The NOAA/ESRL Global Collaborative Surface Aerosol Monitoring Network: The measurements, relation to the GAW Network and future possibilities for comparison and collaboration

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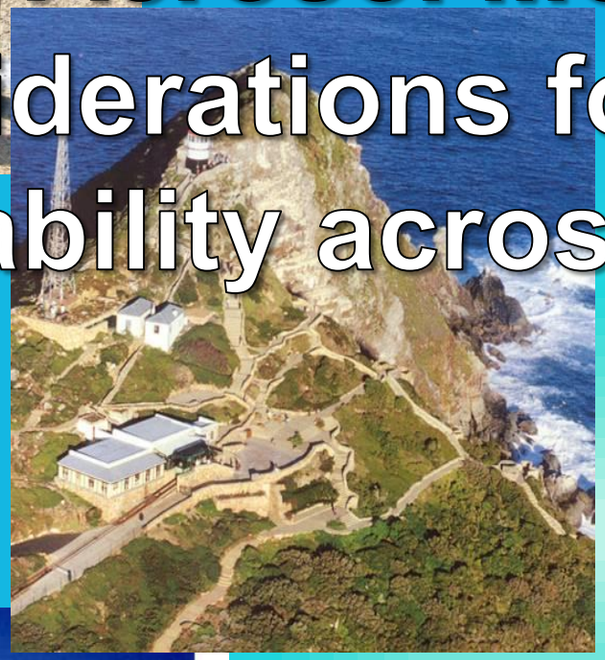
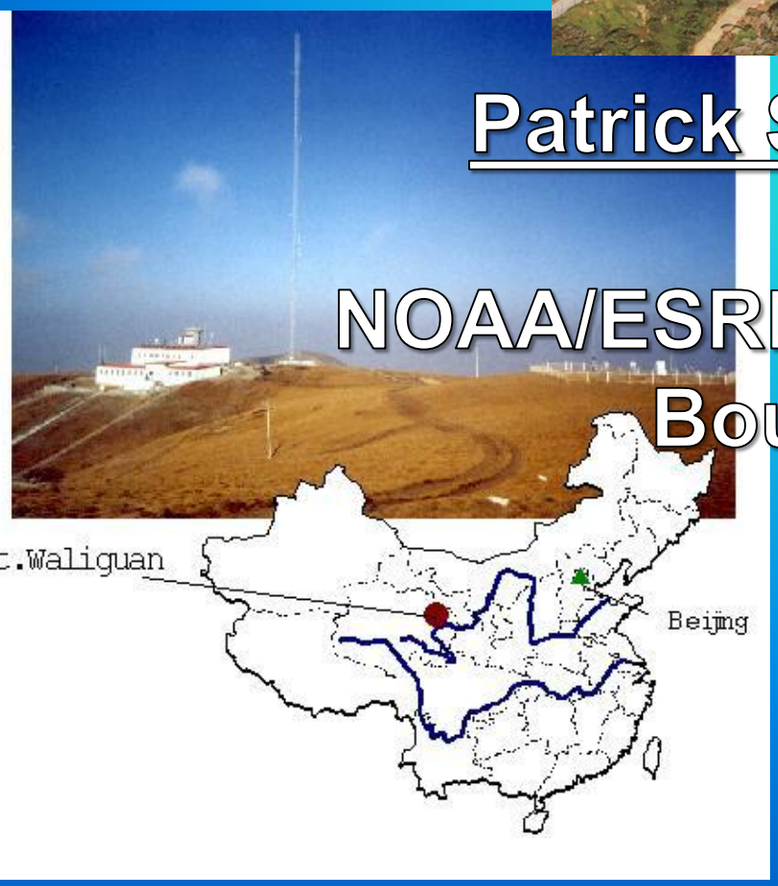


The NOAA/ESRL Global Collaborative Surface Aerosol Monitoring Network: Considerations for measurement comparability across network stations



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NOAA/ESRL Global Monitoring Division Aerosol Program

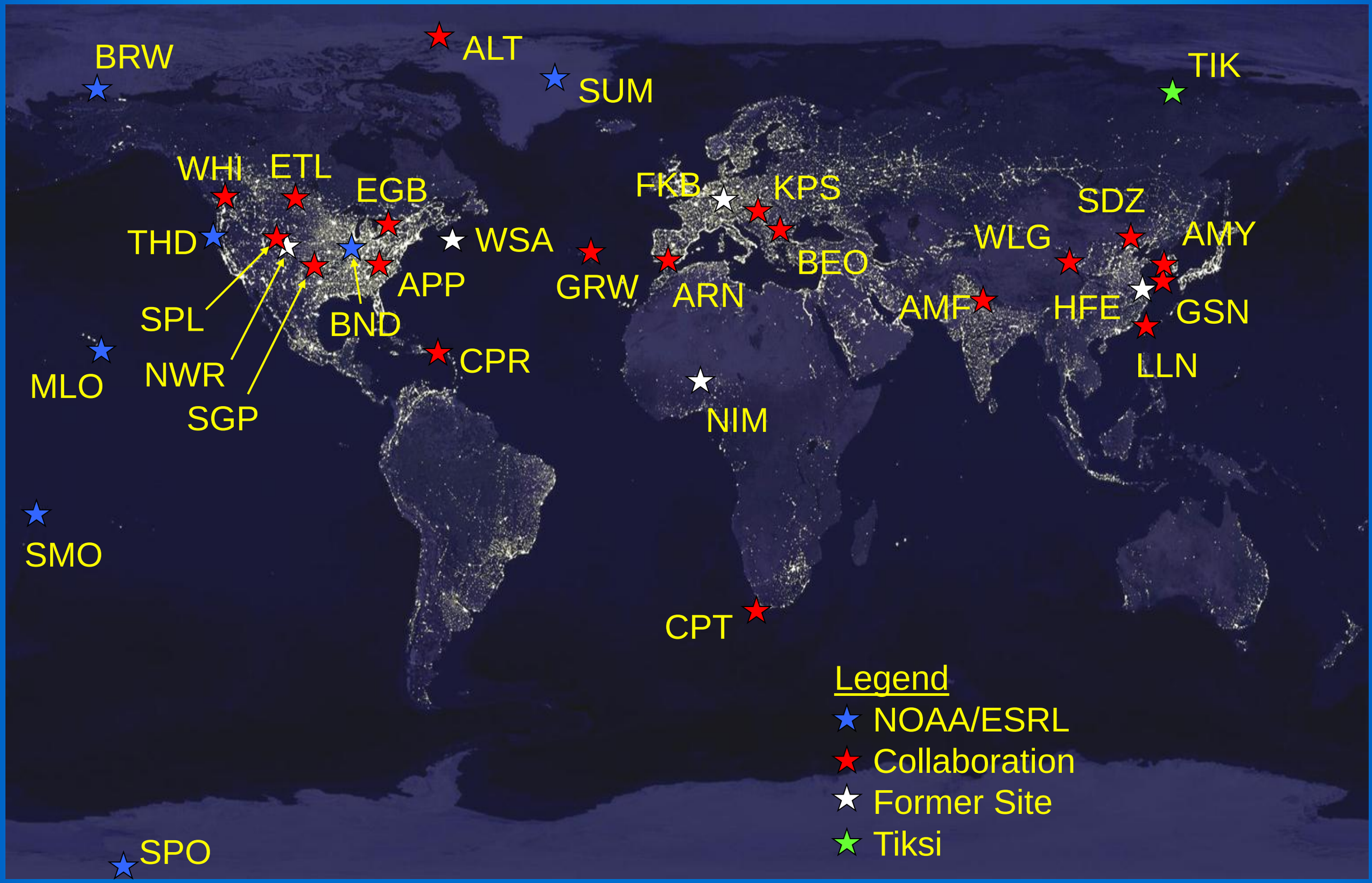
The major goals of this monitoring program are:

• to characterize means, variability, and trends of climate-forcing properties of different types of aerosols on regional scales, and to understand the factors that control these properties.

• to provide ground-truth for satellite measurements, as well as key aerosol parameters for global-scale models.

Requirement:
Need regional aerosol monitoring stations in different parts of the world sampling different types of aerosols (polluted, natural, background, etc.)

NOAA/ESRL Collaborative Global Surface Aerosol Monitoring Network in 2012



A Collaborative Global Aerosol Monitoring Network Model

NOAA/ESRL Approach:

- Find partners with scientific interest in long-term aerosol measurements (university researchers, other government agencies, other countries, etc.)
- Provide partners with:
  - proven designs for aerosol sampling infrastructure (e.g., inlets and sample conditioning, housekeeping data sensors, calibration methodology)
  - standardized support hardware, as funding allows (e.g., racks, modular components for sample conditioning and data acquisition)
  - standardized operating procedures, calibration schedules, maintenance schedules, etc.
  - GMD-developed and supported data acquisition, visualization, data processing, QC editing, and archiving software
  - Technical assistance in station operation

Need for standardization of sampling methods, data collection, data processing, data QC editing, etc.

