Update on WMO/GAW Aerosol Data for Evaluating Global Models

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GAW Aerosol Variables - Continuous

- **Column and profile**
  - Multi-wavelength aerosol optical depth (AOD)
  - Vertical distribution of aerosol backscattering and extinction
- **Chemical (in two size fractions)**
  - Mass and major chemical components
- **Optical coefficients at various wavelengths**
  - Light scattering and hemispheric backscattering
  - Light absorption
- **Physical**
  - Number size distribution and total concentration
  - Cloud condensation nuclei number concentration at various super-saturations

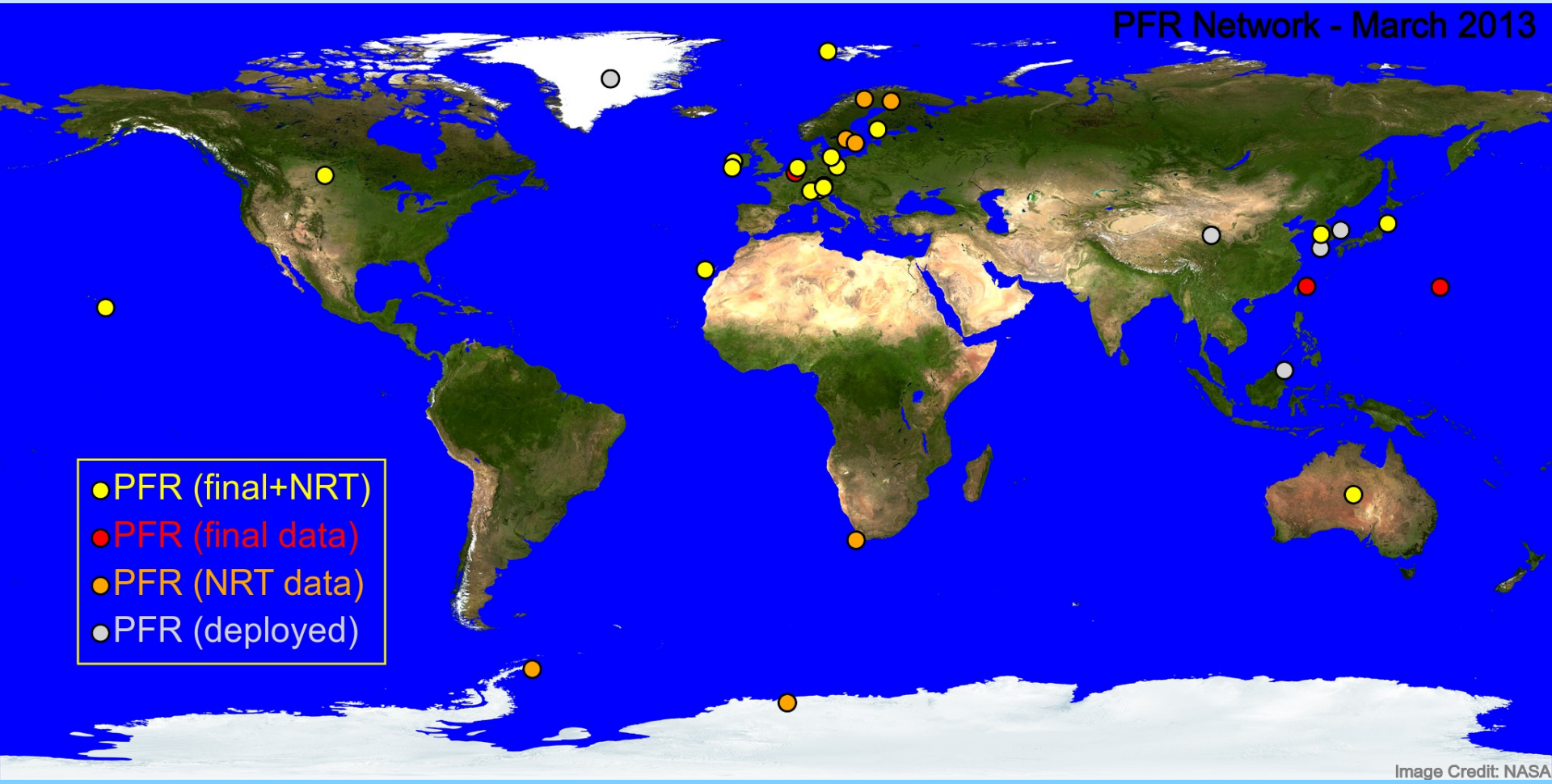
GAW Aerosol Variables - Intermittent

- Detailed, size-fractionated, chemical composition
- Dependence on relative humidity

