Study of Water Reservoirs at Different Hydrological and Climatic Systems in Spain Based on a Map of Isotopic Distribution in Precipitation

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9th ISEG International Symposium on Environmental Geochemistry Aveiro'12 | Portugal

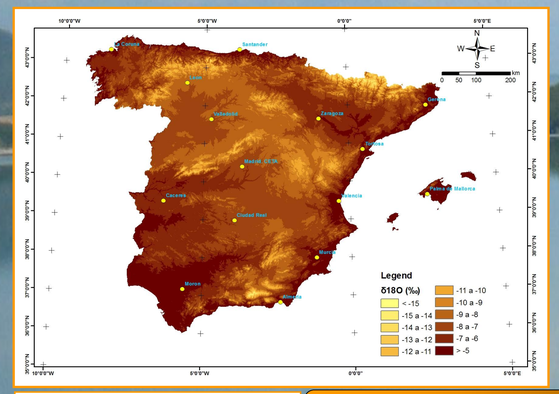
OBJECTIVES

This paper presents a methodology that puts into practice the model of the spatial distribution of $\delta^{18}O$ in precipitation over Spain, to determine the isotopic composition of water reservoirs and their river basins. This is meant to:

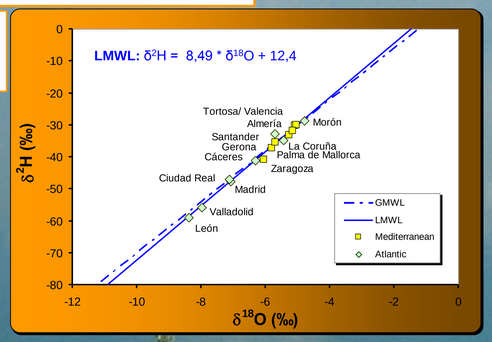
1) help identify factors that regulate the isotopic composition in water reservoirs from different hydrological and climatic systems within the country;
2) improve on the understanding of the water budget, by defining a more precise evaporation line at the selected sites and;
3) provide $\delta^{18}O$ referenced values to be used on hydrological studies of lakes and water reservoirs.

REVIP NETWORK/ MAP OF ISOTOPIC DISTRIBUTION IN PRECIPITATION IN SPAIN

Data collected from the Spanish Network for Isotopes in Precipitation (REVIP), during the time period that runs between 2000-2006, has allowed for a continuous digital map of the $\delta^{18}O$ distribution in precipitation over the Peninsular Spain to be performed (Díaz-Teijeiro, 2009; Rodríguez-Arévalo et al., 2012). This map is based on a multiple regression model depending on two geographic factors: latitude and elevation. Nowadays, the *Centro de Experimentación y Obras Públicas* (CEDEX) investigates on the possibilities that offers a map to provide $\delta^{18}O$ reference values that could be used on studies of surface hydrology and, in particular, on water reservoirs.



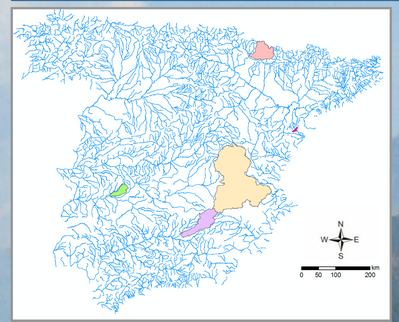
Digital map of $\delta^{18}O$ distribution in precipitation in Spain and the REVIP network, excluding Santa Cruz de Tenerife station.



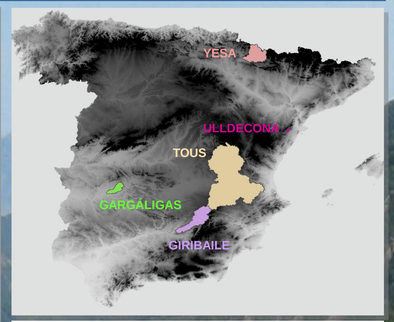
ISOTOPIC STUDY OF WATER RESERVOIRS

The methodology followed consisted on:

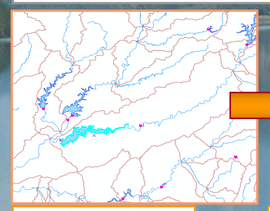
a) Selection of water reservoirs in order to have a wide representation of the geographic-climatic and physical variability present in Spain. These are: Yesa (Zaragoza), Tous (Valencia), Ulldecona (Castellón), Gargáligas (Badajoz) and Giribaile (Jaén).
b) Characterization of the isotopic content (Deuterium and Oxygen-18) observed in the selected water reservoirs, relative to the Local Meteoric Water Line (LMWL) of the Peninsular Spain and Balearic Islands.
c) Comparison between the observed isotopic content of different water reservoirs with the mean value of $\delta^{18}O$ in precipitation over their watersheds, calculated by the use of GIS tools.



