Atmos. Chem. Phys. Discuss., 11, C6989–C6992, 2011
www.atmos-chem-phys-discuss.net/11/C6989/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Horizontal variability of aerosol optical depth observed during the ARCTAS airborne experiment" *by* Y. Shinozuka and J. Redemann

Y. Shinozuka and J. Redemann

yohei.shinozuka@nasa.gov

Received and published: 26 July 2011

Response to Referee #1

Thank you very much for the review, especially for taking the time to verify the line-to-area conversion factor.

"above the aircraft" has been inserted to the first sentence of the second paragraph of Section 2.1. It now says "AOD above the aircraft at 13 wavelengths between 354 - 2139 nm were measured with the 14-channel Ames Airborne Tracking Sunphotometer (AATS-14) under clear skies, ..." We also note a few sentences below that "Measurements made above 2 km are excluded from our analysis . . .." Based on our analysis of

in situ extinction coefficient (a separate manuscript in preparation), we speculate that the lack of measurements below aircraft has little impact on the derived horizontal variability in AOD. More specifically, including the below-aircraft extinction, if it were possible, would cause two compensating effects, one of which works to raise the variability and the other to lower it. The first effect is to bring in extinction coefficient which, being closer to the surface (sources), may be more heterogeneous than at higher altitudes. The second effect is to increase the degree of vertical smoothing, i.e., integrating over a range of altitude cancels out some of the variability at each altitude.

The following has been inserted in Appendix. "Taking the arithmetic mean is less preferable because of the evidently skewed distribution of the ratio on a linear scale (left panel). On the arithmetic basis, the mean ratio is $\sim$20 according to our Monte Carlo calculation, high because of a few yet extremely large values when the denominator of the ratio is near 0. Moreover, the ratio of the distance means is significantly different (1.56) from the mean of the ratio ($\sim$20), which would raise the question as to which number should be used as the guideline conversion factor if we were to choose the arithmetic method. On the geometric basis, the distribution (on a log scale) looks closer to normal. The mean ratio and the ratio of the distance means are the same (2.0035. . .)."

Response to Referee #2

Thank you very much for the review.

Response to Referee #3

Thank you very much for the review.

p. 16248, line 16. We do not know how the wind speeds affect the relative standard deviation of AOD. We speculate that under limited circumstances the wind speed may have an influence. For example, the generation of sea salt and dust at the ocean and desert surface, respectively, may be a non-linear function of surface wind speed which may or may not be associated with various relative standard deviations. Low wind speed may contribute to stagnation of air which may lead to higher degrees of spatial mixing of atmospheric aerosols (lower relative standard deviations). More generally, local meteorology may affect the spatial variability through wet deposition, dilution due to entrainment, etc.

For these and other cases, the history of wind speed (over minutes, hours or days prior to the time of aerosol measurement) would matter, in addition to the instantaneous value. We did not measure the history. In the meantime, the instantaneous values of wind speed during ARCTAS were comparable to previous airborne experiments.

The wind speed is noted in our manuscript in order to indicate that the aircraft speed determines the horizontal scale used in Figure 2 and 3. If a similar study is conducted with a measurement platform whose velocity is low or negligible compared to the wind speed (e.g., AERONET), the scale would be defined by advection.

p. 16249, lines 1-5. Both flight leg and segment are a fraction of flight path. Each leg is separated into segments.

p. 16253, line 13. Each measurement takes 3 seconds, as noted in Sect. 2.1. The distance between the midpoints of two consecutive measurements is 0.4 km. This distance excludes the first half of the first measurement and the second half of the second measurement. The two AATS measurements encompass $\sim$0.7 km, measured from the beginning of the first measurement to the end of the second measurement. These are noted in Sect. 2.5.

p. 16254, line 14-18. One might think the absolute value of AOD may somehow be related to its relative variability, which, if true, would complicate the comparison of the two environments. Our test described here assures that this consideration is not necessary. The result implies that we have no evidence for a correlation of the variability on the magnitude.

Table 1. "stdrel, med" has been corrected to "stdmed" for Angstrom exponent. We now note that "Whereas stdrel,med for AOD is given in percentage, stdmed for Angstrom exponent is pertinent to the absolute values of Angstrom exponent and has no unit."

Voluntary changes

References:

The reference to ACE/GEOCAPE white paper has been eliminated from the first sentence of Introduction.

The paper by Bréon, F. M., Vermeulen, A., and Descloitres, J. has been updated from submitted to in press.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 16245, 2011.