The paper by Voudouri et al. presents statistics of cloud occurrence over the Mediterranean from spaceborne radar observations and reanalysis data. While this work could be a good contribution to a more specialised journal, I am afraid it is not within the scope of ACP. I have based this decision on a few major drawbacks:

We would like to thank the Reviewer for the evaluation of our manuscript and for the constructive comments and suggestions. We have carefully considered the concerns raised and revised the manuscript to strengthen the analysis, improve the discussion and interpretation of the results, and better highlight the scientific contribution of the study. Below, we provide a point-by-point response to the Reviewer's comments and detail the corresponding changes made to the revised manuscript.

We respectfully acknowledge the reviewer's comments regarding the scope and scientific contribution of the study. We would, however, like to clarify why we consider this work relevant to the scope of Atmospheric Chemistry and Physics. By analysing long-term satellite observations, our study aims to improve the understanding of cloud vertical structure, occurrence, and variability over the Mediterranean, a climate-change hotspot characterized by pronounced regional and seasonal contrasts. Furthermore, the availability of the EarthCARE observations provides an opportunity to extend and complement the CloudSat record, allowing us to examine the consistency of cloud property estimates across satellite missions and their implications for the development of long-term climate data records.

In the revised manuscript, 1) we have revised the Introduction to clarify the scientific motivation and objectives of the study, expanded the analysis and discussion of differences between satellite observations and ERA5, and refined our statements regarding the implications of our findings for climate modelling and future multi-mission cloud climatologies. 2) We have added new figures and analyses, including an assessment of ERA5 ensemble spread and an estimate of the ice water content associated with optically thin cirrus clouds, to provide further insight into potential discrepancies between satellite observations and reanalysis data and 3) We further added a Discussion section to the revised manuscript, including a time series of monthly mean cloud liquid water content (LWC) and ice water content (IWC) derived from CloudSat and EarthCARE observations and ERA5 reanalysis data.

This additional analysis allows us to discuss the potential factors contributing to the differences among the three datasets, including differences in the observational sensitivity, the temporal sampling and the retrieval baseline algorithms. These revisions aim to make the scientific contribution of the study more explicit and to better distinguish it from existing global cloud climatologies.

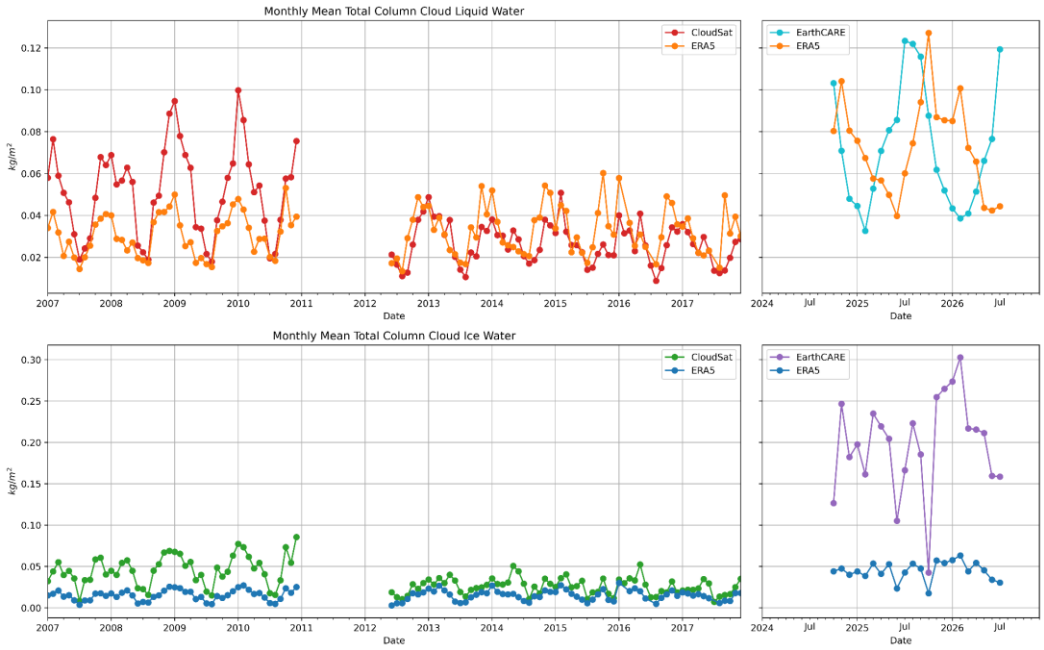
- The study is purely descriptive, i.e. describes differences between datasets, and contains no actual advancement of current knowledge. There is no hypothesis or science question that is being pursued.

Answer: We thank the reviewer for pointing this out. Specifically, the Introduction in the revised manuscript now identifies two main research questions: (1) how cloud vertical occurrence patterns vary across the Mediterranean in response to seasonal variability and land–sea contrasts, and to what extent ERA5 reproduces these regional and seasonal structures; and (2) how consistent cloud liquid and ice water content estimates are across CloudSat, EarthCARE, and ERA5, and what the identified differences imply for cloud climatological assessments and future multi-mission studies.

