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Study of classified severe convective weather probability forecasts based on the ECMWF ensemble prediction system

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Based on the ECMWF ensemble prediction system, a joint-probability method are used to forecast the probabilities of classified severe convective events, including heavy rains above 30mm in an hour, gales exceeding 17.2m/s, and hails over 5mm in diameter. The joint-probability method can be summarized in two main steps. The first step is to choose the proper thresholds of essential convective parameters, such as moisture, lifting, instability and vertical shear of horizontal wind, which are significantly related with severe convective weather and are uncorrelated with each other. It is useful to analyze on the statistical characteristics of the convective parameters prior to this step. The second step is to calculate the probabilities of the convective parameters exceeding certain thresholds respectively and combine them. Therefore, the probability forecasts of severe convective events, in the form of joint probability distribution, are products of the probabilities of related convective parameters. The verification of these probability forecasts during the flood season of Fujian Province from March to September in 2013 have also been carried out. In general, the forecasts are encouraging in short-time heavy rain cases, of which the Brier skill score is less than 0.4. But the Brier score is higher in spring than that in summer, indicating that the joint-probability method is flow-dependent. According to the climatic characteristics of this region, the short-time heavy rains frequently occurring in spring are related with the convective scale systems, of which the uncertainties are the highest in the prediction. On the contrary, the heavy rainfall events during July to September usually resulting from synoptic systems, especially typhoon, which are much more predictable. Under specific synoptic situations, the probability forecasts are also valuable for predicting the events of gale and hail influencing for a long time and a wide area. But for those relatively less intense cases, in which convective systems are disperse and lack of organization, majorly induced by local heat convection, the capacity of this method is rather limited although several ensemble members may still capture important features to some extent. One of the main possible reasons to this defect is that the temporal and spatial resolutions of the ECMWF ensemble prediction system are not high enough to forecast local and short-lived mesoscale convection well.