Numerical Modeling of a Masurian Lake District Severe Convective System from 21 August 2007

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The 21 August 2007 severe convective system over the Masurian Lake District brought high public attention in Poland. The system led to severe surface wind gusts (up to 35 m/s) and significant storm-induced waves on the lakes. These caused extensive property damage and loss of life. The operational numerical weather prediction (NWP) model did not forecast the system development in advance. A meteorological study documented that the convective system developed within a tropical air mass and was weakly forced by synoptic-scale processes. The 2-m dewpoint temperatures along the path of the system exceeded 20 degree Celsius, and the spatial distribution of those high dewpoint temperatures overlapped the upper-air wind direction. The system evolved into a severe bow echo.

First attempts to model the system development applied operational COSMO NWP model in setup with the horizontal grid length of 7.0 km and nudging-based assimilation of conventional observational data. Neither that simulation nor the convection-permitting simulations (horizontal grid lengths of 2.2 km and 1.1 km) were capable in capturing the convection initiation and the subsequent system organization. To identify key discrepancies that prevented prediction of the convection initiation an analysis of key differences between observational and model data was undertaken. The key biases were identified in the soil temperature and in the lower tropospheric profiles. A revision of model data applying the Cressman objective analysis and the nudging scheme allowed obtaining NWP forecasts that represented quite realistic convection initiation. Additional sensitivity simulations examined relation between strength of the system and the environmental conditions, the dynamic equation solver (compressible versus anelastic), and the horizontal grid length.

This presentation will provide a short overview of the severe convective system as well as the analysis and modeling efforts described above.