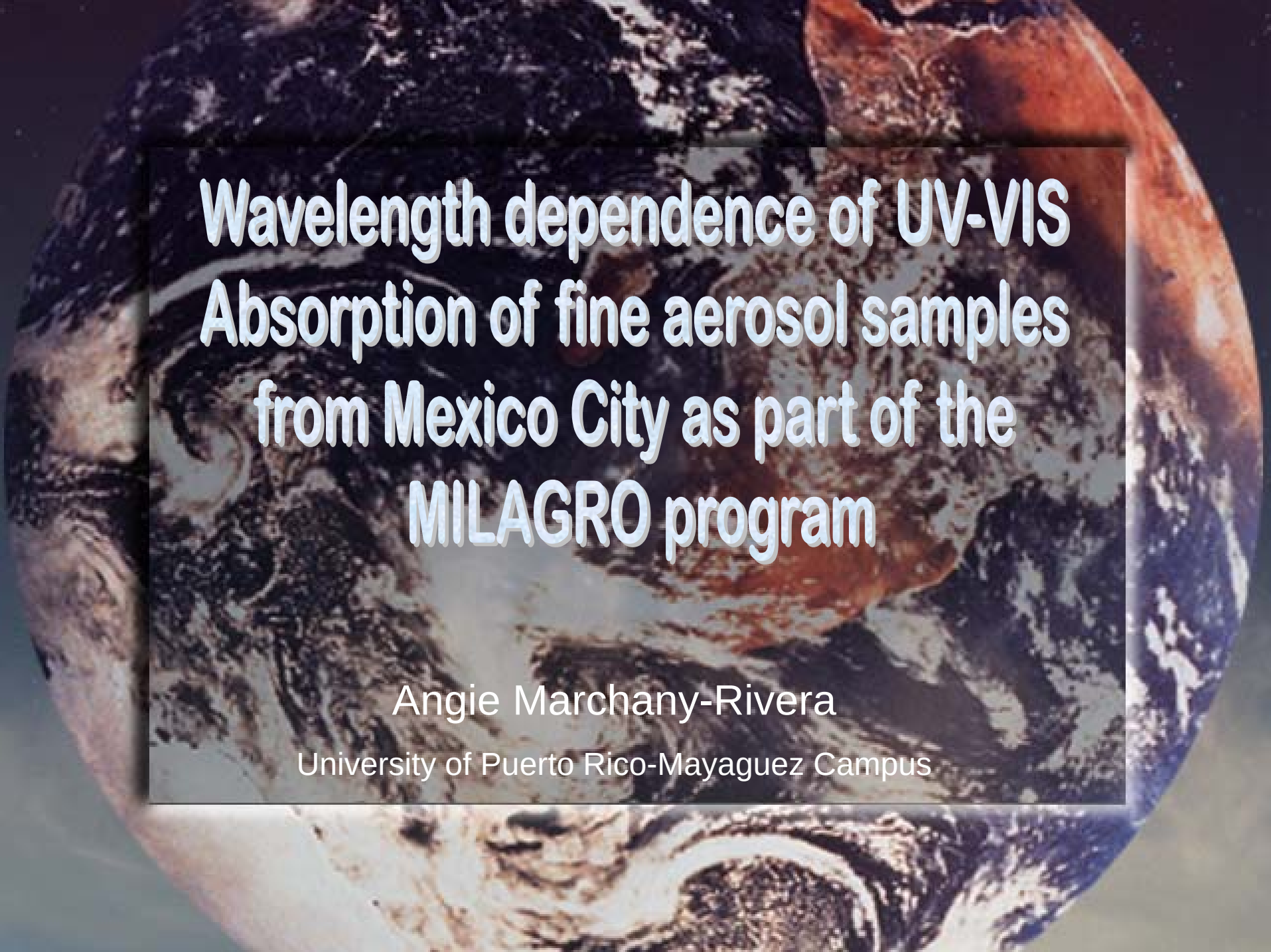


# Wavelength dependence of UV-VIS Absorption of fine aerosol samples from Mexico City as part of the MILAGRO program

Angie Marchany-Rivera

University of Puerto Rico-Mayaguez Campus

# Outline

- What are aerosols and why we need to study them
- 

- Research at UALR
- Aerosols optical properties

# Aerosols

- Suspension in a gas, usually air, of microscopic liquid or solid particles, such as smoke, dust, fog, or smog, that tend to remain dispersed rather than to settle.



Size ranges between
< 0.1-10 microns.

