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**MeteoRuta: An interactive weather forecasting WEBGIS for roads in Spain**

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**Subject: road weather information systems**

## **ABSTRACT**

An interactive weather forecasting WEBGIS has been developed by AEMET. The system uses HTML5, pure javascript and OpenLayers 2.13 API on the browser side, and compiled ANSI C and C++ coded programs on the server side. The server is accessed using the "XMLHttpRequest" object.

The application works in two different modes:

MODE 1, whole road-network viewer (<http://meteoruta.aemet.es>). Forecasts up to 36 hours of hourly severe traffic conditions are displayed using vector-polylines in different colours classified by the weather severity. The user can click on the road or any other place to get more information on weather conditions and evolution. Weather forecasting data are obtained from the operational AEMET-HARMONIE numerical model, running at 2.5 km resolution for the Iberian Peninsula and surroundings. Model runs 4 times a day (00, 06, 12 and 18 UTC) and is going to be updated up to 8 times a day this summer.

MODE 2, pathfinding mode, (<http://meteoruta2.aemet.es>). The user, from the client browser, may choose his own way from the starting point to the final point, and one optional intermediate point. Defining the departure time, the server returns a vector-polyline fitting the shortest path, with route directions, timetables and forecast weather conditions. The polyline is coloured according to the severity of the forecast. For the shortest path calculus we use our own implementation of OSRM (Open Source Routing Machine). The forecast is obtained from AEMET-HARMONIE numerical model and, after reaching its longest forecast, from ECMWF numerical model.

## **1. EXPLANATORY NOTE**

In order to illustrate our presentation in the 2016 SIRWEC Conference, we've made a "meteoruta" version for the US zone (Alaska and overseas territories have been excluded).

The links are: <http://meteoruta2.aemet.es/sirwec.html> & <http://meteoruta2.aemet.es/sirwecPATH.html>

Flashing warnings have been added to them both to show its "demo" nature.

The road network (only Principal roads used) was downloaded from "OpenStreetMap" [1].

The forecasts are downloaded, every 12 hours from NOAA – NCEP NAM model [2]:

<http://www.nco.ncep.noaa.gov/pmb/products/nam/>

## **2. THE APPLICATION**

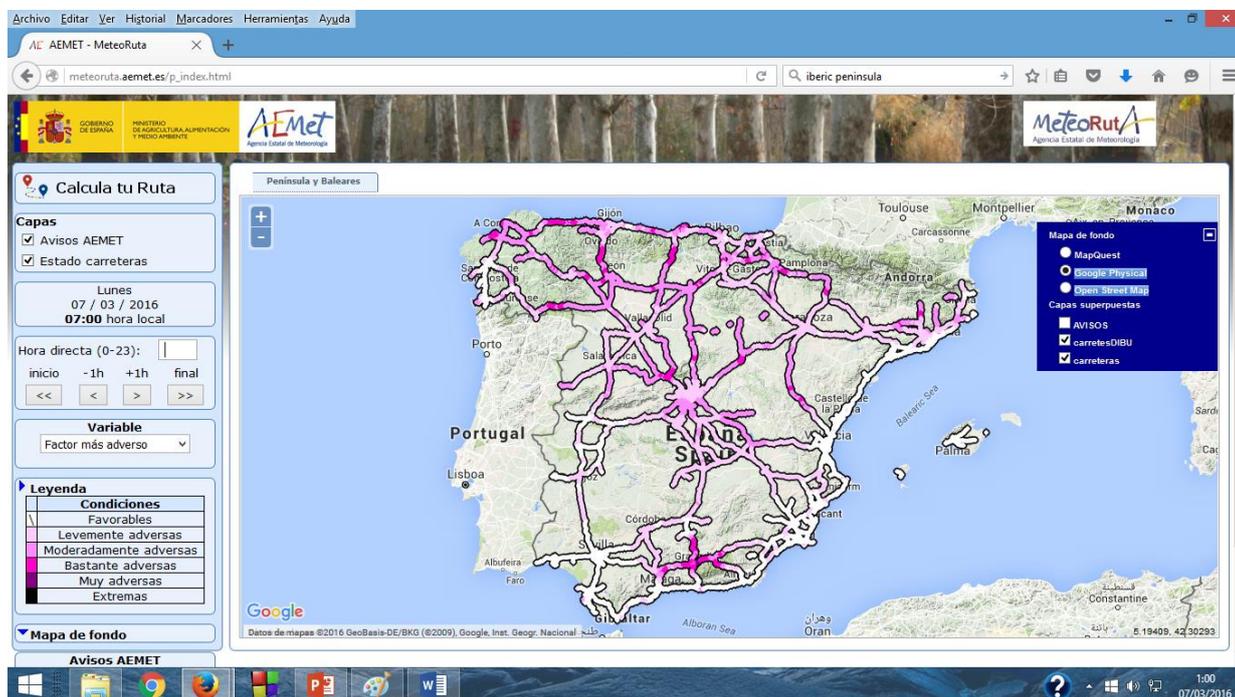
Works in two different modes:

MODE 1, whole road-network viewer, forecasts up to 36 hours for periods of one hour of severe traffic conditions are displayed using polylines in different colours classified by the weather severity.

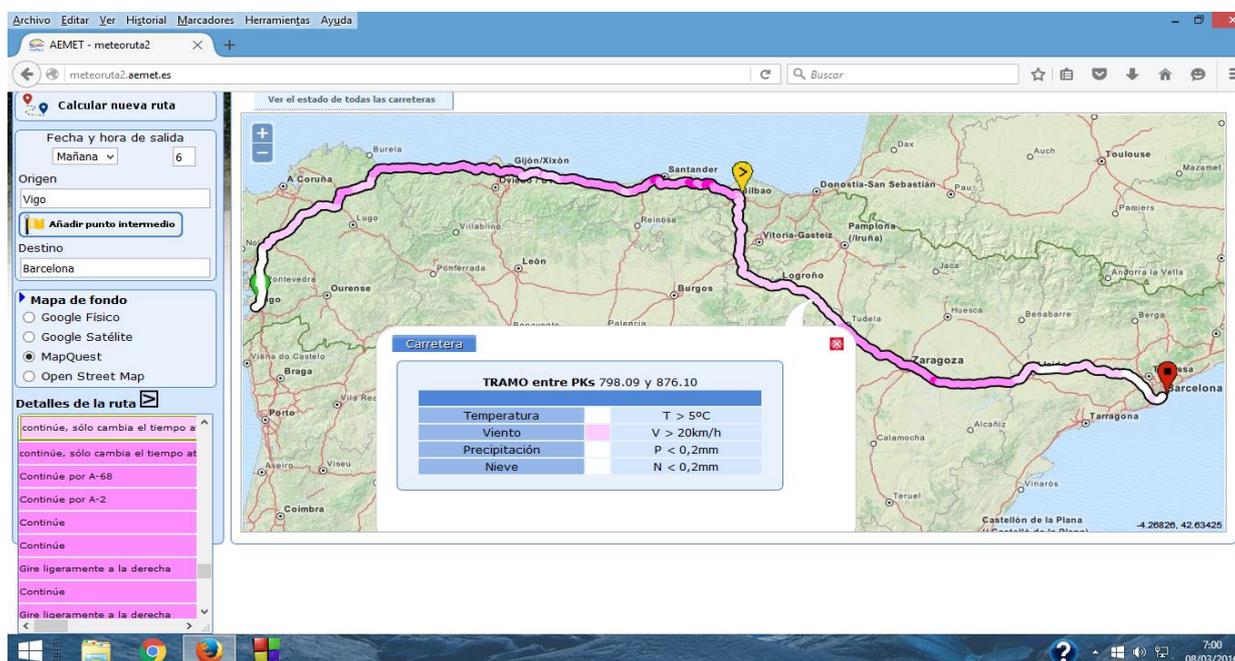
Variables such as air and soil Temperature, wind average, wind gust, visibility, rain and snow, can be displayed alone or combined all.

