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Modelling Species Effects on Carbon and Water Cycle Feedbacks in Mountain Catchments

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In the European Alps, forest cover is expected to increase in the future due to an increase in temperatures and land abandonment. This will lead to an increase in carbon storage capacity of Alpine catchments. At the same time, changes in vegetation cover will influence the water balance of the ecosystems by changing the evapotranspiration patterns and therefore also soil moisture content. This will have direct impacts on the local and regional weather conditions and on the run-off pattern of the catchments.

When soil moisture decreases below a threshold, observational evidence (Leuzinger et al. 2005) suggests that some tree species do save water by reducing evapotranspiration, while other tree species do not. These different water-saving strategies are expected to have an impact on evapotranspiration and thus the total water balance.

Here, we apply the ecosystem model LPJ-GUESS to evaluate the hypothesis that the establishment (by natural regeneration or planting) of water-saving tree species would change the climatic feedback potential of ecosystem in terms of the daily and annual water fluxes.

We implement the concept of tree species being characterized by different water saving strategies into LPJ-GUESS and applied the model at the catchment scale. We show that land use, i.e. land management as grassland or forest, is more important for the ecosystem water balance than considering different tree species within the forest. We discuss these results in view of the carbon storage capacities of the different management scenarios, showing the trade-off between the carbon sink potential of afforested areas and the change in evapotranspiration patterns.