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Assimilation of snow cover data in a distributed rainfall-runoff model

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Snow cover is an important parameter in hydrological models since snow melt has a significant contribution to spring floods in large lowland basins. Hence, an accurate estimation of the spatial distribution of the snow melt volume is crucial for runoff predictions. Snow cover distribution is often spatially interpolated for hydrological models with Thiessen polygons. However, this frequently gives wrongly simulated distributions, especially for medium and large catchments. In this research assimilation of MODIS Terra/Aqua daily snow cover extent (MOD/MYD10A1 data) in the distributed WetSpa hydrological model was proposed. WetSpa is a physically based distributed rainfall-runoff model, which uses a day-degree method to estimate snow melt and distributes by default the snow pack uniformly over the catchment. The problem of cloud cover in MOD10A1 is overcome by interpolation of the snow cover (in space and time) based on a relationship of measured snow depth. The snow depth has a strong linear relationship (r = 0.7) with fraction of a snow cover in a catchment. WetSpa was adapted to use differences between daily snow covers obtained from MOD/MYD10A1 data by: (1) allocating in a realistic way snowfall to snow pack in the catchment; (2) weighting the day-degree snow melt volume from the model grid cells. The method was evaluated for the Biebrza catchment, Poland, which is a reference site for natural European lowlands rivers. Improvement of the runoff prediction at a daily temporal resolution was presented for a spring flood and in a period of early snow pack accumulation, when the snow cover showed highest spatial variability.