

Speciating Absorbing Aerosol from AOS Observations

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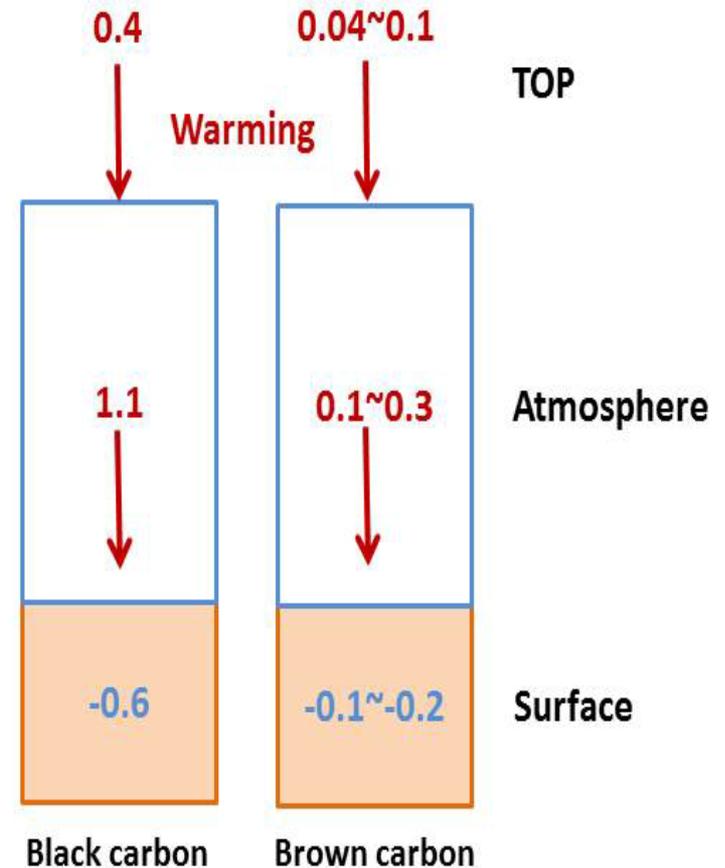
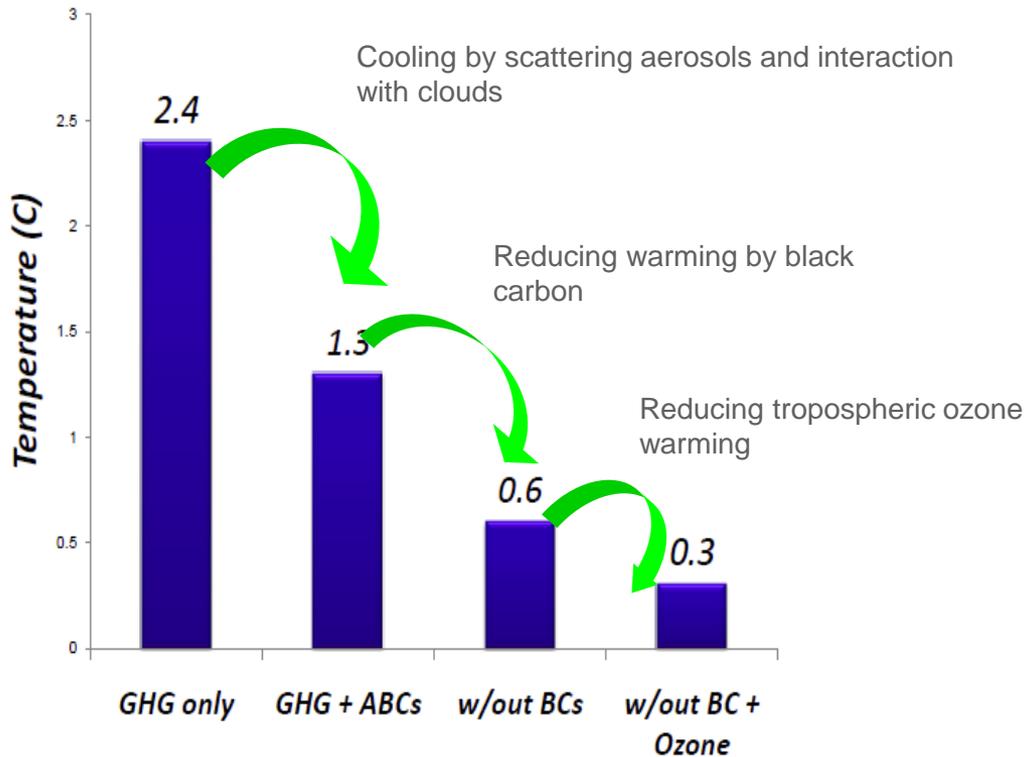
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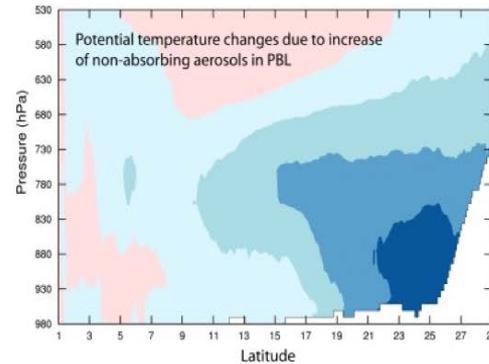
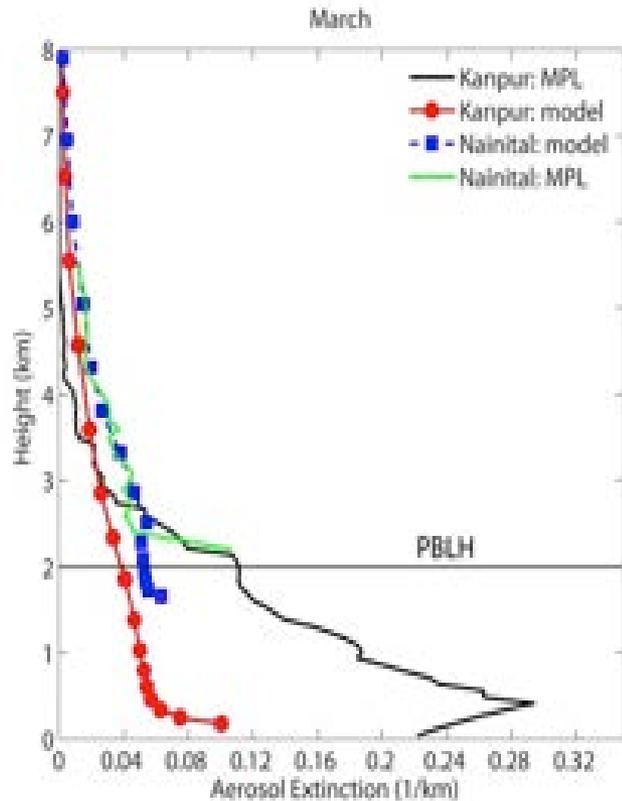
Absorbing Aerosols and Climate (Black and Brown Carbon)



