



Evaluation of Tracking Methods for Mediterranean Tropical-Like Cyclones using satellite observations: A Comparative Study Using the Generation Index and Mean Sea Level Pressure

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Mediterranean Tropical-Like Cyclones or "Medicanes" tracking is a crucial aspect of understanding and predicting these rare meteorological phenomena. In this study, we aimed to evaluate and compare two tracking methods based on the genesis index (GEN) and mean sea level pressure. The GEN index, initially developed for tropical cyclones (Emanuel and Nolan, 2004), integrates various meteorological parameters, including the idealized maximum wind speed or Potential Intensity (PI), low-tropospheric vorticity, mid-tropospheric relative humidity, and deep-layer wind shear. While this index has shown promises in the literature, for tropical cyclones (Emanuel and Nolan, 2004), but also in synthetic generation of medicane tracks for climatological studies over the Mediterranean (Romero and Emanuel, 2013), its performance in tracking tropical-like cyclones and its comparison to the most common tracking method remains uncertain. Our analysis is carried out on a subset of seven documented medicane cases from 2014 to 2021, focusing on those exhibiting warm-core characteristics in the satellite observations (Panegrossi et al 2023). Using ERA5 reanalysis data, we tracked these medicanes with two methods, one based on the tracking of minimum mean sea level pressure, and one based on the tracking of maximum GEN index values and compared the results against the reference track as obtained by combination of different tracking methods (Flaounas et al., 2023). The information about the warm core center provided by passive microwave radiometers is used as reference. Our findings reveal that while the GEN index tracking method presents greater RMSE than the mean sea level pressure tracking method compared to the reference, it demonstrates improved performance in capturing intense phases of cyclones, particularly when these cyclones exhibit deep warm core characteristics for ERA5 as evidenced by means of the ERA5-based Hart Parameters (Hart, 2003). We observed that initial phases of cyclone development pose greater challenges for both tracking methods, suggesting higher uncertainty in ERA5 reanalysis center location during early cyclogenesis stages. Our study provides valuable insights into medicane tracking methodologies and highlights the need for continued refinement and validation using satellite observations, particularly in the context of ERA5 reanalysis data. Further research efforts are warranted to optimize tracking methods, especially in the early development phase, and improve our understanding of medicane dynamics, ultimately enhancing forecast accuracy and preparedness for these impactful weather events in the Mediterranean region.

References:

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