CommonGIS - Common Access to Geographically Referenced Data

Natalia Andrienko[1], Gennady Andrienko[1], Robert Peckham[2], and Hans Voss[1]
[1] GMD – German National Research Center for Information Technology,
AiS.KD – Knowledge Discovery research team,
http://ais.gmd.de/KD/
[2] JRC - European Commission - Joint Research Centre
Ispra, Italy
http://www.jrc.it/

Public access to the immense volume of existing geo- and geo-referenced thematic data and their exploitation is of significant value for the development of an open and democratic ”information society” and a true global market. The widespread use of such data and GIS (geographical information system) will promote general public awareness and further social cohesion. Publicly available geo-data is, however, of little use unless people can easily access and easily exploit it. CommonGIS (Esprit Project 28983), which is coordinated by the Knowledge Discovery Team of GMD's AiS institute, is developing Web-based tools for access and analysis of geo-data that can be utilized likewise by skilled and casual, non-expert users.

Geo-data encompass various thematic or statistical data on demography, economy, education, culture, history, etc., which are associated with objects and locations in space. Probably the best way to explore such data is to visualize them on maps. The key-thought of CommonGIS (http://commongis.jrc.it) is thus to make geo-data commonly accessible and usable for everyone, from everywhere, by providing a Web-based Geographical Information System (GIS) with knowledge-based functions for the automatic generation of thematic maps. To a very large extent, the user should not at all worry about visualization issues but rather focus on the analytical task. Currently available GIS are not well suited for this because they suffer from at least one of three intrinsic pitfalls: they tend to be architecturally closed, monolithic, and costly environments; their use requires specific technical skills; they require the user to think more about obtaining visually nice presentations than about the selection of appropriate data and solving problems with their use. The CommonGIS project is now (as of June 2000) in its 20th month, and current achievements include:

- The definition of a data characterization schema (DCS), and a data characterization language (DCL) as an instantiation of the schema. The DCL is used to describe syntax and semantics of a set of thematic data that shall be published, and to utilize this so captured information for the further automated support of data visualization and analysis [1].
- A first prototype for the support of building new applications (application builder [2]), and the application software itself: a Web-based, intelligent GIS for automated thematic mapping [3].
- Several demonstrator applications showing the potential of the new technology to data providers and users.

The proper goal of CommonGIS, namely to provide smart support to non-expert users, can only be satisfied if the application program can utilize more knowledge: about the data of the specific application, and about cartographic visualization and analysis in general. As basis for the latter we have chosen the existing knowledge base for cartographic visualization from Descartes ([4], see http://borneo.gmd.de/and/java/iris/), which was developed at GMD's AiS

institute. In addition, some ideas are being incorporated from the cartographic visualization system VIZARD [5] from FhG—IGD. A so-called data characterization scheme (DCS) was developed. In contrast to other work known from the literature, the DCS provides a rich arsenal of concepts, data structures and operators for defining domain models of the given data. The reason for this particular emphasis is that the focus of previous work was mostly on the visual presentation of data on then static maps, while in CommonGIS we are dealing with very interactive maps, and we want to support users in handling more complex analytical tasks. For example, in the context of exploring some demographic data the CommonGIS system should and will eventually be able to automatically identify, formulate, and support analytical tasks like "Compare gender structure of population in different age groups" or "Look at the distribution of a specific age group (0-14 years, 15-64 years, or 65 years and over) across the countries". In the latter example, it could also propose that using relative values (age group in percentages of the total population) would probably make more sense than using absolute numbers.

The CommonGIS software is developed as an open, object-oriented, distributed system. The user interface is realized as Java-applets, thus providing comfortable access and interactivity while only requiring a standard (Java-enabled) Web-browser. Currently, what the user sees after starting CommonGIS in the Internet looks like something that one would expect to see when running a typical GIS on a local PC. In fact, what was taken as the base technology is the Java-based Lava/Magma GIS from PGS ([6], cf. http://www.pgs.nl). One achievement of CommonGIS was to make the Descartes system running from within Lava/Magma. The user can thus select and define a desired map with ordinary GIS operations, and then select certain thematic variables for visual display on this map. Thereby the full interactivity of Descartes stays available as the systems were redesigned so that Descartes can use the Lava/Magma display methods for presenting results of interactive manipulations.

The CommonGIS system has a client-server architecture [3]. The server is a C/C++ program running on Unix or Windows – based Internet servers. It provides access to geographical and thematic data, connection to databases, generalization of geographic data, and design of visual presentations of thematic data. The client, implemented as a Java applet, provides the user interface and map display within standard Internet browsers. It also performs sophisticated caching of information for optimization of performance.