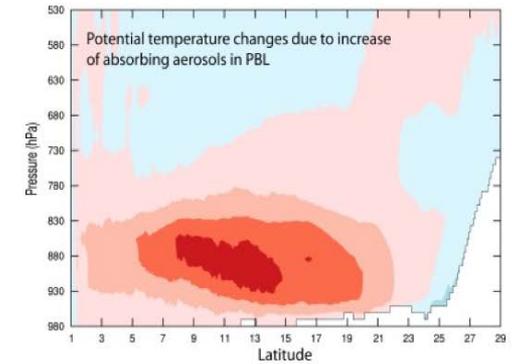
Ramanathan and Feng, 2008; Feng, Ramanathan, Kotamarthi, 2013



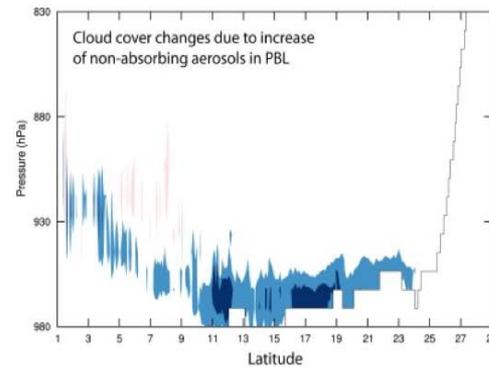
Absorbing aerosol Profiles are Critical for estimating semi-direct effects



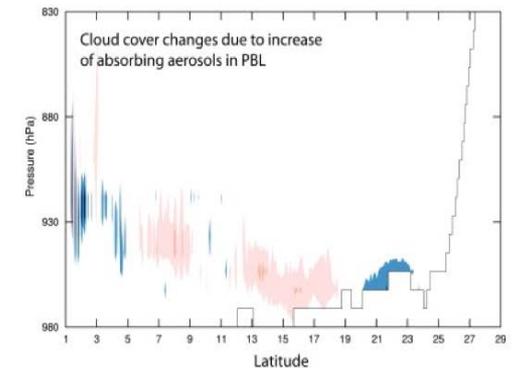
(b)



(c)



