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The impact of the uncertainty in the initial soil moisture condition of irrigated areas on the spatiotemporal characteristics of convective activity in Central Greece

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The region of Thessaly is the second largest plain in Greece and has a vital role in the financial life of the country, because of its significant agricultural production. The intensive and extensive cultivation of irrigated crops, in combination with the population increase and the alteration of precipitation patterns due to climate change, often leading the region to experience severe drought conditions, especially during the warm period of the year. The aim of the DAPHNE project is to tackle the problem of drought in this area by means of Weather Modification.In the framework of the project DAPHNE, the numerical weather prediction model WRF-ARW 3.5.1 is used to provide operational forecasts and hindcasts for the region of Thessaly. The goal of this study is to investigate the impact of the uncertainty in the initial soil moisture condition of irrigated areas, on the spatiotemporal characteristics of convective activity in the region of interest.

To this end, six cases under the six most frequent synoptic conditions, which are associated with convective activity in the region of interest, are utilized, considering six different soil moisture initialization scenarios. In the first scenario (Control Run), the model is initialized with the surface soil moisture of the ECMWF analysis data, that usually does not take into account the modification of soil moisture due to agricultural activity in the area of interest. In the other five scenarios (Experiment 1,2,3,4,5) the soil moisture in the upper soil layers of the study area are modified from -50% to 50% of field capacity (-50%FC, -25%FC, FC, 25%FC, 50%FC),for the irrigated cropland.Three model domains, covering Europe, the Mediterranean Sea and northern Africa (d01), the wider area of Greece (d02) and central Greece – Thessaly region (d03) are used at horizontal grid-spacings of 15km, 5km and 1km respectively. ECMWF operational analyses at 6-hourly intervals (0.25ox0.25o lat.-long.) are imported as initial and boundary conditions of the coarse domain, while in the vertical, all nests employ 39 sigma levels (up to 50 hPa) with increased resolution in the boundary layer. Microphysical processes are represented by WSM6 scheme, sub-grid scale convection by Kain-Fritsch scheme, longwave and shortwave radiation by RRTMG scheme, surface layer by Monin-Obukhov (MM5), boundary layer by Yonsei University and soil surface scheme by NOAH Unified model.

The model numerical results are evaluated against surface precipitation data and data obtained using a C-band (5cm) weather radar located in the centre of the innermost domain.

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