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Atmospheric Measurement Techniques Discussions

Interactive comment on "Observing ice clouds in the submillimeter spectral range: the CloudIce Mission proposal for ESA's earth explorer 8" *by* S. A. Buehler et al.

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We thank the reviewer for the constructive comments. Below, reviewer comments are in italics and marked by '***R:***', our response is in normal font and marked by '**A:**'.

R: *This manuscript describes the concept for a submillimeter instrument dedicated to cloud ice observations. The scientific and technical requirements are given, the retrieval algorithms described and some synthetic and aircraft observations are used to test the algorithms. The paper is very close to the proposal to ESA it originates from, but summarizes all the work that has been involved in designing the mission. As such,*

it could be considered as a review. My main objection is that some papers are only referred to and the readers have to find the publications themselves. In some cases, it would be better to have a summary of the publications in question. One example is he beginning of section 3.1 where it would have been interesting to read a summary of why the submillimeter spectral range is so useful for ice cloud observations. Overall the paper is clear and well organized, and this reviewer's objections have more to do with the form than the content. Below are some detailed comments in order of appearance, not of importance.

A: Concerning the missing discussion of the usefulness of submillimeter observations at the beginning of Sect. 3.1, we agree with the reviewer that it would make pedagogical sense, and indeed the mission proposal, on which the article is based, did include this discussion. But for this article we on purpose tried to remove all material that is already in the peer reviewed literature. We think it is more appropriate to refer to the source than to repeat something that is already published.

R: *Section 2.1:*
1. How about retrievals of IWP from infrared spectroradiometers, such as those of ISCCP or MODIS? What is their accuracy?

A: At 60° N, ISCIP mean IWP is about 50 g m^{-2}, MODIS is about 100 g m^{-2}, and PATMOSX is about 150 g m^{-2}. In the tropics the discrepancy is even larger. These numbers are from Fig. 2 of the Eliasson et al. [2011] paper.

We added a discussion of this in Sect. 2.1. At the same time, we removed Fig. 1, which is for the climate models, and instead refer to Fig. 3 of Eliasson et al. [2011], of which Fig. 1 was a simplified version. This in the spirit of avoiding duplication of published material that we stated in the answer to the previous question.

R: *Section 2.2:*
2. You may also want to mention the work Heymsfield et al. (JAMC 2008) who compare

AMTD
5, C470–C474, 2012

different methods of retrieving ice water content based on a combination of radar and other instruments or in situ data.

A: Yes, a very useful article. In Elisasson et al. 2011 we also referred to it for the CLOUDSAT accuracy estimate. We now added two additional sentences at the end of the first paragraph of Sect. 2.2, where we cite the Heymsfield article and quote the CLOUDSAT retrieval accuracy (approximately 40% according to Waliser et al. 2009).

R: *Section 2.3:*
3. top of page 1108: Please write in plain English what Zme and Dme stand for as this seems to be the first time you mention these quantities.

A: Yes, thanks for catching this. Added an additional paragraph for this (as second paragraph in Sect. 2.3).

R: *4. What does 'MIPAS' stand for?*

A: Michelson Interferometer for Passive Atmospheric Sounding. Now also added to the text.

R: *Section 3.1:*
5. Please summarize in a couple of sentences what were the conclusions of Evans and Stephens (1995) or subsequent papers.

A: Since the article is already quite long, we do not want to go into more detail here. The main reason for citing the early papers is to give due credit to them for pioneering the technique and to be historically correct.

R: *Section 3.3:*
6. Why isn't it useful for polarization to use a cross-track scan?

AMTD

5, C470–C474, 2012

A: There are two reasons, a geophysical and a technical one. Firstly, the cloud polarization signal depends strongly on viewing angle (it is zero when looking nadir). Secondly, in the typical technical implementation of a cross-track scanning instrument, the instrumental polarization characteristics will be scan dependent. This is for example the case for AMSU. We added a brief discussion of this to the manuscript.

R: *7. What is the link between frontal system orientation and azimuthal biases?*

A: For a conical scan, different pixels along the scan line will have different azimuthal looking angle (if the forward part of the cone is used then from looking 65^circ to the right of the satellite track to looking 65^circ to the left). If, for example, fronts were preferably oriented in the north-south direction, then we wood look roughly parallel to the front for the forward view, but more across the front in the left and right views.

We reformulated the sentence in question as follows: "There could be azimuthal view angle biases if weather features have a preferred horizontal orientation, which could be the case for example for fronts. This effect has so far not been studied to the best of our knowledge, but at least biases in azimuth angle can be expected to be much smaller than the known biases in incidence angle."

R: *Section 4.3.2*
8. How does the minimum precipitation rate measurable by CloudIce compare with existing instruments? (e.g TRMM, AMSR, Cloudsat. . .)

A: We are still working on this question.

R: *Section 4.3.3*
9. Figure 9: could you mark the CoSSIR retrievals in red or a color other than blue so we could see where they are within the error bars and in comparison with the radar retrieval.

AMTD
5, C470–C474, 2012

A: Done. The plot really was hard to read, thanks for pointing this out.

R: *10. The sentence on lines 7-8 'another case study. . .Sreerekha et al. (2008)' is missing a word.*

A: Corrected, the missing word was 'them' (instead of 'the').

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 1101, 2012.