

Review of “Vertical profiles of aerosol optical properties over Central Illinois and comparison with surface and satellite measurements” by P.J. Sheridan et al.

This paper provides an excellent discussion of the routine airborne in situ measurements of aerosols above/near the Bondville, Illinois site between June 2006 and September 2009. The paper summarizes these measurements, shows how these measurements compare with similar measurements made at the surface, and how these measurements of aerosol extinction compare with those provided by the spacebased CALIPSO lidar. These measurements and analyses are similar to those reported by Andrews et al. (2004, 2011) for routine airborne in situ measurements acquired over the DOE ARM SGP site in northern Oklahoma. The Sheridan et al. paper extends this type of study with the measurements over Bondville and comparisons to the CALIPSO lidar measurements.

These are unique measurements and so the paper is a worthwhile contribution to the scientific community. The science approach and methods are valid. The paper is well written. The recommendation is to publish this paper after the authors address the following comments.

General comments:

1. The abstract does not mention that the aerosol extinction comparisons with the CALIPSO measurements were done after the in situ measurements were adjusted to ambient relative humidity. This should be mentioned.
2. (page 17194, line 25) Was there any noticeable difference in the measurements between the beginning and ending of the flights that may be traced to the change in the orientation of the inlet?
3. (page 17198, line 20) Since γ is used to adjust the wet and dry measurements, it would be helpful to show the equation that makes use of γ to make these computations.
4. (Table 3) It would be more helpful if there was a map that showed the locations listed in Table 3. This map could show these satellite tracks.
5. (page 17201, line 15) Were there any systematic differences in the aerosol properties between the flights with and without satellite overpasses?
6. (page 17202, line 7) What was the supermicron (large) particle response of the surface based in situ measurements? How much different was this response than the large particle response of the airborne instruments?
7. (page 17204, line 20) In figure 7, dry scattering values were restricted to values above 3 Mm^{-1} . How much better would the correlations in Figure 5 have been if this same restriction been used there also?
8. (Page 17205, line 3 and Figure 7) The altitude dependence of the intensive parameters shown in Figure 7 are generally similar to that found in the Andrews et al. (2004, 2011) studies, with the exception of single scattering albedo. These earlier studies found that the single scattering albedo decreased with altitude; however, this study over Bondville found single scattering albedo increased with altitude. Why the different behavior? Can this variation be attributed to uncertainties in measuring the low values of absorption at high altitudes?
9. (page 17206, line 6) If the absorption lower limit threshold was raised to 1.0 Mm^{-1} instead of 0.2 Mm^{-1} , how would the results in Figure 7 have changed?

10. (page 17210, line 19) In making the adjustment to ambient relative humidity, was the instantaneous RH for each point, or was the mean or median RH used for each segment? Since the adjustment of scattering to ambient RH is nonlinear in RH, the procedure on how this is done is important.
11. (page 17211, line 13) What was the mean and median extinction measured by the AAO sensors during the 35 cases where there were no CALIPSO retrievals? This may help answer whether the extinction was too low for the CALIPSO retrievals.
12. (page 17212, line 19) How many of these 28 AAO-CALIPSO cases had clouds? Do the AAO measurements keep a record of which of these cases had clouds? If so, why not do a separate comparison of only those cases that had no clouds as observed by the AAO in order to reduce the impact of imperfect cloud masking?
13. (page 17213, line 13) Instead of simply taking the closest 60 m range bin result from CALIPSO, why not have averaged the CALIPSO data over 120-180 m or so to avoid this? It seems strange to have a horizontal average that extends over 35 km, yet no vertical averaging to reduce the impacts of changes in the layer heights.
14. (page 17213) The CALIPSO retrievals of aerosol extinction depend heavily on the aerosol type that was assigned to the CALIPSO measurements and the resulting lidar ratio used in the computations. It would be helpful to summarize what the aerosol type was chosen in these 28 cases. This could help determine if the CALIPSO bias may have been due in part to an inappropriate assignment of aerosol type and/or lidar ratio.
15. (page 17215, line 19) This sentence should be changed to reflect that the surface measurements could be used, on average, to estimate column RFE. However, an instantaneous retrieval of RFE using surface properties could be in error.
16. (page 17215, line 25) The behavior of the AAO-CALIPSO extinction comparison as a function of cloud cover was not shown in the paper. If the authors have indeed examined this behavior as a function of cloud cover to make this statement, why not show a graph that illustrates the behavior as a function of cloud amount? What was the behavior with no clouds present?
17. (page 17216, line 19) A CAD score of -20 seems a bit too high and may lead to cloud contamination. If the authors indicate that the differences between CALIPSO and AAO aerosol extinction measurements may have been due to cloud contamination, could they have repeated this using a lower CAD score? See the article by Yang et al. in Atmospheric Research (2012, vol. 116, 134-141) regarding the impact of the CALIPSO CAD score on observations of aerosol properties near clouds. This could have an impact on the level of agreement between the CALIPSO and AAO measurements.
18. (Figure 1 caption) Suggest changing to “Lettered areas are described in the text and in Table 1”.
19. (Figure 5 and captions) It would be helpful if this caption indicated what the various solid lines represent.

Typographical comments:

1. (page 17197, line 14) “lose” should be “loose”

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