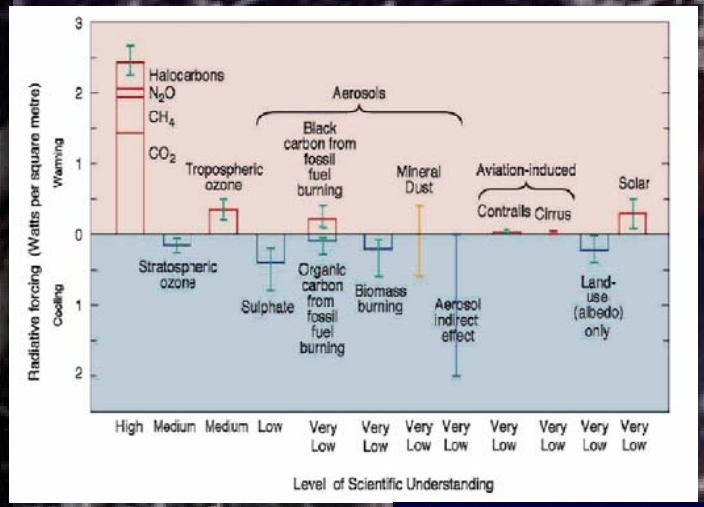
Primary types of aerosols:

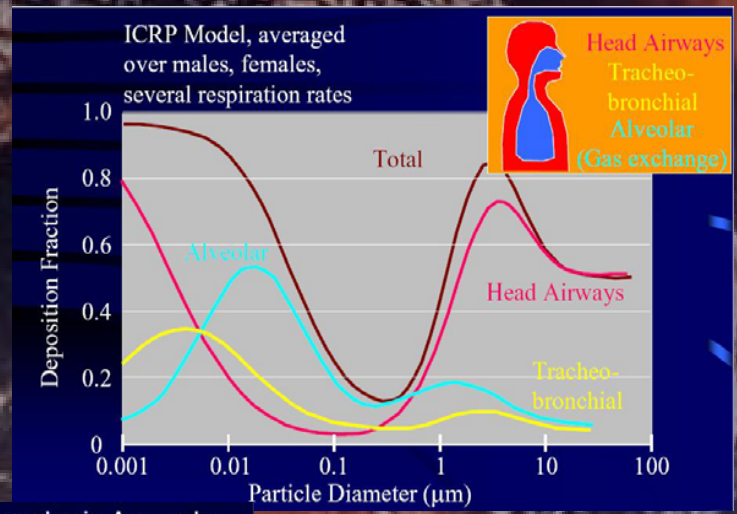
- Combustion
- Diesel Soots
- Biomass Burning

