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RIVER FLOOD ANALYSIS WITH A 2D HIGH PERFORMANCE COMPUTING SOFTWARE

Hydraulic simulation tools are able to provide useful information concerning floods with 2D shallow water models. Although 2D models are notably more accurate and adequate to reproduce the river flood-plain, the use of 1D models is more extended when dealing with large scale scenarios due to its low computational cost. However, GPU implementation turns 2D computation into an affordable technique for large space and time domains due to the computational time reduction (Lacasta et al., 2014). Here, a domain of the Ebro River (477 km^2), located at the northeast of Spain, is represented by a 2D mesh in which Shallow Water Equations for free surface flow are solved and numerical results of flooding events are shown.

The domain analyzed can be seen in Figure 1. A Digital Terrain Model (of 5 m resolution) is used to represent the floodplain, while river cross sections are used to represent 2D information inside the river bed (Caviedes-Voullième et al., 2014). Regarding roughness, its characterization is done by setting Manning roughness coefficient, n[

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Figure 1. 3D representation of the domain and boundary conditions

With this topographical data, a triangular structured mesh is constructed with 867672 cells, whose cell size is adapted to the required level of accuracy (around 10 m in river bed or levees and 150 m at boundaries). The flood hydrograph is set as the upstream boundary condition, while a gauging curve is used as outlet boundary condition.

As a numerical result, the comparison between the observed maximum flooded area (pink) over the topography represented by the bed elevation, z (green), and the computed (representing water depth (h) in blue scale) is shown for the 2015 flood in Figure 2 (left). Figure 2 (right) also shows time evolution of computed water surface elevation in the town of Tudela (located at 15 km downstream from inlet boundary condition) together

with observed free surface level.

Figure 2. Maximum flooded area and time evolution of water surface elevation comparison

The coincidence between observed and computed flooded areas is calculated reaching an 87% following Bates and de Roo, 2000. Besides that, these results of a 500 hours hydrograph were provided in 17 hours using GPU, while 21 days were needed to simulate the same event in a conventional CPU parallelized in 8 cores.

Considering the comparison between the computed model and the observed measurements, it is possible to conclude that 2D models in GPU are a functional, confident and fast tool to predict large flood scenarios and, therefore, to prevent and mitigate them.

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