Preprint egusphere-2023-436, RC1

Response to Anonymous Referee #1 (RC1):

General comments:

The subject of the paper is certainly of scientifc relevance, as made clear in the Introduction. I could imagine that the data set the authors present is very valuable and bears potenital for an in-depth analysis of the precipitation processes over Andalusia and their relation of aerosols.

This manuscript does not meet required scientific standards. Essential ones are missing, such as formulation of a clear research question/hypothesis, presentation of comprehensible methods, discussion of the uncertainties of the applied methods, scientifcally sound relation of the results to the derived conclusions. Also, the drawn conclusions as presented here do not really present novel findings as far as I see. Additionally, a number of formulations are scientically unprecise.

Response :

We sincerely appreciate your dedicated review of our paper and the feedback you have provided. We acknowledge your recognition of the scientific relevance of our paper's topic, and your appreciation of the potential value of the dataset we have presented.

We understand and respect your concerns regarding the scientific standards of our paper. We wish to address these concerns by providing further clarification:

Regarding the research question, our study is centered on addressing the persistent uncertainties surrounding the intricate interactions among precipitation, aerosols, and clouds in the context of Andalusia's semi-arid Mediterranean climate, which is notably influenced by Saharan dust. This question is explicitly stated and forms the foundation of our investigation (please see line 20-41).

For the physical algorithm used in rainfall retrieval for the microwave radiometer HATPRO, we have provided detailed descriptions in our prior publications [1-2]. Your suggestion of scientific imprecision in some formulas is noted, and we kindly request that you specify them, which would aid our discussions and future improvements. The composite analysis method, also better known as the Superposition Epoch Method (SEA), is a well-established technique in atmospheric research [3-5]. SEA simplifies complex meteorological and climatic inquiries by superimposing and contrasting data from different time periods. This method enables the analysis of interactions and trends in atmospheric phenomena. In response to your query about the SEA method's accuracy, we have included standard errors ($\sigma/\sqrt{n}$) for IWV and ILW in the revised manuscript (please refer to Figure 3).

Additionally, we highly prioritize establishing a scientific and logically sound connection between our results and the derived conclusions. Throughout the manuscript, we carefully elucidate this connection using physical principles. For instance, we explain in detail the types of rainfall in Granada and the variations in meteorological parameters before, during, and after rainfall, as well as the causes and progression of the virga phenomenon.

We would like to emphasize that this paper represents a significant scientific innovation and offers novel

findings. To the best of our knowledge, there exist no prior studies that explore the complex aerosol-influenced rainfall characteristics and temporal evolution of rainfall in the Mediterranean Sea using multiple remote sensing and in-situ techniques, and beyond this studies about virga phenomenon are rare.

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[2] Wang, W., Murk, A., Sauvageat, E., Fan, W., Dätwyler, C., Hervo, M., ... & Hocke, K. (2023). An Indoor Microwave Radiometer for Measurement of Tropospheric Water. IEEE transactions on geoscience and remote sensing, 61, 1-13.
[3] Jia, J., Kero, A., Kalakoski, N., Szeląg, M. E., and Verronen, P. T.: Is there a direct solar proton impact on lower-stratospheric ozone?, Atmos. Chem. Phys., 20, 14969–14982, https://doi.org/10.5194/acp-20-14969-2020, 2020.
[4] Rong, P., von Savigny, C., Zhang, C., Hoffmann, C. G., and Schwartz, M. J.: Response of middle atmospheric temperature to the 27 d solar cycle: an analysis of 13 years of microwave limb sounder data, Atmos. Chem. Phys., 20, 1737–1755, https://doi.org/10.5194/acp-20-1737-2020, 2020.
[5] Friederich, F., Sinnhuber, M., Funke, B., von Clarmann, T., and Orphal, J.: Local impact of solar variation on NO2 in the lower mesosphere and upper stratosphere from 2007 to 2012, Atmos. Chem. Phys., 14, 4055–4064, https://doi.org/10.5194/acp-14-4055-2014, 2014.