2014

Determination of Optical Properties of Secondary Organic Aerosols Using UV-VIS Spectroscopy

Vanessa Selimovic
Concordia University - Portland

Matthew E. Wise
Concordia University - Portland, mawise@cu-portland.edu

John Shilling
Pacific Northwest National Laboratory

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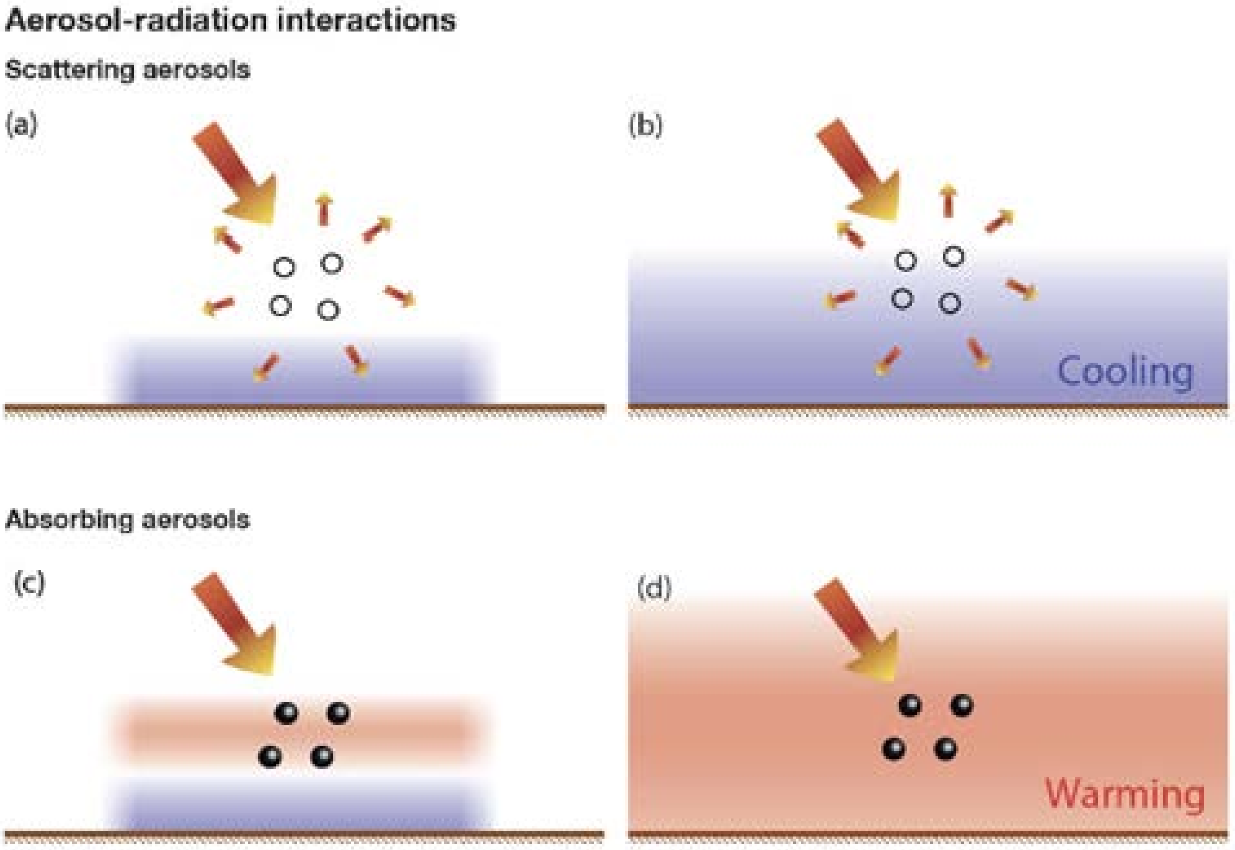
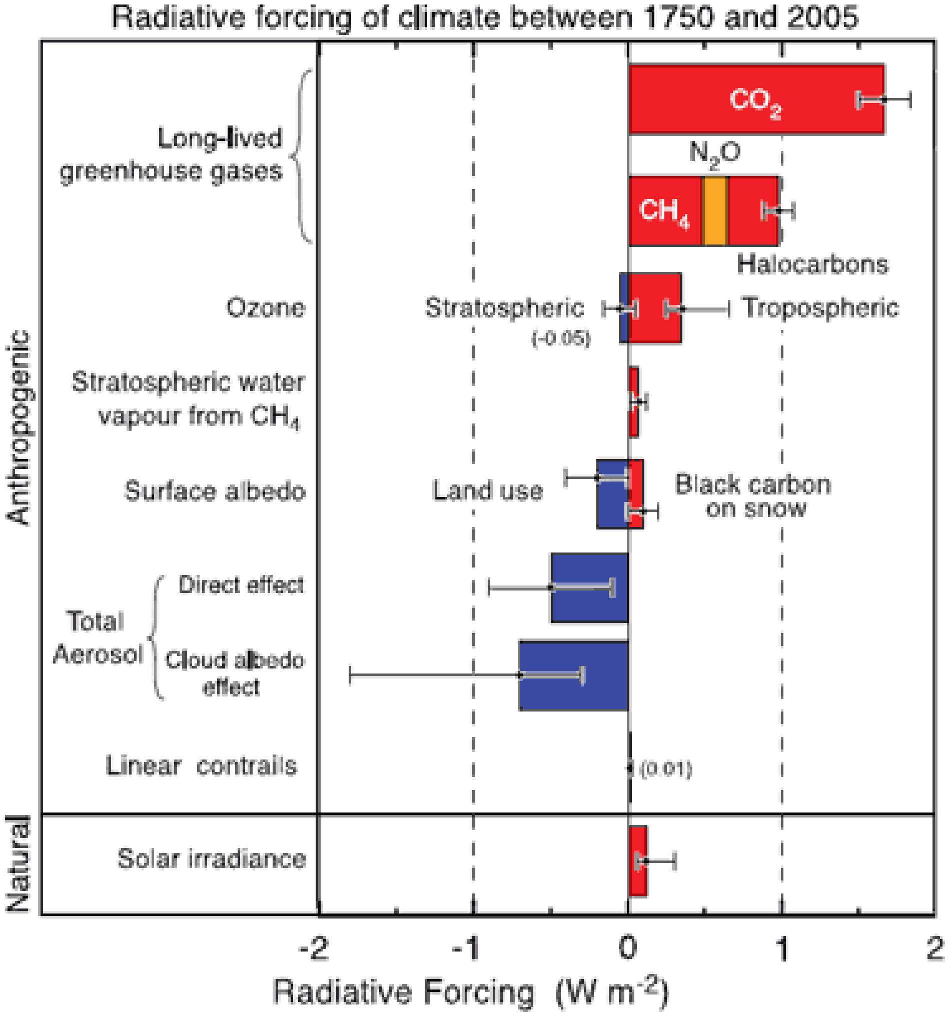
AEROSOL-ATMOSPHERE INTERACTIONS