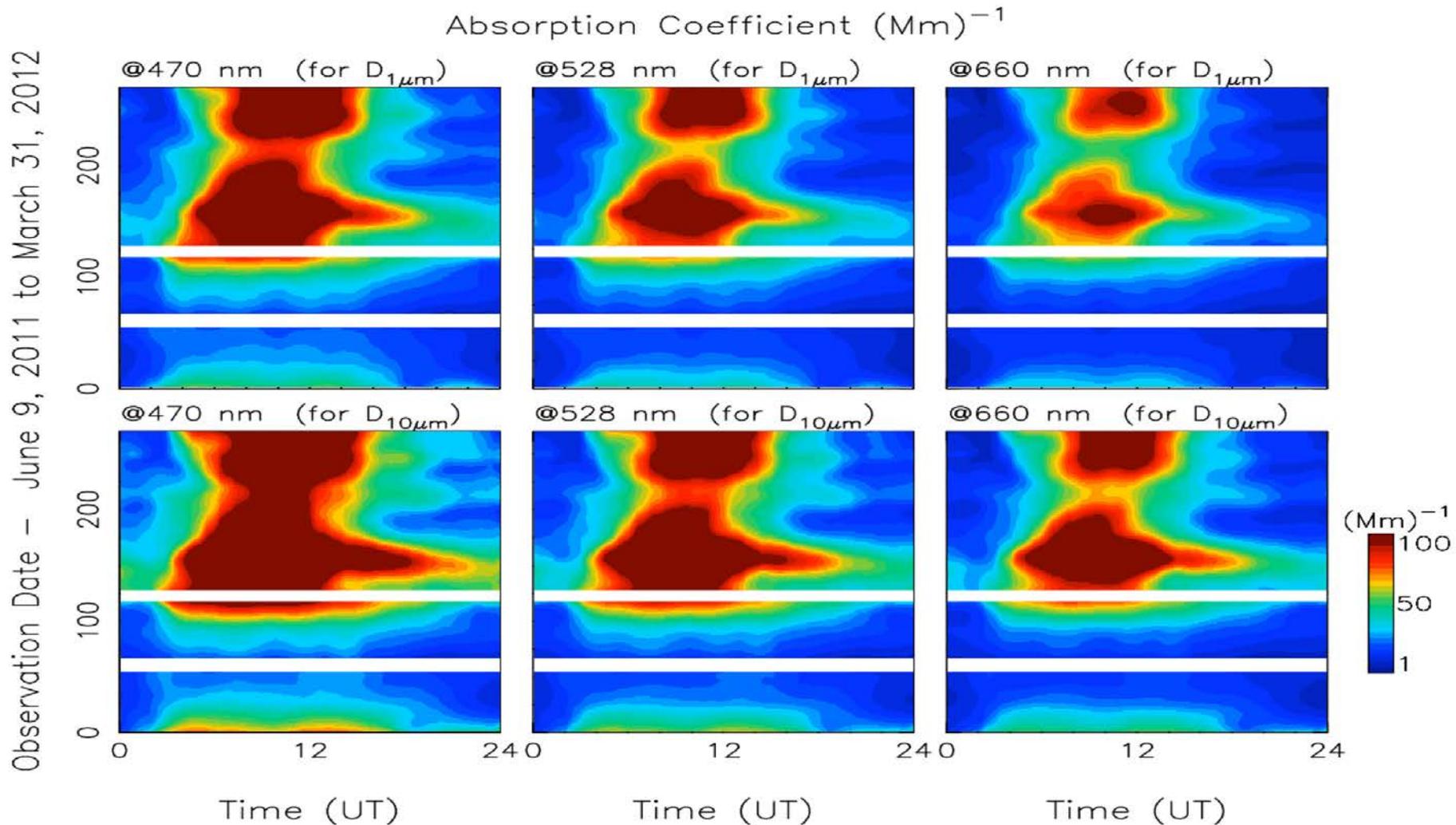
(d)



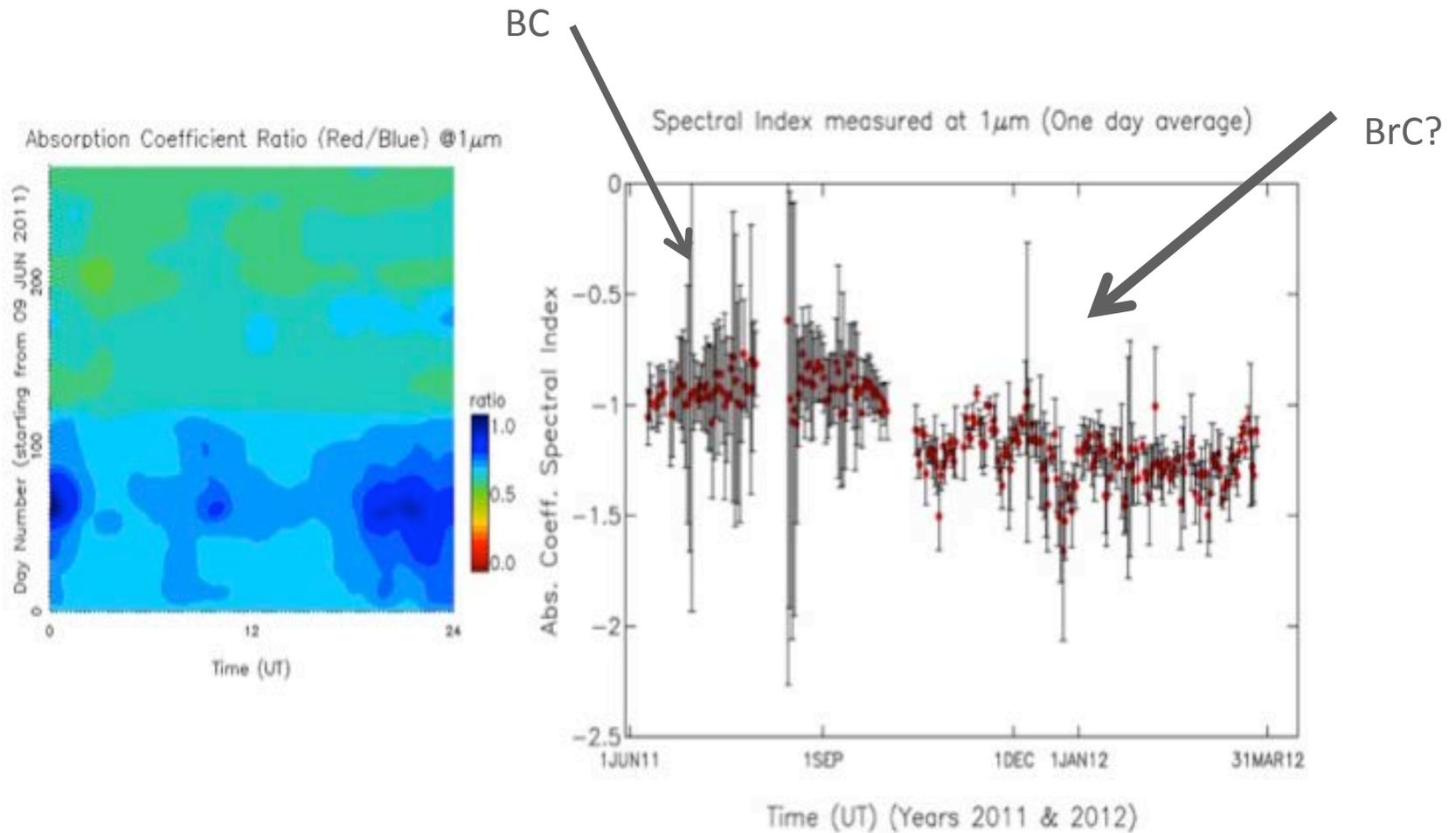
(e)



