to target simultaneously an objective of communication for the general public and a cartography more operational and stimulating the thinking process (Peterson, 1999). Figure 3 shows the complexity of the interactivity developed in IAER and the concept of interactive browsing.

Figure 3: Organisation of the AIRE screen pannel

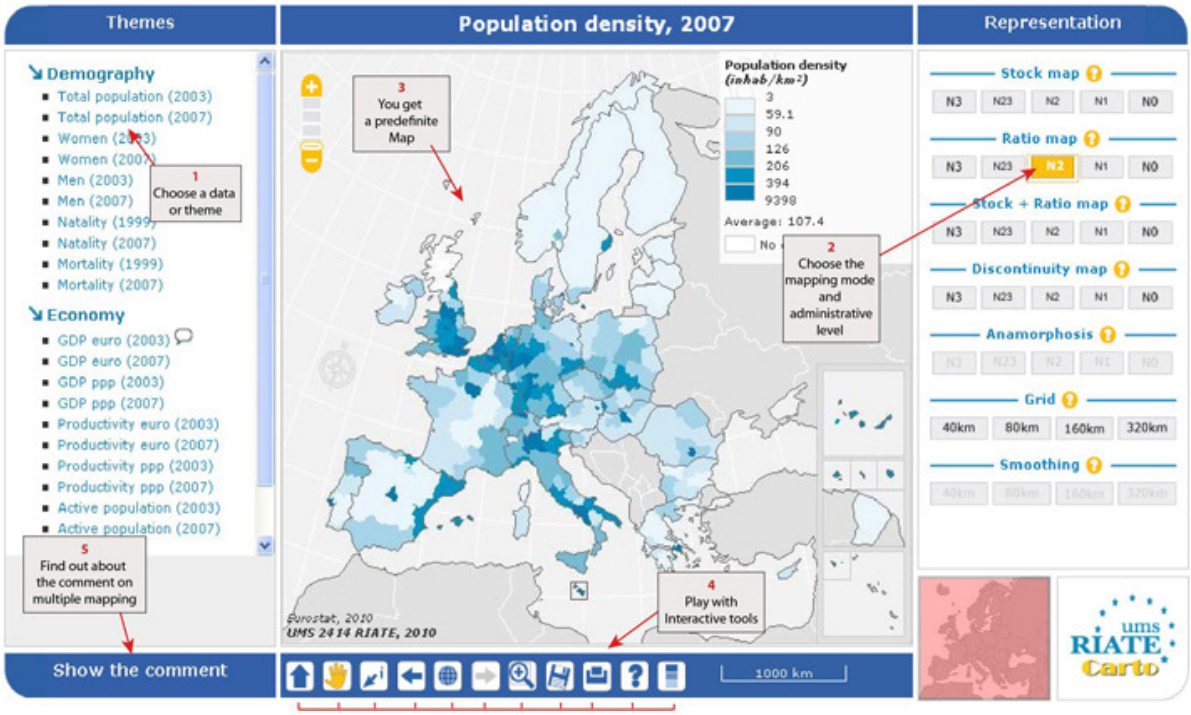
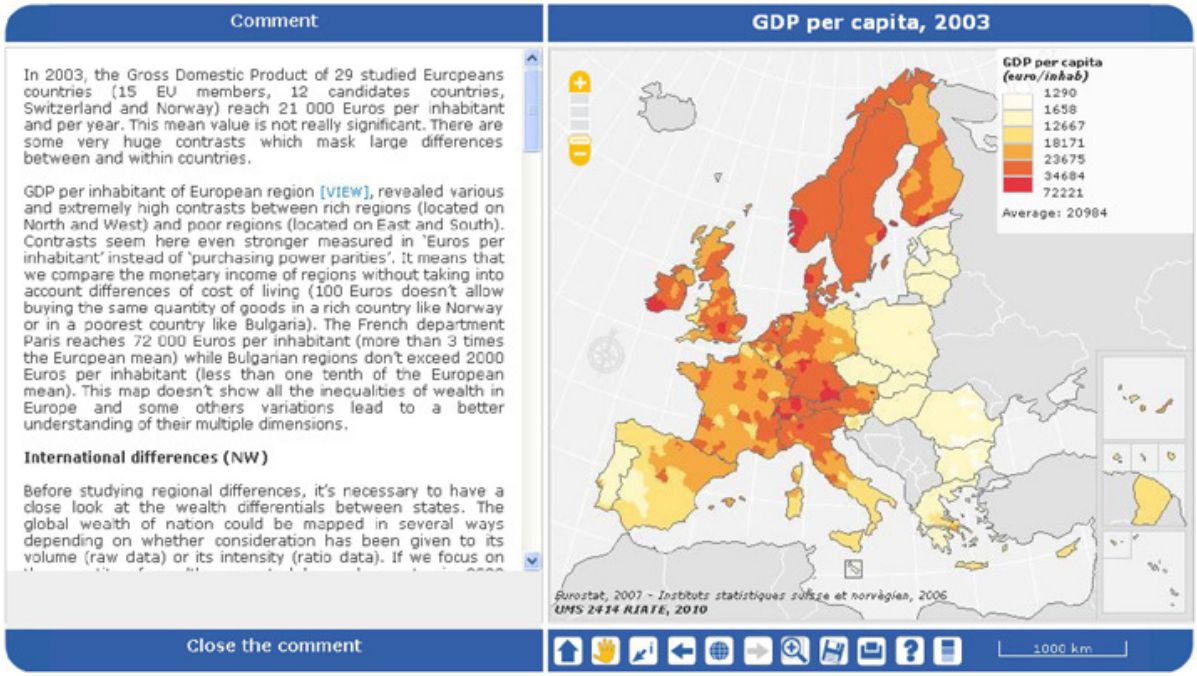


