

# SOS Server Deployment for Sharing Environmental Sensor Data Through the OTALEX-C Spatial Data Infrastructure

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## Abstract

OTALEX Spatial Data Infrastructure (SDI) project is funded by the INTERREG III European Programme and its main objective is to study and show the reality of the territory composed by the regions Alentejo in Portugal and Extremadura region in Spain. The current project phase is called OTALEX C and it is focused on showing the results of environmental studies through the OTALEX SDI. For that goal, it is necessary to catalogue, standardize, geoprocess and publish data from environmental sensors, as well as publish thematic contour and continuous maps derived from the interpolation of these sensors data. The first part of the project was the development of the processes to load a heterogeneous group of data from different types of sensors into a central repository using open source and self-developed Extract Transform and Load tools (ETL).

## 1 Introduction

The SDI OTALEX project is funded by the European Programme INTERREG III and its main objective is to study and show the reality of the territory, made up by regions of Alentejo in Portugal and Extremadura in Spain. Both regions are separated by country frontiers but share physical, environmental, social and economic characteristics.

The current phase of the project called OTALEX-C includes environmental sensor data publishing, as well as thematic maps publishing. These thematic maps are composed of isolines and continuous maps from the interpolation of environmental sensor data.

The project involved data transformation and load, standardization and integration of data from heterogeneous environmental sensors using the SOS-T protocol and thematic maps generation.

## 2 Evolution of the Project

Within the framework of OTALEX project, an automatic system was created to catalogue, standardize, geoprocess and publish data from heterogeneous environmental sensors, as well as publish thematic contour and continuous maps derived from the interpolation of the sensors data.

Figure 1: Current Geoportal of OTALEX SDI.



Source: OTALEX IDE web page: [www.ideotalex.eu](http://www.ideotalex.eu)

### 2.1 Data Capture from Internal Data

A portable environmental station was acquired to measure in real time the following parameters:

- Wind's direction and speed
- Air pressure
- Relative humidity
- Temperature
- IR, UV, Beta and Gamma radiation

To access the data from the portable environmental station, some ETL processes were developed. These processes allowed to integrate the observations stored in the main Access/SQL database by the program GEONICA SUITE into the main repository of OTALEX-C project (Postgres/PostGIS). The ETL processes were developed with the open source GeoKettle tool, having direct access to the Access/SQL database and discovering the sensors for its registration into the SOS server.

## 2.2 Data Capture from External Data

A study to detect the environmental data sources that are useful in this project was carried out. The selected sources were:

- Extremadura Protection and Research Quality Network (REPICA). This network provides the following data: Sulfur Dioxide, Carbon Monoxide, Wind's direction and speed Wind, Temperature, Relative humidity, etc. The incorporation of these data to the SOS service was made by receiving daily data e-mails. This data was imported it into the main database of OTALEX by using ETL processes.
- Extremadura Irrigation Advice Network (REDAREX). This network provides the following data: Sun radiation, Relative humidity, Pluviometer, Wind's direction and speed and Temperature. In this case, as the data was not published through standards, a HTML scrapping process was carried out, in order to store these data into the central OTALEX database.
- Évora University. This station provides the following data: Solar radiation, Ultraviolet Solar radiation, atmospheric radiation, Temperature, Infrared radiation, etc. These data were imported into the main database of OTALEX by using ETL processes from an FTP server.

All these external data become the main kernel of data to build thematic maps with the environmental sensor measurements.

## 2.3 Central Database Definition

In order to store the sensors data, a scheme was deployed over a PostgreSQL/PostGIS 9.1. It was also created a scheme with different views for the simplification of the suitable information to be consumed by the thematic map server, as it will be explained ahead.

## 2.4 SOS Server Configuration and Implementation

In order to make possible the standardization and integration of data from environmental sensors a SOS server was

integrated in the current architecture of OTALEX SDI, taking into account the standard SWE (Sensor Web Enablement).

A 52 North server was implemented, as well as the implementation of a SOS client inside the Geoportal to display and query current and past sensors observations.

All datasets from sensors were not directly loaded into the database but through the SOS-T protocol.

The SOS-T protocol allows to abstract the process of the schema of the database, allowing keep the process, even changing the SOS or the database software of the system.

The last server release 3.x that supports SOS 2.0 and SOS 1.0 was installed.

The implementation of a SOS client inside the Geoportal to display and query the repository of environmental data was made by using the SOS OpenLayers client. This SOS client makes possible to add SOS servers and point layers over the map.

## 2.5 Transformation and Load of Data into the Main Repository

To load the heterogeneous data from sensors into the central repository PostgreSQL/PostGIS a self developed ETL(Extract Transform and Load) process were designed by using the open source GeoKettle project.

On the other hand, other processes were developed for scrapping of data in HTML format.

The results of both processes were inserted into the database through HTTP requests to the SOS server.