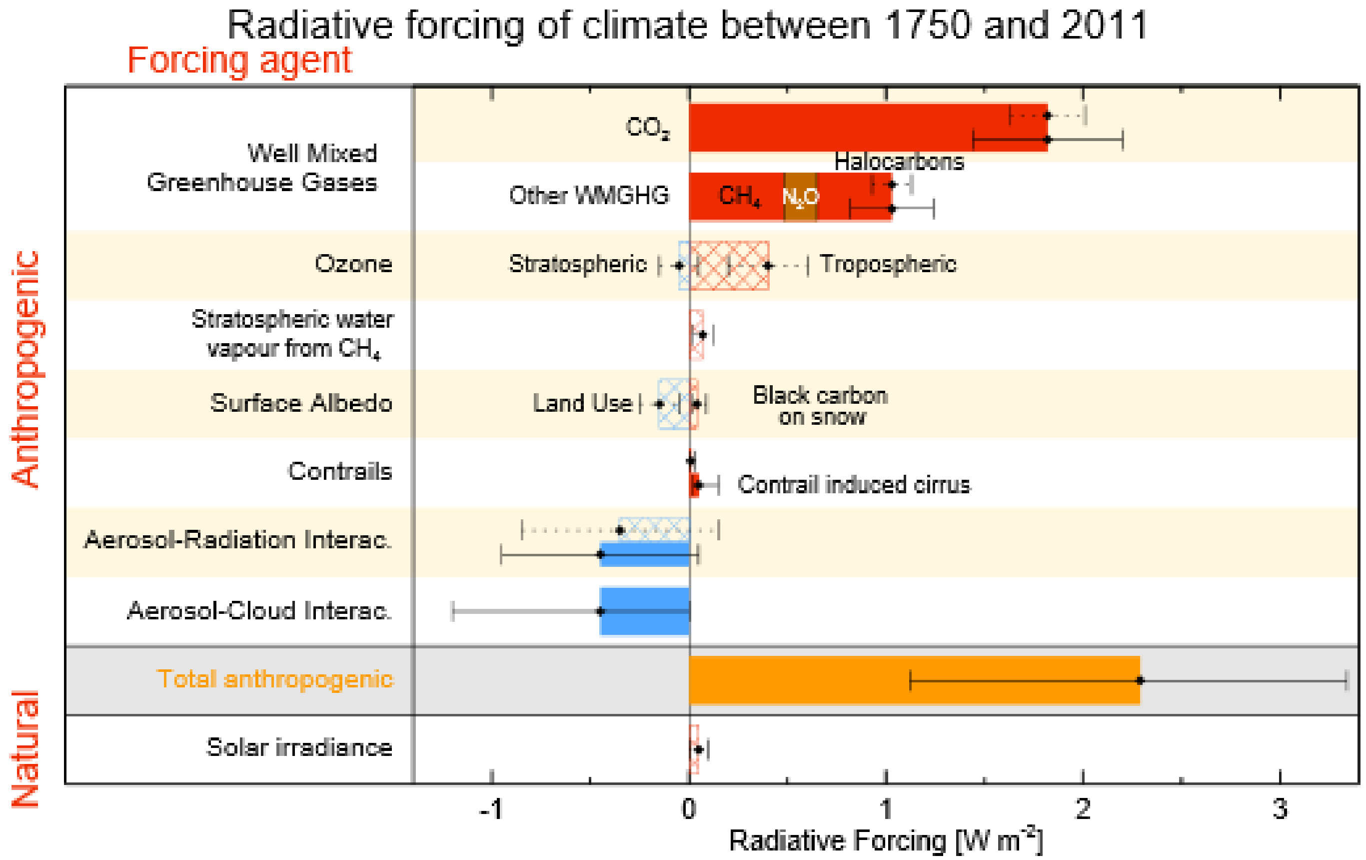
- Aerosols interact differently with the atmosphere depending on:
    - Composition
    - Size
    - Phase
    - Reactivity
    - Optical Properties

