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Modelling coupled dynamics of water and vegetation in drylands under climate change

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In this study we investigate the impact of climate change on coupled water-vegetation dynamics of arid and semi-arid systems. Drylands worldwide are exposed to a highly variable environment and face a high risk of degradation. The effects of global climate change such as increased temperature or more variable precipitation will likely increase this risk. Thus, sustainable land use of these systems e.g. by livestock grazing requires careful planning and detailed knowledge of the system dynamics under climate change.

A suitable way to assess changing dynamics of highly complex systems is the development and application of simulation models. When simulating the vegetation of dryland systems it is essential to also consider water as the main driver of vegetation and to incorporate the key feedback mechanisms between these two components. To apply the model to various sites and to draw generic conclusions, parameter acquisition has to be feasible.

We addressed this task by developing a spatially explicit eco-hydrological model, which strikes a compromise between abstracting to keep its data needs low, and resolving processes where necessary. The water component of the model simulates daily moisture dynamics of two soil layers and surface water. Vertical water movement between these layers, as well as redistribution of surface water by runoff are taken into account. Vegetation is modelled by the growth of two functional types, namely shrubs and grasses. These compete for soil water and strongly influence hydrological pro-

cesses.

This talk will introduce our modelling approach and show that the model reproduces time series of measured soil moisture on a precipitation gradient for different soil conditions. This validates our model for present conditions and demonstrates its capability to capture moisture dynamics well for a range of conditions. Based on this, we evaluate the effects of climate change on soil moisture patterns as well as on vegetation cover and composition. The results show that increased annual precipitation does not necessarily lead to increased water availability to plants, contrary to assumptions made in many current ecological approaches.