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Combined use of complementary methods for a continuous thunderstorm forecast

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Thunderstorms are often accompanied with hail, heavy rain and gale-force wind gusts. Furthermore, lightning and flash floods could cause severe damages to properties and infrastructure and may lead to live threatening situations. Losses due to natural catastrophes represent about 0.3% of the GDP globally, out of which 30% to 45% are related to severe convection. Real time thunderstorm forecast requires complementary tools with different forecasting horizons such as NWP models, nowcasting algorithms and different observation systems. In this presentation we describe a typical procedure to monitor the risk of thunderstorms at MeteoSwiss from an early outlook several days before the event up to specific high precision warning shortly before the event.

From few days up to 12h before the event, information about convective activity is assessed through forecasts of the NWP model ensemble COSMO-E and high resolution model COSMO-1 by examining predictors such as wind shear, CAPE and near surface moisture. A numerical checklist based on COSMO-1 data is used to estimate the probability of severe convection, distinguishing between thunderstorms triggered by synoptic forcing and air mass thunderstorms. In case of large probabilities, the specific COSMO fields are analyzed more in detail. This could lead to the emission of a general warning outlook without exact localization, as current NWP models face difficulties to predict the precise position and strength of thunderstorms. Hence, during the day of interest, radar, satellite, and lighting observations as well as nowcasting algorithms are employed to monitor the triggering and intensification of convection and to issue a localized warning with correct severity. The TRT algorithm locates severe cells by means of radar observations and monitors a comprehensive set of cell properties, such as precipitation rate, VIL, echo tops, and lightning frequency. TRT also generates automated thunderstorm warnings including hail. The forecasters have 3min to reject or modify the proposed warning before the delivering process to the end-users takes place. Other algorithms help to evaluate the quality of the automatic system and possibly to anticipate the detection of probable severe thunderstorms. E.g. the COALITION-3 algorithm exploits a multi-sensor database with machine learning algorithms to estimate convective intensification. In particular it uses MSG/SEVIRI observations for an early detection of emerging convection. To further improve the quality of the thunderstorm warnings, continuous development of innovative automatic systems and training of forecasters to use those are fundamental to integrate the steadily increasing amount of available information coming from various sources in real time.