- Reactivity with atmosphere determines impact on Earth's radiative budget



CONTRIBUTION TO CLIMATE



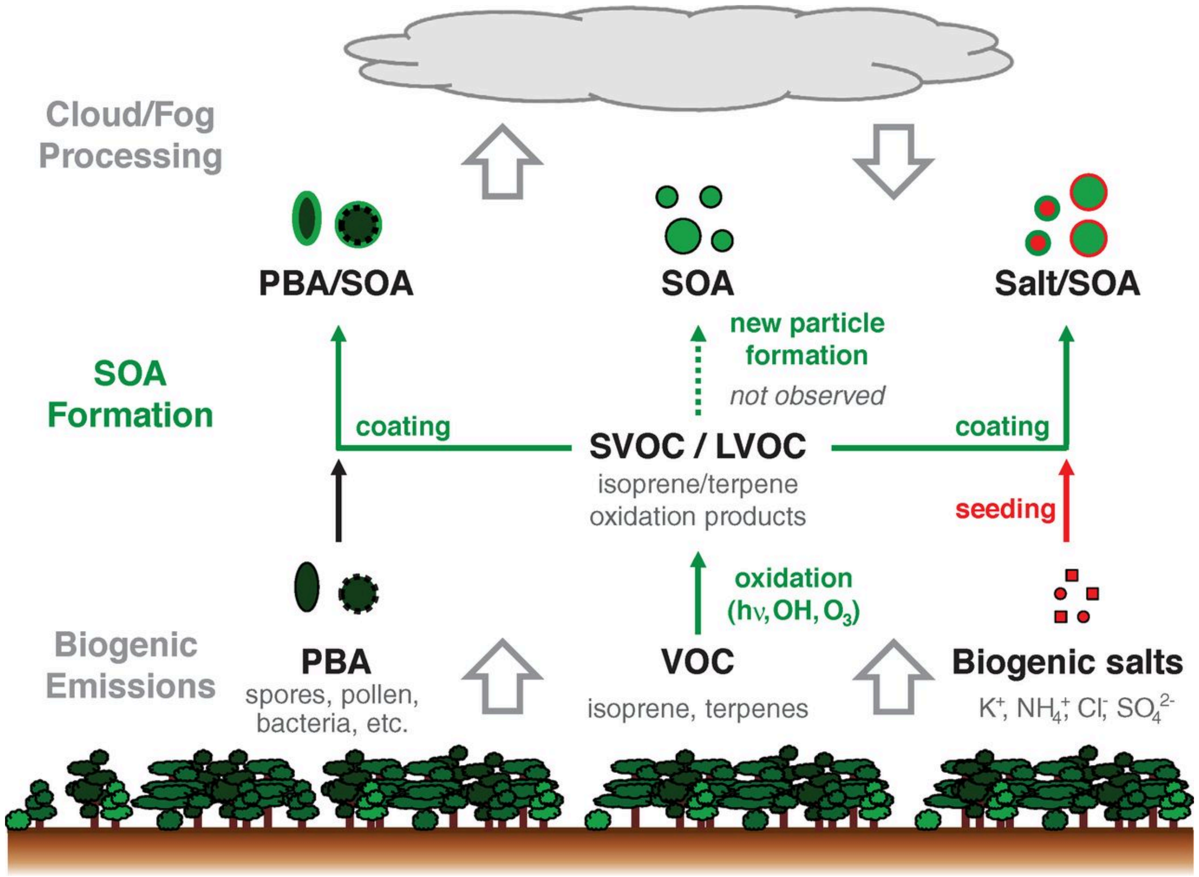


LIGHT ABSORBING CARBON

- Atmospheric light absorbing carbon (LAC), plays an important role in global climate change.
  - Black Carbon (~500nm)
    - Soot
  - Brown Carbon
    - Secondary Organic Aerosol Particles (SOA)

FORMATION OF SECONDARY ORGANIC AEROSOLS

- Originates from a variety of sources
- SOA formed in the atmosphere
  - VOC's react w/ anthropogenic aerosols
- Several studies have been done on SOA, but no quantifiable values
  - MAC
  - *(k)* Values

