

Responses to Anonymous Referee #2 (Referee comments are in italics)

The paper presents the variability of sea ice and snow parameters on two repeated OIB survey lines across the Weddell Sea and examines the potential synergism between OIB lidar and CS-2 radar. The paper is well written and can be published with some minor revisions.

We thank the reviewer for his or her time in reviewing the manuscript and providing helpful feedback. The suggestions have significantly clarified the text and figures; we are appreciative of your help in improving the manuscript.

The authors use data from three sensors: CS-2 radar, OIB LIDAR ATM and Snow Radar (SR), which have vastly different spatial resolutions and data collection date/time. In the “Data Description” section, the authors provide some background information about each sensor/dataset used but don’t include sufficient details on how these data sets are matched up and their associated mismatching uncertainties (spatial and temporal). In addition, the authors made many comparisons between the “derived estimates” and “retrieved quantities.” What is missing from those comparisons are consistencies between CS-2 and SR ice freeboard, as well as ATM and SR snow (total) freeboard, which is fundamental to the differences between the “derived estimates” and “retrieved quantities.”

In this paper, we start with three independent retrieved quantities: ATM total freeboard, snow depth from the snow radar, and radar freeboard from the CS-2. The aim was to attempt to understand the differences between the retrieved quantities and the derived quantities, and their relative impact on ice thickness estimates.

Specifically, we compared the use of:

1. retrieved snow depth and derived snow depth.
2. retrieved total freeboard and derived total freeboard.
3. retrieved radar freeboard and calculated radar freeboard.

The relative consistency of both the retrieved and derived quantities can be found in Table 1 and Table 3. Their impact on thickness estimates can be found in Table 2. Our intent is clarified in the text. We have added text to clarify the overall intention in this regard.

We also note that snow radar freeboard is not used in this work. There has been less attention paid to snow radar freeboard to date and is not addressed here.

Page 3, Ln 32: It is not clear “what “aspect of the algorithm” has been disabled.

Sentence has been modified to read: “...the aspect of the algorithm that deals with system sidelobes has been disabled..”

Page 4, Ln 1-11: A detailed and quantitative description of the interface detection algorithm is necessary but missing. Also, please provide references if available.

The details of the interface detection algorithm is described in Kwok and Maksym (2014) and briefly summarized in the text.

Page 4, Ln 24: “described above” should be “described below.”

To be clear, the phrase has been revised to read: “... described in Section 2...”

Page 6, Ln 14-15: The sea ice thicknesses are calculated in six different ways. Can the authors compare this calculated thickness against the ice thickness derived from the snow radar data only?

Yes, it is theoretically possible but locating the sea surface in the snow radar has not been attempted and beyond the current scope of the manuscript.

Page 7, Ln 22-23: It’s fine to compare total freeboard against snow depth, but comparisons of ATM and SR freeboards should be included in the discussion.

The ATM lidar heights, when referenced to the local sea surface, are the total freeboard. And, snow depth is an independent estimate from Operation IceBridge. This is clarified in the text. We added a sentence at the beginning of the section as a reminder to the reader: “...As a reminder, snow depth is the retrieved parameter from the snow radar (h_{fs}^{SR}) and total freeboard is from the ATM lidar (h_f^{ATM})...”

Page 9, Ln 10-11: When comparing monthly CS-2 data against individual OIB track data, one needs to understand the variability of sea ice at month scale. This discussion should be included in the paper.

The monthly variability of the CS-2 radar freeboards can found in Table 1 in the original manuscript. As suggested, we have included this variability in of the observed and the calculated radar freeboards in the text of the paper.