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Interactive comment on "Cloud_cci AVHRR-PM dataset version 3: 35 year climatology of global cloud and radiation properties" *by* Martin Stengel et al.

Anonymous Referee #1

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This article describes the third version of the Cloud Climate Change Initiative AVHRR-PM dataset; a 35 year climatology based on measurements in 5 spectral bands from the Advanced Very High Resolution Radiometer (AVHRR) instruments on board several polar orbiting satellites. This dataset includes both cloud properties retrieved from the AVHRR measurements and surface and top of atmosphere irradiances calculated using these retrieved cloud properties. The article describes changes since the previous version of the dataset and presents some evaluation of the dataset and comparisons with the previous version.

This article is generally very well written. The description of the cloud retrieval algorithm is quite brief, but this is appropriate as the previous version of the algorithm is described in detail in a previous publication (Stengel et al. 2017). The description of the radiative transfer calculations is also quite brief and in my opinion more detail is required here (see comments below for suggestions). The dataset was accessed through the given identifier and appeared to be complete and consistent with the description in the article.

Recommendation

Accept pending minor revisions.

Minor Comments

1. Why does this article focus specifically on AVHRR-pm, as opposed to describing datasets for multiple instruments as in Stengel et al (2017)? At the very least, it seems odd not to include the AVHRR-am dataset in the scope of this article. On similar lines, would it be possible to produce a product combining AVHRR-am and AVHRR-pm measurements? Presumably the additional sampling of the diurnal cycle would lead to smaller errors in the radiation diurnal cycle corrections.
2. It's very difficult to see any differences in most of Figs. 1,2,5,6,7,8. I would consider including difference plots, either instead of the v2/CERES images, or as an additional row/column.
3. Is there any attempt to account for changes in the surface albedo with the angle of incident light in the SW radiative transfer calculations (e.g. Wang et al 2007)? Perhaps this could explain some of the differences between the CERES and AVHRR-pm surface SW upwelling irradiances?

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Discussion paper

4. With regards to the LW diurnal cycle correction factors, are separate factors derived for clear and cloudy scenes?

5. If I understand the radiative transfer model correctly, it requires the cloud to be split into layers. If this is the case, how do you determine how many layers to include cloud in (i.e. where is the cloud base?). I would expect this to have a reasonably large impact on the calculated surface LW downwelling irradiance.

6. Page 15, Line 11 -13. I don't follow the argument that "the larger standard deviations. . . is primarily related to variances in surface albedo and cloud cover which tend to have significant annual cycles". Relating the larger s.d. to the surface albedo variance makes sense, but I don't understand why the cloud cover variance will lead to a larger s.d. as it also affects the downwelling SW irradiance.

7. For TOA radiation, clear-sky differences between CERES and AVHRR-pm are attributed to sampling differences. Presumably this is relatively easy to test by calculating a CERES-like value from the AVHRR-pm product?

8. To further demonstrate the usefulness of the radiation products, it would be good to see some further comparisons with other datasets, such as the ERA-Interim reanalysis, or the GEWEX radiation budget data. Perhaps you could add a couple of extra lines in table 8 to show mean values for other products?

9. I really appreciate the effort undertaken to provide useful and accurate uncertainty estimates for the cloud variables. It would be very helpful to have some estimate of uncertainty in the computed radiation variables too. This could be based on further radiative transfer calculations using different cloud inputs to represent the uncertainty in the input cloud profiles, though this may be time consuming. Alternatively, a simple quality variable to indicate when the radiation calculation is uncertain due to larger uncertainty in the input cloud profiles could potentially be quite helpful.

10. Looking at the daily data, there appear to be some artifacts in the retrieved cloud water path at the edges of the swaths for the descending overpasses (e.g. for the 1 June 2016 data). These do seem to correspond with very large uncertainty estimates. In such cases, where the uncertainty is much larger than the retrieved value I wonder whether it would be better to replace the retrieved value with a missing data value? In particular, I have concerns about these retrieved values undergoing further processing (e.g. passed to radiation calculations, or used in monthly mean/histogram products) and the information about the large uncertainty associated with the particular retrieval being lost.

References

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