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Mesh geometry: Impacts on flood extension and flows in TELEMAC – 2D

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Abstract: In two-dimensional hydrodynamic simulations applied to flood case studies when used for the purpose of modelling implementation for predicting events or managing water resources, the computational time in contrast to the quality of the results obtained are important factors to be taken into account. Therefore, in order to test the performance of the TELEMAC-2D model in terms of computational time, simulations with different mesh configurations were performed aiming at changing the number of nodes and mesh geometry in the computational domain of a case study carried out in the Rio do Sul region, in the state of Santa Catarina, Brazil, where floods are recurring. Aiming the implementation of an auxiliary system in the prediction of flood events and management of water resources. For this, two meshes with different configurations were created in Blue Kenue software. The first mesh (mesh A) consists of distant nodes about 5 meters to the nodes within the river, gradually increasing up to 50 meters in the outline, producing 564563 nodes. In the second mesh (mesh B) the Channel Mesher tool was used to create independent meshes for the rivers. This sub mesh was created so that in the flow direction there were cross sections spaced by 10 m, and there were 4 nodes within the river in each of these sections. In the floodplain the imposed configurations were the same used in the mesh A. With this, the mesh B is composed of 310083 nodes. For the two simulations performed the number of parallel processors used was 24, the mesh A had a computational time of 55 hours with a time step of 30 seconds, while the mesh B had computational time equal to 53 hours and a time step of 15 seconds . It was not possible to keep the same time step for errors in the simulation. The results of the simulations, which had the same initial and contour conditions, were evaluated by the model's ability to simulate flows and extent of flood in contrast to a polygon provided by the municipality's civil defence. The flood areas were very similar in both simulations. The mesh A had as areas of flood hit and underestimation of 6.08 km² and 0.13 km², respectively, while mesh B obtained 6.08 km² and 0.14 km² in that order. The flow rates were evaluated by Root Mean Square Error, Nash and Sutcliffe efficiency and Pearson correlation coefficient. For mesh A the results were 131.81, 0.45 and 0.78, respectively. For mesh B, in the same order, the results were 125.24, 0.50, 0.88. All the flow statistics were better for mesh B, and the differences found in the flood extension simulation were minimal. Besides of these results was interesting to note that the model simulated the flows for the mesh B with greater stability in the results. Simulated flows with mesh A presented high peaks and depressions throughout the simulation, which are highly mitigated by the use of mesh B. This fact reinforces the idea that the simulations using mesh B are more stable, and for this reason their mesh configurations are considered preferable for this type of simulation. Stability may also be due to change in the time step, however, decreasing the time step to the mesh would certainly make the simulation even more time-consuming.

Proposed session: *River and urban floods, flood forecasting and management*
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Speaker: *Juliana Costi*