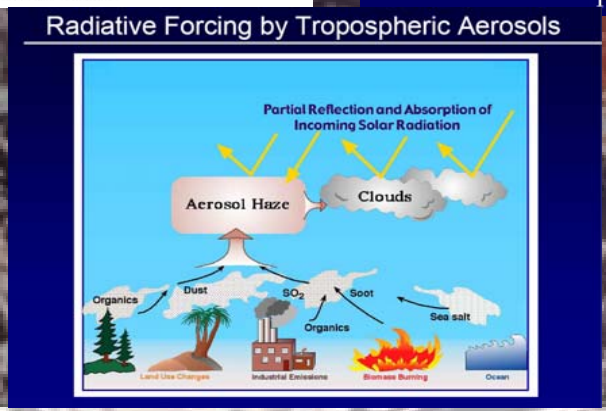
Mexico City, Mexico

# Why we study aerosols?

- Climate Change
- Health issues



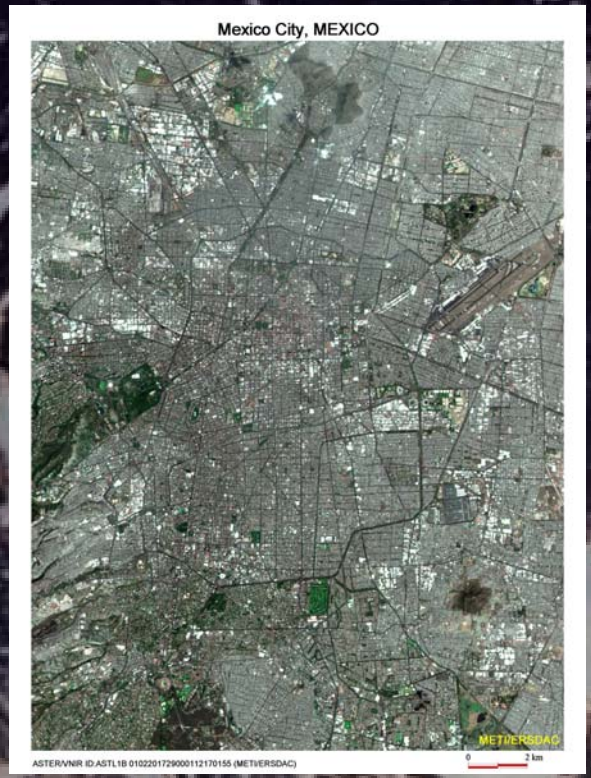
# MILAGRO

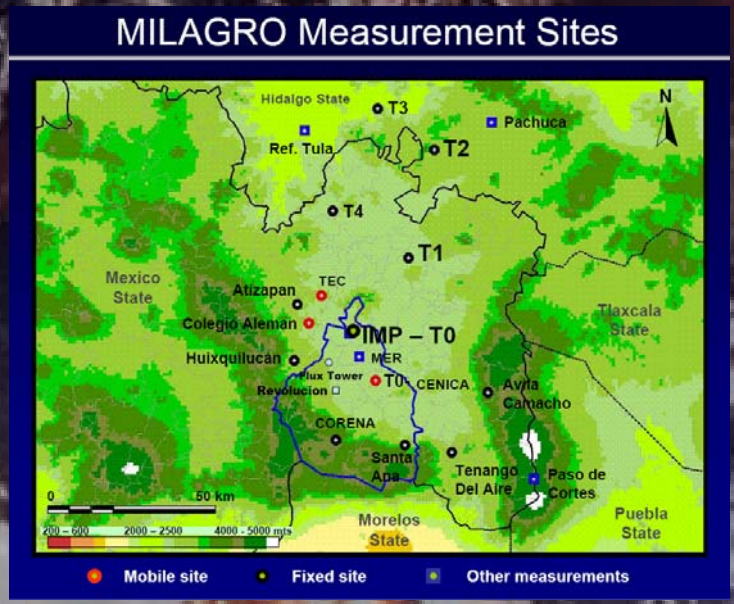
Mexico City, D.F.
March 2006

Megacity Initiative: Local and Global Research Observations

- The MILAGRO campaign
  - ✓ MIRAGE-Mex (NCAR)
  - ✓ **MAX-Mex (DOE) - Megacity Aerosol Experiment in Mexico City**
  - ✓ MCMA-2006 (MIT)
  - ✓ INTEX-B (NASA)
- Megacities and mini-megacities are major sources of aerosols and precursor gases.
- Main objective:
  - ✓ Characterize aerosol properties and evolution for models. Size, composition, size dependent composition, optical properties, cloud-nucleating properties.

Gaffney, J.S. "Reconfigured Atmospheric Science Program and 2006 Mexico City Campaign" 10 July 2006



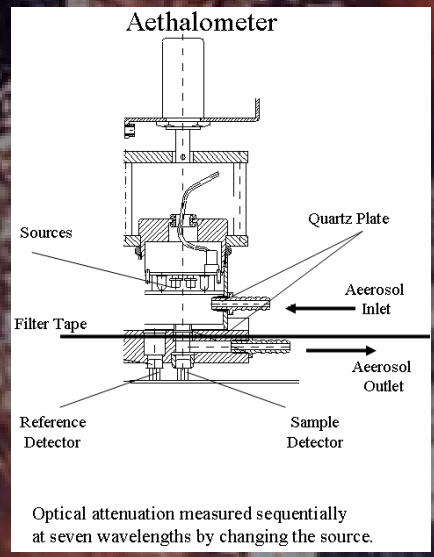



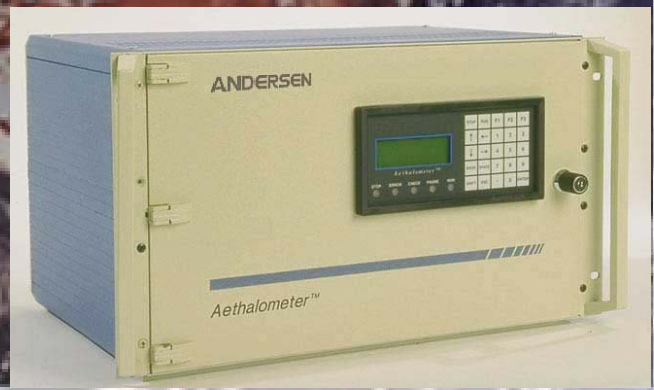

Population: >10 Million

# Instruments used at T0 AND T1 sites during the MILAGRO campaign in March 2006

## Aethalometer:

- Located at T0- *Instituto Mexicano de Petroleo*
- The aethalometer is a tape sampler that takes in air at a controlled flow rate, and then passes the air through a special glass fiber filter tape.
- As the pollutant accumulates, the aethalometer measures the attenuation of light at seven different wavelengths: 370, 470, 520, 590, 660, 880, 950 nm.
-



# Instruments used at T0 AND T1 sites during the MILAGRO campaign in March 2006

High volume sampler impactor plates:

- Located at T0-IMP and T1-Technical University of Tecamac.
- Large particles (1.0-10 µm) are trapped first.
- Only smaller particles (0.1-1.0 µm) are collected in the filter paper.


T0- IMP

T1-UTT

# Research at UALR and UChicago

Analyze fine aerosol samples from Mexico City in March 2006 using various instruments:

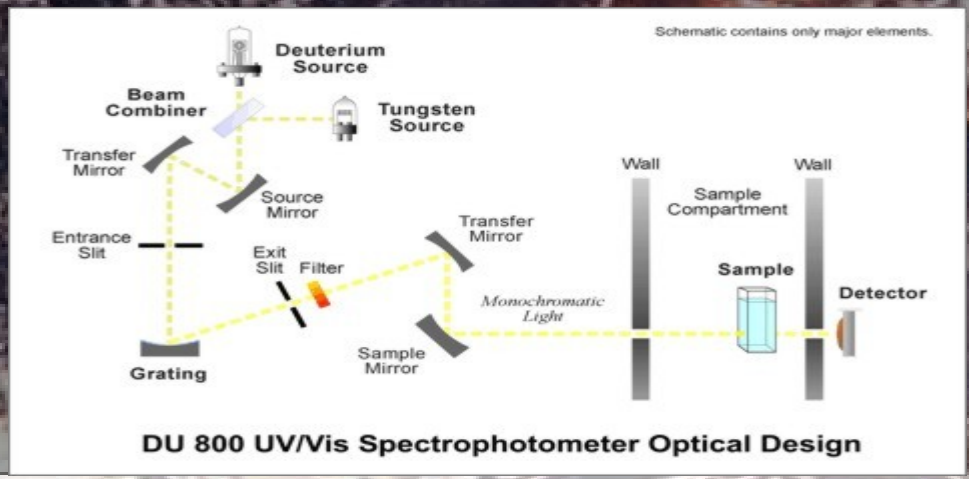
- UV-VIS Spectrophotometer: used to study the absorbance dependence on wavelength.
- IR Spectroscopy
- Measurements of total Carbon

# Research at UALR and UChicago

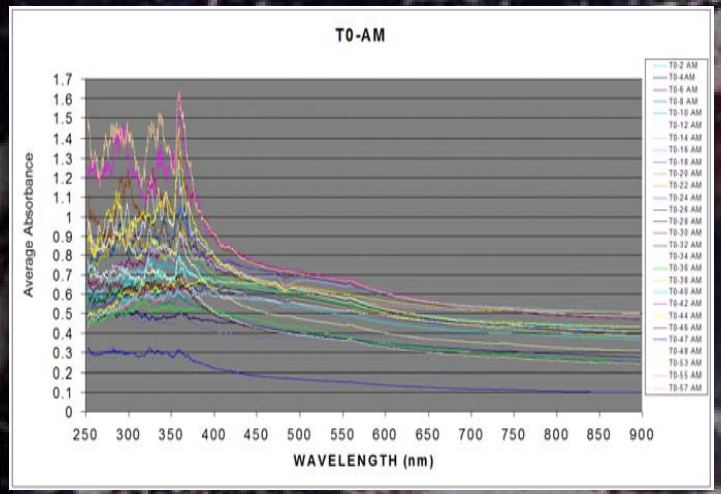
- New samples are being collected at University of Chicago using aethalometers and other instruments.

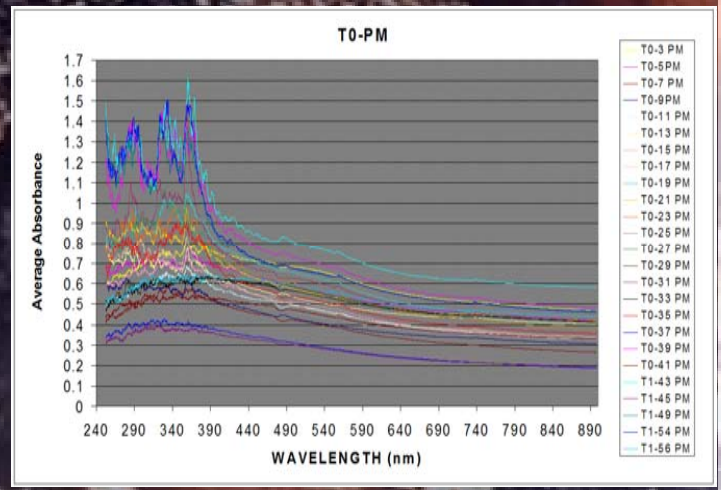
# BECKMAN DU 640 Spectrophotometer

- This spectrophotometer is a single beam instrument that operates in the wavelength range of 190 to 1100 nm.
- Light from both sources enters the monochromator where it is dispersed by a concave holographic grating. Monochromatic light exits the monochromator and illuminates the sample. The amount of light that passes through the sample is measured by a single photodiode detector. The focal point of the beam in the sample compartment is on the right-hand side.



