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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Statistical properties of aerosol-cloud-precipitation interactions in South America" *by* T. A. Jones and S. A. Christopher

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General comments

The authors attempted to use principle component analysis (PCA) to isolate individual physical processes from the combined dataset, especially those processes in relation to aerosol-cloud interaction, and link them to observed rainfall amount. Although the scientific goal (p21469 line 25-28) sounds important, it is unlikely achieved by their used method. Whether the rainfall amount associated with the "aerosol effect" can be successfully isolated determine if the manuscript is worthy publishing. The authors claimed that "PC2 is an indicator of the semi-direct effect" and PC13 is an indicator of the Twomey effect. Unfortunately, they are too arbitrary. PCA simply performs a coordinate rotation that aligns the transformed axes with the directions of maximum variance. If the aerosol-cloud interactions are highly correlated with meteorology processes and

much weaker than the cloud dynamical processes, I don't agree with the authors that the statistical method like PCA can isolate the "aerosol effect". For example, assume that rainfall is dominated by two processes: cloud dynamical process (CD) which explains 90% rainfall variance and aerosol-cloud interaction (AC) which explains 10%. If CD is partially correlated with AC, PC1 will explain rainfall variance between 90% and 100% and PC2 explain 0% $\sim$ 10%. Only if CD is independent on AC, CD and AC can be separated. Actually, in the partially correlated case, PCA will make PC1 to explain more rainfall variance at the expense of weakening the "aerosol effect" in other PC variables. It sounds opposite to authors' scientific goal. The key issue of isolation of "aerosol effect" based on statistical method is that aerosol abundance often varies coherently with meteorological conditions which make it hard to distinguish among the changes caused by varying aerosol concentration and by different meteorological conditions. This problem should be solved before applying PCA instead of applying PCA to solve this problem.

Specific comments

The weight coefficients before LAT for PC1 and PC2 (Table 2) are large. Does this suggest that the analysis results are highly pattern-dependent? If so, changing aerosol/cloud spatial distribution will result in different weight coefficients. In this regard, I don't think that the presented results are statistically significant. Additionally, the presence of multilayer clouds can make LWP and COT to be overestimated. I wonder if the authors removed multilayer clouds when picking up their clouds.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 21463, 2009.