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Modelling dry thunderstorm environment during a wildfire episode in Portugal

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Under future climate uncertainties, a better understanding of wildfires is necessary both from physical and operational points of view, which are the goals of the CILIFO (Centro Ibérico para la Investigacion y Lucha contra Incendios Forestales) Interreg POCTEP project. Among several sources of fire ignition, lightnings are the main natural source of wildfires and an important contributor to burned areas in many regions. In 2017, devastating forest fires were reported in Portugal. The fires near Pedrógão Grande created a huge wall of flames, killing at least 60 people. The goal of this study is to discuss the atmospheric conditions that were supportive of lightning flashes to cause a fire during this event, as well as to check the possibility to correctly diagnose cloud-to-ground flashes using high resolution simulations with the non-hydrostatic atmospheric Meso-NH model. A set of meteorological data was used to validate the model results and to describe the prevailing atmospheric environment during the afternoon of 17th June 2017 over central Portugal. The Portuguese Institute for Sea and Atmosphere (IPMA) provided the data for this study. The Meso-NH model was configured in order to provide an explicit representation of the clouds and their electrical activity, through the activation of the CELLS electrical scheme. The ICE3 microphysical scheme predicts the mixing ratio of six atmospheric water categories. The Meso-NH system also includes a grid point radar diagnostic given by the total equivalent radar reflectivity, as well as a Plan Position Indicator (PPI) that is a representation mode in which sweeping cones are projected on a horizontal plane determined by scanning the atmosphere at constant elevation. The description of the electrical state of a thunderstorm is based on the monitoring of the electrical charge densities, the computation of the electric field and the production of lightning flashes. The cloud charging involves mostly the non-inductive mechanism, and both Intra-Cloud (IC) and Cloud-to-Ground (CG) flashes are considered. The CELLS scheme provides a realistic representation of the electrical properties of precipitating cloud systems. The simulation was carried out with two nested domains of 4 km and 1 km horizontal resolution. Concerning the atmospheric conditions, the dry thunderstorm environment configured a perfect scenario for the natural ignition and evolution of some fires, since lightning activity came from high-base thunderstorms with relatively dry air at lower levels favouring the evaporation of rain before it reaches the ground, as well as intense outflows. Therefore, the fires on 17th June 2017 occurred in an exceptional hot day, with fire ignitions in places with complex terrain and a favourable vegetation state producing uncontrolled wildfires. The spatial distribution of the

simulated CG lightnings showed a good agreement with the lightning strokes obtained from the national lightning detection network. Besides the identification of favourable conditions for the occurrence of wildfires, this study introduces a possible application of the Meso-NH electrical scheme, namely the study of forest fire ignition by lightning strokes.