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Assessing characteristics of Mediterranean explosive cyclones for different data resolution

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It is well known that the effect of spatial and/or temporal resolution on cyclonic characteristics is more prominent in secondary storm track areas, such as the Mediterranean basin, since these areas are favorable for the formation of smaller scale cyclones, contrasting the areas of main storm tracks, such as North Atlantic. In many studies, the issue of resolution is tied up with the fact that different analysis systems have been used. This issue is complicated because some of the models are actually run at different resolutions, different input observed data are used and the important physics in the assimilating models are different, as well.

Following the above perspective, the objective of this study is to assess the effect of resolution in identifying and investigating explosive cyclones in the Mediterranean, by comparing two climatologies for two different spatial resolutions of the ERA-40 mean sea level pressure data (2.5 x 2.5 and 1.0 x1.0 degrees)[U+F029] For this purpose, the Melbourne University cyclone finding and tracking scheme (hereafter, MS scheme) is employed, which is developed in Melbourne University according to the Lagrangian perspective.

It should be noted that in our study the derived climatologies are based on the same assimilation model, giving the opportunity to test the pure effect of resolution on the detected cyclone tracks, and not the implicit influence from datasets of different qualities.

The explosive cyclones were identified in both datasets in terms of the normalized central pressure deepening rate (NDRc). The number of explosive cyclones in the low resolution dataset (LR cases) is 56 and the respective one for the high resolution dataset (HR cases) is 228.

Comparison between the tracks has been performed using a Lagrangian based methodology and it was found that a large proportion (about 83%) of the defined tracks in the LR cases of this study, are included in the HR cases. On the contrary, only a small portion of the HR cases is present in the LR track set, showing the significant role of the increased spatial resolution in the identification procedure.

Then, the two datasets are compared regarding: a) the distribution of the intermonthly, seasonal and inter-annual frequency, b) specific characteristics of the explosive cyclones, such as deepening rate, central pressure during maximum deepening, explosive deepening and intensity.

It was found that the spatial and time distributions of the explosive cases in the two different resolution datasets present main quantitative differences. The major discrepancies are related to the total number of the explosive cyclones, while the main patterns of cyclogenesis-cyclolysis, maximum deepening positions present reasonable agreement.

The use of lower resolution datasets, especially in secondary storm track areas, mainly suffers due to the fact that smaller scale cyclogenesis is not effectively captured. This is crucial in the Mediterranean, where the orography defines the variations of the behavior of the main cyclogenetic regions. The detection of small scale cyclonic features is important, since their interannual variability may have strong impacts on local weather, as they mainly contribute to the spatial distribution or the decadal trends observed in precipitation.