Replies to Reviewer Comments: Reviewer 1 (W. Eschenbach):

Please find our replies to the reviewer's comments in blue print.

The values given in Figure 1 (b) are not correct. According to the CERES satellite data, from 2001-2014 the amount of sunlight absorbed into the arctic oceans is between 50 and 55 W/m2. Antarctic oceans varied between 55 and 58 W/m2 over the period.

The authors give values from 150 to 180 W/m2 for the Arctic and from 180 to 245 W/m2 for the Antarctic.

The Kiehl-Trenberth global energy budget gives a global average value of 167 W/m2 fro absorption, and the CERES data gives a global average of 162 W/m2 ... the authors' claim is larger than the K/T global average.

We thank you very much for bringing up this point. Indeed there was a mistake in our calculations. Cells with invalid retrievals are labelled as NaN (not-a-number) in the APP-x product. NaN cells were ignored during averaging, resulting in numbers that were too large in our manuscript. We fixed this by attributing zero fluxes to NaN values, as incorrect retrievals originate from too little sunlight in winter. Consequently we set NaN albedos to 1. Our numbers lie now in the range that you report, considering the recently identified underestimation of absorbed fluxes in the CERES data over the Arctic (Riihelä 2017, JGR, in press).

However you unfortunately did not provide any sources or calculation details for your numbers. Your plots are rather inconsistent regarding latitude limits. In these calculations the threshold latitude is of significant importance. While you label all your plots as "absorption poleward of 50°", your second plot clearly only shows data starting from 60°. Also the dotted lines in your plot (~66°) probably present what your plotting routines define as "Arctic" and "Antarctic". We can just assume that your first plot also just shows data poleward of 66°, as even your black "global average" line is around 54 W/m² despite the fact that you claim above a global average of ~165 W/m²

Of course lower latitude contributions to the mean value are crucial due to their relatively large areas and larger fluxes. For a more poleward latitudinal threshold smaller numbers result as average values.

This boils down to a central question for this study: What is the right cut-off latitude? The latitudinal extent of sea-ice differs dramatically both between the hemispheres and also within the different regions of the hemispheres themselves. Our initial approach was to encompass all sea-ice for our calculations. However, we see that this might be confusing as it differs from generally used classifications. Also this leads to a high number of processes other than sea-ice retreat influencing the results.

We thus recalculated for a latitudinal threshold of poleward of 60°. While this still encompasses some of the generally ice-free oceans, it covers most of the sea-ice extent throughout all seasons. We do not want to reduce this limit further to 66° as this would exclude a significant portion of the area seasonally covered by sea ice and areas that have experienced large changes in sea ice cover in recent decades.

The APP-x shortwave fluxes have been successfully validated e.g. against observations from SHEBA, a drifting observation ice camp, as well as again CERES fluxes (Riihelä 2017, JGR in press). We are thus confident in the calculated fluxes.

There is a separate issue. The CERES data shows a clear peak in Arctic oceanic absorption during the 2012 low in sea ice. There is no indication of this in the APP-x data.

This is also visible in the APP-X data after correcting the calculations. A new version of Figure 1b will be included in the revised version.