GAW Data Summary

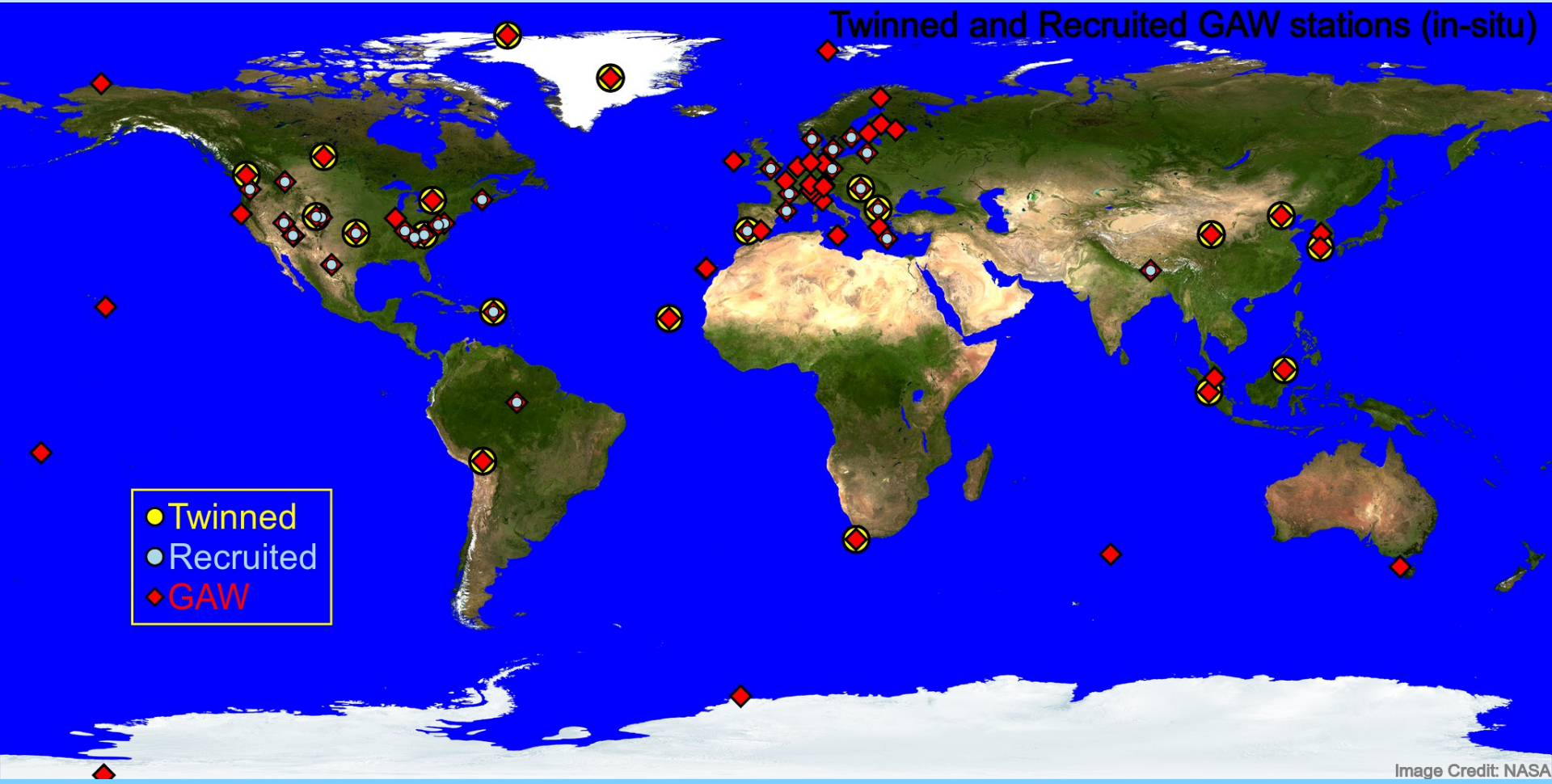
- GAW stations are generally rural or remote (i.e., non-urban)
- GAW data (NRT and final) available from http://www.gaw-wdca.org

Aerosol Optical Depth Network



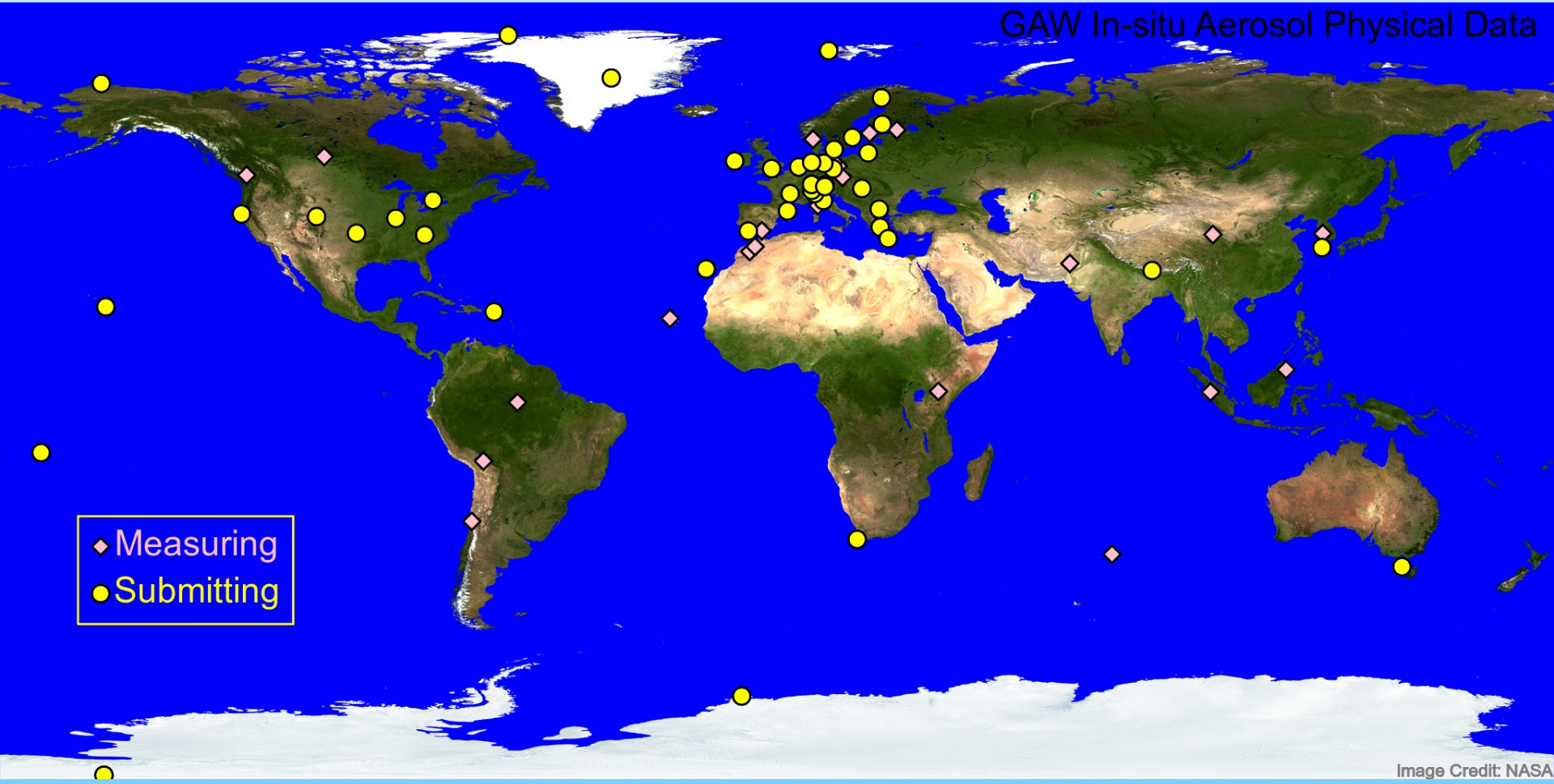
- Precision Filter Radiometer, manufactured and coordinated by World Optical Depth Research and Calibration Center (Davos)