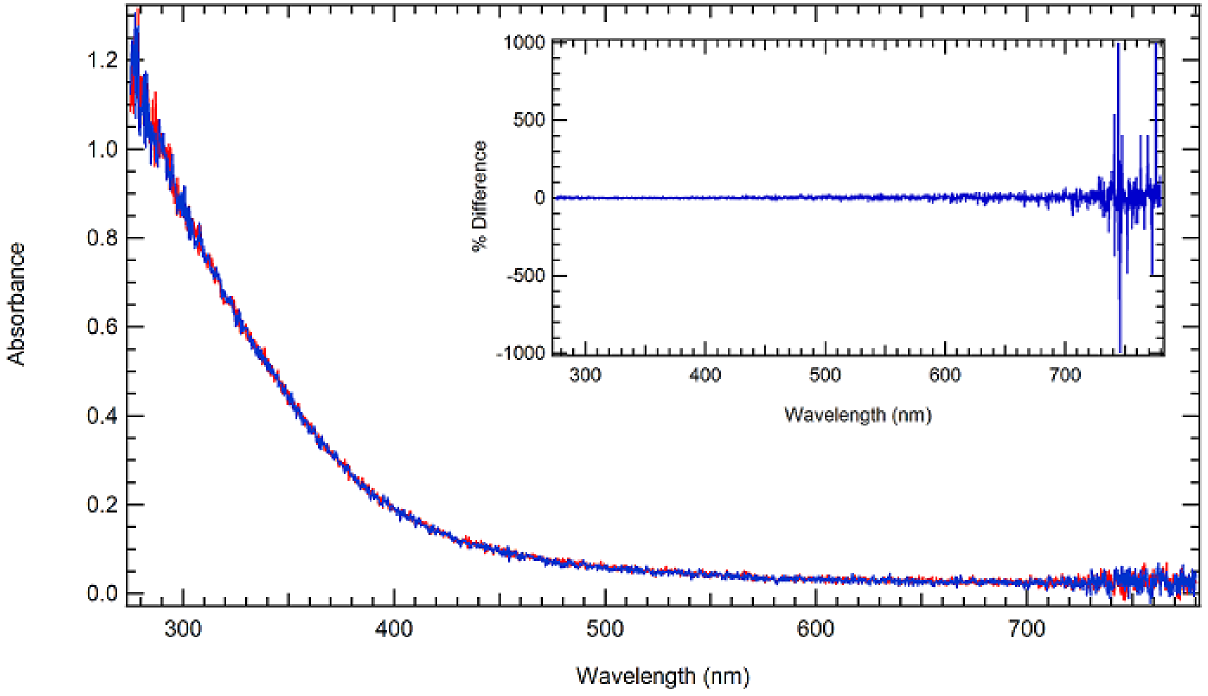


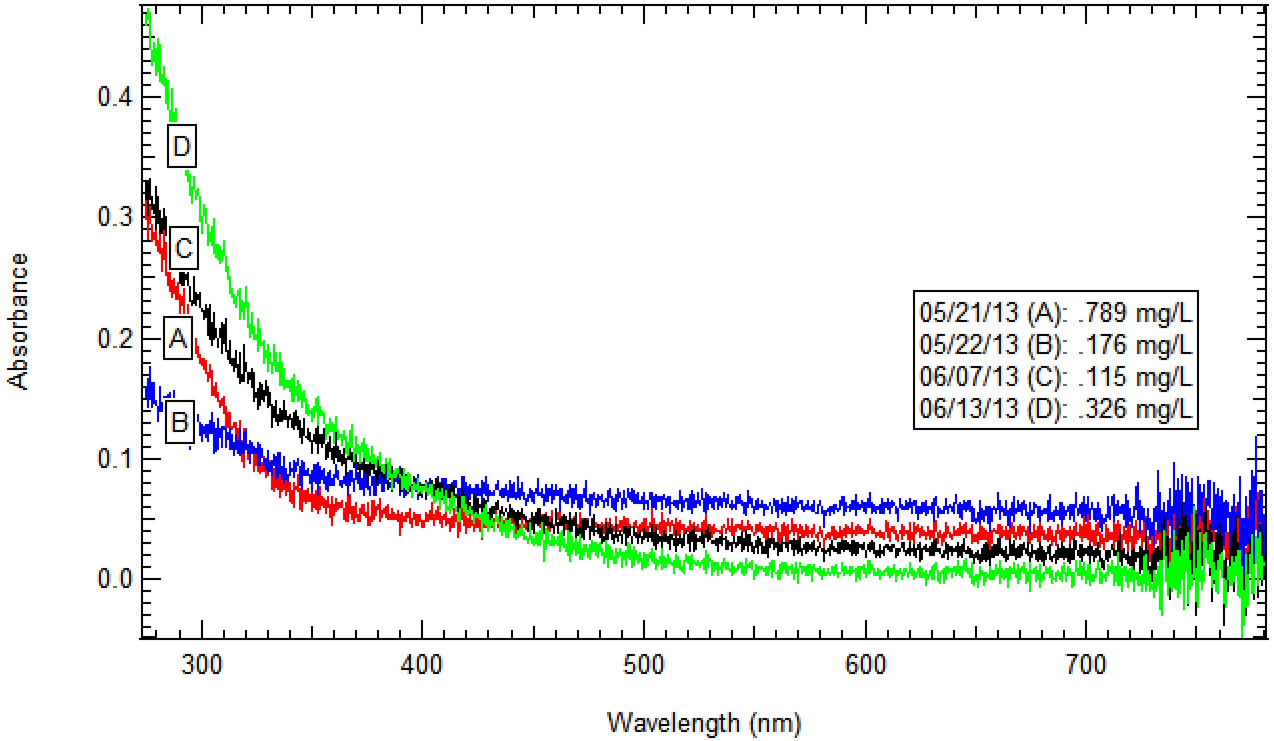
EVALUATION OF SECONDARY ORGANIC AEROSOLS

Date	Oxidant	[TMB]	[NO]	[NO_x]	[ozone]
05/21/2013	H_2O_2	170.4	1.94	2.1	21.22
05/22/2013	HONO+O_3+RH	189.7	22	1673.7	5.85
06/07/2013	HONO+RH(naifon)	173	642.2	854.7	3.08
