Atmos. Chem. Phys. Discuss., 10, C13314–C13317, 2011
www.atmos-chem-phys-discuss.net/10/C13314/2011/
© Author(s) 2011. This work is distributed under
the Creative Commons Attribute 3.0 License.

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Scale-by-scale analysis of probability distributions for global MODIS-AQUA cloud properties: how the large scale signature of turbulence may impact statistical analyses of clouds" *by* M. de la Torre Juárez et al.

M. de la Torre Juárez et al.

mtj@jpl.nasa.gov

Received and published: 8 February 2011

Response to Reviewer #2:

Thanks to the reviewer for his/her comments. We have introduced changes trying to address his/her remarks. We show in blue the reviewers remarks and then respond in black by including references to the revised paper correction by giving the section number, paragraph within that section and sentence number within that paragraph. For

instance, 2:3:4-5 means section 2, paragraph 3, sentences 4 to 5.

1 General Comment This work attempts at quantifying scale-dependence of MODIS-observed cloud fraction, LWP, and effective radius by analyzing their PDFs, means, standard deviation and normalized means (mean-to-standard deviation ratio) as a function of spatial averaging scales. The paper contains results that are useful for understanding the perplexing issue of scale-dependence of cloud properties and for upscaling cloud parameterizations. However, the paper is difficult to follow. Major clarification and elaboration are needed before I can recommend its publication.

We have made an effort to make it easier to follow by following the specific comments by the reviewer and adding where we thought that it could help. We hope to have succeeded.

2 Specific Comments

1. P21308, Section 2: it is mentioned, "a granule covers about 1364 x 2030 km^2 and is treated as if it was a realization of a cloud experiment. This resulted in about 2880 realizations". Please explain where 2880 come from?

The number comes from the number of 5-min granules/scenes (=288/day) times the number of days (10) used for our study. We have prepared a draft that includes that information. Lines 2:1:11-12 explain it.

2. There is no clear bimodal structure for the PDF for cloud fraction shown in Fig. 2a. Using a log ordinate may help. Also, the ordinate value is larger than 1, not consistent with PDF as claimed.

The bimodal character of the observed data is in the symbols piling up at 0 CF.Some PDFs, p(x), can have values larger than one. We only require that Int(p(x) dx) = 1. If dx$<$1, as is the case for the CF, some p(x_i) can be larger than 1.

3. It seems to me that Figs d-f are used to demonstrate the performance of the different analytical functions as fits to the corresponding observations. But, these figures are not

even mentioned in the corresponding discussion, and the discussion itself is difficult to follow. I have only got the guessed understanding after reading the discussion and fig several times.

Paragraph 2:3 discussed figures 2d-f. But the paragraph had a typo, though, in referring to one of the figures as 2b in the published ACPD, where it was supposed to be 2e. Corrected.

4. Section 3 is difficult to follow, and much clarification is in order. For example, (1) Sx(n) as given does not seem to the generalized structure function, but simply the n-th moment. Typos here or I miss sth here? (2) For a Poisson distribution, the mean is equal to the variance, not the absolute deviation as discussed here. Again, typos or I miss sth here? Please clarify. Also,

We stress now that in 3:3:2 and in 5:2:6 that Sx(n) is the structure function when X is zero-centered, hence our comment in section 3, right after formula (1), highlights that cloud properties are not zero-centered. The coincidence despite being normalized moments and not structure functions, hopes to provoke and lead to questions as to why a scaling valid for zero-centered functions works for LWP. One encouraging conclusion in the paper is that given the generality of scaling arguments in turbulent flows, some of it can probably be applied to LWP. That goal is out of the scope of this paper, which remains descriptive of the observations.

P21309, L15: Fig 2a should be Fig 3a?

Correct. Thanks. Somehow this was a typo in the ACPD version.

5. The observational analysis of the scale-dependence is valuable. But some discussion on the physical mechanisms underlying the observations will be more valuable. For example, what is behind the decrease of normalized mean, or increase of standard deviation, with increasing scales?

We do not have a physical explanation, but an empirical based on how the PDFs

change with scale L. We give an empirical interpretation in the Summary and conclusions in a new paragraph 5:8 based on looking at Figure 2 in a logarithmic scale. We have added a new figure based on the reviewer suggestions to illustrate the observation.

6. The scale-dependence addressed here, especially for the PDF of effective radius, is highly related to the scale-dependence of cloud droplet size distribution as revealed by the systems theory developed by Liu and his coworkers (JAS, 55, 527-536, 1998; 59, 2279-2290, 2004, and Recent Research Development in Geophysics, 4, 119-142, 2002). Linking with these publications, especially in mechanism discussion, will enhance the presentation.

We had in the original version a brief mention of Liu's work on cloud droplet radius sizes. We have replaced the original reference with new ones more related to the reviewer's comments. We have devoted also a new paragraph in 5:5. Liu's theory however is for cloud particle radius and depends on the type of clouds. We have explained how our PDFs are for cloud effective radius which is a different magnitude and measure the scale dependence of the parameters for his Weibull.

7. I do not see any connection with the subtitle "how the large scale signature of turbulence may impact statistical analyses of clouds"

The connection is through the non-gaussianity (lognormal distributions), the generalized flatness factor for LWP, the scaling of the standard deviations, the entropy maximization theories of Liu for cloud droplet radii that require a non-laminar system where one of the parameters depends on the turbulence intensity. More emphasis on the specific connections to turbulent flows are given now in the abstract and conclusions: 5:2:4, 5:3, 5:4, 5:5.