One Year of Aerosol Optical Property Measurements from APP Monitoring Station

James Sherman
Brett Taubman
Will Beuttell

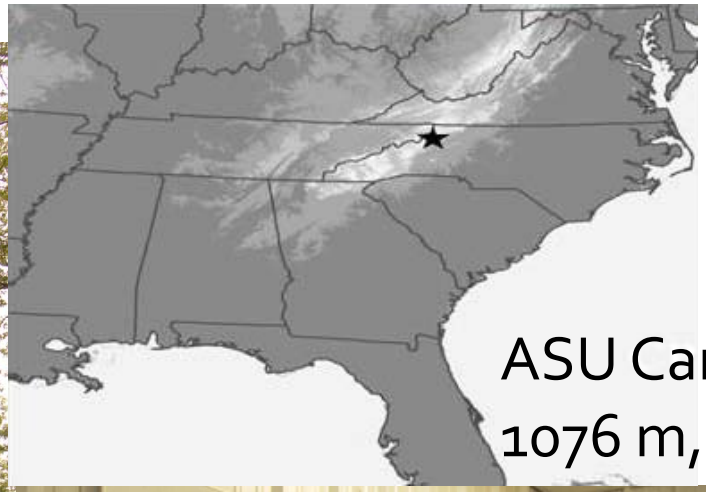
Appalachian State University

2010 NOAA ESRL Global Monitoring Annual Conference
19 May 2010

Topics to be Covered

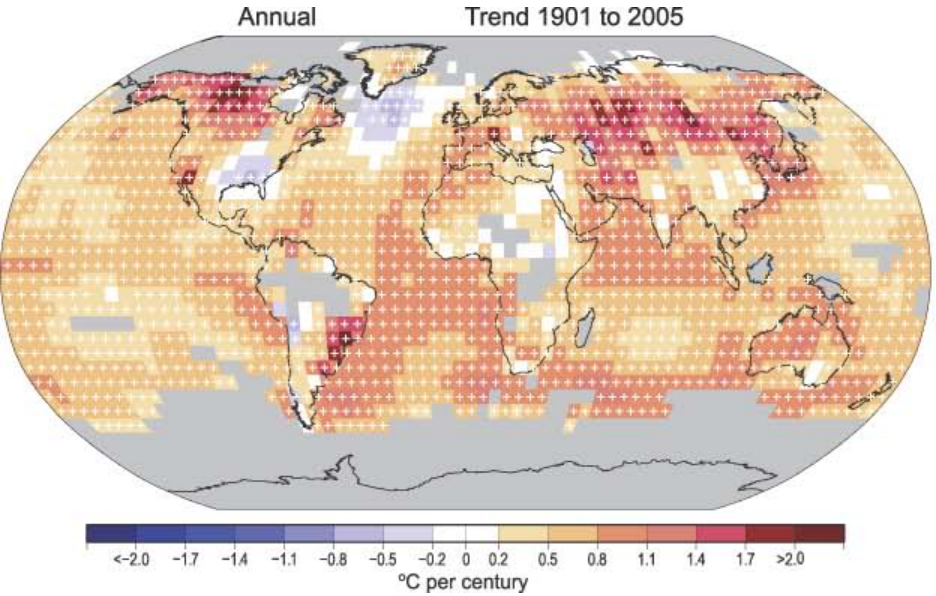
I. Introduction to the APP Station
II. Relevance of Aerosol Measurements in the SAM
III. Instruments and Collaborators
IV. Monthly-Averaged Aerosol Optical Properties
V. Diurnal Aerosol Optical Properties
VI. Sample AOT Data
VII. Future Studies

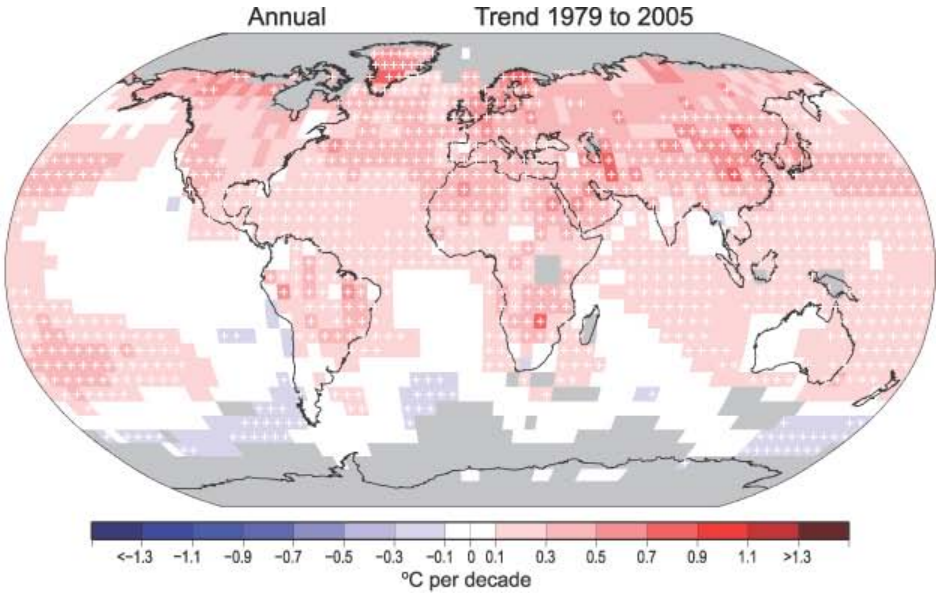
I. Introduction to the APP Station



ASU Campus, Boone, NC
1076 m, lat 36.2° lon -81.7°

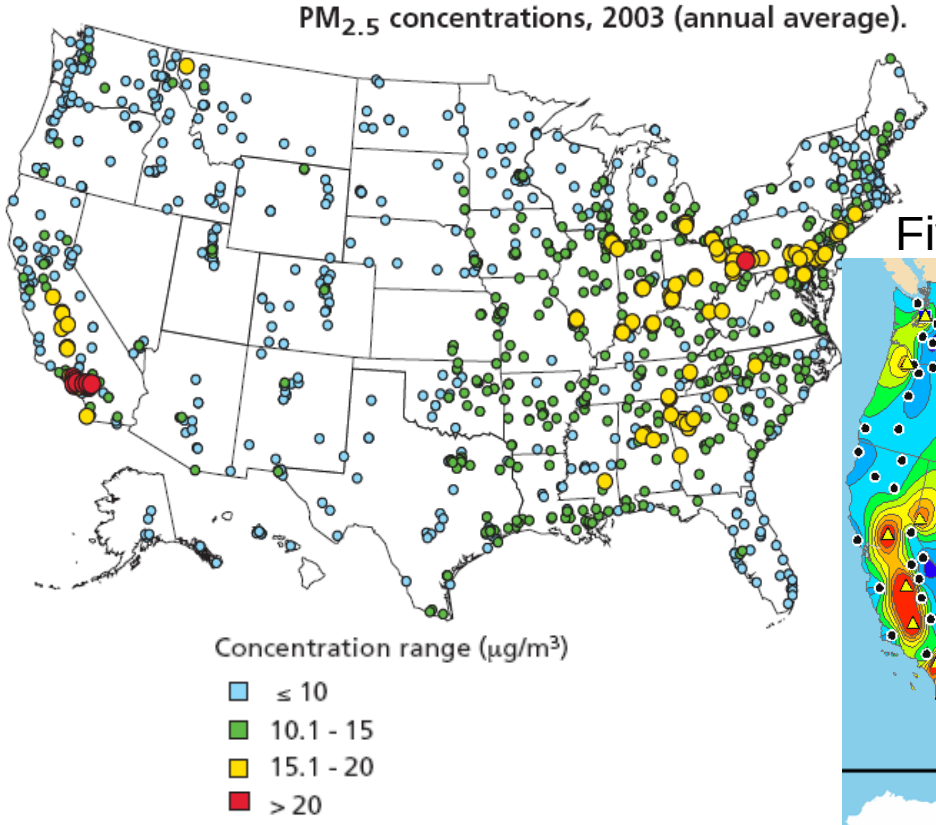
II. Relevance of Aerosol Measurements in Southern Appalachian Mountain Region



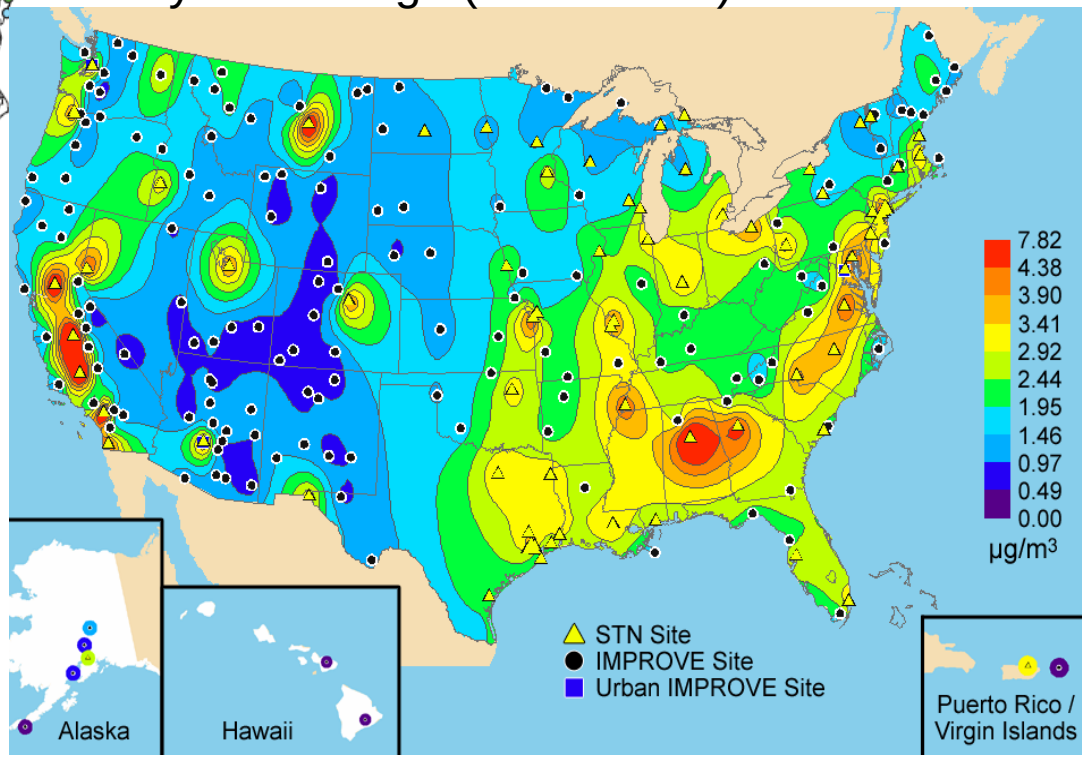


(Trenberth et al., 2007)

II. Relevance of Aerosol Measurements in Southern Appalachian Mountain Region



Five-year average (2000–2004) total carbon



Interagency Monitoring of Protected Visual Environments (IMPROVE)
EPA's Speciated Trend Network (STN)

III. Current Instruments and Collaborators

Measurements

Aerosol chemical analysis – Met One speciation sampler

Aerosol light scattering – TSI 3 λ integrating nephelometer; Radiance Research integrating nephelometer

