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Modeling hydrology and vegetation interaction in a changing climate

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The study provides a proof-of-concept framework to investigate the propagation of climate disturbances as inferred, for example, from General Circulation Models (GCM), through an eco-hydrologic system. When non-stationarity in the climate is considered, non-linear effects and feedbacks between hydrological processes and vegetation seasonality may arise. It becomes fundamental to understand and evaluate potential changes in surface energy fluxes, soil moisture dynamics, as well as vegetation productivity. A stochastic downscaling technique is developed in this study together with a weather generator to generate future climate scenarios. The weather generator is designed to reproduce climate statistics over a wide range of temporal scales, from high-frequency extremes, to low-frequency inter-annual variability. In simulating future climate, it includes the possibility to modify precipitation and temperature, on the basis of statistical information inferred from a GCM scenario. The weather generator simulates hourly variables as input to a novel eco-hydrological model. The hydrological model reproduces all essential components of hydrological cycle, resolving complete mass and energy budgets. The vegetation model parsimoniously parameterizes essential plant life-cycle processes, including photosynthesis, phenology, carbon allocation, and tissue turnover. In this study, hydrological states and vegetation response are examined for two scenarios of future climate in different climatic systems. Possible interaction between ecosystem and hydrological processes in a changing climate are discussed.