Hydrologic consistency analysed through modeling at multiple time steps: does hydrological model performance benefit from finer time step information?

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We investigate the operational utility of fine time step hydro-climatic information using a large catchment data set. The originality of this data set lies in the availability of precipitation data from the 6-minute rain gauges of Météo-France, and in the size of the catchment set (217 French catchments in total).

The rainfall-runoff model used (GR4) has been adapted to hourly and sub-hourly time steps (up to 6-minute) from the daily time step version (Perrin et al., 2003). The model is applied at different time steps ranging from 6-minute to 1 day (6-, 12-, 30-minute, 1-, 3-, 6-, 12-hour and 1 day) and the evolution of model performance for each catchment is evaluated at the daily time step by aggregation of model outputs.

Three classes of behavior are found according to the trend of model performance as the time step becomes finer: (i) catchments presenting an improvement of model performance; (ii) catchments with a model performance insensitive to the time step; (iii) catchments for which the performance even deteriorates as the time step becomes finer. The reasons behind these different trends are investigated from a hydrological point of view, by relating the model sensitivity to data at finer time step to catchment descriptors.

References:

Perrin, C., C. Michel and V. Andréassian (2003), "Improvement of a parsimonious model for streamflow simulation", Journal of Hydrology, 279(1-4): 275-289.