AIR QUALITY RESEARCH CENTER

Comparison of CSN and IMPROVE Speciated $PM_{2.5}$ through Collocated Measurements

IMPROVE Steering Committee Meeting

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Objectives:

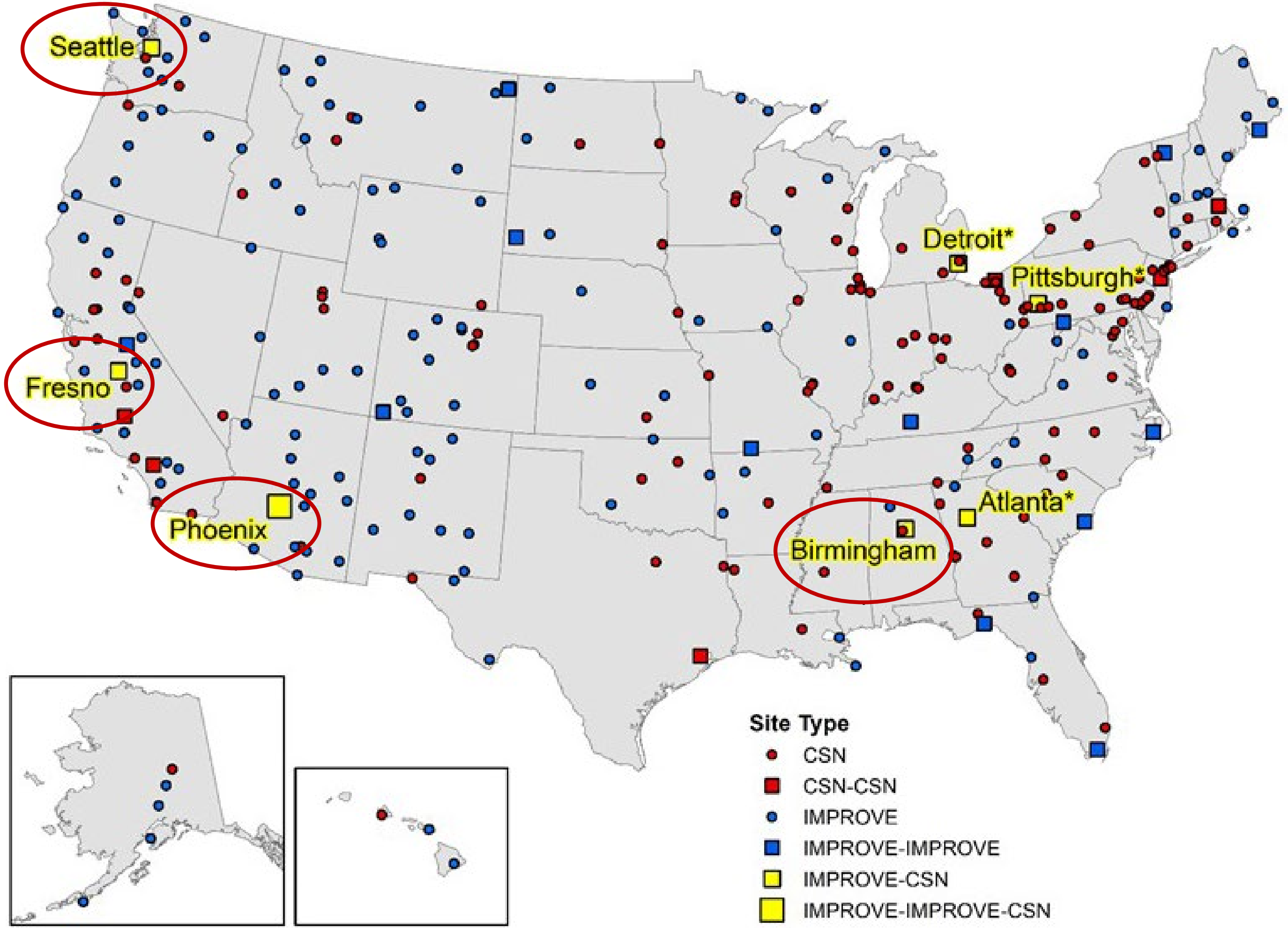
❶ Better understand the comparability of data across networks.

