

Interactive comment on “The relationship between Polar Mesospheric Clouds and their background atmosphere as observed by Odin-SMR and Odin-OSIRIS” by Ole Martin Christensen et al.

Anonymous Referee #2

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General comments:

This is a generally well written and interesting study on NLC/PMC observations using a special Odin tomographic measurement mode complemented by model simulations. Measurements with the two Odin instruments SMR (providing T and H₂O) and OSIRIS (providing cloud occurrence, ice mass density and particle size information) are used. The dedicated tomographic measurement mode in principle allows distinguishing between clouds in the far/near field – which appear at lower altitudes – and truly low clouds. The modelled ice mass densities are systematically larger than the observed ones, consistent with earlier studies. Possible reasons for this discrepancy are discussed, following similar arguments in earlier studies.

C1

In my opinion the paper is of interest to the aeronomy community and suited for publication in ACP. I ask the authors to consider the specific comments listed below. In addition, it would be good to add brief discussions on (a) how the estimated cloud formation and sublimation times agree with earlier studies, (b) how well the SMR and OSIRIS lines of sight are really aligned – both vertically and horizontally. Fig. 2 shows clear vertical shifts between observed and modelled quantities that may be related to small vertical misalignments of the two instruments. In addition, horizontal misalignments may lead to differences in model and measurement results.

Specific comments:

Line 60: "Both SOFIE and ACE-FTS perform measurements using solar occultation, this results in measurements at only a few latitudes during an orbit"

This is only a minor point, but the statement can be a bit more specific. It's measurements at either 1 or 2 latitudes, depending on whether sunrise and sunset observations are made, or only one type of measurements.

Line 90: "The two instruments are near perfectly co-aligned"

Is it possible to provide a quantitative estimate of the alignment or misalignment of the lines of sight of the two instruments?

Line 117: "Observation .. enable" -> "Observations .. enable" or "Observation .. enables"

Line 166: "is taken" -> "are taken" ?

Line 168: "grater" -> "greater"

Line 176: "is known" -> "are known" ?

Line 188: "sublimates completely" -> "sublimate completely"

Line 189: "the total ice remaining cloud parcel is negligible"

C2

I think something is missing here ?

Line 192: "This is know as" -> "This is known as"

Line 215 – 220: I read this paragraph several times, and I still don't fully understand what specifically was done here. Particularly the sentence "The mean background atmosphere, with and without clouds, at that latitude and altitude is then subtracted from each pixel" irritates me. My understanding is that you determined average T and H₂O profiles for for (a) cloud free and (b) cloudy cases, right? I also don't really understand the statement: "This method removes the effect of zonal differences in cloud and cloud-free pixels .."

I may well be missing an important point, but I suggest rephrasing these sentences.

You also speak of anomalies that are shown in Fig. 1. Usually, an anomaly corresponds to the difference between a given value and its temporal or spatial mean value. This is, however, not the case for the T and H₂O profiles shown in Fig. 1.

Lines 238 – 246: I don't find the argument, why no H₂O enhancement below the cloud is observed, very convincing. This effect has been observed by others (e.g. Hervig et al., JASTP, 2015) and I think there is no reason to assume that the SOFIE observations are wrong. I don't see a problem in simply stating that it is currently not well understood, why an H₂O enhancement below the cloud is not observed. Perhaps the effect would show up in a larger data set?

What about horizontal displacements of the lines of sight between OSIRIS and SMR? The SOFIE T, PMC and H₂O measurements are truly common volume observations. But is this the case for OSIRIS and SMR?

Line 256: ".. to reach a cloud brightness $2 \cdot 10^{-9}$ / m / str"

Are the units of this 'brightness' correct? It seems like the units are incomplete. It would perhaps be good to clearly state what "brightness" refers to here. The term has different meanings in the literature.

C3

Line 261: "at different altitudeS"

Section 2.3.1 (Vertical comparison): Looking at the two panels of Fig. 2, a vertical shift between the observed and modelled quantities is apparent – slightly more pronounced for cloud presence. It would be good to state the accuracy of the tangent height information of OSIRIS and SMR. Are there any indications for systematic tangent height shifts between the two instruments?

Another question about Fig. 2: the displayed results are averaged over all measurements analyzed?

Line 324: 2A majority .. IS .." and also later in this sentence.

Line 352: "and if follows" -> "and it follows"

Line 414: "is the amount of water in ice phase if the cloud consisted of 5 nm particles"

This means that the 5 nm particles are entirely made up of ice, i.e. a meteoric nucleation nucleus is neglected?

Line 429: "detected cloudS"

Line 446: "longer that" -> "longer than"

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-268, 2016.

C4