Atmos. Chem. Phys. Discuss., 6, S5243–S5245, 2006
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "3-D polarised simulations of space-borne passive mm/sub-mm midlatitude cirrus observations: a case study" *by* C. P. Davis et al.

Anonymous Referee #2

Received and published: 11 December 2006

The paper presents some simulations of brightness temperatures and polarisations as would be observed by some of the sensors of AMSU-B, CIWSIR and EOS-MLS for a 3D mid-latitude ice scenarios. 3D effects are investigated with a Monte Carlo backward polarised scheme and with two 1D approximations. Results are presented and discussed; a simple model helps in explaining part of the differences found between different models.

Specific comments:

1) The goal of the paper is still not clear to me. In the abstract in fact it is written 'Although .., the results suggest..'. Now the capability of the ARTS-MC code were already

shown in the paper by Davis et al., 2005a so I do not see the reason to write another paper on that. On the other hand the paper, like the title itself suggests, is actually facing important issues related to 3D effects. However it seems to me that, on this respect, the authors are targeting too many aspects: the 3D effects (due to beam-filling and scattering out of the FOV), but also the sensitivity of polarisation to the aspect ratio of the ice crystals and everything both for conical, cross tracking and limb sounding and a wide range of frequencies. However, at the end of the paper, all the conclusions (like 'Aspect ratios in the range 1.3 to 3 cause Q in the range ...', 'For all instruments ...') are drawn based on 5 or 3 footprints only. This because the scene depicted in Fig.1 which represents a mid-latitude scenario has not been exploited for all its potential: why only five footprints for each instruments have been selected? Why are these 5 footprints so special that the authors can make conclusion based only on those simulations? Moreover there is no characterisation of these footprints except for the mean τ value at 334 GHz in Fig.8. If these footprints are so special, I would recommend providing at least the mean and the σ_τ at all frequencies. Why does none of the footprints used include the strong ice cores present in Fig1? Regarding the polarisation part, the ice particle assumptions themselves are very poor. Are these spheroids homogenous ice with 0.9 g/cm3 density? No information is given in that respect. Ice crystals in cirrus clouds are far from spheroids: T-matrix is certainly a wonderful tool but nature cannot be constrained to behave always as spherical harmonics. Many papers including Evans as a main author (e.g. Evans and Stepehens, JAS 2005, Evans et al, JAM 98) are much more detailed in that respect (in a 1D context): why all those works are not cited/exploited here? Perhaps it would be better to focus on the 3D effects only (leaving the influence of shapes in 3D scenarios onto polarisation for another paper). Therefore I would strongly recommend performing at least hundreds of simulations (it should be just a week-end work by a CPU according to the authors' estimate of the execution time) which simulates overpasses in the N-S and/or E-W direction with different field of views and different azimuth viewing angles. After those simulations, Figs 3-7 make no sense anymore and they should be substituted by other figures. Fig.8 on the other

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hand can be completed with many other points (and it would be nice to see the other frequencies as well).

2) It is not clear how the IPA has been performed. Is the 1D profile extracted along the slant path as suggested in Liu et al, JGR, 1996, 101 (D2), 4289-4298 and done by Kummerow 1998 ? At 'emission' frequencies the 1D slant path approximation generally accounts automatically for the geometric effects, i.e. for the leakages from the side which are likely to occur at the borders of the footprints.

Technical corrections

Section4: Although some idea can be gained by looking at Fig.1 and Fig.2 I would suggest specifying the footprints of the instruments in section 4. The footprints are a key parameter driving 3D effects: given the footprints here in consideration I would have bet from the beginning that 3D and IPA would have provided results very close.

Page 12712 line5: The beam-filling effect obviously depends also on the footprint dimension and the frequency under investigation.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 12701, 2006.