To address these questions, we have expanded the analysis. We have added scatter plots showing the mean ERA5 ensemble spread for total-column liquid and ice water. We further estimated the

ice water content associated with optically thin cirrus clouds to assess whether the amount of ice potentially missed due to their under-detection is consistent with the differences observed in CloudSat–ERA5 and EarthCARE–ERA5 comparisons. These analyses provide additional insight into the potential contribution of thin cirrus under-detection to the CloudSat–ERA5 and EarthCARE–ERA5 ice water differences and help assess the extent to which improved cloud detection through active remote sensing could contribute to reducing these discrepancies.

We further added a Discussion section to the revised manuscript, including a time series of monthly mean cloud liquid water content (LWC) and ice water content (IWC) derived from CloudSat and EarthCARE observations and ERA5 reanalysis data (Figure below). This additional analysis allows us to discuss the potential factors contributing to the differences among the three datasets, including differences in the observational sensitivity, the temporal sampling, the retrieval baseline algorithms, and the representation of cloud microphysical processes in ERA5. The related discussion has been added in the revised version of the manuscript.



Moreover, we revised the Conclusions to align with the defined scientific questions. We believe that these revisions provide a clearer scientific rationale for the study and strengthen its contribution beyond a descriptive comparison of datasets.

- The authors state the importance of their results for global climate models but those models are more concerned about cloud vertical structure, i.e., where in the vertical columns do clouds occur, then cloud types which are often ambiguously defined. A translation of observational findings to modelling space would allow for a more immediate pick-up by modellers.

Answer: We thank the reviewer for this comment. We agree that cloud vertical structure is particularly relevant to climate modelling because the vertical distribution of clouds influences radiative transfer and the representation of cloud processes. We also acknowledge that differences in the definitions and classification criteria of cloud types can complicate direct comparisons between observational datasets and model output.

In the revised manuscript, we have updated the Introduction to clarify the scientific motivation and scope of the study and to better distinguish our objectives from those of existing cloud climatologies. We have also expanded the analysis of differences between satellite observations

and ERA5, using the ERA5 ensemble spread as an indicator of uncertainty in the column-integrated cloud liquid and ice water content estimates. Furthermore, we have investigated whether the ice content associated with optically thin cirrus and cirrostratus clouds could help explain the differences identified between satellite observations and ERA5. These additional analyses provide further insight into potential sources of disagreement among the datasets and the interpretation of ERA5-derived cloud water content.

We acknowledge that translating satellite-derived cloud observations into model-oriented metrics of vertical cloud occurrence would provide a more direct basis for evaluating the representation of cloud vertical structure in climate models. Although this specific analysis is beyond the scope of the present study, we have clarified the implications of our findings for the evaluation of cloud properties in atmospheric reanalyses and for future satellite-based cloud climatologies.

- The used data would allow for a global assessment of cloudiness but the authors chose to focus on the Mediterranean. While they give justification for this, a global study could have still focussed on that region as part of a much more comprehensive analysis. However, global radar-based cloud climatologies have already been presented in earlier studies, e.g., https://doi.org/10.1002/2017JD026629, https://doi.org/10.5194/acp-23-8169-2023, https://doi.org/10.5194/essd-16-1301-2024, and the authors would need to clearly define how their work extends beyond those.

Answer: We thank the reviewer for highlighting the importance of distinguishing the present study from existing global radar-based cloud climatologies. Indeed previous studies have provided robust descriptions of global cloud vertical structure and its geographical and seasonal variability, and that the scientific motivation for focusing on the Mediterranean must therefore be clearly established.

We have revised the Introduction to acknowledge these contributions explicitly and to better define the scope and added value of our regional analysis. Rather than presenting the Mediterranean study as a smaller-scale alternative to global climatologies, we now emphasize its focus on the regional and seasonal variability of cloud geometrical properties and types across three Mediterranean subregions, including land–sea contrasts, together with an evaluation of ERA5 cloud water and ice content against CloudSat observations and an initial assessment of the consistency of EarthCARE measurements with the CloudSat record. This regional perspective is important for identifying differences in cloud characteristics and their potential links to aerosol conditions, while also providing observational constraints for future field campaigns planned in these regions.

The Mediterranean region provides a setting in which to investigate how cloud vertical structures vary across distinct subregions and between land and sea, and how well these characteristics are represented in reanalysis data. The addition of EarthCARE observations also provides an opportunity to examine the consistency of observations from a newer satellite mission with the established CloudSat record, while recognizing the limitations associated with the shorter EarthCARE observational period. We have revised the manuscript to clarify these objectives and to distinguish the regional questions addressed here from the broader global climatological questions investigated in the previous studies.