

## ***Interactive comment on “Common volume satellite studies of polar mesospheric clouds with Odin/OSIRIS tomography and AIM/CIPS nadir imaging” by Lina Broman et al.***

### **Anonymous Referee #1**

Received and published: 1 April 2019

Limb and nadir viewing satellite observations have become key observational methods for studying the physical processes leading to the formation and driving the variability of polar mesospheric clouds (PMCs). This study is the first to undertake a systematic comparison of limb tomography and nadir observations of PMCs in real common volumes. Both directly observable quantities such as cloud albedo and scattering coefficients are compared as well as inferred cloud properties such as ice mass density and ice water content. Importantly, this is done by thoroughly taking into account the effects of scattering geometry, differences in spatial resolution, as well as - and most importantly - the detailed error budget of the different observations.

C1

Given the uniqueness of the two considered data sets as well as the great scientific interest in PMC processes this is an important study that paves the way for future applications of this combined data set for studies into the fundamental properties of PMC.

As such I am recommending acceptance of this manuscript provided that the following mostly minor comments are adequately addressed:

- Abstract: the statement that ice mass density agrees with ice water content doesn't make sense since these are two totally different quantities (one is the other integrated in the vertical). Of course, when reading the full text it is clear that the authors mean that the two properties are consistent with each other after properly accounting for the vertical extent of the cloud and integrating the limb observations in the vertical. Please clarify.

- Page 1, line 35: Gadsden and Schröder is a nice textbook but certainly not an original scientific reference. Please replace with suitable references of original measurements (e.g., Lübken, 1999 and/or some even older papers from the Stockholm group based on rocket grenade measurements).

- Page 2, line 4: When referring to these initial observations reference should also be made to the paper by Jesse, 1885:

Jesse, O., Auffallende Erscheinungen am Abendhimmel, Met. Zeit., 2, 311-312, 1885.

- Page 2, line 8: Please add "e.g.," in front of the reference to the paper by Fritts et al., 1993.

- Page 2, line 9: At the end of the sentence after the reference above, I would add a reference to the classical paper by Witt, 1962: Witt, G., Height, structure and displacements of noctilucent clouds, Tellus XIV, 1, 1-18, 1962.

- Page 2, line 22: typo "ferquency"

C2

- Page 2, line 26: How can the ALOMAR lidar data allow to make statements on the horizontal extent of clouds?
- Page 2, line 39: Delete "systems"?
- Page 3, line 41: Maybe clarify that you are discussing the operational retrievals here.
- General statement to introduction: I am missing a paragraph pointing out what added value the combination of nadir and limb data sets allows to benefit from. The three aims listed on page 4 are all quite technical; in order to make this manuscript fit to the scope of a scientific journal such as ACP, the readers should stress the added value of the combined data set and explain what kind of studies can be better done with the combined data set than with the single data sets alone. A similar statement should also be added to the conclusions/summary and the abstract.
- Page 6, line 20: This these -> These
- Page 7, line 28: Please consider adding a table that summarizes the uncertainties that have been mentioned in the text above. Ideally the corresponding uncertainties from CIPS should also be included to make this discussion easier to follow.
- Page 9, line 28: Do you really mean systematic error or just systematic deviation/difference?
- Figure 2: I am missing a discussion of the shape of this distribution. Is it coincidence that the distribution is roughly symmetric around 50%?
- Figure 3: Excellent!
- Page 13, line 7: Reference to Baumgarten et al., ACP 2010 should be added.
- Page 13, line 17: Please spell out "IMD".
- Figures 4,6, and 7: haven't you regressed these data sets? I recommend to show the regression lines and indicate the corresponding parameters with their error bars.

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- Figure 4: Why is the OSIRIS error bar increasing with OSIRIS albedo?
- Page 19, line 15/16: clearly three examples from such a large data set cannot be representative. At most they may illustrate the class of comparisons. Please reword.
- Page 19, line 22: that are we have -> that we have

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Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-1035>, 2019.

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