Aerosol light absorption – Radiance Research 3 λ PSAP; Magee Scientific 7 λ aethalometer and custom UV 6 λ aethalometer

Aerosol light extinction – CRD spectrometer

Aerosol number concentration – TSI CNC 3007

Trace gases – O_3, CO_2, and H_2O

Standard and Micrometeorology

Collaborators include NOAA ESRL, Mountain Research Institute, NASA AERONET (beginning June 2010), UNC-Ashville

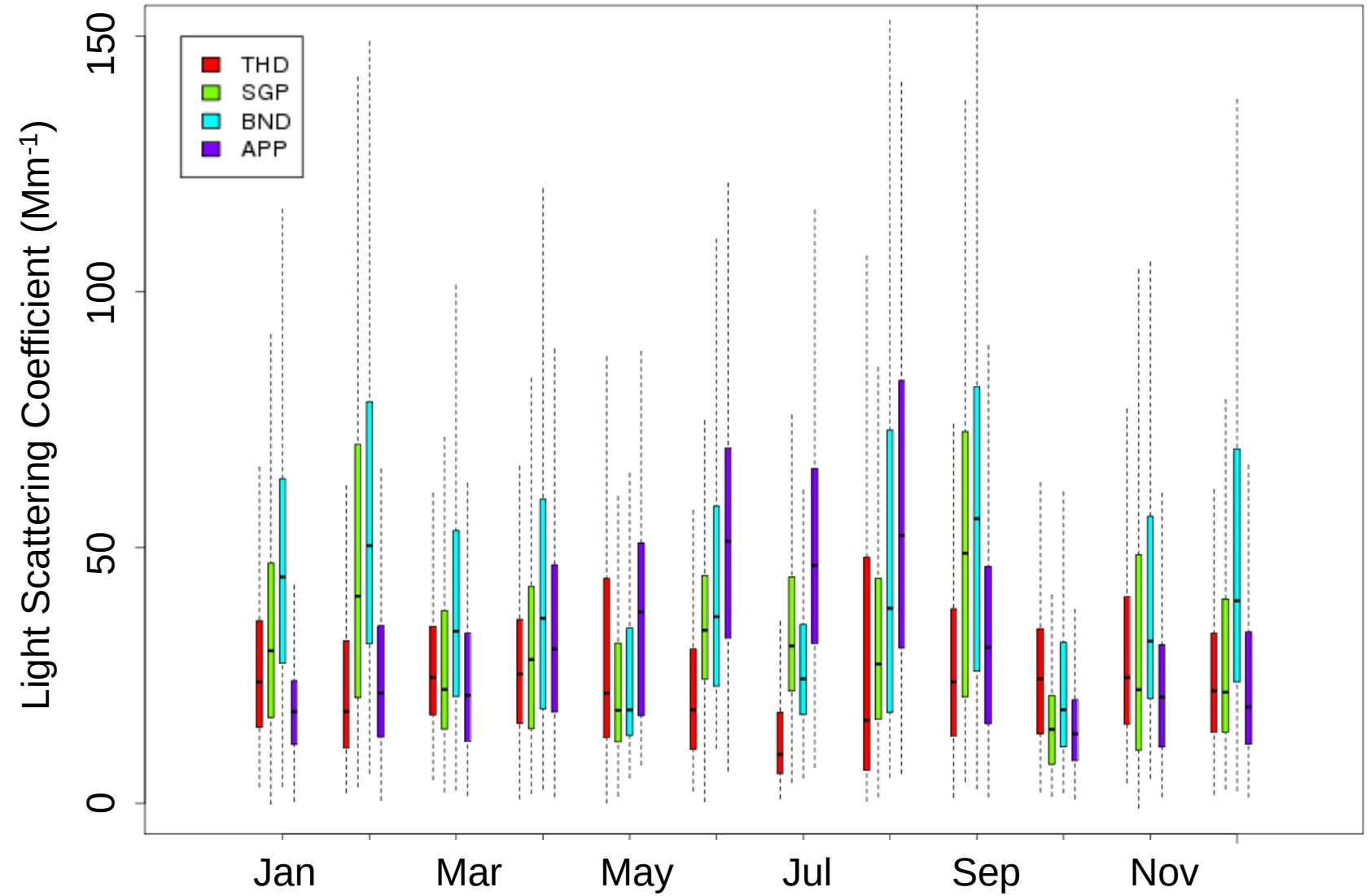
IV. Monthly-Averaged Aerosol Optical Properties

- Monthly statistics based on hourly profiles for sub-10μm aerosol optical properties (at 550nm) compared with those measured at THD, SGP, and BND sites

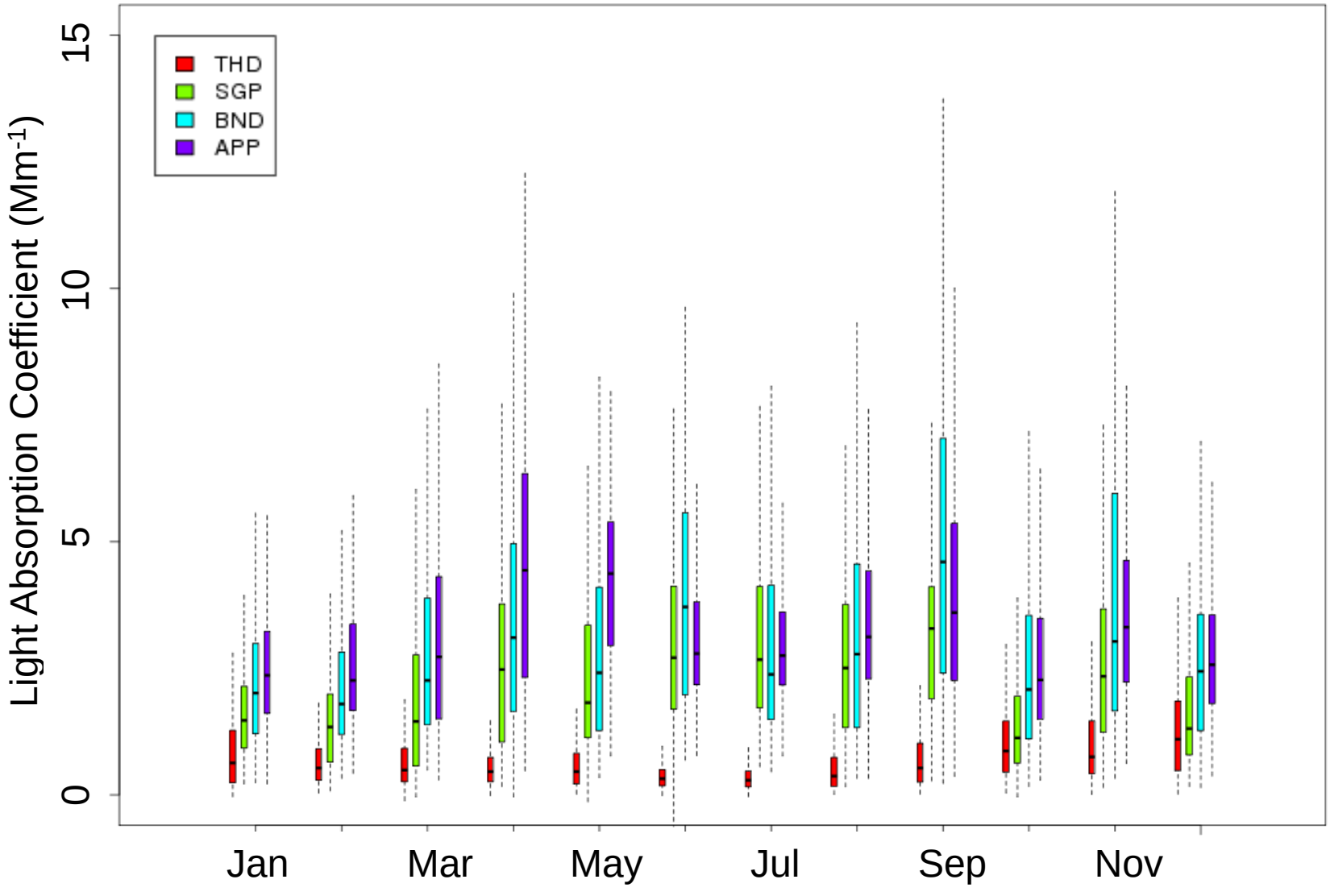
  (a) Light scattering coefficient
  (b) Light absorption coefficient
  (c) SSA

- CN counts, sub-micron scattering fraction, and Angstrom scattering and absorption exponents also shown to provide some information on aerosol concentrations, relative particle sizes, and type

