

Authors' response – AMT

Spatiotemporal variability of shortwave radiation introduced by clouds over the Arctic sea ice by Barrientos Velasco et al.

Response to Anonymous Referee #1 (29 Jul 2019)

We would like to thank the Anonymous Referee # 1 for dedicating time and giving help to the improvement of the manuscript by providing us with valuable comments and suggestions. We have now revised the initial submission, and hope that the manuscript is now acceptable for publication.

Our point-by-point response to the review comments is written here in bold font.

Overall summary of major changes:

We would like to inform the referee about the following major changes:

- Change of title for consistency
- Revision/restructuring of introduction due to suggestion of Referee #2
- Change of Figure 1 according to comments by Referee #2
- Improvement of the discussions section considering the comments by Referee #2
- Removal of table 1 due to suggestion of Referee #1

Small clarifications

- For consistency, we, now, refer to the shortwave component of the radiation as solar and to the longwave component as terrestrial radiation.
- A re-calculation was made of the area covered by the pyranometer network and the longitudinal extension of value of 1.3 Km was re-adjusted to 1.59 Km.

Specific comments:

As mainly atmospheric global transmittance is discussed (and not global irradiance) the title could be changed.

This suggestion has been discussed and we prefer to keep the title and change shortwave to solar just for consistency.

The reason to keep 'radiation' instead of 'transmittance' is additionally explain in the introduction with the following sentences:

'With the aim to better understand the spatial distribution of downward solar irradiance, we consider the solar atmospheric transmissivity as a proxy quantity to measure the influence of clouds on solar radiation, as it compensates at least to some degree for the influence of changes in solar elevation angle (Deneke et al., 2009)'

Figure 2 indicates enormous problems with the horizontal leveling and/or with the cleanliness of the sensors on about half of the measurement days. What was the criteria to differentiate between an unlevelled and a completely unlevelled station?

A more extensive description of the criteria used for the quality assurance is now given in section 2.1.2 and can be read as follows.

'The leveling criteria are based on the bubble position of the spirit level of the pyranometer. When the bubble was located inside the inner ring, the instrument has been considered as well-leveled, in between the two rings as partially leveled, and outside the ring as unlevelled'

Authors should further comment why days with liquid droplets on the domes were used in the analysis and how this probably influenced the results.

Days with liquid droplet were considered because we wanted to include a larger amount of data that was not heavily compromised into the analysis. As we are mainly concerned with changes in transmissivity and not absolute values, we believe that these data are still useful for our analysis. It should be noted that the period of liquid droplets were likely to be relatively short, whereas frozen domes had the tendency to stay in that conditions for a longer period of time.

A corrected explanation is given in section 2.1.2. In the text the explanation is given as follows:

'The presence of liquid droplets is considered in the study due to their likely short residence time around the dome, and the fact that we have found observations to still be useful for our analysis. Furthermore, it is worth mentioning that during this likely short period, the presence of droplets is expected to cause a moderate underestimation of irradiance and more noisy observations.'

As mentioned in the conclusions, the relevance of the results for the energy budget of the sea ice could not be assessed. The authors should describe in a little bit more detail in the outlook what would be necessary to do so.

We improved the explanation with the following text:

‘Future work will also be aimed at the investigation of radiative closure based on radiosonde soundings and ground-base remote sensing observations of cloud properties conducted aboard Polarstern as input to a 1-D radiative model for the entire PASCAL cruise. The output of this analysis will provide insights into the influence of clouds on the surface energy budget’

Table 2 could be omitted.

This table was omitted.

In the following figures, a larger font should be used:

- Figure 1 (d)
- Figure 6 (f)
- Figure 7 (f)
- Figure 9 (f)
- Figure 10 (f)
- Figure 12 (f)

The font was increased for all the figures above.

Technical corrections:

- Page 2, Line 19: replace “sea-ice floe” by “sea ice floe”.
- Page 3, Line 15: replace “Juelich” by Jülich”.
- Page 4, Line 28: replace “better than than 2 %” by “better than 2 %”.
- Page 6, Line 13: replace “Wendisch et al” by “Wendisch et al.” This error occurs several times in the text.
- Page 11, Line 12: replace “dominated with by an anticyclonic” by “dominated by an anticyclonic”.
- Page 12, Line 8: replace “Schade et al,” by “Schade et al.,”. This error occurs several times in the text.
- Page 19, Table 1: replace “responsivity per year)” by “responsivity per year”
- Page 21, Table 3: replace “Ambient temperature [Ta] , atmospheric global transmittance (ATg) [-]” by “Ambient temperature Ta [K], atmospheric global transmittance ATg [-]”

All the points above where changed and fixed.