

# A coastal WebGIS for data sharing and distribution

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## Abstract

*In accordance to the goals of ResMar subproject B, the two partners, Provincia di Olbia Tempio and Provincia di Livorno, through their cross-border centreoffices (OCEANS and CRStDiL) have developed a data sharing system in the form of two Web-based Geographical Information Systems (Web-GIS). Because of the different morphology of Sardinian (a large number of small pocket-beaches) and Tuscan (200 km of relatively wide beaches) coasts, the two platforms were structured differently. Provincia di OlbiaTempio developed an Atlas of Gallura beaches as a set of test sites; the contents are cartographic data derived from an aerial photogrammetric historical set (from 1954 to 2006), sedimentological and geomorphological data and hydrodynamic, wave and sedimentological models. Provincia di Livorno used a platform known as GEO-T, where users can frame any stretch of the Tuscan coast to view the different layers, and interact to obtain additional information as available from the database. Because of the considerable length of most Tuscan beaches, Provincia di Livorno developed a Web-GIS where there is no data gap between the northern and southern borders (with Liguria and Lazio, respectively). The landscape background is created using orthophotos and CTRs, and the shorelines drawn are replaced by lines from surveys and photo-interpretation, from 1938 until today. Each physiographic unit has been divided into 250 m long sectors, with a colour line showing shoreline evolution from 1984 to 2005. Another relevant layer is represented by the database containing data on coastal defence structures and ports, while territorial information is completed with data on the regional ecological network, hydrography and coastal dunes. The aim of both centres is to standardise other available data in order to permit their publication, and collect further data to allow for continuous monitoring.*

## Introduction

ResMar subproject B is based on the creation of a cross-border centre for the study of littoral dynamics. At this moment the centre includes two offices in Italy, one located in Sardinia and one located in Tuscany. The Tuscan center has been developed by Provincia di Livorno and

is called CReStDiL (Regional Centre for the Study of Littoral Dynamics), whereas the Centre in Sardinia is managed by Coastal and Marine Geology Group of Cagliari University, through the Coastal and Natural Submarine Environment Observatory (*Osservatorio Coste E Ambiente Naturale Sottomarino - OCEANS*), with the financial support of the Provincia di Olbia-Tempio. According to the cross-border cooperation programme, partners have developed a data-sharing system that allows external users to gain access to the information. Both Provincia di Livorno and Provincia di Olbia-Tempio developed two Web-based Geographical Information Systems (WebGIS) fed with data collected on field, and platforms will be available on the official website of project Res.Mar (according with INSPIRE EU protocol [1][2]).

### Shared database

There are many differences between the territories studied by the two partners: the Tuscan coast has approximately 200 km of relatively wide beaches interrupted by headlands that subdivide them into ten physiographic units. The Olbia-Tempio province, on the other hand, is mainly formed by pocket-beaches, as does the Tuscan archipelago. Therefore, the WebGIS developed by the Sardinian partner is considered as a set of test sites composed by the beaches studied, and it is possible to reach the page dedicated to the point of interest without needing to get through the global map. Because of the considerable length of most Tuscan beaches the map was organized as a dataset without a gap between the northern border (with Liguria) and the southern one (with Lazio). Moreover, some themes that may be significant at Tuscan coasts, such as the description of existing coastal defense structures or strategies are irrelevant in Sardinia, where their presence is negligible. These and other differences led to the decision of keeping two separately managed platforms with a minimum common content, though both partners are free to add all data they have collected.

