Geophysical Research Abstracts,
Vol. 11, EGU2009-8121, 2009
EGU General Assembly 2009

Development of the distributed hydrological model FRIER for modelling and forecasting runoff in mountainous basins in Slovakia

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The spatially distributed rainfall-runoff model FRIER (Horvát, 2006) developed at the Slovak University of Technology is based on the structure of the physically-based WetSpa model which was originally developed by Wang et al. (1997) and adapted for flood prediction by De Smedt et al. (2000) and Liu et al. (2003). Several of model's components were changed in order to make it more appropriate for modelling and forecasting runoff from rainfall and snowmelt in selected basins of the High Core Mountains of Slovakia. The applicability of the conceptualization of runoff generation in this model has proved under various physiographic conditions in Slovakia, e.g. in the Hron, Hornad and Torysa River basins and within the framework of the Tisza River Project. The FREIR rainfall-runoff model divides basins into uniform spatial units on a grid scale, in which the hydrological balance and the runoff simulation are calculated up to the basin's outlet. Several methods, classifications and determinations of many hydrologic processes and parameters are included in the model. The individual components of the hydrological balance are liquid and solid precipitation, interception, soil moisture, infiltration, actual evapotranspiration, surface runoff, interflow in the root zone, percolation into the groundwater, groundwater runoff and production of a groundwater recharge in the saturated zone. Transformation of the surface runoff in the catchment is simulated by approximating a diffusive wave model using geometric and hydraulic characteristics of hillslopes and of the stream network. Routing parameters are generated from input layers of a digital elevation model and a type of land use. The model is executed as an ArcView GIS extension, and the whole preparation of the spatial distributed data is linked to the GIS interface. The hydrological and climatic data are daily or hourly precipitation totals and mean daily or hourly values of air temperature. Besides of the large number of physically-based parameters derived from the physiographic properties of the catchment, the model requires 12 calibrated "global" parameters which are not spatially distributed and which are constant for all cells of the basin.