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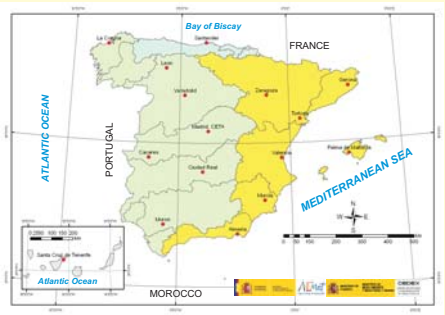
# Contribution of the Spanish Network for Isotopes in Precipitation and related modeling activities to characterize water bodies and their evolution

J. Rodríguez-Arévalo[a], S. Castaño[b], M.F. Díaz-Teijeiro[a]

[a]Centro de Estudios y Experimentación de Obras Públicas (CEDEX), [b]Geological Survey of Spain (IGME)

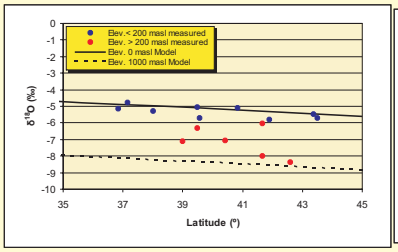


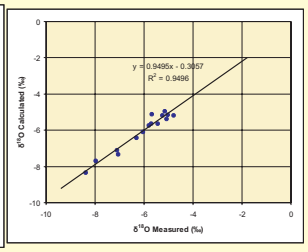

## REVIP NETWORK

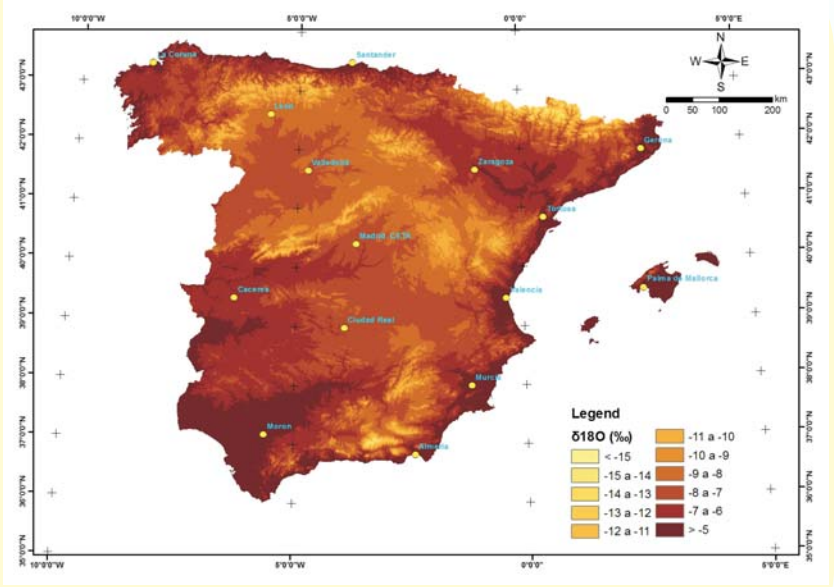
A database has been built that compiles systematic isotope information from composite monthly samples of precipitation collected in the Spanish Network for Isotopes in Precipitation (REVIP). REVIP is operative and managed since 2000 by the Centro de Estudios y Experimentación de Obras Públicas (CEDEX) in collaboration with the Agencia Estatal de Meteorología (AEMET). It consists of 16 meteorological stations located in continental Spain and in Balearic and Canary islands. REVIP is part of the Global Network for Isotopes in Precipitation (GNIP), managed by the International Atomic Energy Agency (IAEA), in cooperation with the World Meteorological Organization (WMO).
REVIP data are being treated by CEDEX and IGME in order to establish the spatial and temporal isotope distribution in Spain for both research and water management purposes.

## MODELING THE ISOTOPE DISTRIBUTION IN PRECIPITATION

$\delta^{18}O$ monthly values were used to derive amount-weighted mean annual $\delta^{18}O$ for each REVIP station. These values are controlled by distillation of atmospheric vapor, driven primarily by changes in air-mass temperature. The main geographical and climate factors that control temperature were used to predict $\delta^{18}O$ observed values. As a result, the spatial distribution of $\delta^{18}O$ in precipitation over Spain has been explained by a simple multiple regression model, based on two geographic factors: latitude and elevation. Using GIS tools, a continuous digital map of the $\delta^{18}O$ distribution in Spain has been generated that reproduces closely the observed $\delta^{18}O$ values.



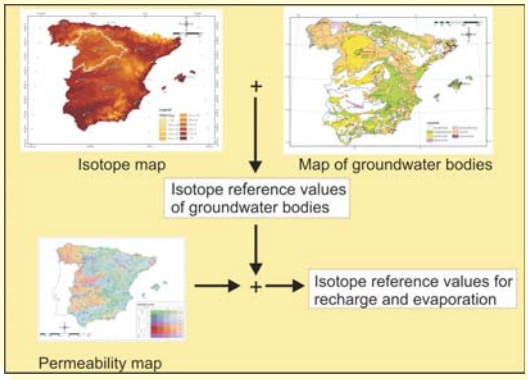



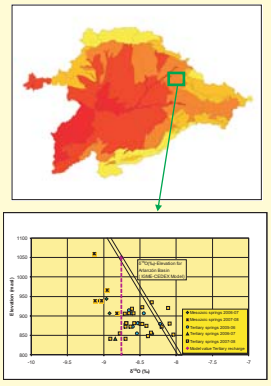

## APPLYING THE MODEL

Comparison of the modeled isotope values with isotope data of surface and ground waters from different case studies in Spain, covering a set of geographic and climatic situations, has been attempted in order to test the model and its application in hydrology. The results obtained so far show a good fit between modeled and measured stable isotope values, and are promising to help in the implementation of the Water Framework Directive.
The model provides integrated isotope values for precipitation, useful to trace the origin of water in surface and groundwater bodies, and may help to understand the stability or the evolution of these values and serve as an indicator of the causes of natural trends or man-made deviations.

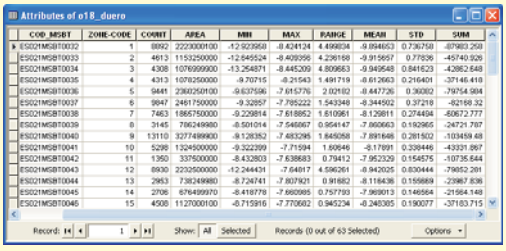
### Example for the Duero Basin (Central Spain)

An example was performed for the Duero Basin in which isotope reference values were obtained combining the $\delta^{18}O$ map with the maps for permeability and groundwater bodies, by means of GIS tools.



Groundwater bodies isotope reference values for Duero Basin

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