

Improving Existing ARM Systems and Programs

The multiplying effect of working together



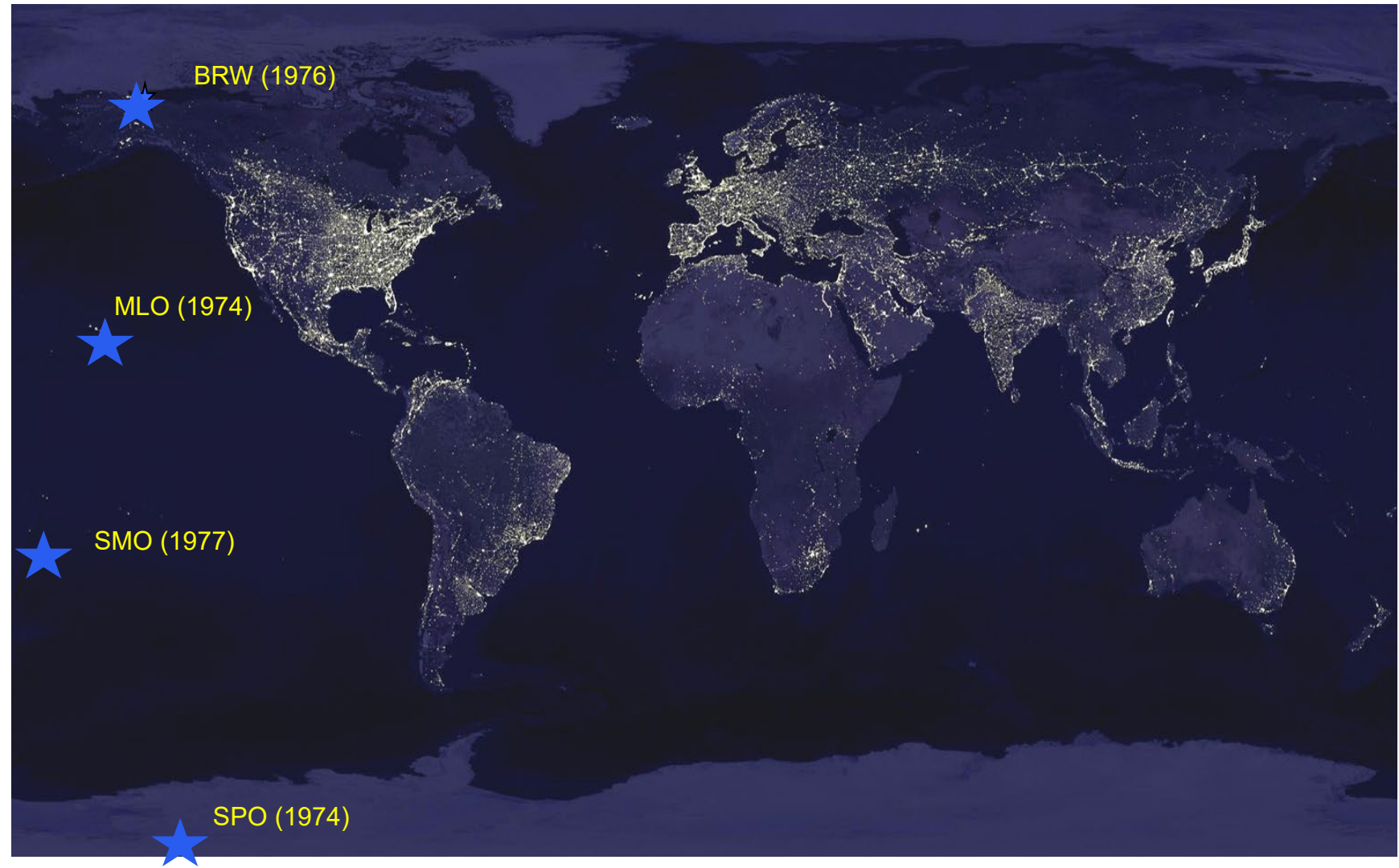
Successes and lessons learned from NOAA's Federated Aerosol Network

NOAA Federated Aerosol Network (NFAN)

How it started...

Sites far removed from human activities

□ Global background measurements

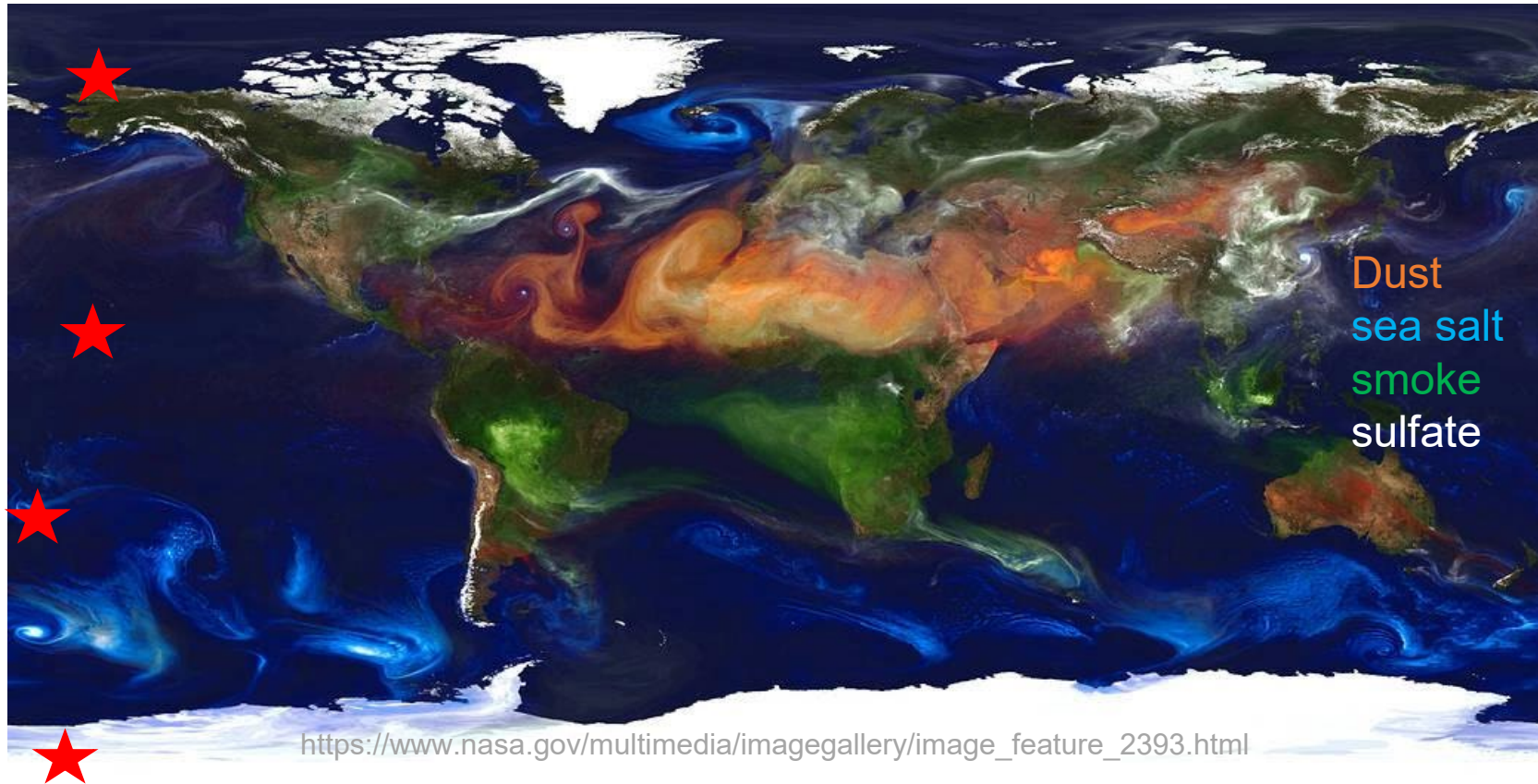


The problem with aerosol particles!

