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Verification of sensitivities of Mediterranean intense cyclones

L. Garcies and V. Homar
UNIVERSITAT ILLES BALEARS, PHYSICS, PALMA, Spain

The Mediterranean region is frequently affected by intense cyclones that produce hazardous weather such as strong windstorms and heavy rains. Sensitivity analysis of these events points at precursor atmospheric features that have a relevant effect on a particular aspect of the cyclone, such as its central pressure. Conclusions derived from such analysis supports decision makers regarding the design of an efficient routine observing network and targeted observation strategies. Previous studies of ensemble sensitivities of Mediterranean intense cyclones showed that in average, the evolution of the intense Mediterranean cyclones 24h prior to their maturity stage depends largely on structures located over Western Europe, the Northern African lands and parts of east North-Atlantic ocean. The accuracy of these initial results were hampered by sub-optimal methodological procedures leading to excessively heterogeneous cyclone classes. As a consequence, the application of the statistical calculation of sensitivities were questionable and a new classification of Mediterranean intense cyclones was rebuild to improve the reliability on the final climatological sensitivity results. We used a classification criteria oriented at improving the results of the ensemble sensitivities method. Thus, cluster homogeneity and size were optimized to increase the signal of physical correlations and reduce spurious distant structures that degraded the original sensitivity results.

In order to quantify the reliability of the optimized ensemble sensitivity results derived from the new classification, as well as to compare the performance of the available ensemble and adjoint sensitivity calculation methods, a verification testbed for sensitivity fields is set up. Numerical experiments with the NCAR Advanced Research WRF ARW model are conducted for a number of case studies to evaluate the ability of each method in identifying areas where perturbations in the initial conditions derived from the sensitivity fields lead to a greater impact on the intense cyclone forecast. The reliability of each sensitivity calculation method will be discussed by means of the verification outcome.