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Derecho evolving from a mesocyclone - a study of 11 August 2017 severe weather outbreak in Poland: event analysis and high-resolution simulation

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This study documents atmospheric conditions, development and evolution of a severe weather outbreak that occurred on 11 August 2017 in Poland. The emphasis is on analysing system morphology and highlighting the importance of a mesovortex in producing the most significant wind damages. Derecho-producing mesoscale convective system (MCS) had a remarkable intensity and was one of the most impactful convective storms in the history of Poland. It destroyed and partially damaged 79,700 ha of forest (9.8 million m3 of wood), 6 people lost their lives, and 58 were injured. The MCS developed in an environment of high 0-3 km wind shear (20-25 m s-1), strong 0-3 km storm relative helicity (200-600 m2 s-2), moderate most-unstable convective available potential energy (1000-2500 J kg-1), and high precipitable water (40-46 mm). Within the support of a mid-tropospheric jet, the MCS moved northeast with a simultaneous northeastward inflow of warm and very moist air, which contributed to strong downdrafts. A mesocyclone embedded in the convective line induced the rear inflow jet (RIJ) to descend and develop a bow echo. In the mature stage, a supercell evolved into a bookend vortex and later into a mesoscale convective vortex. Swaths of the most significant wind damage followed the aforementioned vortex features. A high-resolution simulation performed with initial conditions derived from GFS and ECMWF global models predicted the possibility of a linear MCS with widespread damaging wind gusts and embedded supercells. Simulations highlighted the importance of cloud cover in the preconvective environment, which influenced the placement and propagation of the resulting MCS.