Simulating hailstorms over Croatia using WRF-HAILCAST and LPI – sensitivity to microphysics and PBL parameterization schemes

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Although frequent in Croatia, hail still remains a difficult phenomenon to model or forecast since the processes involved in producing hail are not fully resolved by current convection-allowing models (CAM). One way to address this issue is by embedding a physically-based one-dimensional hail model called HAILCAST within a CAM. HAILCAST is coupled with WRF since WRF, when run at a horizontal grid spacing of 4 km or finer, can reproduce dominant, large-scale circulations and hydrometeor fields associated with organized storms and convective systems.

Selected hail events are analyzed using WRF-HAILCAST model simulations. The vertical updraft, temperature, liquid and ice water content profiles from a given WRF timestep and grid columns are passed to the time-dependent WRF-HAILCAST model which forecasts maximum hail diameter at the surface. Since lightning usually accompanies hail, Lightning Potential Index for selected hail events is analyzed. Based on microphysics fields and updraft velocity, LPI indicates the regions with the potential for electrical activity. Here, a set of numerical convection-permitting experiments are performed to assess the sensitivity of HAILCAST and LPI results to four microphysics and three PBL parameterization schemes and to provide guidance for WRF-HAILCAST tuning. The results are verified by observational (hail pad, hail observations) data and lightning measurements.