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Interactive comment on "Albedo-Ice regression method for determining ice water content of Polar Mesospheric Clouds using ultraviolet observations from space" *by* Gary E. Thomas et al.

Anonymous Referee #1

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General comments:

This manuscript deals with an alternative approach to retrieve the ice water content (IWC) of PMCs from satellite-borne UV-backscatter observations with the CIPS instrument on the AIM satellite. Due to orbital drifts CIPS is since 2016 operated in a different way and the original approach to retrieve IWC is not possible any more for a large part of the measurements. The novel approach estimates IWC from backscatter measurements at a single scattering angle. Overall, the approach works well. The paper is generally well written and is suitable for publication in AMT. I ask the authors to consider the comments listed below. In my opinion the paper should be accepted, once

the (mainly minor) issues listed below were addressed.

Specific comments:

Line 16: "265 nm" -> "265 nm"

Line 114: "..it is necessary to derive scattered radiances from the same algorithm used by CIPS."

I don't really understand this statement "derive scattered radiances from the same algorithm used by CIPS." CIPS measures scattered radiances and the algorithms are used to infer physical properties of PMCs, right? I guess I'm missing a point?

Line 138: "the monochromatic scattering cross-section"

It actually is the "differential" scattering cross section. Perhaps this can/should be added.

Line 140: "number density of ice particles"

Perhaps better "column density"?

Equation (2): I suggest using a slightly different symbol for the albedo than in equation (1). The left hand sides of equation (1) and (2) are the same, but the right hand sides differ.

Line 167: add space before "denotes"

Line 209: "(2) radiance and IWC may be calculated accurately, so that effects of cloud

inhomogeneity are absent;"

I don't fully understand the meaning of this sentence. Is the microphysical model a 1-D model?

Line 216: "thick.)." -> "thick)."

Same line: I suggest adding "resolution" to read "The model height grid resolution is variable, being highest . . .", otherwise "being highest" doesn't make sense.

Line 220 and Figure 1: I'm wondering how the linear regressions are actually done. Is it a single linear fit of y vs. x, or do you fit both y vs. x and x vs. y and determine an average slope and offset? Alternatively, there are routines taking both differences in x and y direction into account, when minimizing chi-square. There may be a large difference between fitting y vs. x or x vs. y.

Line 227: "In fact, we found that the linear relationship breaks down for very small albedo,"

The reason is probably, that particle populations with really small particles (< 10 nm) have a non-zero IWC, but the albedo is essentially zero, right?

Figure 1: Both the IWC and the albedo values have lower limits. Perhaps I missed it, but what is the reason for this lower limit. For IWC the limit seems to be 20 g / km^2.

Figure 2: The caption should clarify that the displayed error is a relative error given in

Line 216: Closing parenthesis missing after "Rapp and Thomas (2006)".

Line 218: "mean DIFFERENTIAL scattering cross-section"?

Line 289: "The mean difference is . . . -13

Looking at the Figure, the mean difference seems to be larger. Also, what is the reason for the characteristic variation of the difference with increasing albedo? Is there a simple explanation?

Line 289: " .. subset .. have" -> ".. subset .. has"

Line 303: "As previously shown, the AIR data applies to the ice mass of 'UV-visible' clouds, not to their total ice mass."

I don't really understand this statement. What is the meaning of "UV-visible clouds"? Was this shown in the current paper? If not, please provide a reference.

Caption Figure 4, line 3: "SA = 40 deg" should read "SA = 50 deg"

Line 366: "AIR overestimates IWC by up to 15

AIR may also underestimate IWC, right? I also think that the overestimation may be much larger than 15

Line 367: "SA = 100 deg" -> "SA = 110 deg"

Line 375: "The accuracy of the average IWC results was estimated by removing half the data from an entire season and comparing the two results. "

I'm not sure, I fully understand this statement. AIR is applied to SBUV data and then you split the data set in half and compare the results. How does this allow you to estimate the accuracy of the "average IWC results"? I guess I'm missing the point here ?

Next sentence: You report on "changes" of $\pm$ 3 - 5 g / km^2 etc., but were there any systematic differences?