Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC1
https://doi.org/10.5194/acp-2020-1312-RC1, 2021

Comment on acp-2020-1312

Anonymous Referee #1

Referee comment on "Influence of sea salt aerosols on the development of Mediterranean tropical-like cyclones" by Enrique Pravia-Sarabia et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1312-RC1, 2021

Influence of sea salt aerosols on the development of Mediterranean tropical-like cyclones

Pravia-Sarabia et al.

The present paper uses WRF-CHEM numerical model to consider the role of cloud condensation nuclei, originated mainly from sea salt aerosols (SSA), in three Medicanes. The aim is to assess the effects of an interactive calculation of SSA on the duration and intensity of Medicanes. To this end, simulations have been conducted both considering prescribed aerosols (PA) and interactive aerosol concentrations (IA). The results indicate that IA produces longer-lasting and more intense Medicanes.

The paper deals with an issue really worth of investigation, at the forefront of the research in the field. Unfortunately, the paper suffers from many limitations; considering that a considerable amount of work is needed, my recommendation is for rejection, although I encourage the authors to complete and investigate more deeply the simulations.

MAJOR POINTS:

- The paper is mainly a model validation exercise, with very limited physics insight; thus, I do not think the paper in the present form fits the topics of ACP;
- The analysis of the results is superficial; all figures should be analyzed and commented

on more deeply (in particular, Figs. 2 and 3); additional figures should be included to investigate the simulations more comprehensively;

- The role of nudging appears only marginally related to the rest of the paper. The link with the main part (aerosol-cloud interaction) appears very weak. Nudging simulation results confirm what is already known and do not add anything new. Also, what emerges from Lines 109-111 is not true: spectral nudging is appropriate to downscale climate simulations in order to obtain finer scale climate fields, but it is not appropriate for individual case studies (as your runs confirm), since the dynamics are not allowed to make the cyclone evolve freely (without constraints) within the domain, affecting negatively the results.
- Line 67, 74: I understand (but I am not sure from what is written in the manuscript) that in the WRF-alone approach you are using the double moment microphysics with the single-moment approach (progn = 0, i.e. a constant concentration of an aerosol with a prescribed size). If this is the case, you need to make intermediate runs with: - double moment microphysics fully active but with chemistry switched off, - single moment microphysics and chemistry switched on. In that way, you will take one step at a time, otherwise the comparison is not fair, i.e. you are changing both microphysics and chemistry.
- Line 84: As discussed in Liu et al. (2012), Veron et al. (2012), Rizza et al. (2021), when intense winds are generated, as in the presence of Medicanes, the range of sea salt size should reach 200 μm, not 20 μm!
- The discussion should be less qualitative and more quantitative: e.g., the comments at Lines 186-188 are difficult to identify in Fig. 1; the inclusion of a Table would be helpful, showing for each cyclone the average track length and cyclone intensity for IA and PA runs, for both nudging and no-nudging runs.
- Figure 2 and related comment:

-Line 197: what do you mean with "limiting the intensification potential of the medicane"? apparently, one of the most intense phases of Cornelia (when the cyclone moves toward Sicily; Reale and Atlas, 2001) is reproduced only in the nudging runs;

- to make the analysis more complete, one should add the track of the cyclone as provided by satellite images;

- I do not understand why you do not show all cyclones but you focus only on one case; for example, important differences emerge between no-nudging and nudging experiments for Celeno, but they are not commented on. I think Figure 2 must include all pictures in an 18-panel figure;

- the difference between IA and PA runs is only superficially commented on.

MINOR POINTS:

Line 27-28: Note that this is not true for all Medicanes. In some cases, the WISHE mechanism is not so important while the baroclinic development is the driving mechanism even in the mature stage. See Miglietta and Rotunno (2019) and Dafis et al. (2020).

Line 44: SSA is not defined yet (apart from the abstract);

Line 45: The role of SSA has been partially addressed already in Rizza et al. (2021);

Line 94: what do you mean with “with dominant categories recomputed”?

Line 96: do you take SST from ERA-Interim as well?

Line 99: Why not using ERA-5 as initial and boundary conditions?

Line 126: what is NRL?

Line 134: I am confused: you indicate here Rolf as a tropical cyclone, but earlier you mention it is a Medicane. So, what is the right classification?

Line 141-145: This is not a disagreement, but a normal difference that may occur between observations and reanalysis for a small-scale system.

Line 157-158: why not evaluating the 4th condition for Celeno???

Line 191: additional indications on KDE should be provided.

Figure 3 caption: “upper half”: do you mean farther from the center?

Line 215: the word “essential” is not appropriate;

Line 270-271: As discussed above, at least the track of the cyclone as derived from satellite are available and must be used. Also, some data for Cornelia (Reale and Atlas, 2001), Rolf (Ricchi et al., 2017) and Celeno (Lagouvardos et al., 1997) are available.

Line 277-281: the paper does not provide sufficient evidence to support the comments provided here.

BIBLIOGRAPHY:

Dafis, S., Claud, C., Kotroni, V., Lagouvardos, K. and Rysman, J.-F. (2020) Insight into convective evolution of Mediterranean tropical-like cyclones. Quarterly Journal of the Royal Meteorological Society, 146, 4147–4169. https://doi.org/10.1002/qj.3896.

Liu, B., Guan, C., Xie, L., Zhao, D., 2012. An investigation of the effects of wave state and sea spray on an idealized typhoon using an air–sea coupled modeling system. Adv. Atmos. Sci. 29, 391–406.

Rizza U., E. Canepa, M. M. Miglietta, G. Passerini, M. Morichetti, E. Mancinelli, S. Virgili, G. Besio, F. De Leo, A. Mazzino, Evaluation of drag coefficients under Medicane conditions: coupling waves, sea spray and surface friction, Atmos. Res., 247, 105207, 2021, https://doi.org/10.1016/j.atmosres.2020.105207;

Veron, F., Hopkins, C., Harrison, E.L., Mueller, J.A., 2012. Sea spray spume droplet production in high wind speeds. Geophys. Res. Lett. 39, L16602. https://doi.org/10.1029/2012GL052603.