

The Veneto sea data system: model of datawarehouse for all Veneto marine environment monitoring and study activities

M. VAZZOLER, S. ANCONA, D. FASSINA, L. MENINI and P. ZAMBOTTO

ARPAV - Servizio Acque Marino Costiere, Padova, Italy

(Received: April 3, 2006; accepted: December 12, 2006)

ABSTRACT: The Environmental Protection and Prevention Agency for the Veneto Region manages to ensure that all activities and regional initiatives at a local, extra-regional and cross-border level are integrated to the greatest possible extent to produce homogenous, coherent action throughout the northern part of the Adriatic Sea through the Osservatorio Alto Adriatico (OAA). These activities are developed both through institutional monitoring plans and with specific study and research activities. The Veneto Region (ARPAV) Sea Data System in the making will become a fundamental instrument for the OAA observatory to gather and organize all sea-related information. It will thus give an across-the-board contribution to activities concerning the Veneto coastal marine environment and, at the same time, it will provide tools to aid in the interpretation of environmental data. The system's structure is currently being set up and has been defined according to the rules of ultimate rationality to enable the widest possible exchange of data.

1. Introduction

The geomorphologic characteristics of the Veneto coast make this an extremely sensitive environment, a condition compounded by its many basins of varying size that carry substances from agricultural, residential, commercial and industrial sources out into the sea. These and other factors, together with the effect of the variability in weather conditions and hydrodynamics, combine to make the Veneto coast an area typically subjected to constant natural fluctuations in chemical and physical properties and, consequently, in the biological component.

The Environmental Protection and Prevention Agency for the Veneto Region (ARPAV) has been involved in monitoring the Region's coastal marine waters for years. In response to the Region's need for a body to unify the coordination of the various measures and to integrate and optimize initiatives, in 2003 ARPAV set up a specific highly specialized permanent operational technical coordination unit called the "Osservatorio Alto Adriatico (OAA) – Polo Regionale Veneto" (observatory for the upper reaches of the Adriatic - Veneto regional centre) to improve management of the complex, wide-reaching activities related to the marine environment. The undertaking was also promoted by the regionally directed Community initiative programme Interreg III A/Phare CBC Italy-Slovenia 2000-2006 "Development of activities to study and monitor the evolution of the marine and coastal ecosystem for the protection, integrated management and development of the sea resource".

The OAA observatory ensures that all regional initiatives and activities at a local, extra-regional and cross-border level are integrated to the greatest possible extent to produce

homogenous, coherent action throughout the northern part of the Adriatic Sea, backing regional policies for the protection and monitoring of the state of the sea with technical assistance and advice and providing integrated management of the marine-coastal environment, oceanography and marine reserves. These activities are developed both through institutional monitoring plans and with specific study and research activities. The unit carries out the analytical side of the job through its own technical units and laboratories called DAP (provincial departments for the environment), who belong to what is known as the “Area Tecnico Scientifica” (scientific and technical area) as well as through independent institutions, whose services are employed in connection with certain research areas.

In order to gather and organize all sea-related information coming from the various activities, whether institutional or related to a specific project, the decision was made to equip the OAA observatory with a datawarehouse called the Veneto Region Sea Data System (SDMV). This instrument will make a high level across-the-board contribution of technical and scientific quality to activities concerning the Veneto coastal marine environment and, at the same time, provide decision makers with tools to help them interpret the data on the environment.

2. Discussion

The OAA’s sea-related institutional activities concern various themes, above all control of bathing waters, coastal marine waters, waters inhabited by sea shellfish, shore rebuilding and the issue of emergencies at sea.

More specifically, ARPAV has monitoring systems placed in 93 points around the Adriatic Sea (Fig. 1) to monitor the waters to ensure they are fit for bathing, in accordance with current provisions (Italian presidential decree 470/82 as later amended and supplemented). At each monitoring point, chemical and physical properties are measured, visual and odour inspections are performed and water samples taken for microbiological analysis.

