Surface schemes and hydrological modelling at the SMHI

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Abstract

The HBV model is the basis of most of the hydrological modelling at the SMHI. It is a simple model with representations of snow accumulation and melt, soil moisture and evapotranspiration, groundwater storage and runoff, and flow through rivers and lake. The model has been applied in some 40 countries, with relatively stable parameter values. The most important part of the model is perhaps the soil moisture accounting routine, with a statistical distribution of storage capacities, and a gradually increasing response to rainfall with increasing soil wetness. This concept has been introduced into the surface scheme in the Rossby Centre Atmosphere Model (RCA) model. Furthermore, the concept of distributed snow storage has been introduced into the same model, based on the experience from HBV modelling. Soil heterogeneity makes it difficult to use flow models based on the Richards equation in natural soils. Another difficulty is parameter interaction and the difficulty in obtaining uniquely defined model parameter estimates by calibration to discharge records. Evapotranspiration in the HBV model is often computed with observed air temperature as the driving force. It has shown to be very difficult to improve on this simple method, despite attempts to use for instance the Priestley-Taylor method or the Penman-Monteith equation. Future model development at the SMHI will focus on better descriptions of water flow paths and residence times in different environments as a basis for water quality modelling. The experience from hydrological modelling is that is very hard to improve on simple methods. In principle, a sounder physical basis should provide safer extrapolations and predictions. We therefore still seek a computationally simple evaporation scheme, with modest data requirements and greater physical relevance than the use of air temperature.