GAW In-Situ Aerosol Data (2013)



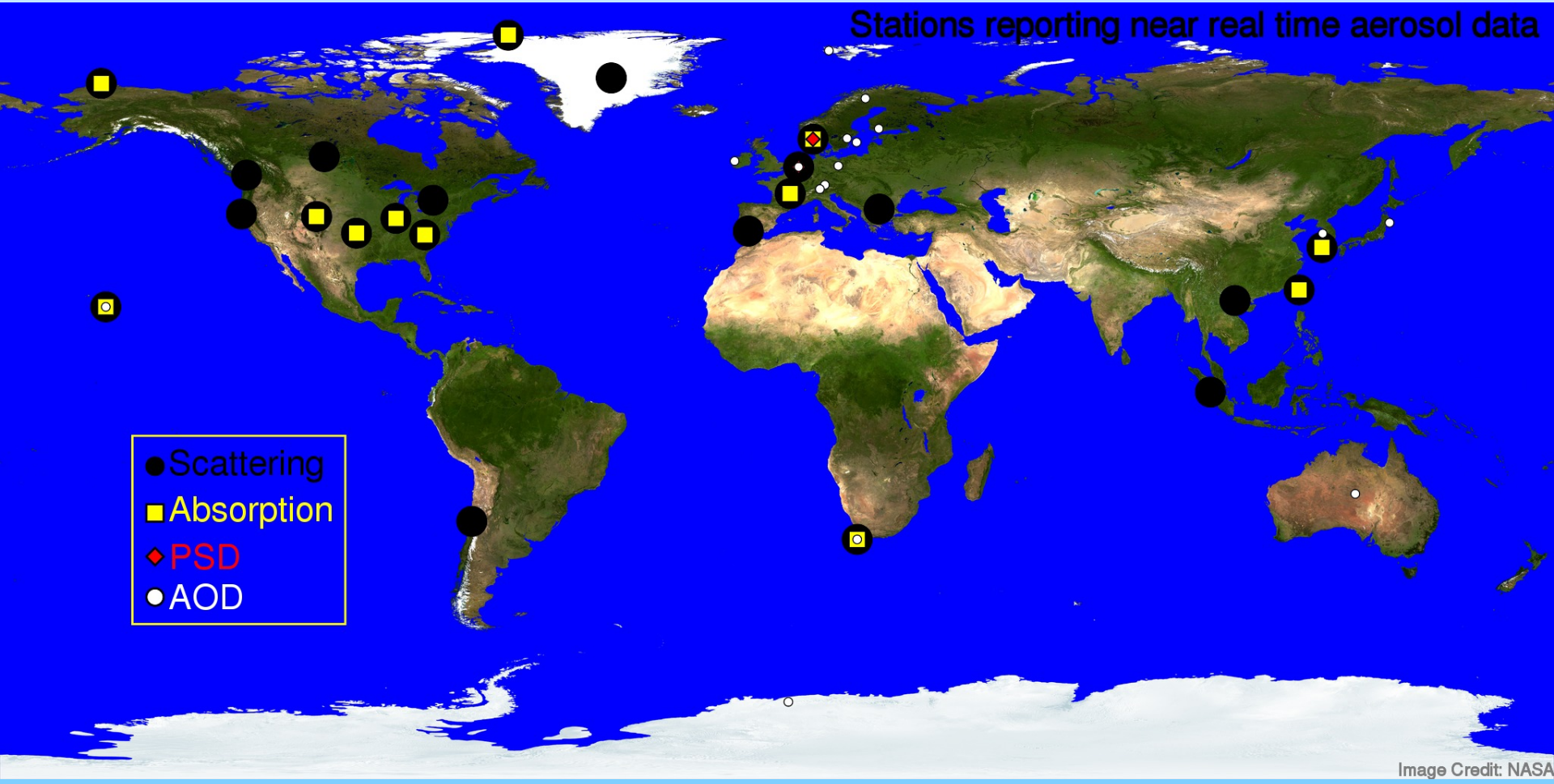
- In-situ: Scattering, absorption, and/or particle size distribution
- Twinned: Operations supported by SAG members
- Recruited: Joined GAW through efforts of SAG members

GAW In-Situ Aerosol Data (2013)



