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Aerosol-related applications of a coupled weather and chemical transport modelling system: the case study of Vernazza, Cinque Terre, 25 October 2011

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Aim of the present work is to investigate the potential effects of dust aerosols on the structure of some severe rainfall events in Liguria. These events are typically associated with intense southerly or southwesterly flows from Southern Mediterranean and Northern Africa and are often associated with mineral dust plumes originating from Northern Sahara. In particular the flooding event occurred in Vernazza (Cinque Terre) on October 25, 2011, is analyzed here.
The specific research objective can be summarized in the so called “aerosol invigoration effect”, that is how the increased aerosol concentration, caused by mineral dust plumes, may enhance convection and, consequently, extreme rainfall events. This is equivalent to investigating the influence that aerosols-clouds-radiation interactions may have on the physics and dynamics of the rainfall events, primarily by means of the so-called aerosols direct (including semi-direct) and indirect effects.
The proposed research is primarily conducted on a numerical modeling basis. In this context, the Weather Research and Forecasting model with online coupled chemistry (WRF-Chem v. 3.8.1) is applied to simulate the formation of the convective storm and its feedback with dust aerosol. The employed simulation strategy concerns various model setups, obtained varying the sectional aerosol modules, starting from the “simple” GOCART mechanism to the more sophisticated MOSAIC.
For this purpose, 3 sets of simulations are performed: (a) the control simulation (RAD0), in which the mineral dust does not interact with clouds and/or radiation, (b) the “ radiation” (RAD) simulation, in which the dust transport is considered and aerosols direct effects are accounted for, and (c) the “total” simulation (TOT), in which aerosols direct and indirect effects are accounted for.