Atmos. Chem. Phys. Discuss., 6, S2203–S2204, 2006
www.atmos-chem-phys-discuss.net/6/S2203/2006/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of H_2SO_4/H_2O coating and ice crystal size on radiative properties of sub-visible cirrus" *by* P. Räisänen et al.

Anonymous Referee #2

Received and published: 1 August 2006

This study looks at the sensitivity of radiative fluxes through thin cirrus to the coating of dilute sulfuric acid on the surface of ice crystals. Using the results of laboratory studies of this type of coating process, the authors do a theoretical analysis of the short and long wave forcing of thin cirrus as a function of particle size and coating. The primary result is that the largest changes are seen when the cloud is composed of 1-2 m particles since these have the thickest coatings.

This is a useful study and provides further insight to the importance of small crystals in cloud interactions with solar and terrestrial radiation. There are several comments that I would like to make.

1) I object to the use of non-standard references, in particular: Bogdan, A., Molina, M.

J., Molina, L. T., and Kulmala, M: Formation of a liquid over-layer around ice particles in high cirrus clouds, in: Proc. 16-th Intern. Conf. on Nucleation and Atmos. Sci.,Kyoto, pp. 123-126, Kyoto Univ. Press, 2004. Bogdan, A.: On microphysics of high-altitude cirrus clouds, in: Abstracts of the European Aerosol Conference, Ghent, Belgium, p. 280, 2005.

Not only are these publications difficult to find, but they are not very well-arbitrated. Given that the study in this manuscript hinges to a large extent on the validity of the lab results that are in these non-standard references, I think that much more needs to be presented of these laboratory studies than is given in the current manuscript. The laboratory studies are actually more instructive than the radiative effects since it seems that probably only a fraction of thin cirrus actually have the coating. The authors reference several observational studies that report that the crystals are non-spherical. It is possible, that there could be a liquid layer that conforms to the non-spherical shape of the crystal but unlikely unless the layer is quite thin and then it makes little difference from a radiative point of view. To me, what is much more interesting is the microphysical process by which a droplet freezes and subsequently coated with the sulfuric acid. As eluded to by the authors, this might have the effect of suppressing the growth of the particles, in a similar way that nitric acid has been hypothesized as a coating that suppresses growth or evaporation.

2) The authors fail to acknowledge work that has been done with calculating the radiative properties of small crystals; in particular there is the study by Arnott et al., 1994, in which they look at the SW and LW properties of very small ice crystals with similar conclusions as drawn in the current manuscript.

3) If these results are to be compared with observations, the temperatures and humidity with respect to ice should be specified.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 5231, 2006.