For the purpose of monitoring the marine and coastal environment (D.lgs. 152/99, D.lgs. 258/2000), a network of eight transects (Fig. 1) has been set up in lines perpendicular to the coastline for monitoring each point, with sampling stations located up to 2 nautical miles offshore. Campaigns of measurements, sample-taking and laboratory analyses on various matrices are carried out bimonthly, for a total of 24 campaigns a year. The positioning of the sampling points was decided taking into account the distinctive features of the Veneto shore, i.e. allowing for a number of critical points such as the mouths of rivers, entrances to the lagoon and tourist resorts dotting the coast, also taking into account the presence of both natural banks of *Mytilus galloprovincialis* and *biocoenosis* associated with well-sorted fine sand.

Lastly, to obtain complete realtime information on the Adriatic basin’s environmental situation, a regional system of weather-marine buoys was set up, with the involvement of scientific bodies of the highest calibre, such as the CNR-ISMAR (National Research Council-Marine Science Institute) of Venice and the ICRAM (Central Institute for Marine Research) of Chioggia. The OAA observatory’s role in this undertaking has been to continuously coordinate, optimize and homogenize the characteristics and positioning of the various measurement stations involved in the different projects.

More specifically, the regional network of weather-marine buoys consists of three monitoring

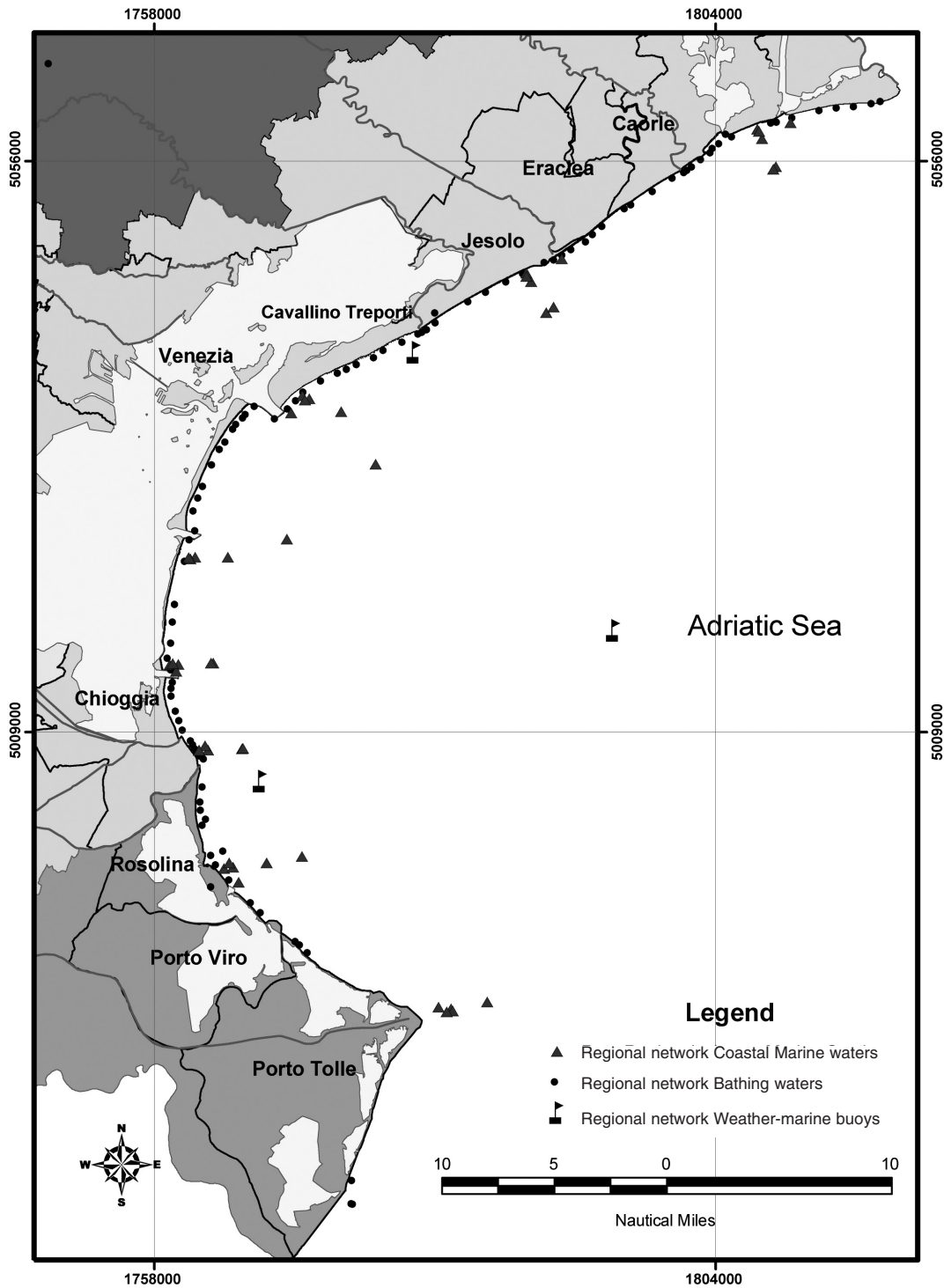


Fig. 1 - The marine monitoring networks.

stations, two elastic beacons, placed respectively approximately 2 nautical miles from the mouth of the River Adige and about 15 nautical miles off the coast at the “Secca dell’Abate” outcrop. This equipment was set up as part of the Interreg III A Phare CBC Italy Slovenia 2000-2006 project, whilst another buoy is located near the mouth of the River Sile and was placed there as part of the “Intervento 72-Campo Sperimentale a Mare” (measure 72-experimental field at sea) project (Fig. 1).

Via this network, realtime information can be gathered on weather and oceanographic conditions. All resulting data from the whole system, after checking and validating, are processed to produce graphs and thus provide prompt, comprehensive information for the various parties concerned, who can access the information via the web.