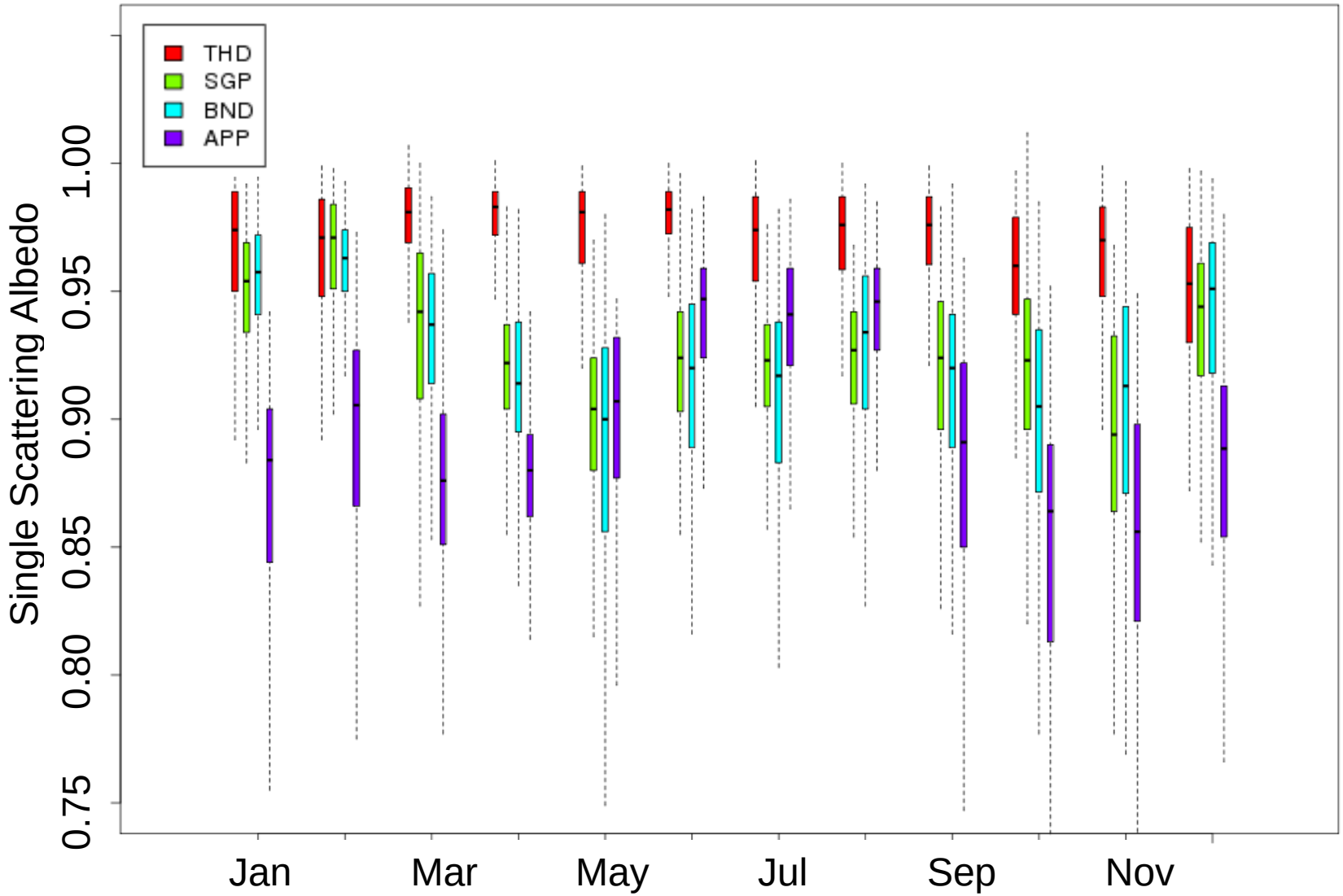
Aerosol Light Scattering at 550nm



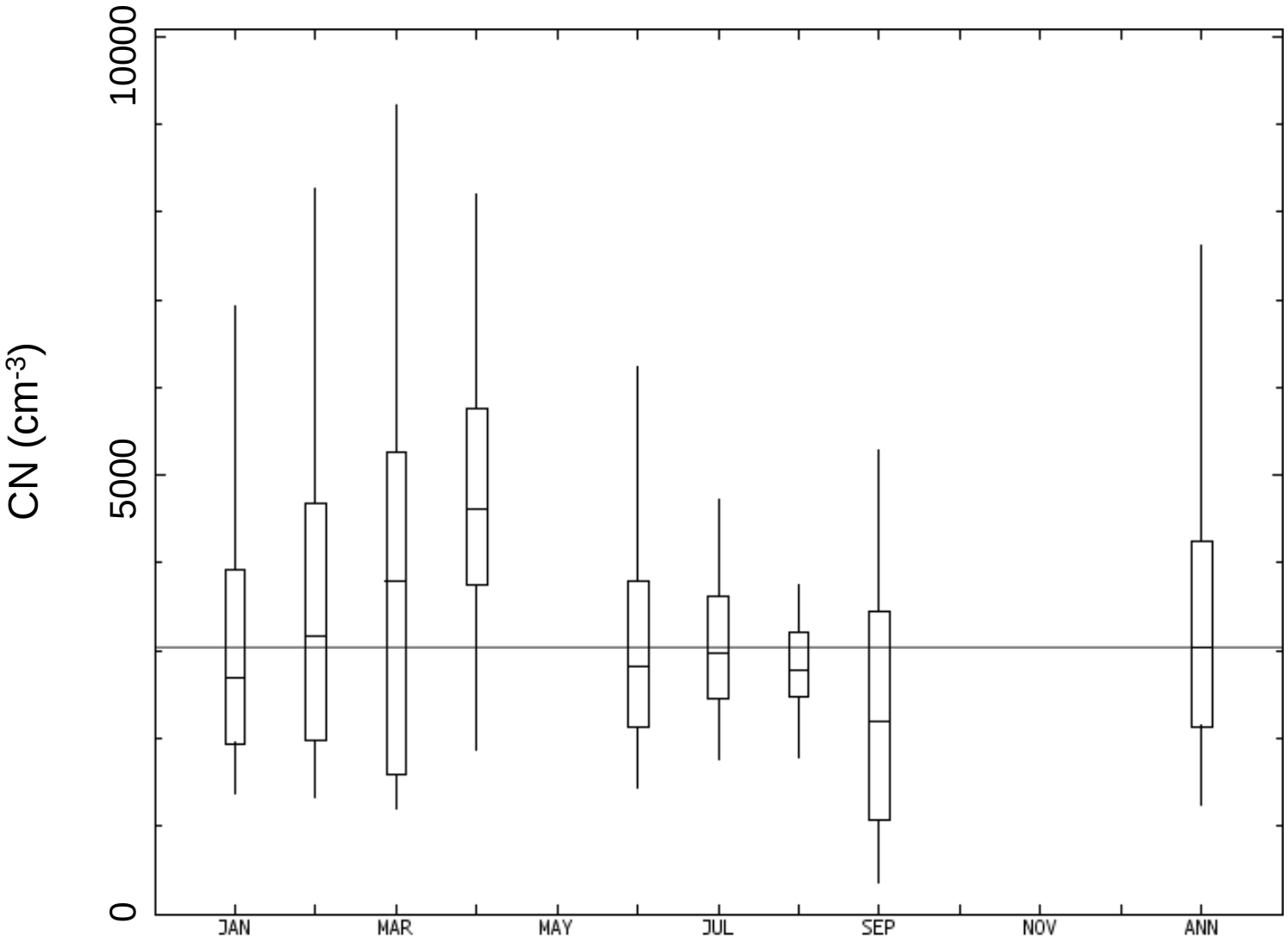
Aerosol Light Absorption at 550nm



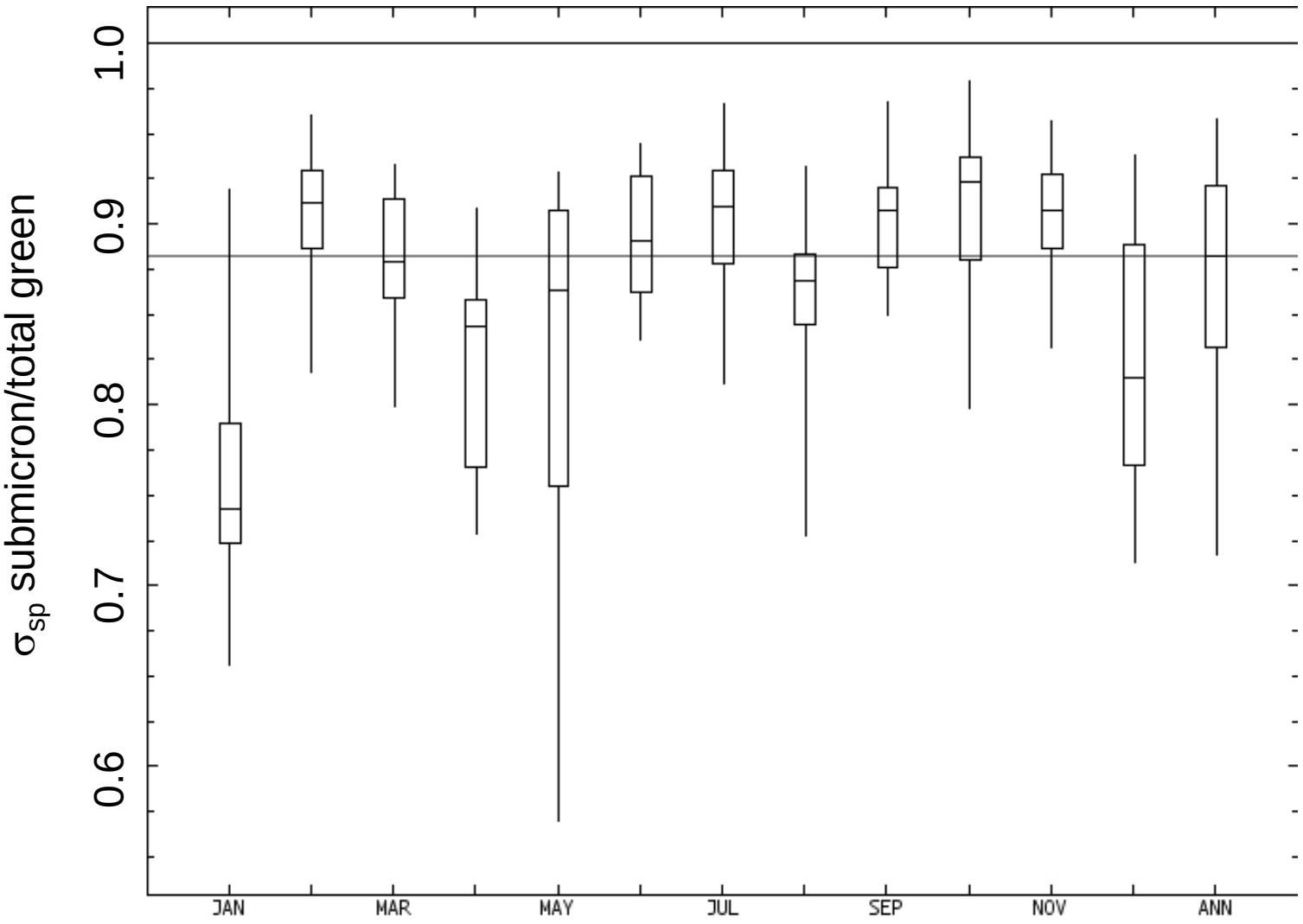
Single Scattering Albedo at 550nm



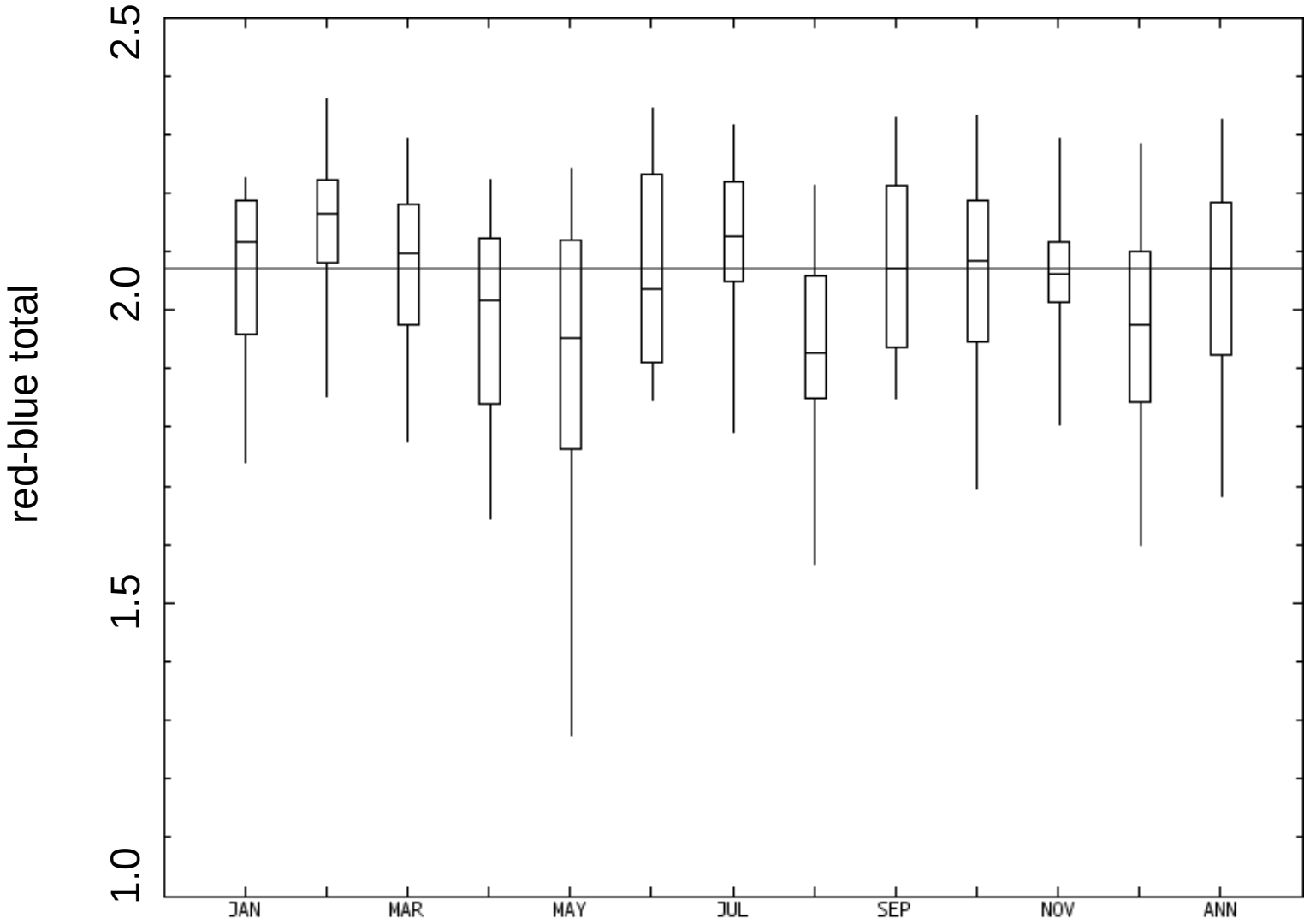
Number Concentration



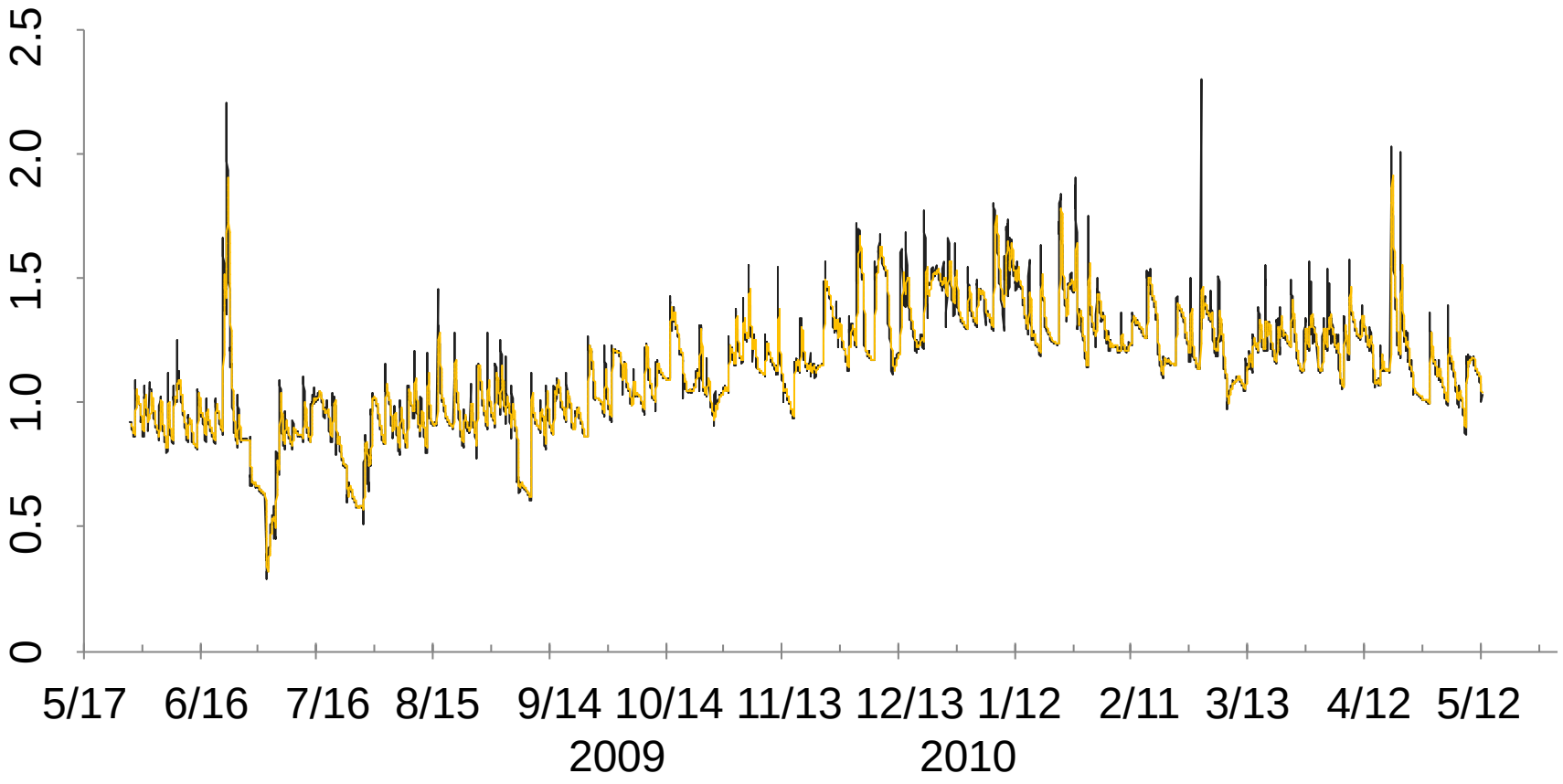