Standardization issues related to aerosol measurements:

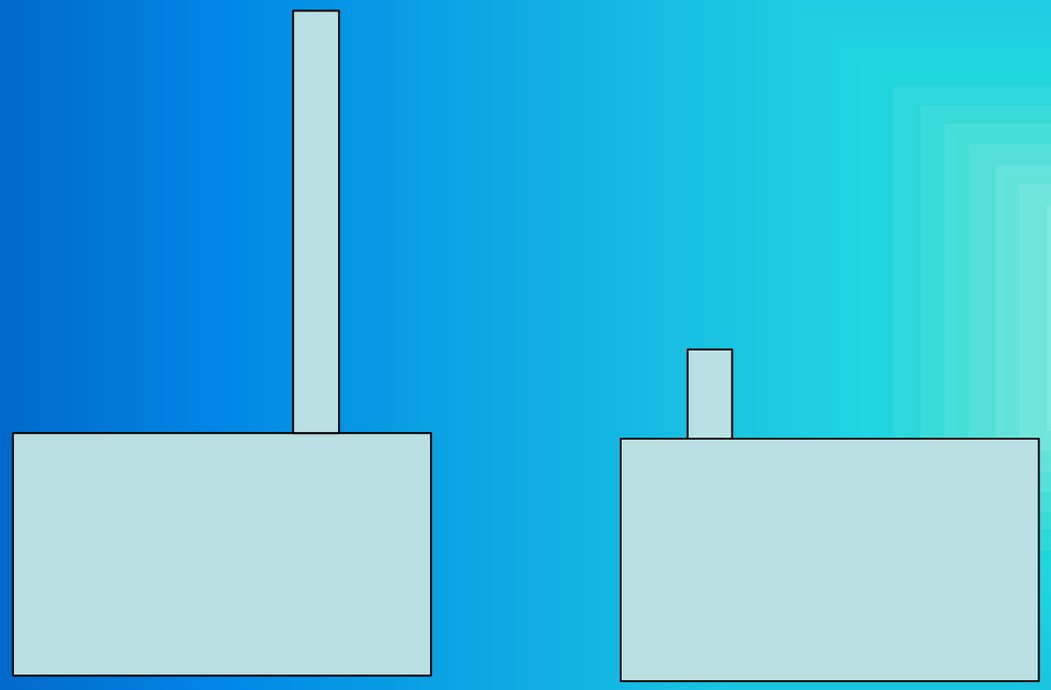
- Inlet height above ground or canopy (can affect sampled particle size and composition)?
- Sampling line sizes, materials, pickoffs, and flow rates optimized to promote maximum passing efficiency for particles of interest?
- RH control (difficult to compare sites at different RH conditions)?
- Particle size cuts?
- Measurement observation frequency?
- Has a common, non-drifting time stamp been applied to all instruments?
- Measurements reported at what conditions (e.g., instrument, ambient, standard)?
- Have all known instrument corrections been applied?
- In what order have the corrections been applied?
- Have QC editing strategies been discussed for consistency between different users (e.g., how is local contamination identified)?

Examples

Inlet height

Inlet at 10 m above surface

Inlet at 5 m above surface



Inlet height concerns:

- Fall off of larger particles with altitude
- Building effects on the wind field
- Different particle transmission efficiencies through different lengths of inlet

Sample RH (controlled or variable)

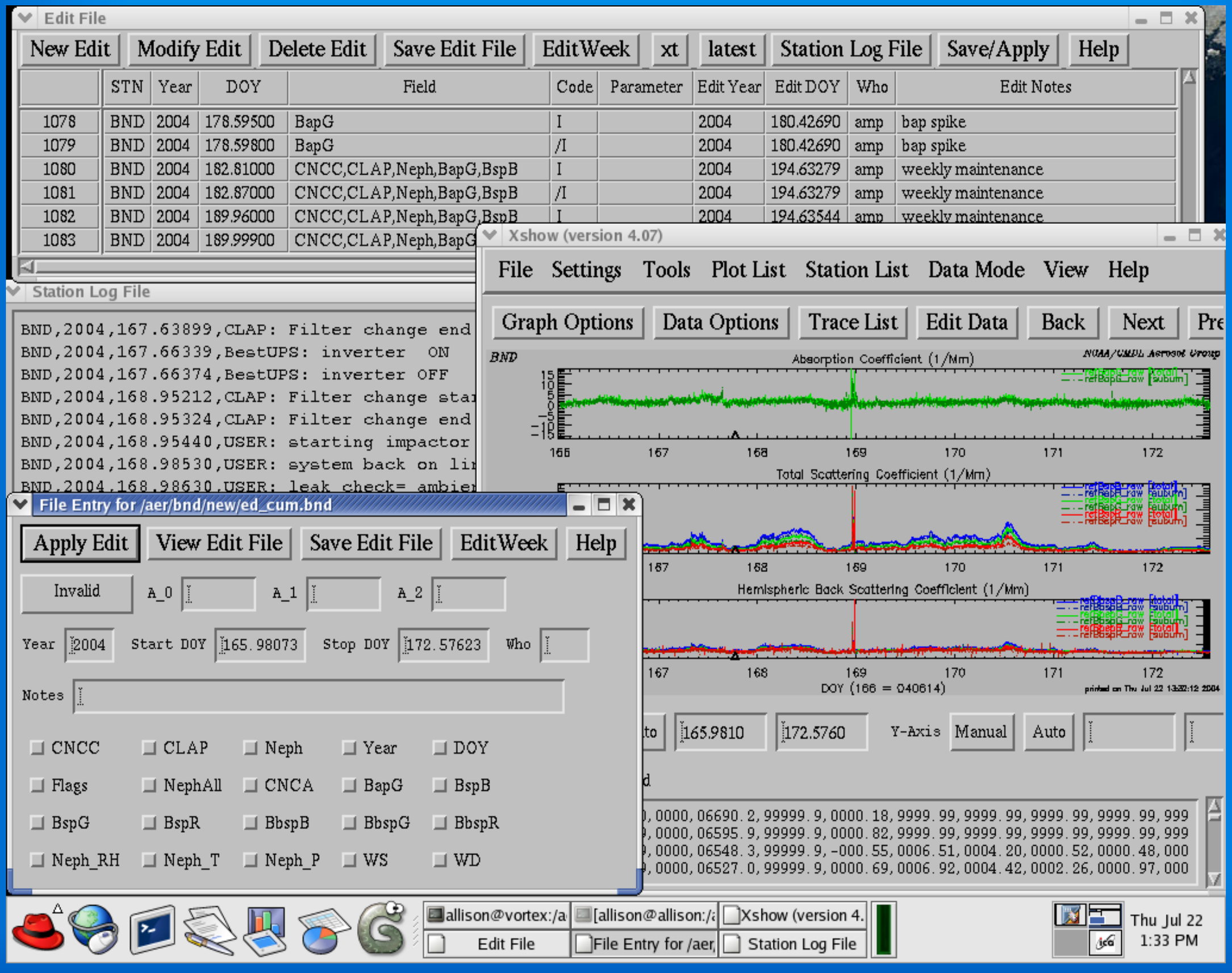
Measurement made at low controlled RH

Measurement made at ambient or instrument RH

RH < 40%, particle is essentially dry, optical properties vary due to the nature of the aerosol

RH ~ 70%, particle is wetted, same particle is larger than dry case, different size and refractive index than dry case.

