

Aerosol Optical Properties of Smoke from the Las Conchas Wildfire, Los Alamos, NM

Kyle Gorkowski¹ (gorkow@lanl.gov), Manvendra Dubey¹, Bradley Flowers¹, Allison Aiken¹, Benjamin Klein¹, Claudio Mazzoleni², Swarup China², Noopur Sharma²

¹ Los Alamos National Laboratory, Los Alamos, NM, United States.
² Michigan Technological University, Physics Dept., Houghton, MI, United States.

Michigan Tech
 Michigan Technological University
 Atmospheric Science Program

Los Alamos National Laboratory
 EARTH & ENVIRONMENTAL SCIENCES

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Introduction

The Las Conchas wildfire was started on June, 26 2011. Due to the close proximity to the fire the Los Alamos National Laboratory (LANL), Earth and Environmental Sciences Division (EES-14) obtained unique measurements of the smoke after LANL was reopened.



Aerosols in Smoke

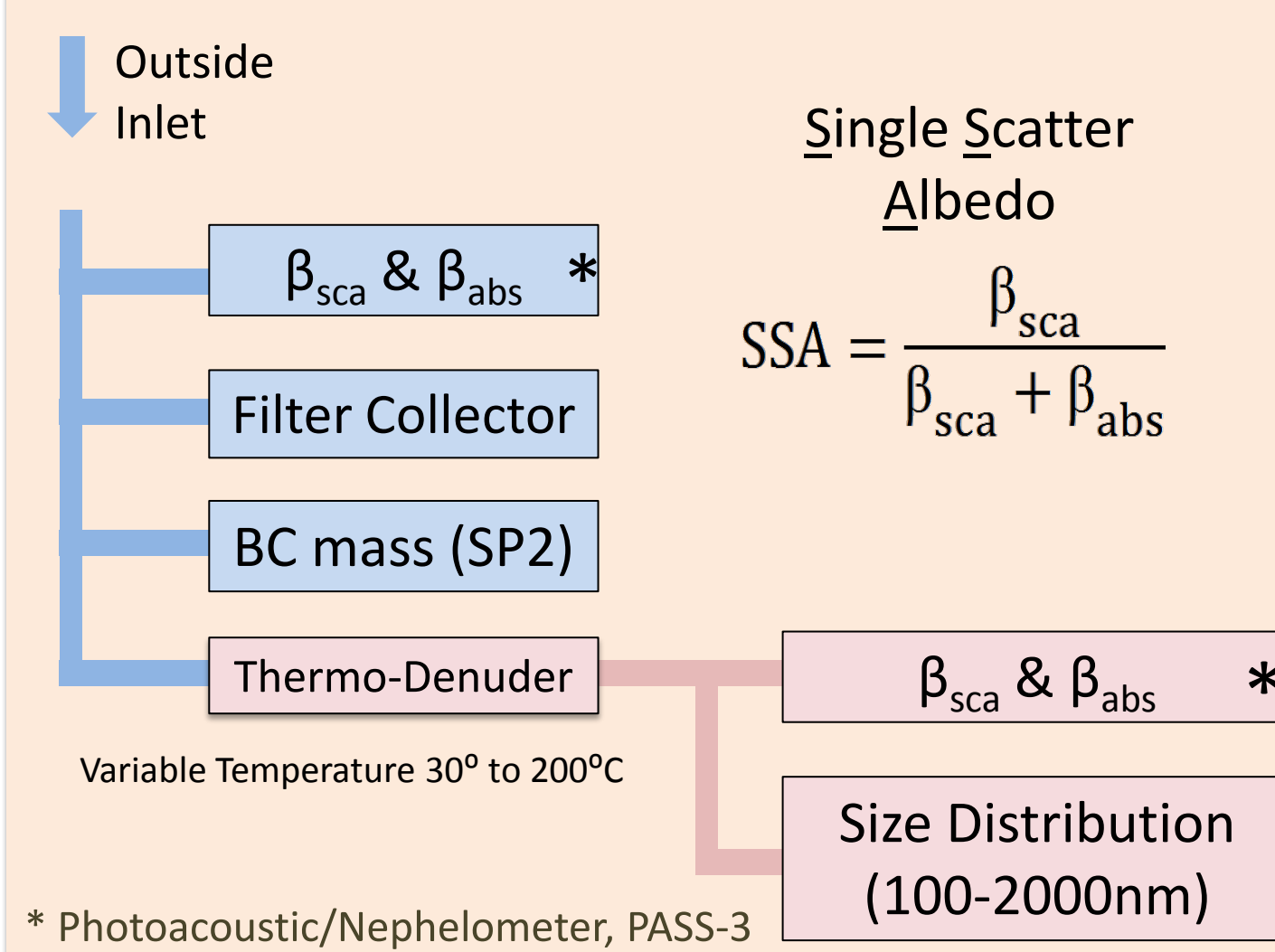
- Aerosols are composed of organic and black carbon (soot).
- Formed during fuel combustion and pyrolysis.

Complexity of smoke aerosols causes large uncertainty when modeling its optical properties relative to CO₂ for climate forcing calculations.

