Detection of Mediterranean hurricanes: a challenging task aimed at assessing the risk in the present and future climate

Tropical-like cyclones occasionally develop over the Mediterranean Sea, sometimes attaining hurricane intensity and threatening the islands and coastal regions. These extreme small-scale warm-core storms, called medicanes (MEDIterranean hurriCANES), operate on the thermodynamic disequilibrium between the sea and the atmosphere and in this respect, as well in their visual appearance in satellite images, are much like tropical cyclones.

Due to the small size of the medicanes, traditional methods used to detect cyclones are not suitable here. For that reason, an alternative method was applied in this study. A database of twelve medicanes was created based on Meteosat satellite images for the period 1982-2005. It was necessary to decide selection criteria to isolate medicanes from other Mediterranean cyclones, typically baroclinic storms. Main selection criteria are cyclone size, cyclone eye clarity and lifetime. The identification on the satellite images was done subjectively.

Some meteorological features of large-scale environments associated to tropical cyclones, here extended to medicanes, have been compared against the bulk of ordinary (i.e. baroclinic) Mediterranean cyclonic environments. These conditions have been described in terms of thermodynamic indices highlighted in previous studies on hurricanes. Among these, an empirically-derived genesis index for the tropical regions and the diabatic contribution to surface-level equivalent potential temperature local tendency are revealed as appropriate discriminative parameters.

Finally, since this work is included in the framework of the project “MEDICANES: meteorological environments, numerical predictability and risk assessment”, which pursues the quantitative assessment of medicane risk and its uncertainty under future climate conditions by nesting the MM5 model within a large collection of GCM simulations, it was necessary to evaluate the capability of MM5 to resolve medicane events depending on varying spatial resolutions of the GCM forcing. Then, different case studies have been simulated at 7.5 km horizontal resolution under three configurations: a control run nested in the ECMWF analyses with a resolution of T213 (~85 km), higher than typical grid lengths of future climate models, and two coarser experiments using 125 km and 250 km input resolutions. These experiments reveal the development of medicane-like structures, even with the coarsest input resolution.