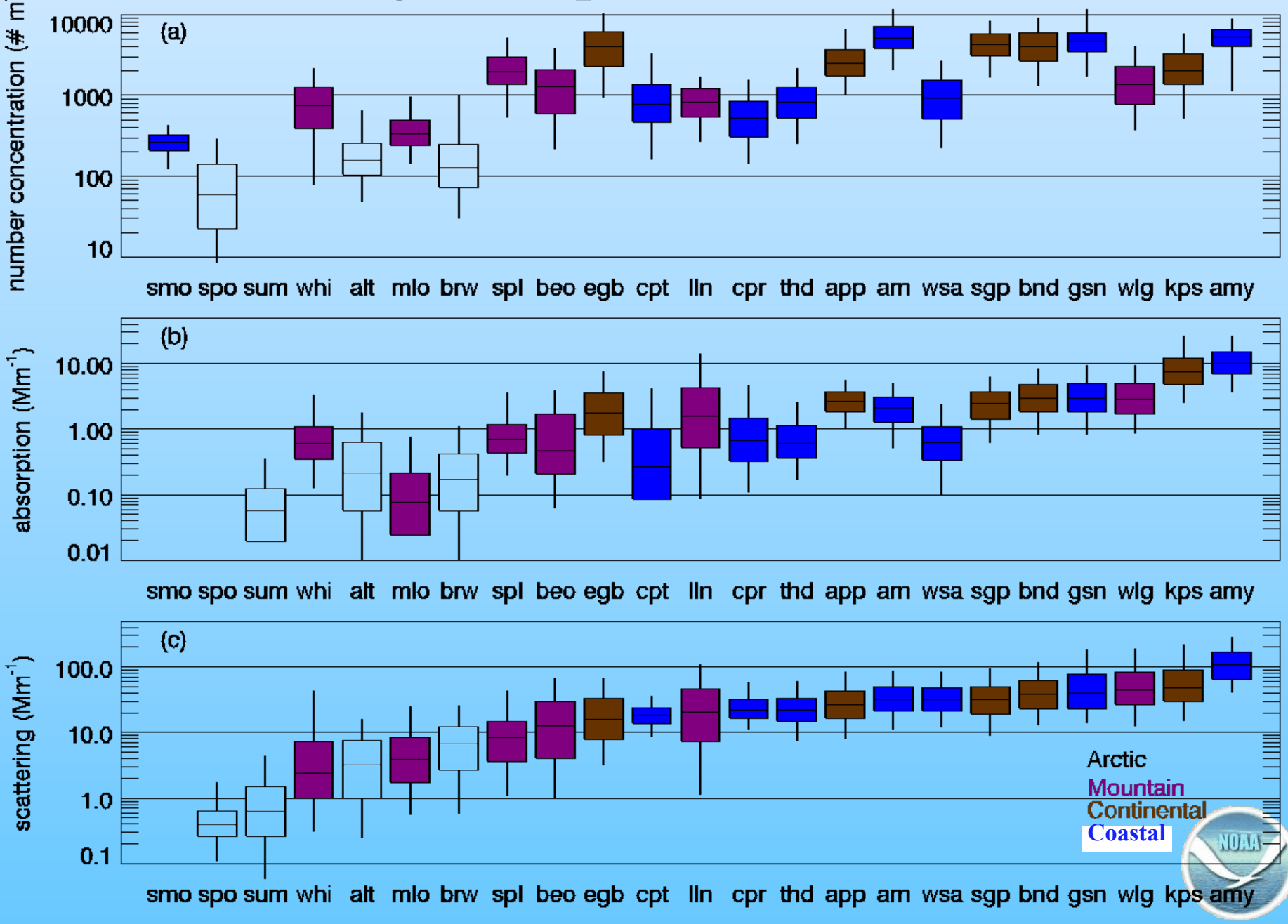
- **Still working on getting all stations to submit their data**

GAW NRT Aerosol Data (2014)



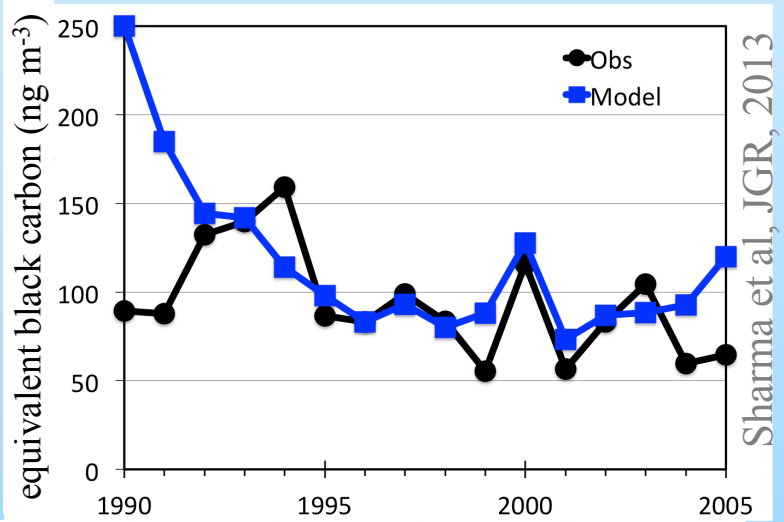
- **Some data reporting stations are missing due to on-going WDCA database upgrade (e.g., most stations with scattering also measure absorption)**

