MAPPING ENVIRONMENTAL TRITIUM ACTIVITY CONCENTRATION IN RECENT PRECIPITATION IN SPAIN TO TRACE MOISTURE SOURCES FOR THE HYDROLOGIC CYCLE

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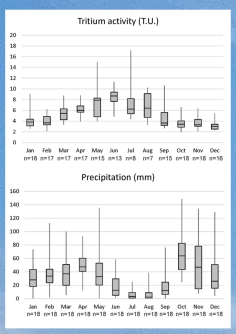
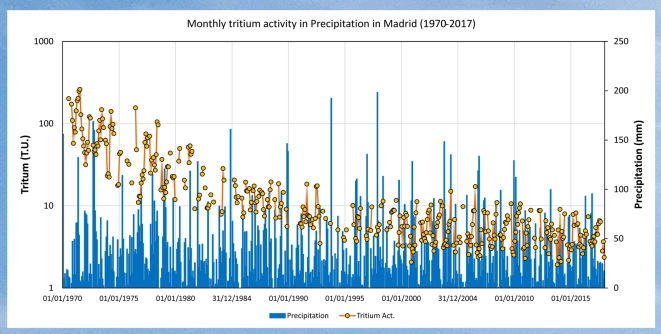
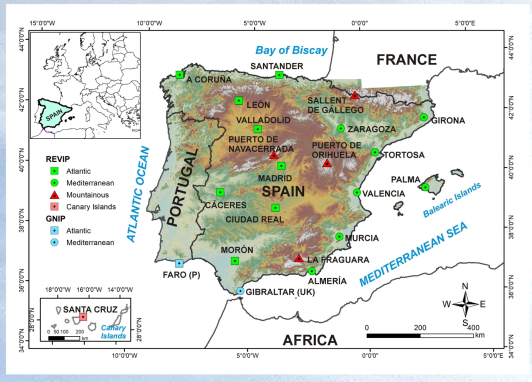
The Spanish Network of Isotopes in Precipitation (REVIP), measures $\delta^{18}O$, $\delta^{2}H$ (IRMS) and ^{3}H activity (electrolytic enrichment and LSC) since 2000.

REVIP comprises 20 monitoring stations managed by CEDEX and the Spanish Meteorological Agency (AEMET). It is integrated in the GNIP (Global Network Isotopes in Precipitation).



