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Lightning activity and radar observations of the multicell thunderstorm system passing over Swider Observatory (Poland) on 19 July 2015 and its dynamic and electric charge structure obtained from the WRF_ELEC model

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In this work we present preliminary results on the thunderstorm event at IG PAS Swider Geophysical Observatory (52.12°N, 21.25°E, geomagnetic latitude ∼50.5°N, near Warsaw, Poland) on 19 July 2015. The storm was caused by the abrasion of the warm front that stretched almost latitudinaly and cold front moving from the west to the east. Warm continental-tropical arrived at southern and eastern part of the country and the rest was covered by cool polar-maritime airmass. The storm had the squall-line character of approximately 100 km length and consisted of several cells, and the height of the cumulonimbus (Cb) cloud base was 1 km and top was 14 km, as inferred from the analysis of CAPPI (Constant Altitude Plan Position Indicator), CMAX (Column Maximum Display), MLVCUT (Multiple-Line Vertical Cut) radar map products from POLRAD observations at Institute of Meteorology and Water Management - National Research Institute (IMWM-NRI), Legionowo station. In our paper we have discussed the obtained results of the post-time analysis of lightning activity and radar observations of the extended multicells thunderstorm system passing over IG PAS Swider Geophysical Observatory, on 19 July 2015 together with its dynamic and electric charge structure obtained from the WRF_ELEC model. We have used the archive data from the Polish National Lightning Location and Detection System PERUN (provided by IMWM-NRI) together with radar data obtained from the Doppler meteorological radar METEOR 1500C at Legionowo. Additionally, during the approach, passing over and moving away phase of the thunderstorm system, we have gathered the simultaneous and continuous recordings of E-field, the electric conductivity of air and the independent supplementary reference lightning detections delivered by the Swider measuring station of the Local Lightning Detection Network (LLDN) operated in Warsaw region. These data have given us a new possibility to acquire many valuable information about the characteristic type of the particular lightning flashes that were initiated by different adjacent thunderstorm cells developed in this time. On the other hand, the recorded E-field signatures of the lightning strokes by the LLDN measuring station have enabled us to differentiate between the variety of their types indicating the complex electric charge structure of the particular thunderstorm cells which developed in this storm system. Moreover, on the base of the supplementary numerical simulations of the considered thunderstorm episode by applying the WRF_ELEC model to the post-time analysis we were able to obtain the more detailed picture with more thermodynamic parameters not only about the specific electric charge structure of the considered thunderstorm cells, and how their thermodynamic pattern created the suitable conditions to initiate the observed lightning stroke types.

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