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Oxygen-18 and deuterium spatio-temporal variability in throughfall and stemflow in Scots pine and Downy oaks forests under Mediterranean climate

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Rainfall partitioning processes can be better understood complementing classical hydrometric techniques with water isotopes. Oxygen-18 and deuterium can be used to shed some light on mechanisms of rainfall evaporation from the canopies, and their relationship with canopy and meteorological variables that are not completely understood. Several mechanisms have been described to explain the differences between event-scale bulk rainfall and throughfall isotopic compositions (i.e. evaporation, selective storage, exchange with ambient vapor, residual moisture), and their relation to factors like the amount of water held in the forest canopy, rainfall intensity, time interval between rainfall events, or meteorological conditions. However, there are much fewer studies examining the spatio-temporal variability of isotopic composition in both throughfall and stemflow along rainfall events.

This study aims to characterize the water stable isotopes spatio-temporal variability in throughfall and stemflow in a Downy oak (Quercus pubescens) and a Scots pine (Pinus sylvestris) forests located in the Vallcebre research catchments (NE Spain, 42º 12'N, 1º 49'E), under Mediterranean climate conditions. The isotopic sampling design of each stand consisted of one automatic sampler to sample the temporal variability of throughfall signature every 5 mm of rainfall, 10 throughfall collectors distributed within the stand to sample the spatial variability and 4 stemflow collectors. Bulk rainfall was collected with automatic samplers and bulk collectors in two open areas near each forest plot. At each stand isotopic sampling was combined with hydrometric measurements that consisted of 20 tipping buckets to measure throughfall spatial variability and 7 stemflow rings connected to tipping buckets to measure stemflow depth. Moreover, rainfall depth was measured in the open areas and meteorological variables in two towers located above canopies. The study started on May 2015 and is still in progress. Up to now, a total of 1235 samples, corresponding to 27 rainfall events, have been collected in the two stands and are being analysed by infrared spectroscopy.

First available results show the complexity of rainfall partitioning process and its spatial and temporal variability, as well as the high diversity of responses, depending on rainfall characteristics, canopy structure and meteorological conditions.