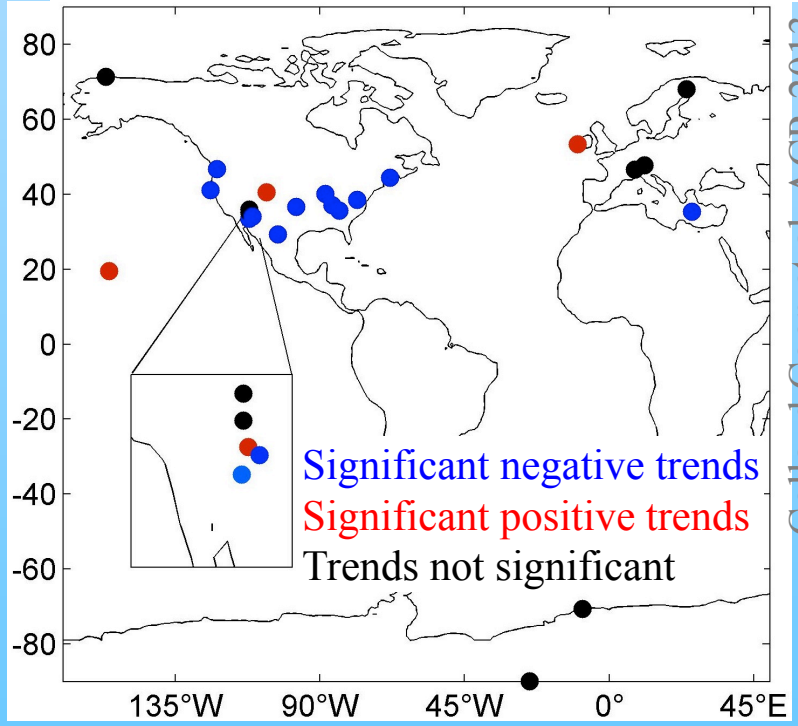
Scattering/absorption/CN statistics



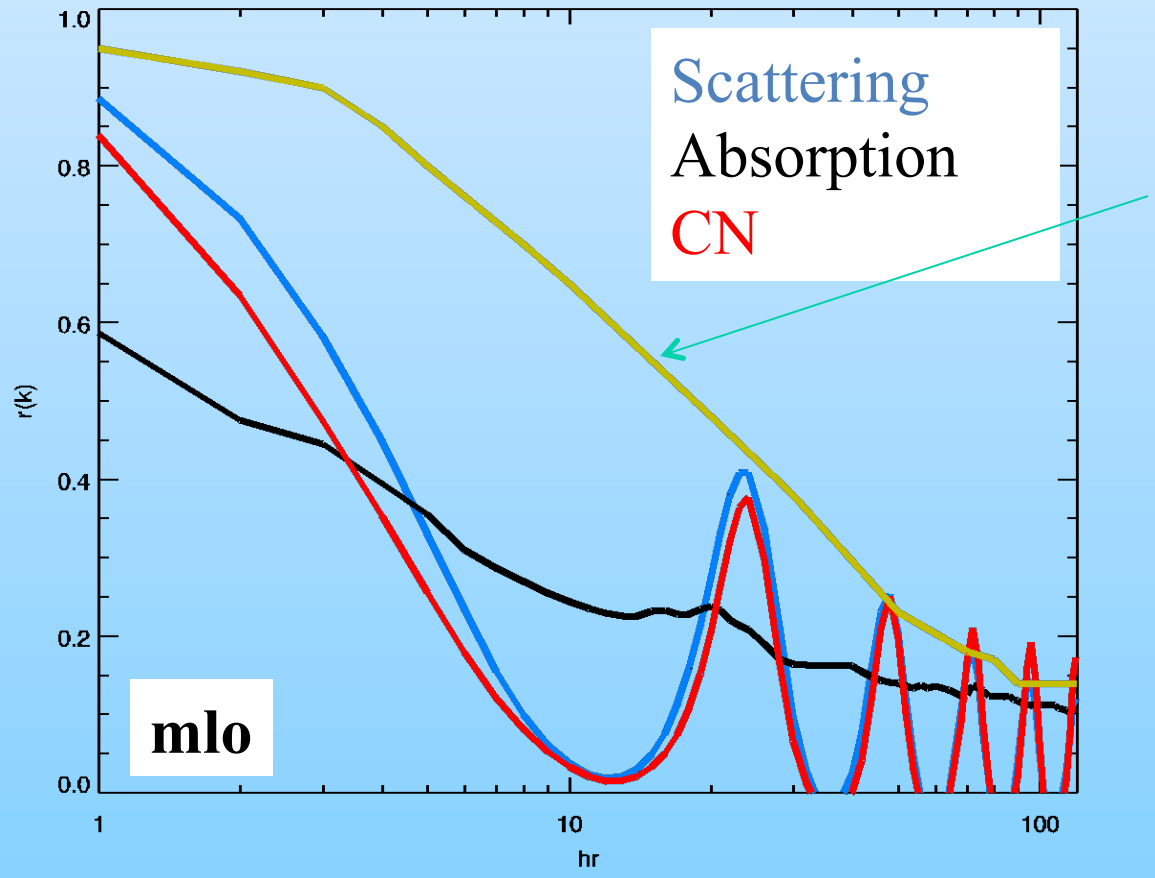
Aerosol Trends from GAW

- **Trends in light absorption**
  - Measurements interpreted as “equivalent” black carbon
  - NIES (Canada) model reproduces long-term, wintertime-average trend at Barrow
- **Trends in light scattering**
  - WMO/GAW and US/IMPROVE networks
  - Stations with at least 10 years of data submitted to World Data Center for Aerosols
  - 2-3 %/yr significant negative trend across US
- **A rich data set for evaluating models**





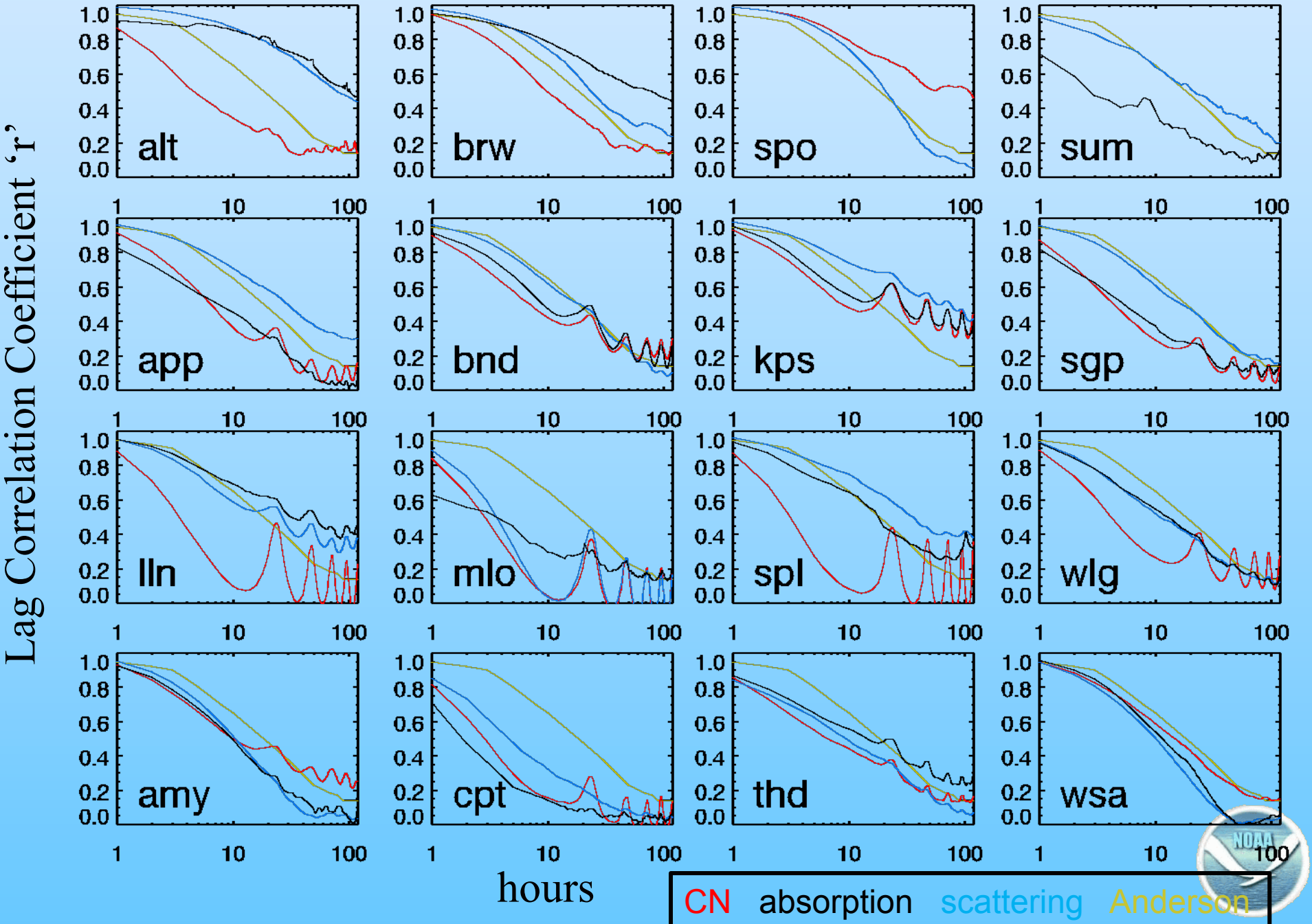
Lag Autocorrelation at the NOAA network sites