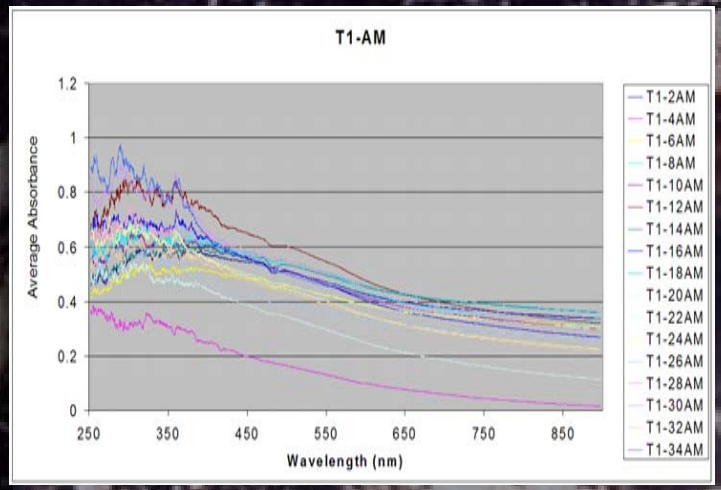
# Aerosols optical properties

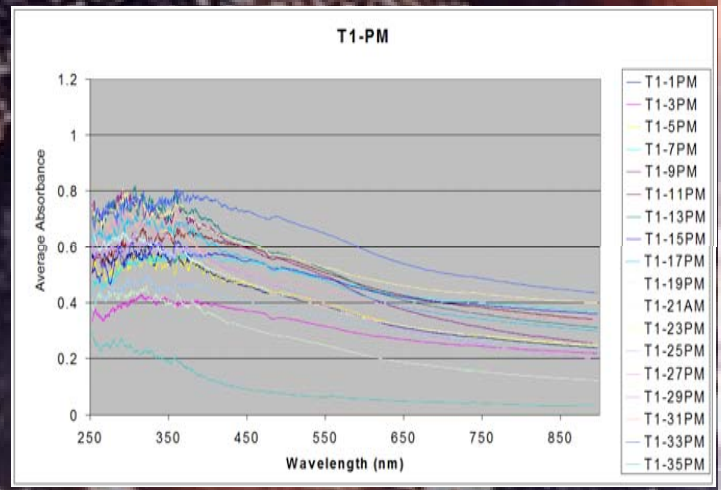



- Absorption decreases as the wavelength increases from 350 to 900 nm.
- T0-AM Absorbance range between 0.10 - 1.64
- T0-PM Absorbance range between 0.16 - 1.61

# Aerosols optical properties



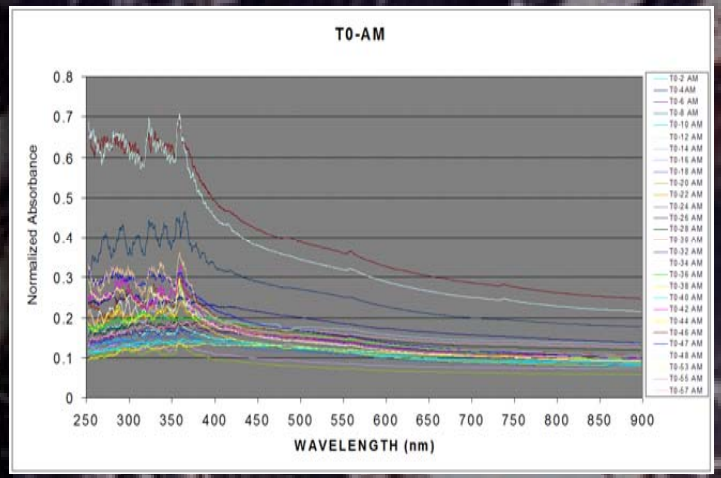



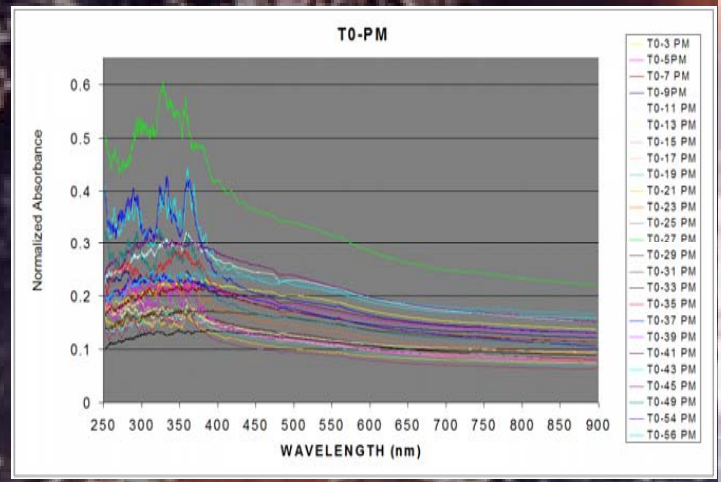

- T1-AM Absorbance range between 0.01 - 0.97
- T1-PM Absorbance range between 0.12 - 0.82

# Aerosols optical properties

- Aerosols help in the formation of cloud droplets.
- More aerosol in the atmosphere equals smaller water droplets in clouds (average size 20 microns) which reflects more solar radiation back to space.
- Nevertheless, absorption and scattering of solar radiation depend not only in the size of the particles but also in the chemical composition of the aerosol.
- Absorption in the troposphere is believe to be dominated by black carbon.