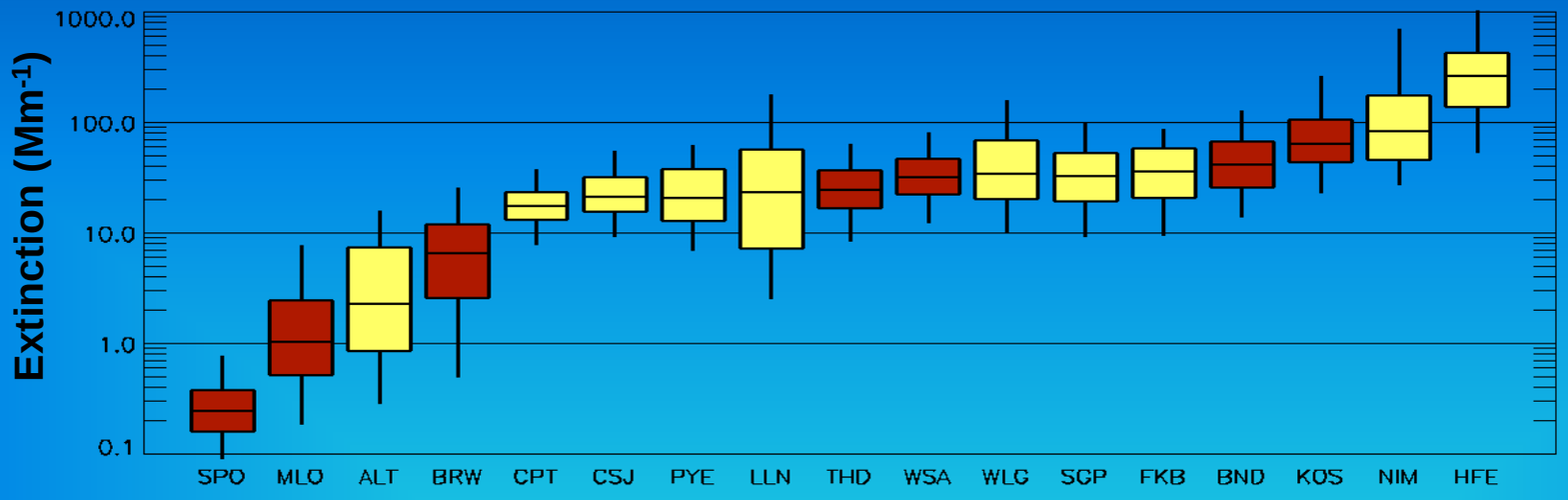
Data Visualization/Data Editing Software



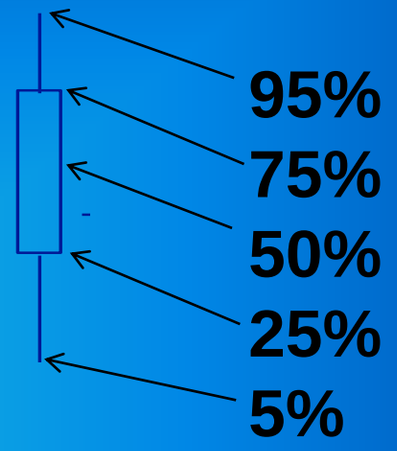
Summary of NOAA Network Collaboration Benefits

- Proven design of sample inlet and sample conditioning system
- Construction and fabrication drawings are provided
- One data acquisition/instrument control system for all instruments
- A single time stamp for all recorded measurements
- Easy to use data visualization/data editing tools
- Known corrections to measurements are automatically and consistently applied across all network stations
- Raw and final data are archived at NOAA and at the collaborator's institute
- Final data are automatically translated into proper format for ingest into WDCA data archive.

