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Hindcast Simulation of Medicanes with an Atmosphere-Ocean-Wave Coupled Modelling System

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Tropical-like Mediterranean storms associated with strong winds, low pressure centers and extreme precipitation are called medicanes. These devastating storms threaten the coastal regions and some small islands in the Mediterranean. Recent studies including future climate projections indicate that the intensity of medicanes could increase under the climate change conditions. Therefore it is important to improve a comprehensive understanding of the medicanes and their occurrence processes including thermodynamic mechanisms between the atmosphere and the sea. In pursuing these mechanisms, we use reanalysis/observations (ECMWF's ERA5 and MyOCEAN etc.) and coupled Regional Earth System Model (RegESM). The RegESM model is run in coupled mode (Regional Climate Model-RegCM4-12km coupled with Regional Ocean Modelling System-ROMS-1/12°, and Wave Model-WAM-0.125°) and uncoupled mode (RegCM4 only-12km) for 1979-2012 period over the Med-CORDEX domain prescribed under the CORDEX framework. Additionally, standalone simulation of RegCM4 has been forced by Era-Interim Reanalysis over the Med-CORDEX domain and the standalone simulation of the wave model (WAM) has been forced by the standalone RegCM4 wind field (12 km horizontal resolution) for the Mediterranean Sea.

We analyze the ability of the coupled and uncoupled models to reproduce the characteristics of the observed medicanes and to investigate the role of air-sea interaction in the simulation of key processes that govern medicane occurrences over the study area. In general, the spatial extent and the timing of the observed medicanes better simulated with the coupled model. The reason behind this better replication with the coupled model is the wave model's interactive contribution with the roughness length to the surface winds, which allows necessary conditions for medicane formation. Our results also reveals that the recently developed modeling system RegESM incorporates atmosphere, ocean and wave components and thereby is better capable to improve the understanding of the mechanisms driving medicanes.

Keywords Regional earth system model, Ocean-atmosphere-wave coupling, Medicanes

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