### The Sardinian WebGIS platform

The Olbia-Tempio Province has been supported by the Coastal and Marine Geology Group (CMGG) of Università degli Studi di Cagliari, which founded and developed the Coastal

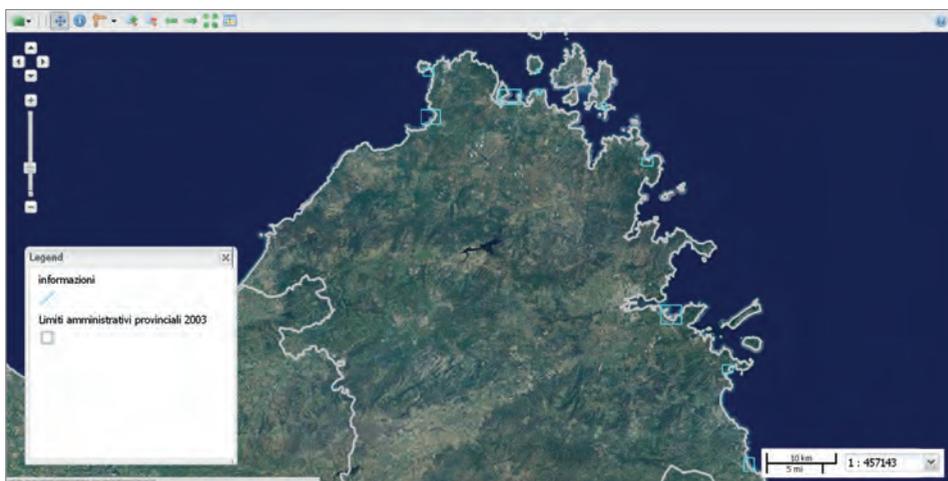


Figure 1 - Map index of sample sites.

and Natural Submarine Environment Observatory (Osservatorio Coste E Ambiente Naturale Sottomarino - OCEANS). The CMGG developed an Atlas of Gallura beaches[9], which represents an experimental dataset with information on the historical-geographic evolution and trend of ten beaches [6][8](Fig.1).

The Atlas is proposed as a support tool for local governments since it offers essential elements, required to start a successful integrated environmental management programme. The contents of this Atlas are cartographic data derived from an aerial photogrammetric historical set (from 1954 to 2006), sedimentological and geomorphological data and hydrodynamic, wave and sedimentological models[3][4][5][7][10].

Part of these data have been converted to GIS format and published on a WebGIS platform, currently posted on the [www.osservatoriocostesardegna.eu](http://www.osservatoriocostesardegna.eu) website (Fig.2).

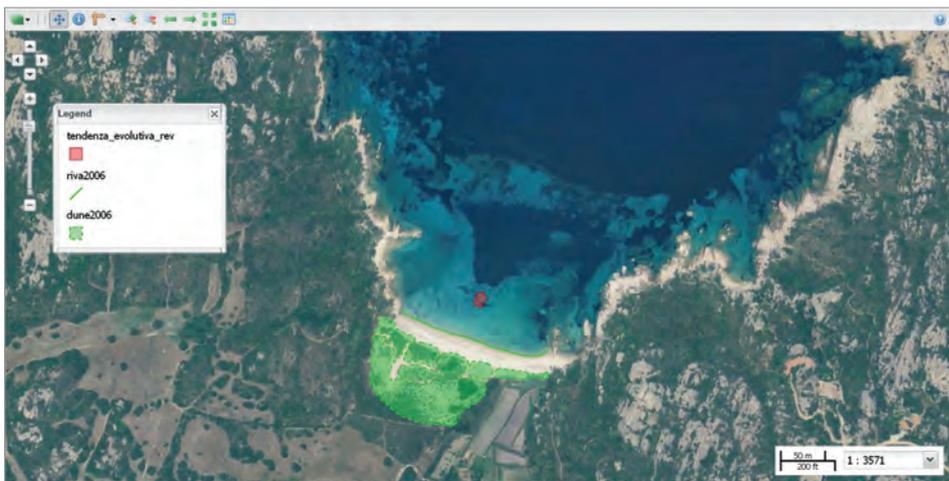


Figure 2 - Section of the Sardinian WebGIS platform (example: Cala di Trana beach).

