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An approach for transient consideration of forest change in hydrological impact studies

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Abstract An approach for exploring the impacts of climate change on tree migration and on the natural water balance of two large Swiss catchments (Rhône and Ticino) has been developed. We run the spatio-temporal forest model TreeMig for the period 1400–2100 with climate input from observations and from the A1B Scenario ECHAM5-REMO (from the "ENSEMBLES"-Suite). We post-processed the outcomes of TreeMig concerning forest biomass and leaf-area-index (LAI) and modified the forest coverage and LAI used in the hydrological model PREVAH. Every fifth computational year, forest coverage and LAI have been updated. PREVAH has been recently used to assess climate change impacts on water resources for the whole of Switzerland for the control period 1980–2009 and for the scenario periods 2021–2050 and 2070–2099. Analyses show a degradation of forest for the 2070–2099 period in the lowest elevation ranges (<1200 m) as a result of increased drought stress. This results in lower LAI, reduced interception and increased discharge as compared to a baseline run without implementation of forest scenarios. For elevation ranges above 1500 m, TreeMig predicts higher biomasses and LAI. The simulated tree-line elevation might increase by up to 200 m. PREVAH computes in these areas higher evapotranspiration and less runoff as compared to the baseline run. Consideration of forest change yields in both areas changes in simulated discharge of –5 to –10 mm per year and changes in evapotranspiration of +5 to +10 mm per year. However, changes at specific elevation bands are up to four times higher.

Key words hydrological impact modelling; forest change scenarios; European Alps