Black Carbon Aged Biomass Burning Aerosol from Wildfires at the Mt. Bachelor Observatory in Central Oregon

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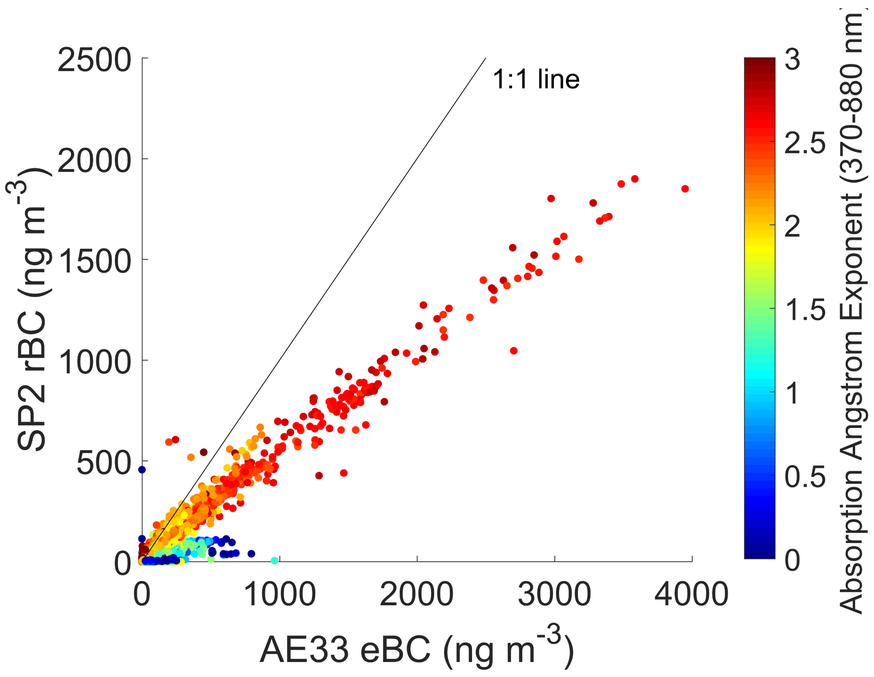
Introduction

During the summer of 2016 at the Mt. Bachelor Observatory (MBO, 2.7 km a.s.l.) we measured fine particulate matter (PM1), carbon monoxide (CO), aerosol light scattering (σ_{scat}), aerosol absorption (σ_{abs}) from a Tricolor Absorption Photometer (TAP), Scanning Mobility Particle Sizer Spectrometer (SMPS) aerosol number size distributions, and Black Carbon with an Aethalometer at 800 nm (AE33) (eBC) and an Single-Particle Soot Photometer (SP2) (rBC). The main scientific questions of this deployment were:

- How do the measurements of Black Carbon from the Aethalometer and SP2 compare?
- What is the range of ΔBC/ΔCO enhancement ratios in aged Wildfire Events and how do they compare to other enhancement ratios?
- What are the aerosol and rBC size distributions during Wildfire plumes?