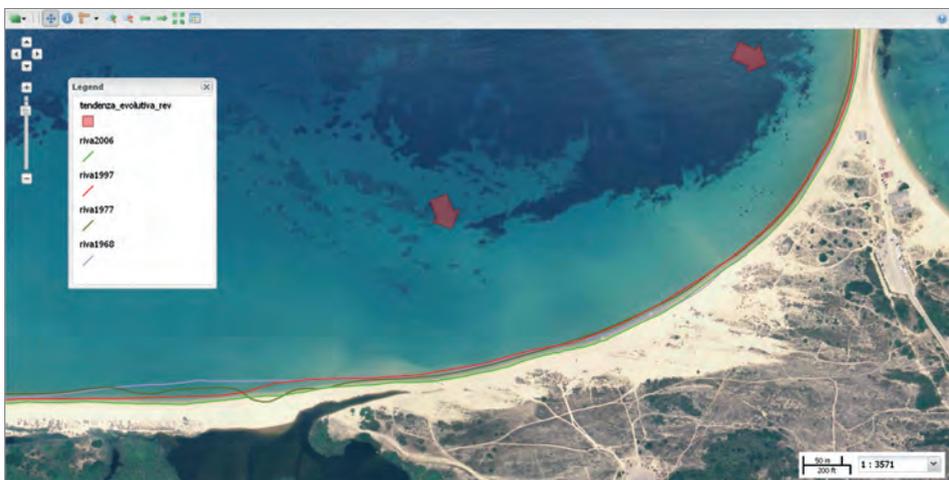


Figure 3 - Shoreline evolution at Porto Liscia beach.

The system uses an open source software platform named GeoSuite. This enables management and display of several information layers, using a navigation software called GeoExplorer.

WebGIS will be also reachable from the ResMar website and, consistent with the project specifications, will enable the display of information layers concerning:

- shoreline position (by aerial photography interpretation) (Fig. 3);
- shoreline evolution trend;
- bathymetry;
- location of sedimentological samples;
- layers of sedimentation from Sardegna Regional agency "Regione Autonoma della



Figure 4 - Geological information layers at La Colba beach.

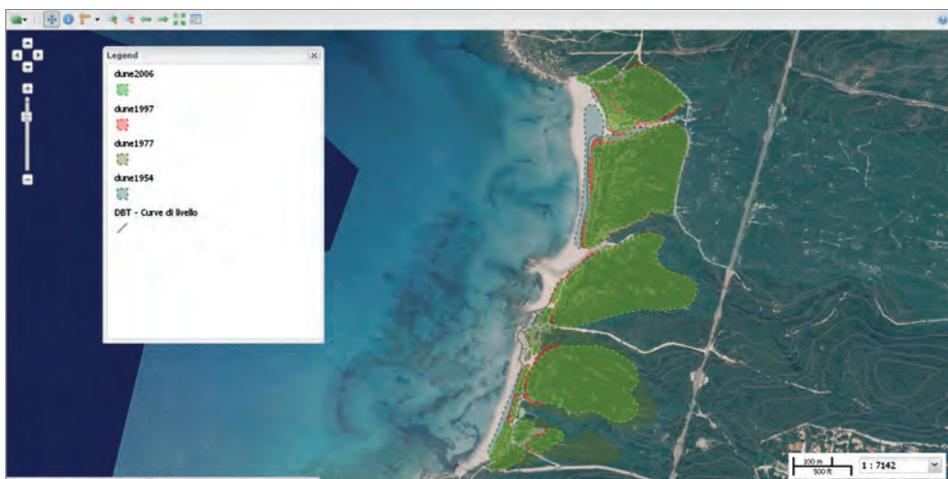


Figure 5 - Dune area evolution at Rena Maiori beach.

Sardegna" RAS (Eg.SCIs, SPAs, geology, orthophotos etc.) (Fig. 4);

- extent of the dune area (Fig. 5);
- main hydrography.

The GeoExplorer navigator allows viewing different layers superimposed on orthophotos from several years. These aerial orthophotos are available from the "Regione Autonoma della Sardegna" database.

