Interactive comment on **"Three years of sea ice freeboard, snow depth, and ice thickness of the Weddell Sea from Operation IceBridge and CryoSat-2" by Ron Kwok and Sahra Kacimi**

Anonymous Referee #1 (Referee comments are in italics)
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The paper is almost flawless, with results and discussions complete. It is also very well organized and structured making the case study approach easy to follow and make comparisons. However, there are few confusing sections which could be clarified (see below).

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.

1) Introduction
(Page 1, lines 1 to 8): One of the biggest differences between the Arctic and the Antarctic sea ice is with its associated snow cover (eg. how thick the snow cover is and its corresponding variable geophysical properties including its freeboard). I think the authors should briefly summarize the observed differences in snow covers on Antarctic versus Arctic sea ice and how they likely influence (and complicate) ice freeboard and thickness retrievals from radar altimetry.

We have added a few sentences to the first paragraph (below) to highlight the differences between Arctic and Antarctic snow depths and ice thickness. But, we point the reviewer/reader to perhaps one of the best summaries of Antarctic snow depth (Massom et al., 2001).

Added text: "…One distinguishing feature of sea ice in the Antarctic vis-à-vis the Arctic is the common occurrence of snow-ice due to heavier snow fall (Massom et al., 2001): when the snow load depresses the ice surface of the thinner Antarctic sea ice below sea level, seawater infiltrating the base of the snow layer leads to the formation snow-ice when the resultant slush freezes. The thicker snow cover, flooding, and snow-to-ice conversion (in addition basal freezing) complicate the large-scale retrievals of snow depth and ice thickness…."

Line 13: "Remote sensing issues" ?? The author needs to briefly describe what these issues are. "to determine freeboard" snow or ice?

The follow text has been added to clarify the meaning:

"…of ICESat and the launch of the ICESat-2 (IS-2) lidar this year, OIB has acquired a unique time series of that allows for examination of the interannual behavior of Antarctic sea ice cover as well as a better understanding of the remote sensing issues associated with the retrieval of sea ice freeboard and thickness. In addition to a lidar to determine freeboard, the OIB instrument suite includes an ultra-wideband radar that is capable of resolving the location of the air-snow and snow-ice interfaces, and hence providing snow depth estimates. Over the OIB mission, the sensitivity of snow depth retrievals to

associated snow properties (density and salinity) has become a special emphasis because of the significant impact of snow on thickness estimates using lidar or radar (Kwok, 2014)."

Page 3: "Data description" should be 2, not 1. And section numbering should be corrected throughout thereafter.

Corrected.

Page 4 and throughout thereafter: The authors should really consider simplifying the symbol notations if possible. It looks very confusing, small and complicated. Too many subscripts within a subscript (for e.g. snow depth from the snow radar in line 25). This causes sections 2.2 and 2.3 to be read in a very unclear and confusing manner.

Yes, we recognize that it is somewhat confusing but we think that they are needed for the discussion in the text. In order to make it more accessible to the reader, we've done the following:

1. At the beginning of Section 3, the differences between retrieved and derived quantities are defined. Added text: "…Here, we define derived versus retrieved quantities. Derived estimates, referred to in the balance of this paper and this section, are quantities calculated from the retrieved quantities. The significance of these derived estimates is discussed…"

2. Wherever possible in the text, we use the full text description of a variable in addition to its symbolic notation. For example, instead of,

"…Comparison of $\tilde{h}_{fs}$ with h_{fs}^{SR} tells us how well we can estimate snow depths using the differences between h_{f}^{ATM} and h_{fi}^{CS2} in the absence of a snow-radar…."

We substitute with:

"…Comparison of the derived ($\tilde{h}_{fs}$) with the retrieved snow depth (h_{fs}^{SR}) tells us how well we can estimate snow depths using the differences between lidar (h_{f}^{ATM}) and radar freeboards (h_{fi}^{CS2}) in the absence of a snow-radar…"

Table 3: Even though the table shows differences and correlation between derived and measured freeboard, the "/" symbol is confusing. Please consider changing.

A separate column added, for the correlation values, has been added to Table 3 so that a "/" is no longer needed.

Figure 2: No coordinate info in the map figures for the flight lines. Something needs to be added for visual geo-referencing.

Latitudes and longitude labels have been added to Figure 2.