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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A simple model for cloud radiative forcing" *by* T. Corti and T. Peter

Anonymous Referee #2

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The paper presents simple equations for TOA shortwave and longwave cloud radiative forcing. The parameterizations have an accuracy of 20% for the examples studied and the authors suggest they will be useful for quick estimates of cloud radiative forcing and as a tool for teaching. The paper is well written, the derivation of the equations is well organized, and the parameterization of CRF should be of interest to a wide audience.

I recommend the paper be accepted after the comments below are addressed:

General comments:

1) The authors attempt to keep the paper short and to the point by not going into detail about the many simplifying assumptions made in determining the analytical expressions. In some cases I would have appreciated more information about the basis for and implication of some of the assumptions made to better understand the applicability of the equations. Two specific areas of concern are listed below. On a related note, it

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would be useful if the authors could summarize in one place the assumptions, conditions, and needed input parameters required for application of the derived equations.

Specific comments:

1) In the first paragraph, the authors introduce the concept of radiative forcing with reference to the IPCC 2007 report. However, in Section 2 the authors state that their definition of CRF is not consistent with that used in the IPCC 2007 report. It would be useful to define the convention used in this paper in the first paragraph, when CRF is first mentioned. It is also unclear if the CRF values quoted from the Chen et al. (2000) paper are consistent with CRF as defined by the authors.

2) The authors quote Stephens et al. (1990) for the approximate formula for cloud emissivity, but do not state what approximations went into that equation. Also, they quote a typical value of 0.75 for delta*, but do not give information about what this quantity depends on or how it varies. In discussion of accuracy of equation (5), only a mean error is given – a standard deviation or RMS error would also be useful.

3) The discussion of Eq (10) through Eq (13) was somewhat unclear to me. The authors state that Eq (11) is only accurate at small optical depths so an optimal value of gamma* will be derived from the radiative transfer calculations. Does the derived gamma* now make Eq (11) applicable to all optical depths? Only a single value for gamma* is given in the text; some information on the range of this value for liquid and ice clouds would be useful. Also, I was not clear on the derivation of Eq (12).

4) In discussion of Figure 4c, there should be some mention of the fact that the uncertainty in the approximated net CRF is largest right where the transition from heating to cooling occurs. Therefore care must be taken in use of this approximation for study of changes in CRF associated with changes in optically thick high clouds.

5) I understand this paper was developed as part of the SCOUT mission, and hence the primary example used was for tropical cirrus clouds. However, to illustrate that the

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derived equations are applicable across the globe, it would have also been interesting to see examples from a very different climatic region – such as the arctic or midlatitudes – that have very different temperature and water vapor characteristics.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 8541, 2009.