

Climate model simulations of the large-scale conditions associated with the genesis of Medicanes

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Medicanes (Mediterranean tropical-like storms) are violent windstorms that, once developed over the sea, have the potential to affect islands and coastal regions. This phenomenon operates on the thermodynamical disequilibrium between the sea and the atmosphere like tropical cyclones. This analogy is confirmed through their visual appearance in satellite images: axisymmetric cloud structures with a convective wall around a relatively cloud-free central eye.

A genesis probability index “GENpdf” has been formulated in the literature which has been successfully tested for the observed genesis of tropical storms. It depends on the thermodynamic contrast between the sea surface and overlying air, the low-tropospheric vorticity, mid-tropospheric relative humidity and the deep-layer wind shear. Large values of this index are revealed as a necessary -although not sufficient- diagnostic indicator of medicane producing synoptic environments after analysing twelve different cases. The present study attempts to analyse the changes in frequency and intensity of these medicane potential environments imposed by global warming.

Specifically, the ERA-40 reanalysis for the period 1981-2000 are first analysed to obtain the q99 and q99,9 percentiles of GENpdf for the whole Mediterranean basin. On the other hand, climate simulations for 1981-2000 (control) and 2081-2100 (future) under A2 and A1B scenarios provided by five GCMs are considered. Monthly and subregional exceedance of q99 and q99,9 are calculated from these simulations. These exceedances are first compared against the ERA-40 time-spatial patterns to assess the goodness of each GCM for the control period, and then the changes between control and future time slices are evaluated.

Furthermore, a first guess of a probabilistic risk map of medicane genesis is produced for the present and future climates. The present map is shown to be compatible with the true occurrence of medicanes. The future map indicates, for most of the regions and GCMs, a lower occurrence of medicane-favorable conditions at synoptic scale.