Progressive refining of spatial and temporal resolutions in a hydrological model: how far should we go?

Alban de Lavenne, Andrea Ficchí, Julien Goullet

Geophysical Research Abstracts
Vol. 19, EGU2017-10125, 2017
EGU General Assembly 2017

Progressive refining of spatial and temporal resolutions in a hydrological model: how far should we go?

Alban de Lavenne, Andrea Ficchi, and Julien Goullet
Irstea, HBAN, Antony, France (alban.de-lavenne@irstea.fr)

Choosing a modelling resolution for an hydrological model is an important preliminary question. However, it is quite often arbitrary determined by the modeller experience according to the objective, the model capacity or the available measurements. The hydrological literature provides numerous studies which focus on the effect of refining either spatial resolution or (sometimes) temporal resolution in order to better catch hydrological response. In this study, we investigate the impact of changing simultaneously both resolutions on hydrological model performance. The idea is that these resolutions are linked and should be considered together. Thus, we look for the combination of spatial and temporal resolutions fitting at best each catchment behaviour and type of rainfall events.

A large data set of 240 catchments scattered all around France is used, and in particular, we benefit from a high-resolution precipitation database (ANTILOPE, Météo-France) that describes hourly precipitation at 1 km^2 resolution. Data were aggregated at different time steps (1h, 3h, 6h, 12h and 24h). Streamflow simulations are performed at these different time steps using the GR5 model in its lumped and semi-distributed version (GRSD, de Lavenne et al. (2016)), with a mesh grid of 500, 250, 100 and 50 km^2. Ten different indices are used to describe spatio-temporal characteristics of rainfall events, in order to analyse in which contexts refined resolutions are needed to improve the performance of the model. These indices characterise the spatial variability, localisation, movement, intensity and temporal variability of rainfall events. In addition to some indices already reported in the hydrological literature, we propose some new indices like an indice usually applied in economics. This analysis at different time steps, events and catchments demonstrates the limits for some of them and allows to propose some corrections (Goullet J., 2016).

Model performances are shown to be significantly improved at refined resolutions for events with convective trends. Indeed, a synergy between spatial and temporal resolutions is obtained when refining both of them at the same time. These encouraging results suggest that in a flood forecasting context, in particular for fast response catchments subject to intense events, a significant increase of model performance can be expected by refining both resolutions.

References

de Lavenne, A.; Thirel, G.; Andréassian, V.; Perrin, C. & Ramos, M.-H. (2016), 'Spatial variability of the parameters of a semi-distributed hydrological model', *PIAHS* 373, 87–94.

Goullet, J. (2016) 'A la recherche des résolutions spatiales et temporelles caractéristiques du comportement hydrologique d'un bassin versant', Master's thesis, UPMC, Paris.