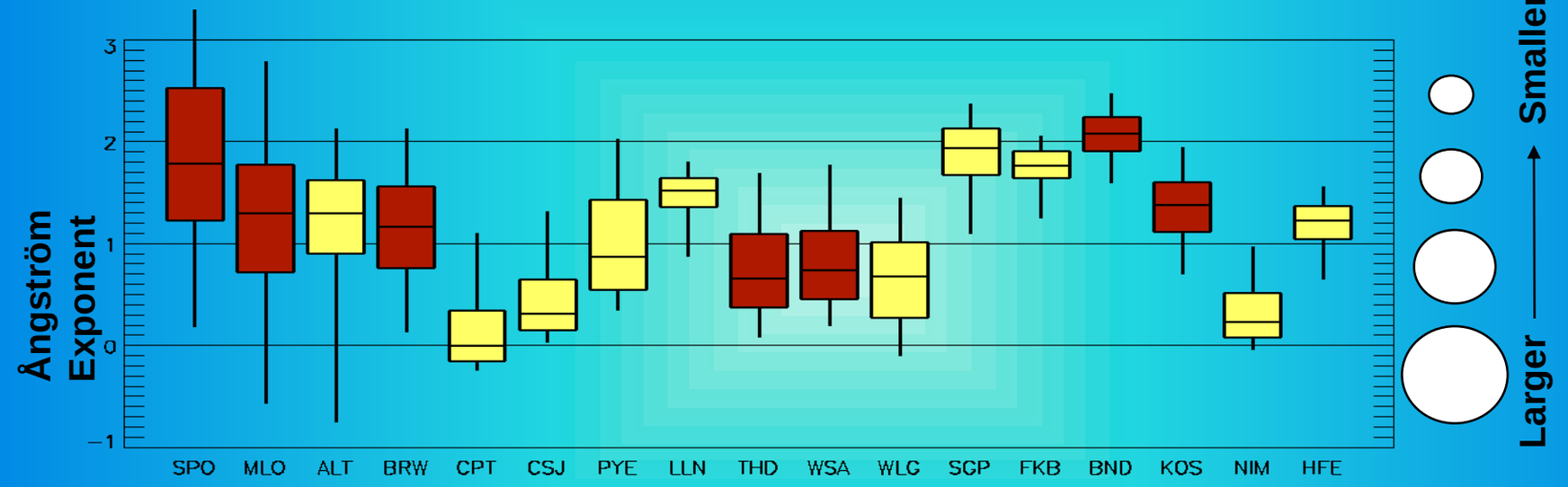
Variations in Aerosol Amount and Type

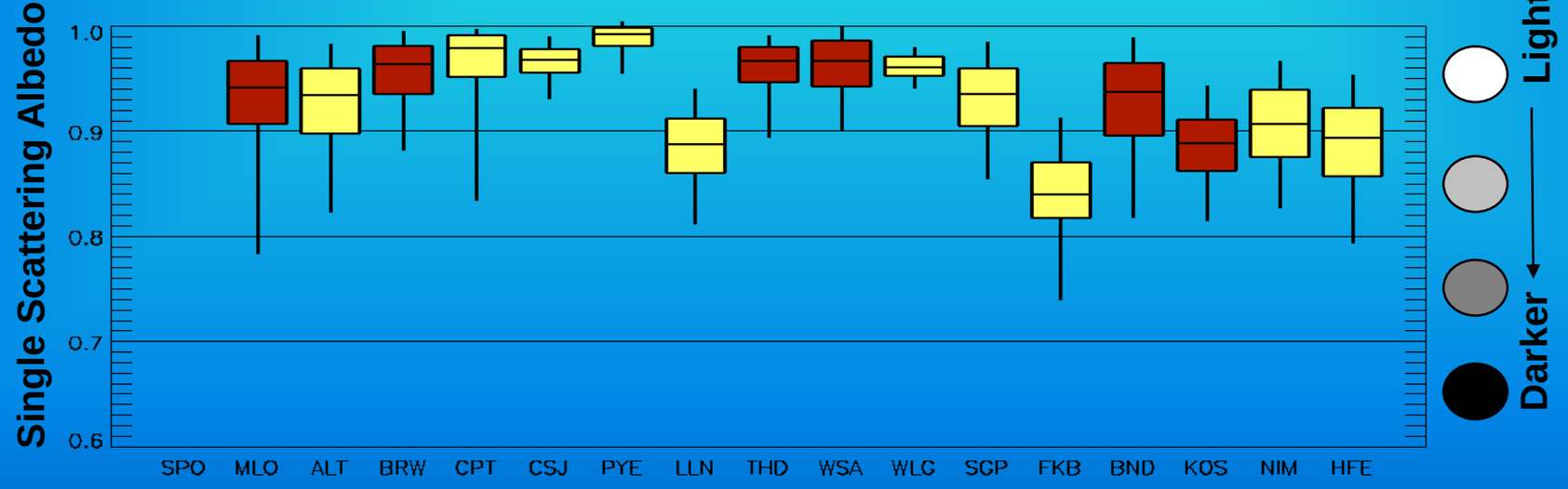


Percentiles



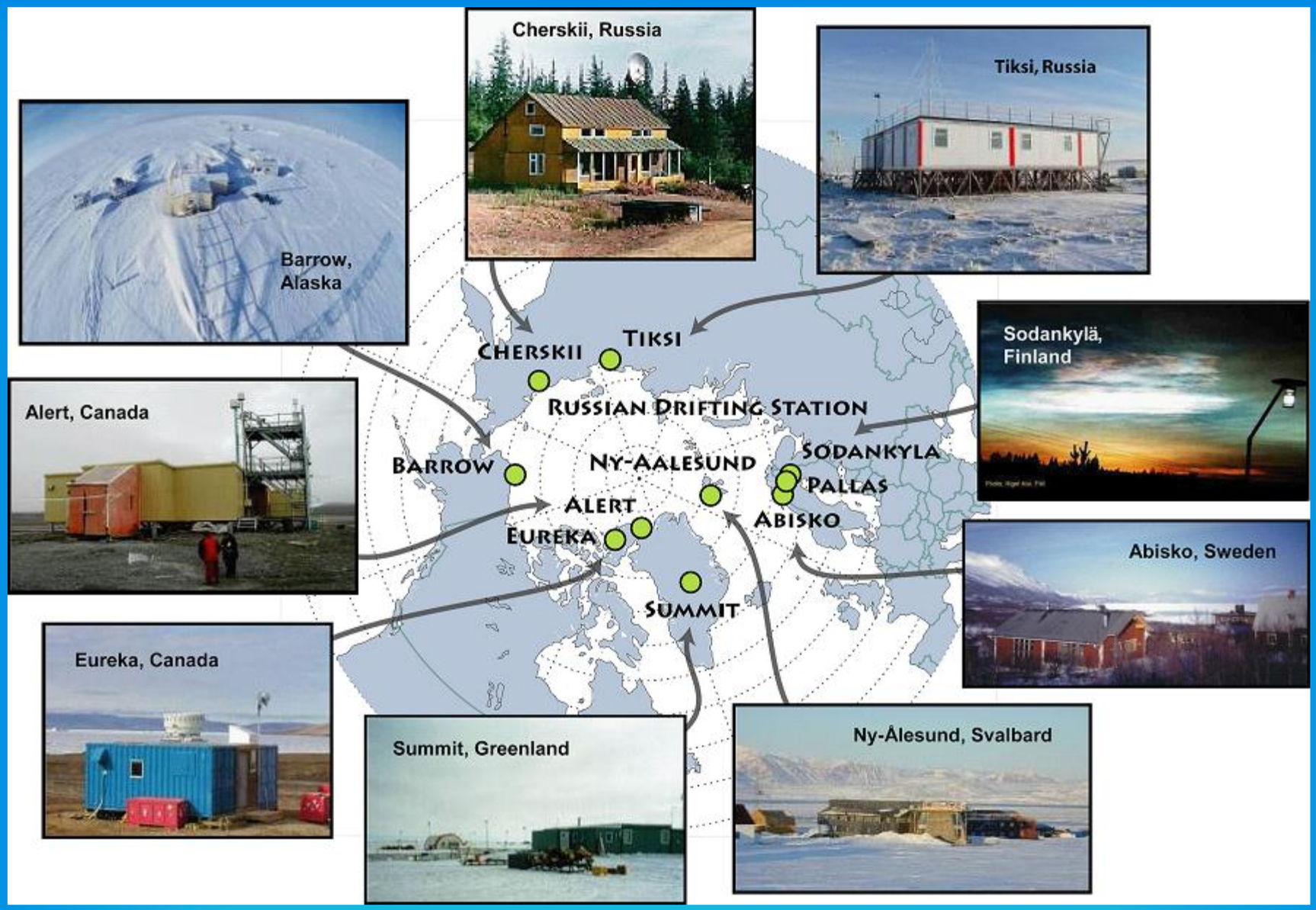
Very Clean → **Less Clean**





A rich data set for evaluating chemical transport models!

Comparison of Data Between IASOA Network Stations



Need to discuss:

- Measurement comparability across network stations
- Maintenance and calibration schedules and methods
- Data processing and QC editing procedures and strategies
- Data archiving in a way that facilitates data exchange and comparison

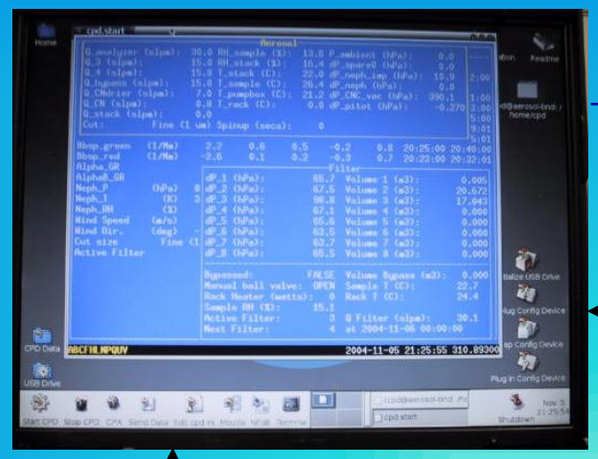
Thank you for your attention!

Collaborators (Past, Present, Future)

- DOE Atmospheric Radiation Measurement Program (SGP, NIM, FKB, HFE, SPL, AMF (India))
- Environment Canada (WSA, ALT, BRM, EGB, WHI)
- WMO Global Atmosphere Watch Program (CPT, WLG)
- China Meteorological Administration (WLG, SDZ)
- South African Weather Service (CPT)
- University of Puerto Rico (CPR)
- University of Pannonia, Hungary (KPS)
- Georgia Tech Iniversity (SUM)
- Bulgarian Academy of Sciences (BEO)
- Taiwan Environmental Protection Agency (LLN)
- Taiwan National Central University (LLN)
- Appalachian State University, North Carolina, USA (APP)
- Instituto Nacional de Tecnica Aeroespacial (ARN)
- Korea Meteorological Administration (AMY)
- Seoul National University (GSN)
- NOAA SEARCH Program (TIK)
- Roshydromet (TIK)
- Others?