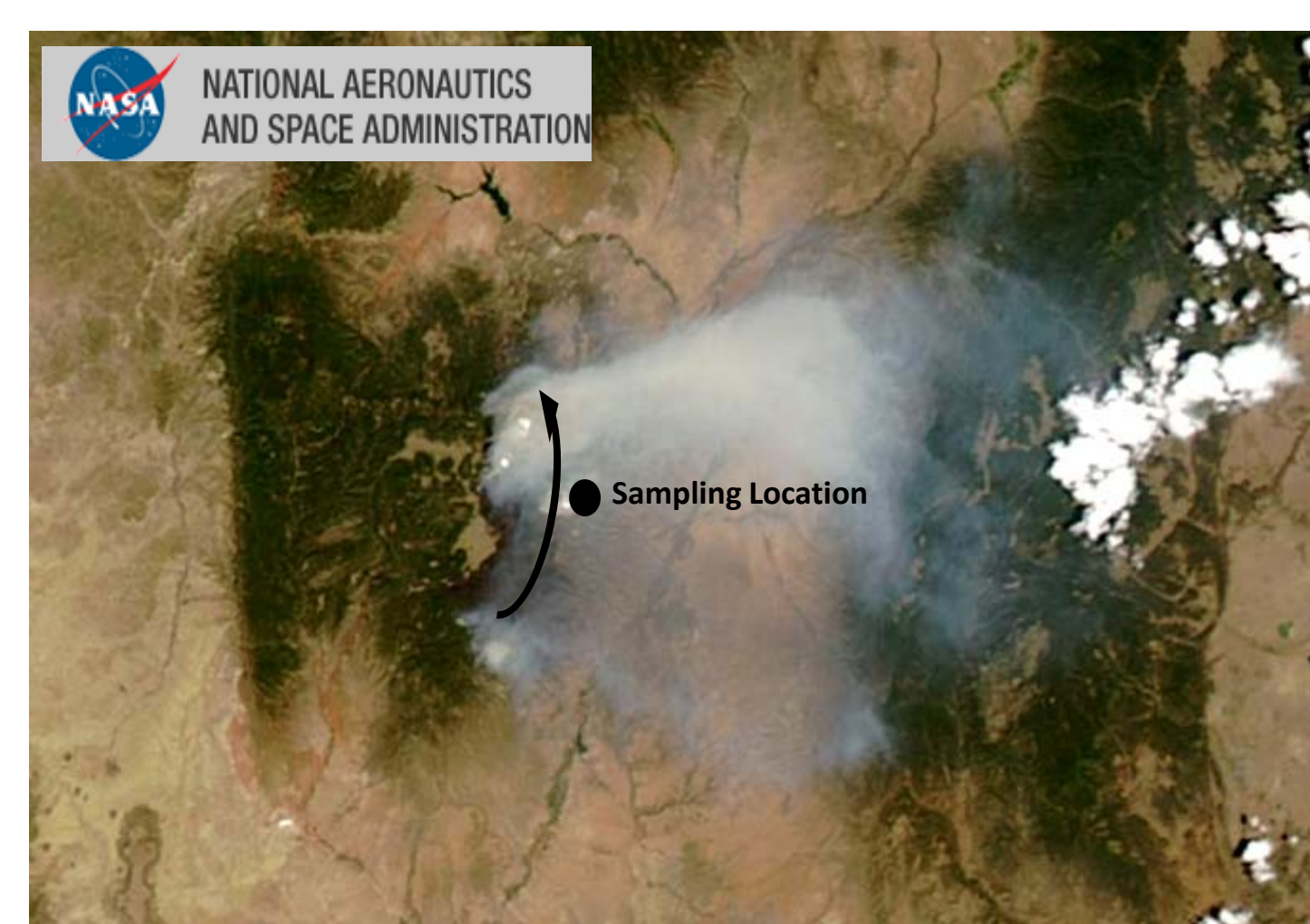
- CO₂ absorbs thermal radiation emitted by earth.
- Soot absorbs sunlight which warms the surrounding air.



