



EMS Annual Meeting Abstracts
Vol. 19, EMS2022-341, 2022, updated on 07 Feb 2023
<https://doi.org/10.5194/ems2022-341>
EMS Annual Meeting 2022
© Author(s) 2023. This work is distributed under
the Creative Commons Attribution 4.0 License.



Triggering and evolution of early morning hail over the Croatian coast – convection-permitting modeling study

Barbara Malečić¹, Damjan Jelić¹, Lucija Blašković¹, Anna-Maria Križanac², Kristian Horvath³, and Maja Telišman Prtenjak¹

¹University of Zagreb, Faculty of Science, Department of Geophysics, Croatia (bmalecic@gfz.hr)

²Ericsson Nikola Tesla d.d., Zagreb, Croatia

³Croatian Meteorological and Hydrological Service, Zagreb, Croatia

Gaining a deeper physical understanding of the high-impact weather events repeatedly occurring over the Croatian coast is highly needed to reduce the casualties and economic impacts due to these highly localized and hardly predictable phenomena. Recently obtained national hail climatology in Croatia revealed that parts of the Croatian coast are frequently struck by early morning hailstorms with the local maximum of the daily activity occurring approximately at 08:00 h local time (CET). While the afternoon maximums of hail activity could be attributed to the daily heating cycle over land, the mechanisms responsible for the occurrence of the early morning maximum of hail activity are still unknown. This high uncertainty regarding the mechanisms associated with early morning hail formation stem from the scarcity of high-resolution modeling studies and observations of such events further lowering their forecasting ability.

Benefiting from the advantages associated with the convection-permitting high-resolution numerical modeling, this work aims to inspect the triggering mechanism and evolution of such hailstorms. Moreover, a special focus is on the role that synoptic, mesoscale, but also local conditions such as orography or the shape of the coastline, play in the formation of the convergence zone responsible for severe weather effects. Several cases of early morning hailstorms are selected for simulations using Weather Research and Forecasting (WRF) model alongside HAILCAST and Lightning Potential Index (LPI) parameterizations. HAILCAST is a one-dimensional hail growth model that forecasts the maximum hail diameter at the ground. Similarly, LPI highlights the areas with the potential for developing lightning activity. Using these recently developed tools alongside a highly valuable data set of hail observations from Croatian meteorological stations, Croatian hailpad network, and lightning observations from the LINET network, the ability of HAILCAST and LPI to reproduce the observed hail and lightning activity is assessed.

By utilizing a process-oriented approach for analyzing such high impact events, a deeper understanding of the synoptic, mesoscale and local conditions that benefit the development of hailstorms is obtained. This directly benefits the forecasting ability of early morning hail over the Croatian coast, but also highlights the ability and potential improvements of the high-resolution modeling systems and specific tools to represent such highly localized severe weather phenomena.