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Simulations of the soil moisture dynamics in the small scale forested catchment using mesoscale hydrological model

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Soil moisture plays a key role in the hydrological cycle and also in the entire ecosystem. It controls the fluxes of water between soil, vegetation and atmosphere. Thus, the understanding of the soil moisture variability can lead us to the understanding of the climate system, improve the skills of eco-hydrological simulation and also provides the background for the hydrological forecasting systems as the antecedent moisture conditions and its pattern are the crucial parameters.

The study is focused on the modelling skills of the mesoscale eco-hydrological model SWIM concerning discharge and soil moisture fluctuations in the small scale forested watershed. The Liz experimental basin in the Bohemian Forest (0.99 km2) was used as a study area. Moreover, the suitability of two computational techniques (kinematic storage model and SWRRB storage routing model) for lateral flow estimation is investigated. The soil moisture content is measured by the set of tensiometers in three different depths (15 cm, 40 cm and 60 cm). Thus, the model performance is evaluated not only on the basis of the total soil moisture content but also according to its depth distribution.

It was found that the model is able to reproduce the fundamental dynamics of the runoff response from the forested single hillslope catchment. However, the drawbacks are in the area of snowmelt routine and also recession curves estimation. According to the values of the Nash-Sutcliffe index of performance and other statistical indicators the kinematic storage techniques performs slightly better in this particular conditions. The soil moisture simulations showed that, in the warmer part of the year (April-August), the model is able to reproduce the dynamics of the moisture content satisfactorily. In the colder season (September-March) the modelled values are not able to capture the depletion of the moisture content in the non-precipitation periods, which is probably caused by gradual percolation to deeper layers of the soil profile or groundwater. The observed values generally coincide with the simulated ones only after the period of significant precipitation or snowmelt. The moisture content and its dynamics are well captured in the case of 40 and 60 cm depth. However, the simulated water content in the 15 cm depth is significantly underestimated by the model. This fact may be caused either by the influence of hysteresis (when using tensiometers) or by the extremely variable porosity present in the top soil layer.