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Short term and long term impact of vegetation recovery on seasonal streamflows

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Changes in stream flow due to changes in vegetation cover have been reported worldwide and it is commonly accepted that a decrease in annual water follows afforestation, and the opposite effect occurs when forests are converted into shorter vegetation or croplands. Besides the focus put on the changes in annual water yields, there is a growing interest in looking at the effects of afforestation on the seasonal pattern and duration of stream flows. This is important from an ecological point of view and for water resources management, especially in locations where seasonal water shortages are reported. Conclusions in this respect are not straight forward because of the complex relationships among water fluxes at sub-annual scale, especially the existing temporal lags between vegetation processes (evaporation and transpiration) and the soil water storage and water outflows.
Changes in stream flows due to afforestation have been mostly explained by changes in canopy interception and vegetation evapotranspiration. However, a land cover change also modifies other associated landscape characteristics such as soil properties or topography, especially when considering long-term impacts
In this study, we provide a quantitative analysis of the relative contribution of soils and vegetation to changes on stream flows in relation to vegetation recovery. This way we can assess the hydrological impact of short-term and long-term vegetation recovery. This is of special interest in order to assess the overall hydrological impact of natural re-vegetation of former agricultural land or deforested areas, and of reforestation programs. For this purpose, we use an approach based on hydrological data collected in two neighboring small catchments with similar topography but different land cover (abandoned land recolonized by shrubs and natural forest, respectively), and an advanced modeling approach based on the application of a process-based hydrological model. The two catchments are located in the Spanish Pyrenees, where vegetation recovery from abandoned agricultural land to natural shrubs and forest has taken place in most of the hillslopes.
Results show that in both catchments, the decrease in runoff is larger in the short term, i.e. when only vegetation cover is changed, than in the second part of the vegetation recovery process, when also soils are changed. For both catchments the reduction in discharge occurs mainly during the wetting-up period (form October to March) and the effect of vegetation recovery becomes less important as the catchment gets wetter. During the recession/drying-down period (from April to the end of the summer) the effect is almost negligible. Vegetation recovery causes an overall reduction of high, median and low flows, although low flows are the most affected. The impact is greater in the short term, when vegetation is changed from shrubs to forests. Zero-flows increase by more than 100 days in the short term and by more than 135 days in the long term, suggesting that vegetation recovery results in a significant drying up of the streams.