18–22 September 2017, Pula, Croatia
ECSS2017-136-1

Thunderstorm nowcasting by applying machine learning to a multi-sensor observation and NWP model data base

Lea Beusch (1), Lorenzo Clementi (1), Ulrich Hamann (1), Alessandro M. Hering (1), Elena Leonarduzzi (2), Daniele Nerini (1), Luca Nisi (1), Marco Sassi (1), and Urs Germann (1)

(1) MeteoSwiss, Locarno, Switzerland (lea.beusch@meteoswiss.ch), (2) Institute of Environmental Engineering, ETH Zurich, Zurich, Switzerland

Severe convective systems and thunderstorms often cause risks due to the formation of hail, heavy rain, gale-force wind gusts, lightning and flash floods. Because of limited spatial resolution and parameterized cloud physics, current NWP models face difficulties to predict the exact position and strength of hail producing thunderstorms. Nowcast methods improve the quality of the thunderstorm prediction for a forecast period of some hours supporting the issue of specific, high precision, localized severe weather warnings. Most nowcasting algorithms are composed by a series of threshold tests. An alternative approach are machine learning techniques, a collection of powerful methods able to extract the wealth of information about the typical development of severe convective systems contained in continuously growing archives of modern remote sensing observations such as radar, satellite and lightning measurements.

In this talk we present the latest version of the "Context and Scale Oriented Thunderstorm Satellite Predictors Development" algorithm COALITION-3 developed by MeteoSwiss. Its overall goal is to identify, track and nowcast the position and intensification of convectively active regions in an accurate, continuous and robust manner. It focuses on Switzerland and its adjacent regions, has an update cycle of 5 min and a spatial resolution of 1 km. The thunderstorm velocity is estimated by optical flow methods in combination with winds predicted by COSMO. By Lagrangian translation, the storm's movement can be separated from its temporal development. Subsequently, COALITION-3 locates the area of thread, estimates the future convective intensification and quantifies the probability and severity of the different risks associated with thunderstorms. It extracts this information by applying machine learning techniques to a comprehensive data archive containing observations of the MeteoSwiss dual polarized Doppler radar system, rapid scan measurements of MSG/SEVIRI as well as forecasts of the high-resolution NWP model COSMO-1. Furthermore, Météorage lightning observation are used as convective indicator. This database contains the evolution of a large number of thunderstorms, in ideal situations over the whole life cycle of a cell including initiation, intensification and decay. To conclude, an evaluation of the pre-operational COALITION-3 results for the summer season 2017 is presented.