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# Are hydrological models able to integrate high-resolution precipitation and temperature data?

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In the past few decades, much research has been dedicated to increasing spatial representation complexity of catchments in hydrological models. Despite these efforts, distributed models were not proven to be superior to lumped models for the prediction of streamflow. Several authors have questioned whether low quantity and/or quality of meteorological data constrained the performance of distributed models. The aim of this study is to compare the quality of simulations produced by one distributed model to that of lumped models, when fed with physically coherent hydrometeorological data at different spatial densities.

To achieve this, simulations from four lumped models of different complexities (6 to 23 parameters) and one distributed model (24 parameters) were tested on nearly 200 watersheds in Quebec, Canada. The watersheds range from 1125 to 72900 km2 in surface area and precipitation varies from 750 to 1100 mm/year. This dataset includes small (<= 2500 km2), medium (2500 km2 < x < 10000 km2) and large (>= 10000 km2) watersheds. All of this work was done in a virtual environment in order to remove all errors commonly found in precipitation and temperature datasets. Forty years of high-resolution precipitation and temperature data were extracted from a simulation of the Canadian Regional Climate Model V4.2.3 (15 km resolution, driven with reanalysis) to feed the hydrological models. Three objective functions (the natural logarithm of the root mean squared error (RMSE), the Nash-Sutcliffe efficiency coefficient (NSE) and a combined metric of the bias, RMSE and NSE) were used to evaluate the models' performances. These analyses were performed at various spatial densities of the observation network (ranging from one to all meteorological stations). A spatial average of the meteorological data was used to calibrate the lumped models while all the data were used for the distributed model.

Preliminary results suggest that the two most complex lumped models performed slightly better than the distributed model. This phenomenon was observed on virtually all watersheds using the three objective functions. The two simpler lumped models had a poor performance on most watersheds. All models were repeatedly calibrated using five densities of virtual weather stations (from 200 km2 to 20000 km2). Preliminary results indicate that increasing the spatial density has little to no impact on the performance of both lumped and distributed models. Indeed, models using as little as one station have shown to perform comparably to when using the maximum allowable station density. The distributed model was unable to use the additional information provided by additional weather stations.