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Key role of snowmelt in high-resolution discharge forecasting during rainfall and snowmelt mixed events

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The hydrological processes related snowmelt and rainfall mixed events, mostly concerning the rain-on-snow phenomena, were simulated or analyzed recently in a number of studies. Unfortunately, the snowmelt and rainfall mixed events received relatively little attention in high resolution discharge forecasting, especially in study areas where snow processes are tend to be disregarded.

In this study we use a machine learning algorithm - Random Forest - for 24 h discharge forecasting in 1h resolution in a 105.9 km^2 urbanized catchment in NE Poland - Biala River. The meteorological data used as the predictors are obtained from Weather Research and Forecasting (WRF) simulations in 1 h temporal and 4 x 4 km spatial resolutions. The Random Forests based discharge forecasting models are set in two scenarios with (1) snowmelt and rainfall and (2) rainfall only predictors in order to depict the effect of snowmelt on the model structure and forecasts.

We show that the snowmelt and rainfall scenario decrease the forecast errors for longer forecasts lead times in comparison to the rainfall only scenario. Moreover, importance of discharge based predictors (which were used in the model next to the rainfall or snowmelt predictors) is higher in the rainfall only scenario then in the snowmelt and rainfall scenario. We conclude, that effect of including snowmelt data (which accounts only for 20% of precipitation depth in our study) in discharge forecasts for mixed snowmelt and rainfall environment allows to account for non-linearities and feedbacks such as initial wetting or rain-on-snow phenomena that enforces rainfall based runoff generation.

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