❷ Evaluate the strengths and limitations of the combined dataset.

Time period, January 1, 2016 through September 30, 2018:

Collocated sites being considered were continuously operated during this time.

There were no laboratory or contract transitions during this time.


Seattle
Fresno
Phoenix
Detroit*
Pittsburgh*
Atlanta*
Birmingham
Site Type
CSN
CSN-CSN
IMPROVE
IMPROVE-IMPROVE
IMPROVE-CSN
IMPROVE-IMPROVE-CSN

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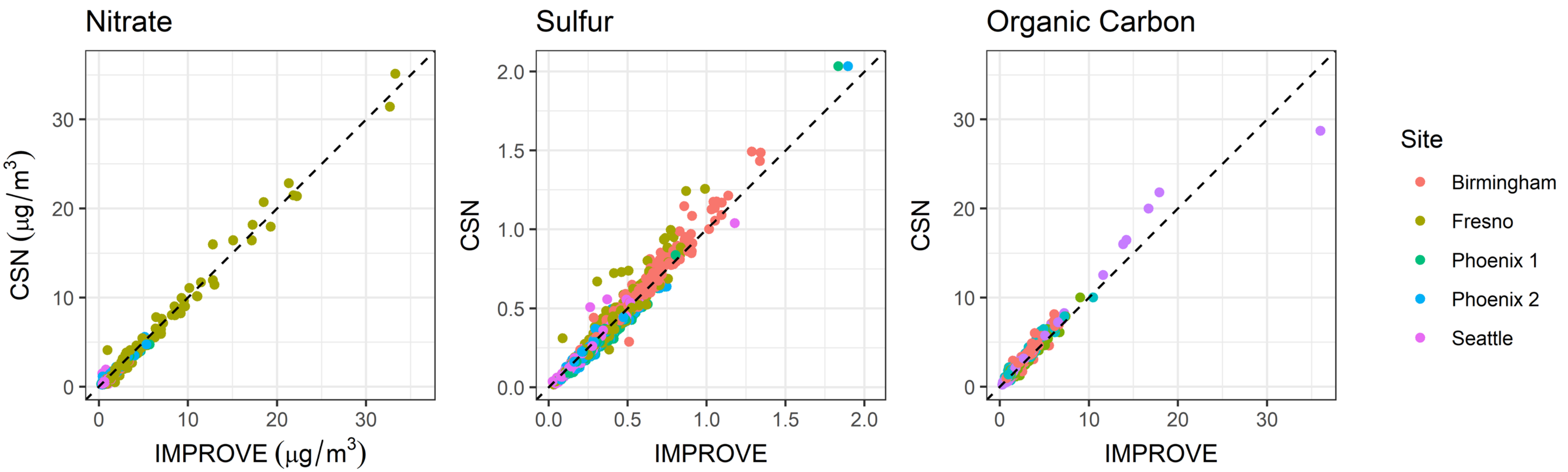
Differences between CSN and IMPROVE

	CSN Program			IMPROVE Program		
Filter Type	PTFE	Nylon	Quartz	PTFE	Nylon	Quartz
Sampler	Met One SASS / Super SASS		URG 3000N	IMPROVE Sampler (A-, B-, C-, & D-Modules)		
Flow Rate	6.7 L/min		22.8 L/min	22.8 L/min		
Filter Size	47-mm		25-mm	25-mm		
Analytical Method	XRF (UCD)	IC (DRI)	TOA (DRI)	XRF (UCD)	IC (RTI)	TOA (DRI)
Species Reported	Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Br, Rb, Sr, Zr, Ag, Cd, In, Sn, Sb, Cs, Ba, Pb, Ce	chloride, ammonium, sodium, potassium, nitrate, sulfate	organic carbon, elemental carbon, fractions	$PM_{2.5}$ mass, PM_{10}, optical abs, Na, Mg, Al, Si, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Ga, As, Se, Br, Rb, Sr, Zr, Pb	nitrate, nitrite, sulfate, chloride	organic carbon, elemental carbon, fractions

Transport Temperature

Operator Practices

Species measured well above MDL



Well measured species show agreement across the networks, but are there subtle biases that are not immediately apparent?