Data come from new surveys and from the interpretation of historic aerial photographs, available from the "Regione Autonoma della Sardegna" (RAS).

The aerial photography interpretation was performed using CAD and GIS software on geo-referenced orthophotos from different years. Positioning is referenced, in accordance to RAS database, to Gauss-Boaga Roma40 datum, but positioning of all data is also available on UTM WGS84 datum.

### The Tuscan WebGIS platform

Provincia di Livorno used a platform known as GEO-T, elaborated by a private company; at the centre of the architecture there is a map server (Map Guide Open Source) that interacts, usingFDO technology, with heterogeneous geographic data sources, file-systems and database servers.

It's possible to access the platform trough an authentication, in administrator or read-only mode.

The homepage of the application shows a map of Italy zoomed on Tuscany; in this way it is possible to see almost all upload layers, although at this scale most of them are hardly discernible (Fig. 6). Users can frame any stretch of the Tuscan coast to view the different layers, and interact with them to obtain additional information as available from the database.

The landscape background is created using CTRs (Regional Technical Maps from Regione Toscana, and by orthophotos taken by AGEA in 2010 at the scale 1:10000. These were

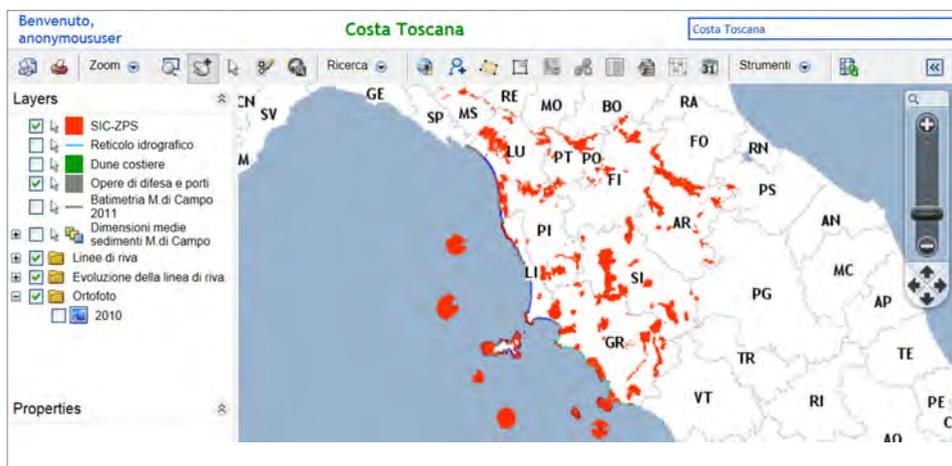
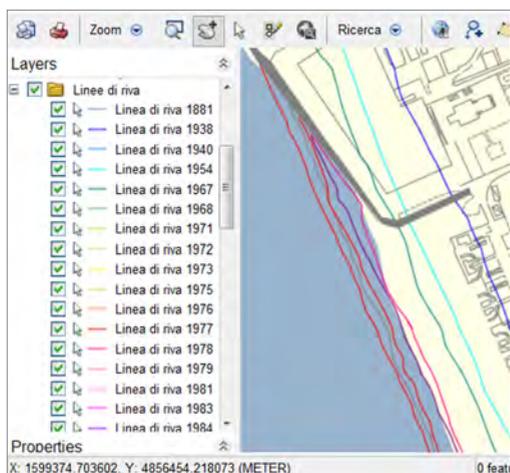


Figure 6 - Homepage of the Tuscan coast map.

provided, as other datasets, by Regione Toscana through the Geoscopio WMS system. The CTRs are opportunely cut with a buffer at 2 km from the sea; shorelines drawn over them are replaced by lines obtained from surveys and photo-interpretation. A large amount of coastline data has been collected by the Dipartimento di Scienze della Terra dell' Università di Firenze, from the digitization of 1938 maps until recent surveys[12].

