Geophysical Research Abstracts
Vol. 15, EGU2013-5715, 2013
EGU General Assembly 2013

Assessing the relative effect of vegetation and soils on stream flow response in relation to vegetation recovery

Noemí Lana-Renault (1), Derek Karssenberg (2), M.Pilar Serrano (3), and Marc Bierkens (2)

(1) University of La Rioja, DCH, Physical Geography, Logroño, Spain (noemi-solange.lana-renault@unirioja.es), (2) Department of Physical Geography, Faculty of Geosciences, Utrecht University, Utrecht, The Netherlands, (3) Instituto Pirenaico de Ecología, CSIC, Zaragoza, Spain

The impact of land cover change on stream flows is an ongoing issue of interest for hydrologists but also land and water managers. It has been demonstrated worldwide that deforestation causes a short-term increase in water yields, while reforestation mostly results in a reduction in flows. Differences in the shape of the hydrograph have also been observed, usually with higher peak flows, faster response time and shorter recession limbs associated to deforestation. Changes in stream flow have been mostly explained by changes in vegetation and, surprisingly, fewer studies have considered the effect of changes in soil properties. Considering the soil-forest relationship and distinguishing the relative effects of these factors is a key issue, particularly for studying the long-term hydrological effects of vegetation recovery.

Here we used an approach based on hydrological data collected in two neighbouring small catchments with different land cover, and an advanced modelling approach, to investigate the relative effect of soils and vegetation on stream flow response related to forest establishment in previously cultivated areas.

Both catchments are located in the Spanish Pyrenees, where most of the hillslopes have been affected by land abandonment and subsequent vegetation recovery. One catchment (2.8 km2) was extensively used for agriculture in the past and at present is mainly covered by shrubs; the other catchment (0.9 km2) is covered by dense natural forest. Their similarity in terms of lithology and topography enabled us to separate the effects of soil and vegetation cover on their hydrological responses. For our modelling experiment, we used a process-based distributed hydrological model. First, we calibrated the model parameters using discharge data from the two catchments. With these calibrated parameters and observed meteorological drivers, runoff at the outlet of each catchment was simulated. Land cover was swapped between catchments and new runoff simulations were performed, using the same meteorological drivers. The separate effect of vegetation and soils was determined by analyzing the differences between the first simulation and the "swapped" scenarios. Two scenarios were investigated: i) only vegetation cover was swapped, and ii) both vegetation and soils were swapped. Results showed that changing only vegetation cover from shrubs to trees had a significant impact on annual water yield: the decrease in discharge was related to an increase in interception and evapotranspiration. Changing also soil properties, from abandoned farmland to forest, had a smaller impact on decreasing water yields; instead, changing soils mostly affected the shape of the hydrograph, with a tendency to lower peak flows and longer recession limbs, suggesting a change on water storage capacity and downslope water transfer.