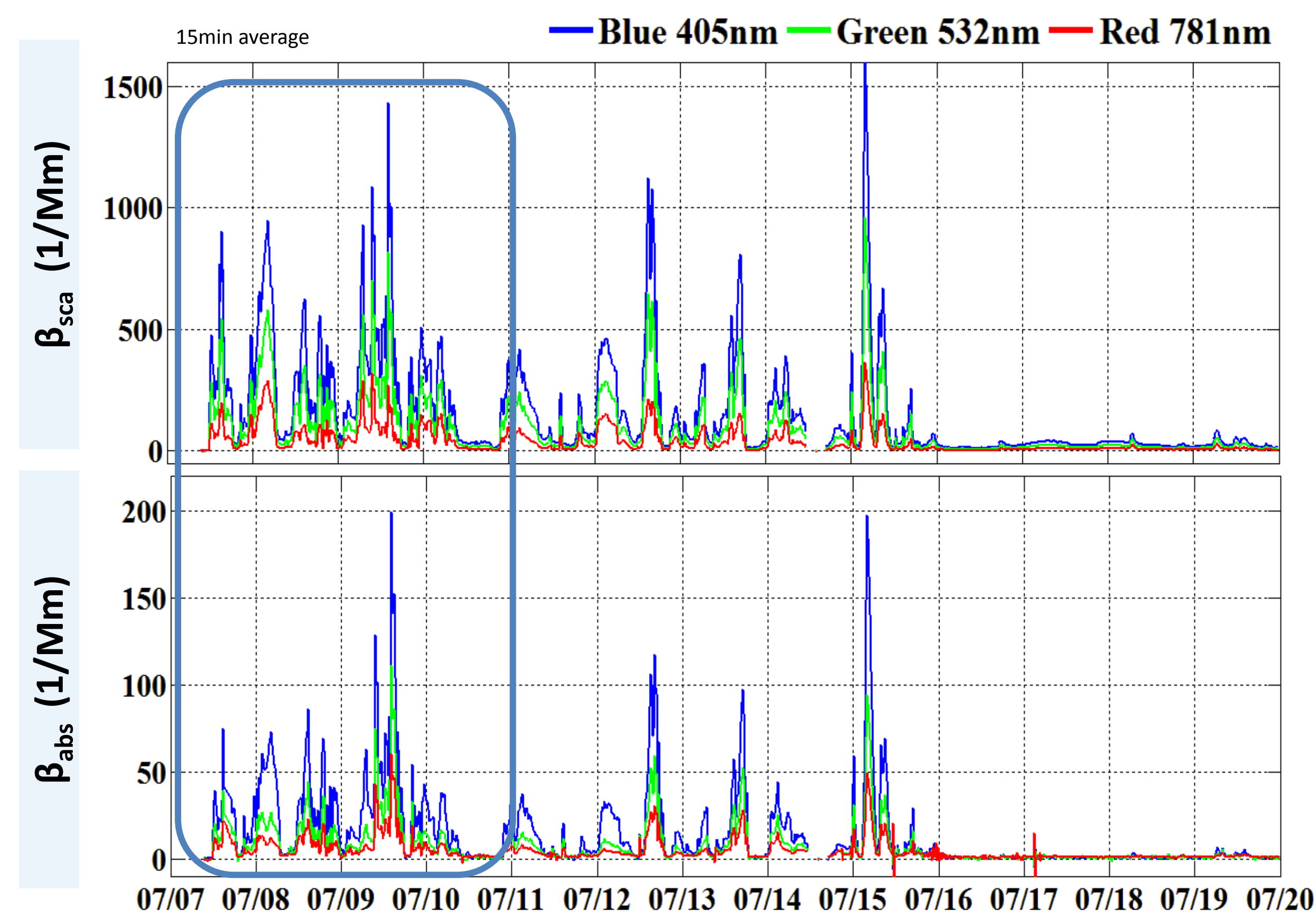
Instrument Setup



MODIS True Color Satellite Image (7/1/11)

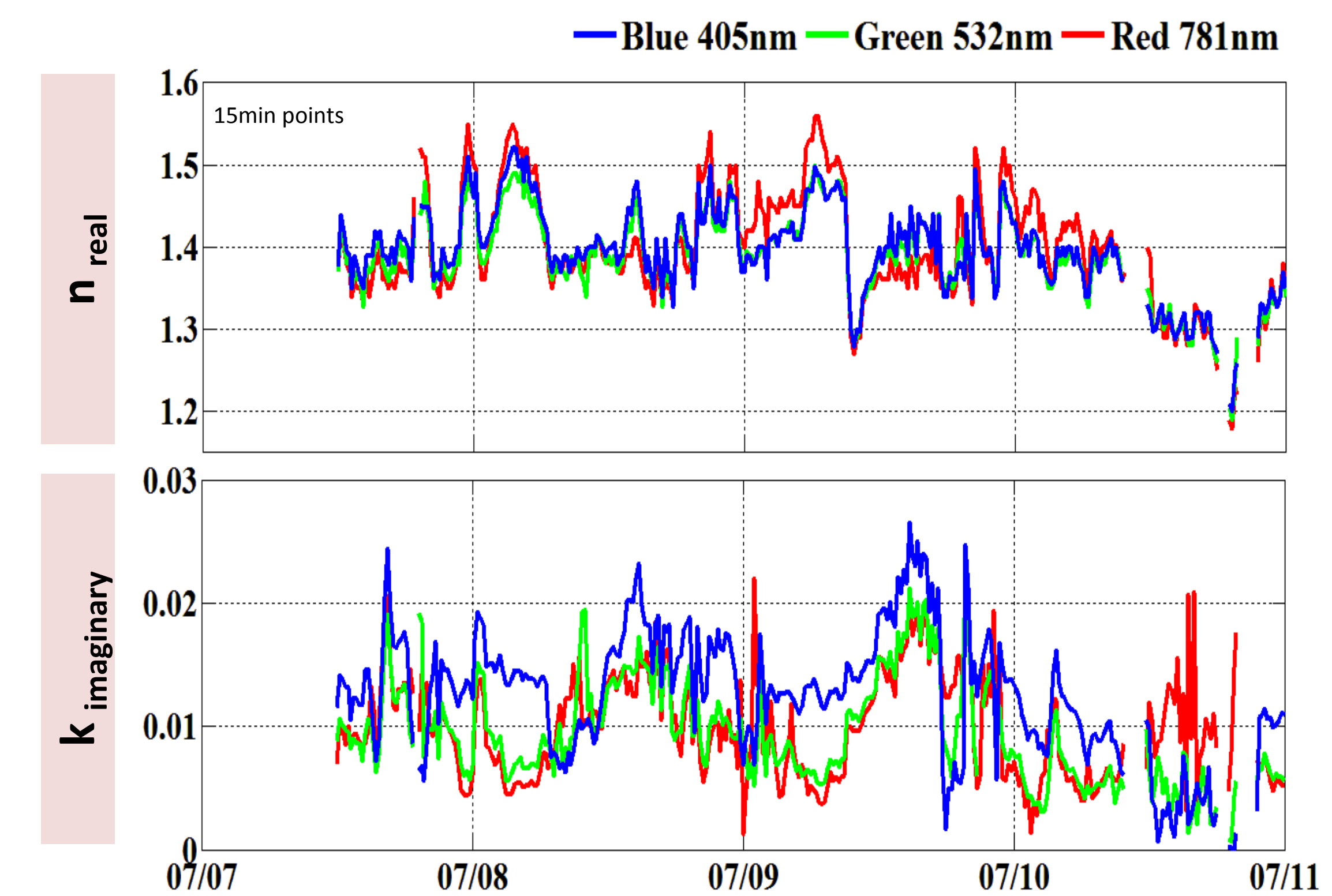


Aerosol Optical Properties - Ambient



Above is the time series of the Scattering (β_{sca}) and Absorption (β_{sca}) Coefficients. The peaks vary depending on how the meteorology transports the smoke, and how the fire is burning. After the 16th the winds shifted the plume away from our sampling location and by the 19th the fire was down to a few small hot spots.

