

## ***Interactive comment on “The Arctic summer atmosphere: an evaluation of reanalyses using ASCOS data” by C. Wesslén et al.***

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The manuscript addresses performance of atmospheric reanalyses over the Arctic sea ice in late summer. Due to the Arctic climate change and rapid sea ice decline, particularly in this season, the topic is very actual and important. Compared to previous evaluations of atmospheric models and reanalyses, the main strengths of the present manuscript are the availability of detailed cloud observations from the ASCOS campaign and the inclusion of the Arctic System Reanalysis (two versions of it) in the study. The manuscript is based on detailed and careful analyses and reaches important conclusions. The results are presented clearly both in the text and figures. I suggest that the manuscript can be accepted in ACP subject to minor revisions, as detailed below.

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1. Point measurements over sea ice are compared against grid-averaged values of reanalyses. The impacts of this practice should be evaluated for different variables. The impact is probably small for the turbulent and longwave fluxes, because in late summer the thermal differences between sea ice and open sea are so small, but it may be an important issue for the analyses and conclusions on shortwave radiation and surface albedo. This problem is mentioned on page 16504, lines 1-2, but only from the point of view of time averaging, which I did not fully understand. Information on sea ice concentration should be provided, with estimates on its effect on the comparison of point measurements and grid-averaged values. For the momentum flux, the authors already mentioned that observations were made both over ice and open water and the result did not differ significantly.

2. It appears that the authors did not apply the full vertical resolution of the reanalyses (Page 9, lines 19-21), but only the data from isobaric levels. The reason for this selection should be explained, as also the high-resolution model-level data are available, at least from ERA-Interim. It should also be evaluated how the application of the coarse-resolution isobaric level data has affected the main results, such as the errors in the cloud thickness.

3. I am somewhat confused about the analyses of longwave emissivity. I suggest the authors to check that they have correctly derived the surface temperature from pyrgeometer data, also taking into account the longwave radiation reflected from the surface (see e.g. Vihma et al. (2009), eq. (4)). If taken into account, the results should not be very sensitive to the emissivity used. A second issue is to make sure that exactly the same variables from observations and reanalyses are compared (longwave radiation emitted from the surface or the total upward longwave radiation). Also, clarify the sentence on Page 16516, lines 10-11 (the surface temperature of snow/ice should never exceed 0 deg C).

4. The manuscript remains isolated from previous work on evaluation of atmospheric reanalyses over sea ice. Such studies have been carried out in the Arctic also in the

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same region and season as in the present study, and some of the results presented in the present manuscript are not new. At least Lüpkes et al. (2010) and Jakobson et al. (2012) have observed the warm and moist biases of ERA-Interim in the ABL. Also the results for the vertical profile of the wind speed are worth comparing against Jakobson et al. (2012). The previous evaluations of Polar WRF - the basis for ASR - are mentioned in the Introduction, but a reader would also be interested to see at least a brief summary of the differences/similarities between those and the results of the present study. If the authors are interested in evaluating their results in a broader context, the studies by Tastula et al. (2013) over the Antarctic sea ice zone may also be of interest.

5. It would be good to explicitly mention that there is a large positive bias in ERA-Interim near-surface specific humidity.

6. Beginning of the Abstract and Introduction: are you sure that the climate changes in the Arctic have been larger than those in the Antarctic Peninsula – Bellinghausen / Amundsen Sea region?

#### References

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