Flood Modeling in Urban Area Using a Well-Balanced Discontinuous Galerkin Scheme on Unstructured Triangular Grids

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Abstract : Urban flooding resulting from a sudden release of water due to dam-break or excessive rainfall is a serious threatening environment hazard, which causes loss of human life and large economic losses. Anticipating floods before they occur could minimize human and economic losses through the implementation of appropriate protection, provision, and rescue plans. This work reports on the numerical modelling of flash flood propagation in urban areas after an excessive rainfall event or dam-break. A two-dimensional (2D) depth-averaged shallow water model is used with a refined unstructured grid of triangles for representing the urban area topography. The 2D shallow water equations are solved using a second-order well-balanced discontinuous Galerkin scheme. Theoretical test case and three flood events are described to demonstrate the potential benefits of the scheme: (i) wetting and drying in a parabolic basin (ii) flash flood over a physical model of the urbanized Toce River valley in Italy; (iii) wave propagation on the Reyran river valley in consequence of the Malpasset dam-break in 1959 (France); and (iv) dam-break flood in October 1982 at the town of Sumacarcel (Spain). The capability of the scheme is also verified against alternative models. Computational results compare well with recorded data and show that the scheme is at least as efficient as comparable second-order finite volume schemes, with notable efficiency speedup due to parallelization.

Keywords : dam-break, discontinuous Galerkin scheme, flood modeling, shallow water equations