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Effects of Discretization Schemes on Simulation of Watershed Hydrology

This paper adapts the Distributed Large Basin Runoff Model (DLBRM) to the Heihe Watershed in northwestern China for understanding the distribution of glacial/snow melt, groundwater, surface runoff, and evapotranspiration in the watershed. Two discretization schemes are used to represent landscape heterogeneity of the study watershed: 1) a network of 1 km^2 (or other size) grid cells, and 2) a system of hydrological response units (HRUs) that are based on the combination of land use/cover, slope, and soil texture. Each cell or HRU of the watershed is composed of moisture storages of the upper soil zone (USZ), lower soil zone (LSZ), groundwater zone (GZ), and surface, which are arranged as a serial and parallel cascade of “tanks” to coincide with the perceived basin storage structure. Water enters the snow pack, which supplies the basin surface (degree-day snowmelt). Infiltration is proportional to this supply and to saturation of the upper soil zone (partial-area infiltration). Excess supply is surface runoff. Flows from all tanks are proportional to their amounts (linear-reservoir flows). Mass conservation applies for the snow pack and tanks; energy conservation applies to evapotranspiration (ET). The model computes potential ET from a heat balance, indexed by daily air temperature, and calculates actual ET as proportional to both the potential and storage. It allows surface and subsurface flows to interact both with each other and with adjacent-cell surface and subsurface storages.

Simulation of the daily river flows of the Heihe Watershed by DLBRM for the period of 1990-2008 shows that Qilian mountain in the upper reach area produced most runoff in the Heihe watershed. Both discretization schemes (grid cells and HRUs) used in the DLRBM had similar simulation accuracy while dependent upon the size of HRUs, grid cells seemed to produce a slightly better results when compared against observed flows at the watershed outlet.