The relationship between cloud parameters and storm severity based on lightning and satellite data over Ukraine

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Integrated information from lightning detection sensors network and satellite systems are the primary tools for severe storm analysis and nowcasting. Lightning detection network (Earth Networks Total Lightning Network), which was installed in Ukraine is capable to detects the components of both intra-cloud (IC) and cloud-to-ground (CG) flashes, and algorithms use waveform shapes to differentiate between the IC and CG pulses (i.e. components) with a high efficiency and very precise spatial detection (200 m). Severe thunderstorms have certain characteristics in the lightning flashes, such as high IC flash rates in the storm formation stage. Severe storms may have either exceptionally low negative CG flash rates, or have exceptionally high positive CG flash rates; the greater volume of strong updrafts during a severe thunderstorm results in more charging overall, leading to greater numbers of ICs and positive CGs. Satellite images are extremely important for estimation of cloud parameters, such as brightness temperature (BT), optical thickness (OT), effective radius (ER) of ice particles, ice water content (IWC), cloud phase (CPH) and cloud top height(CTH). The MSG satellites, which has significant advantages compare to other one in spectral bands, spatial resolution and time sampling that provides a reliable tool for the estimation of these parameters in order to monitor the storm life-cycle.

This paper presents results of the analysis of cloud parameters (CP) and storm severity especially with strong lightning incidence, hail and intense precipitation observations during events in Ukraine. The CP considered here – BT, OT, ER, IWC, CPH and CTH, which are compared with the number of strokes, IC/CG and Peak Current as measured by a ground lightning network (Earth Networks Total Lightning Network). Results show a strong correlation between measured parameters and high IWC content and relatively high ER. Other cloud parameters have specific ranges, when lightning can be occur.