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The role of small-scale topographic features on inundation dynamics: potential impacts on large-scale investigations

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The execution of large-scale (i.e., continental or global) hydraulic modeling is nowadays a reality thanks to the increasing computational capacity, data availability, as well as understanding of essential physical dynamics. Such achievements are typically associated to a compromise in terms of model resolutions (the finer being of few tens of meters, with a coarsened representation of the terrain) and, thus, accuracy on representing the topographic peculiarities of the flood-prone areas. Nevertheless, the experience gained observing the dynamics of past inundations highlights the role of small-scale topographic features (e.g., minor embankments, road deck, railways, etc.) in driving the flow paths. Recent advances on automated identification of flood defense from high resolution digital elevation model paved the way to include hydraulically relevant features (e.g., main levees) while preserving the model resolution suitable for large-scale applications (Wing et al, 2020).
The present study extends this approach to flood-prone areas by investigating how the automatic detection of minor topographic discontinuities can enhance the estimation of flood dynamics of large-scale models. Taking advantage of high-resolution topographic data (i.e., 1-2 m) the approach automatically detects hydraulically relevant features and preserves their height while coarsening the resolution of the terrain used into the hydraulic model. The impact of such approach on the inundation dynamic is tested referring to three different case-studies that recently experienced riverine flooding: Secchia and Enza rivers (2014, 2017, respectively; Italy), Des Moines (Iowa, USA). The results confirm the relevance of small-scale topographic features, which, when considered, ensure a high correspondence to observations and local models. The element of strength of the presented approach is that such performances are ensured without requiring the adoption of high grid resolutions, and thus, not affecting the overall computational costs.