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Assessment of Land Use Change Impact on Runoff with a Hydrological Model with Distributed Parameters

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The influence of land use on runoff generation is very complicated; as land use and soil cover have an effect on interception, surface retention, evapotranspiration, and resistance to overland flow. Due to the complexity of the processes involved, the magnitude of their impact on runoff generation and subsequent flood discharge into the river system is still highly uncertain. The effects of land use change on the hydrological responses of catchments, particularly those connected to forest management, have been documented for smaller watersheds. The same applies to results from experimental watersheds and tracer experiments. When interpreting the results of land use change simulations using distributed rainfall-runoff models on mid sized and large catchments, several interacting sources of the uncertainties must be considered. The reliability of the results depends not only upon the availability and quality of the input data, but also on the extent of the schematization of the processes represented by the model and their parameterisation. In the absence of direct experiments with the impacts of usually patchy land use change in catchment of such scales (which is mostly the case in practice), modelling results could be only confronted with results from experimental catchments (which are rarely available) and with results from other modelling studies in similar environments and also with expert judgement. In order to improve the performance of models, sensitivity analysis to verify the model structure could also be conducted e.g. based on tracer studies. In this study an alternative approach was followed to assess the adequacy of a distributed hydrological model to estimate changes in the runoff regime due to land use changes. Several basins in central Slovakia with different processes of runoff formation were selected for the

study. A physically-based rainfall-runoff model with distributed parameters was used for modelling runoff from rainfall and melting snow. Parameters of the model were estimated using climate data from 1981-2000 and from 3 digital map layers: the land-use map, soil map and digital elevation model. Several scenarios of land use change were prepared, and runoff under new land use conditions was simulated. Long-term mean annual partial runoff components and the design maximal mean daily discharges with a return period from 5 to 100 years under unchanged and changed land use were estimated and compared. Simulated an expected scenario based runoff changes were confronted bases on expert judgement and estimates from literature and feedback to model parameterisation and process schematisation established.