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Assessing the effect of natural and artificial re-vegetation on stream flow in the Spanish Pyrenees

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In the last century, most of the Mediterranean mountains areas, with a long history of farmland activities, have undergone a process of economic and demographic decline and land use extensification and abandonment. As a result, some hillslopes were artificially reforested whereas others were subject to secondary succession. At present, time span is sufficient to compare the hydrological response of naturally and artificially re-vegetated areas, a key issue to assess the impacts of restoration measures such as afforestation works. With this purpose, three neighboring small catchments were monitored in the Spanish Pyrenees: one catchment (2.8 km2) was extensively used for agriculture in the past and colonized with dense shrubs; another catchment (0.12 km2) was also cultivated in the past and afforested in the 60′s with P. sylvestris and P. nigra; the third catchment (0.9 km2) is covered by dense natural forest (P. sylvestris). In this study, we compared the stream flow response of the three catchments for the period 2007-2010 and we examined the differences between the stream flow hydrographs for a set of several floods that co-occurred in each catchment as a consequence of the same rainstorm. The naturally forested catchment was characterized by a dual behavior, with high flows only occurring in spring, under very wet conditions. In the naturally re-vegetated and the afforested catchments runoff was generated during the entire water year, although runoff coefficients tended to be lower in the latter. Peak flows were always higher in the naturally re-vegetated and the afforested catchments, suggesting the limited capacity of afforestation to control large floods. We suggest that differences in soil properties (e.g., depth, permeability), together with differences in vegetation cover, may explain the different hydrological behavior of the catchments.