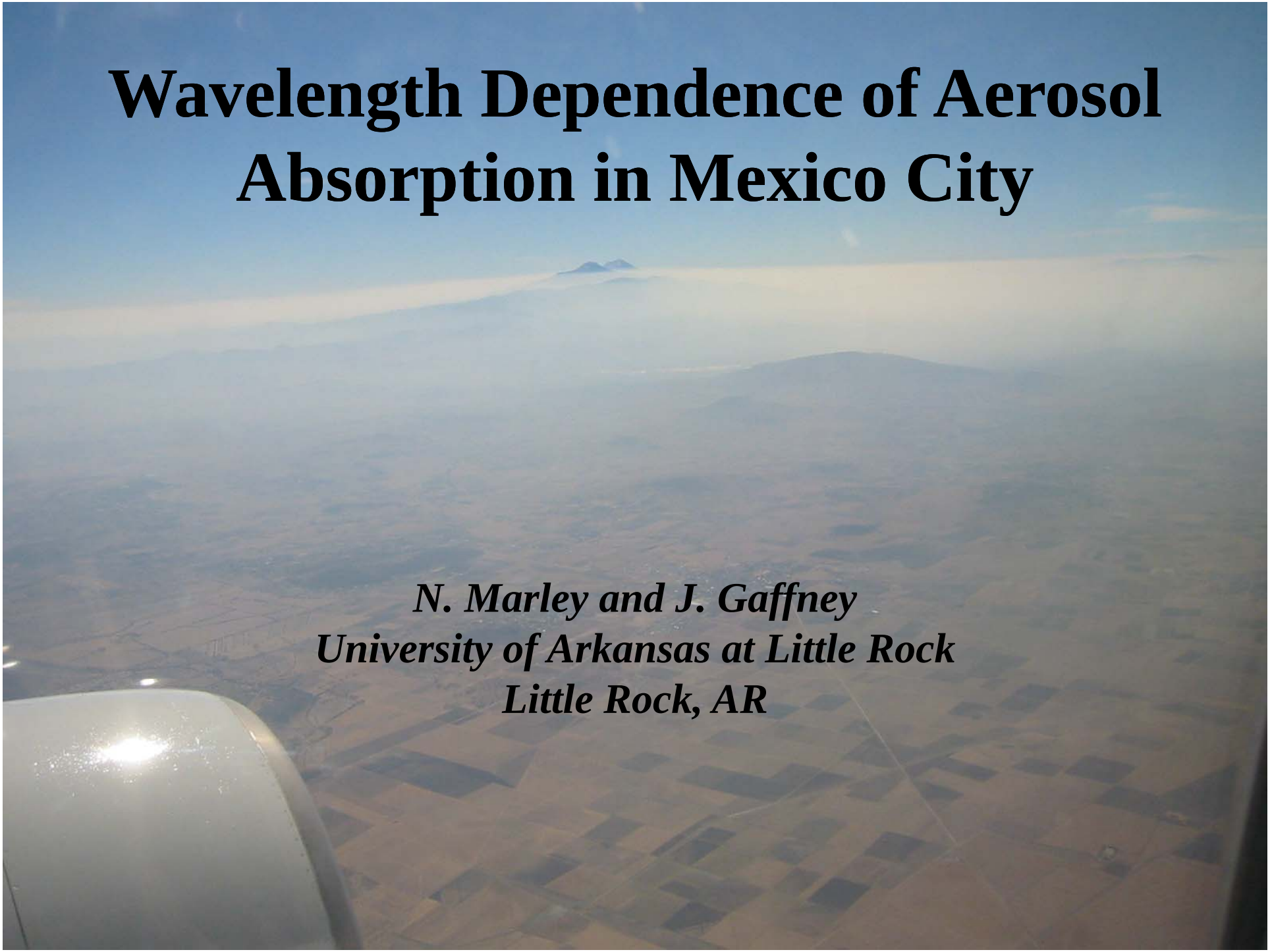
Wavelength Dependence of Aerosol Absorption in Mexico City

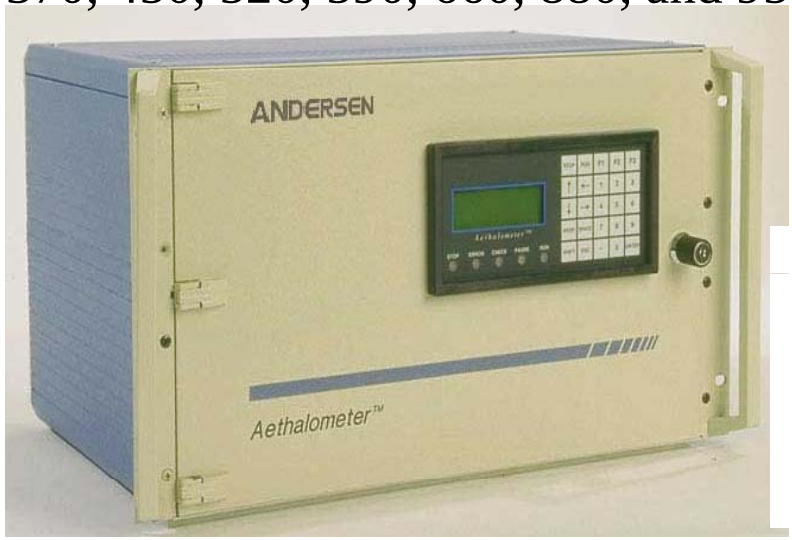


N. Marley and J. Gaffney
University of Arkansas at Little Rock
Little Rock, AR

T0

7 channel AETHALOMETER (Thermo-Anderson)