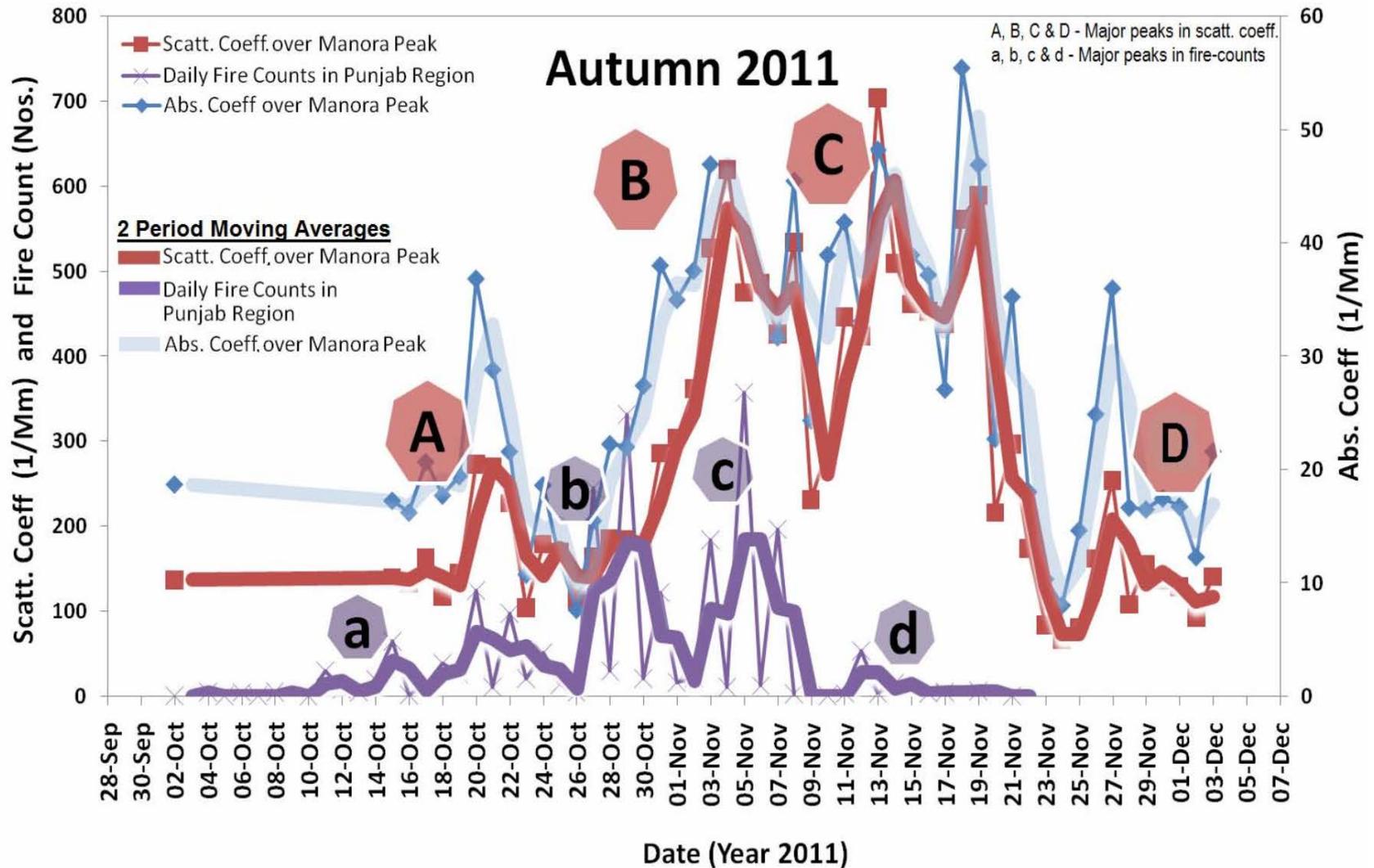
Large Seasonal and Diurnal Variability Surface absorption measured by PSAP



Spectral Index and absorbing aerosol separation



Biomass Burning events and absorptive aerosols



Sahai et al., 2013



Spectral differencing for speciation of absorption

For submicron (<1 micron) particles and assuming dust is negligible

$$Absp_i = Absp_{BC,i} + Absp_{BrC,i} \quad (i=467,530 \text{ and } 660 \text{ nm})$$

$$Absp_{BC,i} = Absp_{BC,ref} \left(\frac{wavl_i}{wavl_{ref}} \right)^{-\lambda_{BC,i,ref}}$$

$$Absp_{BrC,i} = Absp_{BrC,ref} \left(\frac{wavl_i}{wavl_{ref}} \right)^{-\lambda_{BrC,i,ref}}$$