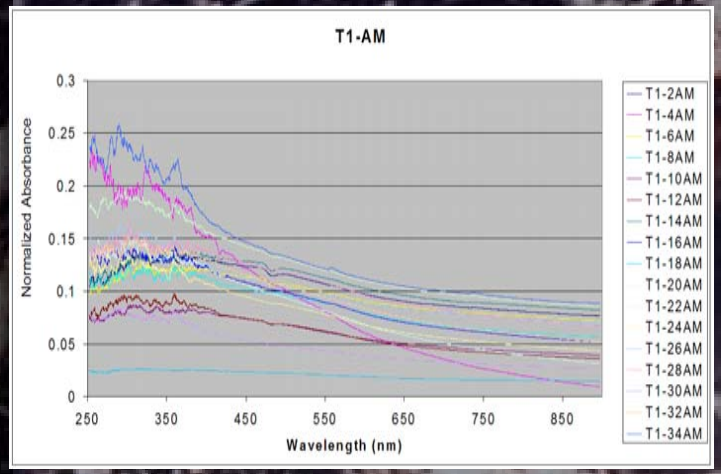
# Aerosols optical properties

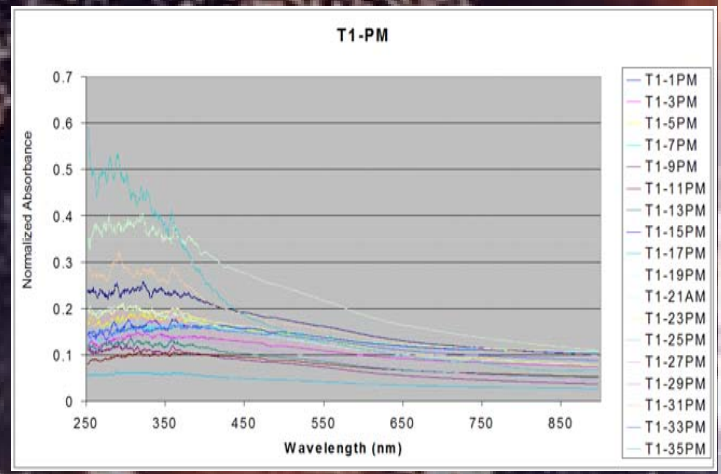



- T0-AM Absorbance range between 0.05 - 0.71
- T0-PM Absorbance range between 0.06 - 0.60

# Aerosols optical properties




- T1-AM Absorbance range between 0.009 - 0.26
- T1-PM Absorbance range between 0.03 - 0.59

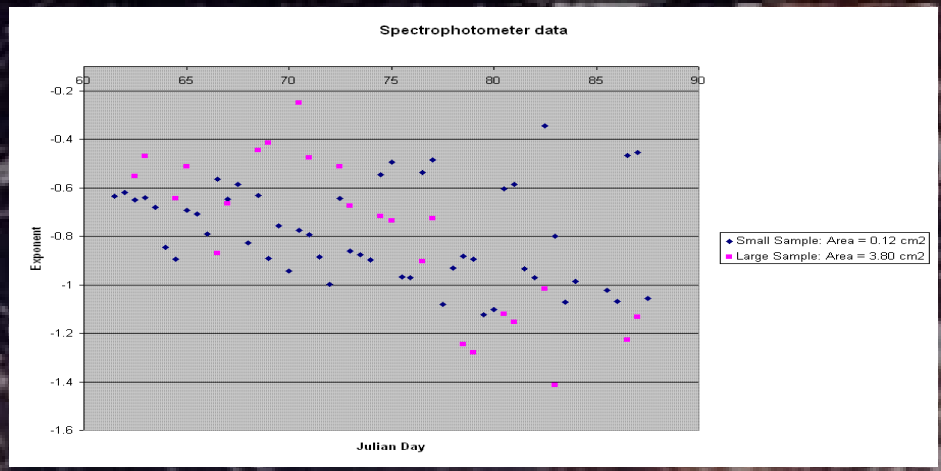
# Aerosols optical properties

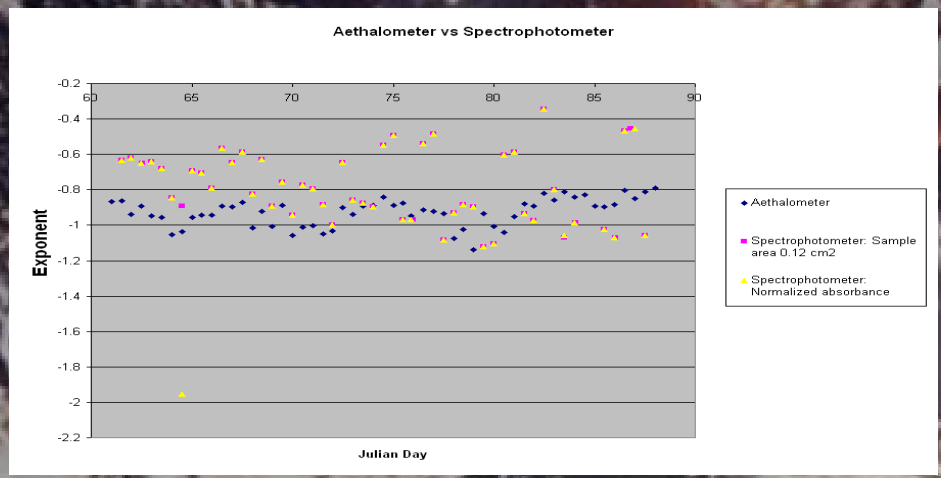
- Using these UV-VIS spectra we can identify what organic compounds are in the samples.

