

# ***Interactive comment on “Complexities in the First Aerosol Indirect Effect over the Southern Great Plains” by Sam Pennypacker and Allison L. Steiner***

## **Anonymous Referee #1**

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The contribution of this manuscript is to uncover the relationship of the aerosol measurements made by 5 IMPROVE SGP sites - the PM<sub>2.5</sub> speciated masses - to the low-level meridional flow, and to a reduction in the MODIS-derived liquid cloud effective radius, over a land site, for which the MODIS retrievals are more challenged than over a dark ocean.

The document needs to be rescoped and rewritten completely before it can be considered for further publication. The relationship between the surface observations and cirrus cloud properties is pure speculation. Datasets from the nearby DOE ARM SGP site that could put some of the speculation on firmer ground, such as the lidar datasets capable of documenting the aerosol vertical structure, go unmentioned. Mention is made of semi-direct effects, which depend on shortwave absorption, without any effort to composite the IMPROVE data by carbon mass. The relationship between the

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aerosol masses and the meridional flow is interesting. How about compositing radiosondes from a representative site to firm up the presence of the wind shear at the top of the boundary layer, and using cloud condensation nuclei measurements from the DOE SGP site, to firm up the relationship between the aerosol mass and liquid cloud effective radius? I would also recommend combining the MODIS effective radius and cloud optical depth measurements into a cloud droplet number concentration estimate. While the MODIS retrievals have been validated over the dark ocean, during, e.g., the VOCALS campaign in the southeast Pacific, I am unsure if a similar assessment has been done over land. It would be good to check, for example, the satellite retrievals may have been assessed using aircraft data from the RACORO campaign over the SGP.

Furthermore, please let go of making a connection between the surface aerosol mass and cirrus cloud properties unless you are prepared to make the extra step of examining the aerosol vertical structure to confirm a correspondence between the surface and high-altitude aerosol loading.

When rewriting, please keep the reference list more specific to the study. And, given that you have measurements of the carbon mass, why not examine if the cloud response differs depending on aerosol species?

I hope the authors will make the effort to redo this work and resubmit it.

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