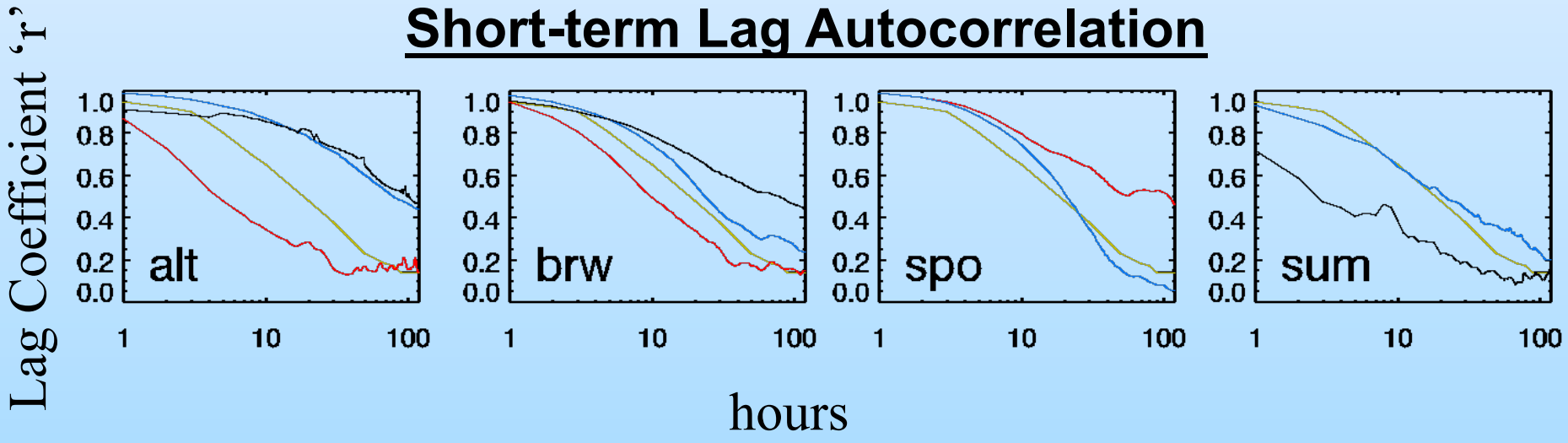
Autocorrelation for light scattering at Bondville (Anderson et al., 2003)

- **Lag autocorrelation plots can**
  - indicate timescales for comparing different data sources
  - suggest controlling processes

Short-term Lag Autocorrelation



Short-term Lag Autocorrelation

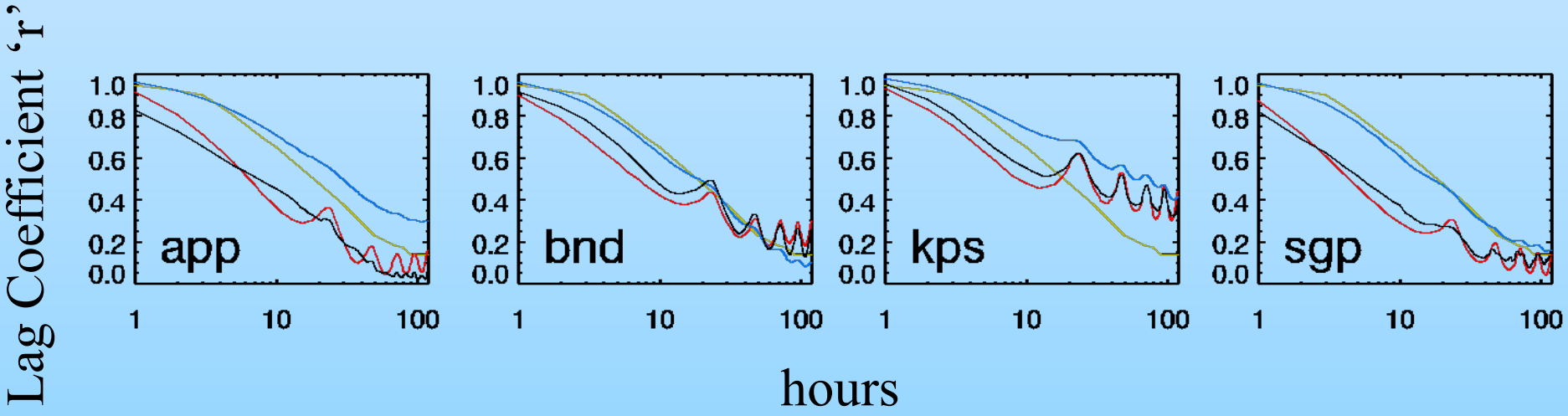


Polar sites:

- very persistent, i.e., above Anderson line (especially scattering, but also absorption at ALT and BRW and CN at SPO)
- no diurnal oscillations in CN

CN absorption scattering Anderson

Short-term Lag Autocorrelation



Continental sites:

→All sites show diurnal behavior in CN, but this may have different causes

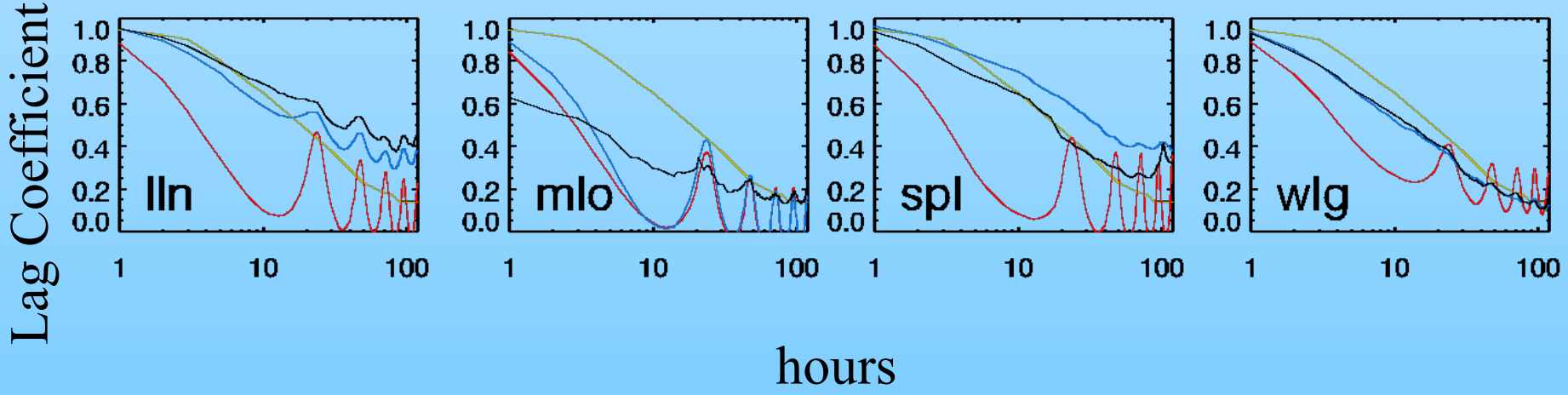
- APP – new particle formation (NPF) – don't see diurnal cycle in other params
- BND&SGP – source differences – CN and absorption have diurnal cycle, scattering does not
- KPS – Boundary layer dynamics and/or diurnal sources

CN absorption scattering Anderson

Short-term Lag Autocorrelation

Mountain sites:

- LLN&MLO – dominated by upslope/downslope flow – all parameters show diurnal cycles
- SPL&WLG – dominated by new particle formation – only CN shows diurnal cycle

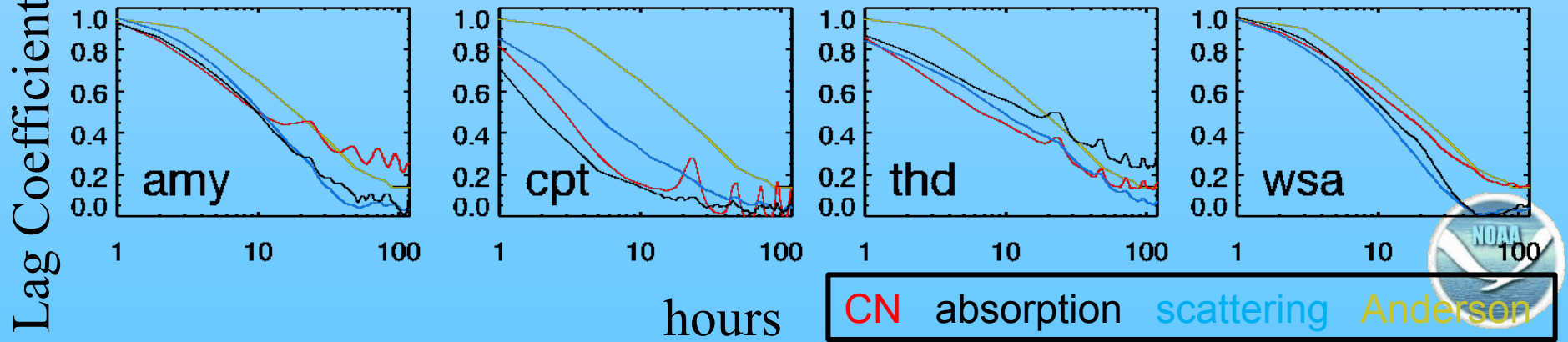


CN absorption scattering Anderson

Short-term Lag Autocorrelation

Coastal sites:

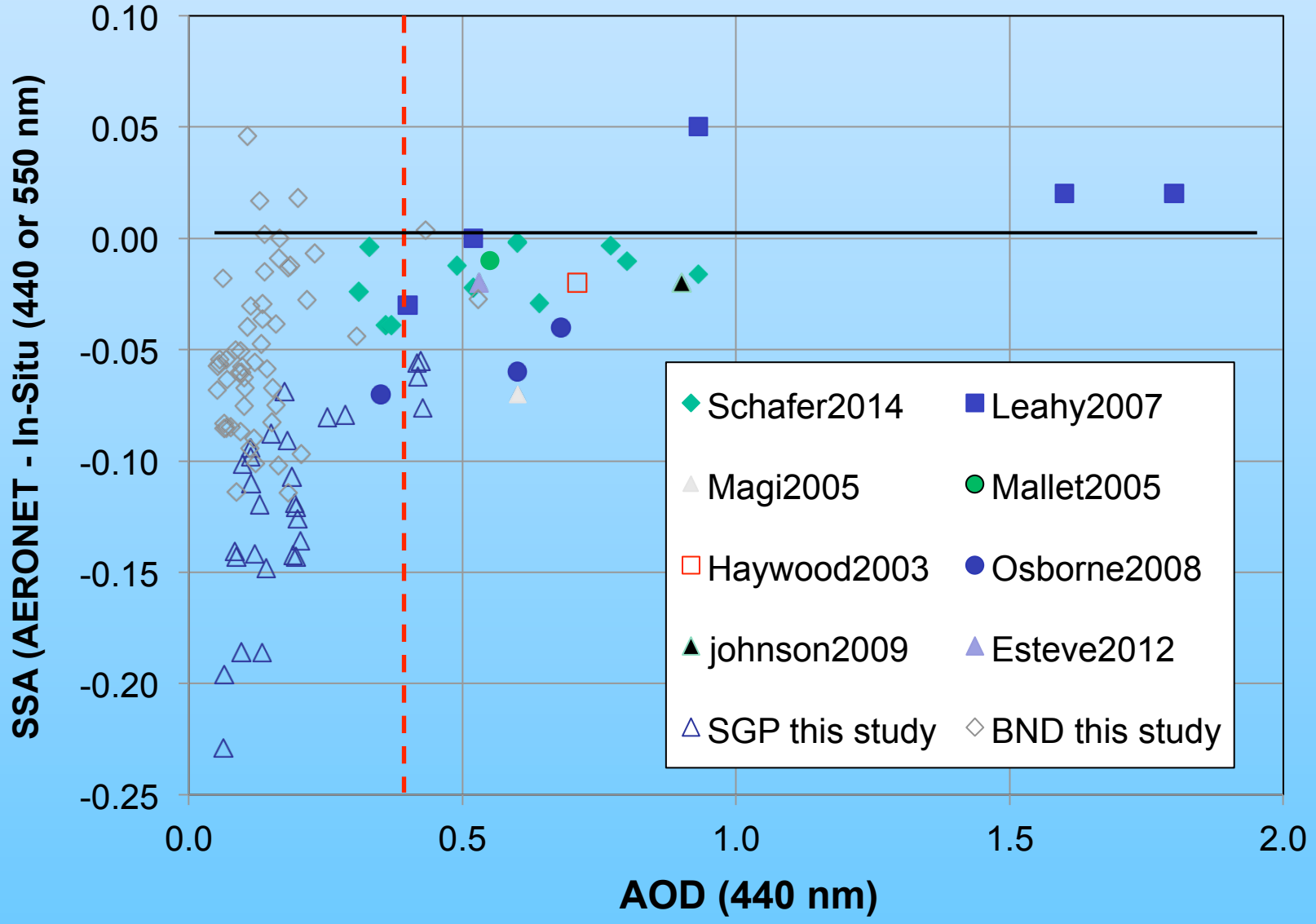
- AMY&CPT – indications of NPF – only CN shows diurnal pattern
- THD – local daily sources (harbor?) and/or onshore/ offshore – all parameters have hint of diurnal cycle
- WSA – remote, small island – no significant sources, not enough land mass to instigate onshore/offshore flow.



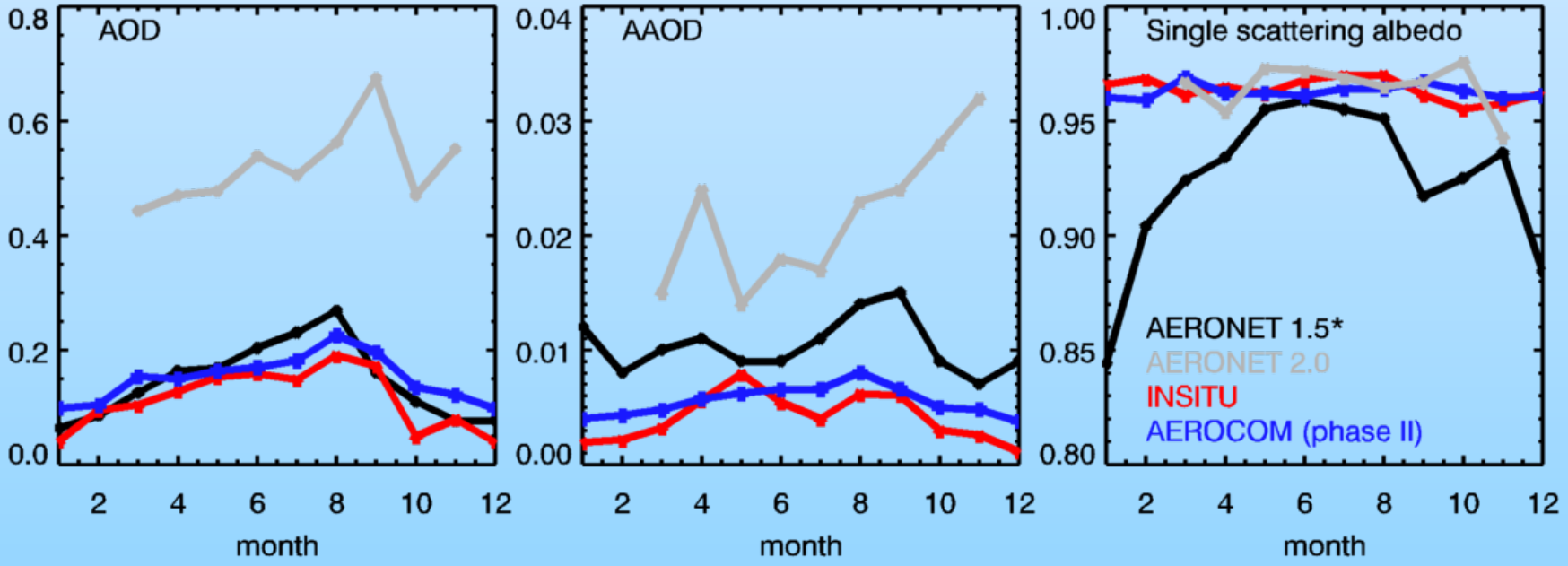
Comparisons of AERONET vs. In-situ

- Aircraft campaigns measure vertical profiles of aerosol light scattering and absorption to derive column-average single-scattering albedo and aerosol absorption optical depth
- AERONET Level 1.5 data shown when AOD_{440}<0.4, but only for cases when the Level 2.0 AOD almucantar retrieval was available (“Level 1.5*”)

AERONET SSA Direct Comparisons



Monthly comparisons at BND



- AERONET Level 2.0 AOD and AAOD are much higher than in-situ, model, and Level 1.5* results, as expected
- In-situ AOD and AAOD tends to be lower than AeroCom models
- AERONET Level 2.0 SSA agrees well with in-situ and model results, while Level 1.5* values are much lower (c.f., direct comparisons)