**Reviews, and response to reviews, of the essay on:**

# Cloud Cover and Surface Radiation

## Reviewer #1

| | | **2. Cloud Cover and Surface Radiation** |
|---|---|---|
| Page No. | Line No. | Comment |

General comments: No specific comments. The editors note that no general comments were provided. Nor did the reviewer provide any specific comments in the table.

## Reviewer #2

| | | **2. Cloud Cover and Surface Radiation** |
|---|---|---|
| Page No. | Line No. | Comment |
| 7 | 175 | Would it be possible to include the unit in the legend of the figure (as these figures are usually used without the legend in presentations)? The editors note that the authors did provide the cloud cover anomaly unit (%) in the figure caption. This is adequate for readers of the Report Card. |
| 8 | 185 | What is the unit for the anomalies in net radiation? The unit is W $m^{-2}$ and this has been added to the figure caption. This is adequate for readers of the Report Card. |

General comments: The editors note that no general comments were provided.

## Reviewer #3

| | | **2. Cloud Cover and Surface Radiation** |
|---|---|---|
| Page No. | Line No. | Comment |

General comments: The editors note that no general comments were provided. Nor did the reviewer provide any specific comments in the table.

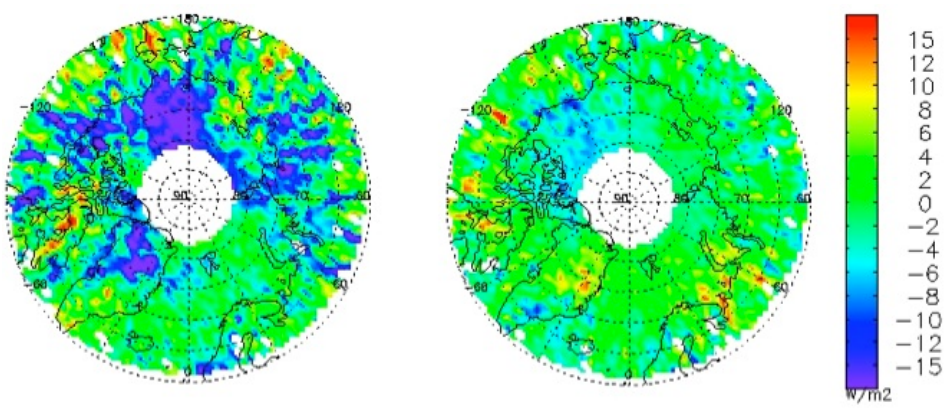
## Reviewer #4

| | | **2. Cloud Cover and Surface Radiation** |
|---|---|---|
| Page No. | Line No. | Comment |
| 8 | 185 | The units are not shown at Fig. 8 The units, W $m^{-2}$, have been added to the figure. Additionally, the period over which the anomalies were calculated has been changed to be consistent with the cloud anomalies (2002-2011 rather than 2002-2010). |
| 8 | 190 | It seems that Fig.9 in contradiction with Fig.8(a), where negative anomalies in Barrow region are not evident. May be it is due to different time periods for calculation of anomalies. The ECMWF net radiation anomalies (Figure 8) are, in fact, negative around Barrow but are of slightly lower magnitude than the measured values. This is not surprising given the low spatial resolution of the reanalysis and smoothing of the field that is inherent in the assimilation. |

General comments: It would be good to comment the decrease of net radiation balance at the Canadian part of the Arctic Basin (Fig.8). Other – it could be better to delete Fig.9, which is in contradiction with Fig. 8 (see comment above). The authors feel, and the

editors concur, that Figure 9 is important as validation/verification of both the reanalysis field (Figure 8) and satellite estimates of the surface radiation budget (not shown). Furthermore, reviewer #5 pointed out the uncertainty in the ERA-Interim radiative fluxes.

## Reviewer #5

| | | **2. Cloud Cover and Surface Radiation** |
|---|---|---|
| Page No. | Line No. | Comment |
| 6 | 158-169 | I am not convinced that the anomalously large cloud cover has cooled the surface all June over all region where it was observed. Accurate measurements on the cloud radiative forcing over Arctic sea ice are rare, and the results are scattered. On the basis of Russian drifting station data from 1968-1991, clouds significantly decrease the surface net radiation in May – July (Chapman and Walsh, 1998), but on the basis of SHEBA data only in mid-summer (Intrieri et al., 2002; Shupe and Intrieri, 2004). The sign of the net radiative forcing is very sensitive to the surface albedo, solar zenith angle, cloud water and ice contents, cloud droplet size, cloud base and top heights, and the shape of the air temperature profile. Hence, the representativeness of the above-mentioned results for the present Arctic climate is uncertain.<br>The authors don't actually claim that the positive cloud cover anomaly led to cooling for the entire region over which it occurred. They simply said that there was a correspondence between above-average cloud cover and below-average net radiation, and also a correspondence between average cloud cover and some areas of below-average sea ice cover. In fact, the cloud radiative forcing is much weaker in June than in January, based on their estimates using CALIPSO cloud cover. A sentence has been added to clarify the relative importance of clouds in the two months. However, due to space restrictions, no figures have been added.<br><br>Here is the cloud radiative forcing at the surface estimated with CALIPSO cloud cover anomalies for January (left) and June (right), 2013:<br>  |
| 6 | 166-169 | Conclusions based on Figure 8 should be written bearing in mind the |

| | | |
|---|---|---|
| | | uncertainty in ERA-Interim radiative fluxes. See e.g. Tastula, E.-M., T. Vihma, E. L. Andreas, and B. Galperin (2013). Validation of the diurnal cycles in atmospheric reanalyses over Antarctic sea ice, J. Geophys. Res., published online: 28 May 2013, doi: 10.1002/jgrd.50336.<br>Thank you for this reference and the important point. However, the Barrow data in Figure 9 confirms the ERA-Interim surface net radiation, at least for one point. The authors' work with satellite data also confirms the general spatial pattern and magnitude of the ERA-Interim fields.<br><br>The authors also refer to the results being consistent with the "below-average surface air temperature", referring to the essay on air temperature. There, however, results are presented for the 925 hPa level, not for the surface temperature, and I am not convinced that the negative anomalies were real (see my comments to the essay on Air Temperature).<br>The authors have also examined skin (radiating) temperatures, both from satellite (MODIS) and from ERA-Interim. In June the skin temperature anomaly is slightly negative, but close enough to zero so that it is not really a factor. Therefore, the authors deleted the text about the below-average temperature. |

General comments: The structure of the text is clear.

## Reviewer #6

| | | **2. Cloud Cover and Surface Radiation** |
|---|---|---|
| Page No. | Line No. | Comment |

General comments: The editors note that no general comments were provided. Nor did the reviewer provide any specific comments in the table.