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Improving hail nowcasting by combining crowd-sourced hail reports with machine learning

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Since 2015, the MeteoSwiss App allows its users to report the hail size they observe by choosing one of six hail size categories (going from “smaller than a coffee bean” to “tennis ball”) and “no hail”. The comparison with the radar-based hail algorithms POH (probability of hail) and MESHS (maximum expected severe hail size) has shown that the quality controlled crowdsourced reports could potentially improve the operational radar hail products that are used for nationwide hail monitoring and nowcasting.

Here, we present the development of machine learning models to recognize, differentiate and correctly nowcast the properties of thunderstorms that lead to “no hail”, “small hail” (hail stone diameter <2cm) or “large hail” (≥2cm). We use the hail crowdsourcing dataset as ground truth. The training dataset describes the environment of thunderstorms passing over areas with high population, where all hail events should be captured by the crowd sourced data. The potential predictor variables are taken from the Swiss radar network, MSG SEVIRI observations, the Meteorage lightning detection network and several convective variables from COSMO-1 model.

The goals are twofold: First we diagnose which combination of parameters best describes the properties that lead to hail at the location and time steps of the crowdsourced reports. As a comparison, this analysis is repeated for the same locations and time steps to describe the radar-based hail products.

Secondly, a hail nowcasting algorithm is trained to predict hail occurrence for the near future. The thunderstorms are detected using Meteoswiss’ thunderstorm radar tracking. The thunderstorm properties of the previous 45 minutes are monitored within a circle of 23km around each cell following the cell in a Lagrangian frame (see also other conference contributions of Hamann et al. and Nath et al. about COALITION-3). Using a machine learning algorithm, the input variables are ranked according to their importance and the probability for the onset of small hail or large hail is predicted.