Effective Refractive Index - Ambient

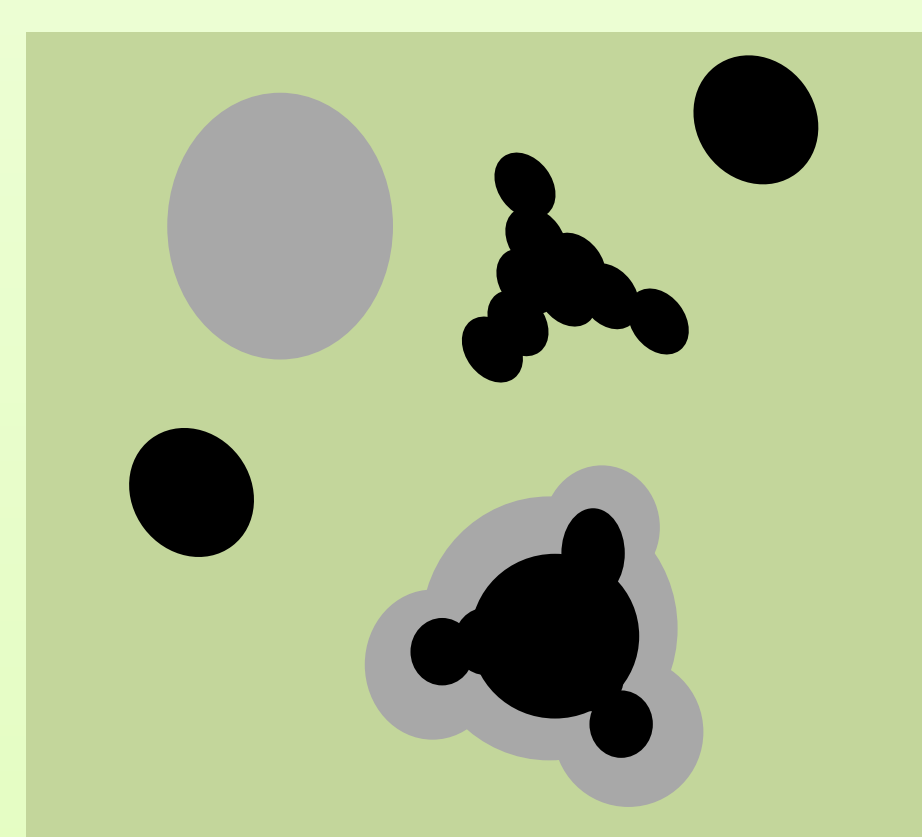


The effective refractive indexes vary with time due to the composition of the smoke changing. The effective refractive indexes were optimized using Mie Scattering.

Aerosol Coating and Mixing

Aerosol Mixing

- BC, Soot
- OC, Pure Organics & Tar Balls
- Others (e.g. Inorganics)



