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Hydrograph separation in headwater catchments of the Andes using water isotope composition

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Water isotopes have been used in hydrology for two purposes: 1) identify the age of water when it leaves a catchment, both for baseflow and for individual storms; and 2) identify the source of water that leaves the catchment during and after a precipitation event, (e.g. whether it comes from rain or from particular water reservoirs within the catchment). This knowledge has been used to understand the interactions between precipitation and catchments and as a proxy for the capacity of a catchment to store water and regulate its flow, which is particularly relevant for water managers.

This study has taken three small neighboring catchments and one sub-catchment in each of them containing a wetland, to analyze their baseflow and discharge response to rain events using TRANSEP. The objectives of this study are: 1) to compare the hydrological response of the six units to test the hypothesis that connected units of the landscape e.g. wetlands have a large influence on catchment yield; 2) to analyze the effect of land use on water yield during rain events; and 3) to analyze the effects of land use on baseflow.

Results indicate that for B1, the catchment with 68% of area in forest, discharge is predominantly quickflow (70%), whereas for the other two catchments, it comes from around 50% of both the quickflow reservoir and the persistent reservoir. The big influence from wetlands is seen in two results: 1) the higher proportion of baseflow discharge for BB, the catchment with a 6% of total area in wetlands, since wetlands could be contributing to groundwater recharge; 2) the mean transit time of water in BB, 172 days compared with 97 days for B1 (the forested catchment) and 28 days for B2 (the catchment with 69% in grasslands) influenced by the longer transit time for BBW and B2W. The larger proportion of discharge coming from the slow quickflow in wetlands B2 and BB, and their mean transit times, indicate that the water stored in wetlands, despite constituting surface storage, remains for a significant amount of time in the catchment. The small runoff coefficient of BB gives an idea of the storage capacity of this wetland relative to the other two wetlands studied.

Event analysis shows that the storage capacity of forests and soils under forests is higher, but during an event old water is pushed out of wetlands in a higher proportion than from riparian and natural forests.