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Can drop characteristics explain differences in isotopic composition between open rainfall and throughfall?

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Throughfall is the major water input to forest soils. In spite of being a widely studied process, some gaps remain in our current knowledge about the factors and mechanisms controlling its dynamics. No known empirical research has focused on exploring relationships between rainfall/throughfall drop characteristics (diameter and velocity) and their isotopic composition (δ18O and δ2H). In order to investigate how these isotopic differences between throughfall and open rainfall were related to fractionation and mixing processes, we carried out a continuous monitoring of open rainfall and throughfall (tipping-buckets), drops characteristics (laser disdrometers), and isotopic composition, for several rainfall events of different magnitudes and intensities in a Scots Pine plot under Mediterranean conditions. With our set up, rainfall and throughfall passed through the laser disdrometers, at the same time were measured by the tipping-buckets and finally the water was collected by automatic samplers (at 5mm interval).
Preliminary finding show that throughfall median drop diameter (D50) was on average larger than for rainfall and drops mean velocity was slower than for rainfall. Throughfall samples were almost always more enriched than rainfall ones. Isotopic shift between throughfall and rainfall: i) decreased along the rainfall event, with increasing rainfall amount, and was lower when rainfall and throughfall samples volumes were more similar, and ii) increased in conditions with more and smaller throughfall drops. These preliminary findings will lead to a better conceptualization of rainfall partitioning processes.