A sensitivity of two MAP IOP events to the estimated uncertainties in the upper-level dynamical factors

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Mesoscale mountain ranges, such as the Alps, are well known regions of frequent lee cyclogenesis. Two events of Alpine lee cyclogenesis during MAP, IOP5 and IOP15, were both associated with severe weather in the south-eastern Alpine region - heavy precipitation (locally exceeding 200mm/12h) occurred during IOP5 over the northeastern Italy, Slovenia and continental Croatia, while extreme Bora (gusts over 50ms^{-1}) developed during IOP15 over the northern Adriatic.

A numerical analysis on the sensitivity of the analyzed events to initial uncertainties in the upper-level dynamical factors was performed with the MM5 mesoscale model. First, a statistics of the differences in the upper-level potential vorticity was calculated using ECMWF and NCEP reanalysis of the 21 events of the strongest Mediterranean storms. This statistics served as a proxy for estimating the model uncertainties in the intensity and position of the upper-level trough. Thereupon, the statistics was used to deterministically scale the synoptic modifications (with a 90th percentile of the derived model error statistics) in the intensity and position of the upper-level trough in the initial conditions of the analyzed events. In this way, a consistent method was used to produce an ensemble of MM5 model simulations, with an estimate of the model uncertainty in the upper-level trough only, thus exploring the predictability of the analyzed phenomena due to the factor that strongly favors their development. The ensemble results indicated a notable variability in the intensity and position of the analyzed lee cyclones, especially during the lee cyclone generation and dissipation phases. Furthermore, the non-dimensional analysis of the background flow properties during extreme Bora and quasi-geostrophic forcing during heavy precipitation showed that both extreme weather events were highly sensitive to a synoptic environment, indicating the strong influence of initial uncertainty in the upper-level dynamical factors to the correct prediction of the severe weather in the region.