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Identification of hail environments by machine learning methods

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Hailstorms are one of the most costly natural hazards, causing damage in agriculture, to buildings, vehicles and infrastructures. Since direct observations are sparse, alternative pathways are sought to quantify the hazard and potential future changes.

Here we present a novel approach using machine learning techniques to identify typical environments of hailstorms. Several thousand hail reports from quality-controlled databases, including the European Severe Weather Database ESWD and the Australian Severe Storm Archive, are evaluated for this purpose. Parameters such as CAPE, wind fields, lapse rate and freezing level in a domain around the hail reports are extracted from the ERA-Interim reanalysis. They are then fed into a machine learning algorithm in the Tensorflow/Keras framework.

Dense and convolutional neural networks have been developed. Retained parameters, recognized patterns and predictive skill are compared. The trained networks can be used to estimate the climatological frequency of hail events in model data. Existing hail proxies such as overshooting top data can serve as a reference climatology or be improved by attributing a hail probability via these networks. First results will be presented for regions in Europe and Australia, and differences will be discussed.