06/13/2013	HONO+RH+seed	158.9	575.5	799.2	3.08

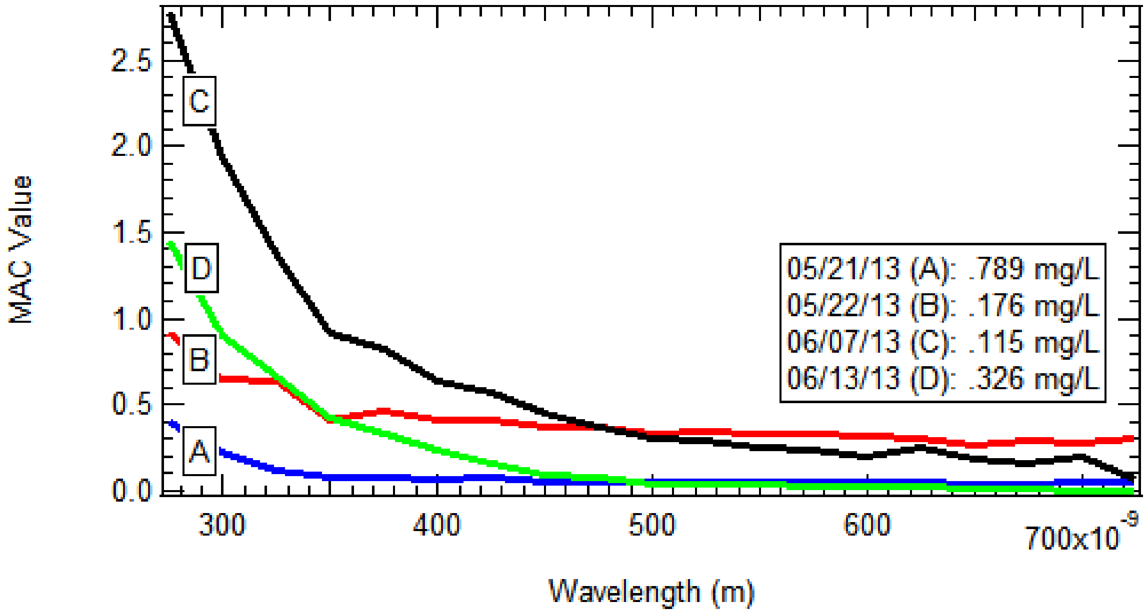
- Produced in the aerosol chamber at PNNL in their Atmospheric Measurements Lab.
  - Analyzed using UV/Vis spectroscopy
- Fulvic Acid used as a model
- MAC & *k* values calculated using equations from literature

