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## ***Interactive comment on “Cloud macroscopic organization: order emerging from randomness”*** **by T. Yuan**

**Anonymous Referee #1**

Received and published: 22 March 2011

The manuscript by T. Yuan covers an immensely important topic, namely the formation of cloud size spectra of low-level warm clouds. Basically organization of cloud sizes follows a powerlaw – a result that per se is not new. The method used is based on graph theory, a well established mathematical methodology allowing to handle random organization of individual elements by well defined rules. The study also benefits from a very large sample of cloud size information over different geographical locations and for several years. Results show dependence of the cloud size spectra on geophysical conditions, but much less so on interannual variability in these settings. While these facts are much appreciated, it seems that nevertheless the manuscript needs truly major revision (or better resubmission) before it could be possibly published. This concerns the description of the methodology as well of the results and discussion. Especially, there is lacking discussion on the physical reasons of geographically varying powerlaw

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exponents. What are the main determinants for these differences? A complete rewrite of the main parts of the manuscript seems to be necessary in order to present a convincing strain of arguments for the application of the method used to determine cloud size spectra from rules based on Graph theory to naturally occurring cloud fields.

In the following I will comment on the manuscript in more detail and I will follow the flow of text rather than separating between methodology and results. I am not commenting in detail on the numerous language deficiencies!

Data and Method: P1107: L 16: Sk is not defined L 19: why are diagonal neighbours ignored? L 21: The sentence starting "For every level-2 ...." is hard to understand L 25: Discuss the effects of cutting off scales less than 3km! That causes omission of a large number of cloud elements. How much of spectrum information is going to be missed by this approach? P 1108: L 4+: What is the exact algorithm of the "computer program"? How are non-liquid cloudy pixels defined? This is not adequately defined in the SOM (and actually is too important to be hidden there!)

Results: L 10: "The scale-free..." The powerlaw relationship is not defined before. Probably the relationship from Fig. 1 is meant, but that needs to be defined mathematically. Re-arrange sentences here. A correlation of log/log relationships is not very meaningful as it covers magnitudes rather than actual values. L 19: "... because they..." Who is meant here? Quotations missing! Since the "break" in scale is an important issue, more discussion is needed here. L 26: "...strong yearly variation" What is meant here? Annual (i.e. within the annual cycle) or interannual?

P1109: L 1+: If I understood right that means whenever clouds develop they create a certain size spectrum independent of how many individual clouds are there and what the cloud coverage is. But should that not be the case when normalized cloud numbers are being used anyway? Self-organization does not necessarily mean constant organization, i.e. following a constant power law. Are there other mechanisms than just randomized merging and separation in play? L 5: "from other regions" Here some

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literature should be quoted! L 14: I cannot see the mentioned differences from Fig 1. I suggest discussion of the exponents for different conditions, including a statistical analysis of potential differences. L 16+: What is the meaning of "(it is transition season ... over Amazon)"?

Model: P 1109/1110: What is meant as a Model, seems to be rules following GRAPH Theory. It will be necessary to introduce these rules in a more understandable and systematic way since it is not a usual tool in atmospheric sciences. The whole paragraph needs to be rewritten showing how Graph theory rules would match the processes observed. In principle most of the information is there, but the sequence of arguments is not adequately substantiated and organized. It remains unclear on which information the first guess ("few vertices") is based upon.

P 1111: The first and second paragraph on this page reads more like an introduction and might be moved to the beginning of the model section. Then be followed by introducing Graph theory as a means to simulate the random interactions of individual elements. As it is now, the logic of the method remains quite unclear.

Discussion: The confusion of the reader continues in this part. The logic would require discussion to what degree the proposed method based on Graph theory can mimic observed (and such simulated in explicit modelling) processes, not introducing more complications. The last part of the last sentence of the manuscript is certainly true: " ... this study barely scratches the surface."

SOM: What is the meaning of negative frequencies shown in the one figure included in SOM?

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 1105, 2011.

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