Aerosol particles come from different sources

Aerosol particles have a short (days-weeks) atmospheric lifetime....

- They are not uniform in space or time



In 1992 NOAA started working with other institutions to establish long-term aerosol sites.

NOAA Federated Aerosol Network

How it's going...

Currently ~30 active sites

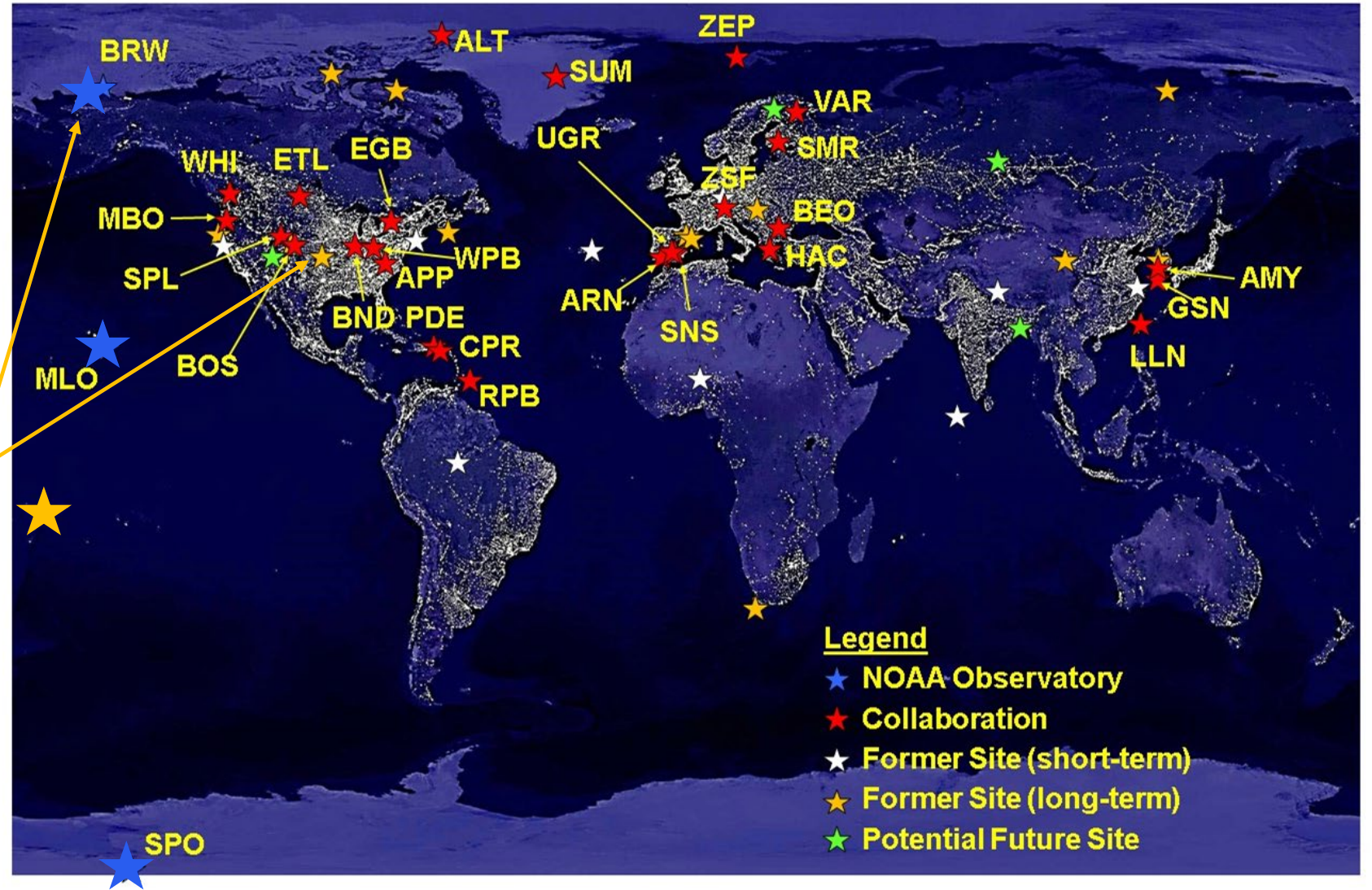
- Regionally representative
- Collaborative
- Gaps

NOAA/DOE Collaboration:

NOAA designed original SGP in-situ aerosol system in 1994.

Since 1997, NOAA has provided their BRW aerosol data to ARM (as NSA).

- BRW data is popular



NOAA-DOE collaboration has been a multiplier for both groups:

--shared support/expertise

--shared data

--science!

NFAN – how it works...

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, etc.
- Long-term station operation costs (site, power, internet, etc.)
- Data quality checking and editing
- Submission of data to World Data Centre Archive (WDCA)

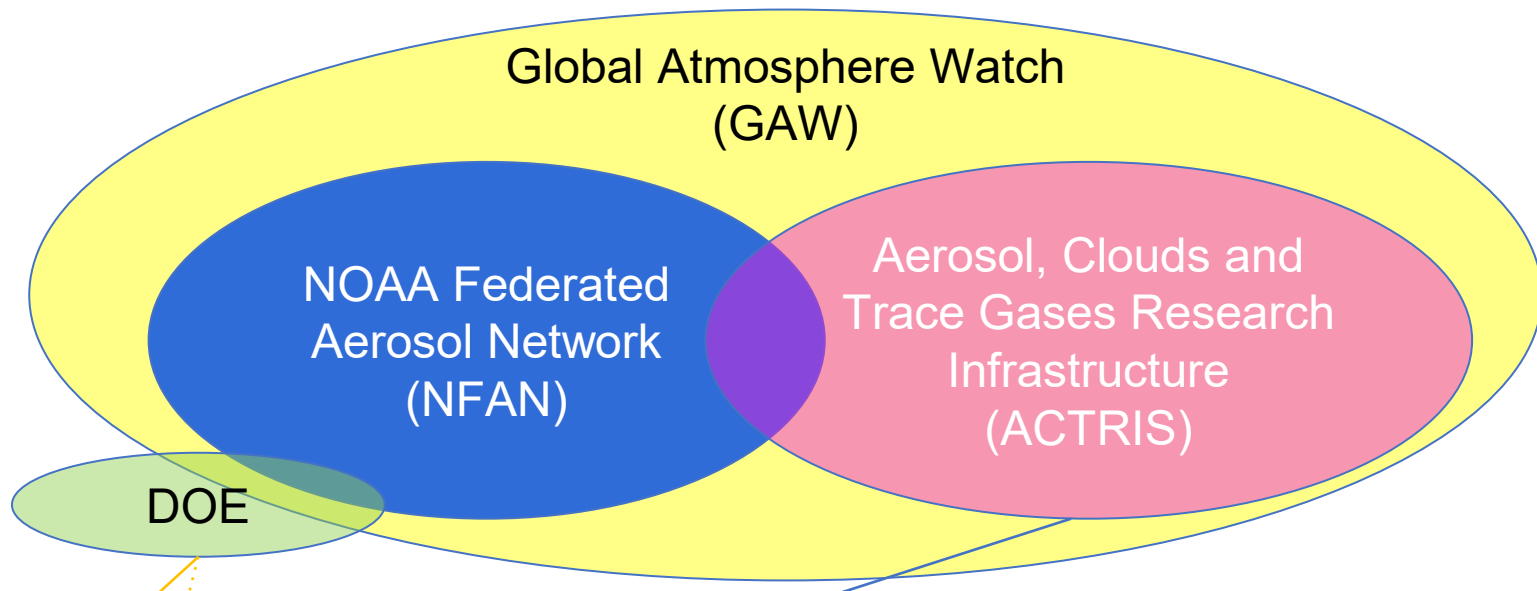
NOAA/GML supplies...

