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The sensitivity of mesoscale heavy precipitation on atmospheric boundary layer over complex orography

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Heavy precipitation at the atmospheric mesoscale is among the important hazardous meteorological phenomena. Every year, at mid latitudes flash floods cause a considerable amount of damages, injuries and casualties. [1] [2]. Furthermore the simulation of high efficiency precipitation weather events is a challenge for numerical models because it is expected they grasp both the microphysical and the dynamical processes involved in the rain formation.

Nowadays operational weather numerical models aim to reproduce the precipitation rates and patterns measured during local extreme precipitation events. In this work we show the application of the WRF model [3] to the September 2013 flash flood that interested a few square kilometers in the NE Italy, recording precipitation rates of 15 mm/5min lasting for two hours. The computational approach to generate and compare a large number of high resolution (< 2 km) simulations which were performed on a medium size High Performance Computing infrastructure is described in detail. Such simulations were carried out to investigate the sensibility of the model on boundary layer parametrization schemes, orographic effects, initial and boundary conditions. From the meteorological point of view, results show that the boundary layer plays a significant role in maintaining deep atmospheric convection stationary for several hours over the same geographical area, furthermore it is evident the supporting effect given by the interaction between synoptic moist flows and the orography.
The WRF model is running operationally at the Regional Center for Environmental Modeling of ARPA FVG.

[2] Mapping the impacts of natural hazards and technological accidents in Europe EEA Technical report No 13/2010 http://www.eea.europa.eu/publications/mapping-the-impacts-of-natural

[1] UNISDR - UNEP/GRID-Geneva.Global Risk Data Platform http://preview.grid.unep.ch/

[3] Weather Research & Forecasting model http://www.wrf-model.org

[4] Application of Theory to Simulations of Observed Cases of Orographically Forced Convective Rainfall
Miglietta, Mario Marcello, Richard Rotunno, 2012: Application of Theory to Simulations of Observed Cases of Orographically Forced Convective Rainfall. Mon. Wea. Rev., 140, 3039–3053.