Overview and Selected Results from the NOAA Federated Aerosol Network

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The NOAA Earth System Research Laboratory maintains Baseline Observatories to monitor the atmospheric background levels of trace gases and aerosols. Measurements at these remote sites permit us to determine to what extent the global backgrounds are changing over time. Since aerosols are perturbed near the sources, these Observatories are in prime locations to assess baseline changes to the atmospheric aerosol.

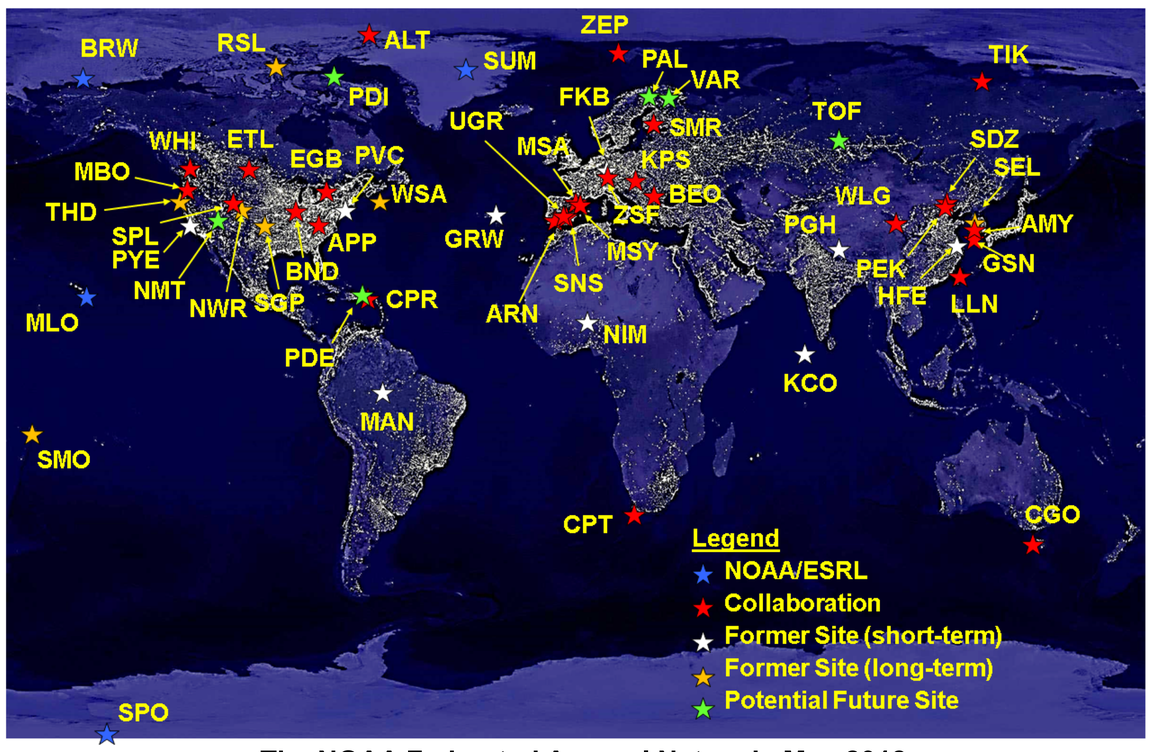
In order to assess anthropogenic aerosol radiative forcing and its contribution to global climate forcing, ESRL has expanded its network of surface aerosol monitoring sites to locations that are at times influenced by human activities and emissions. This long term strategy allows us to determine to what extent the forcing is caused by human activities. Unfortunately, NOAA's remote Baseline Observatories are not in ideal locations for this research effort, so we have had to expand the network to include regional monitoring stations around the world that experience different aerosol types and different degrees of human influence. These new regions include a major anthropogenic aerosol source region (southeast Asia), a region considered the bellwether of global climate change (the Arctic), and other perturbed areas.

