Review of "Correction of CCI cloud data over the Swiss Alps using ground-based radiation measurements"

Authors' response to anonymous referee 2

Fanny Jeanneret and co-authors
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We thank the reviewer for the review and presenting his/her suggestions. We have considered each one carefully, and answered below using these abbreviations:

RC: referee comment

AR: author's response

AC: author's changes in the manuscript (if appropriate)

RC Page 2, Line 8: These papers are still under review so 2017 needs to be changed to 2018.

AR Both are still under review and the DOIs correspond to the discussion papers (hence, 2017). The references will indeed be updated if the papers get approved before this one.

RC Page 2, Line 17: The author mentions shortwave and longwave measurements before mentioning passive. Also, microwave should be grouped with shortwave and longwave measurements. Finally, the next sentence uses 'latter ones' which refers to a group that contains active instruments and passive microwave when I believe the author intends for this second sentence to refer only to active instruments. For example, this would be clearer '. . . passive measurements of shortwave, longwave and microwave, as well as active instruments such as cloud radars and lidars. The latter ones ...'

AR Corrected, it is indeed simpler to understand now.

RC Page 3, Line 7: 'open-source' refers to source code. Another terminology should be used.

AR 'open-source' was replaced with 'open', here and in the introduction as well

RC Page 3, Line 8: 'the National' → 'the US National'

AR Corrected

RC Page 3, Line 9: 'from MODIS' → 'from the MODIS'

AR Corrected

RC Page 3, Line 9: 'the National' → 'the US National'

AR Corrected

RC Page 3, Line 12: '3.7 μm. For' → '3.7 μm-channel. For'

AR Corrected

RC Page 3, Line 26: A more complete list: "data such as atmospheric pressure, temperature and ozone, snow and ice cover, and land and sea surface temperature, all coming from ECMWF ERA Interim (...) along with surface reflectance from the MODIS MCD43C1 product (Schaaf et al., 2010)."

AR Corrected (see author's correction in the next question).

RC Page 3, Line 26: Choosing the phase based on cost is not how it is done for Cloud cci. For all versions up to and including the version discussed in Stengel et al. [2017] a method based on that of Pavolonis and Heidinger [2004] and Pavolonis et al. [2005] was used. Newer versions use a neural network approach, much like the cloud mask. This brings up a very good question as cloud phase determination suffers from very similar problems as cloud detection. Have the authors thought about this in the context of high altitude regions?

AR The algorithm described initially in our paper is indeed not the one producing the data used. We apologize and corrected this (see below). Indeed, the cloud phase is affected, similarly as all the retrieved microphysical variables are affected by the false cloud detection problem. Figure 5 shows, for each variable as well as for the cloud phase, the impact of false cloud detection on the retrieved microphysics.

AC "Cloud properties are retrieved from the satellite-measured radiances using an optimal estimation approach, following the theoretical basis for inverse retrieval methods described in Rodgers [2004]. The algorithm, called Community Cloud retrieval for Climate (CC4CL), works in three steps: first, a neural network trained on co-located data from CALIPSO-CALIOP [Winker et al., 2009] is run on the measured radiances to determine if a cloud is present in the retrieval scheme or not. Then, the cloud phase is determined with a decision tree, as proposed by Pavolonis and Heidinger [2004] and Pavolonis et al. [2005]. Lastly, the retrieval is done using the measured radiances and some ancillary data such as atmospheric pressure, temperature and ozone, snow and ice cover, and land and sea surface temperature, all coming from ECMWF ERA Interim [Dee et al., 2011], along with surface reflectance from the MODIS MCD43C1 product [Schaaf et al., 2010]. The cloud top pressure, cloud optical thickness and cloud effective radius are returned directly by the optimal estimation, whereas the cloud top height, cloud top temperature, cloud albedo, liquid and ice water path are then inferred from them. For more information, the algorithm is described in detail in Sus et al. [2017] and McGarragh et al. [2017]."

RC Page 6, Line 15: 'satellites' → "satellite's"

AR Corrected

RC Page 9, Line 3: 'pyrgeometers, respectively pyranometers,' → 'pyrgeometers and pyranometers, respectively,'

AR Corrected

RC Page 9, Line 6: I don't think the cosine of the incidence angle weighting is required for the thermal instrument.

AR A pyrgeometer's response (longwave) is weighted by the cosine of the incidence angle, as specified in the manual of the CGR4 instruments
(`http://www.kippzonen.com/Download/35/Instruction-Sheet-Pyrgeometers-CGR4`).
It is correct that it is far from being as important as for the pyranometers (shortwave).

RC Page 9, Line 13: 'modified' → 'a modified'
Page 9, Line 13: 'which have an' → 'which has an'

AR The sentence has been corrected this way:

AC "Older measurements from the ASRB network have been taken by modified Eppley PIR pyrgeometers, which have an observed uncertainty of 3 Wm^{-2}."

RC Page 9, Line 17: 'come from' → 'comes from'

AR Corrected

RC Page 9, Line 25: Subscript 'sky' should not be italicized. Only subscripts that are variables should be italicized.

AR This is indeed correct, subscripts have been checked and corrected everywhere.

RC Page 9, Line 28: Need a comma after the equation. And, 'sky' should not be italicized.

AR Corrected

RC Page 9, Line 29: 'approximated to 1' → 'approximated to unity'

AR Corrected

RC Page 12, Line 11: Need a comma after the equation. And, subscripts 'e' and 'm' should not italicized.

AR Corrected

RC Page 12, Line 12: Subscripts 'e' and 'm' should not italicized.

AR Corrected

RC Page 12, Line 16: Need a comma after the equation.

AR Corrected

RC Page 14, Line 1: Is their a formal way to train this decision tree that the author can describe and/or give references for?

AR The decision tree is trained using recursive partitioning (Breiman, 1984). The information and reference have been added to the manuscript.

AC "The training is done by 10-fold cross-validation with random sampling, using recursive partitioning as presented in Breiman (1984)."

RC Figure 10 caption: 'letters corresponds to' → 'letters correspond to'

AR Corrected

RC Page 17, Line 5: 'twice larger' → 'twice as large'

AR Corrected

RC Table A1 caption: 'temporally with MODIS' → 'temporally with the MODIS'

AR Corrected

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