- Site visit(s), design assistance
- Initial installation assistance and instrument calibrations
- Training (hardware, **software**, data QC editing, etc.)
- Data visualization and editing software
- Help with submission to WDCA archive (if desired)
- Future assistance and troubleshooting support

□ A long-term, cooperative program with shared data access and following established aerosol sampling protocols (e.g., GAW).

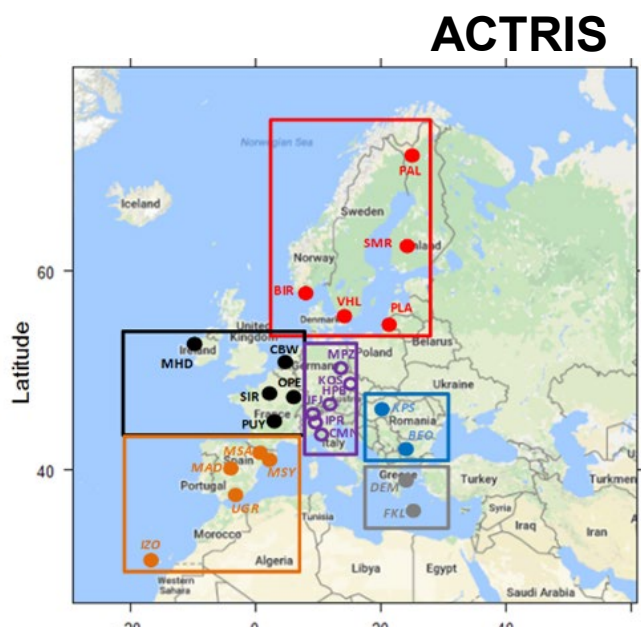
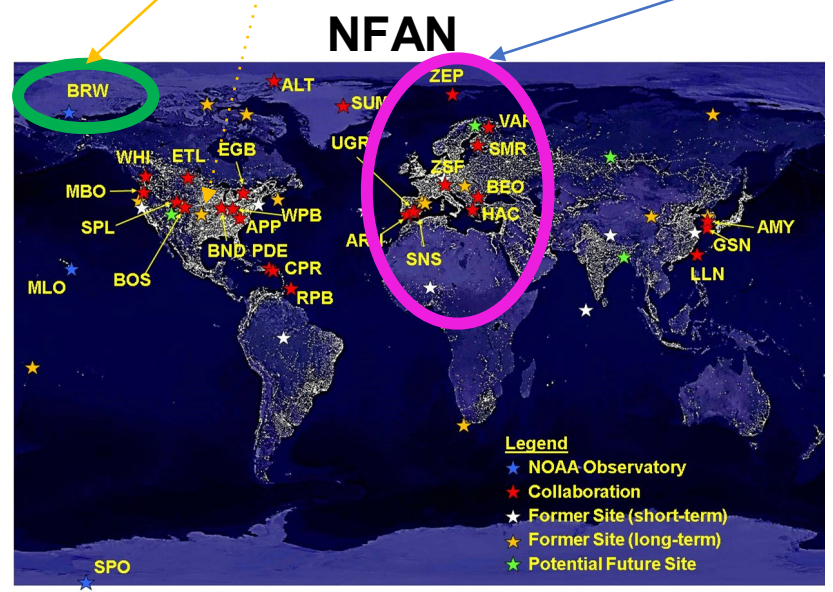
□ Measurements that are directly comparable with the other stations in NFAN and ACTRIS (European network).

How NFAN relates to other in situ aerosol networks



- Spatial coverage
- More aerosol types
- Common archive (WDCA)
- Common format

One stop shop:
 WDCA GAW data widely used!

