

## ***Interactive comment on “How small is a small cloud?” by I. Koren et al.***

**I. Koren et al.**

Received and published: 5 June 2008

First, we would like to thank Dr. Hurley for taking the time to freely offer her comments in the discussion.

1) The point of an appendix is to be able to read a paper without having to read the appendix - not the other way around, as is the case here.

We are delighted that Dr. Hurley found the paper interesting enough to read the Appendix as well as the body of the paper. The paper contains a great many mathematical details that we felt unnecessary to understand the two main points of the paper: (1) small clouds are surprisingly important in number, total area and contribution to the total outgoing radiative flux in a cloud field and (2) lower resolution data inherently can not represent such cloud fields correctly (either in terms of aerosol properties or cloud properties). To describe these points in a fluent way and to discuss the possible consequences, we minimized the mathematical details in the body of the text. However,

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



those details are included in the Appendix for interested readers, like Dr. Hurley, to examine in depth. We disagree with Dr. Hurley in that we feel that one does not have to read the Appendix to understand the paper, and that the body of the paper tells a coherent and complete story in its own right.

2) More explanation about moments - what are they - you haven't explained at any point.

We meant statistical moments (1=mean, 2=variance, 3=skewness). We have added a few words in the text to clarify this point.

3) Is it reasonable to assume that reflectance is independent of cloud area? Don't larger clouds have particles with different optical properties to smaller clouds? Also, more likely to be thicker?

The reflectance depends strongly on the cloud area. We write in the body of the paper (in the results part): " The reflectance distribution (eq. 4) is a product of two functions with opposing trends. The total area per cloud size is larger for the small clouds while the average reflectance is greater for larger (thicker) clouds. However, both the data and the analytical derivation (which can be found in Appendix B) show that for our measured slopes of the power-law distribution, the total-area-function decreases faster than the total-reflectance-function increases with cloud size" In Appendix B we give more mathematical information and link the cloud reflectance to the cloud area and in figure A2 we show it graphically.

4) It is unlikely that cloud area is a continuous variable. There must be some minimum cloud size below which clouds cannot form, ie. area is too small for sufficient vertical motion to cause cloud formation.

There may be a size too small even for a small cloud, but that size is definitely below the 30 m resolution of our data base, and on the other hand, there may not be a discernible lower size limit for a cloud. Some of us have spent hours watching small clouds form

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Interactive  
Comment

and dissipate. We can see wisps and filaments of cloud that appear to be only a few meters in length. We can imagine even smaller pockets of cloud that we are unable to see from the ground. Smaller clouds may require less vertical motion to form, and those updrafts could be turbulent in nature rather than organized cells. Smaller clouds may appear statistically while a larger cloud is forming or dissipating. We can't prove or disprove a lower size limit, but there is no indication in the data at 30 m that such a size limit exists. We write in the summary: "5) For any resolution significant cloudy parts will be missed. This is an outcome of the nature of the power-law distribution of cloud areas. Since there is no physical limit at the highest Landsat resolution of 30 m this distribution may well extrapolate toward finer resolutions, suggesting that small clouds of only a few meters may contribute significantly to the total cloud fraction and reflectance."

5) A map of LandSat locations used would be helpful.

This would unnecessarily increase the size of the paper. The exact coordinates are given in table 1.

6) Several plots are missing axis labels.

Thanks - we fixed it.

---

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 6379, 2008.

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)