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Transit time estimation using tritium and stable isotopes in a Mediterranean mountain catchment

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Water resources of Mediterranean regions mainly depend on runoff generated in mountain areas. Therefore, study of the time water spends travelling through Mediterranean mountains is important for water resources management as it reflects the ability of catchments to retain and release water. Natural isotopes (tritium and stable isotopes) have been used in different environments to quantify the ages of water within catchments. However, there are relatively few studies of water transit times in Mediterranean mountain regions. Additionally, tritium dating is more common in Southern Hemisphere streams because they were less affected by tritium produced mainly in the North Hemisphere by nuclear weapons testing in the 1950s and 60s.

With the aim of improving knowledge of the hydrological catchment functioning of Mediterranean mountain areas, this work estimates water transit times in spring water, groundwater and stream water using tritium and stable isotope (δ18O and δ2H) measurements in the Vallcebre Research Catchments (NE Spain, 42º 12'N, 1º 49'E). Tritium measurements from a previous study carried out in 1996-1998 (Herrmann et al., 1999) were supplemented by new samples collected on 3 November 2013. Difficulties with the age interpretation of the tritium measurements arise from the determination of the tritium input function, the different accuracies of the tritium measurements and the ambiguous ages resulting from past input of tritium from nuclear testing to the atmosphere. Water stable isotope samples were collected in rainfall, spring water, groundwater and streamwater at baseflow conditions every 15 days over a 27 month period. Detailed distributed hydrometric measurements (precipitation, potential evapotranspiration, discharge and water table level) were obtained during the same period.

Preliminary results using δ18O, δ2H and tritium show that mean transit times in the Cal Rodó catchment (4.2 km2) ranged between 1.3 and 11.6 years. The lowest mean transit time was observed in groundwater followed by stream water, while there were longer water retention times in springs. Analysing the spatial distribution of mean transit times using tritium, we observed a mix of different water ages at the catchment outflow. Two sub-catchments had mean water transit times shorter than the adjacent catchment area; this is attributed to differences in slopes and geologies of the areas.