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Interactive comment on "Reflective properties of white and snow-covered sea ice" *by* Aleksey Malinka et al.

Anonymous Referee #2

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Referee Comments for "Reflective Properties of White and Snow-Covered Sea Ice" by Malinka et al.

General Comments

This manuscript takes an analytical approach to modeling optical properties of summer sea ice with a highly scattering surface layer. The approach is reliant upon the notion that a justified application of geometrical optics and stereology allows the use of an analytical examination of scattering, the property that dictates the optical behavior of the ice cover with the specified surface conditions (i.e. large grains of snow or drained ice). In establishing this analytical basis, the authors show that optical thickness and effective grain size can be used to determine apparent optical properties, particularly reflectance. The presented findings are relevant and useful to the sea ice community.

I recommend publication after minor revisions.

This approach is particularly useful in that simplicity is achieved with requiring only a few input parameters. Additionally, it is important to note the similarities in optical treatment of a snow cover and a summertime white ice surface scattering layer. A useful addition to the discussion or conclusion would be explicitly stated limitations to this model. Can the authors determine and optical depth and or chord length threshold at which this analytical approach no longer holds true? Maybe it is a more qualitative caveat for surface type or point during the melt season.

Specific Comments

Section 1: What about the importance with respect of larger climate models that call for absolute accuracy of 0.02 for albedo measurements (Sellers et al, 1995)? Could be worth mentioning.

Section 2 lines 23-25: What is the chord length distribution used for this mixture? What type of function? Following Malinka, 2014?

Section 2.2 lines 9-13: The value of g= 0.67 strikes me as low. However, I note the approach to obtain this value. Maybe this needs a bit of clarification and comparison to common g values for different cover types. Would this be for white ice, or snow?

Section 2.3 lines 24-26: There may be value in explaining or showing (briefly) how other contaminants could be modeled either in an additional parameter in eq. 18 or with the acknowledgement of the potential of adding absorption coefficients for Chl-a or sediment for example.

Section 3.2 line 21: The authors could add a specific example or citation to strengthen this idea.

Section 3.3 line 4: Authors can refer to Figure 3 here.

Section 4.1 lines 7-11: It would be useful to include temperature information for the

cruise and ice stations as well as the approximate thickness of the observed scattering layer on the surface of the white ice.

Technical Comments

Section 2.3 Line 4: I am not sure what '(see Figures below)' is referring to.

Figures 5-6: Add τ= 8.5 and a= 3.333 mm to the figure captions.

Section 3.2 line 11 and 14: Describing variations in wavelength as 'layers' may not be optimal, particularly because line 16 and Figure 7 caption refers to the 'same layer', which I assume is an optical thickness of 8.5 and chord length 3.333 mm?

Section 5 line 8: Missing the word 'size' in phrase "effective grain size 1-4 mm".

Please also note the supplement to this comment:
http://www.the-cryosphere-discuss.net/tc-2016-153/tc-2016-153-RC3-supplement.pdf

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