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Ensemble sensitivities of the real atmosphere: Application to Mediterranean intense cyclones

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Ensemble sensitivity has been recently proposed as another approach to sensitivity analysis in which simple statistical tools are used to estimate relationships between forecast features of interest and initial conditions. In this study we compute sensitivities of prototype intense Mediterranean cyclones using this technique. The climatology is based on the ECMWF ERA-40 fields, from which 1202 intense Mediterranean cyclones are objectively detected and classified in 25 clusters, focusing on the location of the cyclone at the time of maximum intensity as well as the precursory low and mid-level synoptic standard fields. Sensitivity maps for each class are calculated. As one could expect, there is a wide range of areas that are influential during the 48h preceding the mature stage of intense Mediterranean cyclones. Sensitivity patterns tend to focus on upstream strong-gradient regions for the temperature and height fields, confirming its relevance on the future evolution of the situations and eventual cyclone intensification. A synthetic result combining the sensitivity fields for all intense Mediterranean cyclone classes shows that the climatological areas where the prediction of these cyclones is most sensitive to encompasses western and central Europe, the north-eastern Atlantic and north Africa. This climatological sensitivity results could support future decisions regarding the optimization of observational strategies at European scale, with special emphasis on Mediterranean high impact weather. This results complement with and compare well to sensitivity fields obtained using adjoint techniques, although differences among them will be shown and further discussed.