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Climate change and water conservation effects on water availability and vegetation patterns in a stream valley

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Climate change predictions include an increase in global temperature and changes in precipitation patterns at spatial and seasonal scale. The seasonal changes for temperate Europe include a decrease in the amount of precipitation in summer and an increase in winter. This may lead to an increased flooding risk in winter and early spring, while in summer the drought risk is likely to increase. These hydrological changes can have profound effects on vegetation patterns and development, especially for groundwater dependent vegetation. Water conservation measures can be used to combat the potential negative effects of these changes. Conservation measures can include aquifer storage and recovery, damming streams, or creating retention zones for flooding events. The implementation of these measures can contribute to preserving groundwater dependent vegetation patterns. In this study we simulated with an integrated surface- and groundwater model and a climate robust vegetation model, the implementation of water conservation measures in a stream valley catchment in the Netherlands. We modeled the effects on water availability and on vegetation patterns. The conservation measures were simulated for the current climate and for two climate scenarios, with a temperature increase of two degrees Celsius and either an increase or decrease in precipitation. Water tables were increased in stream valley zones, where groundwater dependent vegetation dominates, to ensure suitable abiotic conditions. The results showed that the water conservation measures increased the water table considerably in a future climate, compared to no conservation measures. Groundwater dependent vegetation was positively stimulated with these new hydrological conditions. With these models we successfully tested the effectiveness of the water conservation measures on water availability and vegetation patterns to ameliorate the negative effects of climate change. We therefore argue that water conservation measures can contribute greatly to minimize the negative effects of climate change and are therefore essential to counteract the projected deterioration of groundwater dependent vegetation.