ECSS2023-59, updated on 24 Apr 2024
https://doi.org/10.5194/ecss2023-59
11th European Conference on Severe Storms

Nowcasting thunderstorm hazards with radar polarimetry using deep learning

Nathalie Rombeek, Jussi Leinonen, and Ulrich Hamann
Federal Office of Meteorology and Climatology MeteoSwiss, Locarno-Monti, Switzerland (nathalie.rombeek@meteoswiss.ch)

Severe convective weather events, such as hail, lightning and heavy rainfall pose a great threat to humans and cause a considerable amount of economic damage. Nowcasting convective storms can provide precise and timely warnings and, thus, mitigate the impact of these storms. Dual-polarization weather radars are a crucial source of information for nowcasting severe convective events. These radars provide important information about the microphysics of the convective systems, on top of the rainfall rate and vertical structure of the reflectivity. Nevertheless, polarimetric variables, which can provide additional information about the size, shape and orientation of particles, are often not considered in nowcasting.

This work presents the importance of polarimetric variables as an additional data source for nowcasting thunderstorm hazards using machine learning, compared to using radar reflectivity alone. We add these data to the neural network architecture of Leinonen et al. 2022 (Seamless lightning nowcasting with recurrent-convolutional deep learning), which uses convolutional and recurrent layers and analyzes inputs from multiple data sources simultaneously. This network has a common framework, which enables nowcasting of hail, lightning and heavy rainfall for lead times up to 60 min with a 5 min resolution. The study area is covered by the Swiss operational radar network, which consists of five operational polarimetric C-band radars. In addition, we analyze the contribution of quality indices as an additional information source, which takes the uncertainty of the radar observations throughout the complex mountainous terrain and scanning strategy in Switzerland into account. Results indicate that including polarimetric variables and quality indices improves the accuracy of nowcasting convective storms.