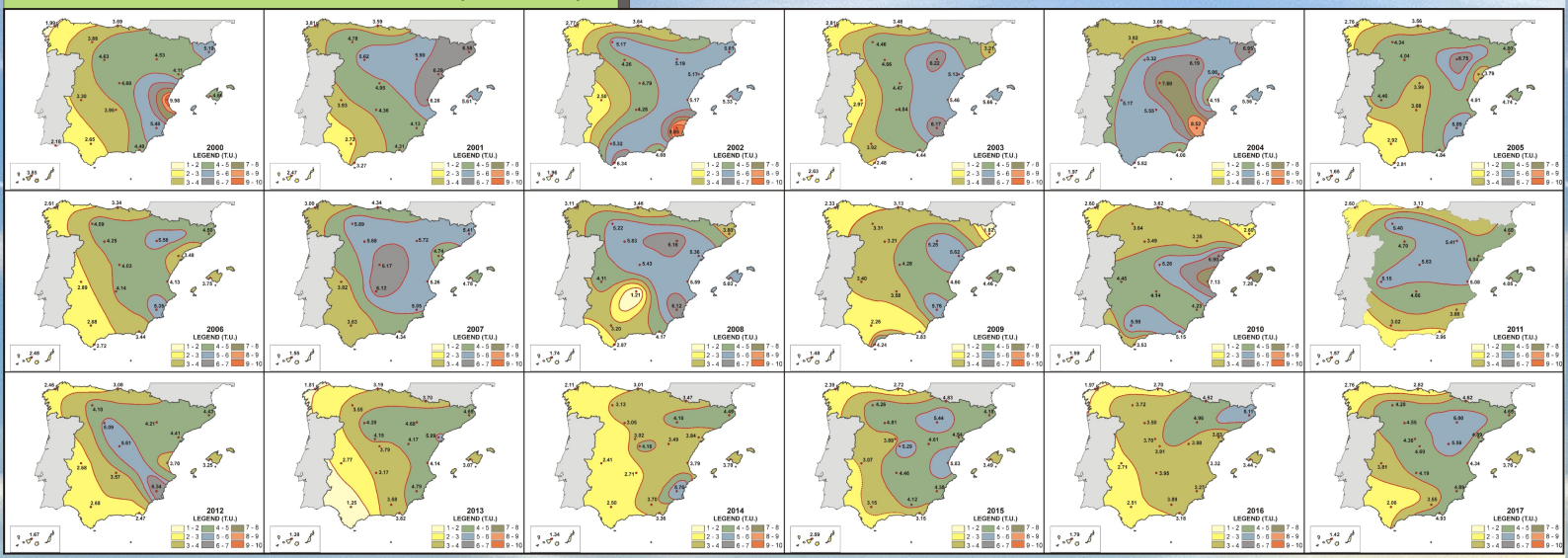


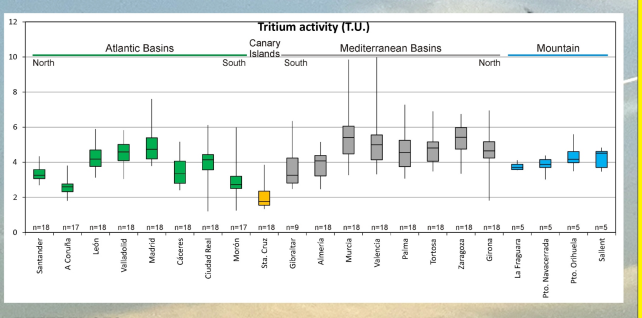


Composite yearly samples for ^{3}H in all stations, except Madrid (sampled monthly).

^{3}H activity has decreased to natural levels of cosmic production. Seasonallity is observed, with the highest values in spring-summer.

ANNUAL TRITIUM ACTIVITY IN SPAIN (2000-2017)





Maps and box-plots show a regional trend of ^{3}H contents. The highest values are found inland and at the Eastern part of the Iberian plateau, due to:

1) recycling of water vapour in the Iberian microcontinent;

2) predominant stratiform and convective precipitation, in the W and E of the Peninsula, respectively.

Orographic precipitation homogenizes ^{3}H values in the mountainous stations.

^{3}H data help to trace runoff, date groundwater and provide natural background of ^{3}H for radiological quality of drinking-water provided that the same assay method is used (AMD: 0.5 Bq/l = 0.42 T.U.)

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RODRÍGUEZ-ARÉVALO, J., DÍAZ-TEIJEIRO, M.F., CASTAÑO, S. Modelling and mapping oxygen-18 isotope composition of precipitation in Spain for hydrologic and climatic applications. In I*sotopes in Hydrology, Marine Ecosystems and Climate Change Studies Proceedings of an International Symposium, Monaco. Vol. 1.* IAEA (2011) 171–177.

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MAPPING ENVIRONMENTAL TRITIUM ACTIVITY CONCENTRATION IN RECENT PRECIPITATION IN SPAIN TO TRACE MOISTURE SOURCES IN THE HYDROLOGICAL CYCLE

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Abstract: Maps of ^{3}H activity concentration in recent precipitation in Spain complement the information provided by stable isotopes to trace the hydrologic cycle. These maps reveal the importance of water vapor recycling (evaporation and/or transpiration) in Peninsular Spain. They also show the potential influence of the different types of precipitation: i) frontal and/or convective, which dominate the Western and Easternmost parts of the Peninsula, respectively; and ii) orographic, which gives a different isotopic signature to the hydrologic cycle in geographical areas located at elevations greater than 1,000 m.

1. INTRODUCTION

Since 2000, the Centre for Studies and Experiments in Public Works (CEDEX) manages, in collaboration with the State Meteorological Agency (AEMET), the Spanish Network of Isotopes in Precipitation (REVIP). REVIP is integrated in the Global Network of Isotopes in Precipitation (GNIP of IAEA and WMO), and it is composed of 20 monitoring stations for composite monthly sampling of precipitation in the Spain, measuring $\delta^{18}O$, $\delta^{2}H$ and tritium. GNIP information has been widely used for water management purposes to define water provenance (stable isotopes) and estimate residence time (tritium). However, spatial distribution of tritium activity concentration in precipitation has been scarcely used. The potential of continuous maps of tritium in climate and hydrology is explored in this paper.