NOAA/GAW Aerosol Data Flow

Field data system



ftp

ssh + VNC

NOAA server

ssh + VNC

ftp

ftp

ssh + rsync

firewall

WDCA archive

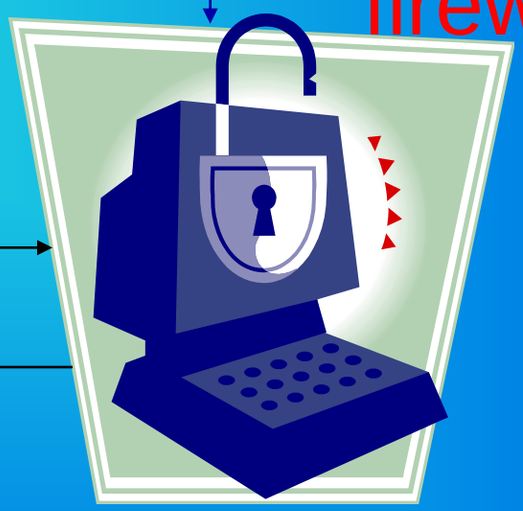
World Data Center for Aerosols

ftp

Site operator

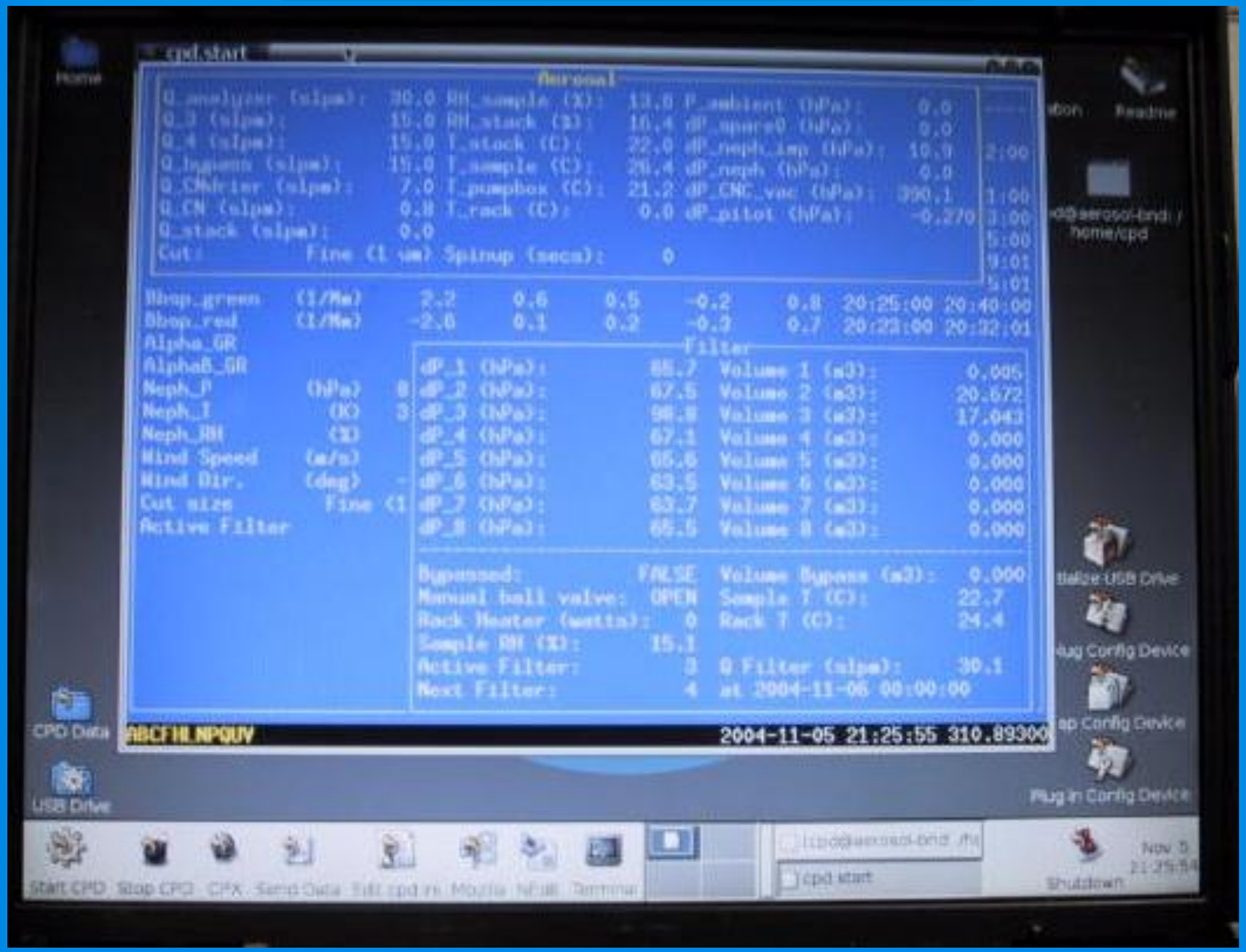
ssh + NX

sftp



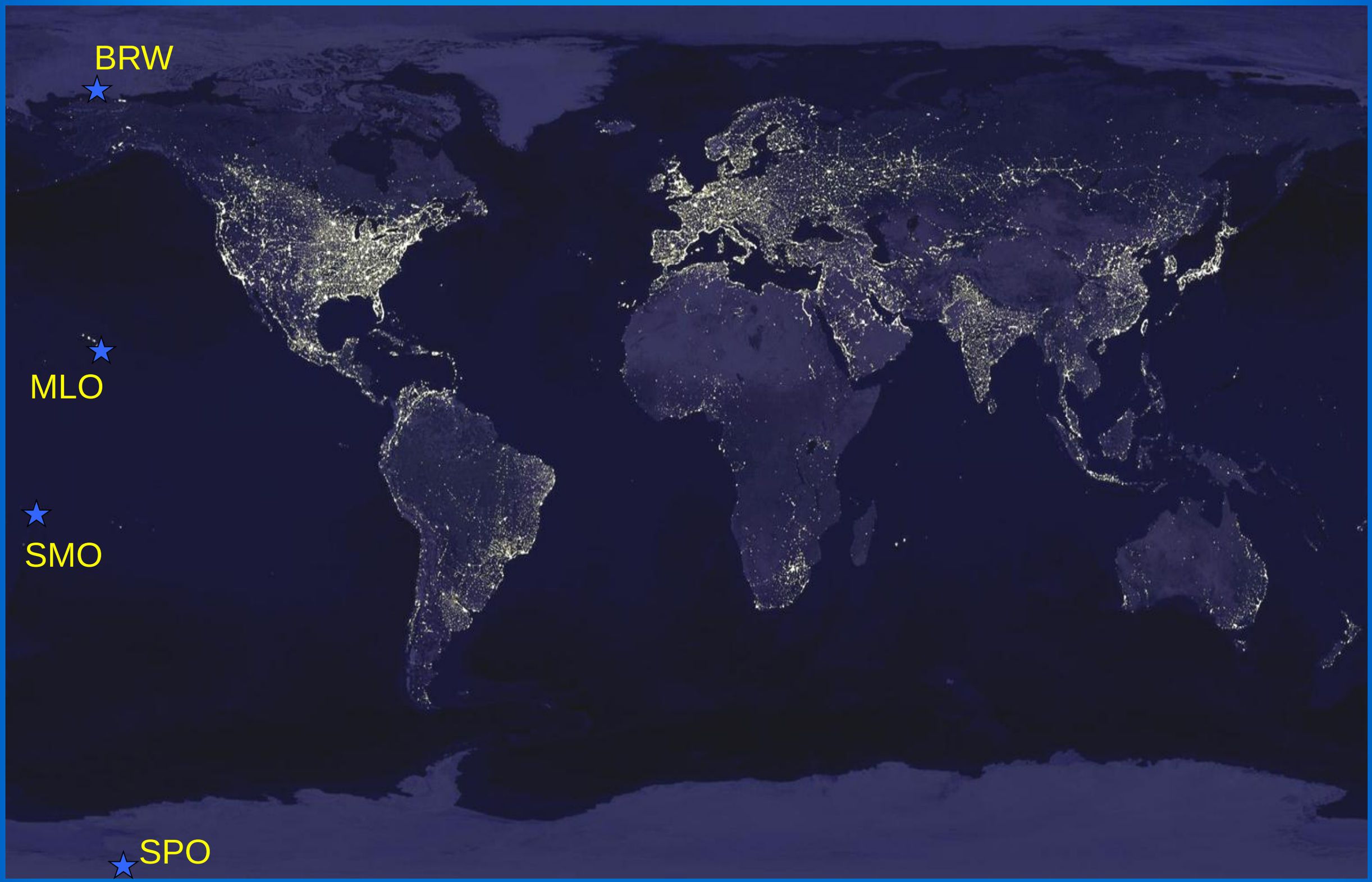
GAW workstation at NOAA

Data Acquisition and Instrument Control Software on Boot CD



ftp://ftp.cmdl.noaa.gov/aerosol/etc/cpd/cpdlive.iso

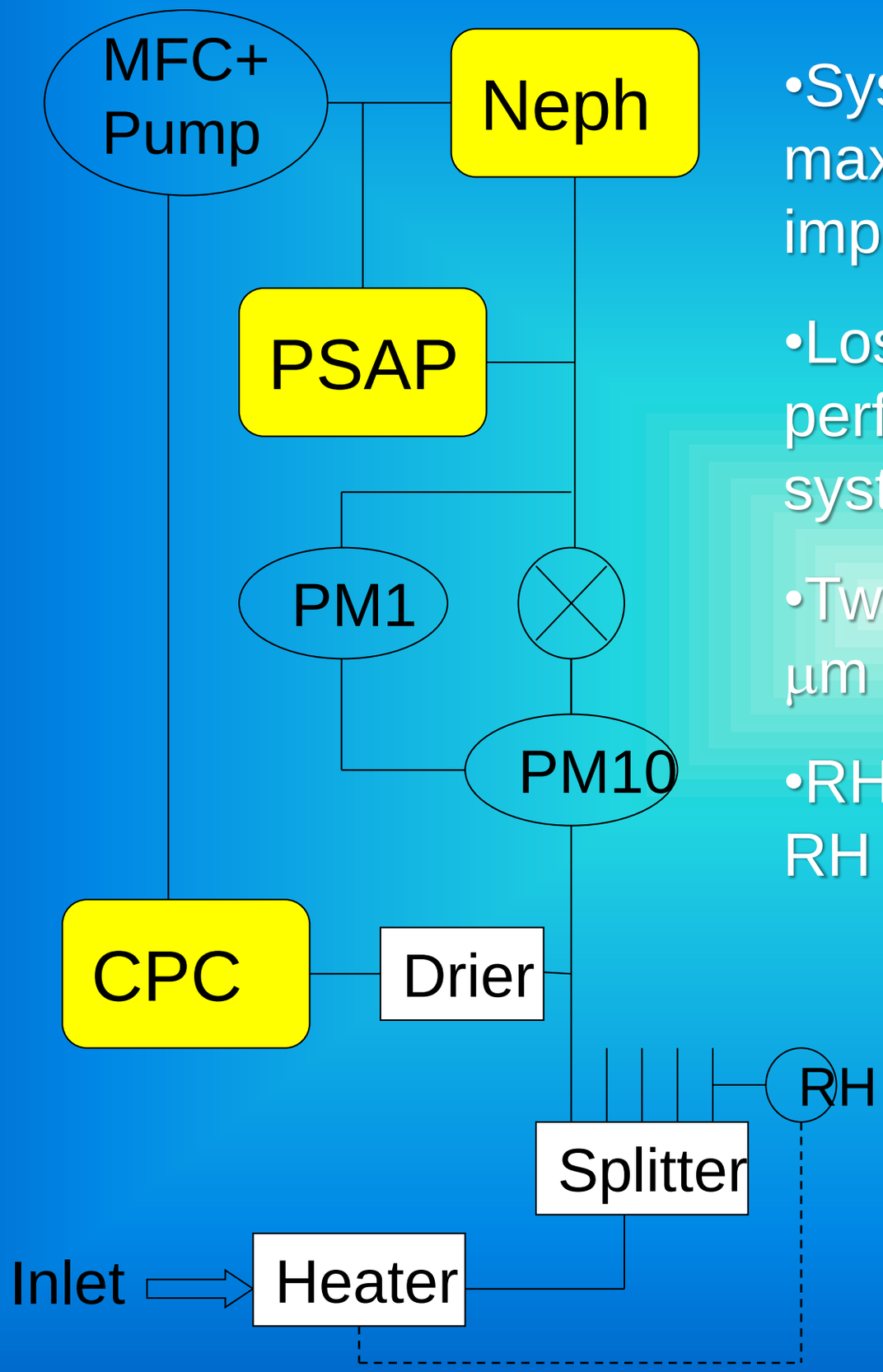
NOAA/ERL Baseline Aerosol Monitoring Network in 1985