A demonstrator of the system with Portuguese Census Data is available in the Internet. A user can run it from one of the CommonGIS WWW sites. After the applet is loaded, it connects to the server, retrieves information, and displays a map. The HTTP protocol is used for communication between the client and the server. This allows the system to run in the Internet or in Intranets without being disabled by firewalls.

Several screenshots from the demonstrator are shown in figures 1,2 and 3.

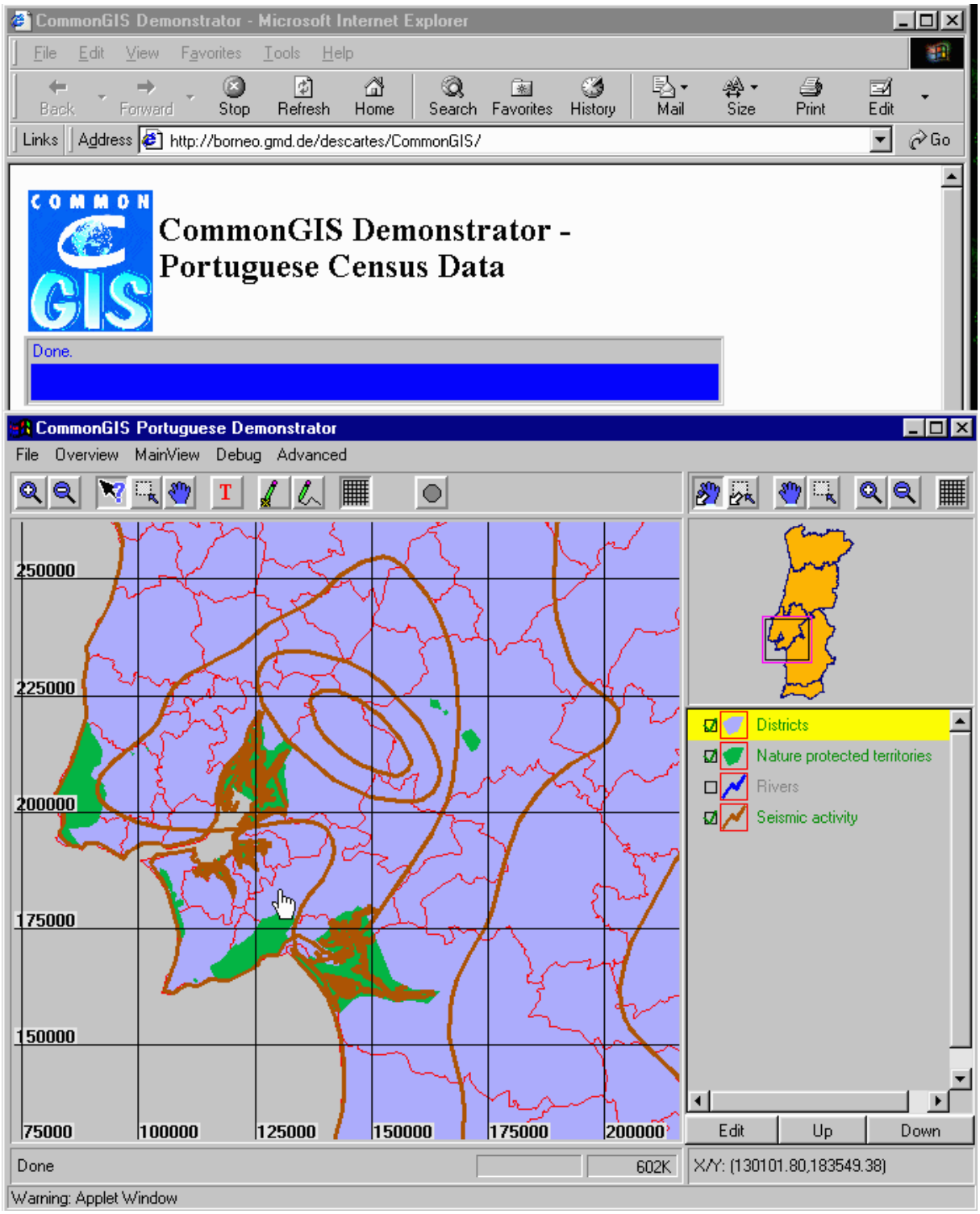

Figure 1. *User interface of CommonGIS in the Internet*

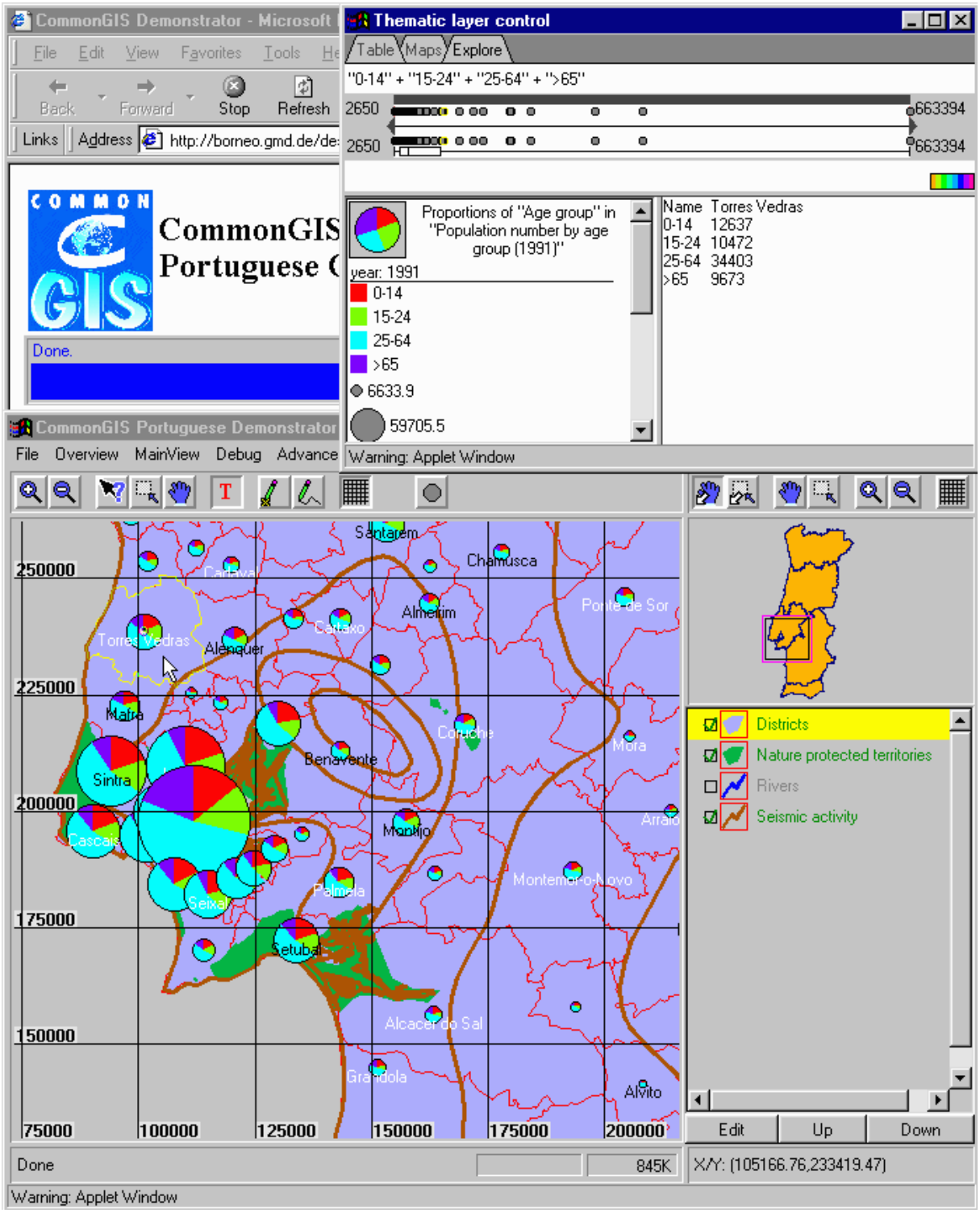

Figure 2. *Pie charts are generating for showing the age structure of the population*

