Authors' response to Anonymous Referee #1

Referee comment:
One general concern I have is about the justification for generating this dataset. For each of the sensors/mission used in the paper, there exist corresponding mature retrieval datasets, which are validated and widely used by the community. One can understand the new dataset presented by the paper applied self-consistent algorithms to all the sensors, which is definitely a desirable thing to do, but the ultimate goal is to have a dataset with higher quality than the existing ones. I would suggest the authors to include results or at least a further discussion on why the new dataset is better than a congregation of each of the individual dataset. This could be achieved through showing that either the quality of the new dataset is better or the new dataset can be used for work that cannot be done otherwise (may be due to the inconsistency of algorithms).

Author's response:
We believe that already all individual datasets presented have their novel characteristics, either by being the first of its kind (e.g. MERS+AATSR: utilizing measurements of both sensors simultaneously.) or by showing better quality that precursor datasets (e.g. GRAPE ATSR2-AATSR) or generally by being based on a OE which ensures spectral consistency and which enables mathematically sound uncertainty propagation into the Level-2 cloud properties. In addition, all datasets feature Level-3 uncertainties that are based on a mathematically sound propagation of Level-2 uncertainties into Level-3 products.

Furthermore, a potential combination of all CC4CL-based sets (all except MERIS-AATSR) facilitates an increased temporal sampling thus a reduction of sampling errors compared to individual polar-orbiting sensors. In addition, studies of the impact of different temporal and spatial sampling as well as of spatial resolution of cloud climatologies are now feasible. Proving that the combination of the individual datasets leads to a dataset of higher quality will be subject to future studies, although this is a difficult task since reference measurements with high temporal resolution are necessary for this.

We rephrased the last two sentences of the manuscript to make this point clearer. We also added a paragraph to the summary section discussing the combinability of the datasets and new studies that are now possible.

Author's changes to the manuscript:
Last sentence of the abstract was modified to:
"In particular the ensured spectral consistency and the rigorous uncertainty propagation through all processing levels can be considered as new features of the Cloud_cci datasets compared to existing datasets. In addition, the consistency among the individual datasets allows for a potential combination of them as well as facilitates studies on the impact of temporal sampling and spatial resolution on cloud climatologies."

In addition we added the following discussion paragraph to the summary section:
"Applying the same retrieval system to multiple sensors also facilitates a combination of the individual datasets, ideally leading to higher quality. This will be subject to future studies. In addition to such a combination of the datasets, the consistency (i.e. by using the same retrieval system) among them will also enable studies that investigate the impact of the imaging characteristics of the different sensors on derived cloud climatologies. These imaging characteristics are for example the spatial resolution (1km x 1km for AATSR/MODIS vs. 1km x 4 km for AVHRR GAC) as well as the observation frequency driven by the sensor swath width (2399km for AVHRR vs. 500km for AATSR)."

Specific comments:

Referee comment:
1) P1, Line 15 in Abstract: "though" suppose to be "through"
Author's response:
Thanks. Has been corrected.

Referee comment:
2) P3: "developing physical retrieval systems for cloud properties with spectral consistency over all utilized bands". Take the 36-channel MODIS as an example, how many bands are utilized and how is the spectral consistency achieved?

Author's response:
Information on both is already given in the manuscript, but it seems to be useful to point to the information behind the sentence mentioned by the referee.

Author's changes to the manuscript:
We added "(See above for definition of spectral consistency and see Section 2.1 for the set of the spectral bands that have been utilized for each sensor considered)" below the sentence indicated by the reviewer.

Referee comment:
3) P5, Line 5 in Section 2.1: "night-time node)" unmatched ")"

Author's response:
Has been corrected.

Author's changes to the manuscript:
Has been corrected.

Referee comment:
4) P15: regarding the offsets between the datasets shown in Fig 8. It's puzzling to me why "they appear to be related to differences in the spectral characteristics of AVHRR heritage channels", as the spectral response functions should have been applied in the radiative transfer calculations. Could it be a calibration issue?

Author's response:
Yes, it could also be a calibration issue. Our comment was more referring to the cloud detection and cloud typing for which no radiative transfer modelling (with sensor specific spectral response functions) was done. The cloud mask and typing procedure was developed for NOAA-18 AVHRR. We developed empirical adjustments to the measurements of MODIS and ATSR2/AATSR to mimic NOAA-18/AVHRR, but we assume these adjustments to be imperfect. For all AVHRR sensors other than NOAA18/AVHRR even no adjustment was done, even though the spectral characteristics among them differ as well. The imperfect mimic of NOAA-18/AVHRR probably causes systematic errors in cloud detection and cloud typing which will most likely also introduce systematic errors in the other variables either by including more or less cloudy pixels in the monthly means (shown) or by different retrieval setups depending on the phase selection. We will elaborate more on this in the manuscript. As suggested by the reviewer, we will also mention that imperfect calibration might have an impact too.

Author's changes to the manuscript:
We have changed the corresponding sentence to:
"Though these offsets have not been investigated in detail yet, it is currently assumed that they are caused by to the following three reasons. (1) Differences in the spectral characteristics of the AVHRR heritage channels used, i.e. the position and shape of the spectral response functions, which is only accounted for empirically in cloud detection and cloud typing schemes. (2) The applied, but maybe still imperfect, calibration of the measurement records. (3) Differences in the spatial resolution of AVHRR (footprint size of 1km x 4km) compared with MODIS and AATSR (1km x 1km footprint size) may have a significant impact."

Referee comment:
5) P19: Fig. 6g: should be "cloud ice water path"; the word "ice" is missing in the color bar.

Author's response:

We assume Fig. 6e is meant. Actually, both Fig. 6c and 6e (which are identical) show the cloud water path example, which is in Level-3U (daily, global composites) liquid water path in pixels identified as liquid clouds and ice water path in pixels identified as ice.

Author's changes to the manuscript:
We added the following sentence to the figure 6 caption: "…for Level-3U (left panels) and Level-3C (right panels) products. Panels (c) and (e) both show the Level-3U cloud water path, which represents liquid water path in liquid cloud pixels and ice water path in ice cloud pixels."

Referee comment:
6) P28, Line 23: "surface)", unmatched ")"
Author's response:
Has been corrected.
Author's changes to the manuscript:
")" was deleted. We also modified surface -> surfaces.