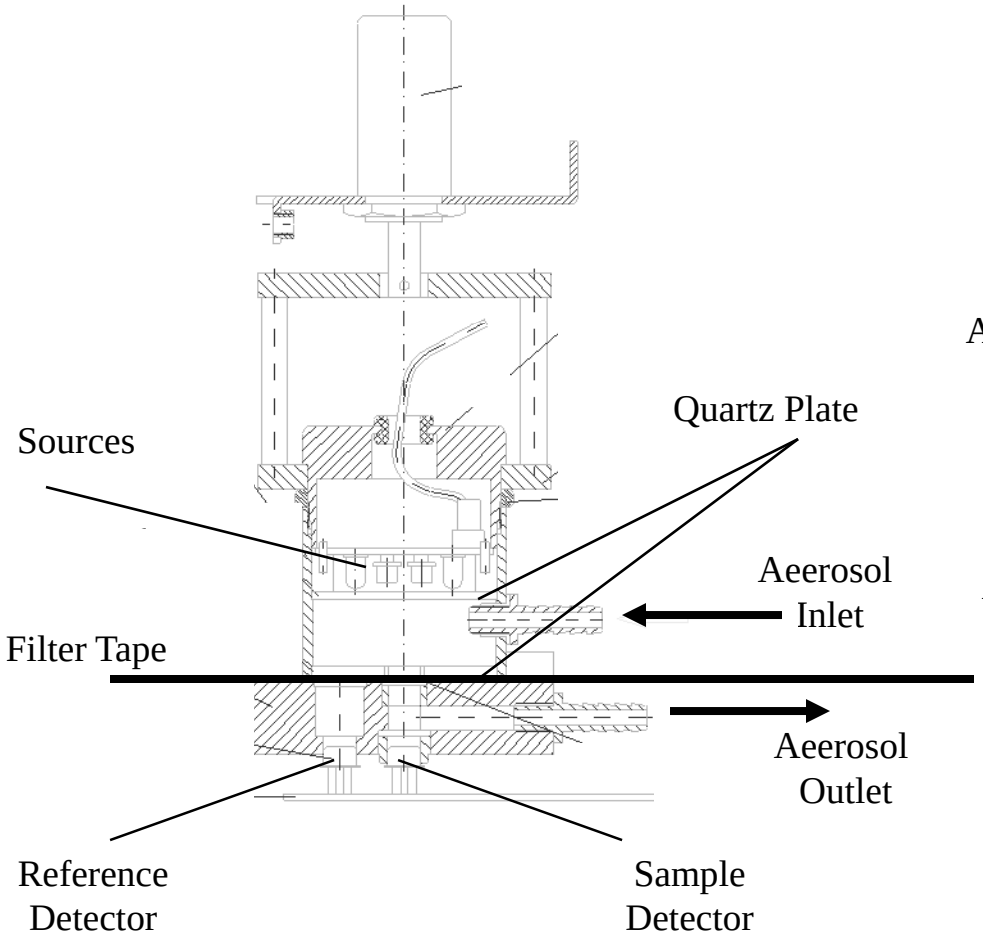
370, 450, 520, 590, 660, 880, and 950 nm



Single Channel MAAP (Thermo Electron)

