



## **CALIOPE: An operational air quality forecasting system for the Iberian Peninsula, Balearic Islands and Canary Islands**

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According to recent studies of the European Environmental Agency, air pollution is the environmental factor with the greatest impact on health in Europe and is responsible for the largest burden of environment-related disease. Recent estimates indicate that 20 million Europeans suffer from respiratory problems every day. Particulate matter and especially small particles with a diameter less than 2.5 micrometers (PM<sub>2.5</sub>) are associated with increased mortality, especially from cardiovascular and cardiopulmonary diseases. The societal cost of asthma has been estimated at 3 billion euro per year. Clearly, asthmatic persons, and particularly asthmatic children, are sensitive to air quality and several studies show a strong association between exposure to air pollution and the aggravation of asthma.

In Europe, the mother Directive 1996/62/EC on air quality establishes the basic principles of a European common strategy to set the air quality objectives to avoid, prevent or reduce the harmful effects on the health and the environment. One of the topics in which the European Commission has shown a greater concern is the necessity of developing actions that allow increasing the knowledge on transport and dynamics of pollutants to assure the accomplishment of legislation and to inform the population about the levels of pollutants, especially before 2010, date when the Directive 1999/30/EC (setting the thresholds for particulate matter) comes into effect. The regulation is especially demanding when the threshold levels are exceeded. In this case, it demands a detailed diagnosis of those areas where the exceedances are found and a forecast of the evolution of ground-level concentrations. Namely, the directive establishes, in its articles 4 and 6, the possibility of using modelling techniques to assess air quality.

In this context, the CALIOPE project has as main objective to establish an air quality forecasting system for Spain coordinated by the Spanish Ministry of the Environment through funded project 441/2006/3-12.1, delivering air-quality related products useful to a wide range of users for reducing the impacts of air pollution on human health. A partnership of four research institutions composes the CALIOPE project: the Barcelona Supercomputing Center (BSC), the CIEMAT, the Earth Sciences Institute 'Jaume Almera' (IJA-CSIC) and the CEAM Foundation. This consortium will deal with both operational and scientific aspects related to air quality monitoring and forecasting.

The contribution will be devoted to present the activities performed under the CALIOPE umbrella; that is, the development, implementation and validation of an integrated air quality modelling system with a high resolution (spatial resolution of 12 km for Europe and 4 km for Spain, with nesting to 1 km to the cities of Madrid and Barcelona; and temporal resolution of 1 hour), formed by a set of models taking into account both anthropogenic and natural pollution. These models are the WRF-ARW meteorological model; the HERMES emission model; the CMAQ and CHIMERE chemistry transport model; and DREAM natural dust model.

The HERMES emission model has been specifically developed as a high-resolution emission model for Spain under a GIS framework. The emission model focuses in the estimation of gas and particulate matter pollutants, including the ozone precursors and using a high spatial and temporal resolution for Spain. The land has been divided in cells of 1 km<sup>2</sup>. For that the model uses land-use information (CORINE Land Cover Map of high resolution, 100 m, population density, industrial location, etc.). The emission model includes biogenic and anthropogenic (on-road, ship and planes traffic, airports and ports, industrial sectors, power generation, domestic and commercial) and it

is essential when providing data to the air quality models on a hourly, daily, monthly and annual basis.

The model qualitative and quantitative verification studies performed so far for a reference year (2004) using data from observation networks provided by IJA-CSIC and CEAM have outlined the good skills of the CMAQ and CHIMERE models (operated by BSC-CNS and CIEMAT) concerning the concentrations of gaseous pollutants and aerosols in Spain. The initial state of the system is based on the BSC air quality forecasting system, which provides daily forecasts for Europe and the Iberian Peninsula (<http://www.bsc.es/projects/earthscience/aqforecast-en/>). The fast-track development, testing and implementation of the initial operational capability result from close co-operation among BSC, CIEMAT, IJA-CSIC and CEAM. The improvement of the resolution achieved with CALIOPE project in the whole region will serve as a standard tool, for public and private, state and local forecasters who provide tailored forecasts for their communities, and will allow taking preventive measures to safeguard human health.

Also, it should be highlighted that the CALIOPE system is useful to complement the data obtained in the present networks of air quality measurements managed by regional and local authorities, and in certain experimental measurement campaigns or air quality studies performed both in urban or background areas. The results of the CALIOPE system will allow a better level of information for the citizenship related to the forecasting of air quality.