Atmos. Chem. Phys. Discuss., 6, S3386–S3389, 2006
www.atmos-chem-phys-discuss.net/6/S3386/2006/

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.

Anonymous Referee #1

Received and published: 28 September 2006

General:

The retrieval of ice cloud properties from Odin-SMR is described. This is an important paper since, besides that of EOS-MLS, it presents the only global dataset on ice water amount in the upper troposphere.

Major points for improvement are: (1) error sources for IWP should be summarised/quantified more systematically, and, (2) the absorption effects of small ice particles at sub-mm wavelengths should be considered in the text.

Specific:

p. 8686, l. 5: 'Figure 1 shows that Odin-SMR spectra with evident scattering signatures can be recreated in detail by simulations, a fact that gives high confidence in the

performance in ARTS-1.1.'

-> Is it really possible to distinguish on basis of these spectra absorption from scattering? I think absorption would make a very similar brightness temperature depression. Thus, I think you can only conclude that it is caused by 'extinction'.

p. 8688, l. 15: 'and with particles large enough to cause scattering at these wavelengths, will result in a decrease in the observed brightness temperature, Tb.'

-> Not only large particles, but also small ones lead to a Tb decrease through absorption (see below).

p. 8689, l. 18: 'This is the case as the ice amount in principle can be infinite as long as all particles sizes are sufficiently small that no scattering effects appear at the sub-mm wavelengths employed.'

-> Of course, scattering effects are small for small particles, but ice also absorbs at 500 GHz. The absorption is even larger than scattering for particles with diameters < 60 μm. Thus, for such particles the effect on the spectrum (or better: the optical depth leading to the absorption of the background radiation) is proportional only to the particle volume density, i.e. to the ice amount. This absorption is by about a factor of 100 smaller than the scattering induced by e.g. 400 μm particles (same ice amount), and, thus I agree with the authors that scattering makes the major part for most clouds. However, for small particle distributions, the effect of absorption should at least be mentioned.

p. 8695, l. 8: 'The dominating error source of the IWP retrieval is the assumed PSD.'

-> Various errors sources are discussed throughout the paper (e.g. calibration, humidity, cloud height assumption, PSD, particle shape). However, I miss a systematic listing of these (e.g. in the form of a table) and their induced error in IWP. Especially, the error for clouds IWP below 14 km where 544GHz cannot be used for cloud height should be evaluated.

ACPD
6, S3386–S3389, 2006

EGU

-> Other errors like tangent altitude knowledge, spectroscopic data (e.g. of H2O lines and continuum), ECMWF temperature used for the forward simulations should additionally be evaluated and included in this listing.

-> Also, there should be a comment on the effect of mixed-type clouds on the retrievals.

p. 8696, l. 5: 'The maximum sensitivity of Odin-SMR at 200 μm (Sect. 4.3) is centrally placed in this size range.'

-> I think this sentence should be weakened: From Mie calculations for single particle sizes, the maximum sensitivity on the ice amount at 500 GHz lies between 300 and 600 μm diameter. For particles with 200 μm diameter the sensitivity is about 25% of the maximum (which is of course still strong). I believe that for the used gamma distribution with maximum at 200 μm the effect is strongest because this includes also larger particles. However, when comparing the instrument's response with different size distributions in Fig. 11, the sensitivity on single particles should better be applied.

Technical:

p. 8682, l. 22: 'phenomenom'

-> 'phenomenon'

p. 8685, l. 8: 'decembre'

-> 'December'

p. 8691, l. 14: 'the the'

-> 'the'

Fig. 1:

-> Can you indicate somehow that the broad continuum stems from H2O?

Fig. 2:

ACPD

6, S3386–S3389, 2006

Interactive Comment

-> Are these spectral means and, if so, which spectral range has been used?

-> Are these values confined to the tropics?

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