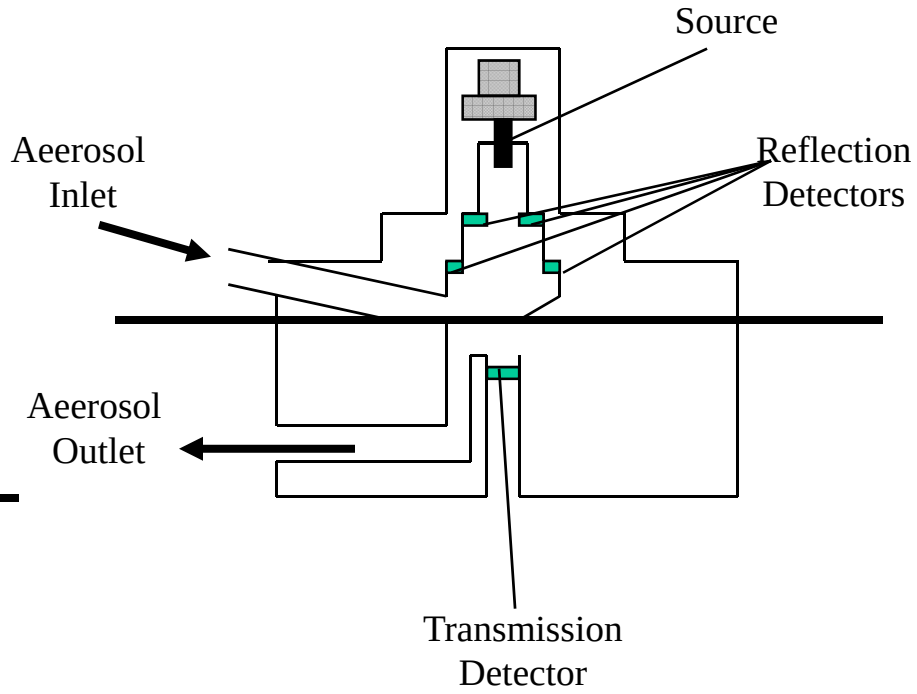
670 nm

Aethalometer



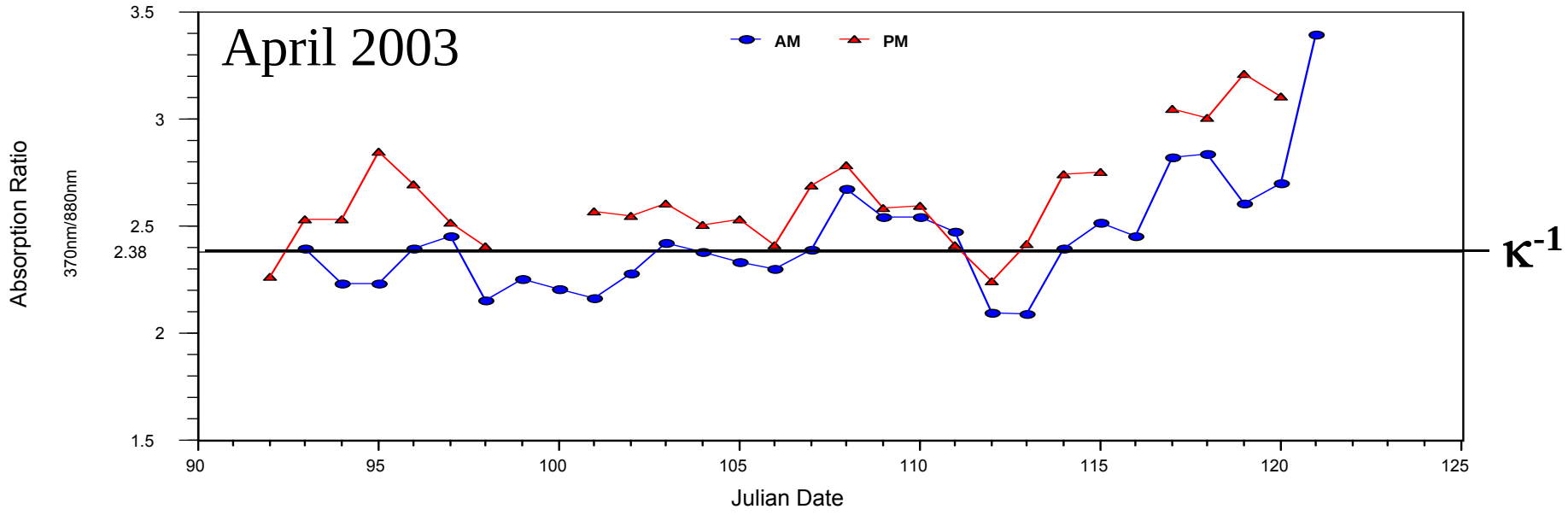
Optical attenuation measured sequentially at seven wavelengths by changing the source.

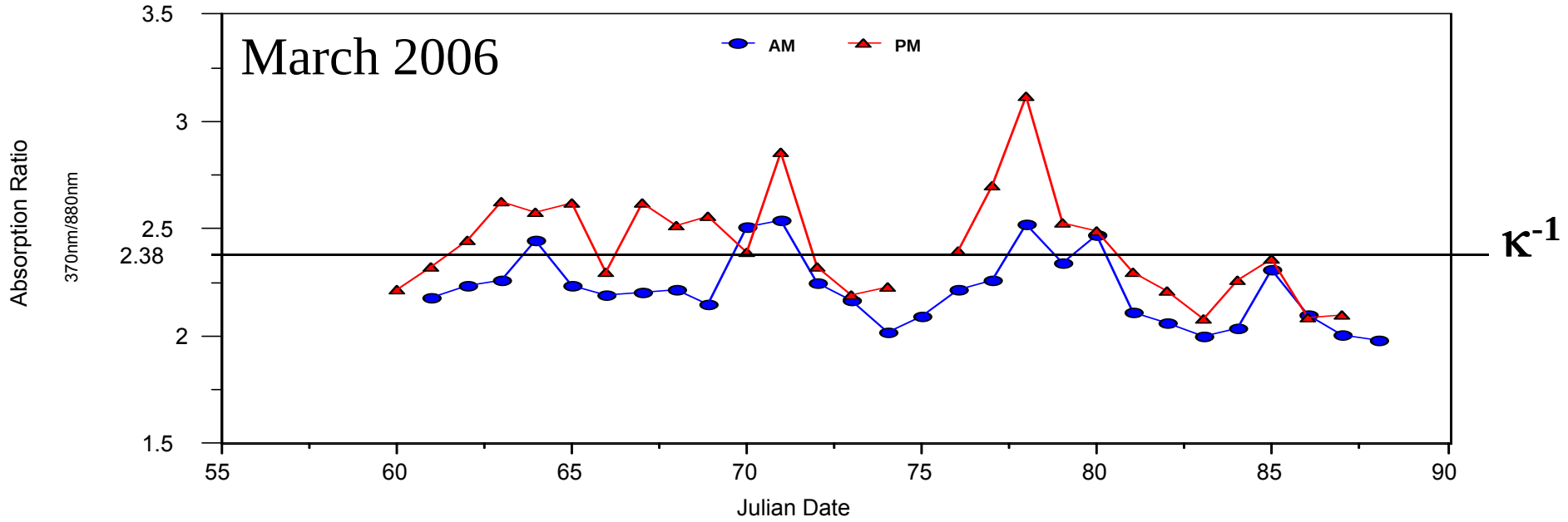
Multi Angle Absorption Photometer



Multiple detectors simultaneously measure transmitted and scattered light.

