Atmos. Chem. Phys. Discuss., 9, S465–S469, 2009
www.atmos-chem-phys-discuss.net/9/S465/2009/
© Author(s) 2009. This work is distributed under
the Creative Commons Attribute 3.0 License.

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of ice particle model on retrieving cloud optical thickness from satellite measurements: model comparison and implication for climate study" *by* Z. Zhang et al.

Anonymous Referee #1

Received and published: 27 February 2009

Review of Influence of ice particle model on retrieving cloud optical thickness from satellite measurements: model comparison and implication for climate study; By Z. Zhang et al.

This is an interesting paper that examines the influence of assumed ice particle shape on the retrieval of cirrus solar optical thickness, and the dependence of this retrieval on satellite sampling (in this case MODIS and POLDER) and seasonality as well as the impact of assumed ice crystal model on the cirrus CRF. The sections on the influence of seasonality are interesting. Though the major conclusion of this paper is not too surprising, that is the assumed ice crystal shape and its associated phase function

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

has a major influence on the retrieved optical thickness. Due to this conclusion the authors argue for a more consistent approach to the retrieval of ice cloud properties from space-based instruments. This more consistent approach involves applying the most appropriate single-scattering properties to all space-based retrievals of cirrus optical thickness so that a common climatology of this parameter can be constructed in order to further constrain GCM predictions. Though I would agree with the sentiment, and such a sentiment is worth stating, the paper could make a start in answering the question. What are the most appropriate single-scattering properties to apply, invariant of instrument?

1. Firstly, it needs to be demonstrated that the Baum 05 model is an appropriate model to apply to the POLDER data. The authors should use the methodology outlined in Labonnote et al. (2001) to address this question. If it is proved that it is not appropriate for the particular case under consideration then there is little point in using that model to retrieve optical thickness using that instrument. This application would improve this paper and would make their argument stronger; if it is proved that the Baum 05 model is appropriate. If it is proved that it is not applicable to POLDER for this particular case then that is also worthy of publication.

2. The paper misses a further point, which is that solar intensity measurements by themselves are insufficient in testing the physical consistency of single-scattering models of cirrus and therefore their appropriateness for application to GCM simulations. It is important that ice crystal models are tested over a wide range of wavelength space using a simultaneously derived set of measurements. It was demonstrated in Baran and Labonnote (2006) [JQSRT 100, 382] that it is insufficient to use intensity alone measurements since intensity alone measurements could not differentiate between models which possess a high degree of randomization. Since their scattering phase function were very similar. This is why polarization measurements are also required. The forthcoming GLORY mission should be cited in regard to this point. Moreover, ice crystal scattering models with very similar phase functions do not necessarily have the same

ACPD

9, S465–S469, 2009

Interactive Comment

volume-to-area ratio and so their absorption properties may be very dissimilar. This is why simultaneous measurements are required in the visible and infrared regions of the spectrum as argued in Baran and Francis (2004) [QJRMS 130 763]. This is an important point to stress since the paper is also concerned with CRF. So, for climate models demonstrating physical consistency of ice crystal models across a wide range of wavelength space (visible to the far-infrared) is crucial since this wavelength range determines the energetics of the Earths atmosphere. The paper would be further improved if these points were also made with appropriate references.

3. On page 1774 the author state, it is still controversial which assumption represents better the nature of ice clouds. What about the following series of papers, see for instance Foot (1988), Francis (1995), Francis et al. (1999), Baran et al. (1999),Baran et al. (2001), Boucher et al. (2000), Labonnotte et al. (2001), Field et al. (2003) and Jourdan et al. (2003) which all demonstrate that ice crystal models exhibiting strong optical features in their scattering phase functions do not generally describe aircraft-based or space-based measurements of the transmitted angular radiance or reflected angular reflection properties of cirrus, respectively. The authors seem to have ignored all these references which contradict their statement.

I also find the paper lacking in regard to the list of references.

References

4. Cirrus climatology, the Sassen and Comstock (2001) [JAS 58 2113] should be cited. Discussion on radiative forcing using GCMs should include Donner et al. 1997, Kristjansson et al. 2000, and more recently the paper by Edwards et al. 2007 should also be cited. The references on ice crystal habits are only a few, more recent work by Lawson et al. (2008) amongst others should also be cited and the reader should be given an indication of the occurrence of particular habits, for instance Korolev et al. (2000) and others. The references cited for some of the campaigns miss out other tropical campaigns such as EMERALD. These references should also be included.

ACPD

9, S465–S469, 2009

CC BY

Other references concerned with the development of ice crystal models applied to retrieval of cirrus properties on page 1760 should also include McFarquhar et al. (2002), Baran and Labonnote (2007), Baran et al. (2001), Macke et al. (1996), and Noel et al. (2006), and a number of others.

Other references that have studied the impact of ice crystal models on retrieval of cirrus properties, such as the optical depth, should also include Baran et al. (1999). The influence of the phase function on retrieval of cirrus properties was also noted in Boucher et al. (2000).

As regards the impact of ice crystal shape on CRF the following references such as Kristjansson et al. (2000), Edwards et al. 2007, Liou and Takano (1994), Schlimme et al. (2005) and the more recent paper by Fu (2008) are also deserving of citation in this regard.

Other comments

5. The word photon is used repeatedly throughout this paper when infact the phase functions have been computed using ray-tracing or a physical optics approach. Suggest remove the word photon and replace with ray or rays.

6. The discussion on optical thickness on page 1761. Here it would be appropriate to introduce the asymmetry parameter as this of course also influences the bulk reflection properties of cirrus, whilst stating that w0 ˜ 1, since the bulk reflected flux back to space is determined by ˜ w0(1-g)tau.

7. Also Eq. (2) was not derived originally by Liou (2002). Please re-write as, see for instance Liou (2002).

8. The IHM model also included a distribution of aerosol as well as spherical air bubbles?

9. Also in figure 1 please state the range of scattering angle sampled for the case under consideration.

ACPD

9, S465–S469, 2009

CC BY

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 1757, 2009.

ACPD

9, S465–S469, 2009

Interactive Comment