

## ***Interactive comment on “Ground-based remote sensing of thin clouds in the Arctic” by T. J. Garrett and C. Zhao***

**Anonymous Referee #3**

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**Review of:** Ground-based remote sensing of thin clouds in the Arctic T. Garrett and C. Zhao

### **General Comments:**

This paper presents a new technique for retrieving the properties of thin (greybody) Arctic clouds. In general, the paper is well written and well thought out. I would have liked to see more than one case represented as a case study (maybe a campaign or a month?). Having said that, the article is generally in good shape and should be accepted in AMT after some revisions are made (see below).

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### **Specific Comments:**

- Figures 3 and 9 are switched in the manuscript
- Why bother with (a)-(g) in section 2.1 and Figure 3? Maybe use color instead in the figure, since (a)-(g) are not really referenced in the text at all.
- Should the second microwindow be  $860.5 \text{ cm}^{-1}$  or  $862.5 \text{ cm}^{-1}$ ? The text says one thing, while Figure 3 has a different number.
- What do the dashed and solid lines represent in Figure 6? This doesn't appear to be discussed in either the text or the figure caption.
- In your discussion of phase in section 2.5 (page 8662, lines 20-21 and page 8663, line8), is this now the microphysical phase, or the radiative phase? Please clarify.
- How representative are the measurements from the four flights covered by Garrett et al., (2004)? Why not use additional results from campaigns such as ISDAC, ARCPAC, ARCTAS, AMISA and M-PACE?
- You state that values for the standard log-normal deviation (sigma) for ice crystals is not necessarily all that different than the liquid value. Is this true even at larger sizes? Or do the liquid and ice hydrometeors generally have comparable size distributions?
- Since “cloud base” in a mixed-phase environment can mean several things, please clarify what is meant by “bases” on page 8665, line 11. Is this the bottom of a liquid-containing layer? Or a certain level of extinction? How does snow-fall/precipitation play into this estimate?
- What is the impact of assuming multilayer clouds with ice crystals in between are one single cloud layer on your retrievals (page 8665, lines 17-19)?

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- What is your basis for assuming 15% uncertainty in tropospheric water vapor measurements and 5% uncertainty in upper-level temperature profiles? Are these the upper-level temperature profiles from ERA-40?
- I don't follow how the 45%/6% and 11%/73% splits of phase determination at 273 and 238 K result in an estimate of 15% in phase misclassification. Please elaborate on how this number was derived.
- The ice number concentrations in Figure 16 seem high to me, though I suppose they're representing cirrus (and diamond dust?) clouds.

**Technical Corrections:**

- Page 8655, Line 27: Remove "and extend" from this sentence, since later on in the sentence you state "and is extended here to Arctic ice and liquid clouds".
- Page 8656, Line 23: Remove "values of"
- Please increase the size of Figure labels.

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Interactive comment on Atmos. Meas. Tech. Discuss., 5, 8653, 2012.