For low zoom levels only highways are displayed, as the user moves to closer zoom levels , principal and secondary roads appears.

The user can click on the road or any other place to get more information on weather conditions and evolution.



MODE 2, pathfinding mode, the user, from the client browser, may choose his own way from the starting point to the final point, and one optional intermediate point. Defining the departure time, the server returns a vector-polyline fitting the shortest path, with route directions, timetables and forecast weather conditions.



### 3. WEBGIS COMPUTING TECHNOLOGY

#### 3.1 BROWSER SIDE

Javascript open-source library OPENLAYERS 2.13 API [3] is used for displaying maps, in both modes. Openlayers library allows the use of any map provider or technology, and an excellent performance and extendibility.

Roads are requested using AJAX object, and served in real time in response to “move end”, pan and zoom events, or in response to any change in variables, time or route selected.

#### 3.2 SERVER SIDE

For both modes, we can use any html server technology; we have chosen Apache2 because of its maturity and documentation.

The key factor to save processing time, furthermore the use of compiled ANSI C coded programs, is the use of binary databases and shared memory.

##### 3.2.1 Road-network viewer mode:

Roads can be sent to the browser using vector or image format depending on the number of features.

Only for small bounding boxes, and high zoom levels, vector polylines is the best option.

Because of the increasing number of potential smart-phones clients and to avoid client browser memory overload, for future versions we will use only image polylines. In addition, we will maintain a vector version to be used only for roads authorities and professional clients.

The vector and image polylines can be sent through our own-programmed software or using OGC WFS/WMS standard software.

As is shown in the below benchmark images, both options have a similar performance and scalability.