2. METHODS

Tritium contents are obtained from monthly samples for the Madrid station (Central Spain) and composite yearly samples for the rest of stations. Tritium assays are carried out through electrolytic enrichment and decay counting in a low-background liquid scintillation counting system. Seventeen maps of environmental tritium activity concentration in precipitation have been elaborated through inverse distance weighted interpolation (see the maps for 2000, 2007 and 2016 in Figure 1).

3. RESULTS

A general trend from lower to higher values of tritium concentration from W to E is observed over the Iberian Peninsula for the period 2000-2016. In several years, a dome is found in the center of the Iberian plateau. Most mountain stations show values of tritium concentration lower and more homogeneous, than those of the closest stations, located at a lower altitude. Tritium activity concentration in precipitation in the last two decades has reached the natural levels of cosmic production (Figure 1, map for 2016). Monthly values from the Madrid station (higher from May to August) show a seasonal variability (Figure 2). Tritium ejection from nuclear power plants into precipitation appears to be of a local character in Spain.

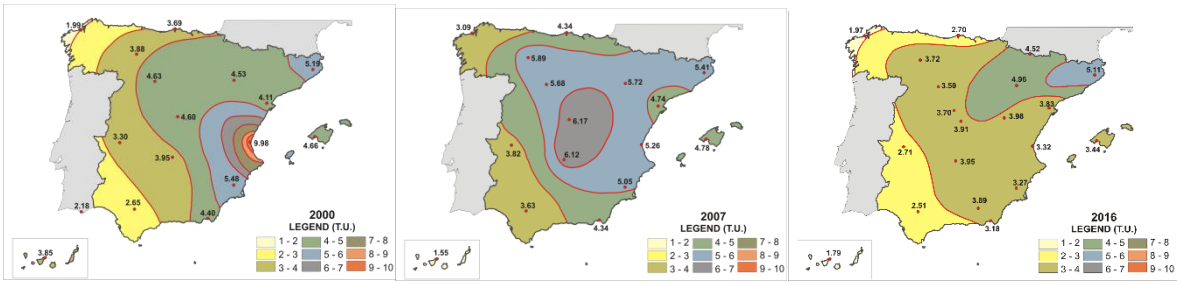

Figure 1. Examples of spatial distribution of activity concentration in precipitation in Spain.

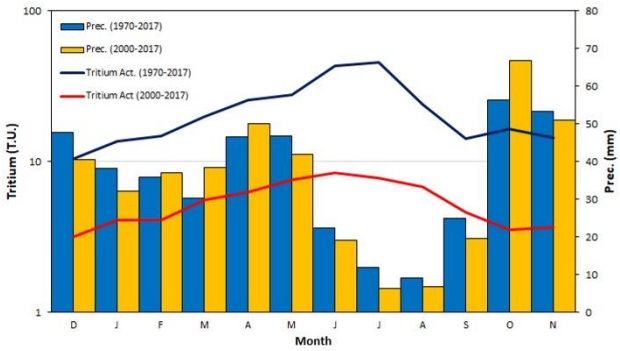

Figure 2. Average monthly values for precipitation and tritium activity concentration for the Madrid station for the period 2000-2016.

4. CONCLUSIONS

Maps of environmental tritium activity concentration in recent precipitation show a W to E trend from higher to lower values over the Iberian Peninsula for the period 2000-2016. This trend is coherent with the general atmospheric circulation model that originates precipitation in Spain, in which the westerlies and vapor from subtropical Atlantics are dominant [1]. Two main hypotheses could explain this pseudo-continental effect: i) water vapor recycling in the microcontinent of the Iberian Peninsula [2], and ii) the signature of the different types of precipitation (stratiform and convective) [3] that dominate the W and E of the Peninsula. In the mountain stations, orographic precipitation homogenizes tritium values. Seasonal variability observed in the Madrid station values reflects the effect of the tropopause changes during spring time [4].

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