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Dynamics and predictability of Medicanes in the ECMWF ensemble forecast system

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Medicanes are intense tropical-like cyclones which occasionally strike the Mediterranean region. These storms constitute a major threat due to strong winds and intense precipitation which can lead to flooding. While initially originating from extratropical systems with a baroclinic energy source, Medicanes later undergo a transformation referred to as tropical transition (TT), during which they develop tropical-like features such as a warm core, deep convection near their center with sometimes a cloud-free eye, a largely axisymmetric appearance and surface fluxes from the underlying sea as prominent energy source.

The dynamics and predictability of several Medicanes in the ECMWF ensemble prediction system (EPS) will be analyzed in this presentation, from the planetary scale down to the mesoscale. The influence of Rossby wave breaking (RWB) on the formation and early phase of Medicanes is assessed by linking the uncertainty of Rossby wave forecasts with the one in storm formation, intensity and position. The uncertainty in position and depth of upper-level geopotential height and PV precursor troughs is then linked to RWB as well as to different storm development pathways. A suite of methods and diagnostics is utilized, including storm track comparison, cyclone phase space "Hart" diagrams and track clustering, to assess the extent to which TT occurs and ultimately the ability of the ECMWF EPS to accurately predict Medicanes.

Results show a clear influence of large-scale processes on storm development pathways. The occurrence of RWB and the presence of a deep upper-level cut-off trough, usually associated with PV streamers, are crucial in decreasing vertical wind shear and facilitate the development of intense convection. For this reason, the EPS members having large errors in large-scale processes also tend to have poorer accuracy in storm intensity, position and structure. Spatial uncertainty in storm tracks is high even for short lead times, whereas structure changes linked to TT are usually better forecast. A jump in forecast accuracy is found between 3 and 5 days lead time for most storms, marking a limit in mesoscale predictability due to larger-scale errors propagating to the smaller scales. Cluster analysis based on storm characteristics sheds further light on the linkage between the uncertainty in storm evolution and forecast uncertainty of larger-scale features.