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Analysing the hydrological impacts of climate change at a small catchment scale

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Hydrological cycle within the complex climate system requires special attention for which the cooperation of experts in hydrology and climate modelling is a key element. Extreme runoff characteristics (both low and high) interfering regional climate change may result in several environmental and moreover, economical damages. In order to mitigate these hydrological hazards, both past experiences and building adaptation strategies for the future are essential. To analyse the hydrological consequences of climate change, coupling a hydrological model to a climatological model is necessary, so based on the results, suggestion can be made with respect to flood protection or shipping among other factors.

In the present study, the distributed, physically-based DIWA (DIstributed WAtershed) hydrological model is coupled with the RegCM4 regional climate model. DIWA considers several aspects, like for example topography and its relevant derivatives (slope, aspect, local drain directions, etc.), land cover, soil layers and their hydraulic properties, interception, snow accumulation and melt, infiltration, evaporation and transpiration, surface and stream runoff, etc.. To run the hydrological model, gridded meteorological data – namely precipitation, minimum and average temperature – are needed, which are provided by RegCM4, which is adapted by the Dept. of Meteorology, Eötvös Loránd University. This simulation of RegCM4 uses 10 km as horizontal resolution and new RCP scenarios.

The methodology of coupling the hydrological and climatological models is presented for the Uppest-Tisza basin (with an area of 9707 km2) which rises in the Ukrainian Carpathians and drains south-west into Hungary. It enters Hungary at the Tiszabecs discharge station. To achieve our aim, the following steps are made:

- Calibrating and validating the model DIWA against the time series of discharge at the Tiszabecs discharge station using historical meteorological data;
- Running the calibrated DIWA model for the past 30 years using historical meteorological data;
- Running the calibrated DIWA model using meteorological data provided by RegCM4 simulations;
- Comparing the specific runoff characteristics of the past and the future;
- Summarizing recommendations for decision makers in order to mitigate climate change induced hydrological hazards.