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The Cryosphere Discussions

Interactive comment on "New insights into radiative transfer in sea ice derived from autonomous ice internal measurements" *by* Christian Katlein et al.

Anonymous Referee #1

Received and published: 3 September 2020

This manuscript describes the development and implementation of a novel sensor system for the measurement of shortwave radiation within ice. The "light chain" is a simple, inexpensive, easy-to-deploy instrument that collects optical propagation data within a 5 cm diameter bore hole autonomously. The demonstration deployment was in ∼2m thick sea ice in the vicinity of the North Pole. This tool is novel and, I expect, will be very useful for understanding the propagation of light through ice, a topic which is highly relevant to current climate research. Beyond development and implementation, the manuscript offers insights regarding the transport of light within the ice in ways that could fundamentally streamline many routine measurements. I find this paper to be very nicely written, easy to read, appropriately referenced, and supported by clear

illustrations and informative figures.

Overall, the manuscript gives a great overview of the motivation, methods, and materials of this new system. I am pleased to see the conclusion regarding the proportionality that exists between the side-welling planar irradiance and the spherical irradiance. This seems to be a very useful result. I have only a few minor questions and a few technical points:

The title is fine, and it is completely acceptable to leave as is. However, I suggest a modification: 'New insights into radiative transfer within sea ice derived from autonomous optical propagation measurements' might be slightly more informative?

It appears the data from this system were perhaps downloaded locally (during the 4 weeks the ship was on station)?, but then telemetered (past September), but this is never explicitly stated. It would be helpful to know what the telemetry requirements look like.

Line 15: shortwave shouldn't be hyphenated

Line 115: "The ice was homogeneously grown,. . ."? Please clarify what is meant by this statement.

Line 155: "in the clear"? does this refer to the broadband channel on the sensor? It's not obvious.

157: delete "both,"

Fig 6 caption: "attenuation coefficients", color bar label: "apparent extinction". It would be helpful if the terminology was consistent.

Fig 7: I am assuming that the borehole did not immediately re-freeze, given the August deployment, but it would be helpful to know what that process looked like? I wonder if some of the features shown in Fig. 7 are associated with the refreezing process? In particular, I would not expect the surface scattering layer to re-form within the bore

hole after drilling and installation. Why does a highly scattering surface layer appear to increase so quickly between 31 Aug and 14 SeptâĂŤmaybe that is a SSL reestablishing? It is interesting that the attenuation in the uppermost 5 cm of the ice drops so dramatically when snow began to accumulate. I suppose that happens because the uppermost portion of the ice is no longer at the top boundary, and the new snow above is now attenuating light strongly. Should one be surprised that this attenuation drops so much?

Fig 8b shows values increasing 1.7 to 2.1m-1. Is this really an ice-evolution time series? Or a refreezing bore hole time series?

247: not “identical”, but “proportional”!

Fig11: I need a bit more info to know how to look at this RGB rendering. I don’t see obvious colors, but perhaps some guidance could help?

Fig 12 (and line 286): looks like the Trios transmittance data are picking up some chla absorption (strong dip wavelengths < 470 nm)? Is this detectable in the light chain data?

315-316: significantly reducing? Please quantify!

361: data suggest (not suggests); also...why only summer?

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