Atmospheric
Measurement
Techniques

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Discussions

Interactive comment on "Combined retrieval of Arctic liquid water cloud and surface snow properties using airborne spectral solar remote sensing" *by* André Ehrlich et al.

Summary:

This paper presents a new retrieval method to retrieved concurrently arctic cloud properties (optical depth and effective radius) and surface snow grain sizes. This concurrent retrieval of cloud and surface properties is a distinct improvement in currently used methods. It identifies 3 ratios of reflectances at differing wavelengths that are sensitive to both cloud and surface properties. Its first application of the retrieval method to cases from airborne measurements of spectral albedo in the arctic is presented here.

Overall the paper is very well written with concise description of the retrieval method and first results, and presents a significant contribution to advancing remote sensing of clouds and surface properties in the Arctic. It is recommended for publication with

minor revisions. Besides some specific comments, this paper may be applicable to a broader audience by commenting on the methods' dependence on solar zenith angle.

General Comments:

The paper is well written and well structured. Some minor points to be addressed would make the paper have a slightly more generalized application.

1. The authors used the solar zenith angle of 63° to describe the dependence of the retrieval of cloud optical properties on snow surface albedo grain size. A note on how it would change with a different solar zenith angle would be useful for completeness. His note would also be useful in section 4.2.

2. Section 2.2 is slightly difficult to follow, please refine descriptions.

3. The use of percentages to denote uncertainty is slightly ambiguous and should be better defined.

4. The use of the mean standard deviation per respect to a variable seems to be quite novel. Maybe more description is needed, especially to address the possible covariability of some parameters (i.e. sigma_tau is most variable when there is a high reff_c).

5. Description of the identification process of when the retrieval of snow grain size and cloud property fails would be a useful addition to this paper.

6. The retrieval is applied to data over land although no mention of that in the description of the retrieval methodology description.

7. A note on the availability of surface or in situ measurements for the 2 cases would be helpful.

8. The conclusion is well written, especially with the inclusion of the bullet points.

Specific and Technical Comments:

9. P.2 line 33, exact meaning of sentence not clear, please define what is an improvement of uncertainty by 20%, is it an uncertainty range that is 20% less, or that is it 20% smaller compared to the retrieved value.

10. Fig. 2 could be made clearer if the optical thickness and cloud particle effective radius were put directly on the figure. At least an indication of the low end of the optical thickness and effective radius would be needed.

11. P.5 line 5, cloud reflectivity is also impacted at wavelengths lower than 1000 nm, the word 'only' is erroneous in this case, maybe use a less strict word.

12. P.6 line 9, Sentence slightly difficult to follow.

13. P.6 line 12 Please elaborate or define more clearly 'retrieval forward simulation'

14. P. 8 line 15, typo, should read 'In cases where liquid water clouds are. . .'

15. Fig. 4 – consider only showing the absolute value of the PCA spectra, for easier comparison to the mean standard deviation values.

16. Typo P.12, line 10, 'too weak' instead of 'to week', sentence would benefit from being more precise.

17. Typo P.12, line 13 'ice floes' instead of 'ice flows'

18. P.12, line 16, revise sentence for the use of the word 'also'

19. Comment, Section 5, the radiometric uncertainties quoted for the ratios seem large considering the calibration uncertainty partially cancel.