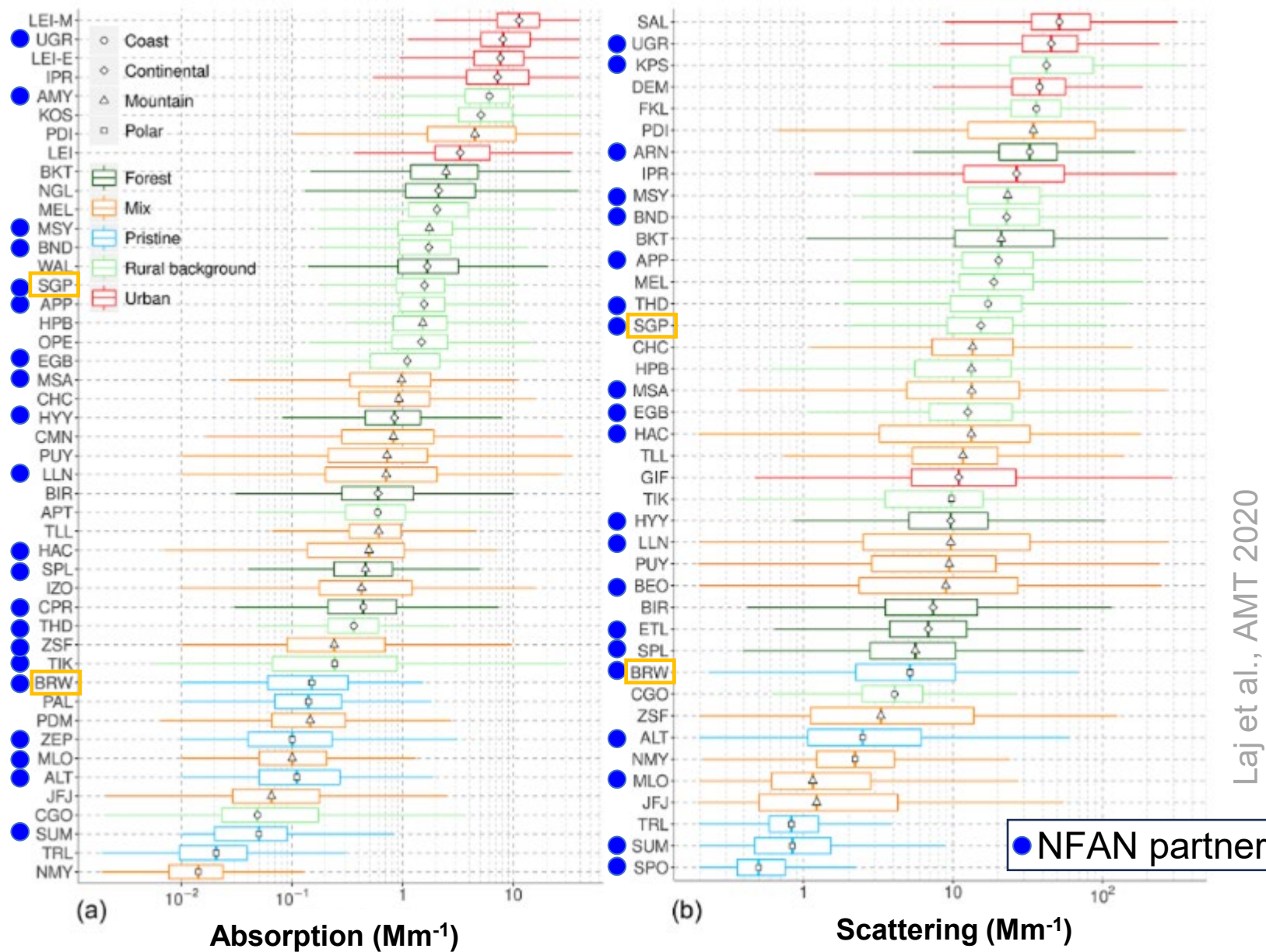


Pandolfi et al., ACP, 2018

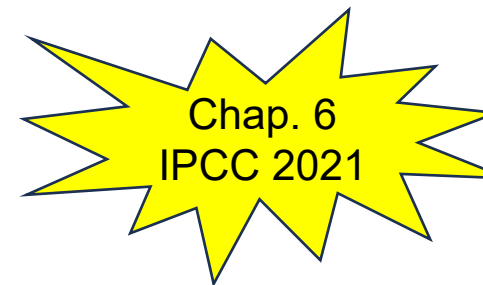
- Other surface aerosol networks...
- IMPROVE
 - SPARTAN
 - ASCENT

Andrews et al., BAMS, 2019

Climatology – GAW annual statistics



“A global analysis of climate-relevant aerosol properties retrieved from the network of GAW near-surface observatories”



Plots based on data in **WDCA archive** (Year = 2016 or 2017)

Lajet et al., AMT 2020

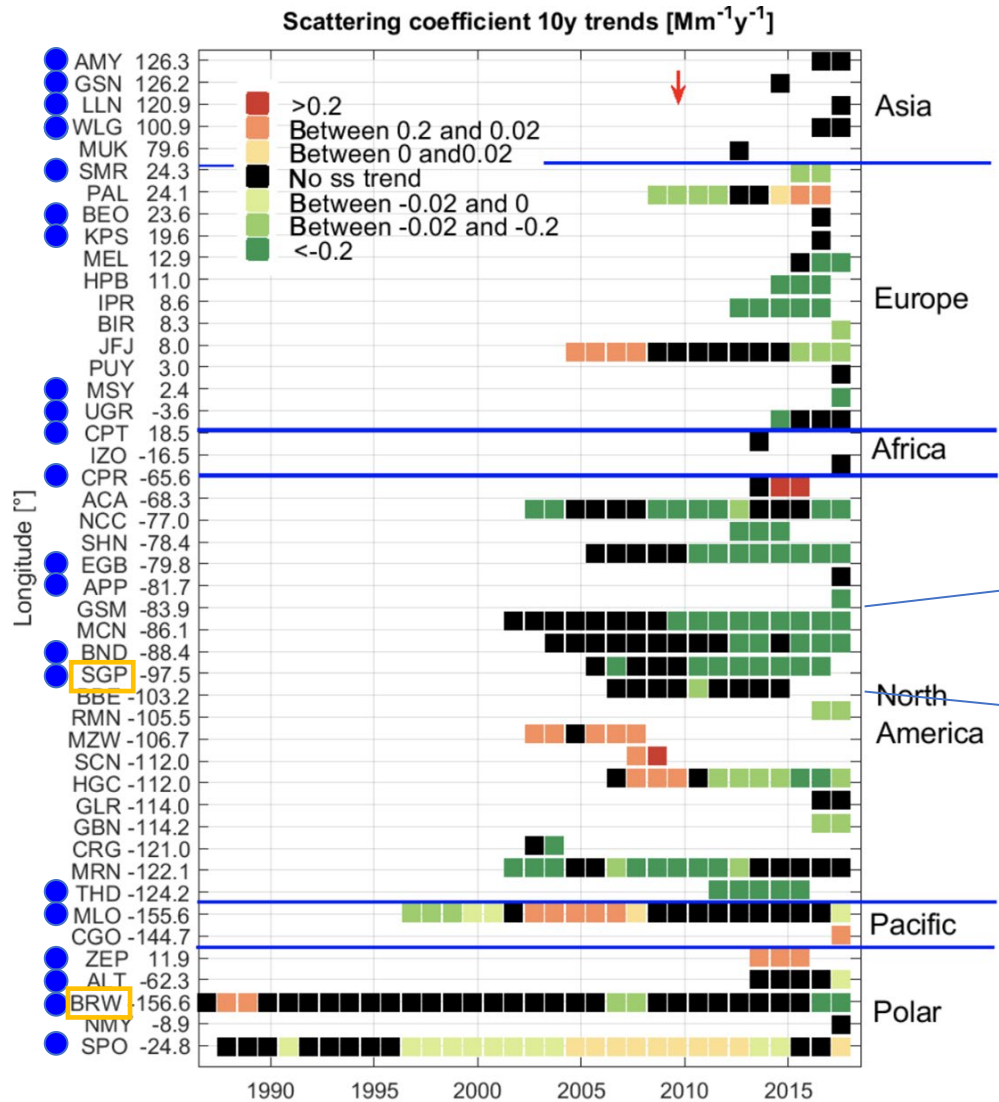
2016 **SGP** data – NOAA AOS in WDCA

2017 **BRW (NSA)** included – NOAA site in WDCA

➡ Wide range in aerosol amount across sites

Trends – GAW annual statistics

Sequential 10-year trends in scattering



“Multidecadal trend analysis of in situ aerosol radiative properties around the world”