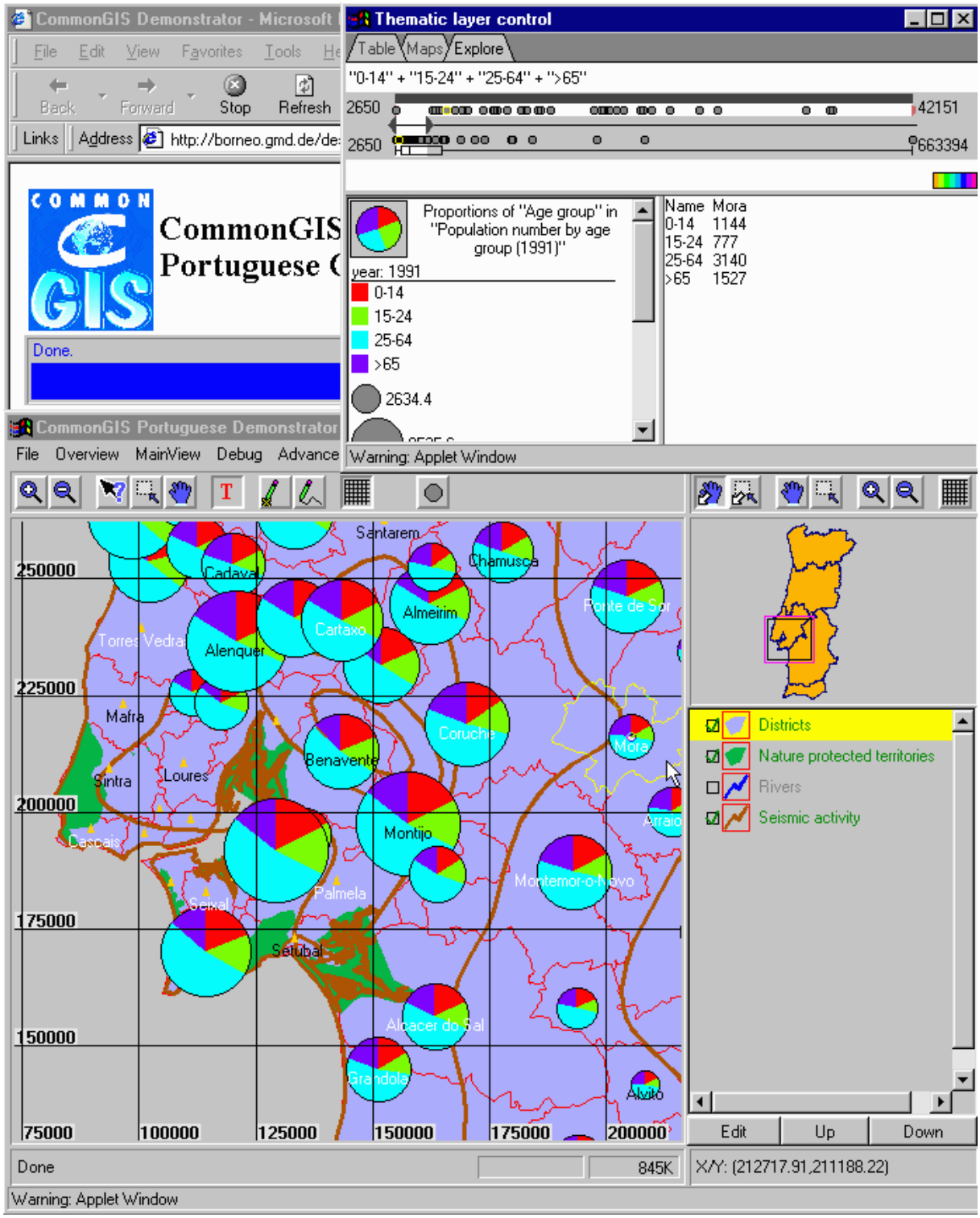

Figure 3. *Pie charts: focus on areas with relatively small population.*

References

1. Andrienko, G. and Andrienko, N. “Data Characterization Schema for Intelligent Support in Visual Data Analysis”. In Freksa, C., & Mark, D. M. (eds.) Spatial information theory - Cognitive and computational foundations of geographic information science COSIT'99, Lecture Notes in Computer Science, vol. 1661. Berlin: Springer, PP. 349-366. 1999

2. Andrienko, G. and Andrienko, N. “Knowledge Engineering for Automated Map Design in DESCARTES”. In C.B.Medeiros (ed.) Advances in Geographic Information Systems. Proceedings of the 7th International Symposium ACM GIS'99, Kansas-City, November 5-6, 1999. NY: ACM Press, PP. 66-72. 1999
3. Andrienko, N., Andrienko, G., Voss, H., and Tuijnman, F. “The Architecture of the CommonGIS System”. In K. Fullerton (ed.) Proceedings of 5th EC-GIS Workshop, Stresa, Italy 28-30 June, 1999. Report EUR 19018 EN, European Communities, PP. 416-426. 2000
4. Andrienko, G. and Andrienko N. “Interactive Maps for Visual Data Exploration”, *International Journal Geographical Information Science*, Vol.13, N.4, PP.355-374, 1999
5. Jung, V. “Knowledge-Based Visualization Design for Geographic Information Systems”. *In Proceedings of the 3rd ACM International Workshop on Advances in Geographic Information Systems*. Baltimor: ACM Press. PP. 101-108, 1995
6. van den Berg, C., Tuinman, F., Vijbrief, T., Meijer, C., van Oosterom, P., and Uitermark, H. “Multi-server Internet GIS: Standardization and Practical Experiences”, In Goodchild, M., Egenhofer, M., Fegeas, R., and Kottman, C. (eds.) *Interoperating Geographic Information Systems*. Boston: Kluwer Academic Publishers, PP. 365-377, 1999