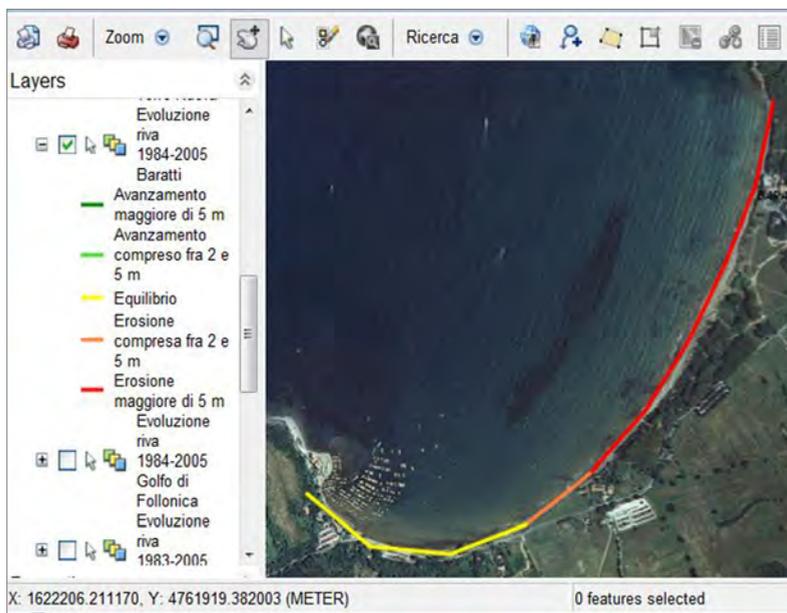
Figure 7 presents an example related to the zone of Viareggio Harbour.



**Figure 7 - Shoreline position in different years, south of Viareggio Harbour.**

The datasets of 1954, 1973, 1984 and 2005 covers the entire length of beaches on continental Tuscany, and they have been used for a report on shoreline evolution during the past decades[11].

Each physiographic unit has been divided, obstacles such as harbours and headlands permitting, into 250 m long sectors. These are symbolized by colour lines(Fig. 8) that represent shoreline evolution during the period from which we have the most recent complete dataset on the Tuscan territory (1984-2005). Selecting a sector, or any object on the map, properties are displayed and it is possible to read values from the other periods investigated.



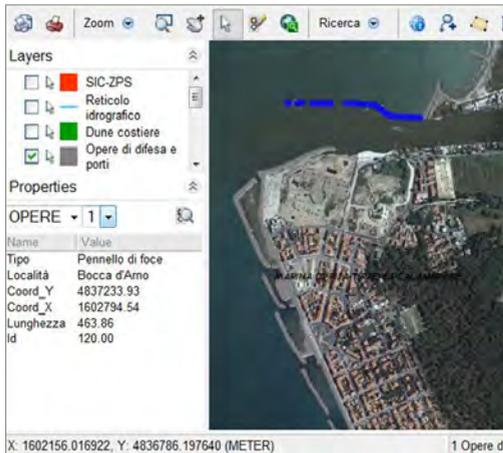
**Figure 8 - Shoreline evolution in the Gulf of Baratti.**

The Tuscan coast is often interrupted by coastal defense structures and ports, and it is useful to maintain an atlas that represents them, followed by an information sheet presenting their main characteristics. An inventory of coastal defense structures, published by Regione Toscana in 2007[13], has been reviewed and updated as part of this study, adding new structures and correcting information related to old structures that had been destroyed or reshaped. Each structure was represented by a polygonal shape digitized from orthophotos and CTRs, and described in a database containing several pieces of

information:

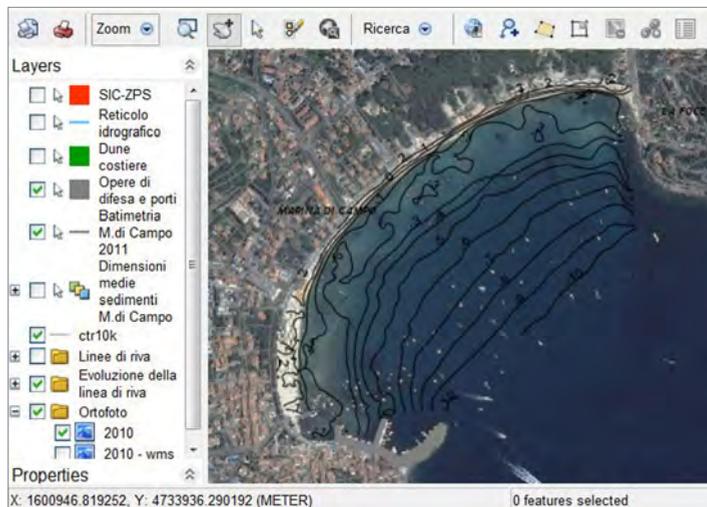
- Site
- Position, identified by the coordinates of the centroid
- Type of structure (groyne, breakwater, etc.)
- Length

These data can be reached, as can all layers, by selecting a single element (Fig. 9) or by opening a separate information sheet. Further information concerning characteristics and history of the structure, as well as aerial and ground photographic documentation, are still being updated, and will be accessed through hyperlinks.

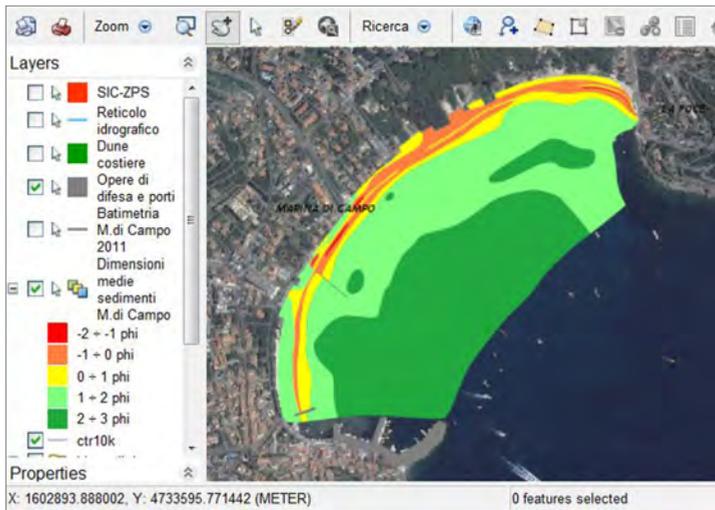


**Figure 9 - Coastal defense structures at Marina di Pisa. The selection of the object allows to display the information.**

Bathymetric and granulometric data from one of the test sites[14] has been loaded to show a possible development of the WebGIS. Figure10 presents two maps of the beach of Marina



**Figure 10a - Bathymetric map of the beach of Marina di Campo (Elba island).**



**Figure 10b - Average size of sediments in the beach of Marina di Campo (Elba island).**

di Campo (Elba island) that indicate bathymetry and the average size of the sediment. The aim is to align the product to the one edited by Provincia di Olbia-Tempio, where mapping of the seabed was published for each beach. This type of data is currently widely available in Tuscany but still requires standardization before data can be shared in the WebGIS. Regione Toscana gave permission to share other layers of information which are relevant to the management of the coastal zone, such as the databases from the website of the regional ecological network, and on hydrography and coastal dunes.

### Future Developments

The amount and range of the information contained in the two WebGIS should not to be considered as definitive and should not be restricted to the duration of the ResMar project. Some layers could become obsolete in a short time, because of the speed of changes to the coastal territory, and the intention of both centres is to keep collecting data so that monitoring can be continuous. Development of new contents may also be possible; for the Tuscan platform, for instance, the available sedimentological and bathymetric data could be published, whereas worksheets could be completed for each work of coastal defence structure, adding information on the technical and structural characteristics and uploading project documents and photographs.

Regarding Sardinian study area a data increasing is foreseen by new sedimentological data, extent of *Posidonia oceanica* seagrass meadow, mapping seabed etc.

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