Submicron Aerosol Scattering Fraction



Scattering Ångström Exponent



Absorption Ångström Exponent

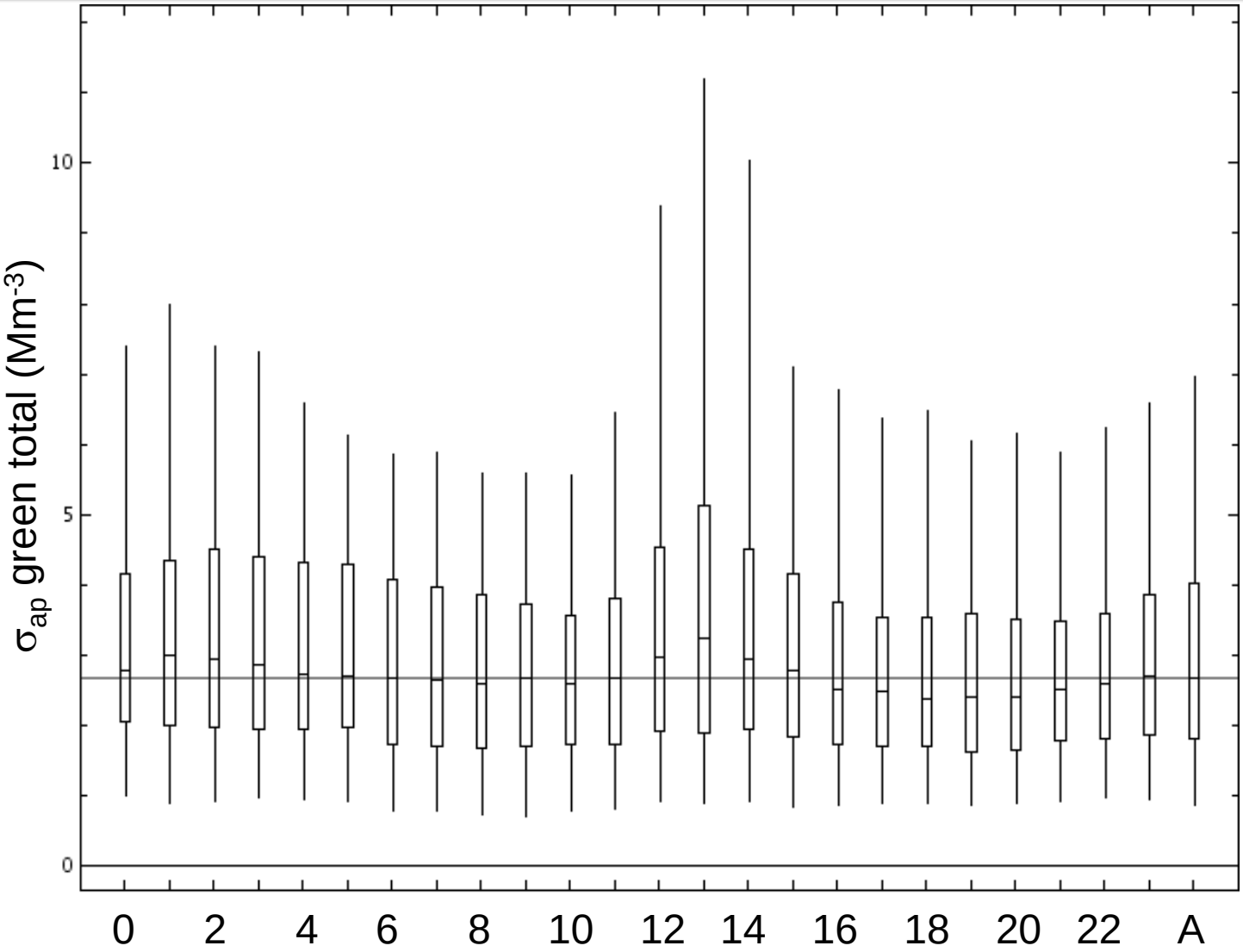


V. Diurnal Aerosol Optical Properties

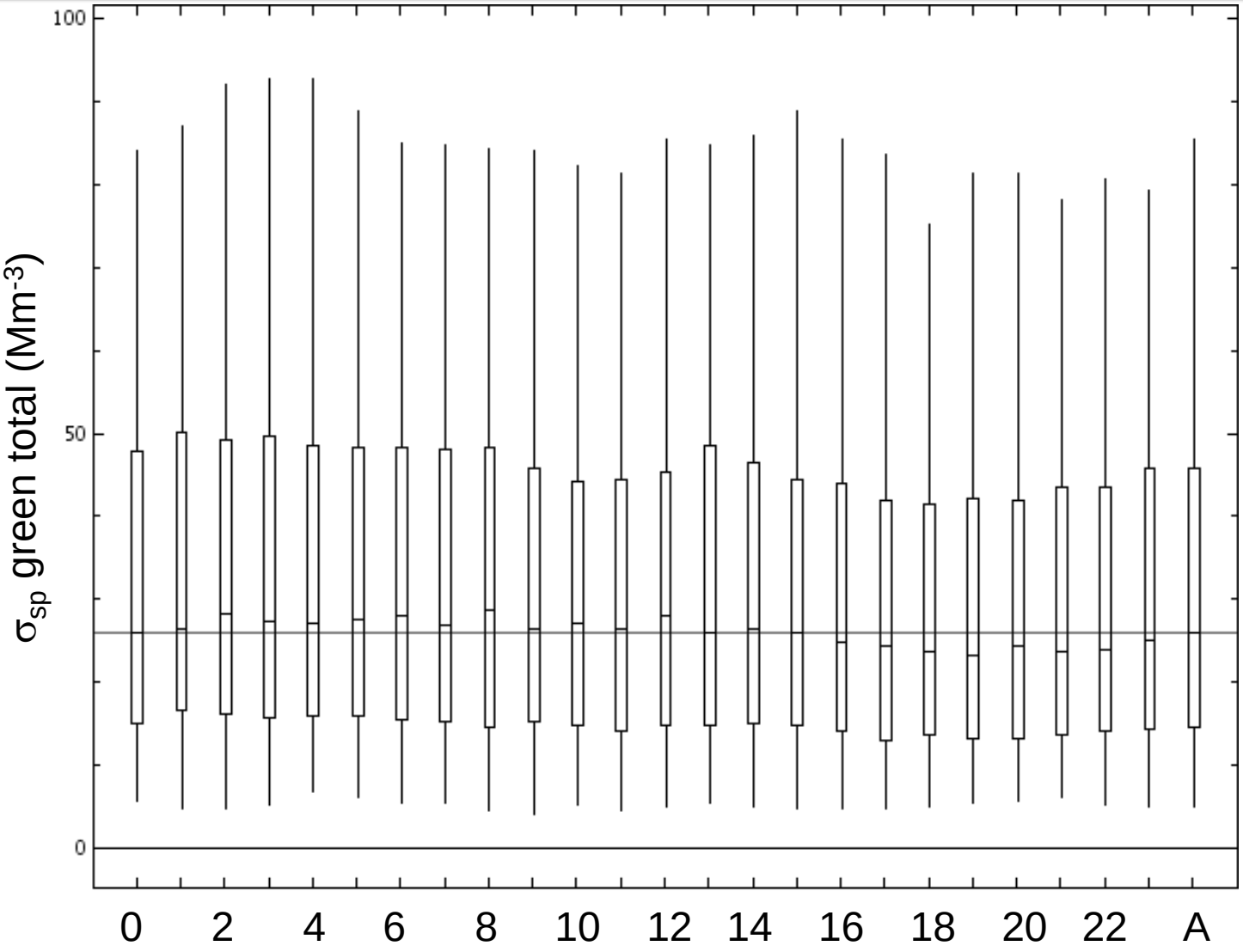
- Hourly-averaged profiles (10μm size cut) binned by UT hour to illustrate small local influence on measured aerosol properties

