Geophysical Research Abstracts, Vol. 7, 10247, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10247

The hydrology of topographical steady-state landscapes

P. W. Bogaart and P. A. Troch

Hydrology and Quantitative Water Management Group, Wageningen University, The Netherlands (patrick.bogaart@wur.nl)

The hydrological response of drainage basins is controlled by many climatic, ecological, geomorphological and pedological parameters. The art of modelling is then 1) estimating the processes and 2) estimating the parameters. This presentation focuses on the use of prior information on hydrologically relevant landscape parameters to constrain the hydrological response of large, relatively homogenous catchments under specific geological boundary conditions.

Our approach consists of coupling a hillslope hydrological model, a hillslope geomorphology model, and a catchment geomorphology model. The model set is driven by climatic and tectonic forcings, and controlled by soil properties (weathering rate, diffusivity, hydraulic conductivity) and bedrock incision parameters. All geometric parameters, such as slope shape, slope gradient slope length, slope shape type distribution, channel network topology, and soil depth are internally solved.

It is assumed that hillslope dimensions are essentially controlled by the hydrological response of convergent source-draining hillslopes. For a given climatic forcing, slope length is fixed by selecting the smallest convergent hillslope that slope length that results in continuous outflow at the slope base for the convergent hillslope shape type. This is equivalent with continuous saturation near the channel heads. On the larger scale, catchment morphology is assumed to be in topographic steady state, i.e. a balance between uplift and denudation. A random-walk model yields a likely channel network topology, as well as the spatial distribution of hillslope shape types (convergent, divergent, parallel).

Finally, the (hillslope-storage Boussinesq) hillslope hydrological model is applied to the generated self-consistent landscape. The resulting landscape-scale hydrological response can be regarded as a most-likely hydrological response for the small set of

parameters used. We show some examples of the approach, and discuss how it helps separating contingent from necessary hydrological response, and thus may assist in ungauged basin problems.