Author's response - minor revisions (Manuscript "egusphere-2023-1834")

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1 Report 1 / Referee 3

1.1 Comment (L 76)

- **Comment**: L76 - The CloudSat data is also 'satellite data' how about visible/infrared, VIS/IR or imager data?
- **Author's response**: We change the term "satellite data" to "imager data" throughout the text.
- **Author's changes in the manuscript**: Lines 76–77: "Satellite images from the MSG SEVIRI instrument displays the input for the network (later referred to as "imager data") (Schmetz et al., 2002).".

1.2 Comment (Table 1)

- **Comment**: Table 1 - Aren't all the solar channels daytime only? I see what you are trying to say, but perhaps the IR3.9 channel should be 'partial'? Alternatively, another name for the column might be more appropriate, perhaps 'Type' which could then be 'Solar reflective', 'Thermal IR' or 'Both'?
- **Author's response**: We see your point and change the naming of the column.
- **Author's changes in the manuscript**: Page 4, Table 1, last column: "Type".

1.3 Comment (L 101)

- **Comment**: L101 - perhaps 'the AOI of SEVIRI' (rather than 'the satellite'), or even just 'the AOI'?
- **Author's response**: We see this is misleading, changed to "the AOI".
- **Author's changes in the manuscript**: Line 100–102: "To match the datasets, we compare their timestamps and locations. If the radar coordinates fall within the AOI, we determine the flight direction to identify whether CloudSat circles the Earth in ascending or descending orbit.".

1.4 Comment (L 304)

- **Comment**: L304 - How closely would you expect these datasets to match? I don't think you need to add much here, but given the CloudSat radar often misses thin clouds, should there be a close match between these datasets?
- **Author's response**: We expect an overall good match whereas our results are less sensitive to thin clouds. The similarity is expected to decrease especially in low and high altitudes where the CloudSat radar is affected by sensor limitations. This height-dependent variability can influence the overall results which reduces the dataset agreement.
- **Author's changes in the manuscript**: Lines 307–309: "CloudSat faces sensor limitations in low and high altitudes of the troposphere (Sect. 2.1.2). While our analysis reveals an overall high agreement, the lack of e.g. thin clouds within the radar data affects the similarity between the CLAAS-V002E1 data and the predicted CTH."

1.5 Comment (L 308)

- **Comment**: L308 - This wording suggests that it is the hemisphere that is important. What would be the reason for this? Is it a seasonal cycle in cloud types, the solar zenith angle, or perhaps something else?
- **Author's response**: Although we have few observations in the tropics on the southern hemisphere, the model performs better than in the northern hemisphere. The distribution of land masses affects the formation of clouds in both hemispheres. This leads to a varying model performance depending on the cloud type. The seasonal cycle and solar zenith angle can further increase the difference.
- **Author's changes in the manuscript**: Lines 310–316: "We observe a connection between the similarity of the datasets and the hemisphere. In the northern hemisphere, the highest amount of image-profile pairs and the highest CTH difference occur between 0–20 °N. Between the tropics of the southern hemisphere, the amount of observations is similar whereas the CTH difference is considerably lower. The variability between the hemispheres can be led back to the distribution of land masses. A higher proportion of oceans in the southern hemisphere and the solar zenith angle affect the formation of clouds (Bruno et al., 2021). The result is an increased model performance which might be caused by the existence of either more uniform or less complex clouds.".

1.6 Comment (L 330)

- **Comment**: L330 - As above, I would avoid using the term 'satellite' here.
- **Author's response**: We change the term to "imager data".
- **Author's changes in the manuscript**: Lines 334–335: "The CLAAS-V002E1 data is computed using the MSG SEVIRI imager data as well as derived products and additional data.".

1.7 Comment (L 391)

- **Comment**: L391 - Such as aerosol measurements - this would depend on the information content of the imager data. It is not clear to me that there is information in these measurements to do a full 3D retrieval of aerosol, even with deep learning techniques (although I would love to be proved wrong!)
- **Author's response**: We do not know for sure whether the approach can be used to extrapolate 2D aerosol measurements to a 3D perspective. Former studies derived e.g. the aerosol optical thickness and type from satellite data (e.g. https://doi.org/10.1029/2009JD012272). We think evaluating the possibility of a full 3D retrieval of aerosol received by e.g. aircraft measurements would be an interesting follow-up.
- **Author's changes in the manuscript**: Lines 398–401: " While we use CloudSat radar data as our ground truth, it needs to be evaluated whether this approach can be adapted to other 2D transect data sources, such as aerosol measurements. Former studies already derived aerosol properties from imager data (Carrer et al., 2010). The DL framework could help to achieve a full 3D retrieval of aerosols.".

2 Report 2 / Referee 2

2.1 Comment (L 376)

- **Comment**: Line 376: The last citation in the following sentence seems misplaced: "In contrast, Leinonen et al. (2019) use data from the MODIS satellite (Zantedeschi et al., 2022)."
- **Author's response**: Thank you for pointing this out, we remove the misplaced citation.
- **Author's changes in the manuscript**: Lines 384–385: "In contrast, Leinonen et al. (2019) use data from the MODIS satellite.".