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Atmospheric Chemistry and Physics Discussions

Interactive comment on "First Odin sub-mm retrievals in the tropical upper troposphere: ice cloud properties" *by* P. Eriksson et al.

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General- This paper describes a novel satellite technique for measuring cloud ice in the upper troposphere. It is interesting to cloud remote sensing community. In the following are my comments and suggestions that hopefully would improve the paper before it is published.

Abstract: The statement about the current satellite techniques needs to be more accurate and fair to reflect the spaceborne radar and other microwave methods. The mm radiometry can measure thick ice clouds better than sub-mm sensors. However, the sub-mm techniques are more sensitive to clouds with low ice water path (IWP) and smaller crystals, which are important in the upper troposphere.

It is not accurate to say or imply that the submm has smaller influence of particle shape than mm sensors. The dynamic range of submm sensors is not particularly higher than mm sensors. Its sensitivity to low IWP and small crystals is better.

The IWP retrieval with the submm can suffer from saturation from cloud itself. The attenuation of cloud-sky absorption creates a bottom of the penetration at 12.5 km as your model simulation suggests for thin clouds. But if clouds are thick with high IWP, the attenuation from cloud itself can prevent the radiation from reaching the 12.5 km and makes the bottom somewhere higher than that altitude. In a sense, this is a saturation effect.

The submm is a promising technique for detecting low IWP in the upper troposphere that would be too tenuous for mm sensors (some even for CloudSat 94 GHz radar) but too optically thick for visible/IR sensors. In the abstract, as well in the introduction, you should also point out that the upper-tropospheric IWP consists of only a small portion of total cloud ice in the troposphere. There is a much great amount of cloud ice in the mid- and lower troposphere.

P8685, line 15: I'm confused by +/-45 deg polarization. Does the receiver have two polarizations at these angles, or just one polarization at 45 deg? If it is latter, just say 45 deg linear polarization and the sign does not add anything. My question applies to this notation throughout the paper.

P8685, line 16: Cloud scattering would make a significant difference for the radiances in the lower and upper sidebands as the scattering effect goes with the fourth power of frequency. It's very helpful to give the local oscillator frequency for Odin here and re-assess your claim here for the sideband impact.

P8687, line 12: It should read: Ě the averaged radiation scattered out is more than one scattered in. Thus, for the limb radiance at low tangent heights where the clear-sky background is "warm", the impact of clouds above the tangent height is to reduce the upwelling "warm" radiation.

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P8687, line 23: It is better read as follows: Ekstrom et al (2006) shows that at these tangent heights the radiance spectra depend primarily on temperature, humidity and cloud scattering. Since these limb radiances are less sensitive to pointing than those at high tangent heights, effects of instrument responses (such as Ě) can be neglected.

P8688, line 10: Ě but the mean particle size Ě

P8689, line 8: I'm confused by the two dT errors here. You said it is ˜2K in line 4 but changes it to 1 K here. It's known that 1K error in atmospheric temperature could induce a ˜17% error in relative humidity. Do you mean that?

P8690, line 4: The *latter* option ..

P8692, lines 1-25: Before these discussions, you need to clarify about the impacts of the other sideband. Depending the frequency and clear-sky absorption of the other sideband, your results here might be different.

Figs. 9 and 10: Both figures show strips in Odin-SMR IWP maps, which orient in the northeast-southwest direction. Please discuss the significance of these patterns and possible cause(s) if they are artifacts.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 8681, 2006.

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Interactive Comment