NOAA Aerosol Rack at Mauna Loa, Hawaii

- Provides size- and RH-controlled measurements of aerosol
  - light scattering
  - light absorption
  - number concentration
- Common, core design at NOAA-federated stations
- Optional components: CCN, humidified nephelometry (f(RH)), SMPS, aerosol composition

NOAA Basic Aerosol Sampling System



- System flow rates are designed to maximize passing efficiency of optically important particles.
- Loss calculations have been performed for all parts of the inlet system
- Two size cuts: Dp < 1 μm and Dp < 10 μm
- RH control to keep a low and stable RH in the system

Collaboration Details

Collaborator supplies…

- **A commitment to long-term site operation**
- **Most of the equipment (i.e., major instrument systems)**
- **Station technicians for daily system checks, maintenance, troubleshooting, etc.**
- **Long-term station operation costs (site, power, internet, etc.)**
- **Data quality checking and editing**

Result: A long-term, cooperative program with shared data access, making atmospheric measurements that are directly comparable with the other stations in the network and following established aerosol sampling protocols (e.g., NOAA, GAW)

NOAA/ESRL supplies…

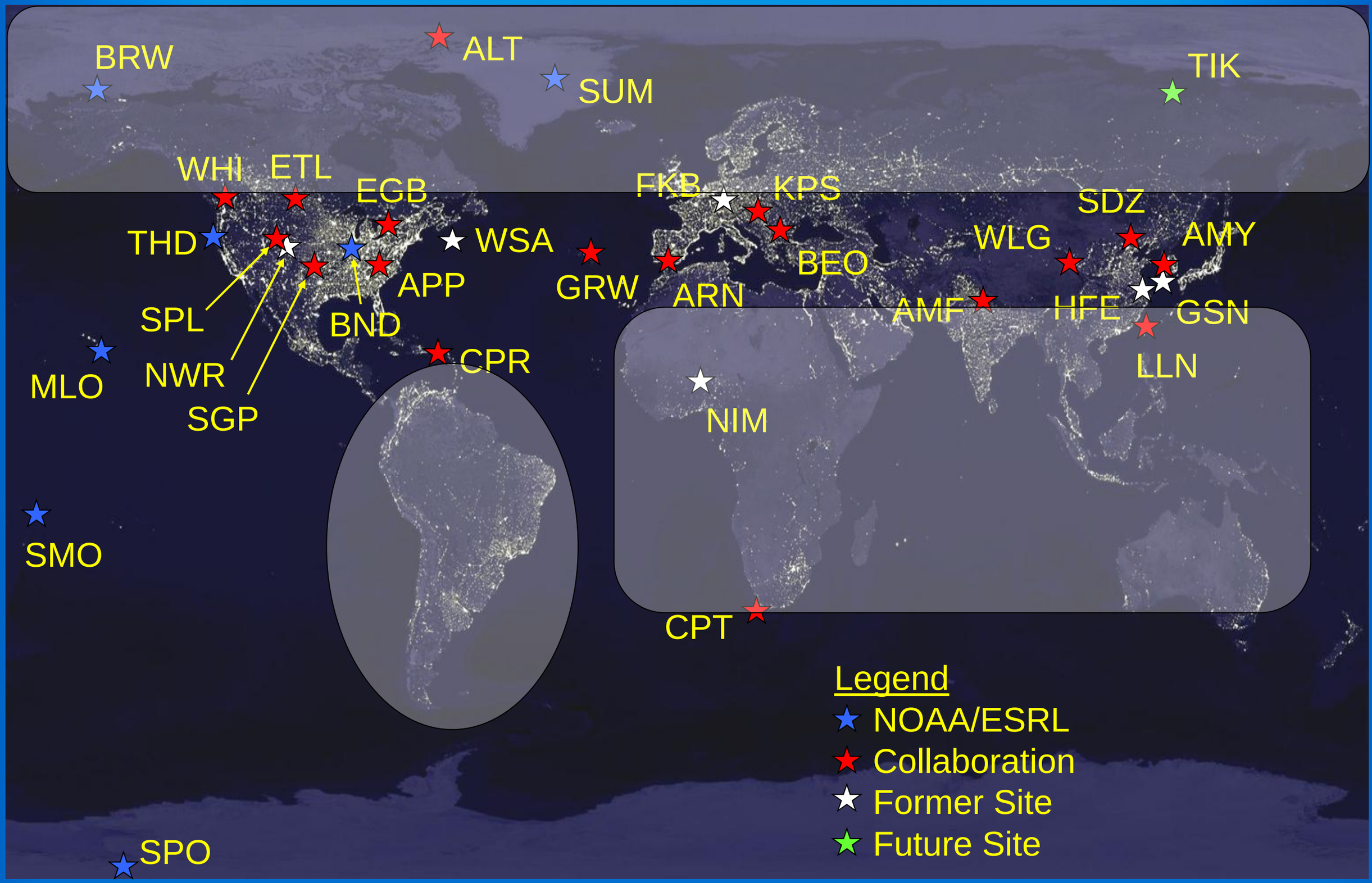
- **Site visit(s), design assistance**
- **Initial installation assistance and instrument calibrations**
- **Some equipment (e.g., support hardware, process controllers, etc.)**
- **Training (hardware, software, data QC editing, etc.)**
- **Automated data transfers and processing, including all known corrections for the measurements**
- **Data visualization and editing software**
- **Future assistance and troubleshooting support**

Future possibilities for comparison and collaboration with NOAA network aerosol measurements

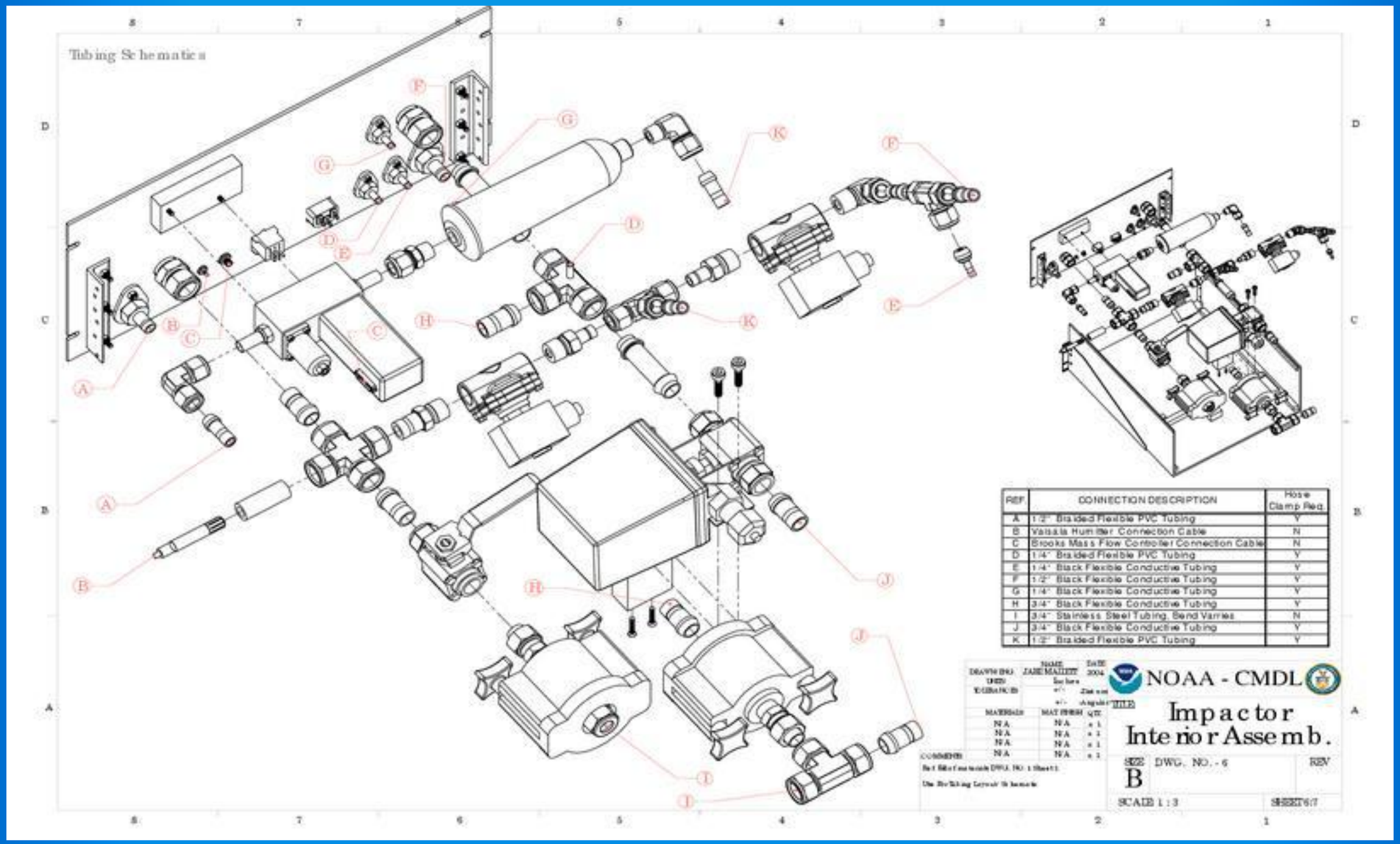
Proposed FMI Measurements at Tiksi:
Integrating nephelometer, ultrafine CPC, MAAP, SP2, CCN.