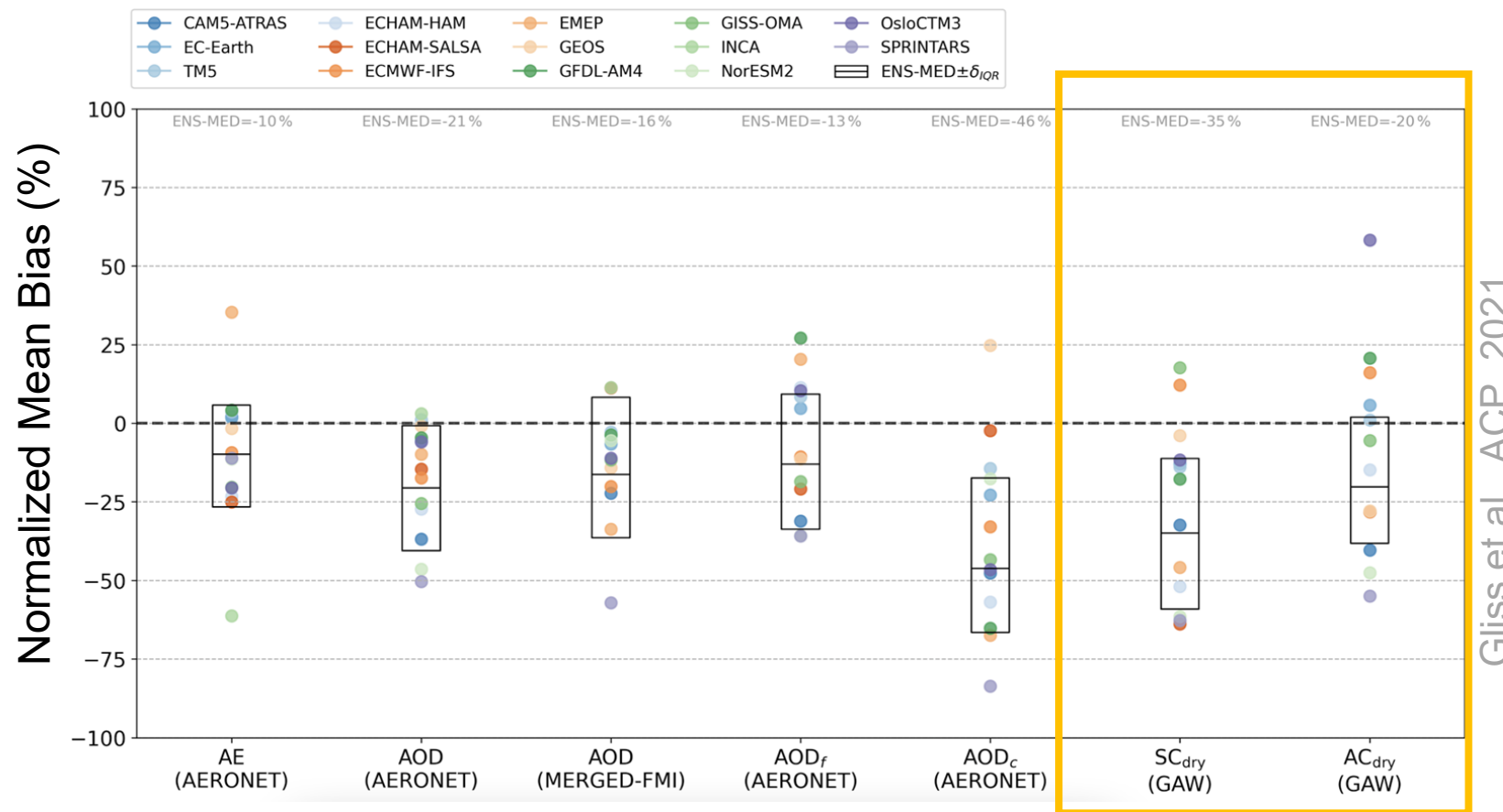


SGP trend ends when data no longer available in WDCA archive

Model evaluation – AeroCom

AeroCom: ‘open international initiative of scientists interested in the advancement of the understanding of global aerosol properties and aerosol impacts on climate, weather, and air quality.’

A central AeroCom goal is to more strongly constrain modeling efforts with observational data from satellite, ground-based, and aircraft observations.



“Multi-model evaluation of aerosol optical properties in the AeroCom Phase III Control experiment using ground and space based columnar observations from AERONET, MODIS, (A)ATSR and a merged satellite product as well as surface in-situ observations from GAW sites”

Chap. 6
IPCC 2021

- Data format
 - file type
 - frequency
 - consistency
- Data interpretation

Model evaluation – AeroCom



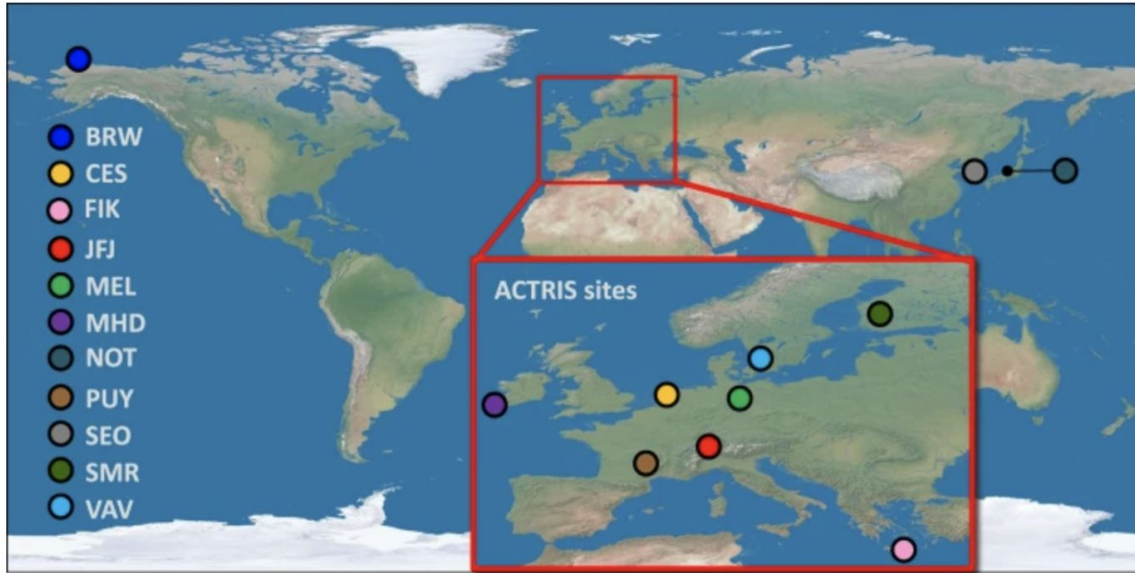
“A global model/measurement evaluation of particle light scattering coefficients at elevated relative humidity”

Project used both DOE and non-DOE observations

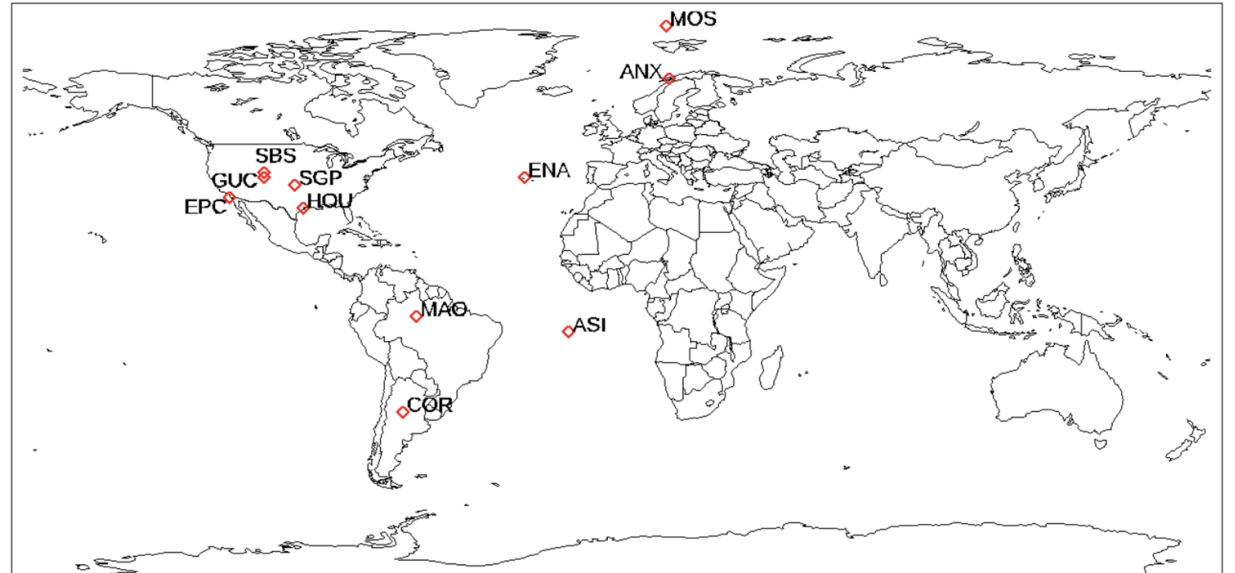
- evaluation of different techniques
- wider coverage of aerosol types & environments
- struggle to harmonize data from different sources

