Sensitivity areas of Mediterranean cyclones derived from the MM5 adjoint model: Application to mesoscale ensemble forecasts

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Many of the cyclones developed over the western Mediterranean region are associated with high impact weather phenomena that affect the society of its coastal countries. In order to improve the short and mid-range numerical forecasts of this kind of events, ensemble prediction systems based on perturbed initial and boundary conditions are being tested in the context of the Spanish project PRECIOSO. In this study, a Potential Vorticity (PV) Inversion Technique operating on the MM5 mesoscale model fields is applied to generate the ensemble members. The simulations are performed for a two-day period with a 22.5 km resolution domain (Domain 1 in http://mm5forecasts.uib.es) nested in the ECMWF large-scale forecast fields.

The method uses the PV sensitivity areas calculated by the MM5 adjoint model under a response function given by the low-level vorticity predicted over the western Mediterranean region. Perturbations of the PV field are introduced in these areas closely following the spatial and intensity pattern of the sensitivity field. The difference between the inverted mass-wind fields from perturbed and unperturbed PV distributions define the modifications introduced in the MM5 initial and boundary conditions. A PV error climatology (PVEC) was found in an earlier work in order to introduce perturbations of realistic magnitude in the ensemble prediction system.

Preliminary results showing the potential of this methodology will be presented for selected MEDEX cyclones, with special attention to forecast precipitation and sea level pressure fields. It seems that perturbing according to PV sensitivity patterns instead of randomly, produces higher spread and more realistic results.