$Absp_i$ = absorption coefficient

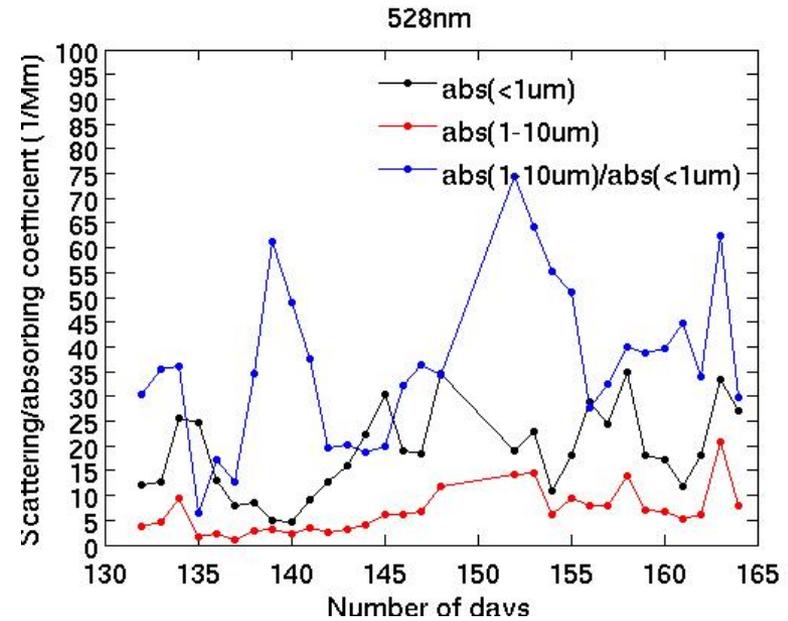
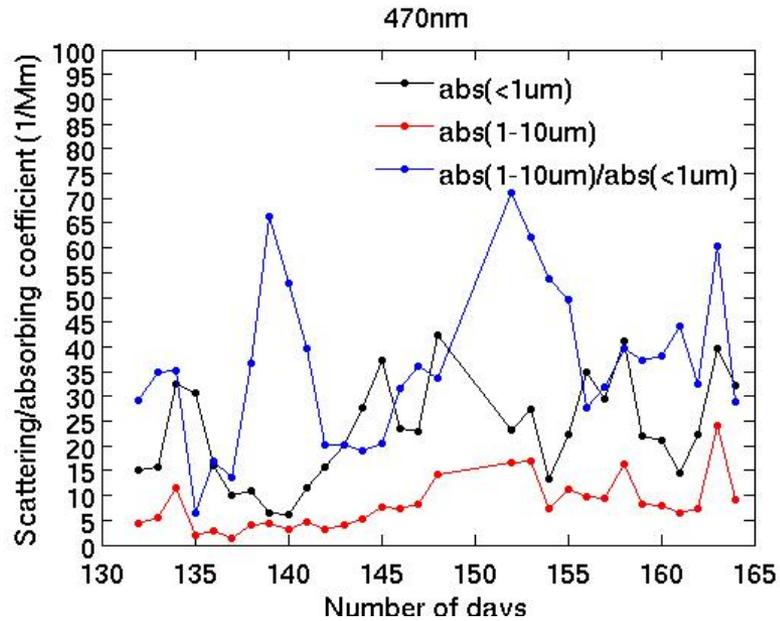
$Absp_{BC,i}$ = absorption angstrom exponent BC(0.8–1)

$\lambda_{BrC,i}$ = absorption angstrom exponent of BrC (~ 4.4)

$wavl_i$ = wavelength measured



PSAP absorption data during GVAX (Oct-Nov 2011)



