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# Understanding the impact of aerosol-atmosphere interactions in warm-core cyclones in the Mediterranean sea

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Medicanes are a type of rare storm that form in the Mediterranean area and shares important features with tropical cyclones: presence of a warm core and strong winds with low vertical shear. Although they exhibit a shorter duration and are smaller than tropical cyclones, medicanes suppose an important natural hazard, as they have the potential to produce intense rainfall and wind gusts over the shoreline of various Mediterranean countries. The physical mechanisms responsible for these phenomena are somewhat known, and are related to the release of latent heat during the condensation of water droplets in the interior of the storm, which is favored by the convergence of humid air in the surface. A critical aspect of this mechanisms is therefore the formation of cloud droplets, which in turn is governed by the presence of marine aerosols, as they act as primary source of condensation nuclei. The strong pressure gradient around the core of these storms leads to intense surface winds, which increase the production of marine aerosols and provide a constant flux of humid air that acts as source of further latent heat, therefore creating a strong positive feedback that is required for the existence of these storms.

Being able to accurately simulate these storms can be an important tool to better forecast their strength, therefore minimizing the associated impacts. Various studies have tried to simulate the behavior of these storms with models of diverse complexity. A common problem emerges as an underestimation of pressure gradients, and therefore the intensity of wind speed. In this contribution, we tackle the simulation of this type of storms using a complex Regional Climate Model (WRF-CHEM) that is able to explicitly consider aerosol-atmosphere interactions. This novel approach to the problem allows us to simulate the above-described positive feedback, and hence is able to better reproduce a key physical mechanism explaining the very nature of medicanes. In particular, we have selected a number of case studies of medicanes observed during the last 20 years, and simulated them with WRF-CHEM driven by Era Interim. For each case, two simulations have been carried out, being the only difference between them the inclusion or not of the dynamical formation marine aerosols. Although the results show that the trajectory of the storms is hardly affected by the model configuration, they also demonstrate the invigorating effects of the released aerosols, which leads to a warmer cores and therefore deeper depressions in most cases, in better agreement with observations. Hence, our results point out that the inclusion of dynamical production of marine aerosols is a pre-requisite for the successful simulation of this type of Mediterranean storms.