

Hereafter, the reviewer comments are written in Black and the Answers to reviewer comments in Blue.

Answers to Reviewer 3 comments

1* the name "CALIPSO–GOCCP product": I find that using this term both for the actual cloud products (which has been published previously under this name) as well as the LW-CRE dataset obtained by the author's parametrization based on CALIPSO-GOCCP based cloud information is unfortunate and confusing. Please change this and use a distinct name/acronym for your LW CRE estimate.

We agree with the reviewer comment. The new product name is **“LWCRE-LIDAR-Ed1”** for **‘LW Cloud Radiative Effect derived from space Lidar observations Edition 1’** and the acronym is CRE_{LIDAR} . We have updated the manuscript using this new name

2* Also, the article is rather unspecific about the form of publication. Which part of the data set will be available? Which variables will be included? Will the published dataset comprise the swath product, or only the gridded product. Given the overlap of authors with the creators of the GOCCP product, is this LW CRE product indeed intended to become part of the CALIPSO-GOCCP dataset? Please clarify this important aspect more thoroughly, ideally creating DOIs for the new data sets.

- Which part of the data set will be available?

We provide the monthly gridded product over the 2008-2020 time period.

- Which variables will be included? :

The table below gathers the variables that will be included in the dataset and provide their description. This Table is included in a new Appendix C named Data availability.

- Will the published dataset comprise the swath product, or only the gridded product.

For now we provide the 2×2 lat-lon gridded monthly product in a netcdf format over the 2008-2020 time period

(<https://doi.org/10.14768/70d5f4b5-e740-4d4c-b1ec-f6459f7e5563>) and we will provide the gridded daily product as well as the orbit instantaneous product soon.

- is this LW CRE product indeed intended to become part of the CALIPSO-GOCCP dataset?

Yes. As this surface LW CRE is derived from the CALIPSO-GOCCP-OPAQ cloud properties, it will become part of the CALIPSO-GOCCP-OPAQ dataset.

- creating DOIs for the new data sets.

According to the reviewer comment we have created the following DOI for this dataset: <https://doi.org/10.14768/70d5f4b5-e740-4d4c-b1ec-f6459f7e5563> and have been added in the paper.

Table 2: LWCRE-LIDAR-Ed1 Monthly Gridded Products: Definitions and Variable Names

Geophysical Quantity	Variable name in the nc file	Unit	Dim
time	time	“month”	time
lon	Longitude	°E	lon
lat	Latitude	°N	lat
Surface Cloud Radiative Effects Net Longwave Flux Monthly Means (Surface LW CRE)	sfc_cre_net_lw_mon	W m ⁻²	(time, lat, lon)
Surface Opaque Cloud Radiative Effects Net Longwave Flux Monthly Means (Surface LW Opaque CRE)	sfc_cre_net_lw_mon_opaque	W m ⁻²	(time, lat, lon)
Surface Thin Cloud Radiative Effects Net Longwave Flux Monthly Means (Surface LW Thin CRE)	sfc_cre_net_lw_mon_thin	W m ⁻²	(time, lat, lon)
Surface Opaque Cloud Radiative Effects Net Longwave Flux Monthly Means derived using Fully Attenuated Altitude (Surface LW Opaque CRE_Z_FA)	sfc_cre_net_lw_mon_Z_FA	W m ⁻²	(time, lat, lon)

Top Of the Atmosphere Cloud Radiative Effects Longwave Flux Monthly Means (TOA LW CRE)	toa_cre_lw_mon	W m ⁻²	(time, lat, lon)
Top Of the Atmosphere Opaque Cloud Radiative Effects Longwave Flux Monthly Means (TOA LW Opaque CRE)	toa_cre_lw_mon_opaque	W m ⁻²	(time, lat, lon)
Top Of the Atmosphere Thin Cloud Radiative Effects Longwave Flux Monthly Means (TOA LW Thin CRE)	toa_cre_lw_mon_thin	W m ⁻²	(time, lat, lon)
CALIPSO Opaque cloud cover (C_Opaque)	cltcalipso_opaque	%	(time, lat, lon)
CALIPSO Opaque cloud altitude (Z_T_Opaque)	cltcalipso_opaque_z	km	(time, lat, lon)
CALIPSO Fully Attenuated altitude (Z_FA)	zopaque	km	(time, lat, lon)
CALIPSO Thin cloud cover (C_Thin)	cltcalipso_thin	%	(time, lat, lon)
CALIPSO Thin cloud altitude (Z_T_Thin)	cltcalipso_thin_z	km	(time, lat, lon)
CALIPSO Thin cloud emissivity (E_Thin)	cltcalipso_thin_emis	1	(time, lat, lon)
Surface Elevation	SE	km	(time, lat, lon)

3* Referring to the following sentence in the conclusions: "All three satellite datasets exhibit some differences relative to ground-based measurements". This is a rather vague and unspecific comment and the abstract is rather more vague on this L26. Looking at Sec6.2, there seems to be a 10W/m² bias in LW-CRE over polar regions! Is this difference significant / indicative of a general lack of understanding in the LW radiation budget? Is this discrepancy caused by clouds? I suggest that the authors to add some more concrete text on this both in the abstract and conclusions.

The 10 W m⁻² bias in LW-CRE over Summit in winter is partly due to CALIPSO-GOCCP missing thin cloud below 2 km above ground level in winter, as shown in Lacour et al. (2017).

This specific information was lacking in manuscript and has been added in the conclusion (L673) and in Sect. 6.2 (L432).

In the abstract we have now stated that this new product shows good correlations with other datasets (L26), because we do not want to focus only on Greenland Summit in winter.

We updated Sect. 2.2.2 to provide a more complete paragraph describing the 2BFLX product.

Toward that point, I also ask that the authors add the bias between obs and the satellite-based products in Table 1.

Done

Specific comments:

L22: "period, We" => use full-stop to separate sentence

Done

L283: "GOCCP observations" => change to "GOCCP product"

Done

Figs 3,4 and 6: please indicate units in linear relations / coefficients.

We have rewritten more properly the equation in the Figures,

The unit of linear coefficients is now given in the figure caption and in the text describing the Figures.