**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "The shortwave radiative forcing bias of liquid and ice clouds from MODIS observations" *by* L. Oreopoulos et al.

Anonymous Referee #2

Received and published: 17 July 2009

This study uses global MODIS observations to estimate the impact on shortwave cloud radiative forcing of using the PPH approximation instead of including variability in cloud optical depth and effective radius across a grid box. It presents some of the first estimates of the global PPH bias due to both liquid and ice clouds, and thus should be of interest to a wide audience. The paper is an extension of a previous study by the same authors. The major differences between the two papers are the addition of ice clouds to the current study, the extension from two months of data to four months of data, and extended analysis of the effect of cloud fraction assumptions on the bias.

General comments:

1) In Section 2, I found the discussion of the radiative calculations very confusing. In particular, I was not clear how liquid and ice clouds are defined in the calculations.

Are you saying that for each 1x1 box, you define all the clouds within that box to be either liquid or ice depending on the mean cloud top temperature of the whole box? Is this true for both the PPH and ICA calculations? Or, do you derive a mean cloud top temperature separately for the ice and liquid portions of the cloud? This section needs to be clarified and the implications of this decision discussed. If the PPH calculations are all liquid or all ice, whereas the ICA calculations are not, then some of the bias may be due to that factor rather than to horizontal variability. If they are both calculated the same way, but using some mean-cloud top temperature, then the relative contributions of ice or liquid to the SWCRF bias may be estimated incorrectly. Also, in the summary of the paper is the first time that "mixed" or "undetermined" clouds are mentioned – treatment (or neglect) of these clouds should be discussed earlier. On a related note, the use of the cloud fraction in the albedo calculations needs to be explicitly mentioned as well before it is discussed in the section on defining SWCRF biases. On page 10342, where you discuss the different methods of calculating albedo, presumably the PPH albedo is calculated using the mean tau, mean reff, *and* gridbox mean cloud fraction? And similarly for the IPH calculations.

2) This paper is an extension of work first reported in an earlier paper (Oreopoulous et al. 2007) and that paper is cited extensively in discussing the methodology, etc. However when I tried to compare the results presented in this paper to those in the earlier paper, I was confused about which numbers I should even be comparing. It would be useful to explicitly compare the results in this paper to those in the earlier paper. If the estimates for SW forcing of liquid clouds have changed it would be useful to discuss whether this is due to changes in the methodology or to a larger sample being examined.

Minor comments:

1) Introduction; The authors jump right into discussion about the magnitude of the PPH bias in the opening sentences of the paper. A sentence or two about why the reader should care about this bias (e.g. that it affects global climate modeling results) would

be useful to motivate the study.

2) Introduction; P 10339, line 6, The use of the word "assumed" in the sentence starting "This so called Plane-Parallel Homogeneous (PPH) bias" is confusing; as it sounds like you are assuming a value for the bias rather than stating the value of the bias in previous results.

3) Introduction; Please define what you mean by cloud radiative forcing when it is first introduced, as it can have multiple definitions in the literature.

4) Section 2, p. 10344, line 10-12. Does this sentence mean that gridpoints with no illumination are not included in the averages, or that they are included but with a value of zero?

5) P. 10347, line 13 Replace "where indeed" with "were indeed"