- Aerosol Light Absorption
- Aerosol Light Scattering
- CN Counts

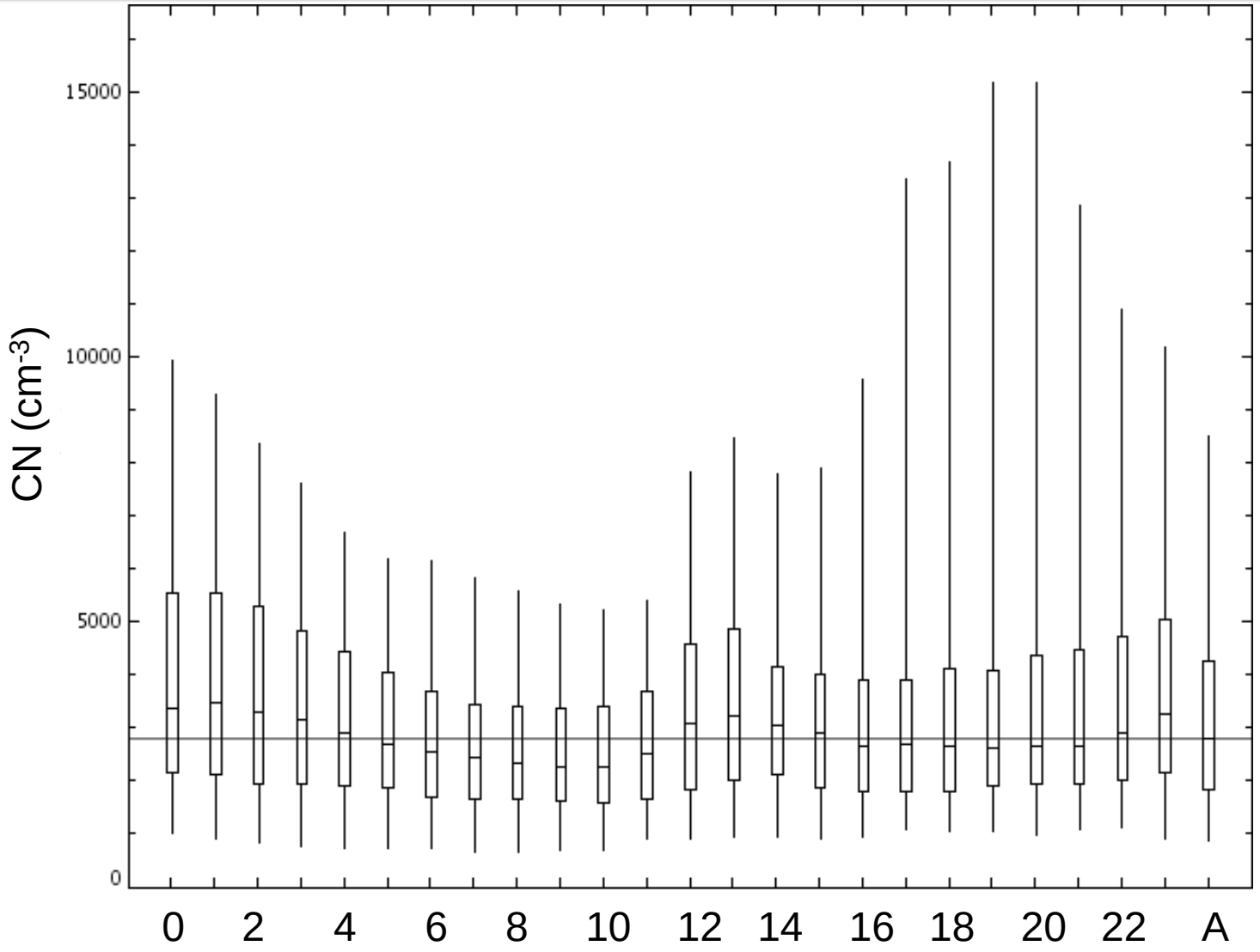
Aerosol Light Absorption at 550nm



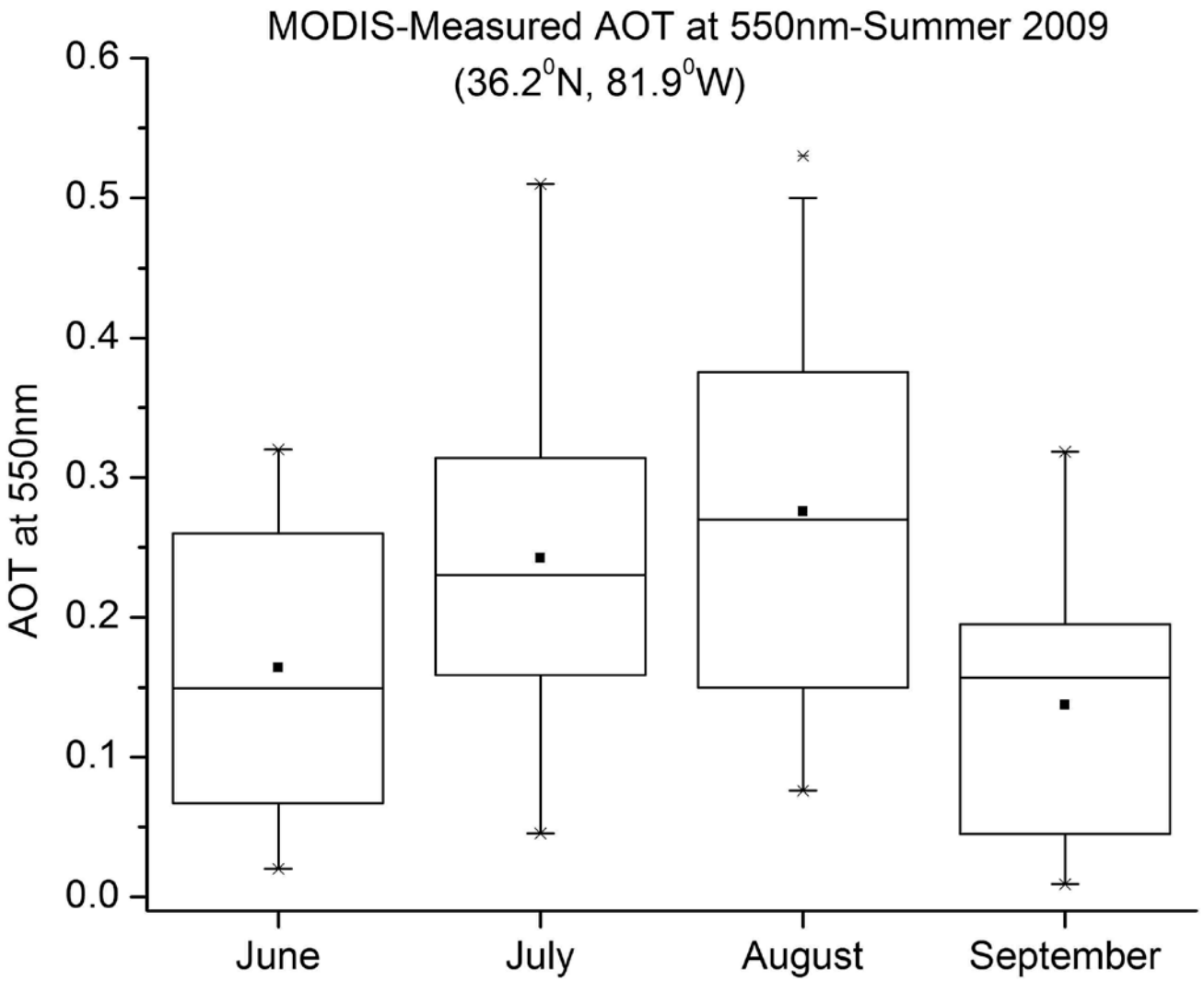
Aerosol Light Scattering at 550nm



Number Concentration



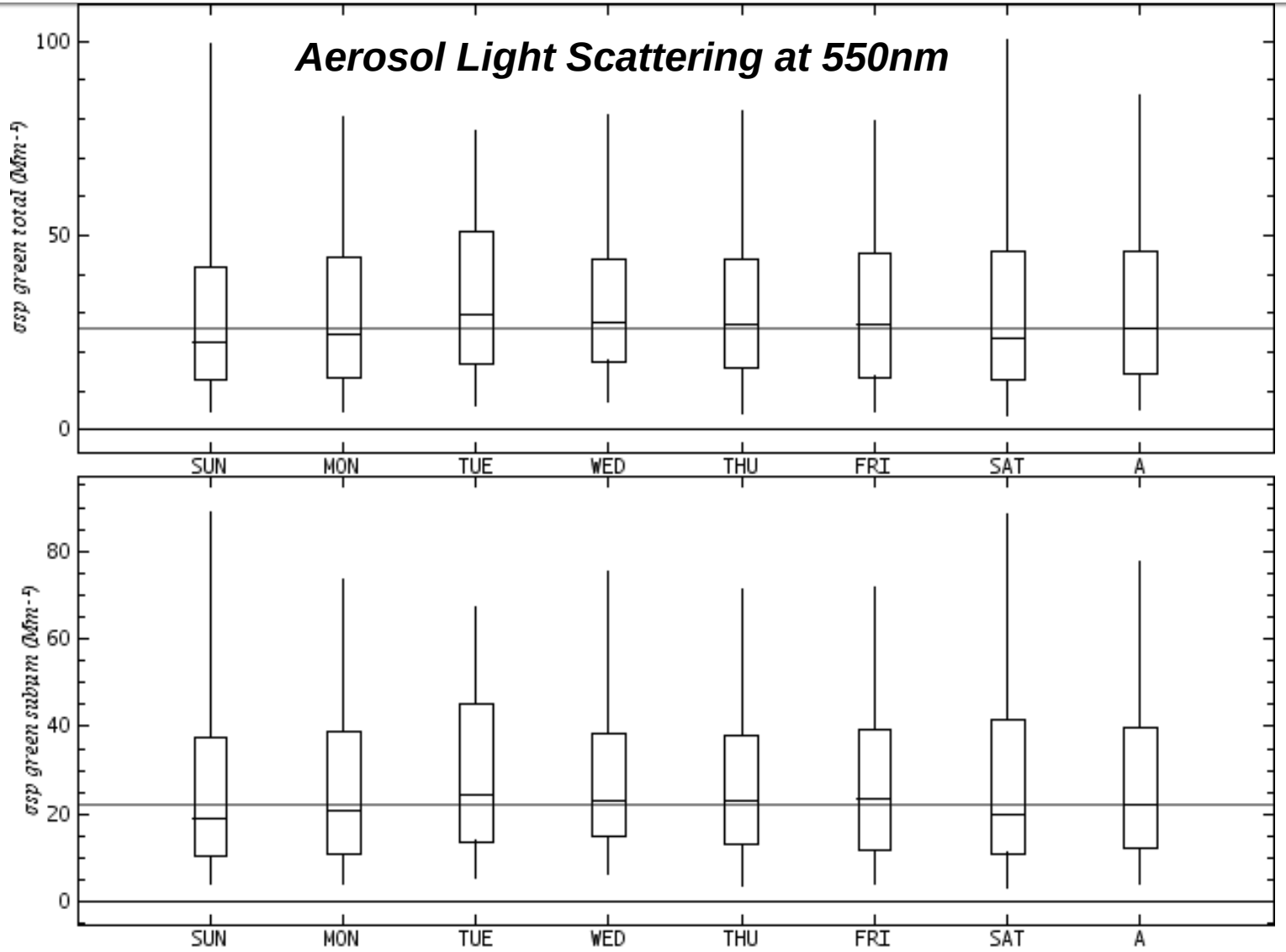
VI. Sample AOT Data



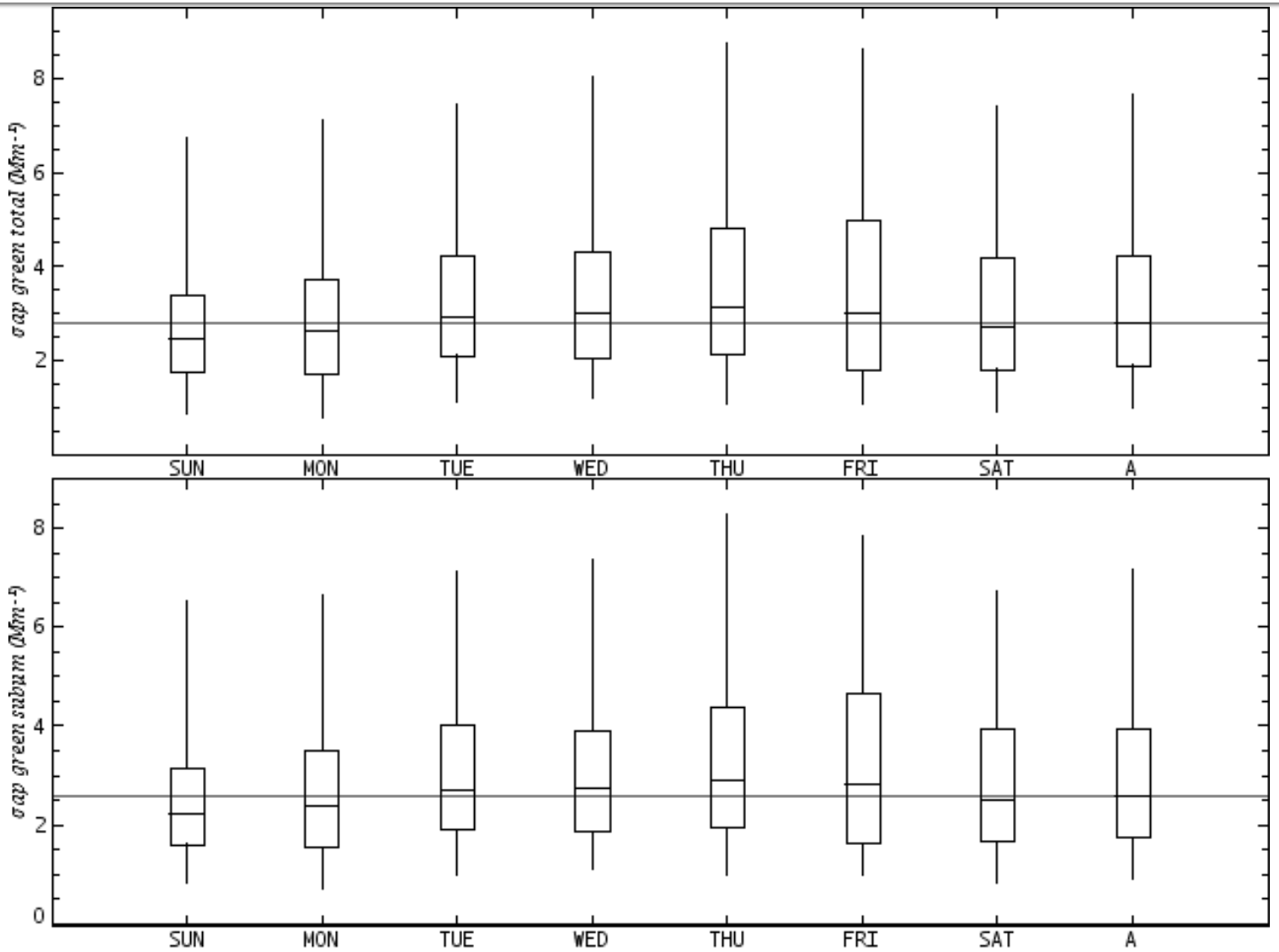
VII. Future Studies

- June 2010-Join NASA AERONET (spectral optical depth, other aerosol radiative and microphysical properties)
- September 2010-Grandfather Mountain International Biosphere Reserve Site Measurements commence
- Fall 2010-Cloud Imager (cloud fraction), facilitating direct radiative forcing calculations