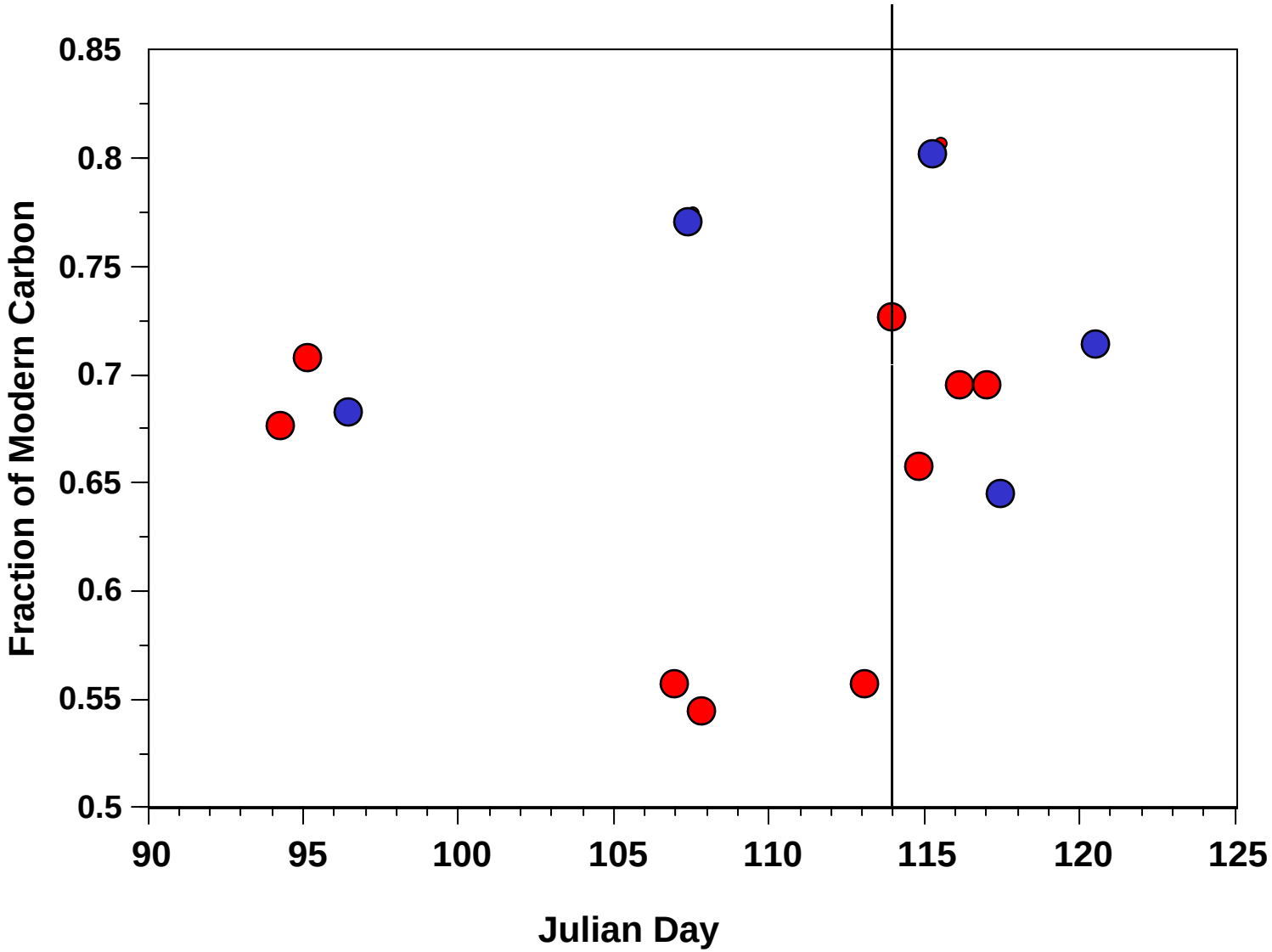
PM Formation of UVAbsorbing Secondary Aerosols



