Patterns in the Composition of Ground Level Aerosols During a Biomass Burning Events at the T3 Site during October, 2015 Determined from Aerosol Chemical Species Monitor Data.

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Introduction

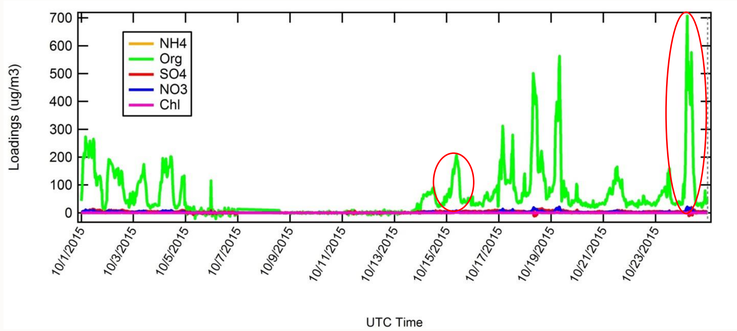

Figure 1: October 2015 ACSM data. The instrument was out of service 10/06 through 10/13. The red circles indicate the biomass burning events of October 15th and 24th.

The Aerosol Chemical Species Monitor (ACSM) was operated at the GOAmazon T3 site near Manacapuru, Amazonia, Brazil from February 2014 through November 15 2015. The ACSM measures particulate sulfate, nitrate, chloride, ammonium, and organic species with half hour time resolution over a range of particle diameters from 1 to 1000 nm. This poster is a case study of two significant biomass burning events that occurred on October 15 and October 24, 2015 and that resulted in high aerosol mass loadings (Figure 1). The October 24 episode resulted in over 700 μg m^{-3}. These aerosols were composed primarily of organic species. A detail of the ACSM and SMPS data for the October 15 event is given in Figure 2.

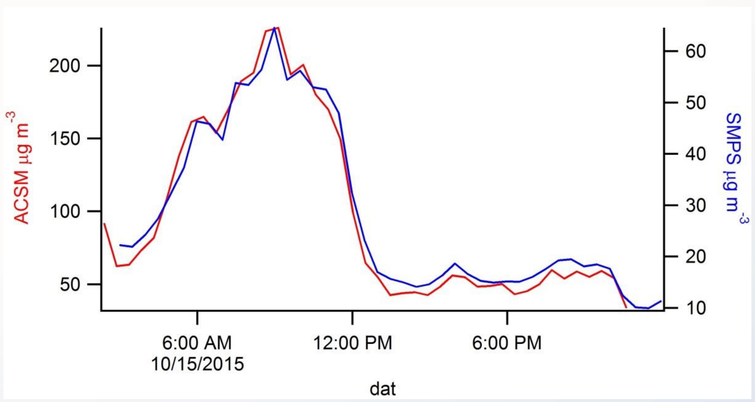

Figure 2: October 15 ACSM and SMPS mass loading time series..

The ACSM and SMPS show qualitative agreement, but disagree significantly in the mass loading quantity. Figure 3 is a correlation plot of ACSM and half hour averaged SMPS mass loading data. There ACSM is generally higher by a factor of 3.4.

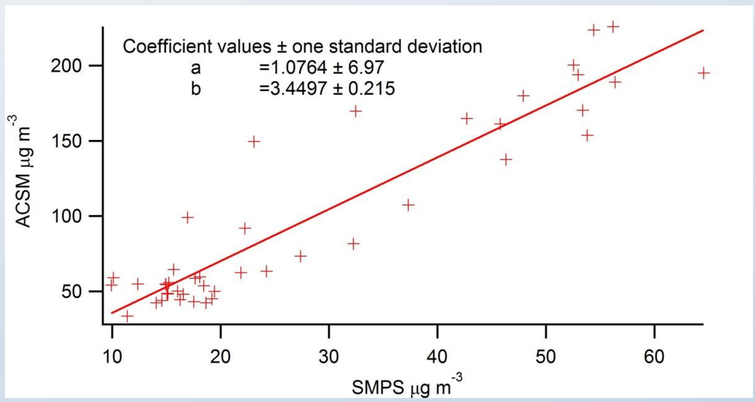

Figure 3: ACSM SMPS mass correlation 2015 10 15. Fit is to the equation y=a+bx

Comparison of the mass loading size spectra of half hour averaged UHSAS and SMPS data (not shown) indicates there is qualitative agreement between the spectra, but quantities are very different. The UHSAS was saturated during this event, so the mass loading is not reliable. What is interesting is the he UHSAS shows significant mass in particles with diameters greater than the 460 nm upper range of the SMPS. The SMPS mass loadings could be significantly lower that the ACSM because it is not measuring the larger diameter particles.

