Geophysical Research Abstracts
Vol. 17, EGU2015-5815, 2015
EGU General Assembly 2015

Spatial transferability of landscape-based hydrological models

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Landscapes, mainly distinguished by land surface topography and vegetation cover, are crucial in defining runoff generation mechanisms, interception capacity and transpiration processes. Landscapes information provides modelers with a way to take into account catchment heterogeneity, while simultaneously keeping model complexity low. A landscape-based hydrological modelling framework (FLEX-Topo), with parallel model structures, was developed and tested in various catchments with diverse climate, topography and land cover conditions. Landscape classification is the basic and most crucial procedure to create a tailor-made model for a certain catchment, as it explicitly relates hydrologic similarity to landscape similarity, which is the base of this type of models. Therefore, the study catchment is classified into different landscapes units that fulfil similar hydrological function, based on classification criteria such as the height above the nearest drainage, slope, aspect and land cover. At present, to suggested model includes four distinguishable landscapes: hillslopes, terraces/plateaus, riparian areas, and glacierized areas. Different parallel model structures are then associated with the different landscape units to describe their different dominant runoff generation mechanisms. These hydrological units are parallel and only connected by groundwater reservoir. The transferability of this landscape-based model can then be compared with the transferability of a lumped model. In this study, FLEX-Topo was developed and tested in three study sites: two cold-arid catchments in China (the upper Heihe River and the Urumqi Glacier No1 catchment), and one tropical catchment in Thailand (the upper Ping River). Stringent model tests indicate that FLEX-Topo, allowing for more process heterogeneity than lumped model formulations, exhibits higher capabilities to be spatially transferred. Furthermore, the simulated water balances, including internal fluxes, hydrograph components, interception and transpiration from different landscapes, fit well with our existing knowledge obtained from experimental hydrologists.