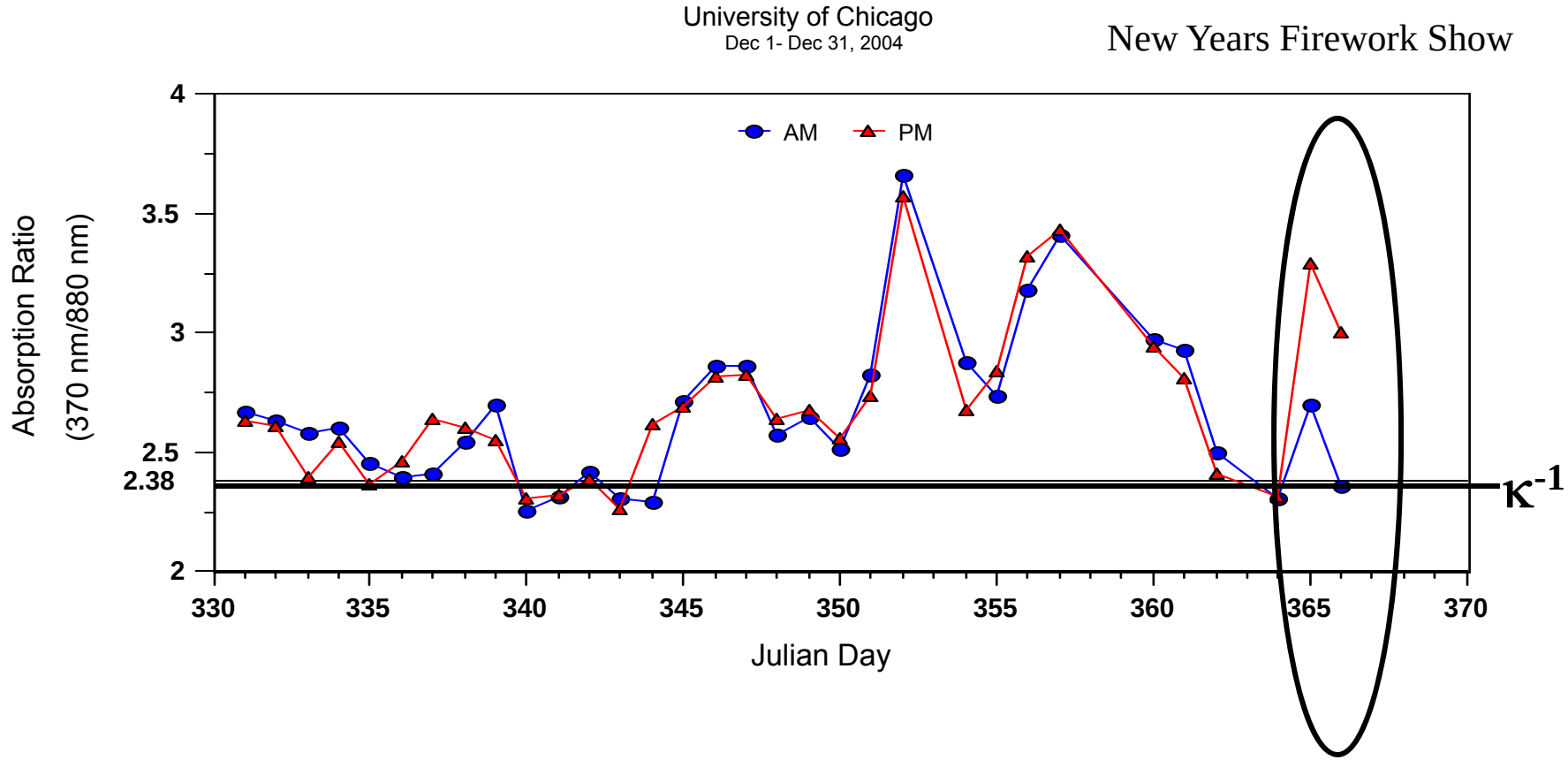


Satellite image of the wildfires in the Yucatan April 2003.

Steven T. Massie, John C. Gille, David P. Edwards, Sreela Nandi, “Sattellite observations of aerosol and CO over Mexico City” Atmos. Environm. 40, 6019-6031 (2006).


Fraction of Modern Carbon
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
90
95
100
105
110
115
120
125
Julian Day

Short Photoperiod, Biogenics shut down – less afternoon photochemical generation of SOA.



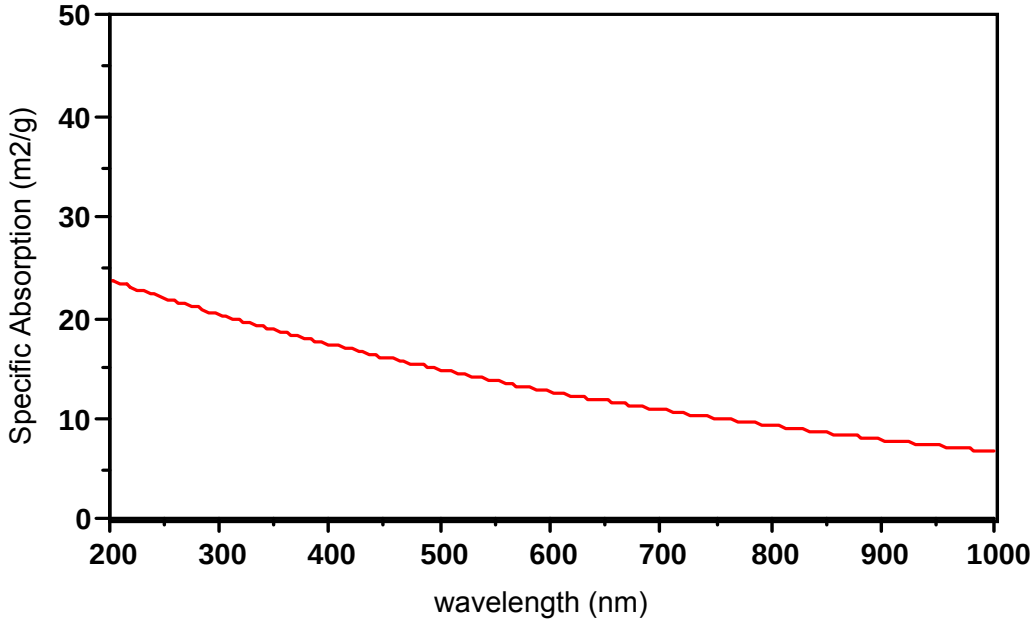
More UV absorbing aerosols AM and PM during Holiday Period.

Light Absorbing Aerosol Species

<u>Black Carbon</u> (soot) – combustion sources

Broadband absorption - UV-Near IR;

