

Reply to Referee 2's comments

The referee comments are in **Arial**. The authors' responses are given following each comment in *Times New Roman Italic*.

We thank the referee for your helpful comments both here and to the previous submission to another journal. We address all of your comments below.

General: This manuscript is revised from a manuscript previously submitted to a journal. It's much improved from the earlier version. It's now close to being ready for publication. Reviewers are often critical of model evaluations for multi-component models, since it's difficult to do a comprehensive evaluation in a standard-size manuscript. Such papers can be piecemeal and incomplete. However, there a series of papers on RASM with more detailed evaluations of the model components, so general paper on RASM performance is appropriate here. The figures and figures-linkage to manuscript could use a more careful editing.

Response: This is done now.

Specific Comments.

(1) latter part of page 2. When RASM first appeared it the resolution advantage over global models was especially an advantage. Global models are now encroaching on mesoscale resolutions in some cases. Also, variable resolution global models (<http://www.tropmet.res.in/introspect/presentation/16feb/skamarock.pdf>) are becoming or will become rivals to regional climate models. This is a concern to be kept in mind for RASM.

Response: At Line 30, the sentence "Many physical and biogeochemical processes in the Arctic are contingent upon interfacial exchanges at fine spatial scales and short time and cannot be represented within the computation constraints of the current generation of ESMs" is changed to "Many physical and biogeochemical processes in the Arctic are contingent upon interfacial exchanges at fine spatial scales and short time scales that may be better represented by a regional coupled model."

(2) second paragraph of page 3. This section fulfills an important need to define how the success of RASM results is to be measured.

Response: Agreed.

(3) page 4, line 11. "ramped upwards from zero" is confusing.

Response: We change this to "starts from zero at ~540 hPa increasing in strength upwards from there."

(4) page 9, line 12. Should be a reference to Figure 2.

Response: We fix this.

(5) page 9, line 20. "regional river basins" seems to come out of nowhere.

Response: We change this to "all of the Arctic region's river basins."

(6) page 9, line 23. "The biases relative to GPCP are generally the opposite ..." Are you discussing Figure 3?

Response: This is in reference to a figure that is not shown. We add "(not shown)" to the end of this sentence.

(7) The figure captions for Figures 4 and 5 are not consistent.

Response: Figures 4 and 5 are updated to refer correctly back to each other.

(8) page 11, line 3. I realize you wish to minimize the discussion of cloud microphysics in this paper. However, it would be a good idea to at least mention the microphysics scheme here. In the second paragraph on this page, it could be mentioned that in general it is difficult to represent Arctic clouds in numerical models (e.g., Vavrus 2004; J. Climate, 17(3), 603-615).

Response: In Line 13, we now mention that the too little or too optically thin cloud could be due to "the Morrison et al. (2009) two-moment microphysics scheme not producing enough supercooled water in mixed-phase clouds." Plus, we add at the end of that paragraph (at Line 22): "It should be noted that Arctic clouds are generally difficult to represent in models (e.g., Vavrus, 2004)."

(9) page 13, line 1. typo "is" to "are"

Response: We fix this.

(10) page 13, line 11 "near-zero observations" ?

Response: We replace this with "observations of $\sim 0 \text{ W m}^{-2}$."

(11) page 15, third paragraph. The correct value of conductive heat fluxes through the pack ice for SHEBA and presumably the Arctic Ocean as a whole is difficult to know, and appears to vary considerably over small distances (Sturm et al. 2001; 33(1), 213-220).

Response: We now mention at Line 28 that "these conductive heat fluxes...can vary considerably over small distances (Sturm et al., 2001)."

(12) Figure 14. I don't see a purple line.

Response: The reference to the purple line is removed.

(13) page 16, line 11. Appears to be a reference to Figure 15.

Response: We correct this.