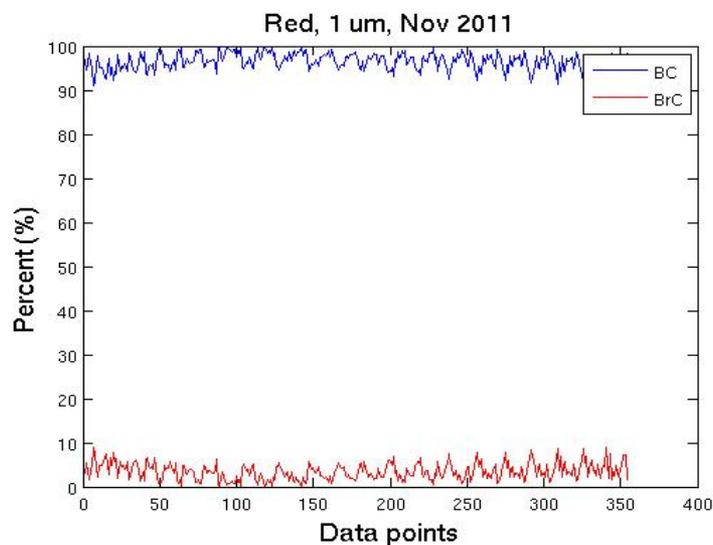
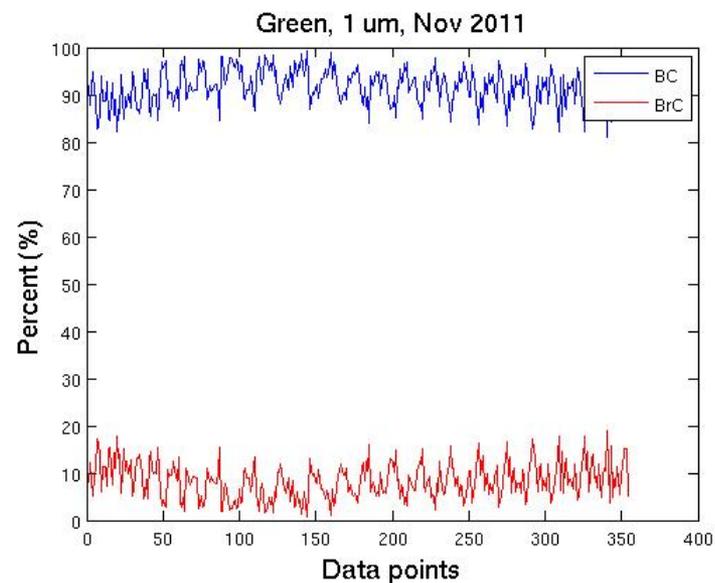
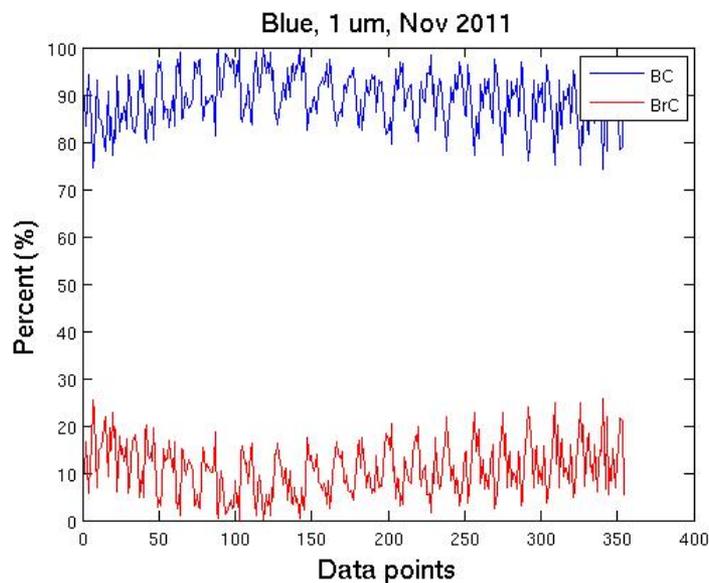
Clear-sky forcing of aerosols: TOA (-5.2 Wm^{-2}), Atmosphere (5.2 Wm^{-2}), and Surface (-10.5 Wm^{-2})

Forcing efficiency of absorbing aerosol: $\sim 30 \text{ Wm}^{-2}$ per AOD

Heating rate: 1 K day^{-1} at day 152 and 0.6 K day^{-1} from sub-micro particles



BC and BrC fractions of the total absorption for Nov 2011

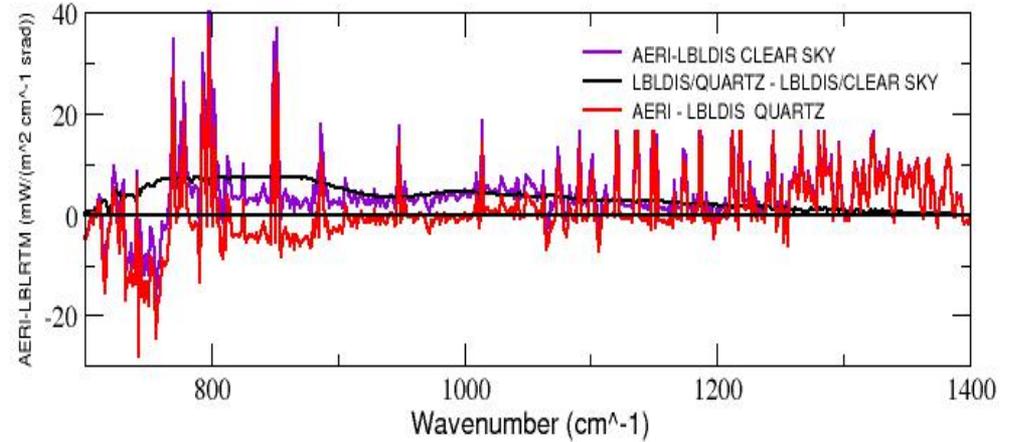
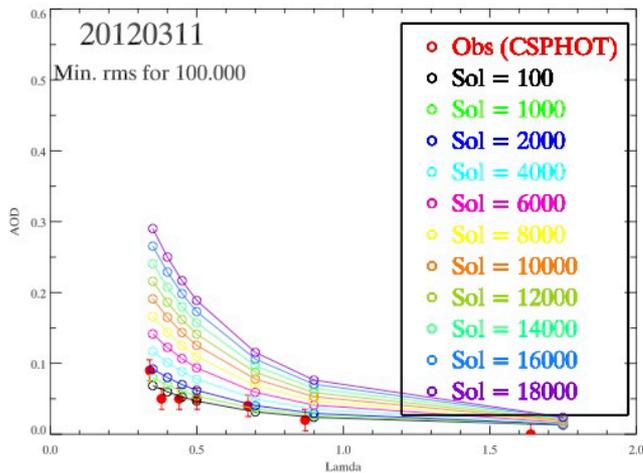
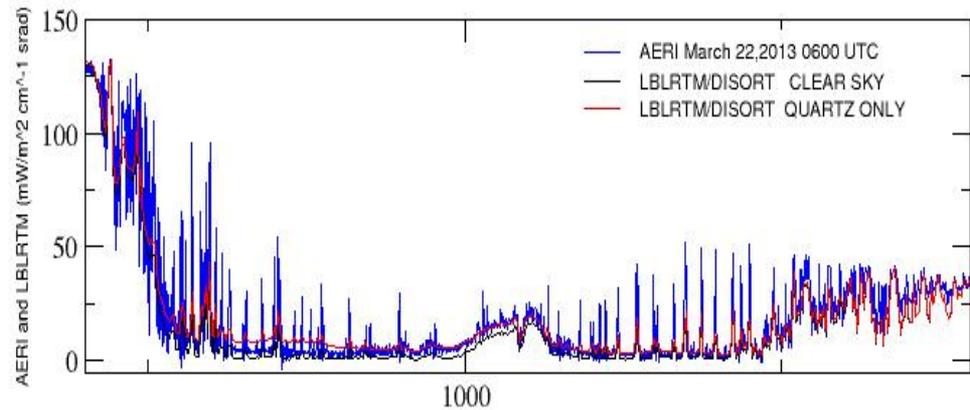
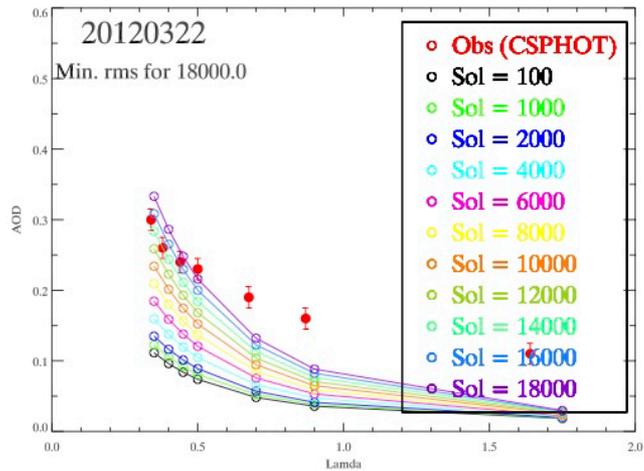