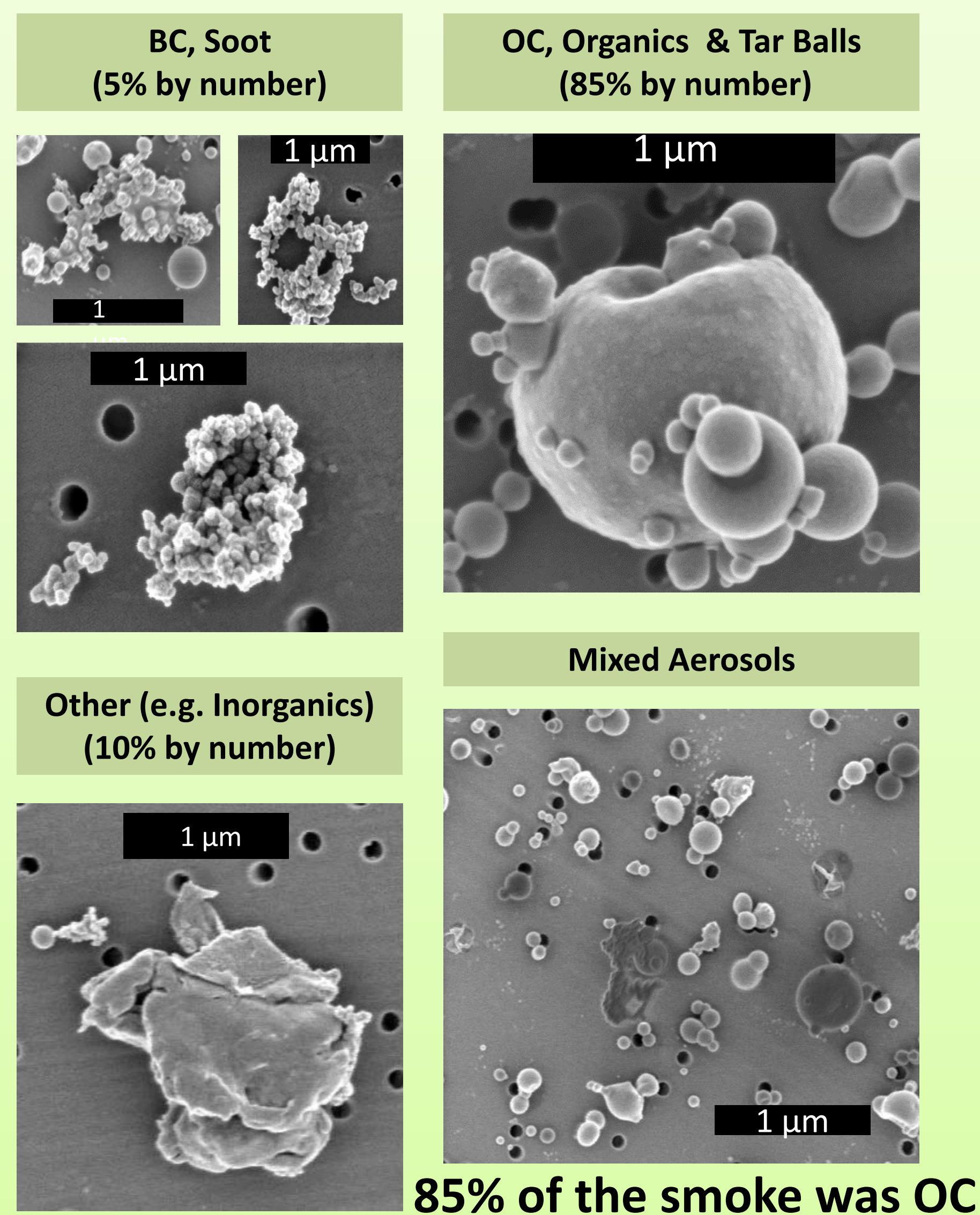
No Coating

Thick Coating

Increased SSA

