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A new a priori methodology to define the best 2D mesh resolution for overland flow models

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In the last decades, Shallow Water Equations (SWE) have been widely used in flood wave propagation studies. Recently (Zhang and Cundy, 1989, Costanzo e Macchione 2005, Costabile et al. 2011, Costabile et al. 2013) the SWE model was applied for the simulation of overland flow by adding the net rainfall as a source term. In the application of this type of model, mesh resolution plays a crucial role in the results reliability (see e.g. Caviedes-Voullième et al. 2012). To define the optimum mesh both an a priori or a posteriori method can be applied. Hardy et al. (1999), address the importance of spatial resolution for flood propagation studies on floodplains recommending the use of at least of four meshes of different spatial resolution. This procedure is computationally expensive. On the other hand, an a priori method does not need first attempt simulations.
In this work a new methodology is proposed to define the best resolution for an a priori mesh.
Assuming that landscape properties might be scale-invariant (Ansoult 1989), the characteristics length scales of natural catchments can be used to define the appropriate mesh resolution which preserves the main catchment features. (Perron et al. 2008)
Spectral analysis turns to be a fascinating approach to obtain spatial scales and the two-dimensional Fourier analysis can be applied to a high-resolution Digital Elevation Model (DEM). The proposed methodology defines the accuracy of 2D domains which can noticeably reduce the computational time optimizing the OF simulation results in terms of both discharge hydrographs and floodable area mapping.

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