Comparison of Aethalometer BC and SP2 rBC

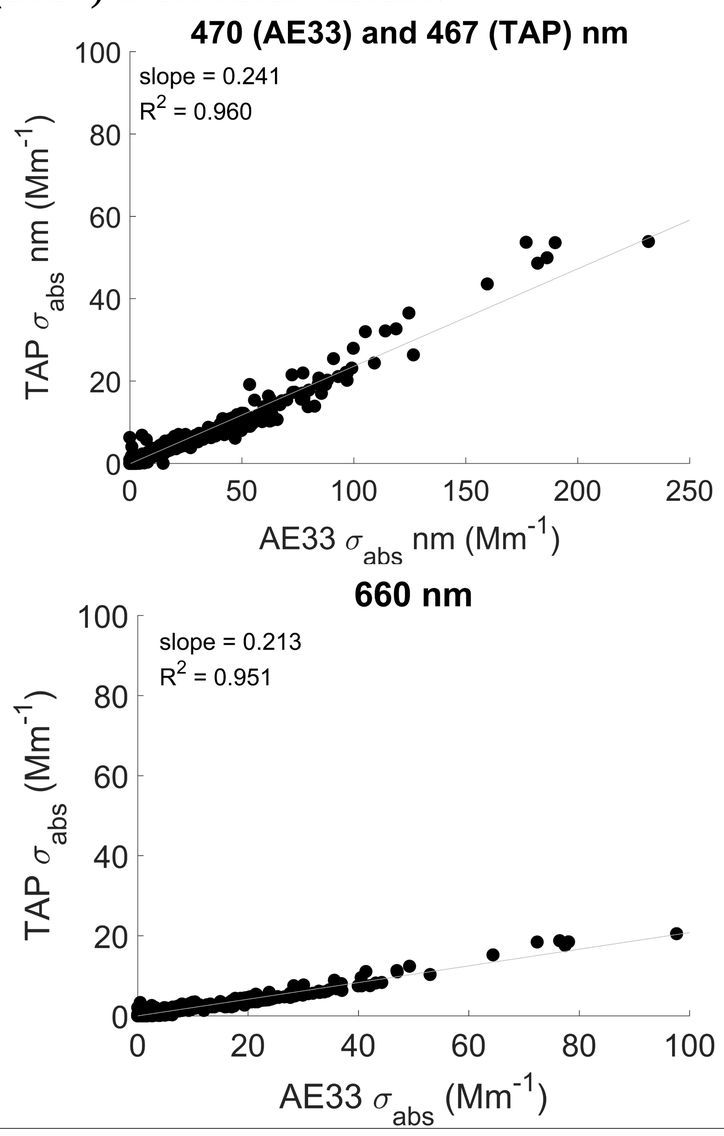
- AE33 eBC higher than SP2 rBC by a factor of 1.6 to 2.15 for Wildfire events.
- This is expected for high OA environment (high AAE values), but also seen during non-wildfire influenced air masses.
- AE33 "dual spot" loading corrected (Drinovec et al. 2015) and multiple scattering corrected (Weingartner et al. 2003).



- Additional correction methods for the AE33 will be investigated and comparisons made to SP2 rBC concentrations.

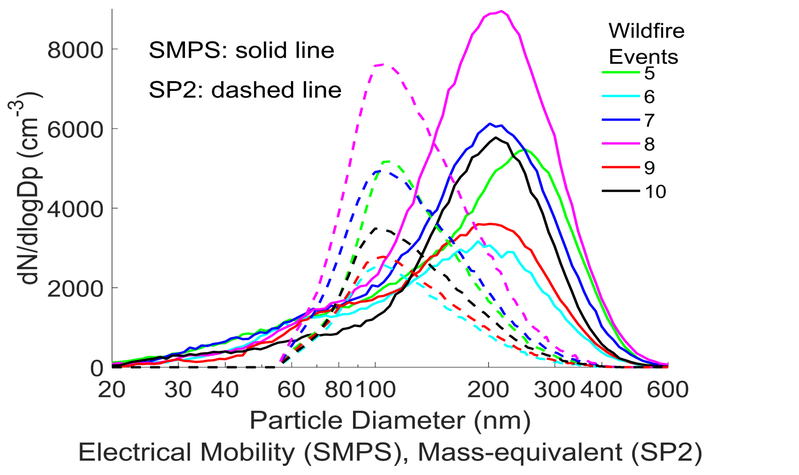
Comparison of Aethalometer and TAP σ_{abs}

- AE33 σ_{abs} substantially higher than TAP σ_{abs} at all comparable wavelengths.
- TAP σ_{abs} corrected using the Virkkula et al. (2010) correction scheme.

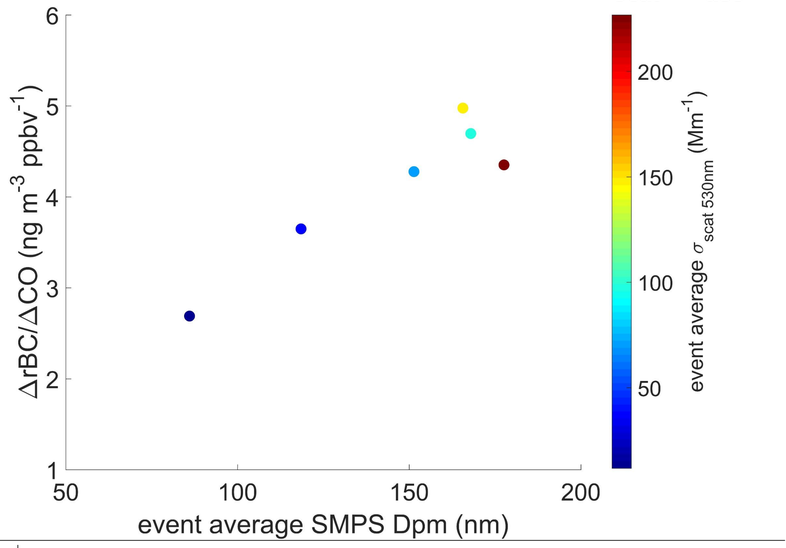


Aerosol Size Distributions during Wildfires

- Size distribution was measured for all aerosols with the SMPS and rBC particles by the SP2.