- NOAA aerosol data from BRW and SUM; also other mid-latitude stations to evaluate transport
- Aerosol data from Canadian collaborative stations (e.g., ALT, etc.)
- NOAA aerosol data from Tiksi?

Network Gaps



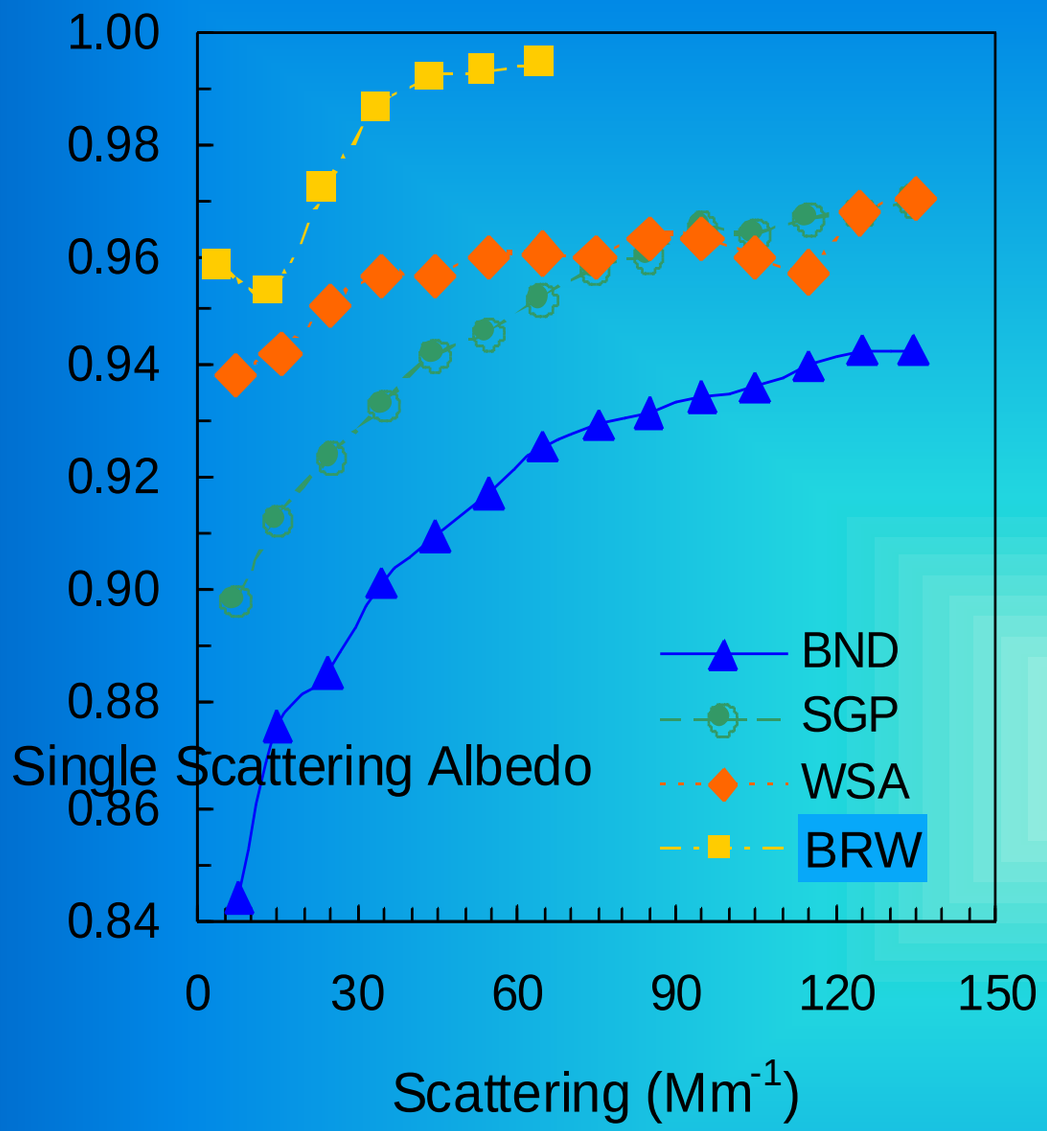
Construction Schematic (example)

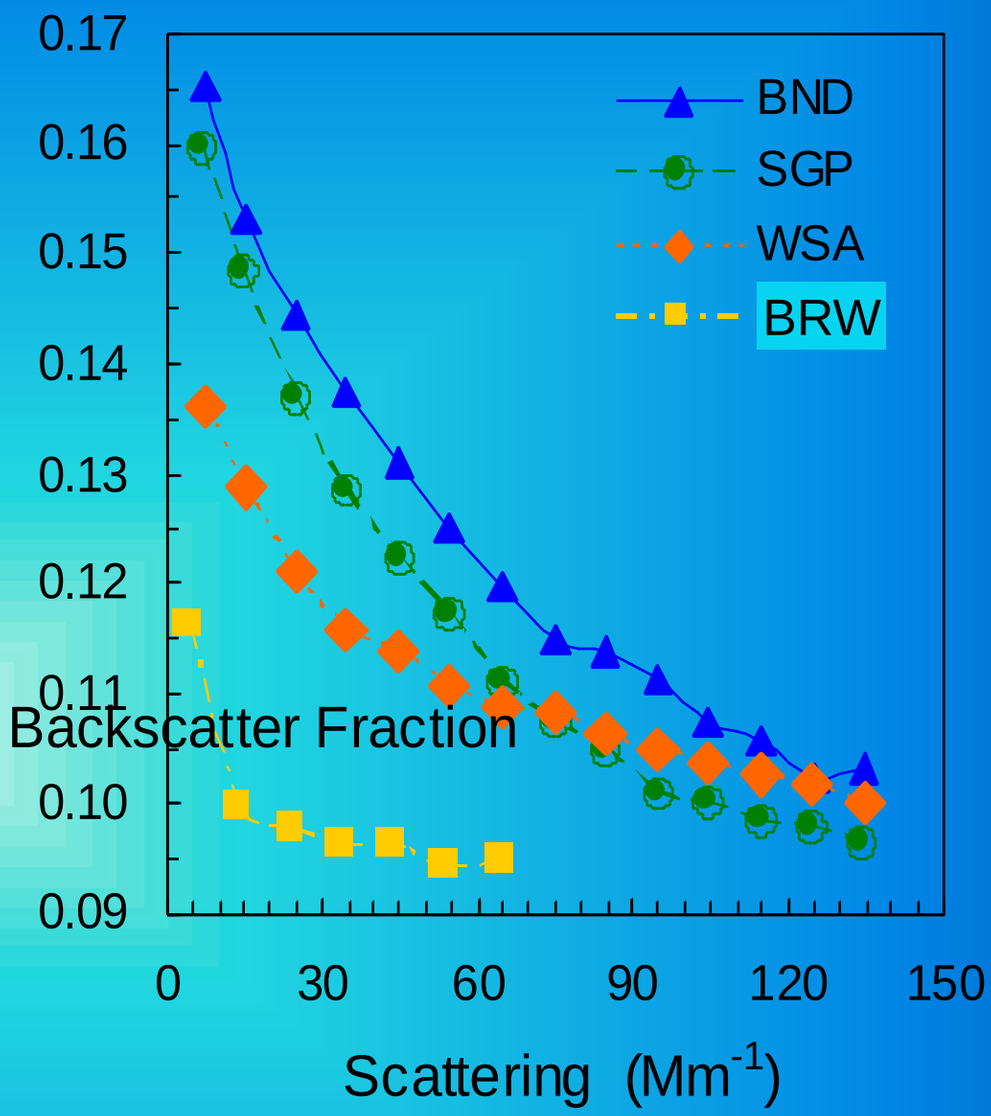


REF	CONNECTION DESCRIPTION	Hose Clamp Req.
A	1/2" Braided Flexible PVC Tubing	Y
B	Vaisala Humitter Connection Cable	N
C	Brooks Mass Flow Controller Connection Cable	N
D	1/4" Braided Flexible PVC Tubing	Y
E	1/4" Black Flexible Conductive Tubing	Y
F	1/2" Black Flexible Conductive Tubing	Y
G	1/4" Black Flexible Conductive Tubing	Y
H	3/4" Black Flexible Conductive Tubing	Y
I	3/4" Stainless Steel Tubing, Bend Varries	N
J	3/4" Black Flexible Conductive Tubing	Y
K	1/2" Braided Flexible PVC Tubing	Y

ftp://ftp.cmdl.noaa.gov/aerosol/doc/drawings

Is Systematic Variability Related to Scavenging?

