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Climate change effects on medicanes based on a dynamical downscaling method

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Mediterranean tropical-like cyclones (also called medicanes) are extreme events that occasionally occur over the Mediterranean sea and threaten the islands and coastal regions. These warm-core storms operate on the thermodynamical disequilibrium between the sea and the atmosphere, and although their dimensions and other meteorological parameters such as the attained maximum wind speed differ in magnitude with real tropical cyclones, their development mechanism and satellite images appear to be similar.

For projecting future climate-driven changes in medicane risk, a collection of GCMs have been used, but their typical coarse resolution make them inappropriate to deal explicitly with this kind of extreme phenomena of mesoscale size. For this reason, it is necessary to find a link between both scales, looking first for some large-scale parameters that are related with medicane genesis. An empirical genesis index for tropical cyclones which involves large-scale environmental ingredients like low-tropospheric vorticity, mid-tropospheric relative humidity, potential intensity and tropospheric wind shear, is revealed as an useful parameter to detect areas with a potential risk to develop a medicane. In second place, the ability of the MM5 numerical model to simulate known cases of medicane storms has been proved. These control simulations have been run with a horizontal resolution of 7.5 km and are forced using large-scale analyses with a coarse resolution, similar to that of the current generation of GCMs.

Then, a dynamical downscaling method has been devised: areas presenting high values of the empirical genesis index are identified and numerically simulated with MM5. Results derived from ERA-40 are compared, on the one hand, against the satellite-based climatology of events and, on the other hand, against the GCM-derived results, thus permitting the assessment of the effects of climate change on the medicane frequency and intensity. As one would expect, the medicanes reported in the current climatology are well represented using this authomatic and objective method. In addition, the statistical distribution of the areas with the highest potential for the development of medicanes, using ERA-40 and GCMs (for the current and future time slices), are consistent with the current climatology of events, both in spatial and temporal distribution. At the time of this writing, possible medicane development in the simulations is checked manually, but an objective cyclone detection algorithm is going to be implemented to make the process fully automatic.