All this information is uploaded into the SDMV, which will be the fundamental tool to aid the observatory in its integrated management of all the information. The system’s structure is currently being set up and has been defined according to certain rules to enable the widest possible exchange of data.

The functional architecture on which the SDMV data system will be based will be divided into three levels: systems containing elementary data (or input systems); systems for integrating and storing “semi-finished” data (or datawarehouse systems); and systems for data access and production of “finished” information (or business intelligence systems).

The datawarehouse was designed according to the Kimball method. In this contest different Data Marts (DM) were created. The DMs are jointed using a common dimension of BUS architecture. Every DMs were designed like a star-shaped scheme with a central Fact Table joined to the dimensions by an external key. In the datawarehouse, there is also a data processing Staging Area (SA) where the row data are stored before cleaning, normalization and conversion processes.

One fundamental element of the SDMV data system is its harmonization with SIRAV (Sistema Informativo Ambientale di ARPAV), its policies and its standards. The SIRAV, written in ORACLE 10G, is the Veneto regional environmental information system managed by ARPAV and has the task of collecting and managing the environmental data produced as a result of institutional obligations, by all environmental-related bodies of the Veneto Region.

The SDMV data system will therefore receive data from multiple sources, such as monitoring networks with periodic, manual sampling stations; monitoring networks with automatic measurement stations; routine and one-off measurement campaigns and historical sets of data that were stored in different formats like txt, xls, etc.

The upload process is incremental and performed by an ETL tool (Extract Transform and Load) through two subsequent steps:

- 1) upload of SA tables with PL/SQL procedure for SIRAV’s data or with Java application for files like txt, xls, etc.;
- 2) upload of DM starting from SA tables by PL/SQL stored procedures.

