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Flood events beyond current numerical models capability: the Valcanale episode

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In the afternoon of 29th August 2003 a flash-flood occurred in Valcanale (North eastern Italy, nearly on the border between Italy, Austria and Slovenia). 380 mm of rain were observed at Pontebba in four hours but even higher values were observed in the same area through radar estimates. This flash flood, produced by stationary thunderstorms, caused severe damages to the
villages of Ugovizza and Pietratagliata both because of the land slides and to the rivers run-off due to the high rain rates. Two casualties occurred during this event and the viability of the area was severely compromised for several months due to the damaged roads. This event was poorly foresee n by operational numerical models (both global and local), in fact all the available runs pointed out the prealpine area as the most interested to precipitations whereas the inner alpine zone, had to be only partially interested by rain. The vice-versa occurred. Moreover, the foreseen amounts of rain, even if misplaced, were only barely comparable to the observed ones. The aim of this work is that to use the ARW-WRF non hydrostatic numerical model (version 2.2.x) to reproduce as much correctly as possible the event, looking for the reasons of: 1) the partial failure of operational numerical models; 2) the stationary onset of deep moist convection (hereafter DMC).

The best descriptions are those obtained through non hydrostatic simulations with 2km grid step and explicit DMC. Switching off cumulus parametrization, the rain spatial distribution is better represented, even if slight displacements remain. Using a six components microphysics in place of simpler schemes shows further improvements in terms of correct positioning of rain maxima; this could be ascribed to the enhancement of advective effects related to the more detailed description of precipitation. A better description of amounts and positioning is obtained increasing orography by a factor 1.2. Even if correctly represented, the high amounts observed could not be reproduced, being the simulated total rain amount lower than that observed nearly by a factor 4. It is guessed that these high values or precipitation might be reached only with numerical models which are capable to reproduce higher wind vertical velocities, then higher condensation rates.

Sensitivity runs carried out looking for the reasons of stationary onset of DMC show that a fundamental ingredient is a relatively dry layer (low relative humidity) near to the ground. Because of this dry layer the DMC onset can take place only when triggered by the relieves through their interaction with the south westerly flow. In other words the DMC onset can take place only in the upwind side of the large stand tallest mountains, then DMC is advected toward the same direction because of the stationarity of the upper air flow. When relative humidity is increased, even if the onset of DMC takes place on the same point of the relieves, DMC is not merely advected by the mean upper level flow, but it propagates eastward interesting a wider area.

Sensitivity runs of the WRF numerical model devoted to increase the comprehension of the Valcanale flash-flood show that this event can not be reproduced correctly in terms of spatial distribution with a parametrized convection but only through a fully dynamical description of convection. The stationarity of DMC, strictly connected with orography, is related to the existence of a relatively dry layer near to the ground (correctly foreseen also by the available operational numerical models). The increasing of relative humidity in the lower levels induces the eastward propagation of DMC which therefore does not insist in the same position, distributing the impact of the flash-flood on a wider area.

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