Monthly mean BC and BrC fractions (<1 μm)

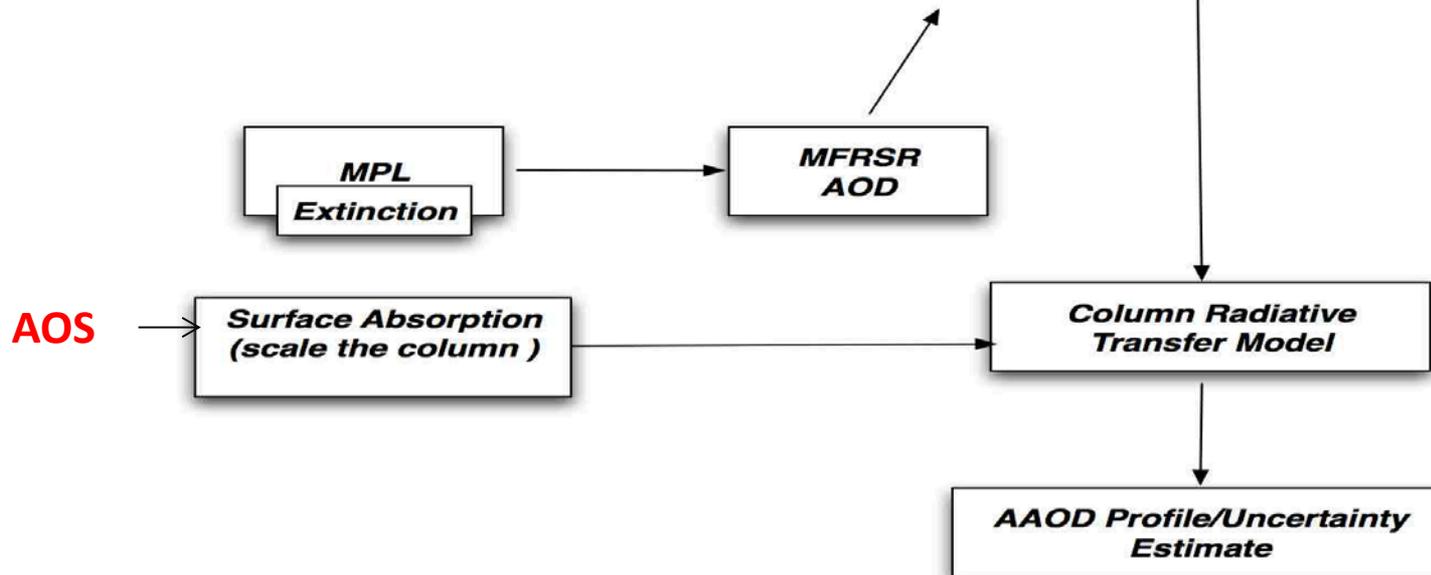
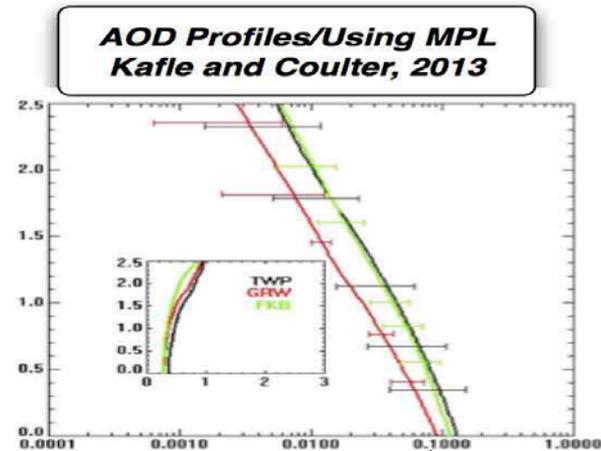
Absorption (%)	Blue (470nm)	Green (530nm)	Red (660nm)	n
BC	89	91.5	96.5	360
BrC	11	8.5	3.5	360



