Geometrical Properties and Cloud Types during Mediterranean Cyclones using decadal dataset
Abstract

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The increasing trend of the intensity of the Mediterranean cyclones, which is linked to the fact that the Mediterranean Sea is warming faster than the larger oceans, raises the necessity of an insight to their patterns not only from a dynamical approach but also from a microphysical perspective.

Tropical-like cyclones on the Mediterranean Sea (Medicanes) are occasionally observed on satellite images, often with a clear eye surrounded by an axisymmetric cloud structure. Clouds are one of the largest sources of uncertainty in regional and climate models. In this study, we show how satellite-based active remote sensing can be used to illustrate the clouds characteristics.

The aim of this work is to characterize the clouds and investigate their microphysical properties at the different stages of their evolution from the active low-pressure disturbance to the development stage of the Medicanes and their tropical-like cyclone phase, in order to comprehend clouds' contribution to the cyclone dynamics and correlate the atmospheric processes with cloud microphysics.

We use measurements of the CloudSat's 94-GHz nadir-looking Cloud Profile Radar (CPR) at a 1.4 and 1.7 km cross and along-track resolution respectively from 2006 to 2020 for the Mediterranean region. Specifically, we detect the Medicane events based on the high radar reflectivity (indicating deep convection) by utilizing the 2B-GEOPROF product. Then, cloud types, cloud top and base heights are derived for five different intense Medicane cases, using the 2B-CLDCLASS-LIDAR product. The clouds formation and evolution throughout the Medicanes' trajectory is shown in three-dimensional plots, from which we notice the primary cloud and precipitation generating flow in all events. We identify the existence of a frontal structure and a stronger convective activity at the development phase.

We, also, correlate the 10-year mean total cloud fraction above the Mediterranean basin with regions in which cyclogenesis occur more frequently. Statistics regarding the cloud tops are produced, concluding to intrusions of cold air in the upper troposphere. Finally, we study the warm core structures during the genesis stages of the Medicanes, which had been unclear since now, based on the vertical cloud distribution.

Our next steps include analyzing data from the EarthCARE's CPR during future Medicanes, their comparison with in-situ measurements and investigating the impact of the aerosols to Medicanes' formation, while the results of this study can be used from models to evaluate their cloud predictions and investigate the performance of different cloud microphysics schemes.

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