Process studies – CCN

CCN, PNSD, AMS/ACSM sites



Schmale et al., 2017, 2018



Andrews et al., in prep; ASR funded - grant no. DE-SC0022886

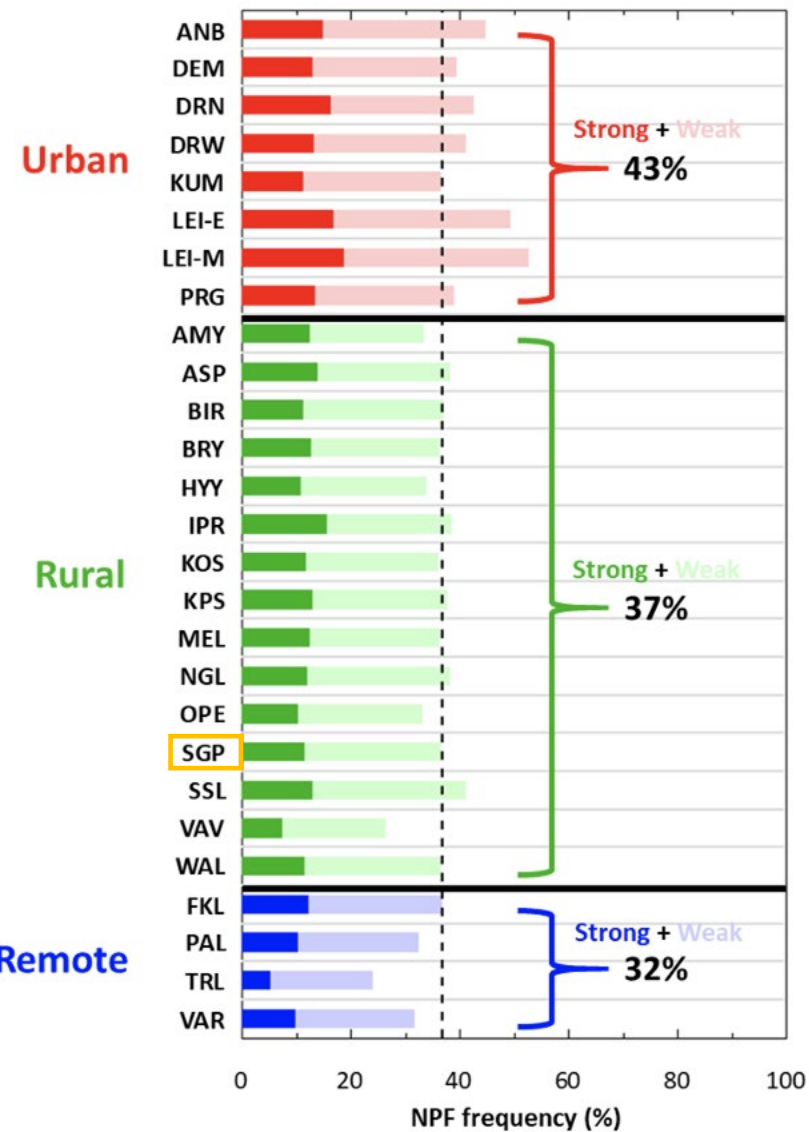
This is awesome! DOE observations have **greatly** expanded spatial coverage of these collocated measurements.

Some struggles:

- finding data in ARM database (e.g., 96 hits on CPC to sort through)
- not all at same data level
- data needing to be reprocessed due to errors
- 1s data is not fun
- combining DQR+data to get final dataset is annoying

Process studies – CCN

“Decadal decrease in nucleated particles across a range of environments”



Park et al., in revisions

Primary data source WDCA archive

SGP PNSD data from DOE archive (co-author O. Mayol-Bracero)

Missed multiple datasets:

(a) Data sets not in WDCA

(b) Hard to find if don't know where to start (siloe community)

(c) Time crunch when datasets were identified

Multi-site analyses often focus on single archive

simpler to process (plus)

limits spatial coverage (minus)

due diligence

two-way street

easier to find/use

Advantages of long-term cooperation with other institutions

- Data awareness and usage
- Publications
- Instrument loans
- Shared expertise
 - new instruments evaluation
 - inter-comparisons
 - sample 'conditioning'
- Students professors
students
- Independent site audits
- Good will



Operational advantages

Co-location at existing long-term sites (e.g., Cape-K deployment)

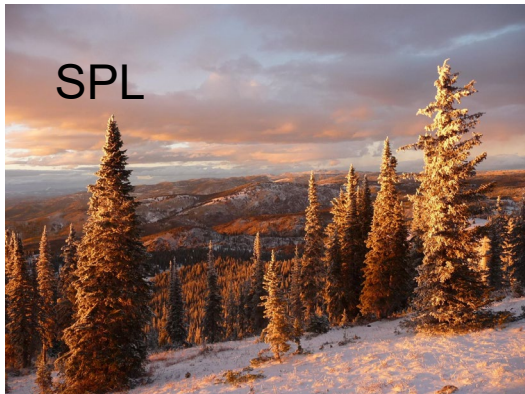
- shared infrastructure
- shared instrument data
- long-term context for measurements

Previous examples:

- BAEC - SMEAR/Hyytiala in Finland
- STORMVEX - SPL

Future:

- ARM instrument deployment to BRW (SP2, APS, ACSM)
- Appalachian State, NC
 - 'AOS' suite operational since 2009
 - could help provide spatial/temporal context for BNF deployment



Cross-agency cooperation – CARGO-ACT

Cooperation and **AgReements** enhancing **G**lobal inter**O**perability for **A**erosol, **C**loud and **T**race gas research infrastructures

The specific objectives of CARGO-ACT are to:

- develop sustainable partnerships and decision making processes with partner RIs
- demonstrate the benefits of converging interoperability and standards to stakeholders and the global research community;
- establish the mechanisms for providing international access to distributed, global atmospheric RIs;
- develop a roadmap for upscaling towards an integrated global research infrastructure