The cost-effective way we chose to do this was to foster collaborations between NOAA/ESRL and interested science/academic organizations in the US and around the world. The collaborations we have developed present significant advantages for both parties. This poster describes the essence of these collaborations.

Approach

Find partners with scientific interest in long-term aerosol measurements. 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 (racks, modular components for sample conditioning and data acquisition)**
- **standardized sampling protocols and operating procedures**
- **GMD-developed and supported data acquisition, processing, visualization, editing, and archiving software**



The NOAA Federated Aerosol Network, May 2018

Collaboration Details

NOAA/ESRL supplies …

- **Initial site visit, CAD drawings, 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**

Collaborator supplies…

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

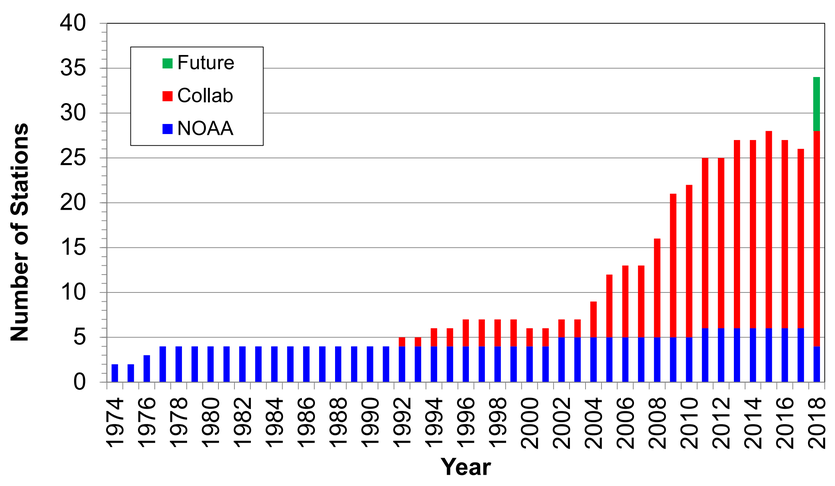
Result

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)

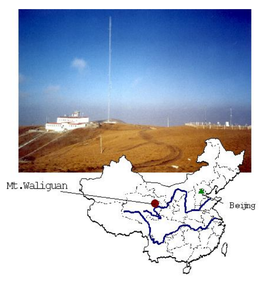
The NOAA/ESRL Aerosol System

- **Basic aerosol system is deployed throughout the Federated Aerosol Network. Major collaborators include the Global Atmosphere Watch (GAW) Program, Environment and Climate Change Canada, and China Meteorological Administration.**
- **Requires internet connection and allows for remote real-time access to aerosol system**
- **Primary long-term measurements are aerosol light scattering, backscattering, absorption, and total particle concentration, with additional measurements (e.g., CCN, aerosol hygroscopic growth, particle size distribution, aerosol filter chemistry) at some stations**
- **Instruments, sampling methods, data processing scheme are identical at the various sites → directly comparable data**
- **The primary measurements, when used along with a measurement or estimate of aerosol optical depth, provide for the characterization of direct aerosol radiative forcing**

Growth of the NOAA Federated Aerosol Network



Some of the NOAA/ESRL Collaborator Stations and the major types of aerosols they encounter



Mt. Waliguan, China
Asian dust, biomass combustion, pollution aerosols from southern and eastern Asia.

Alert, NWT, Canada
Arctic haze, boreal forest combustion aerosols, Asian dust, marine aerosols, northern hemisphere background aerosols