- Also quantify the Absorption Angstrom exponent using the following expression:

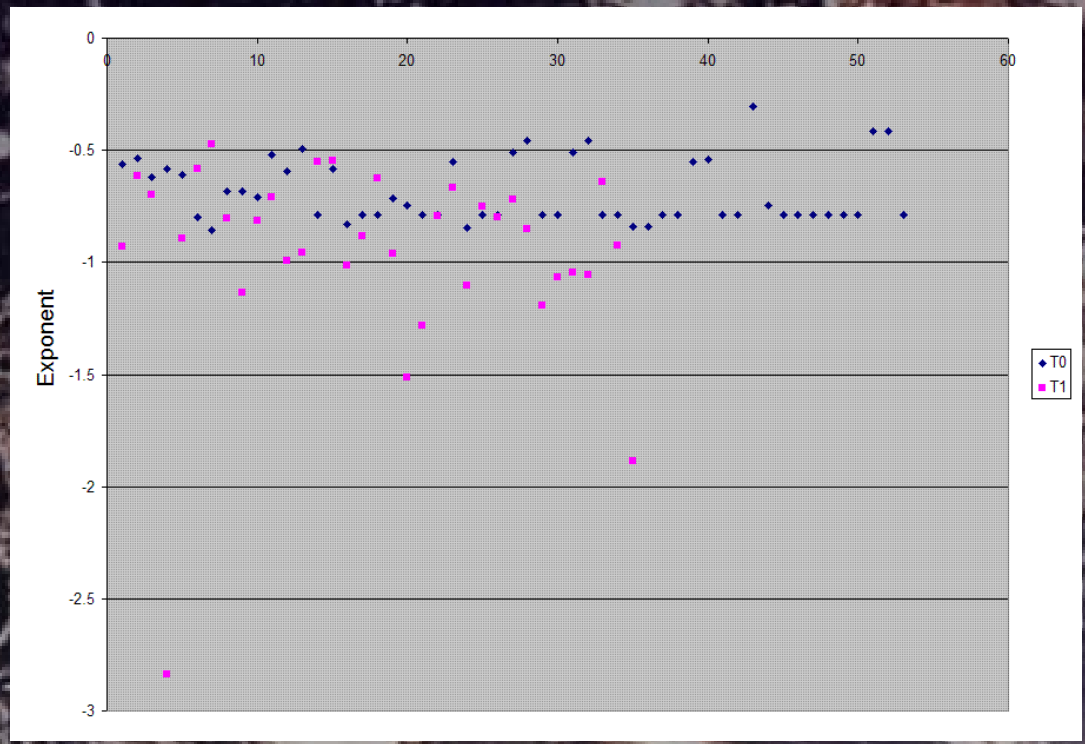
$$abs = \beta \cdot \lambda^{-\alpha}$$

# Aerosols optical properties



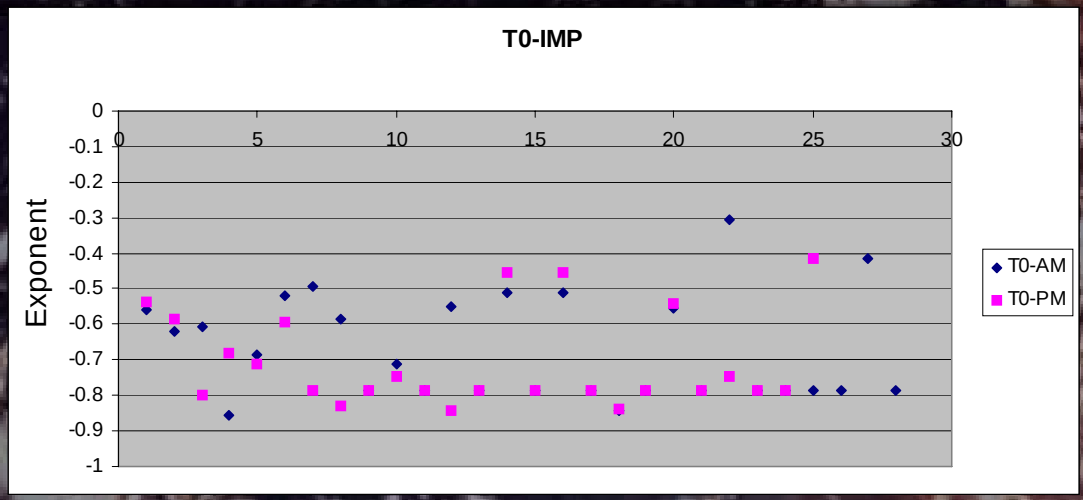
# Aerosols optical properties




T0: -0.688

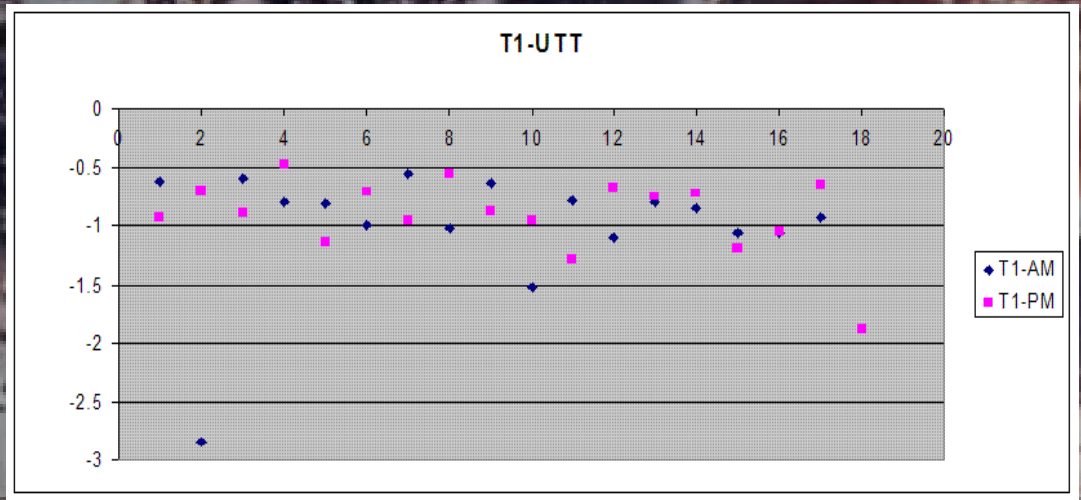
T1: -0.952

# Aerosols optical properties




Average

- AM: -0.671
- PM: -0.706




Average

- AM: -0.997
- PM: -0.909

# References


Baron, P. *Generation and Behavior of Airborne Particles (Aerosols).* National Institute for Occupational Safety and Health.