Figure 4 shows how comments are managed. The idea is to create a multiple comment on each set of thematic maps. One major benefit of such comment is to create a dynamic analysis of territorial patterns. One can read it in a linear way. But it's intended as complementary tool with a back and forth reading with the maps. This reading allows also focusing on one kind of territorial pattern, zooming in and out to specific areas.

Figure 4: AIRE Comments



The originality of such a project is about a multidisciplinary and multi-level approach where are considered simultaneously thematic and methodological issues for spatial analysis and cartography and questions related to Web tools interfaces. IAER allows showing the same information in accordance to different territorial grids, and, at the same time, in accordance with different types of representations, using fast and effective interactive tools. The proposed maps are « objects » designed and achieved up river. Progress in web-related technologies offers enormous possibilities for developing this approach, in particular, because of the flexibility inherent to sophisticated interactivity. Thus, the stake is to target

simultaneously cartographic communication object for the public at large and a more operational cartography to boost the thinking process.

REFERENCES

Andrienko G. & Andrienko N. (2001), Intelligent support for geographic data analysis and decision making in the Web. Journal of Geographic Information and Decision Analysis 5/2.

Buleon P. & Gaio M. (2002), Des atlas électroniques pour comprendre les territoires, Technologies internationales, 90.

http://cg.gapi.fr/documents/21926_1TI090_09.pdf

Debardieux B. (2002), Figures (géo) graphiques et prospective. Les cartes, schémas et modèles au service du projet et de la prospective territoriale. In Debardieux B. et Vanier M. (dir), ces territorialités qui se dessinent. Paris, Editions de l'Aube/Datar, pp.161-190

Kraak M.J. and Brown A. (Ed.) (2001) Web Cartography. Developments and prospects. London, Taylor and Francis 213 p.

Kraak M.J. and Ormeling F.J. (1996) Cartography, visualization of spatial data (London : Addison Wesley Longman)

Mac Eachren A. (1994), Visualisation in modern cartography: Setting the agenda, Oxford, Pergamon.

Martinais E. (2007), La cartographie au service de l'action publique. EspacesTemps.net

http://espacestemps.net/document3643.html

F. Leurent & all, (2007) Enjeux territoriaux et méthodes d'analyse : concepts d'un cours d'ingénierie pour l'aménagement durable. Article de valorisation du cours ENPC- VET « Méthodes d'analyse des systèmes territoriaux ». Ecoles des PontsParisTech, Département Ville, Environnement et Transport.

http://www.enpc.fr/fr/formations/ecole_virt/cours/masyt.pdf

Lussault M. (1995), La ville clarifiée. Essai d'analyse de quelques usages carto- et iconographiques en œuvre dans le projet urbain in Cambrezy L. et de Maximy R. (dir), La cartographie en débat, représenter ou convaincre, Paris Karthala-Orstom, pp. 157-193

Peterson M. (1995), Interactive and animated cartography, Prentice Hall, USA

Peterson M.P. (2007) The Internet and Multimedia Cartography in Cartwright W., Peterson M.P. and Gartner G. (Editors), (2007) Multimedia Cartography, 2nd edition, NY Springer, pp. 35-50.

Yengo P. (2005) Diagnostic de territoire et enjeux stratégiques pour le développement. PDM/AMTER

http://www.amenagement-afrique.com/IMG/pdf/DIAGNOSTIC_DE_TERRITOIRE_EN_AFRIQUE.pdf

NOTES

1 IAER or AIRE in French will be online on July 2011. However, you need a login (riate) and a password (mapping) to access the website currently under construction.

2 Some examples can be find here : http://atlasdumonde.canalblog.com/ or http://www.lexilogos.com/carte_monde.htm, or http://www.theodora.com/maps/abc_world_maps.html, or http://www.universalis-edu.com/atlas.php or http://www.lib.utexas.edu/maps/map_sites/map_sites.html.

3 A Google search on « academic atlas » shows more than 31 000 000 inputs.

4 http://zonages.territoires.gouv.fr/zonages/p3_territ.php

5 http://sigr.iau-idf.fr/webapps/visiau/

6 http://carmen.ecologie.gouv.fr/

7 http://www.gapminder.org/

8 http://www.opengeospatial.org/standards/wms