κ^{-1} dependence ; ~$10 m^2/g$ @ 550 nm



Wavelength Dependence of Fine Aerosol Absorption

$abs = \beta \cdot \lambda^{-\alpha}$

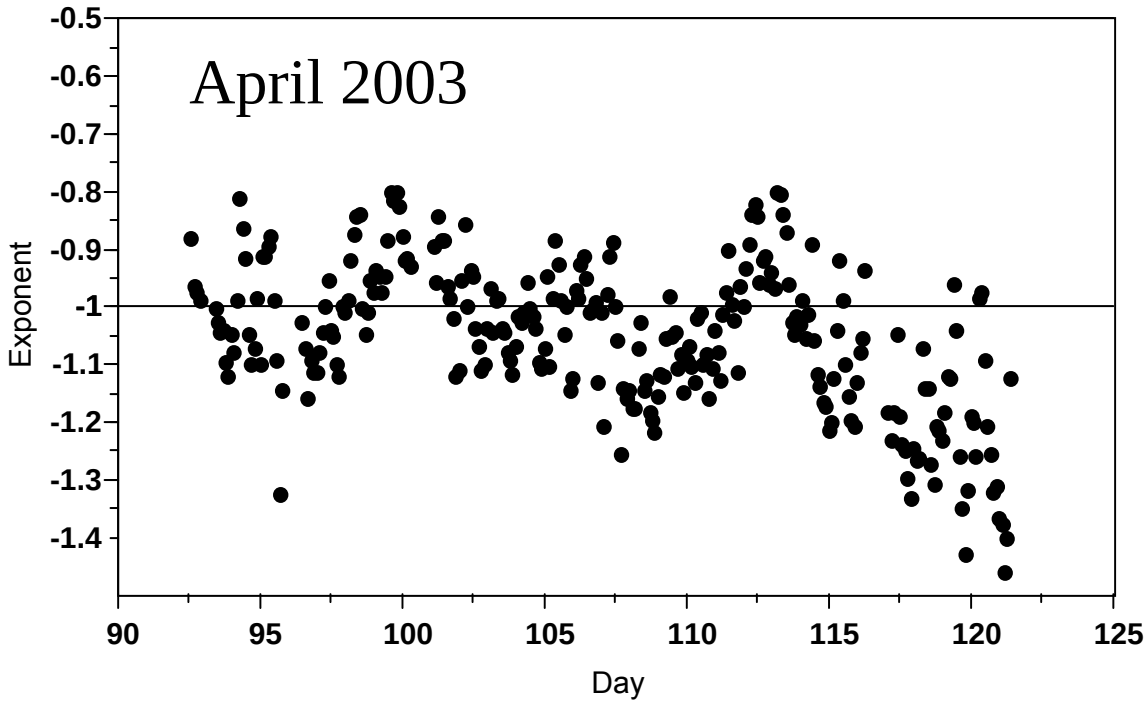
$\alpha = \ln(\tau)/\ln(\lambda)$

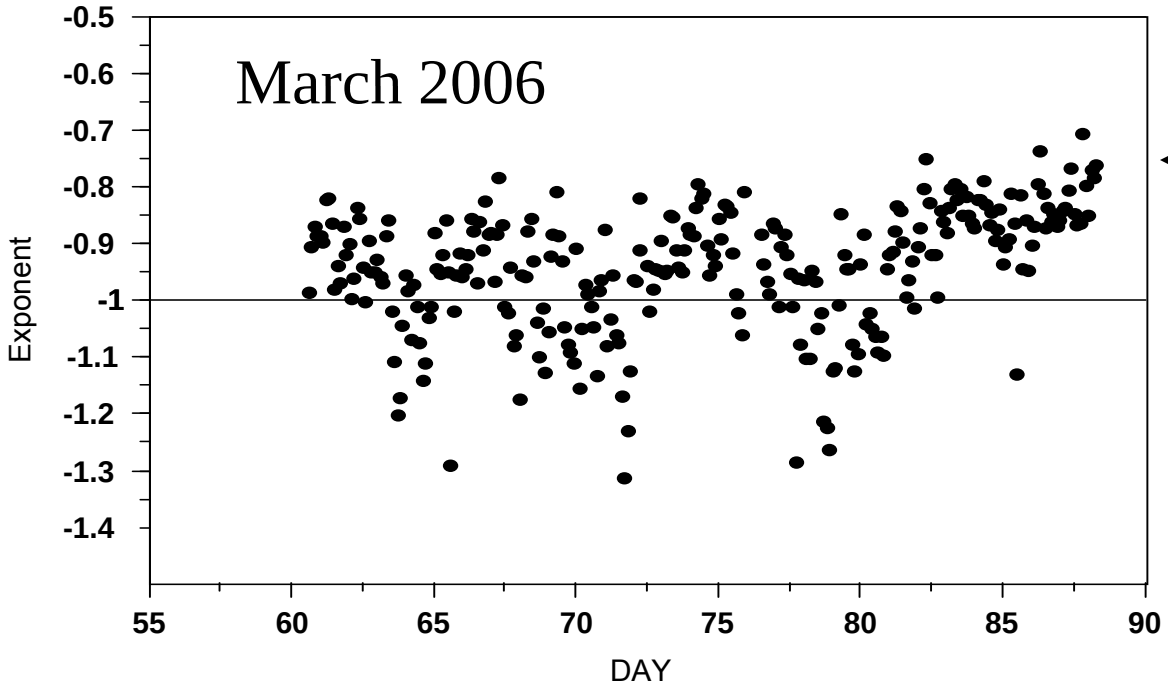
7 point regression at κ = 370, 450, 520,590, 660, 880, and 950 nm

R^2 = 0.9998 – 0.879; average 0.998 (2003)

0.9996 – 0.9531; average 0.997 (2006)

2 hour averages.



