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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The relevance of aerosol optical depth to cumulus fraction changes: a five-year climatology at the ACRF SGP site" *by* E. I. Kassianov et al.

Anonymous Referee #1

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This manuscript suffers from many shortcomings that warrant rejection of this paper for publication. Several of these shortcomings include

1) There is a near complete lack of analysis of the soundings and how they may impact the relationships between cloud and aerosol. Many of the past studies on the indirect effect referenced in the manuscript point to the differences in the meteorological conditions as the key source of uncertainty in interpreting cloud-aerosol relationships from observations, as do most textbooks in cloud physics. While Figure 4 gives an example of two days with similar soundings but different clouds and aerosols, it cannot be carried over to the relationships given in figures 8 - 10. Therefore, the conclusions

drawn from these figures may simply be due to meteorological differences between morning and afternoon, clean and polluted days, etc., thus completely invalidating the conclusions drawn from this study.

2) The authors toot 5 years of data were used, but avoid giving hard numbers on the number of days used and the number of hours per day. One can guess based on Figure 8 that ~ 45 days of data are used, assuming 12 hour days. These 45 days are sprinkled over 5 years. Figure 8 shows that 4 out of the 7 aerosol optical depth bins have little data, thus are subject to large sampling errors. Based on Astin et al. (2001), the sampling errors in cloud fraction are likely too large to draw any conclusions on trends. Even by neglecting this source of error, where the 45 days fall over the 5 year period are extremely important to the analysis, especially when considering how surface albedo, soil moisture, and sun angle may affect cloud dynamics (none of this is mentioned in the manuscript). For example, were the few high aerosol optical depth days all clustered at a time when the surface albedo was high and the soil moisture low? If there is a relationship between soil moisture and aerosol optical depth (and there is), perhaps the relationships observed between cloud and aerosol optical depths are surface-driven rather than driven by cloud-aerosol interaction.

3) The MODIS analysis is consistent with the well known systematic error of under-estimating cloud optical depth and over estimating effective radii for sub-pixel clouds (e.g. Harshvardhan et al. 2004). The authors mention the former and not the latter and briefly (but incompletely) discuss 3-D radiative effects. Much of the conclusions drawn from the MODIS data appear to be consistent with this MODIS problem rather than any real physical relationship.

4) Data considered to be fair weather cumuli were subjectively selected by looking at movies from the TSI. The trends discussed in figures 8 - 10 may be caused in part by systematic errors produced through this subjective analysis.

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