Real-Time Access to Aerosol Systems

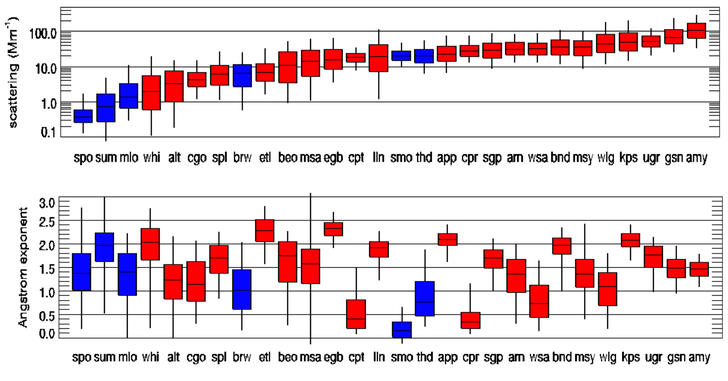
Requirements: Computer, ESRL-developed data acquisition software, internet connection

- **Software permits monitoring of system performance and rapid identification of aerosol events by ESRL and collaborating scientists**
- **Allows for in-depth remote troubleshooting and assistance**
- **Ability to reboot system, and change measurement parameters and sampling modes remotely**
- **Ability to initiate calibration and zero air checks remotely**

Cape Point, South Africa
Biomass combustion, southern African dust, urban pollution, marine aerosols, southern hemisphere background aerosols

Cape San Juan, Puerto Rico
Biomass combustion, Saharan dust, volcanic aerosols, urban pollution, clean marine aerosols

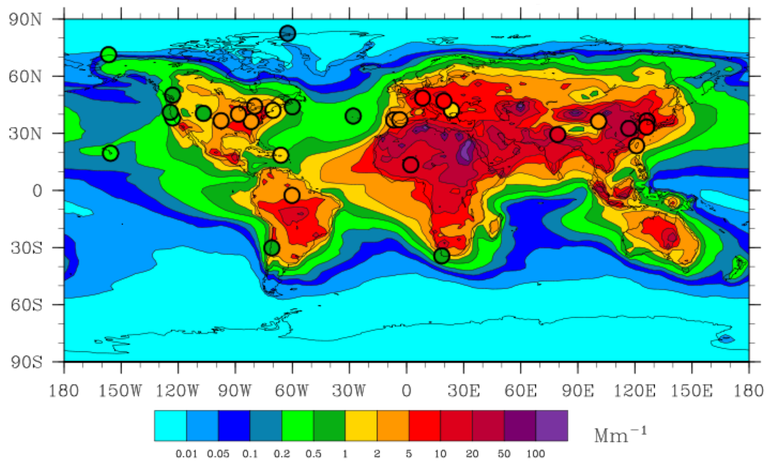
Climatology and Trends – Annual Statistics



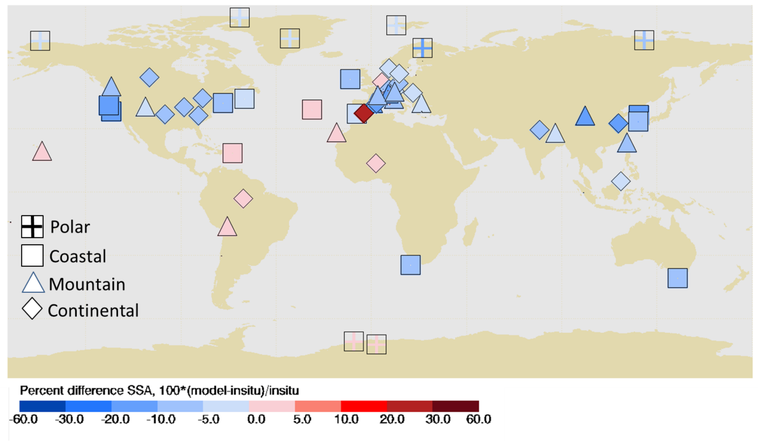
- **Blue = NOAA Observatory**
- **Wide range in aerosol amount**
- **No relationship between amount and "nature" of aerosol**

→Important to measure regionally representative air masses

Use Network measurements to test model performance



Single model (2008 simulated aerosol absorption)



Average discrepancies of 14 models vs. in situ data for all years of the data record (blue means models show darker aerosols than measurements)