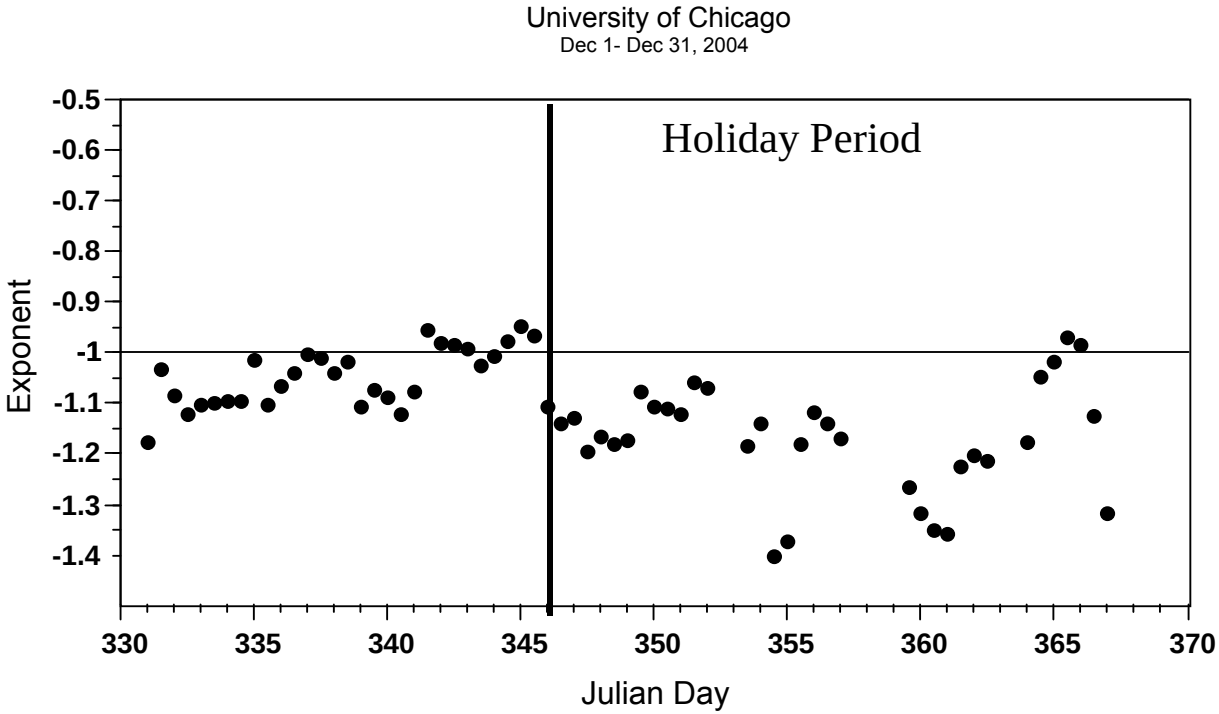


Enhanced visible/near IR absorption

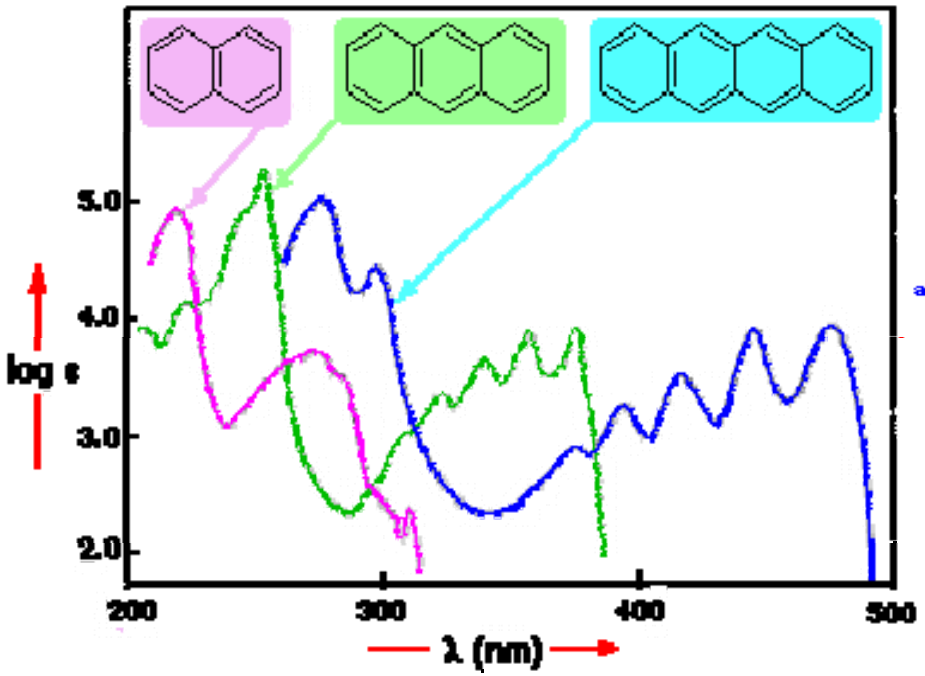
Red shifted nitro aromatics ?

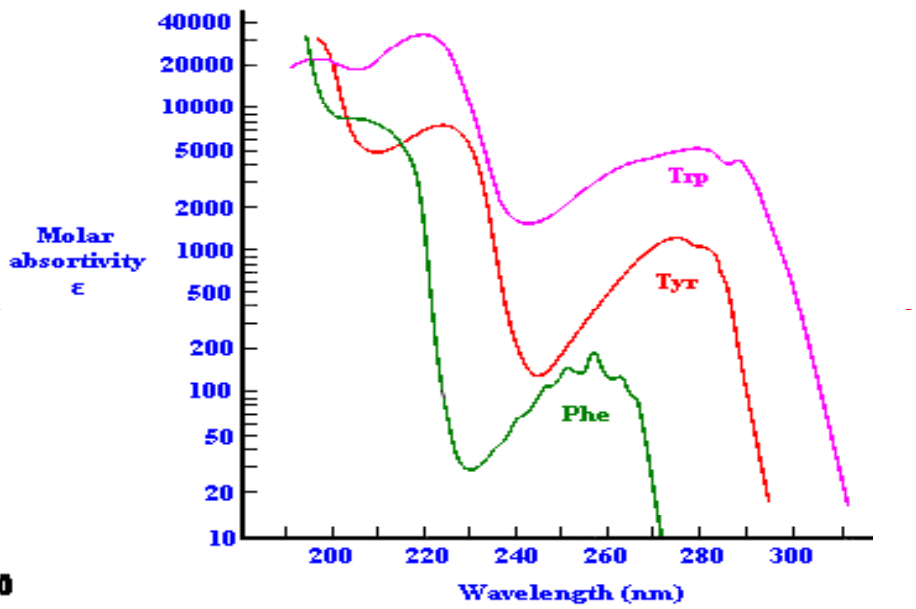
Enhanced UV absorption

Poly carbonyls and conjugated systems ?


