Hydrologic-hydraulic coupling for flash flood real-time simulation: Application to the October 2015 French Riviera floods

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The vulnerability of the French Riviera to hydro meteorological hazards has been dramatically illustrated by the flash floods of October 3, 2015: 20 people were killed and the cost of the direct damages were higher than 600 million euros. Due to their fast dynamics, flash floods are difficult to predict and leave little time for forecasting. In this context, it is needed to improve real-time simulations to enable a short-range anticipation of the consequences of these phenomena. The main goal of this work was to test a hydrologic-hydraulic coupling in order to assess whether this coupling can be used for real-time forecasting purposes. The coupling is composed for the hydrological part of the event-based spatially distributed rainfall-runoff model Cinecar and for the hydraulic part of the Basilisk software, which is based on 2D hydraulic modelling (finite volume methods for shallow water equations) with adaptive grid refinement. The main interest of this coupling method is the compromise obtained between calculation time and precision. The rainfall-runoff model is run on the upstream part of the domain and feeds the hydraulic model applied in the downstream part. The rainfall-runoff model makes it possible to estimate very quickly the streamflow temporal evolution, while the hydraulic model, although much slower when applied at high spatial resolution (up to 4m), makes it possible to have water level and velocity at any point of the downstream area. The application of this coupling approach is presented for three basins severely affected by the October 2015 flash floods: the Brague (68 km²), the Frayère (22 km²) and the Riou de l’Argentière (48 km²) catchments. The results obtained for the three basins are compared with information gathered from post-event surveys, particularly the high water level marks. A particular attention is also put on computation times in order to evaluate the possibilities of real-time simulation. The results show promising performances both in terms of calculation time but also in terms of accuracy of the simulated flood areas and water levels.