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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: *[Overview of review] This paper described the overview of satellite mission that measures the ice cloud by using submillimeter spectral range. This mission will be first mission that can observe the cloud vertical structure including the ice part of cloud and rain (extending to the upper and lower layers of cloud) on higher horizontal and temporal resolution than the previous satellite instruments (e.g. Odin-SMR, EOS MLS),*

but the relatively coarse vertical resolution. Although focusing largely on ice clouds, the mission has possibility to understand the cloud life cycle and the retrieved data will be useful to validate the numerical forecasting through the assimilation (Class 4 as described in the manuscript). Although this mission can cover the relatively thick ice cloud located at middle troposphere probably, the measurement of cirrus cloud located at the upper troposphere (below a few km to tropopause) may be lack, the cirrus cloud near the tropopause is quite important on the radiative balance and the numerical model is difficult to simulate the cirrus cloud. Therefore, it is concerned that this mission is not enough to cover the gap of knowledge about ice cloud.

A: The mission will measure also very high cirrus. The limit is not in cloud altitude, but in cloud ice water path (IWP). Very thin cirrus, with IWP below a few $\mathrm{g\,m^{-2}}$ will be difficult to detect with sub-millimeter observations, and are better studied with other existing techniques, such as passive IR observations or lidar.

R: *As mentioned above, although there are some spaces to discuss the gap between the mission objective and the actual observing cloud (In other words, the scientific objective should be more clear, for example the target of this mission is ice cloud associated with the convective system and then the totally knowledge of cloud system and radiation impact would be developed.).*

A: To make the mission objectives more clear, we added a new subsection 2.4 'Summary of mission objectives' at the end of Sect. 2 'Scientific objectives and requirements'.

R: *This manuscript is useful to discuss about the near future satellite mission to investigate the ice cloud feature. This reviewer hopes the author's comment about the gap (or more precise aim of this mission) described above and the a few minor comments below.*

Subsection 2.3: p.1107, l.21: In Table 2, how does the accuracy of IWP (10–50%) de-

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rive? The explanation is not clear in Buehler et al. (2007). Also how much the dynamic ranges of IWP and effective radius of cloud particle are expected from this mission? For example, IWP is 1-1000 g/m2, the effective radius is 1-1000um.

A: It comes from the pure scientific IWP accuracy requirement of 10–100% (which itself is derived from the CEOS/WMO requirement database), combined with the fact that we have already other cloud observations, which would make a new mission with error above 50% unattractive. The whole process and the various studies and inputs that have gone into it is summarized in Buehler et al. (2007).

***R:** Subsection 3.2/ Table 3: Because the 874GHz can capture the smaller particles, why isn't the 874GHz channel included? Please explain the reason in addition to the description in Buehler et al. (2007), especially the difficulty of retrieval.*

A: The 874GHz channel does have a benefit, but it is not very large if 664GHz also is present. This is discussed in the Jimenez et al. 2007 paper. Specifically, see Fig. 14 of that article. The 874 GHz channel is called 'R6' in the figure.

While providing similar information to 664GHz, 874GHz is technically significantly more expensive and risky, therefore we include only 664GHz. It is a matter of trade-off.

We have not modified the manuscript, since this discussion is already in Buehler et al. 2007, with simulation results in Jimenez et al. 2007.

***R:** Subsection 3.3/Table4: Is the overpass time 9:30 local time at Eq. enough for getting the ice cloud feature? And what is the expected feature of ice cloud at this time? Over ocean the convection is active early morning, on the other hand the convection over land is early evening.*

A: There will of course be also a descending node overpass at 21:30. The particular time comes from the Metop orbit. There is no ideal local time, as the reviewer points out.

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The alternative would be to have a non-sunsynchronous orbit, so that one samples different local times. We have in fact proposed a mission with such an orbit (on the international space station ISS) in a subsequent proposal 'ISS-Ice', which can be found at http://www.sat.ltu.se/projects/iss-ice/ .

R: *Sub-subsection 4.2.2–4.2.4: It is helpful for reader the additional explanation about the retrieval algorithm and assimilation method, the reader is not familiar with the satellite measurement with the submillimeter.*

We want to avoid duplicating information that is already in the cited references and keep the article as concise as possible. Furthermore, we fear that the article is already too long.

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