

Interactive comment on “Albedo of the ice-covered Weddell and Bellingshausen Sea” by A. I. Weiss et al.

Anonymous Referee #2

Received and published: 9 February 2012

Summary:

This paper presents an investigation of surface albedo of sea ice areas around the Antarctic Peninsula using aircraft measurements. There have been few direct albedo measurements in the Antarctic. Weather and climate models have generally used simplified parameterizations of albedo and most use information derived from Arctic observations. The study finds large differences in albedo in different regions due to differences in the distribution of open water (e.g., polynyas), thin ice, and thicker ice. Model representations of albedo do not match the observed values well and improvements could be made based on these observations.

General Comment:

C1912

This paper addresses an important deficiency: albedo measurements over Antarctic sea ice. It is a potential benefit to improvements in sea ice and GCM models. The results are not terribly surprising – highest albedo over thick, consolidated pack ice with the western Weddell Sea, lower albedo in the first-year ice dominated Bellingshausen, and the lowest albedos in the southern Weddell due to significant amount of open water in polynyas. Nonetheless, it provides useful quantitative values. It also presents empirically-derived parameterizations from this data as a potential improvement over current model parameterizations. I recommend publication after minor revisions.

Specific Comments:

1. pg. 3261, line 18: shouldn't snow cover also be mentioned? Snow will substantially affect the surface albedo depending on temperature, grain size, melt state, etc.
2. pg. 3267, line 28: “prevailing wind in this area which...” I think there should be a comma before “which”. This occurs in several other places through the paper. It may be an issue of style standards, but to my understanding there is almost always a comma before “which” and almost always no comma before “that”.
3. pg. 3269, line 5: “albedo increases fast.”
4. pg. 3269, line 6: “. . .sea ice changes. . .” and “. . .which causes. . .”
5. pg. 3271, section 4.1: This is a nice discussion of albedo parameterizations, but it seems to address mostly older models – 1970s, 1980s, early 1990s. I think there have been some substantial improvements in model parameterizations in recent years, e.g., in the most recent NCAR CESM sea ice model, CICE. I think most of the albedo parameterizations have been for Arctic sea ice, but there may be some for Antarctic. I would recommend checking the CICE documentation and relevant papers from Cecilia Bitz, Marika Holland, Elizabeth Hunke, and others. There may be other models that have made improvements. It may be also be useful to look into the latest versions of the models to be used for IPCC AR5, which I think are now available.

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6. pg. 3273, 3274: One thing that I don't see explicitly discussed is the scaling issue. Aircraft measurements are presumably obtaining data from a fairly narrow swath at spatial resolutions (instrument footprint) of 10s to 100s of meters. However, model grid cells are on the order of 10s or 100s of kilometers. Did the authors take this into consideration and was any attempt to upscale or downscale the two to harmonize the spatial resolution?

7. pg. 3275, lines 1-14: Another thing notable for its absence is flooded snow and snow-ice formation. While the Antarctic has few or no melt ponds, flooded snow and snow-ice are common in the Antarctic. I would think that these have unique albedo signatures that may be important to measure and parameterize in models. However, I don't see them specifically noted.

8. pg. 3275, line 23: "...as a boundary..."

9. pg. 3276, line 4: "is relatively easily available as an input parameter..."

10. pg. 3276, line 11: remove "not" before "one linear" and add "not" between "can" and "predict"

11. pg. 3276, line 14: "On the one hand..."

12. Table 2: I'm a little surprised that there is so little difference between the albedos for the mix of sea ice and open water vs. the sea ice only. Particularly for the NE Bellingshausen where the concentration is 89%. That means that 11 % is open water, which should have an albedo of ~ 0.07 . It seems considering or not considering that should result in a difference of more than 0.01?

13. Table 3: The units for temperature should be consistent, either C or K. It would probably be easier to convert all to C.

Interactive comment on The Cryosphere Discuss., 5, 3259, 2011.