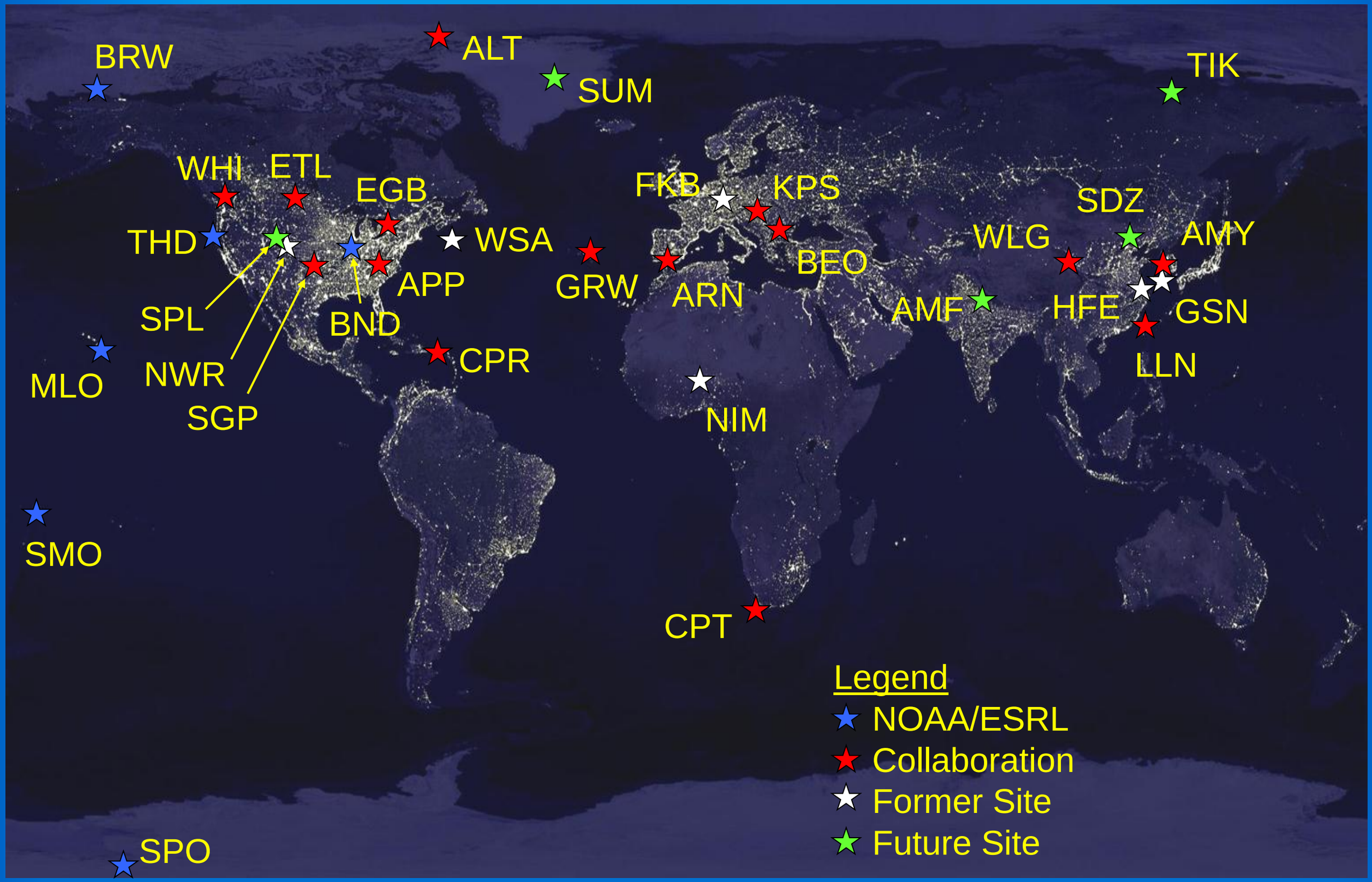




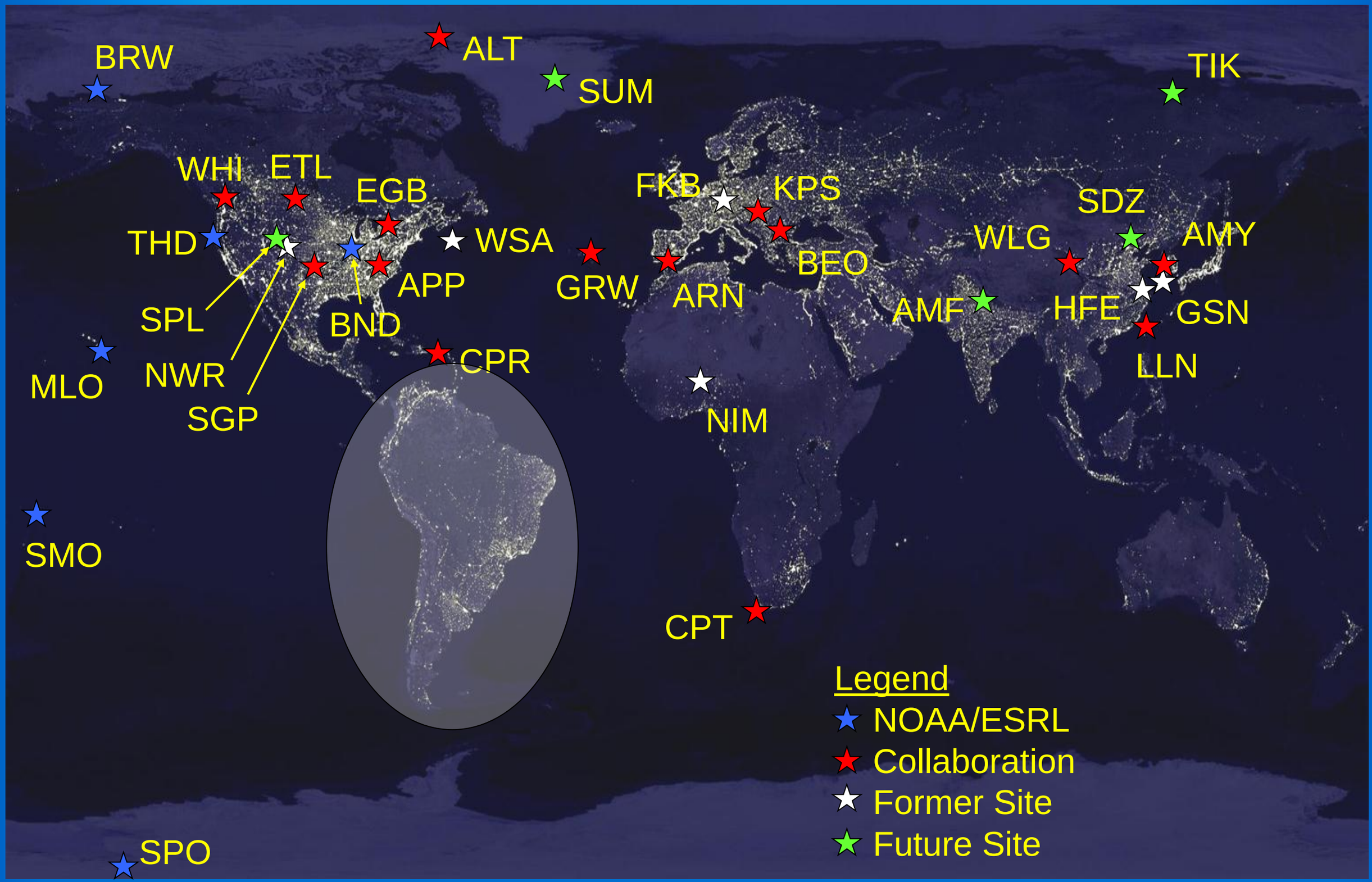
From Delene and Ogren, 2002

Surface and aircraft data from a wide range of places show similar behavior: the lowest single-scattering albedos and highest backscatter fractions occur under the cleanest conditions for that site.

Network Gaps



Network Gaps



Network Gaps