Figure 5 shows the ACSM mass loading time series, the green backscattering of the three wavelength Nephelometer, and the ratio of scattering to organic mass. This ratio is generally accepted to be about 3.6. The ratio is highly variable and never exceeds 2.6. This suggests that the mass loadings calculated for the ACSM data are high. This could be a result of the collection efficiency used in the calculation. The default collection efficiency is 0.5 meaning half the particles are measured. In a bio mass burning event such as occurred on October 15, the collection efficiency could be closer to 1 which would result in a reduction of the calculated mass by half.

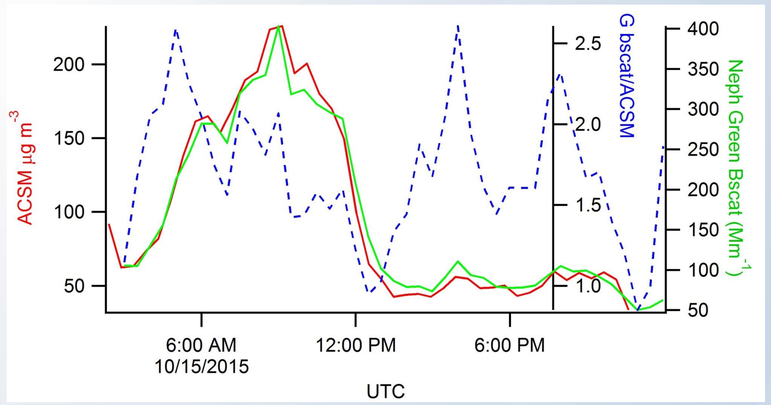

Figure 5: ACSM Mass loading (red), Nephelometer green back scattering (green), and the ratio of green scattering to mass loading (blue dashes).

Figure 6 shows the same plot for the SMPS mass loading data. Here the Ratio ranges from about 5 to 6.5, higher than the accepted value of 3.6 suggesting that the mass loadings calculated from the SMPS data are low.

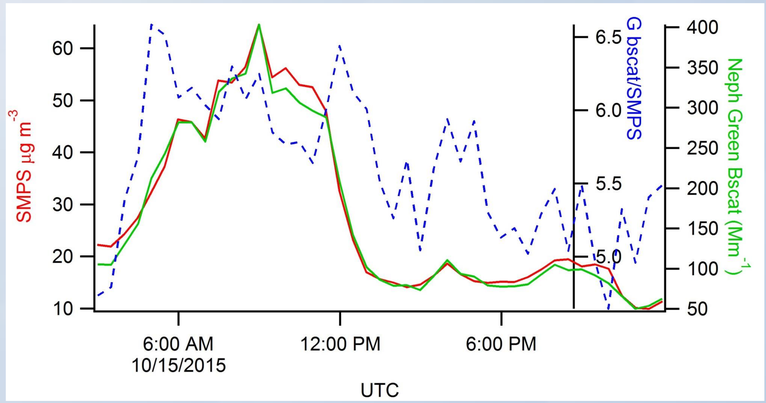

Figure 6: SMPS Mass loading (red), Nephelometer green back scattering (green), and the ratio of green scattering to mass loading (blue dashes).

Similar results are seen in the data for October 24 during which significantly higher loadings were observed (Figure 7 through Figure 10). Although there is good qualitative agreement between the ACSM, SMPS, and Nephelometer data, the correlation plot of ACSM higher mass loadings versus those of SMPS has a slope of 1.9. The UHSAS was operating at saturation on both days so it is not surprising that it is showing the lowest values and will not be considered in the analysis except to indicate that the SMPS may be missing some of the mass loading because it does not measure particles over 460 nm.. The difference in the October 15 organic mass ratio to the Nephelometer scattering is an indication that the ACSM mass loadings are high and the SMPS loadings are low. The ratio of the Nephelometer scattering with the ACSM data for October 24 during the passage of the plume are as high as 10 while during periods when the mass loadings are less than 100μgm^{-3} are in the range of 2 to 4 indicating that the ACSM mass ladings may be low.