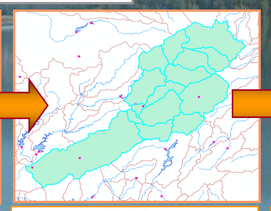
Selection of the watersheds corresponding to five water reservoirs, over a GIS layer showing the fluvial systems of Spain.



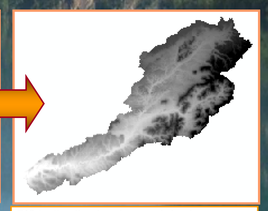
Map of $\delta^{18}O$ distribution in precipitation in Spain over which the areas of the five watersheds are "cut out" to determine the mean value of $\delta^{18}O$.



Giribaile´s water reservoir.



Selection of Giribaile´s watersheds .



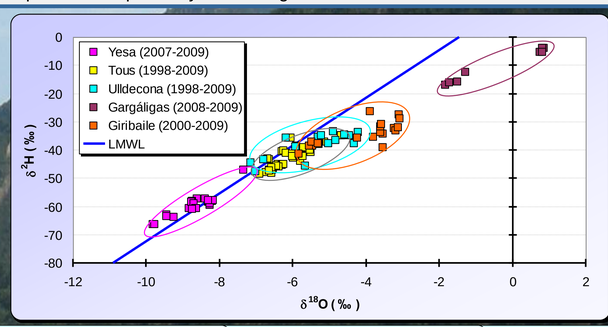
$\delta^{18}O$ distribution in precipitation over the area of Giribaile´s watersheds.

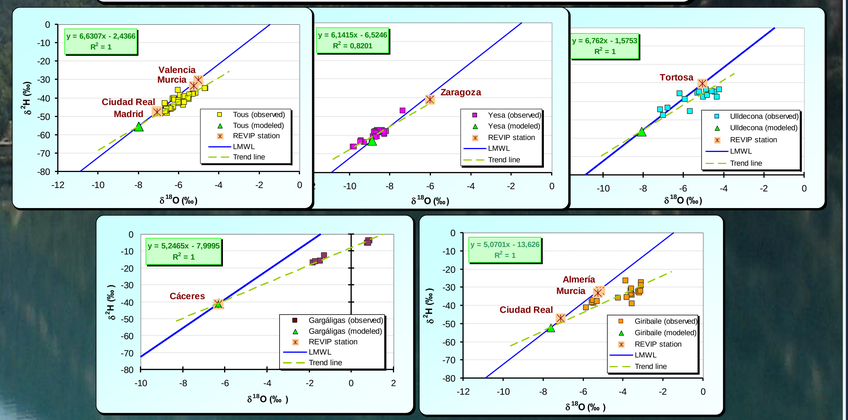
RESULTS

The isotopic fingerprint reveals evaporation processes taking place in most of the water reservoirs studied in Spain, specially that of Gargáligas.

Isotopic data from REVIP stations show $\delta^{18}O$ values in precipitation heavier than those of the reservoirs, except at Gargáligas. This is due to the effect of altitude differences between REVIP stations and the areas of meteoric water source in the studied sites.

A new evaporation line is determined when using as a reference, the mean value calculated with the continuous map of $\delta^{18}O$ in precipitation, over each of the watersheds studied. This line helps to define precisely the tracing of the meteoric water source.





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Rodríguez-Arévalo, J.; Díaz-Teijeiro, M.F.; Castaño, S., 2012 [IAEA, in press]. *Modelling and mapping oxygen-18 isotope composition of precipitation in Spain for hydrologic and climatic applications.*

Acknowledgements : This work has been performed in the framework of the MICINN Project CGL2009-12977 of the Spanish R&D Programme 2008-2011.

CONCLUSIONS

- REVIP´s network contributes to elaborate models and maps of the isotopic distribution of precipitacion over the Peninsular Spain that may be put into practice on hydrological studies of lakes and water reservoirs.
- Evaporation is clearly more significant at those water reservoirs whose river basins are mainly under the influence of warm and dry summer's climate, specifically at those where the residence time of water is longer, in the order of several years.
- The methodology used allows characterizing the isotopic content of oxygen-18 in the precipitation that gives start to the water contribution into the dam.
- Reference isotopic values obtained through this methodology may be used on dam leakage studies and water balances, specially at those sites where there is a lack of previous isotopic information.