Review of "Comparison of retrieved Noctilucent cloud particle properties from Odin tomography scans and model simulations" by Megner et al.

General Comments

1) The paper investigates the inherent errors in retrieved PMC particle size, concentration, and mass density, when using remote observations. This addressed by using modeled PMC properties to simulate the OSIRIS signals, and then conducting retrievals of size, concentration, and mass density from these signals. Comparisons of the known and retrieved PMC properties give a solid indication of the errors / biases inherent to the observations and the chosen methodology. The conclusions of this paper are important for remote sensing of PMCs. The model based studies indicate that OSIRIS retrievals have greater errors for smaller particle sizes.

2) The second aspect of the paper is to determine if inclusion of atmospheric waves in PMC microphysical models gives a better reproduction observed PMC properties, compared to using a static atmosphere. The Author's find that simulations with waves indeed give the best explanation of observed PMC properties, as shown in Figures 6 and 7. The conclusions here are important for PMC modeling efforts, however, the representation of waviness in the model (section 4.2) is somewhat brief. Is it possible to describe the wave parameters used in more detail, perhaps in such a way that other modelers could implement a scheme like yours? Also, the agreement is Fig 7 between the OSIRIS and wavy model is not spot on. Is it possible that some wave tuning would give better agreement (and thus indicate a refined picture of the relevant waves)?

Specific Comments

Throughout: "modelled" should be "modeled".

Throughout: In PMC / NLC literature "IWC" usually refers to the vertically integrated water content (g / km^2). You assign IWC units of ng/m^3, which would be ice mass density (m_i). You need to change IWC for m_i (or M_i) throughout. (I know IWC is a clumsy and probably misplaced acronym, but it is widely recognized as g / km^2 in the PMC field).

p 1 line 12: I don't think we capitalize Noctilucent, or Polar Mesospheric Cloud.

p 1 line 13: add "ground based remote sensing" to the list

p 1 line 19: "…on signals based on modeled…"

p 2 line 10: This statement is missing something, you state that PMCs are a means to monitor the atmosphere, but do not state which aspects of the atmosphere.

p 2 line 25: "number density" typically refers to the number of gas molecules per cc. If you are referring to ice particles, then typical nomenclature would be "ice concentration (N)".

p 3 lines 4-7: The comment in parenthesis can just be a sentence.

p 3 line 12: Again, to be precise, you retrieve PMC properties from signals simulated using modeled size distributions.

p 4 line 18: "…spectral resolution of…"

p 4 line 25: I think this should be "…fixed at 16 nm for radii larger than 40 nm…". You should also state that many other remote sensing PMC experiments have adopted this assumption, e.g. CIPS, SOFIE, SCHIAMACHY, SBUV, & probably others.

p 4 line 27: Is there a reference that supports the choice of AR = 2?

p 4 lines 27-30: You are describing the two-valued solutions for certain conditions. This could be stated more clearly.

p 5 line 15: It would be useful to state the SMR vertical and horizontal resolution.

p 6 line 13: Here you should cite the recent study by Killani et al (ACP 2015) that deals with non-spherical ice in microphysical PMC models. The main point is that there are microphysical effects due to non-spherical shapes that change the modeled PMC properties, in addition to the well known optical effects of non-spherical ice.

p 6 line 29: You should also mention that ice sublimation enhances vapor at the ice layer bottom. Does SMR detect the dry and wet regions associated with ice?

p 7 line 25: "(fraction of 1 nm)" should be stated as "(radii < ~1 nm)"

Figure 1: You should add the frost point temperature vs. height, this would make your arguments on p 7 flow very easily. Also, it would be instructive to add error bars as the standard deviations to give an idea of the natural variability. "OSISIS" - "OSIRIS"

p 8, lines 17-18 & 32 (and elsewhere): You often mix units and nomenclature for ice mass. For example "ice water density" is stated as being in ng/m^3, where I would consider these units to be associated with "ice mass density". Later you refer to "ice mass" which I assume is "ice mass density". Perhaps introduce a variable "m sub i" if that would make the discussion more convenient, in any case make the language consistent.

p 9 line 1: What specifically is the OSIRIS IWC observation mentioned here? Is it the average associated with the SMR data in Figure 1, or something else?

p 9 line 25: By "constant" do you mean "constant in height" ?

p 10 line 11: "less than" should be "broader than"

p 10 line 13: Do you really pass the model size distributions through the OSIRIS retrieval algorithm? I would think that you use the model distributions to simulate OSIRIS signals, and then pass these signals through the retrieval code. Please clarify.

p 10 line 19: I think you mean that the microphysical treatment of ice particles in CARMA assumes spheres. But when you do the OSIRIS signal simulations, do you assume spheres or AR=2? This aspect of the signal simulation should be stated. Again, Killani et al. [2015] discuss the microphysical implications AND the optical retrieval implications for non-spherical NLC particles, and that work is relevant to your study and thus should be mentioned.

p 10 line 28: Please clarify what "mean radius" refers to (e.g., numeric mean, mass weighted mean, the Gaussian median, …).

p 10 line 28: Panel b of which figure?

p 11 line 7-9: Part of the challenge is that the error in concentration (N) is proportional to the cube of the radii error. The propagation of radii errors into the other values exists because you determine radii first, and then mass density and N (presumably based on the modeled signal based on retrieved radii). In any case, you should discuss further the reasons for N having the greatest errors.

p 11 line 20: The retrieval cannot be based on Mie scattering since you accommodate non-spherical particles. Indeed, you state above that the optical calculations are from the T-matrix algorithm.

p 11 lines 21-22: There may be a better explanation for why the retrieval indicates larger particles than the numeric mean. I suspect the reason is that the smallest particles do not contribute to the OSIRIS signal. I think this would be evident if you plot the fraction of total radiance in each size bin of the size distribution. If this explains the discrepancy (I think it will), then showing the additional figure would be very useful (I don't think anyone has published this and it could settle some old debates).

p 12 lines 18-28, and Figure 6: You switch between "rate" and "frequency", the later would be convention.

Figure 7: This might be clearer if you showed standard deviations instead of all the individual profiles (thin lines).

p 13 line 20: The statement "…exist when the temperature is below the average,…" is unclear. The average is of what group of data?

p 13 lines 21-25: The no wave case (thick black) is zero below 82 km, so the statement does not make sense. Perhaps you meant the wave case. You should remind us to look at Figure 7c.

p 13 lines 28-32: Some of this is hard to see because of the many thin lines in the plots. I do, however, see your basic points here, and you should not that both the ALOMAR lidar and SOFIE have shown this behavior as well, where N peaks at an altitude above the peak in ice mass density, and radii are largest below the peak in mass density.

p 16 line 7: I believe the correct name is "PMC microphysics and happy hour working group".