- SMPS geometric mean diameter (Dpm) well correlated to ΔrBC/ΔCO and measures of plume concentration (i.e. PM1, CO, σ_{scat}, σ_{abs})



Slopes colored high (green) to low (red). R^2>0.7 highlighted red

MBO 2016 BB events

Enhancement Ratios of Wildfire Events

Mass Absorption Cross-section (MAC) from TAP and SP2 measurements

start time	end time	$\Delta\sigma_{scat550}/\Delta CO$ (Mm^{-1} ppbv^{-1}) slope	R^2	$\Delta\sigma_{abs530}/\Delta CO$ (Mm^{-1} ppbv^{-1}) slope	R^2	$\Delta PM1/\Delta CO$ (µg m^{-3} ppbv^{-1}) slope	R^2	$\Delta rBC/\Delta CO$ (ng m^{-3} ppbv^{-1}) slope	R^2	$\Delta rBC/\Delta PM1$ (ng m^{-3}/ug m^{-3}) slope	R^2	$\Delta\sigma_{abs467}/\Delta rBC$ (m^2 g^{-1}) slope	R^2	$\Delta\sigma_{abs530}/\Delta rBC$ (m^2 g^{-1}) slope	R^2	$\Delta\sigma_{abs660}/\Delta rBC$ (m^2 g^{-1}) slope	R^2
8/29/16 14:30	8/29/16 23:40	1.39	**0.99**	0.06	**0.98**	0.24	**0.99**	4.98	**0.98**	0.0484	**0.98**	19.49	**0.97**	11.24	**0.98**	6.90	**0.98**
8/30/16 3:05	8/30/16 5:30									0.0511	**0.99**	11.06	**0.99**	6.73	**0.98**	4.17	**0.99**
8/30/16 11:30	8/30/16 14:15									0.0519	**0.99**	11.66	**1.00**	6.88	**0.99**	4.27	**0.99**
8/30/16 14:50	8/30/16 19:00	1.02	0.48	0.04	0.45	0.21	0.45	4.35	0.48	0.0476	**0.98**	15.42	**0.91**	9.03	**0.97**	5.05	**0.95**
8/30/16 19:10	8/31/16 0:35	0.89	**0.89**	0.03	**0.88**	0.24	**0.91**	4.28	**0.89**	0.0555	**0.98**	14.32	**0.98**	8.17	**0.98**	5.15	**0.98**
8/31/16 2:45	8/31/16 7:30	1.01	**0.96**	0.04	**0.96**	0.29	**0.96**	4.70	**0.95**	0.0614	**0.97**	14.13	**0.97**	8.17	**0.97**	5.60	**0.97**
8/31/16 12:40	8/31/16 15:15	0.46	0.66	0.02	0.57	0.18	0.65	2.69	0.65	0.066	**1.00**	13.63	**0.92**	7.83	**0.87**	5.42	**0.80**
8/31/16 15:30	9/1/16 0:30	0.81	**0.76**	0.03	**0.74**	0.27	**0.77**	3.65	**0.75**	0.073	**0.98**	15.01	**0.97**	8.43	**0.96**	5.61	**0.97**

Conclusions and Future Work

- The Aethalometer over-predicts Black Carbon compared to the SP2 and aerosol absorption coefficients compared to the TAP.
- ΔrBC/ΔCO range from 2.69-4.98 ng m^{-3} ppbv^{-1} during Wildfire Events.
- MAC of BC estimated to be 5.05-6.90 m^2 g^{-1} (at 660 nm) for aged Wildfire aerosols.
- ΔrBC/ΔCO from Wildfires correlated with SMPS geometric mean diameter (Dpm) as well as event averaged CO, PM1, CO, σ_{abs}, σ_{scat}.
- Investigate relationships between BC and absorption coefficient measurements using various correction schemes for AE33 and TAP.

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