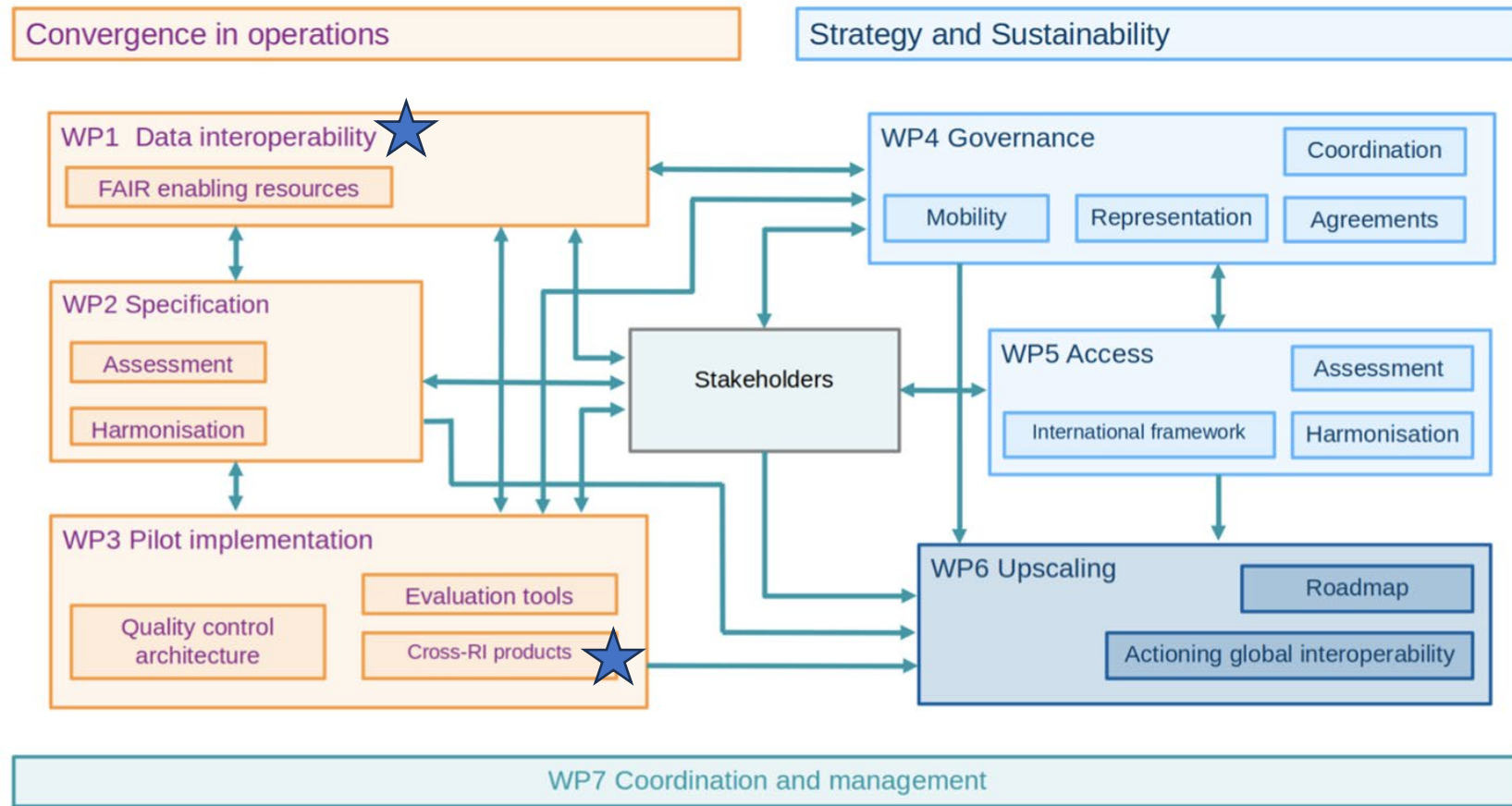
Initial focus/proof of concept:

Aerosol in-situ and remote sensing networks

<http://www.cargo-act.eu>



Cross-agency cooperation – CARGO-ACT



- WCCAP – helping BNL design calibration facility
- Data processing pilot raw final
- WDCA portal will point to ARM data

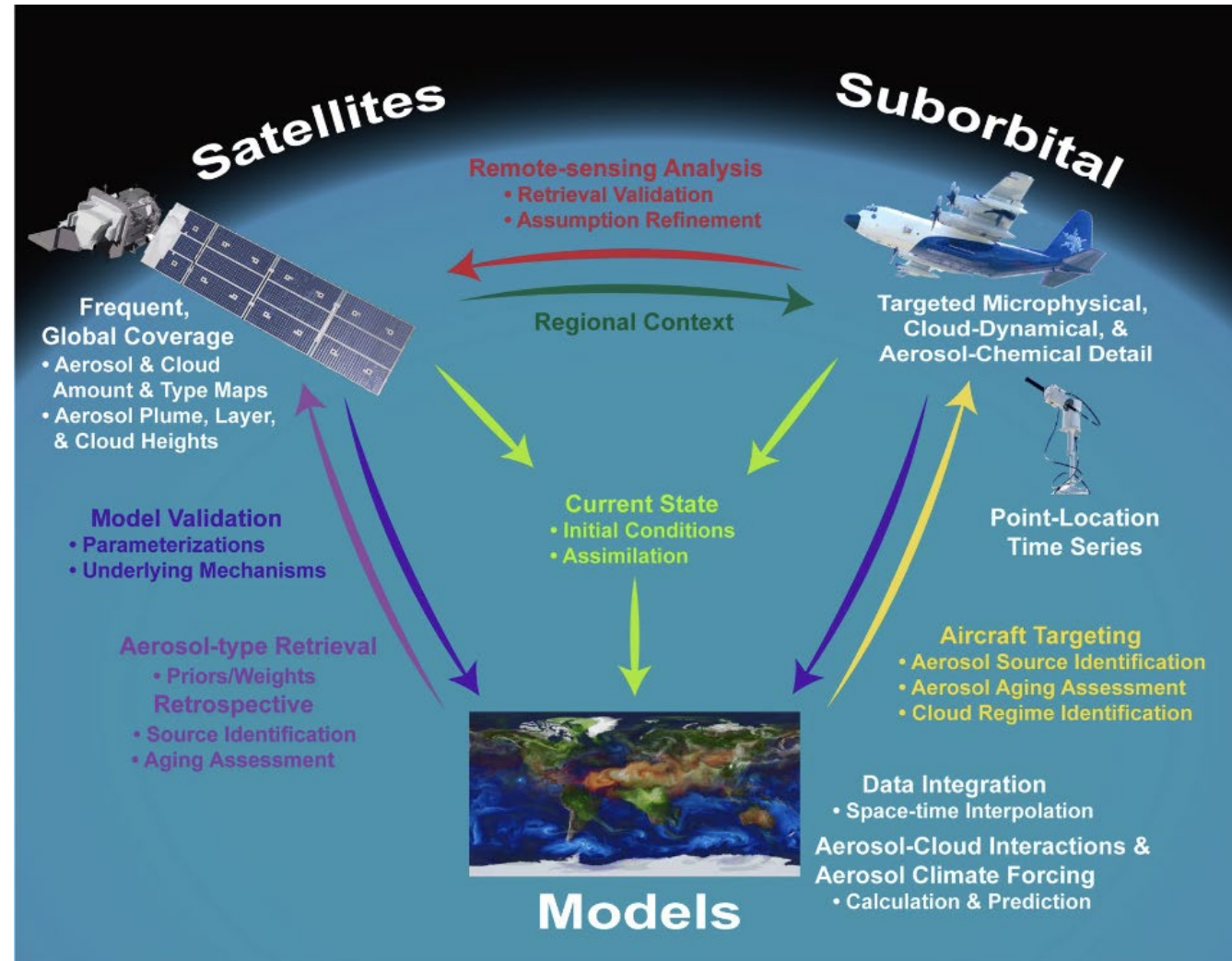
★ Consider VAP to put pointed-at data in WDCA format.