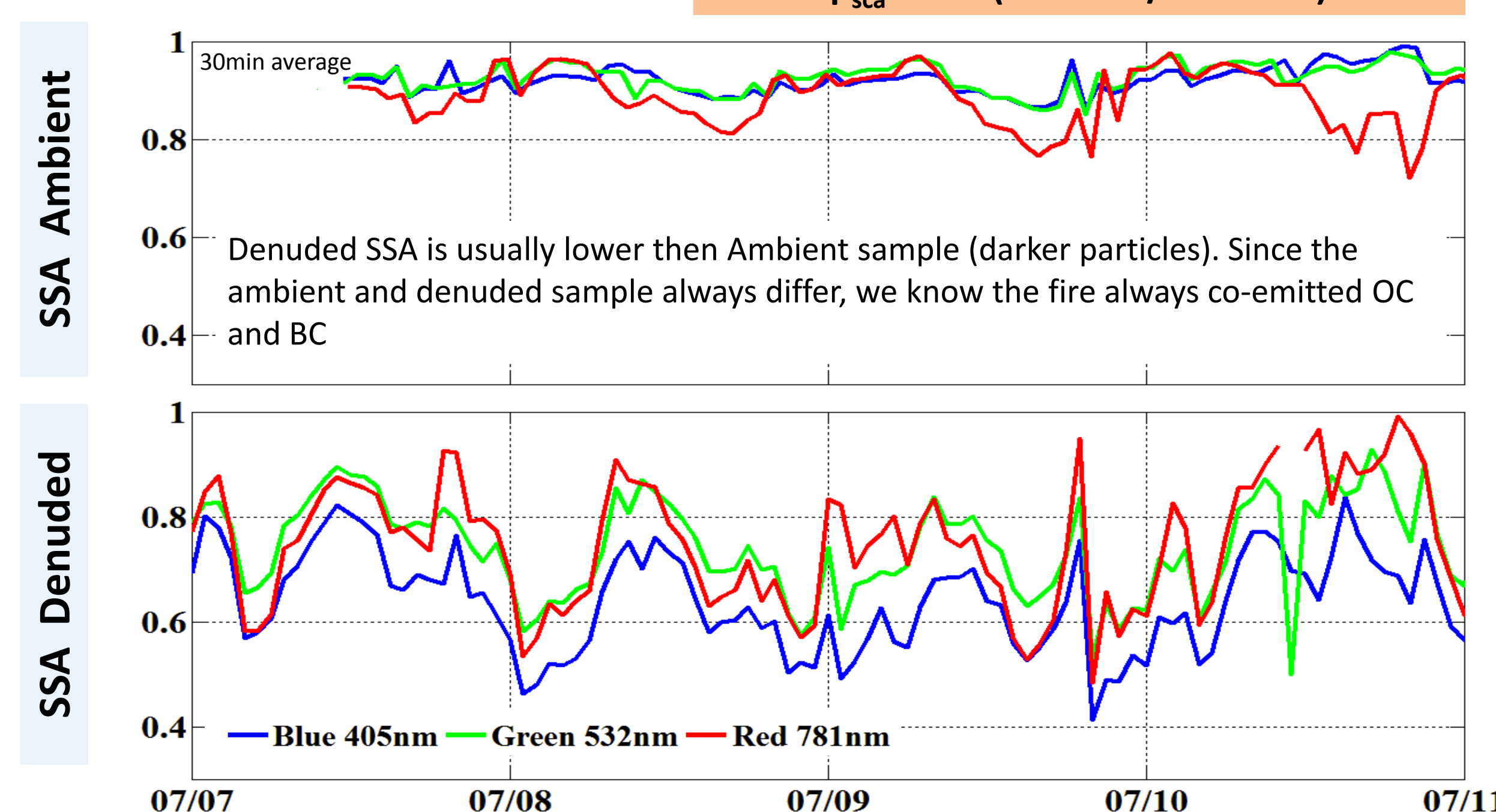
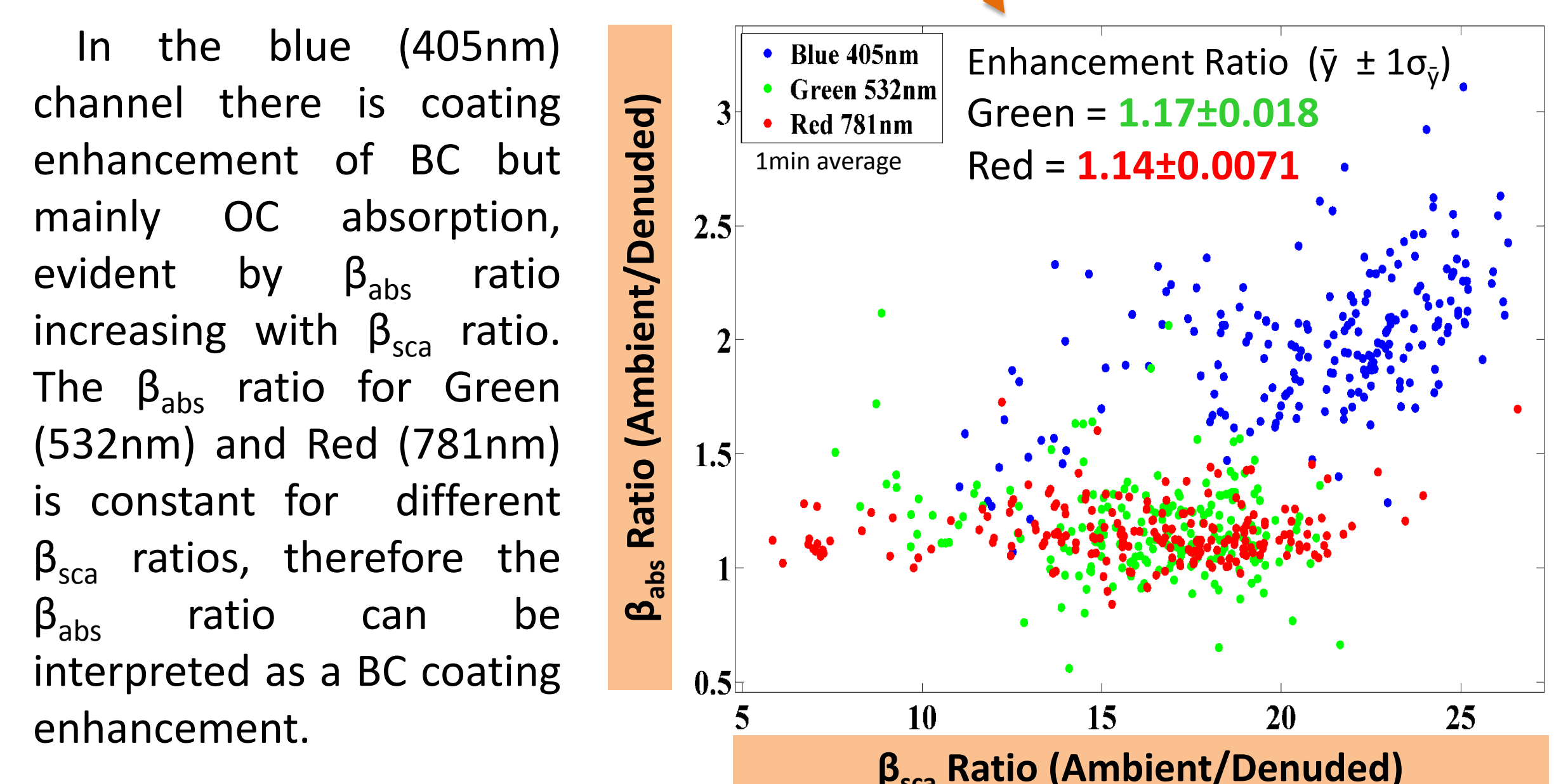
