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Landscape co-evolution and river discharge.

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Fresh water is crucial for society and ecosystems. However, our ability to secure fresh water resources under climatic and anthropogenic change is impaired by the complexity of interactions between human society, ecosystems, soils, and topography. These interactions cause landscape properties to co-evolve, continuously changing the flow paths of water through the landscape. These co-evolution driven flow path changes and their effect on river runoff are, to-date, poorly understood.
In this presentation we introduce a spatially distributed landscape evolution model that incorporates growing vegetation and its effect on evapotranspiration, interception, infiltration, soil permeability, groundwater-surface water exchange and erosion. This landscape scale (10km2) model is calibrated to evolve towards well known empirical organising principles such as the Budyko curve and Hacks law under different climate conditions. To understand how positive and negative feedbacks within the model structure form complex landscape patterns of forests and peat bogs that resemble observed landscapes under humid and boreal climates, we analysed the effects of individual processes on the spatial distribution of vegetation and river peak and mean flows. Our results show that especially river peak flows and droughts decrease with increasing evolution of the landscape, which is a result that has direct implications for flood management.