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Extraction of information for forecasters in convective-scale ensembles: supercell detection and rainfall synthesis

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The use of ensemble prediction systems (EPS) enables the quantification of forecast uncertainty. However, the use of EPS is challenging due to the large amount of information it provides. Forecasts from EPS are typically summarised using statistical measures (such as quantiles maps). Although this mathematical representation is effective in capturing the ensemble distribution, it lacks physical consistency, which raises issues for many applications of EPS in an operational context. Following the application of a bow echo detection tool appreciated by forecasters at Meteo-France, we propose two different approaches for providing physically consistent synthesis of French convection-permitting AROME-EPS forecasts.

The first approach is similar to bow echo detection but it is applied to supercell. Supercell can especially produce hail, strong winds or tornadoes. To summarise the risk of supercell in AROME-EPS forecasts, a convolutional neural network has been trained to automatically detect these supercells in AROME-EPS members based on updraft helicity, reflectivity and hail diagnosis. Then, different synthesis plots are produced, based on these detections. A case study will be presented to better understand the usefulness of these plots.

The second approach is a rainfall synthesis. The aim is to automatically classify the members into different classes pre-defined by rainfall climatology. To design a rainfall synthesis, the procedure can be divided into two parts. The first step aims to extract relevant features from each EPS member to reduce the problem dimensionality. Then, clustering is performed based on these features. The originality of our work is to leverage the capabilities of deep learning for feature extraction. For this purpose, we use a convolutional autoencoder (CAE) to learn an optimal low-dimensional representation (also called latent space representation) of the input forecast field. The clustering task is then accomplished using a SOM algorithm. In this work, the algorithm is developed to work on 1-hour accumulated rainfall from AROME-EPS. The rainfall synthesis plot summarises information concerning rainfall positions, the number of members in each class, and rainfall intensities. The rainfall synthesis will be presented for a case study in this presentation.

The two methods proposed are shown to provide an additional and complementary information, useful for facilitating the human expertise. In addition, their design is generic enough to be applied to other events and variables.