The SDMV data system will integrate the numerous operational data sources and will “uncouple” SIRAV’s operating environment from the analysis and decision-making on “environmental facts” relating to the sea. Digital data (alphanumeric, graphical, multimedia) will be acquired from different information systems in heterogeneous formats, and will be normalized by the SDMV system.

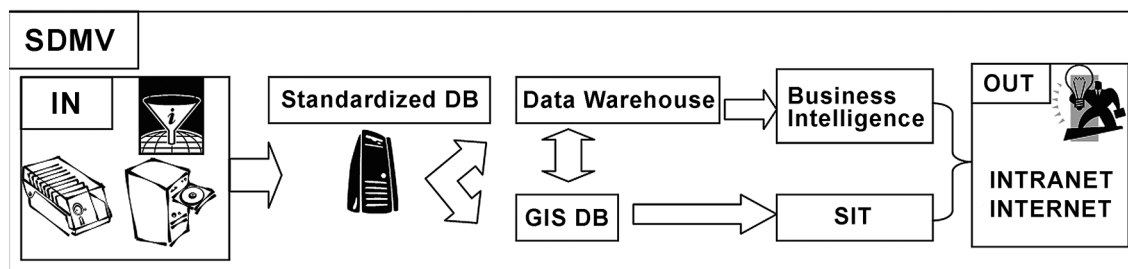


Fig. 2 - SDM V data system architecture.

Information stored in the SDM V data system will be analysed, processed, integrated, formatted and distributed by means of a business intelligence system, Business Objects IX (www.businessobjects.com) second edition, which will provide an intelligent data search feature and will employ push and pull methods to deliver and analyse information in realtime to give the control and decision-making activities with the support they need (Fig. 2).

This Business Objects version allows us to analyse the data set by an internet browser without installing the software client. This feature will provide a data set consultation for use by anyone who needs to know more about the marine environment.

This system will also be implemented by a web-GIS module, based on ESRI products (ARC SDE, ARC IMS), that will be connected with the datawarehouse. Web-GIS interface will allow the user to “navigate” around a map and extract information dynamically by means of drill up and drill down functions (Fig. 2).

3. Conclusions

When dealing with the northern Adriatic basin, a large system of regional, extra-regional and cross-border interest that reflects the state of the environmental health of the land on this part of the sea, a tool is desperately needed to integrate and rationalize all the data produced.

The system will become a permanent tool for data recording of the Veneto marine environment and will enable an efficient and prompt management of information, in order to furnish an overall picture of the basin’s environmental state. By using a friendly web interface, the system will also allow that information to be made available for use by the public.

Acknowledgments. This work was presented at the Workshop Archimede, Rome November 29-30, 2005.

REFERENCES

- Decreto Legislativo, 11 maggio 1999 n. 152: *Disposizioni sulla tutela delle acque dall'inquinamento e recepimento della direttiva 91/271/CEE concernente il trattamento delle acque reflue urbane e della direttiva 91/676/CEE relativa alla protezione delle acque dall'inquinamento provocato dai nitrati provenienti da fonti agricole*. G.U.29/5/1999, n.124.
- Decreto legislativo, 18 agosto 2000 n. 258: *Disposizioni correttive e integrative del decreto legislativo 11 maggio 1999, n. 152, in materia di tutela delle acque dall'inquinamento, a norma dell'articolo 1, comma 4, della legge 24 aprile 1998, n. 128*. G. U. 18/09/2000, n. 218. Suppl. Ordinario n. 153/L.
- Decreto del Presidente della Repubblica 8 giugno 1982 n. 470: *Attuazione della direttiva (CEE) n. 76/160 relativa alla qualità delle acque di balneazione*. G.U. n. 203 del 26/07/1982, pp. 5239-5245

Corresponding author: Marina Vazzoler
Agenzia Regionale per la Prevenzione e Protezione Ambientale del Veneto
Servizio Acque Marino Costiere
Piazzale Stazione 1, 35100 Padova, Italy
phone: +39 049 8767656; e-mail: mvazzoler@arpa.veneto.it