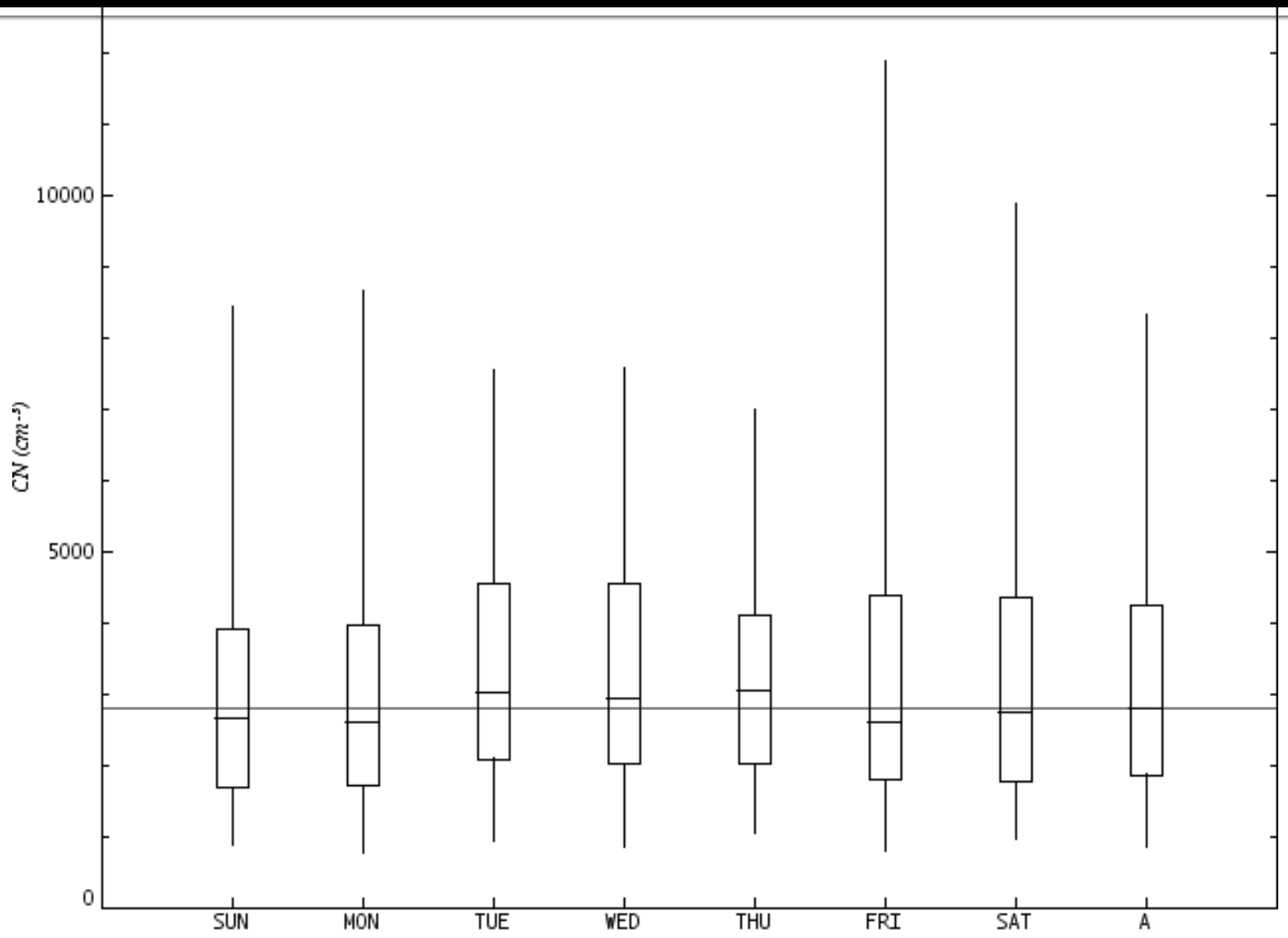
VIII. Appendix A
Weekly Plots



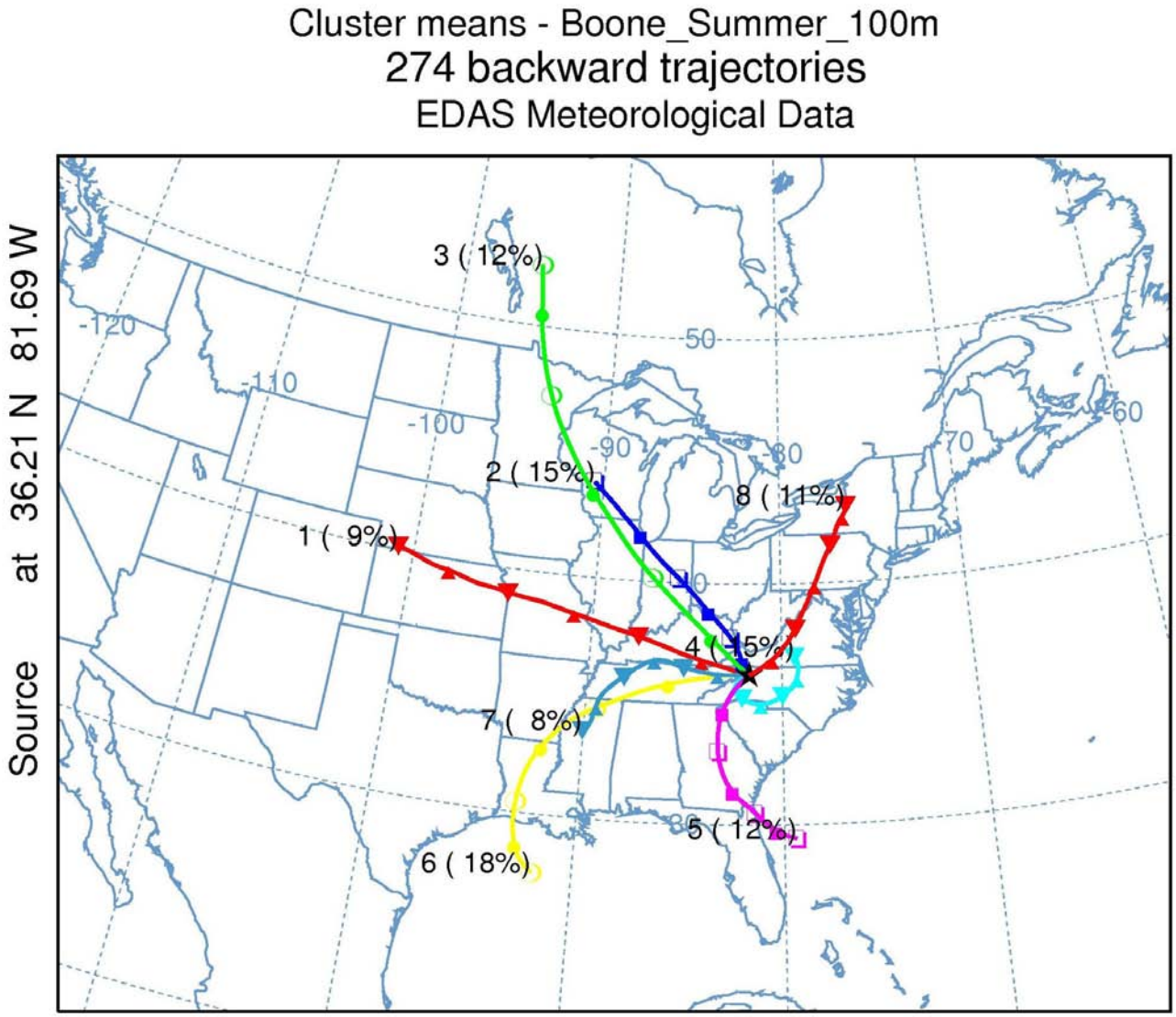
Aerosol Light Absorption at 550nm

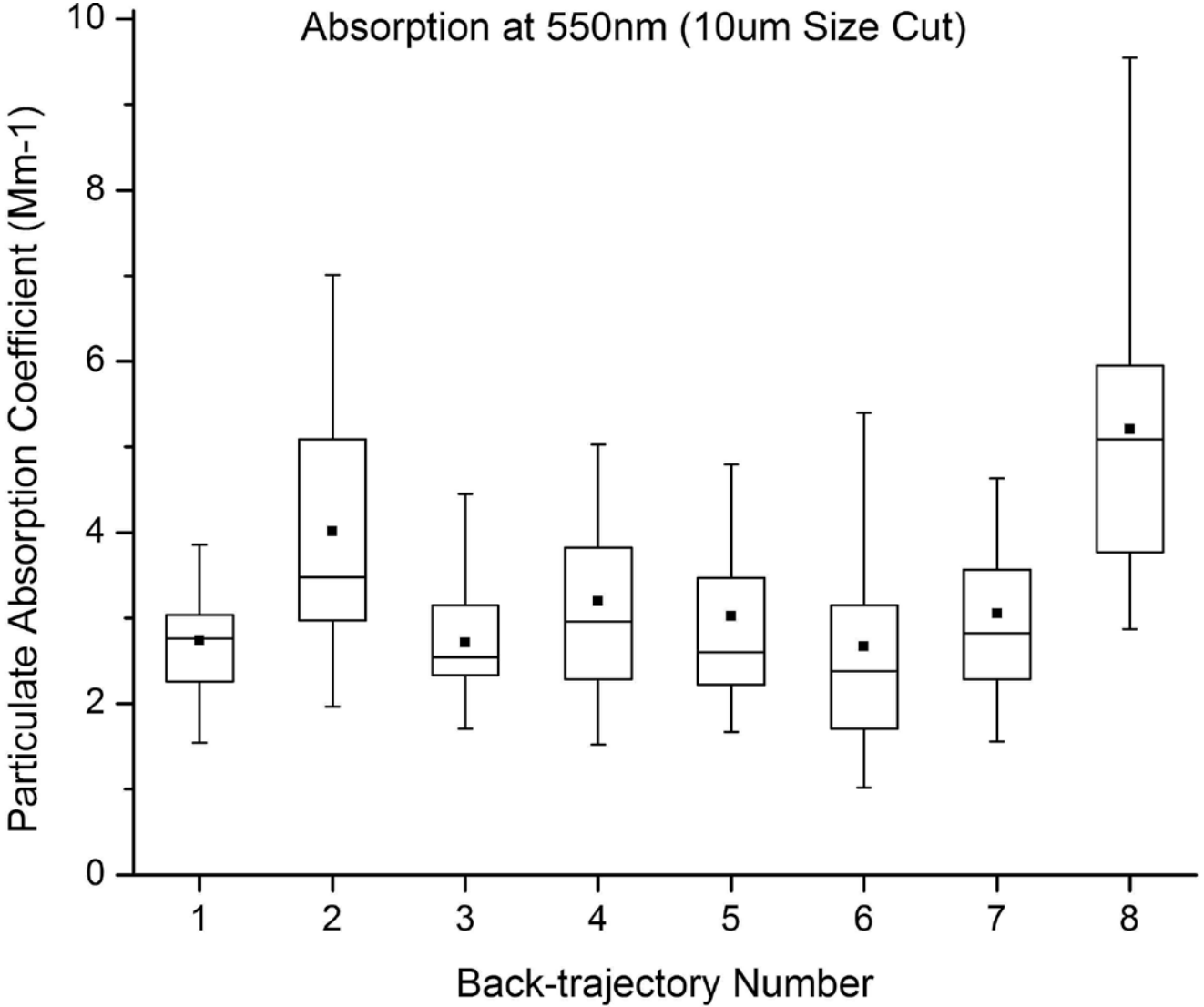


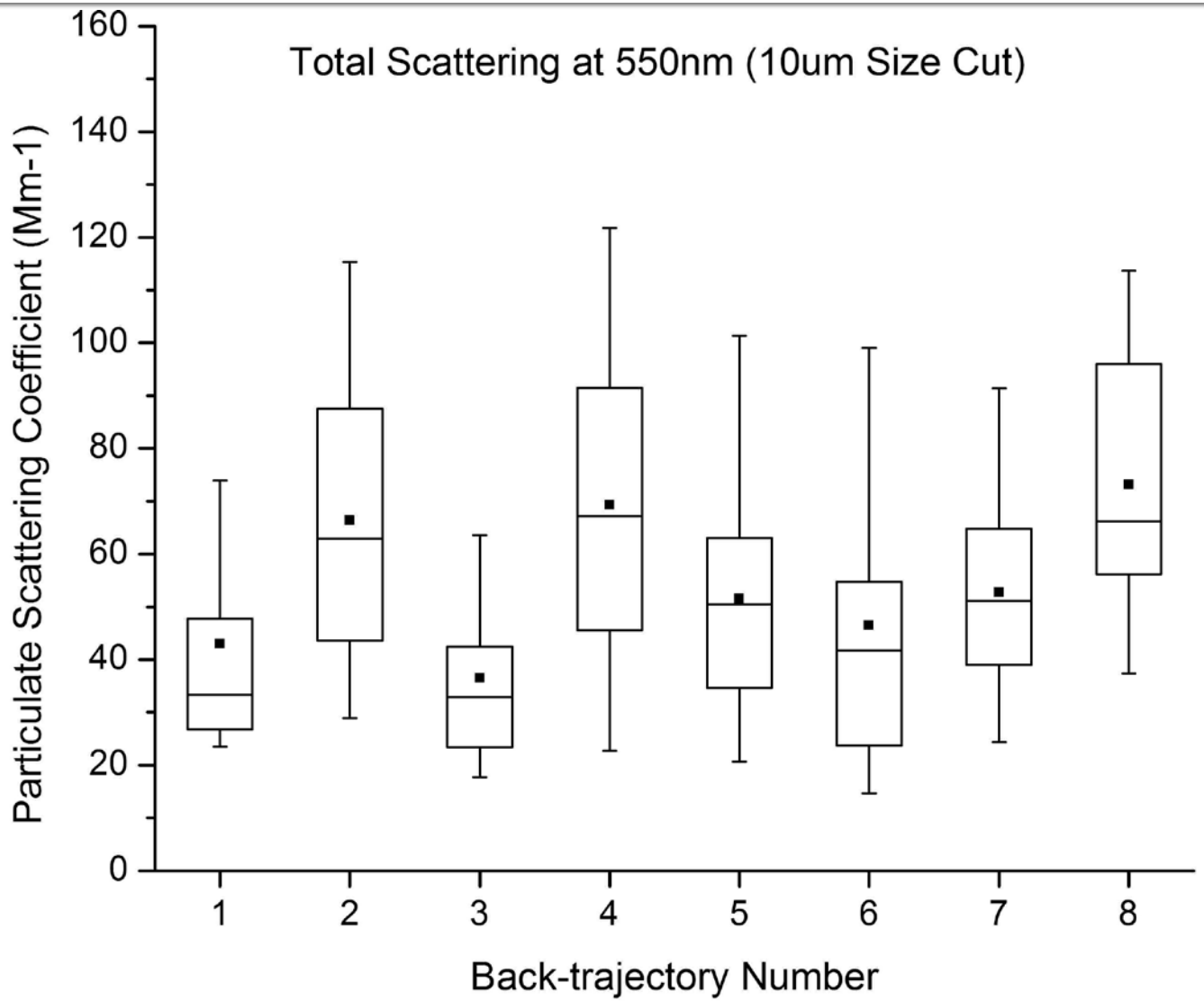
Number Concentration

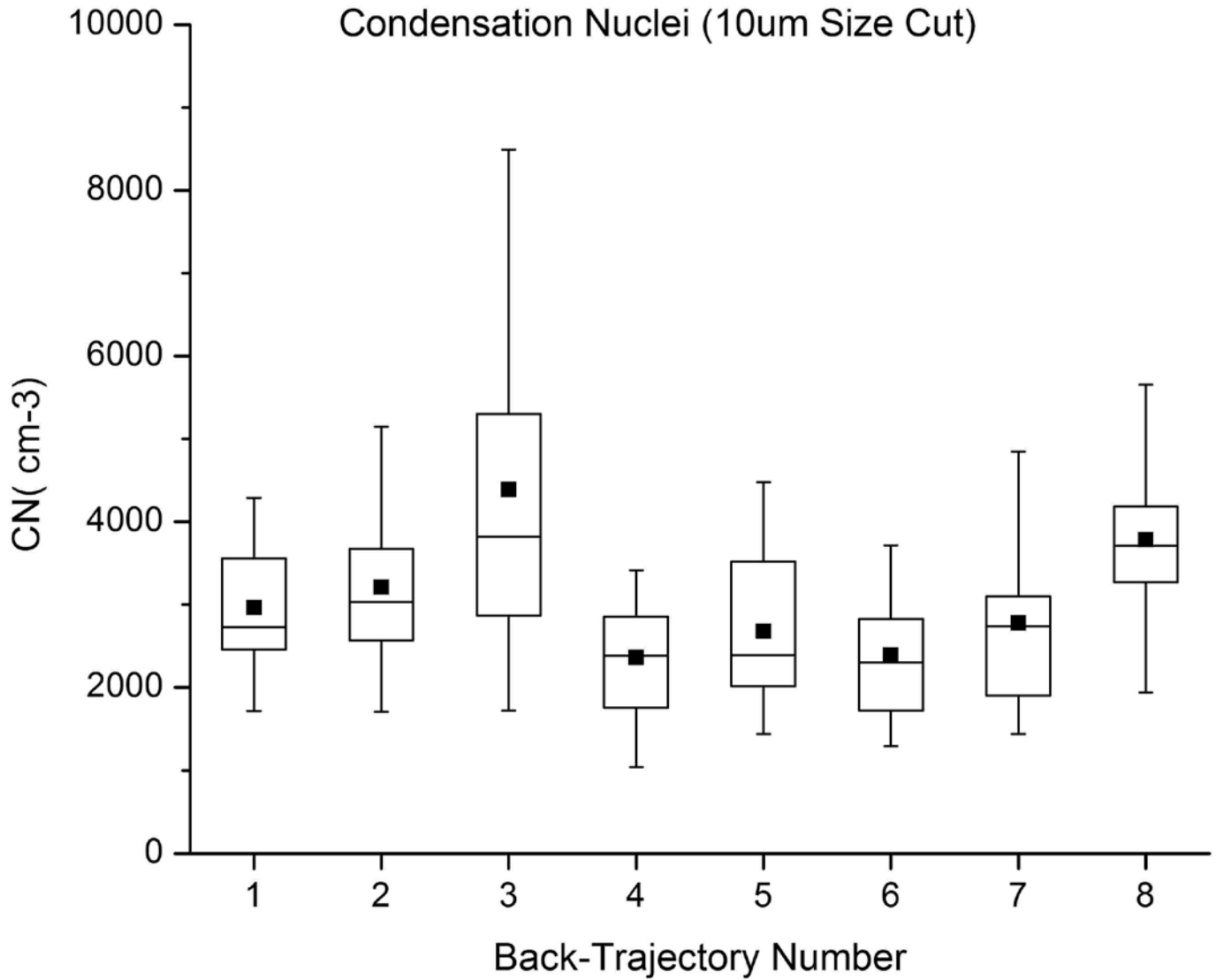


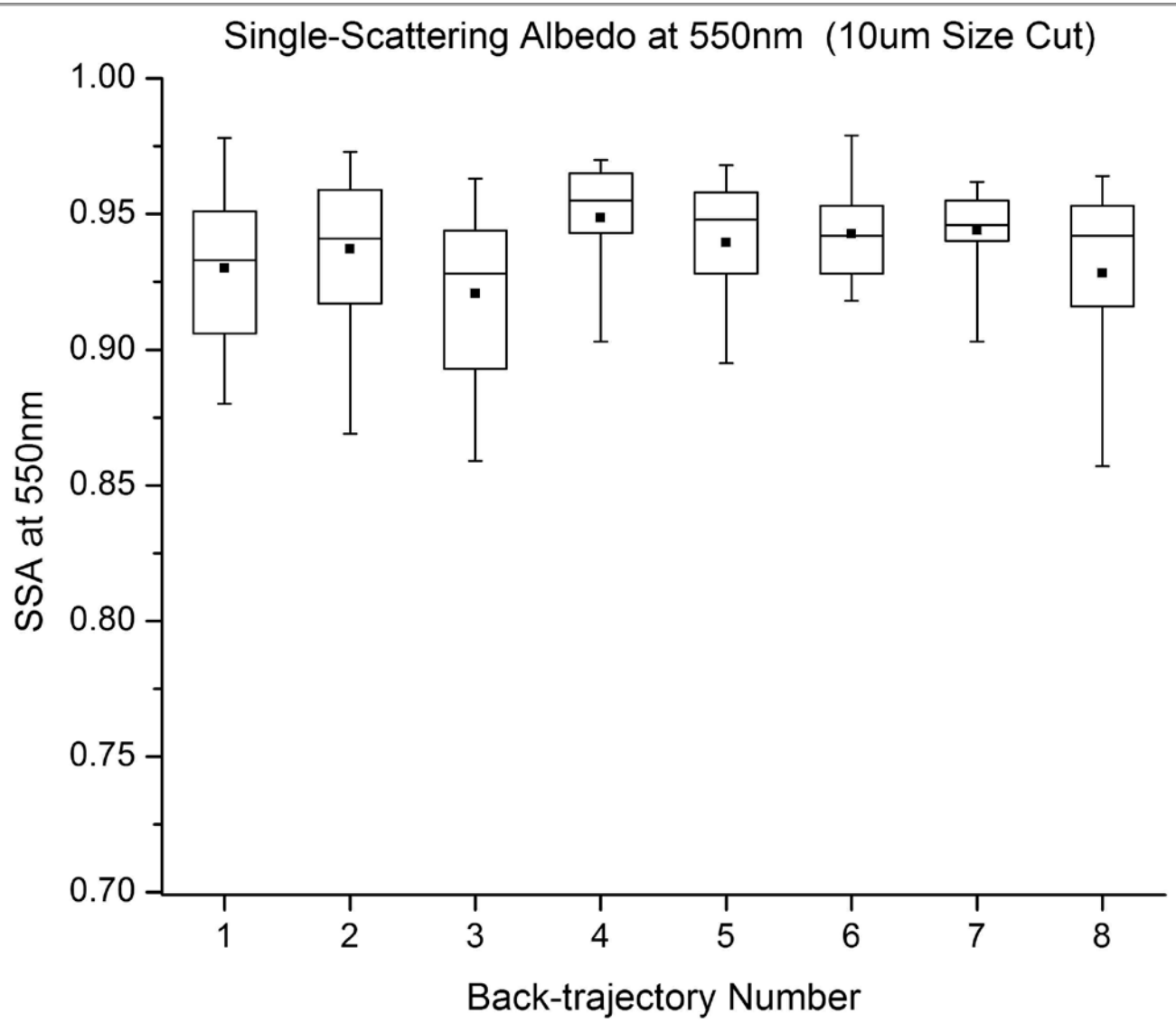
IX. Regional Influence on Observed Aerosol Optical Properties –Summer 2009

