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Interactive comment on "A comprehensive in situ and remote sensing data set from the Arctic CLoud Observations Using airborne measurements during polar Day (ACLOUD) campaign" *by* André Ehrlich et al.

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The comments of the reviewer have been helpful to improve the manuscript. The detailed replies on the reviewers comments are given below.

The reviewers comments are given in bold while our replies are written in regular roman letters. Citations from the revised manuscript are given as indented and italic text.

Detailed Replies

The text should be more concise. The authors should find way to significantly reduce the length.

We did go through the entire manuscript and reduced the text where it was possible without removing important details. However, still the manuscript did not significantly reduce in length. Due to the number of instruments (two fully equipped aircraft, 20 individual data sets) no further reduction is possible without loosing the main intention of the manuscript, which is to describe the data and data processing for new data users. We expect that most readers who are interested in the data, look probably only for a certain group of data. Thus we do not consider the manuscript length as critical. E.g.: If someone wants to use remote sensing observations, he or she only has to look into the section of Polar 5 and may skip the Polar 6 part.

Section 2.3: This paragraph shows the RT model is used in the data, but the justification and uncertainty of this treatment is not well discussed.

The radiative transfer simulations were not used to replace the measurements, if that is what the reviewer understood. The simulations only provide the relative number of the fraction between direct and solar irradiance, which cannot be measured on the aircraft. This fraction is used to weight the correction of the downward irradiance following the common approach by Bannehr and Schwiesow (1993). The contribution of uncertainties of the direct fraction to the downward radiance strongly depends on solar zenith angle and aircraft attitude. For 60° solar zenith angle, roll and pitch angle of 5°, 5 % uncertainty of the direct fraction amounts to a total uncertainty of less than 1 %.

To make this better understandable we changed the section into:

This correction is valid only for the downward direct solar irradiance. Therefore,

the relative fractions of direct and diffuse solar radiation were estimated using radiative transfer simulations (cloud free and cloud covered). The simulations were updated continuously based on available in-flight observations and consider the temperature and humidity profiles and the presence or absence of clouds. For the conditions during ACLOUD, a 5 % uncertainty of the simulated fraction of direct radiation amounts to less than 1 % uncertainty of the corrected downward irradiance.

This paragraph also assumes "The upward solar radiation as well as the upward and downward terrestrial radiation were assumed to be isotropic". This is not valid for solar radiation. What's the effect of this assumption?

This sentence might have been misleading. The point we wanted to make is that upward solar irradiance was not corrected for the aircraft misalignment. This is common procedure because of two reasons. First, a correction would require knowledge on the exact distribution of the radiation field, which is not measured and is difficult to estimate from simulations. Second, the upward radiation is way less anisotropic as the downward radiation (direct solar radiation) and the effects of the aircraft misalignment are little. A perfect isotropic radiation field would cause no effects at all. But it's true that our argumentation was wrong and misleading.

We rephrased this sentence to avoid any misunderstanding.

The upward solar radiation as well as the upward and downward terrestrial radiation cannot be corrected for the aircraft attitude. However, these components are characterized by a nearly isotropic radiation field compared to the downward radiation and the effects of a misalignment is minimal for a nearly level sensor (Bucholtz et al. 2008). To limit the remaining uncertainties due to the aircraft movement, measurements with roll and pitch angles exceeding $\pm 4^{\circ}$ *were removed from the data set.*

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