University of Chicago
Dec 1- Dec 31, 2004
Holiday Period
Exponent
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
-1.4
330
335
340
345
350
355
360
365
370
Julian Day

Light Absorbing Aerosol Species

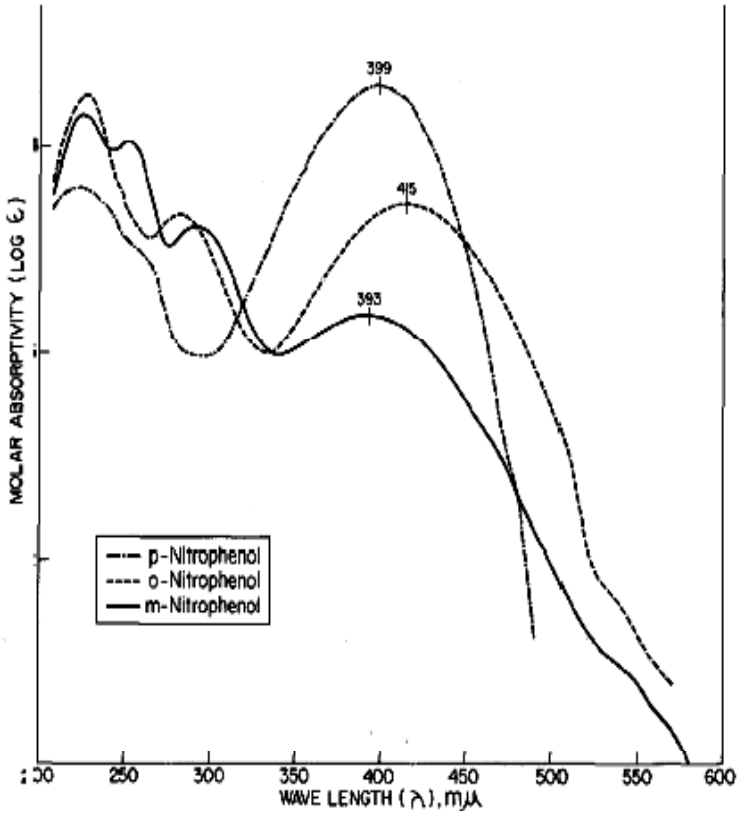


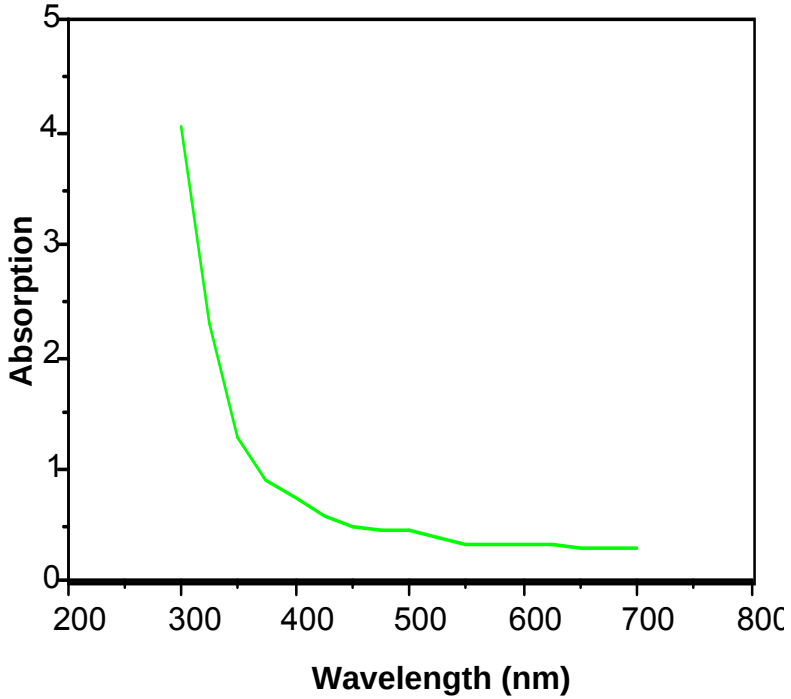


<u>Heterocyclic aromatics</u> – combustion

<u>Tryptophan</u> – amino acid in biological particles

Light Absorbing Aerosol Species





* Hoffer, et. al. Atmos. Chem. Phys. 5, 7341, 2005.

<u>Nitro Phenols</u> –
oxidation of biogenic compounds

<u>Humic Like Substances</u> –
colored, high MW (200-700 Da)
Spectra similar to humic acids

Conclusions

1. UV enhanced absorption in the afternoon indicating an increase in UV absorbing SOA formation (HULIS?)
2. Near IR enhancement in some morning hours (nitrated products)
3. α values from 0.75 to 1.3 (two hour averages).

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12 hour aerosol samples <0.1 micron collected at T1 and T0

Continuous UV-VIS-NIR spectra
Samples collected at T0 and T1.
DRIFT FTIR
Water extraction for HULIS characterization