AERI to estimate Dust AOD



AAOD profile - Scaling with Surface AAOD



Uncertainty Estimate : Data ensemble method – Franklin, Kotamarthi et al., 2008



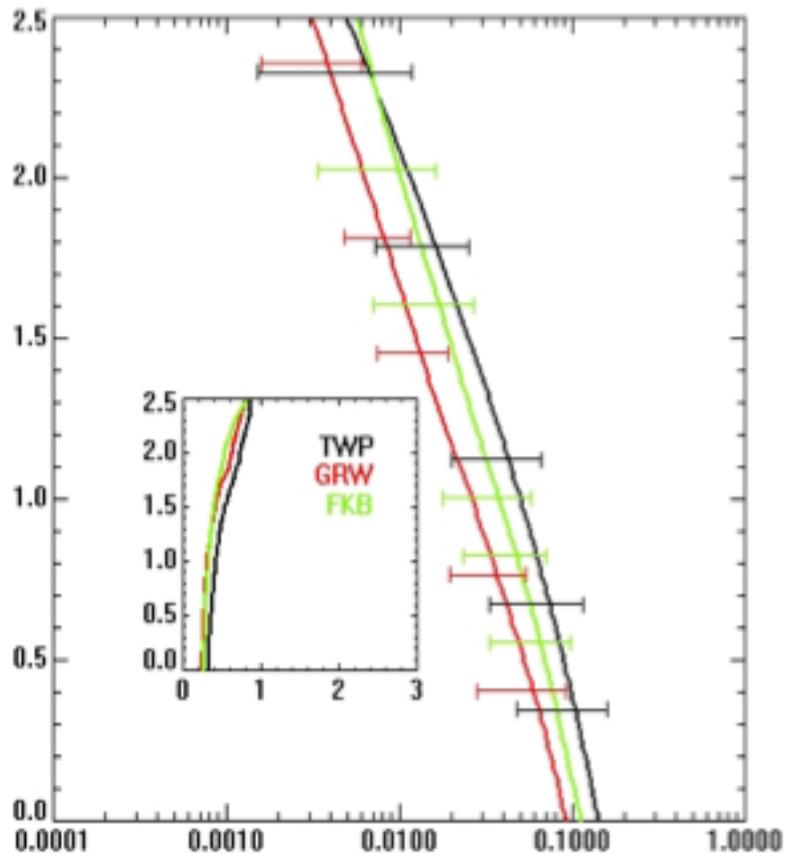
Conclusions

- Separating the Absorbing aerosols into individual species is critical for estimating both the direct and semi-direct effects
- We have established the feasibility of generating speciated AAOD at the surface sites using the AOS measurements
- We have a process for estimating AOD profiles using the MPL data set and MFRSR surface measurements.
- A retrieval method for speciated AAOD profiles is in the process of development.

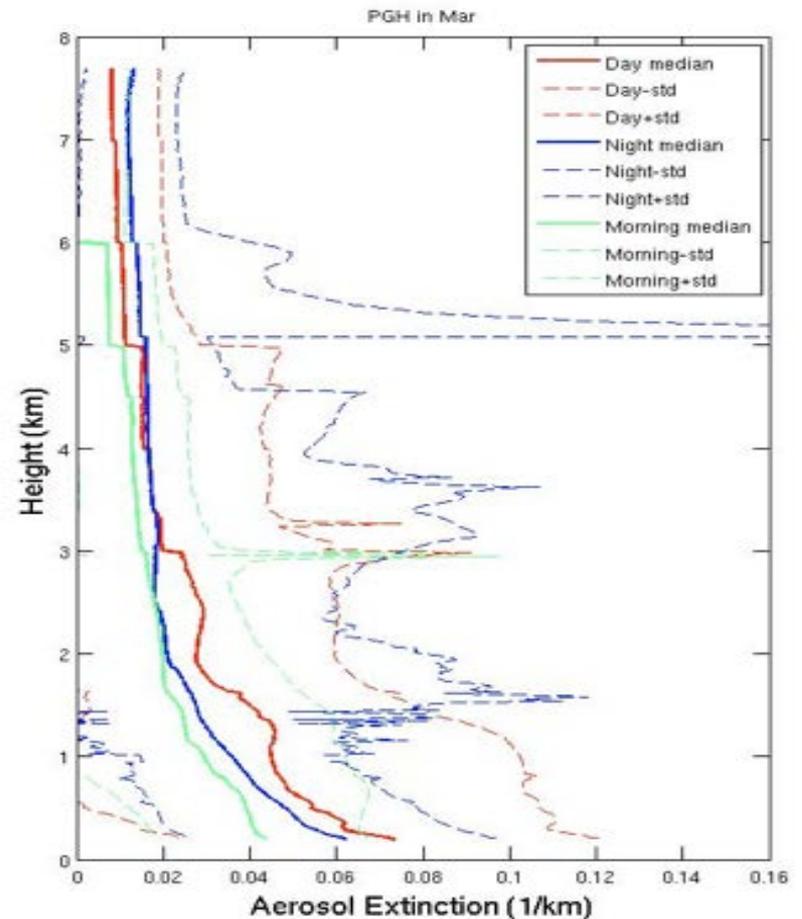


AOD Profiles from MPL

TWP, GRW, and FKB



PGH



Kafle and Coulter, JGR, 2013