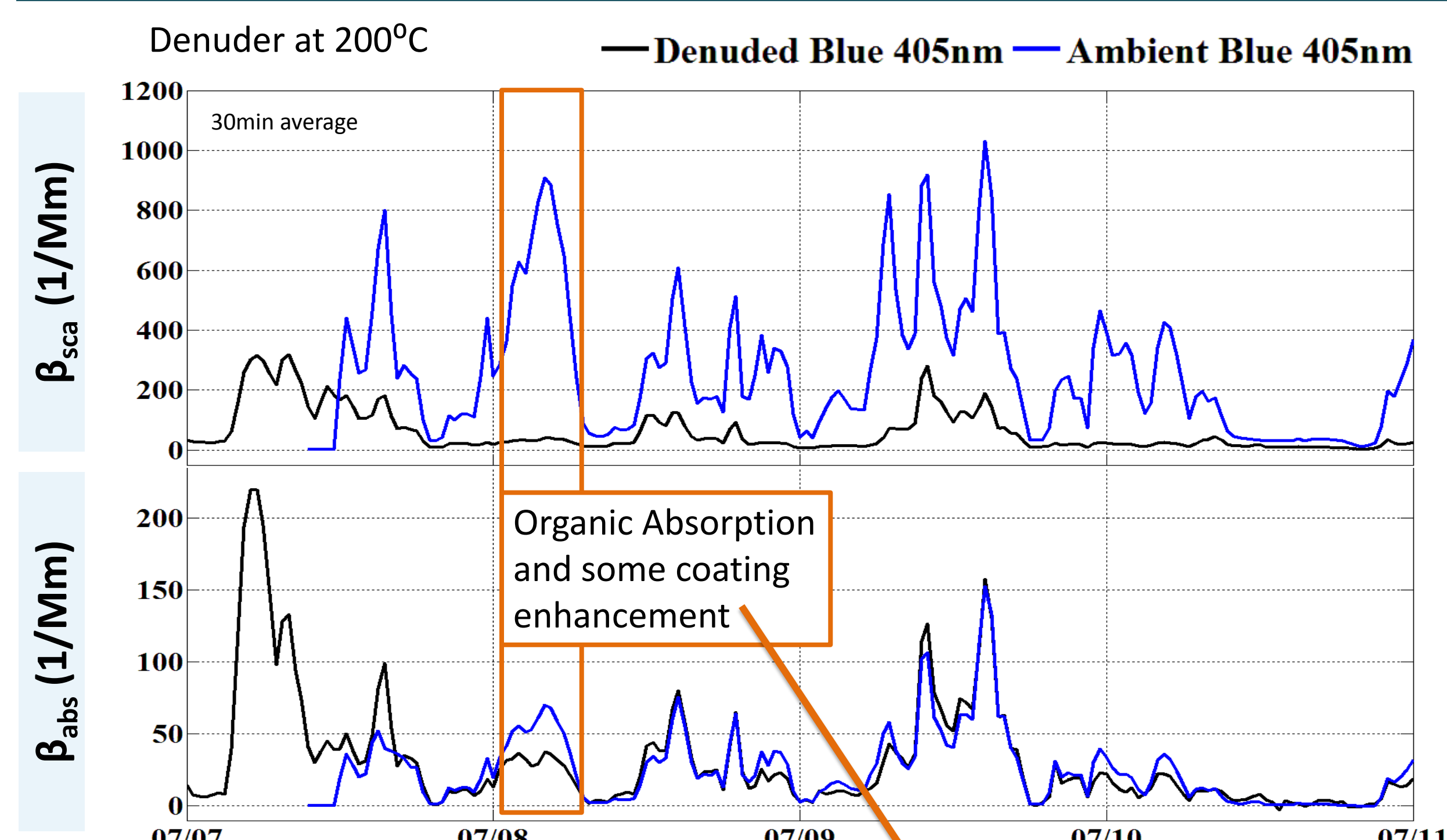
Denuding the Aerosols

