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Discussions

EGU

Interactive comment on "Reflective properties of melt ponds on sea ice" *by* Aleksey Malinka et al.

Anonymous Referee #1

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This manuscript details a model simulating shortwave radiative transfer for melt ponds on the surface of Arctic sea ice. The paper is of interest to TC readership and describes a model that appears sound and well tested. The language is a bit awkward in places (see minor comments below), but I do think it is generally readable.

My only major comment on the presentation is that p. 16 line 16 states that three independent parameters are required for this model: pond depth, ice substrate thickness, and ice transport scattering coefficient. I agree. The results presented in Table 2 show the first two parameters. What is assumed about the third one? There is no information discussed in the manuscript that would suggest what values were inferred for the ice transport scattering coefficient. Almost all of the comparisons between model and observation show remarkable fidelity. It seems so remarkable, that I wonder what range of transport scattering coefficients are used, and whether there is some vertical variability allowed in the ice layer beneath the pond water for that coefficient? If I un-

derstand correctly, the model is inferring an optical depthâĂŤso an assumption must be made about the inherent optical properties in order to retrieve the physical depth of the ice? What is that assumption?

Minor comments:

p.1 line 9, 19: "large part" and "large fraction" are not very specific

p.1 line 24: "nowadays" colloquial

p.2 line 5 -6: "Makshtas and Podgorny give a formula for pond spectral albedo at direct incidence only; they do not consider the angular distribution of the reflected light." This sentence is a bit confusing. I understand that M&P give a formula for pond albedo only for direct incidence, but I don't see why that relates at all to an angularly-resolved description of the reflected field.

p.2 line 15: "banner of the ice grains presence" makes no sense

p. 2 line 16: "common deficient information" makes no sense

p.4 line 1: define 'AW'

p.5 line 3: define 'WI'

p.6 line 6: please supply a reference for the definition of 'transport scattering coefficient'

p. 6 line10: does 'very elongated' phase function mean 'very forward peaked' phase function? I don't believe 'very elongated' is commonly understood. I think the authors are attempting to convey the idea that a smaller scattering coefficient and lower |g| can be used to describe the apparent optical properties of a medium with large scattering coefficient and/or high |g|.

p. 6 line 22: mirabilites and hydrohalites. . . should be mirabilite crystals and hydrohalite crystals

p.6 line 26-28: If the highly scattering surface layer isn't being considered here, then

what is being considered?

p.6 line 28: Statement that air bubbles in sea ice are mostly spherical needs a reference.

p.7 line 3: is exponent +1.24 or -1.24?

p.8 line 20: sloppy notation, with the 't' used as a subscript on the left hand side of the equation and as a superscript on the right hand side, but both mean the same thing.

p. 11 line 11: 'extra-terrestrial solar irradiance' I think is more commonly called 'top-of-atmosphere irradiance'? eqn 49: it is confusing that both A and alpha are used for albedo

p. 13 line 9 – 10: melt ponds forming during 2 Aug – 8 Oct cruise? Seems unlikely.

p. 13 line 11-14: The description here lacks detail. I assume the fiber optic probe coupled to the ASD is used to view light reflected by the Spectralon plate, but this isn't adequately described. The phrase "served as a diffuser" doesn't completely describe how the Spectralon plate was employed.

p. 13 line 31: what does 'open' mean here? No ice skim?

p. 14 line 31: the spectral albedo was taken every 4 days?

Fig 5 The angle of incidence is stated in the text, but needs to also be stated in the figure caption.

Fig 6 Where did these spectral curves come from? There needs to be some data attribution.

Fig 7 caption should include information (from text) that these all had 2-3 cm layer of ice on top.

Fig 7 I am surprised at how high the albedo is at blue wavelengths! Could this be due to the frozen surface? If so, then that would contradict the statement p.13 line 21. I would

expect the peak albedo at blue wavelengths for unfrozen melt ponds to be somewhere in the range 0.1 to 0.5, at most. Would be useful to show all the panels in each cluster (Figs 7, 8, 9 each a cluster) on the same vertical (albedo) scale. Also, captions for Figs 7, 8, 9, 10, 11 need to contain information about the general locations of each series.

Fig 8 If these ponds were heterogeneous, then the exact location of the albedo measurement matters! Can this location be shown?

Fig 12 Caption says 'on June 3', but I believe was July?

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