Modification of initial conditions through perturbing the potential vorticity field in mesoscale forecasts of Mediterranean heavy precipitation events: 10 June 2000 and 9 October 2002

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Heavy precipitation events occur regularly in the western Mediterranean region. These events often have a high impact on the society due to economic and personal losses. The improvement of the mesoscale numerical forecasts of these events can be used to prevent or minimize their impact on the society. Both the uncertainties in the initial conditions and the model parameterizations are the two main sources of forecast error, so in order to deal with the initial conditions uncertainties a new approach based on a manual perturbation of the PV field has been tested. Perturbing the PV field ensures modifications of all the meteorological fields without compromising the mass-wind balance thanks to the invertibility principle.

This manual perturbation technique uses the satellite water vapor (WV) observations to guide the correction of initial PV structures. The correction of the PV field attempts to improve the match between the PV distribution and the WV image, taking advantage of the relation between dark and bright features of WV images and PV anomalies, under some assumptions. Afterwards, the PV inversion algorithm is applied to run a forecast with the corresponding perturbed initial state.

The non hydrostatic MM5 mesoscale model has been used to run all forecasts. 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 MEDEX cyclones of 10 June 2000 and 9 October 2002, that produced heavy precipitations over Catalonia, are a suitable testbed to compare the performance of the method.

The performance of the technique is evaluated through the verification of the rainfall field and compared with a non-perturbed simulation. The results show a good improvement of the forecast if the initial conditions are perturbed to match the satellite information in both events. These modifications may be very useful in short-term forecasting where the satellite information could be available in time.