Collected Filters, SEM Images

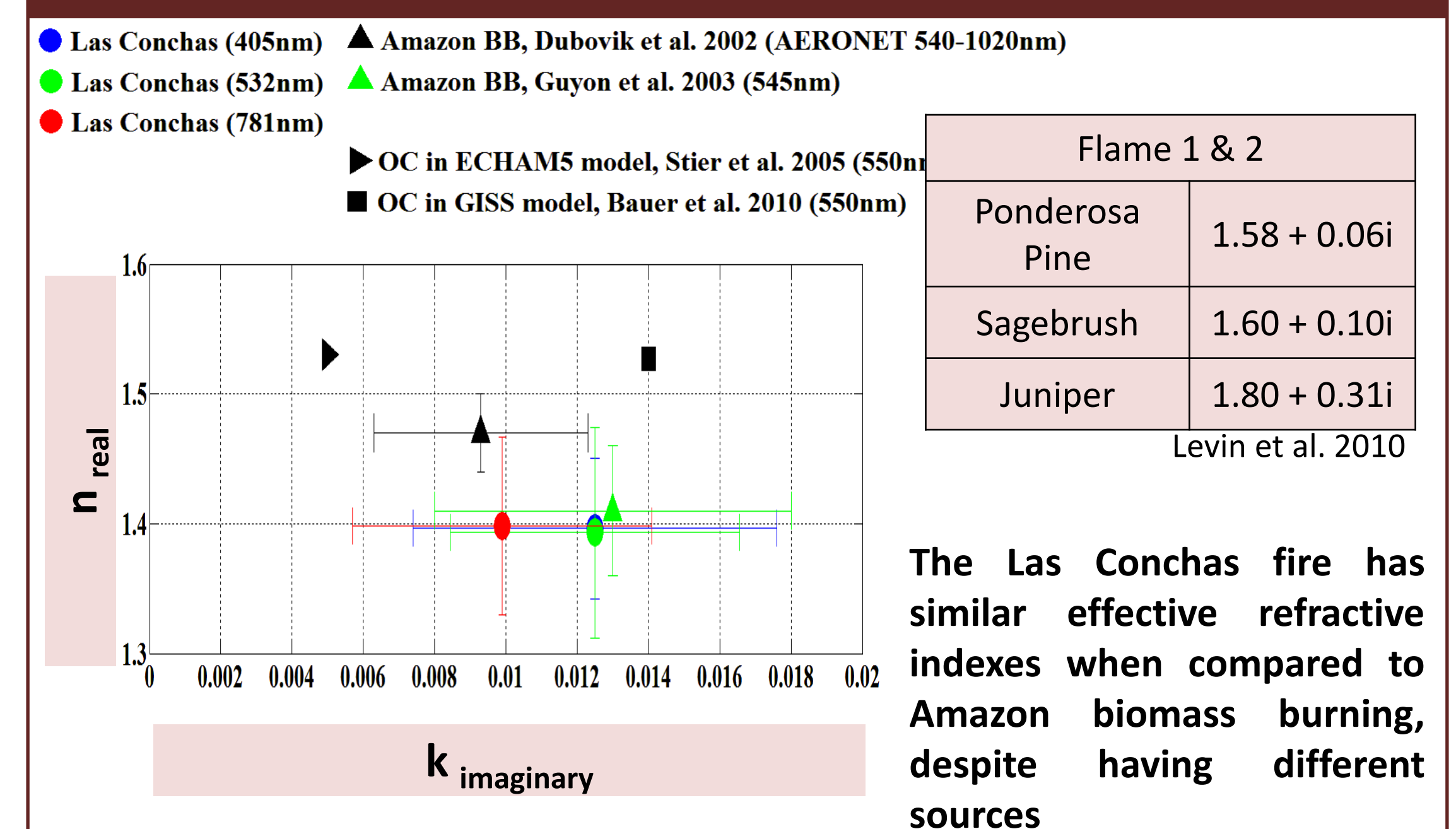


85% of the smoke was OC

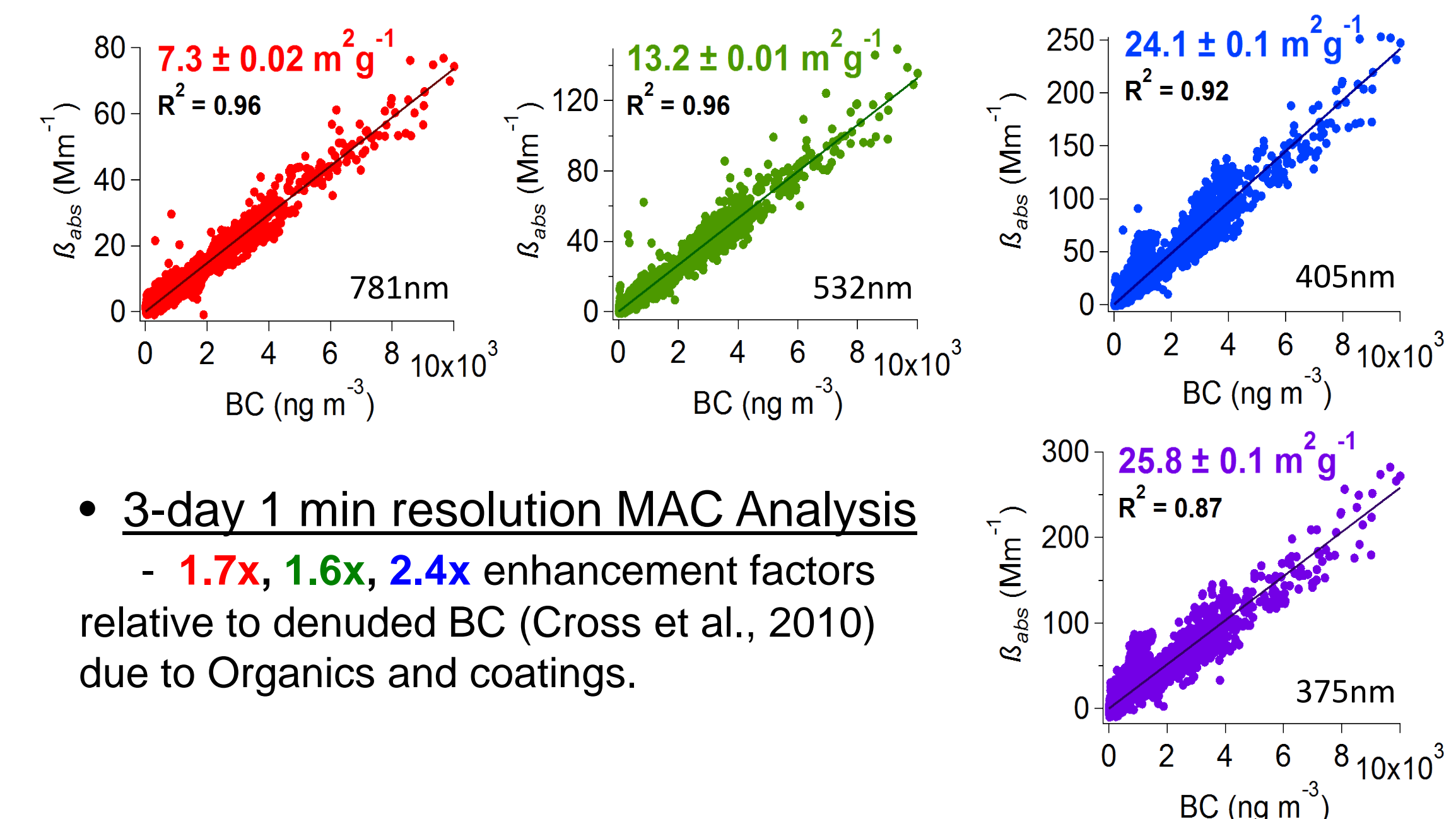
Aerosol Optical Properties - Ambient & Denuded



Effective Refractive Index - Comparison



BC Mass Absorption Cross-sections



- 3-day 1 min resolution MAC Analysis
- 1.7x, 1.6x, 2.4x enhancement factors relative to denuded BC (Cross et al., 2010) due to Organics and coatings.

Conclusion and Future Work

In conclusion the Amazon biomass burning had comparable effective refractive index despite different sources. When compared to laboratory studies FLAME 1&2 had a higher real and imaginary part, this is attributed to aerosol mixing and transport which happened during the wildfire. The smoke was dominated by OC, shown by absorption in the blue, but in the green and red channels there was evidence of absorption enhancement due to OC coating.

Absorption enhancement due to coating on soot will be investigated using the Las Conchas Fire dataset and the recently finished ClearLo 2012 winter IOP. Using the SP2 data to look into the coating thicknesses and how they differ from wildfires and urban pollution. Form this work a better understanding of aerosol optical properties and how to model them will be achieved.