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Evaluation of aerosol direct and indirect effects on extreme precipitation events over Liguria Region

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Liguria region in the last years has been affected by devasting floods as result of extreme precipitation events. During these events, many records in terms of precipitations amount/rates over the Italian peninsula were overtaken, such as181mm/h during the 4 November 2011 Genoa flood, and 741 mm/12h and 884 mm/24h during the 21 October 2021 Rossiglione flood.

From a synoptic point of view, similar configurations characterize the extreme events that affected Liguria region, i.e., the presence of a deep pressure minimum west of the region and a strong high pressure over eastern Europe. Such conditions are favorable to the triggering of a quasi-stationary mesoscale convective systems over the Ligurian Sea.

Furthermore, this kind of configuration is favorable to the formation and transport of wide plumes of aerosol, mainly mineral dust from the Sahara Desert and sea salt aerosols generated under high

wind condition in the Mediterranean basin.

The present study aims to evaluate the impact that these aerosol plumes can have on the triggering and evolution of the deep convective systems responsible for Liguria flooding events. This study is carried out through numerical simulations performed with the WRF (Weather Research and Forecasting)-Chem model, version 4.0. WRF-Chem is the WRF model coupled with the Chemistry: the model simulates the emission, transport, mixing, and chemical transformation of trace gases and aerosols as well as the meteorology.

In particular, the object of the presented research is to investigate the influence that cloud-aerosol-radiation interactions may have on the physics and dynamics of the rainfall events, primarily by means of the so-called direct (aerosol-cloud) and indirect (aerosol-radiation) interactions.

For this purpose, 3 different sets of simulations were performed: a control run, in which the chemical part of WRF-Chem model has not been activated, i.e., the production and transport of

aerosol and its direct and indirect effects on atmosphere are not taken into account; a run in which the dust transport is considered and only aerosol direct effect are accounted for; a final run in which both direct and indirect effects are taken into account.