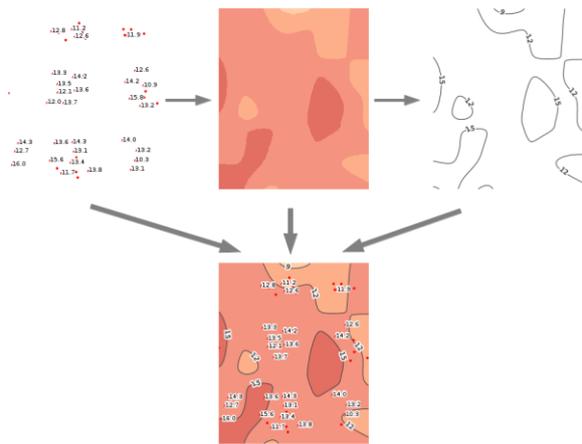
## 2.6 Thematic Maps Publishing

The OTALEX-C project uses GeoServer to publish cartography, through OGC services. Two new features of this server were used:

- SQL Views [1]: The traditional way to access database data is to configure layers against either tables or views. With this feature, layers can also be defined as SQL Views. These SQL Views allow to execute a custom SQL query on each request to the layer.
- Rendering Transformations [2]: They are invoked within SLD styles. Parameters may be supplied to control the appearance of the output. The rendered output for the layer is produced by applying the styling rules and symbolizers in the SLD to the result of transformation.  
There are three processes supported: Heat maps creation, Barnes Interpolation [3] and contour lines extraction from a raster.

In OTALEX, these two features enabled to create maps of interpolation from a layer of points with the environmental data. A second style links the interpolation with the contour lines.

Figure 2: Styles Composition with rendered transformations



Source: <http://www.ideotalex.eu/geonetwork/>

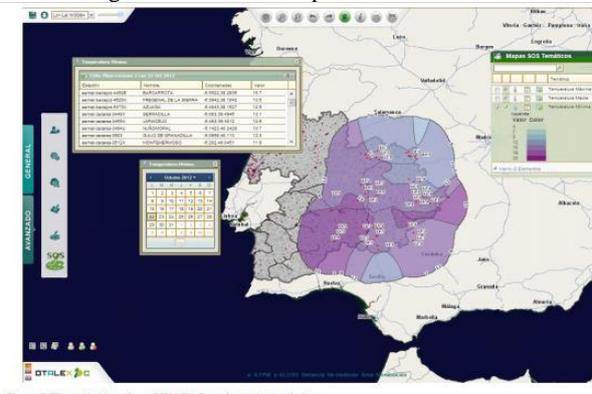
### 3 Conclusions

Some of the main conclusions obtained along the development of this project were:

- The information from sensors should be published by using structured and consistent formats in order to have the possibility to integrate them and to share between different organizations. It's desirable to achieve the Open Data 4th level [4] for published sensor data.
- The use of SWE standards and protocols allows to integrate environmental information from heterogeneous data sensors, making possible the study of the reality of the territory

Source: OTALEX IDE website : [www.ideotalex.eu](http://www.ideotalex.eu)

Figure 3: Thematic Maps in OTALEX-C



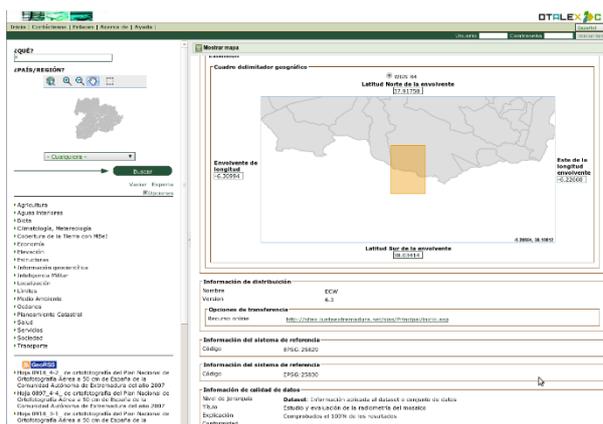
Source: OTALEX IDE website : [www.ideotalex.eu](http://www.ideotalex.eu)

### 2.7 Metadata of SOS and WMS Services Creation

The SOS and the WMS services were included into the Metadata Catalogue of OTALEX. Thereby these services are available for its query through OTALEX SDI.

The metadata of these both services were created by using GeoNetwork and published by using the CSW protocol.

Figure 4: Metadata Catalogue in OTALEX



### References

- [1] Geoserver, Working by databases/SQLViews: <http://docs.geoserver.org/stable/en/user/data/database/sqlview.html>
- [2] Geoserver, Rendering Transformations: <http://docs.geoserver.org/stable/en/user/styling/sld-extensions/rendering-transform.html>
- [3] Barnes, Stanley L.(1964) A Technique for Maximizing Details in Numerical Weather Map Analysis. J. Appl. Meteor., 3, 396-409,1964.doi:[http://dx.doi.org/10.1175/1520-0450\(1964\)003<0396:ATFMDI>2.0.CO;2](http://dx.doi.org/10.1175/1520-0450(1964)003<0396:ATFMDI>2.0.CO;2)
- [4] Tim Berners Lee (2006), Linked Data: <http://www.w3.org/DesignIssues/LinkedData.html>