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Object-oriented processing of deterministic and ensemble weather forecasts: application to rainfall and convection hazard

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A new object-oriented processing has been developed to detect hazardous phenomena predicted by meteorological model. Applied to a deterministic forecasts, the processing enables to cope with small scale unpredictable details of mesoscale structures in meteorological models and to quantify the uncertainties on the location of the predicted phenomena. Applied to ensemble forecasts, the processing traditionally retrieves the uncertainties on meteorological scenarios represented by each ensemble member. The processing is looking for meteorological objects in the forecasts, which are defined by a reference histogram representing a meteorological phenomena in the model predictions. The reference histogram of the meteorological phenomena is built with few representative cases.

When applied to a deterministic model output, the new object-oriented processing is done in two steps.The first one is to built a similarity map by comparing the forecast to a reference histogram. An object is detected where the similarity is greater than a given threshold. In the next step, a particle system is used to quantify the location uncertainty. For each particle, the detection threshold is perturbed using a Gaussian noise with spatial coherence. A new object is then detected using the perturbed threshold. Thus, the obtained ensemble of objects describes the possible locations of the meteorological phenomena associated to the reference histogram.
When the processing is applied to an ensemble model, a third step is added to synthesize the results for all the ensemble members. This step uses the ensemble of objects detected for each member to compute a map of probability to belong to an object.

We will present an application of the object-oriented processing with deterministic (AROME) and ensemble (AROME-PE) models to rainfall detection using predicted precipitation or predicted radar reflectivity. Three severity levels of precipitation objects are defined: a rainfall object, a moderate precipitation object and a heavy precipitation object. Moreover, a work to detect the precipitation texture has been done to distinguish between continuous and intermittent rain. We will show that scenarios adapted to the different users may be deduced from the probability map obtained using the ensemble model. As an example, predicted precipitation hazard for transport will be presented.