Measurements of *in situ* aerosol light scattering phase functions during FIREX-AQ

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The open burning of biomass fuels is an important source of aerosols because they contribute significantly to the pre-industrial radiative forcing budget and they are a large source of aerosol in the modern era that is anticipated to increase due to climate change. However, the optical properties of smoke have been shown to be complex and variable, which in turn complicates a) the retrieval of aerosol properties using remote measurements and b) the estimation of the direct radiative forcing caused by smoke.

During the FIREX-AQ aircraft campaign, we measured the angular distribution of light (i.e. scattering phase function) scattered by smoke *in situ* using the NOAA Laser Imaging Nephelometer. We then used collocated optical particle sizer measurements of the aerosol size distribution to calculate expected phase functions using Mie theory. When comparing the measured versus calculated phase functions, we see there is more backscattered light in the measurements.

This means that the smoke aerosol has a higher real refractive index than is commonly used in the literature, which may be important for remote sensing retrieval algorithms [2]. Calibrating the optical particle sizer with a substance with a higher refractive index results in a smaller measured size distribution, and increases the fraction of light that is scattered backwards [3]. This interpretation is supported by GRASP retrievals using the phase function measurements as inputs. However, not all the GRASP retrievals were able to recreate a size distribution that could be reconciled with the optical particle counter measurements. In these instances, GRASP tended to underpredict the aerosol mode diameter and overpredict the aerosol mode geometric standard deviation.

References

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