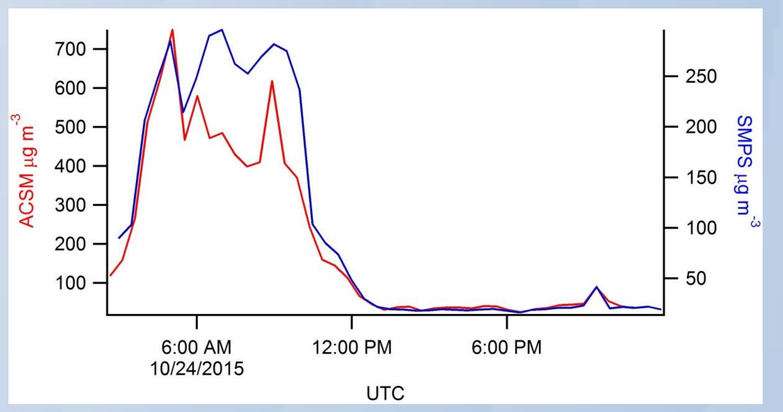

Figure 7: October 24 ACSM and SMPS mass loading time series.

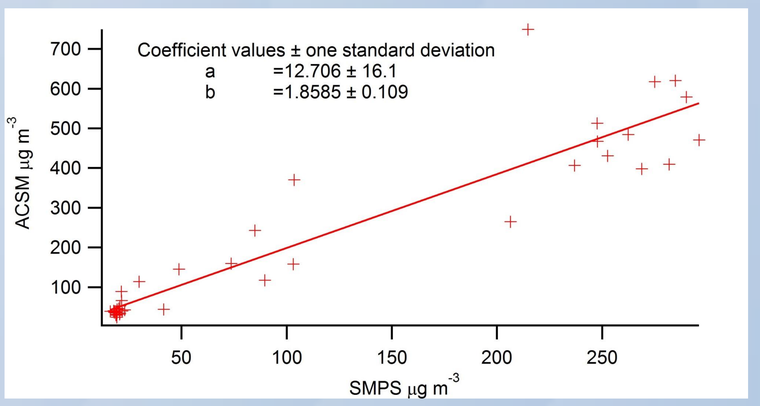

Figure 8: ACSM SMPS mass correlation 2015 10 24.

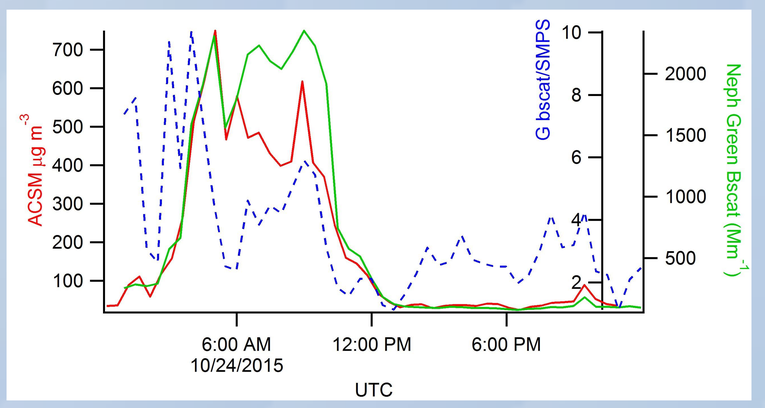

Figure 9: ACSM Mass loading (red), Nephelometer green back scattering (green), and the ratio of green scattering to mass loading (blue dashes).

Conclusions

- The high organic loadings and complex composition of the biomass burning events show that there are questions about the collection efficiencies used in calculating the ACSM mass loadings.
- The comparison of the SMPS data to the ACSM is complicated by the fact that the upper limit to the diameter of particles measured by the SMPS is 460 nm, while the ACSM measures particles up to 1000 nm.
- The UHSAS data are only marginally useful because the instrument was saturated during the high loading events.
- A similar analysis needs to be done with data from relatively clean air with less complex organic composition where the UHSAS data can be compared to both the ACSM and SMPS data. The suite of instruments currently deployed at SGP will provide important data that can be used in this analysis.