Atmos. Chem. Phys. Discuss., 13, C4799–C4801, 2013
www.atmos-chem-phys-discuss.net/13/C4799/2013/

Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Radiative consequences of low-temperature infrared refractive indices for supercooled water clouds" *by* P. M. Rowe et al.

Anonymous Referee #2

Received and published: 14 July 2013

This paper discusses the importance of recently published temperature-dependent complex refractive indices (CRI) for supercooled liquid water on the upwelling / downwelling radiative fluxes and on cloud property retrievals that utilize IR data. This is an important project and needs to be performed, as the temperature dependent CRI data are new and potentially very important. The goal of this work is to highlight the impacts of using these new CRIs instead of the traditional temperature-independent liquid water CRIs; it does not involve the evaluation of the accuracy of these CRIs.

One challenge faced by the authors is the coupling of the CRI values from Zasetsky and Wagner et al., which are not the same in the overlapping spectral regions. This coupling needs to be done as there is some inconsistency between the CRI between these two datasets and the typically used temperature-independent CRI from Down-

ing and Williams, and the Wagner et al dataset does not cover the entire thermal IR spectral region. The authors did estimate the uncertainty between the two temperature-dependent CRIs, but this was not propagated into either the radiative flux calculations or the retrieved cloud properties. [Or, if it was, it wasn't clear from the manuscript.]

The authors pointed out a large difference in the Zasetsky CRI at 273 K and the Hale and Querry data at 300 K. However, they did not elaborate on the need to resolve this, nor make any suggestions on which may be more accurate. [Certainly there would be no "ice like domains" in at 273, so it would seem that the Zasetsky and Hale&Querry results should be the same at 273 or 300 K.]

Furthermore, a previously published work by Cadeddu and Turner (IEEE Trans. Geosci. Remote Sens., 2011) demonstrated (a) with real spectral IR observations that the use of the Zasetsky CRI resulted in poorer fits relative to the Downing&Williams CRI data, and (b) that using the Zasetsky data did not give consistent results with the liquid water absorption coefficients at microwave frequencies. The results of this paper should be connected with the Cadeddu paper, as it would seem to strengthen the discussion here.

Minor comments: âĂć Line 11: "…cloud optical thickness…" âĂć Line 165-166: in tropical atmospheres, the transmission in the IR window is ~0.4, and I would not classify this as "weak" absorption âĂć Line 175ish: A more general statement is that for upwelling cases, the largest impact is where the contrast between Tsfc and Tcloud is the largest âĂć Line 163 and 177: I believe you mean Fig2, not Fig3 âĂć Section 4: this is a good discussion of uncertainty, but since you are comparing calculations from DISORT against different calculations, most of these error sources cancel out. Thus, this section could be reduced significantly to focus on only the uncertainties of the CRI, which is the most important part of the discussion (and should be enhanced a bit, see above) âĂć Fig 3 caption: Did you mean a LWP of 8 g/m2 (instead of 4 g/m2)? âĂć Lines 410-420: It seems like the differences in absorption due to the differences in the CRI are more important that the differences in the scattering that results? âĂć Fig 4:

How does these results change if you used the Zasetsky CRI at 273 instead of the temperature-independent CRIs at 300K? This would seem to get directly at the importance of the bias at the warm temperatures. âĂć Line 426: Why did you compare the surface and TOA fluxes against the fluxes at the tropopause? You can use DISORT to compute the fluxes at the tropopause directly, which can then be compared to show the importance âĂć Section 5.4: The ice and liquid cloud retrievals: are the ice and water particles in the same volume, or was the cloud modeled as a liquid layer over the ice layer or vice versa? If they were considered to be in the same volume, did you model the particles as internal or external mixtures?

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 18749, 2013.