Gaffney, J.S. *Reconfigured Atmospheric Science Program and 2006 Mexico City Campaign.* July 10, 2006. Department of Energy.

Marley, N. *Wavelength Dependence of Aerosol Absorption in Mexico City.* DOE and UALR.

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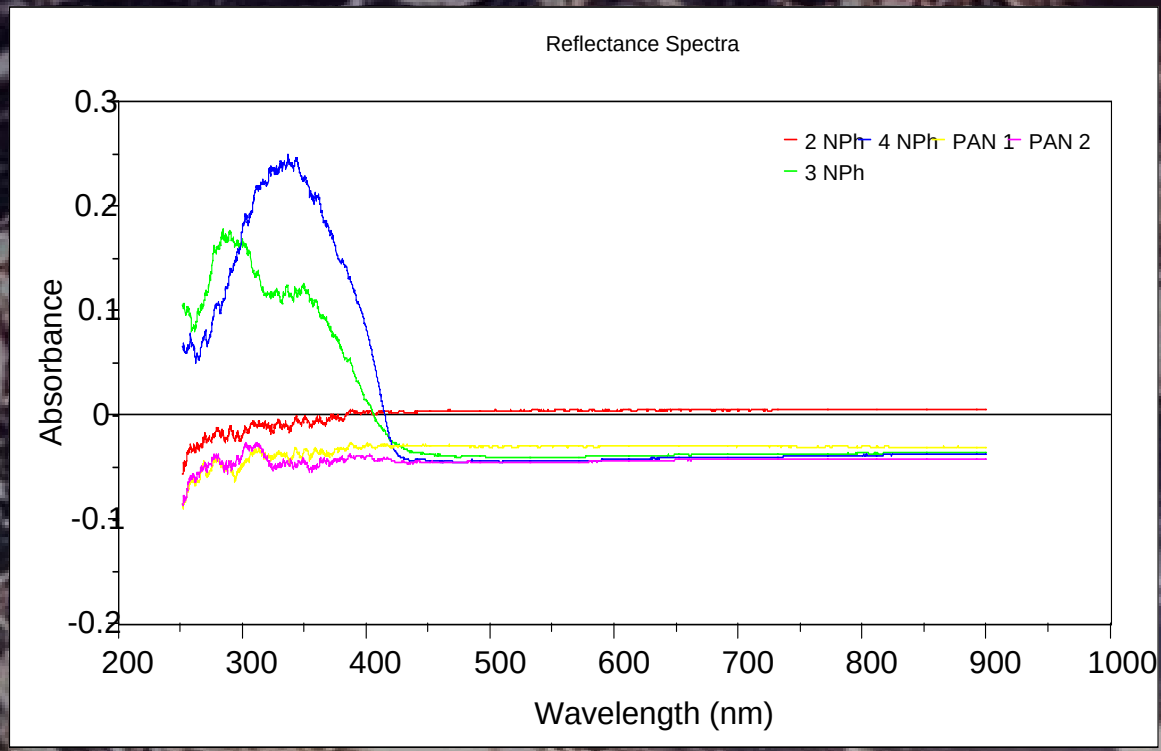
Also to all UALR- Chemistry Department for their hospitality, Dr. Milton Constantin & Alicea Wells at Oak Ridge.



Reflectance Spectra
2 NPh
4 NPh
PAN 1
PAN 2
3 NPh
Absorbance
0.3
0.2
0.1
0
-0.1
-0.2
200
300
400
500
600
700
800
900
1000
Wavelength (nm)