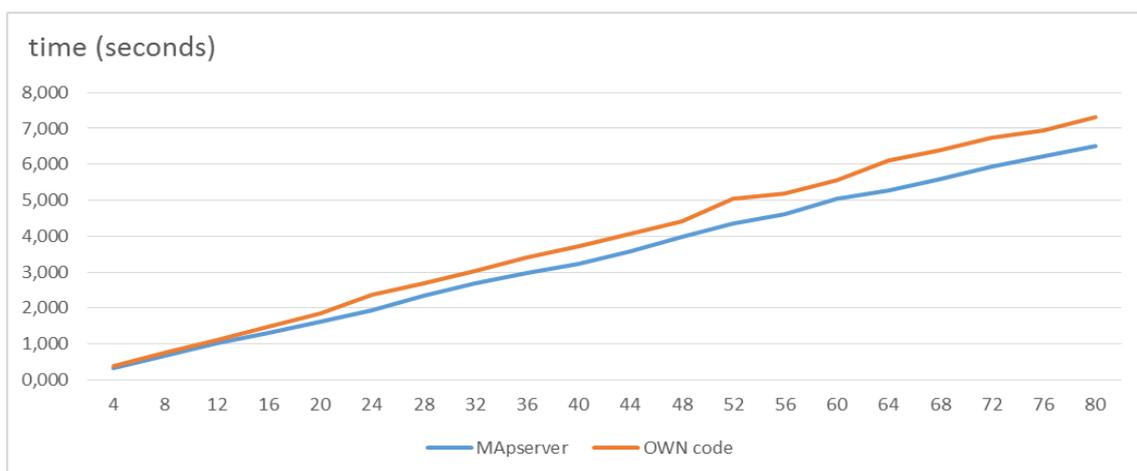


Fig 1: Accumulated response time - queued requests

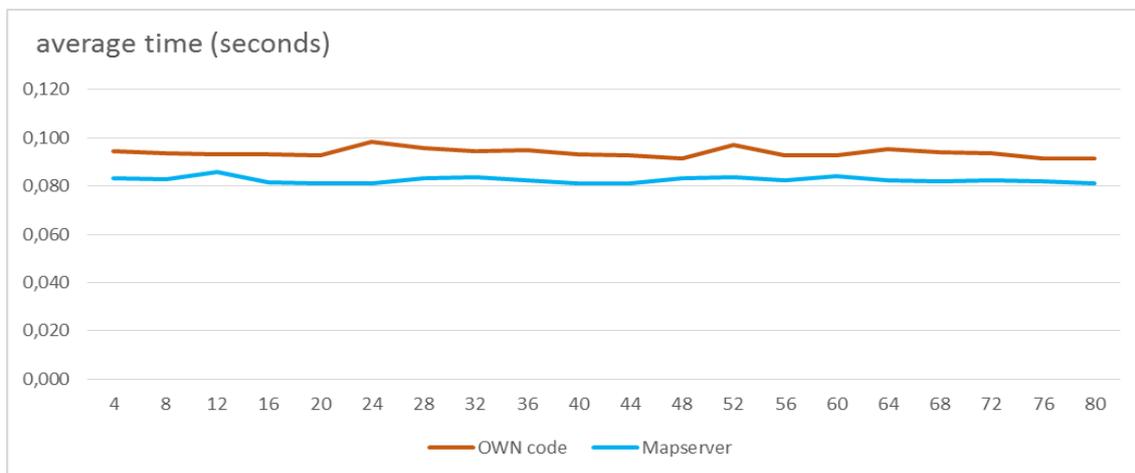


Fig 2: Average response time - queued requests

### **3.2.2 Pathfinding mode:**

We have been using both, our own coded programs (using Dijkstra or A\* algorithms) and free software like Routino [4], Gosmore [5] or OSRM [6]. Eventually we have adopt OSRM because of its better performance.

OSRM uses the “contraction hierarchies” method, which consists in the use of bidirectional Dijkstra's algorithm, in a previous step, preprocessing original graphs to build multi-layered node hierarchies with precomputed shortcuts.

The route found, along with forecast information, is sent to the client browser using geojson vector format.

## **4. NUMERICAL MODEL**

Weather forecasting fields are obtained from the operational AEMET-HARMONIE [7], numerical non-hydrostatic spectral model, running at 2.5 km resolution for the Iberian Peninsula and surroundings. Model runs 4 times a day (00, 06, 12 and 18 UTC) and is going to be updated up to 8 times a day this summer.

Physics of the model is an adaptation of the research model Meso-NH. It includes a sophisticated microphysics (ICE3) using three variables for precipitation (rain, snow and graupel).

Surface processes are based on the ISBA scheme for tesserae soil-vegetation and TEB scheme for urban land.

## **5. CONCLUSIONS**

This new tool is being used by the Spanish Road Authorities to include weather forecasting in their contingency daily operations.

The tool can be easily adapted to be used in any country or region, and it can obtain the weather information from any forecast model.

We are developing a new branch with present weather information (automatic stations, radar, satellite and lightning) and real time traffic information.

## 6. REFERENCES

- [1] OSM , OpenStreetMap, the project that creates and distributes free geographic data for the world, <http://www.openstreetmap.org>
- [2] NOAA NCEP, National Weather Service, National Oceanic and Atmospheric Administration, National Centers for Environmental Prediction:  
<http://www.ncep.noaa.gov>,  
<http://www.nco.ncep.noaa.gov/pmb/products/nam/>
- [3] Openlayers, high-performance feature-packed library for mapping, <http://www.openlayers.org>
- [4] Routino : Router for OpenStreetMap Data , <http://www.routino.org>
- [5] Gosmore is a router and viewer of OSM XML data, <http://wiki.openstreetmap.org/wiki/Gosmore>
- [6] OSRM, Open Source Routing Machine, Modern C++ routing engine for shortest paths in road networks, <http://project-osrm.org>
- [7] HARMONIE numerical model, <http://hirlam.org/index.php/hirlam-programme-53/general-model-description/mesoscale-harmonie>