Answering big questions

“Reducing aerosol forcing uncertainty by combining models with satellite and within-the-atmosphere observations: A three-way street”

- Trends
- Process studies
- Regional effects (Persad)
- Model evaluation
- Satellite validation

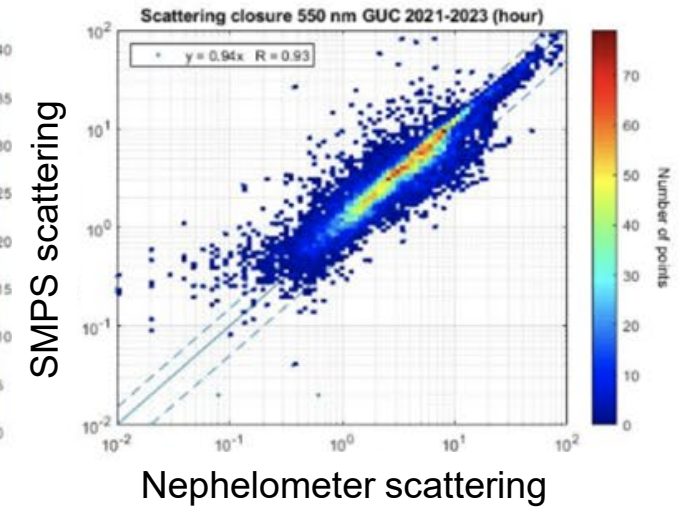
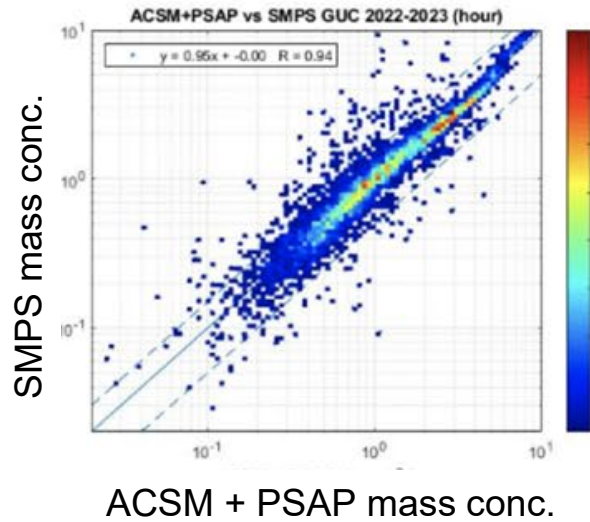
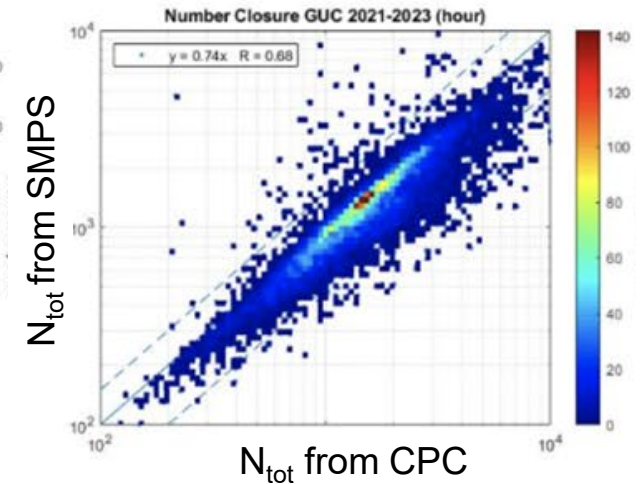
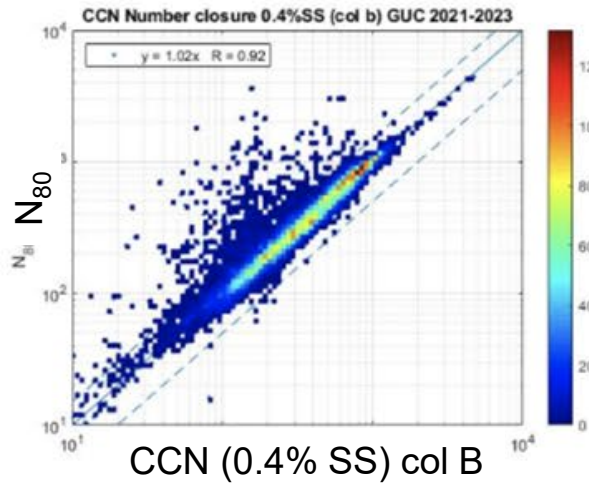
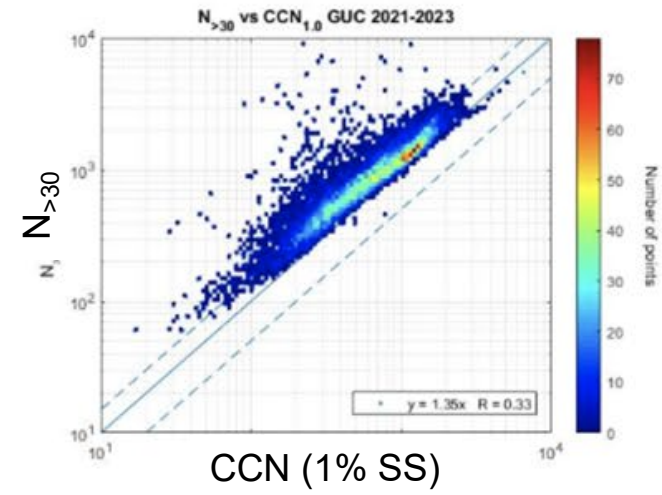
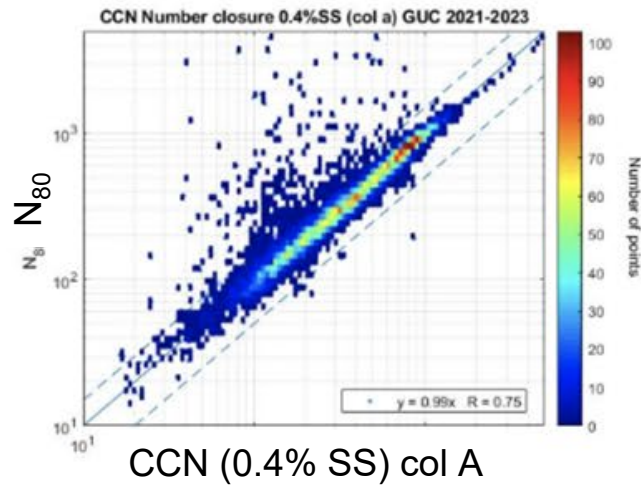
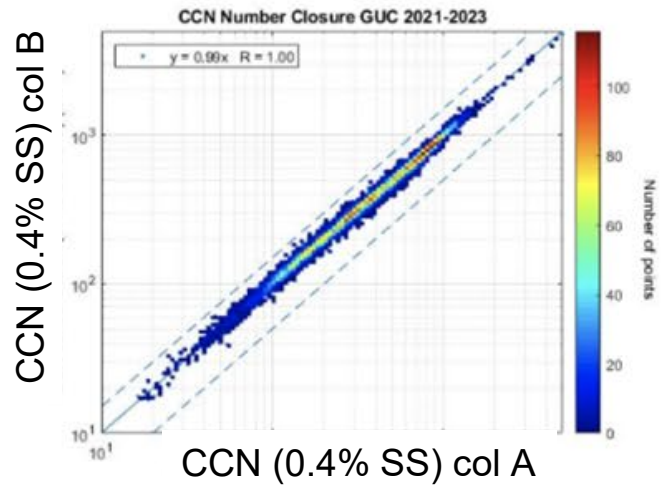
Cooperation
is key!



Kahn et al., 2023

Build bridges to somewhere





also done for SGP, ANX, EPC, SBS, HOU, MAO, COR, ASI, ENA, MOS