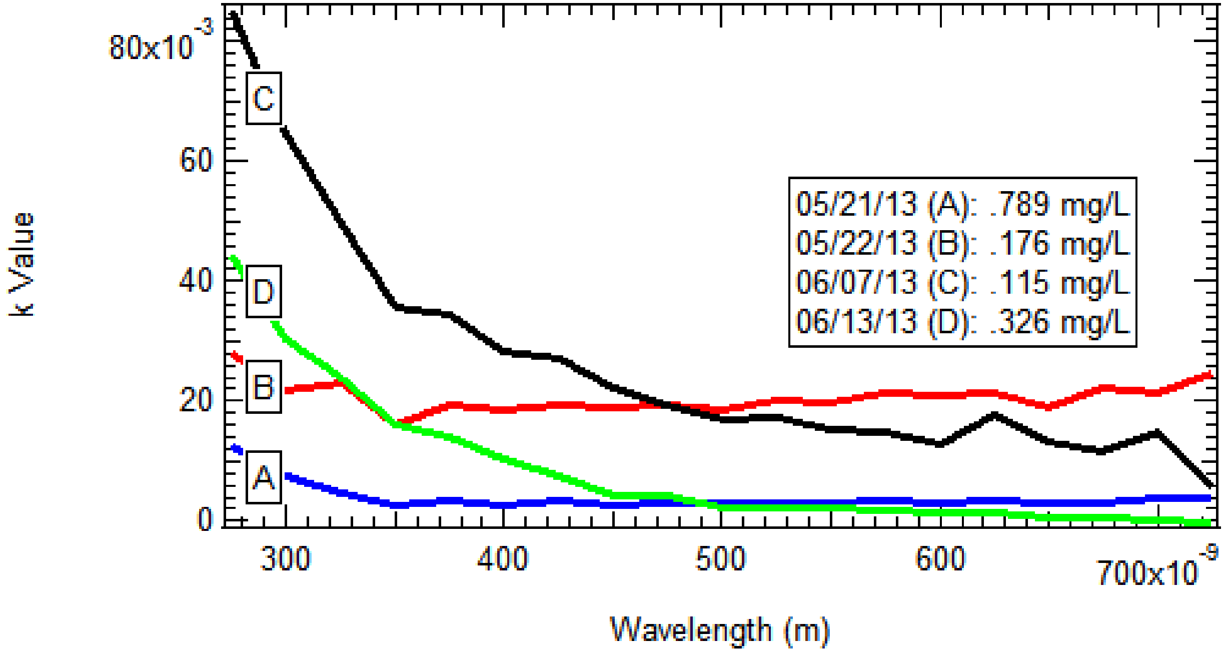
RESULTS


Absorbance
Wavelength (nm)
% Difference
Wavelength (nm)


Absorbance
Wavelength (nm)
D
C
A
B
05/21/13 (A): .789 mg/L
05/22/13 (B): .176 mg/L
06/07/13 (C): .115 mg/L
06/13/13 (D): .326 mg/L

RESULTS


MAC Value
2.5
2.0
1.5
1.0
0.5
0.0
300
400
500
600
700x10^{-9}
Wavelength (m)
C
D
B
A
05/21/13 (A): .789 mg/L
05/22/13 (B): .176 mg/L
06/07/13 (C): .115 mg/L
06/13/13 (D): .326 mg/L


k Value
80x10^{-3}
60
40
20
0
300
400
500
600
700x10^{-9}
Wavelength (m)
C
D
B
A
05/21/13 (A): .789 mg/L
05/22/13 (B): .176 mg/L
06/07/13 (C): .115 mg/L
06/13/13 (D): .326 mg/L

CONCLUSIONS

- Difference in absorption of SOA depending on conditions
  - Organo-nitrate groups

	Experimental	Literature
MAC	<0.0140 to 0.4171	<0.001 to 0.088
(k) Value	.0006 to .0188	.0001 to .025

$$MAC = \frac{A}{L\,[FA]_e}$$

$$k = \frac{(MAC)(\lambda\rho)}{4\pi}$$

FUTURE WORK

- Determine the chemical composition of SOA
- Collect more samples of SOA
  - Look for trends
  - Difference between reactants
    - Studies using a control/controlled environment

ACKNOWLEDGEMENTS

Dr. Matthew Wise & Dr. John Shilling

Concordia University

Pacific Northwest National Laboratory

Oregon Academy of Sciences