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The role of cloud microphysics and model grid resolution in the development of severe convective events.

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The key processes involved in the development of severe thunderstorms or bow echoes still remain elusive, especially in the real time conditions encountered during the operational numerical weather prediction. The spatio-temporal variability and severity of the modeled system is determined by a non-linear interaction between dynamical and microphysical processes, uncertainties in the model initialization and/or boundary conditions, as well as various details of model numerics. In order to increase the predictability of the severe phenomena in the NWP framework it is important to find the best compromise between detailed but costly parametrizations and the efficiency of model setup. This research aims to explore the optimal configuration of the COSMO model for predicting the most devastating convective events. Numerical experiments include initialization of several thunderstorm events over Poland between 2017-2019 and study of the bow echo system which took place on 12 August 2017.

The two operational COSMO model configurations run at IMGW-PIB are set up with the coarse horizontal grid length of 7km and the convection permitting resolution of 2.8 km. Initialization and boundary conditions for the higher resolution cloud resolving simulations are based on the 7 km model forecast. The sensitivity experiments are revealing the effect of an increase of the convection resolving model resolution down to ~1 km and exploring impact of the microphysical parametrizations on the development and strength of the convective systems. The microphysical parameterizations for mixed-phase clouds include Kessler type bulk schemes and two-moment microphysics which predicts the evolution of mass as well as number densities of the several hydrometeor classes: cloud droplets, raindrops, cloud ice, snow, graupel and hail. The effect of nudging-based data assimilation on the convection initialization and the quality of short-range forecast is also explored.