Scale issues in flood forecasting models: how to create a gateway between data at different resolutions?

Juliette Godet*[1], Pierre Nicolle[1], Olivier Payrastre[1], Eric Gaume[1], and Pierre Javelle[2]

[1]Université Gustave Eiffel – Ministère de la Transition écologique et solidaire – France
[2]Risques, Ecosystèmes, Vulnérabilité, Environnement, Résilience – Aix Marseille Université, Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement, Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement : UMR1467 – France

Résumé

The disastrous consequences of floods are expected to worsen in the coming years with the combined effects of urbanization, demographic growth and climate change. As a consequence, an increased number of impact-based flood forecasting chains are being developed (1,2). Traditionally, these chains consist of two parts: a hazard forecasting model generating possible discharge values along the river network and an impact forecasting model computing inundations maps corresponding to the discharges. However, the hydrological models calculating the discharges and the hydraulic models generating the inundation maps have to be connected to build a flood forecasting chain, but are not implemented on grids of same spatial resolutions. It is therefore necessary to create a gateway between both grids and models.
In the context of the study, it is necessary to allocate a large set of hydraulic model outlets (2580 grid points defined on a grid resolution of 50 m), to 1*1km pixels of an operational gridded hydrological model running over 10 departments of the French Mediterranean area. The proposed method consists of two steps. First, an upscaling algorithm (3) is implemented to create a consistent 1km grid, based on the initial 50m grid. Then three methods aiming at co-referencing the 2580 outlets on both grids are compared based on a relevant assessment criterium.

The most appropriate method for linking coarse and fine resolution grids for hydrological-hydraulic coupling purposes, is based on the comparison of the shape, location and area of the upstream basin of each outlet, calculated on the various grids. The results illustrate the difficulties and possible errors related to upscaling/downscaling algorithms, and highlight the limits of gridded hydrological models, which are still the most common models used in hydrology until now.

REFERENCES

(1) Guillaume Le Bihan, O. Payrastre, Eric Gaume, David Moncoulon, and Frédéric Pons. The challenge of forecasting impacts of flash floods: Test of a simplified hydraulic approach and validation based on insurance claim data. Hydrology and Earth System Sciences, 21

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:5911–5928, November 2017. doi:10.5194/hess-21-5911-2017

(2) Francesco Dottori, Milan Kalas, Peter Salamon, Alessandra Bianchi, J Thielen Del Pozo, and Luc Feyen. A near real-time procedure for flood hazard mapping and risk assessment in Europe. 2015.
(3) Dirk Eilander, Willem van Verseveld, Dai Yamazaki, Albrecht Weerts, Hessel C. Winsemius, and Philip J.Ward. A hydrography upscaling method for scale-invariant parametrization of distributed hydrological models. Hydrology and Earth System Sciences, 25(9) :5287–5313, September 2021. ISSN 1027-5606. doi:10.5194/hess-25-5287-2021. Publisher: Copernicus GmbH