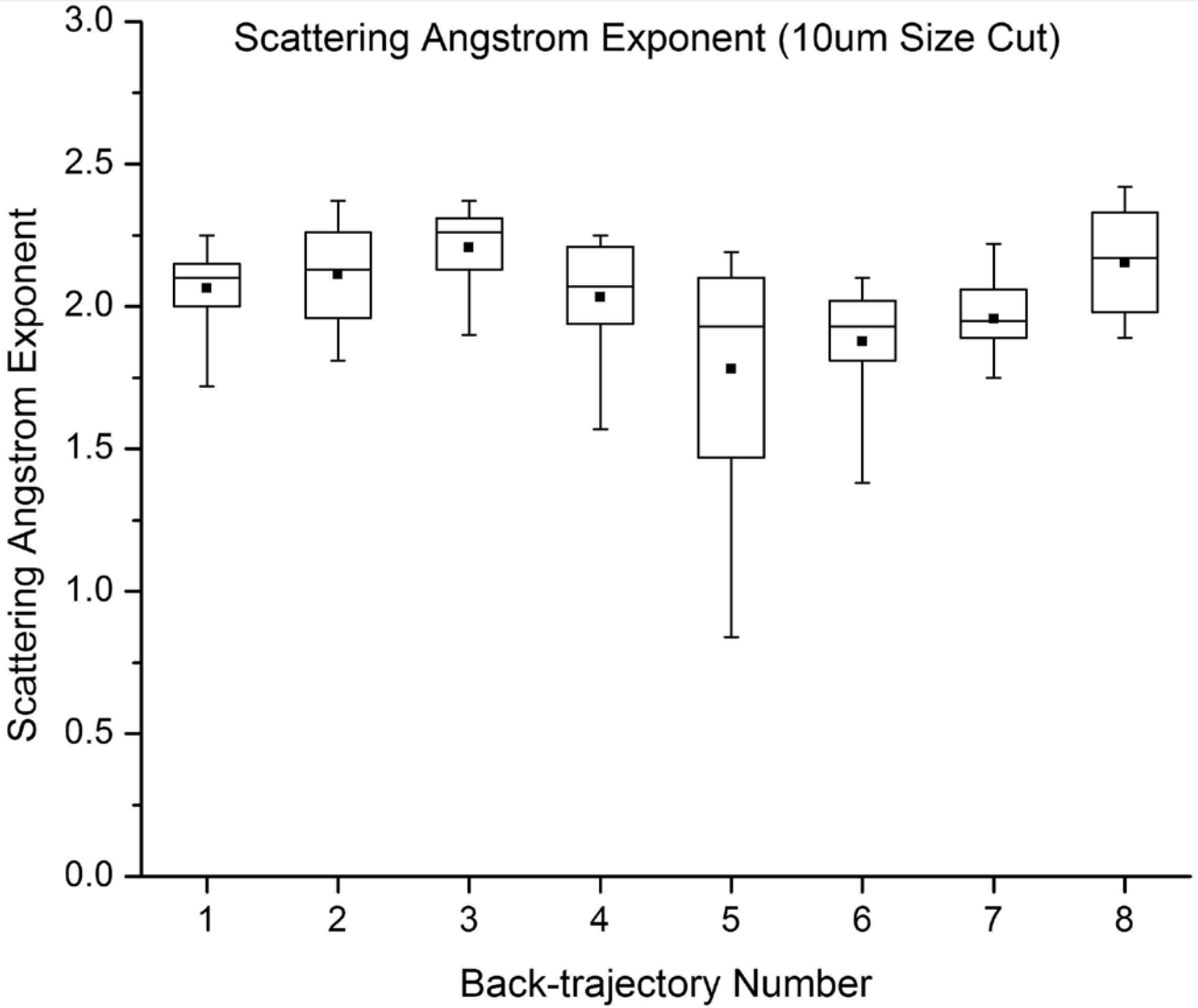



Absorption at 550nm (10um Size Cut)
Particulate Absorption Coefficient (Mm-1)
0
2
4
6
8
10
1
2
3
4
5
6
7
8
Back-trajectory Number


Total Scattering at 550nm (10um Size Cut)
Particulate Scattering Coefficient (Mm-1)
0
20
40
60
80
100
120
140
160
1
2
3
4
5
6
7
8
Back-trajectory Number


Condensation Nuclei (10um Size Cut)
CN(cm-3)
10000
8000
6000
4000
2000
0
1
2
3
4
5
6
7
8
Back-Trajectory Number


Single-Scattering Albedo at 550nm (10um Size Cut)
SSA at 550nm
1.00
0.95
0.90
0.85
0.80
0.75
0.70
1
2
3
4
5
6
7
8
Back-trajectory Number


Scattering Angstrom Exponent (10um Size Cut)
Scattering Angstrom Exponent
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
8
Back-trajectory Number