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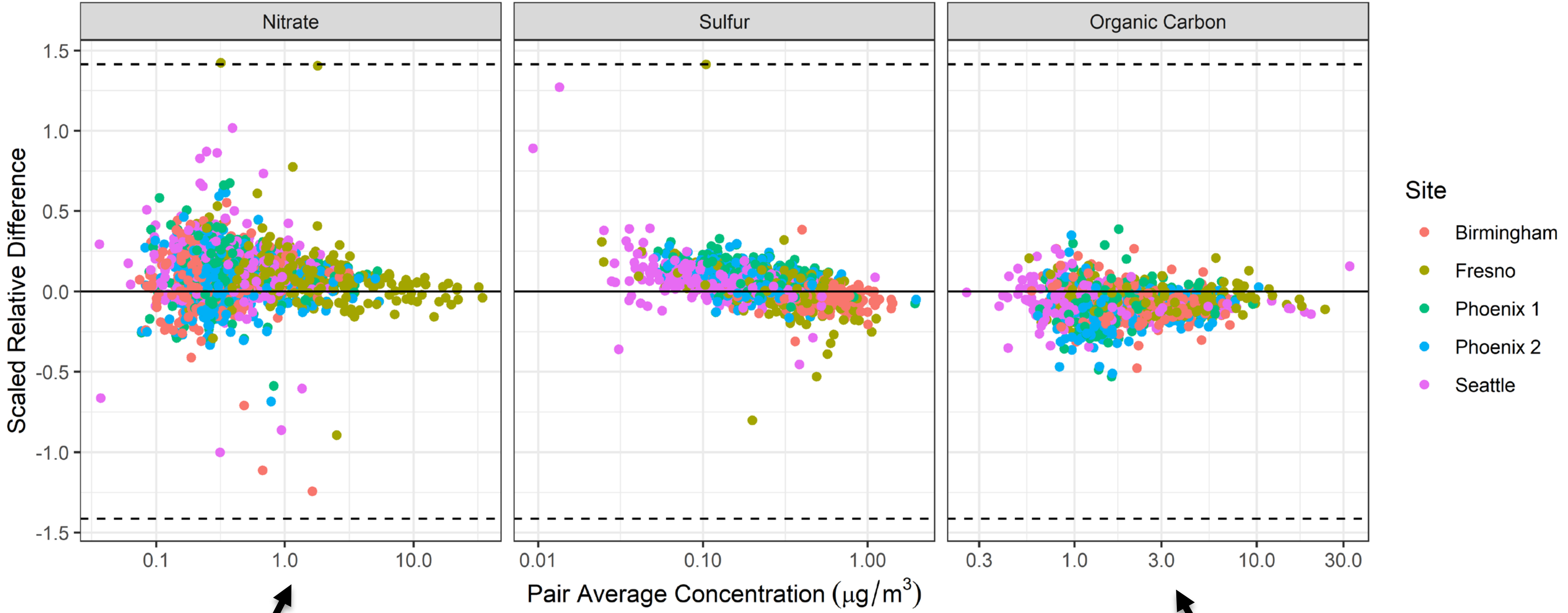
Examination of biases

$$Scaled\ Relative\ Difference(\mathrm{SRD}) = \frac{([\mathrm{C}]_{\mathrm{IMPROVE}} - [\mathrm{C}]_{\mathrm{CSN}})\ /\ \sqrt{2}}{([\mathrm{C}]_{\mathrm{IMPROVE}} + [\mathrm{C}]_{\mathrm{CSN}})\ /\ 2}$$

SRD is expected to approach zero at higher concentrations for measurements that agree.

SRD > 0 indicates IMPROVE measurements higher than CSN.

SRD < 0 indicates CSN measurements higher than IMPROVE.

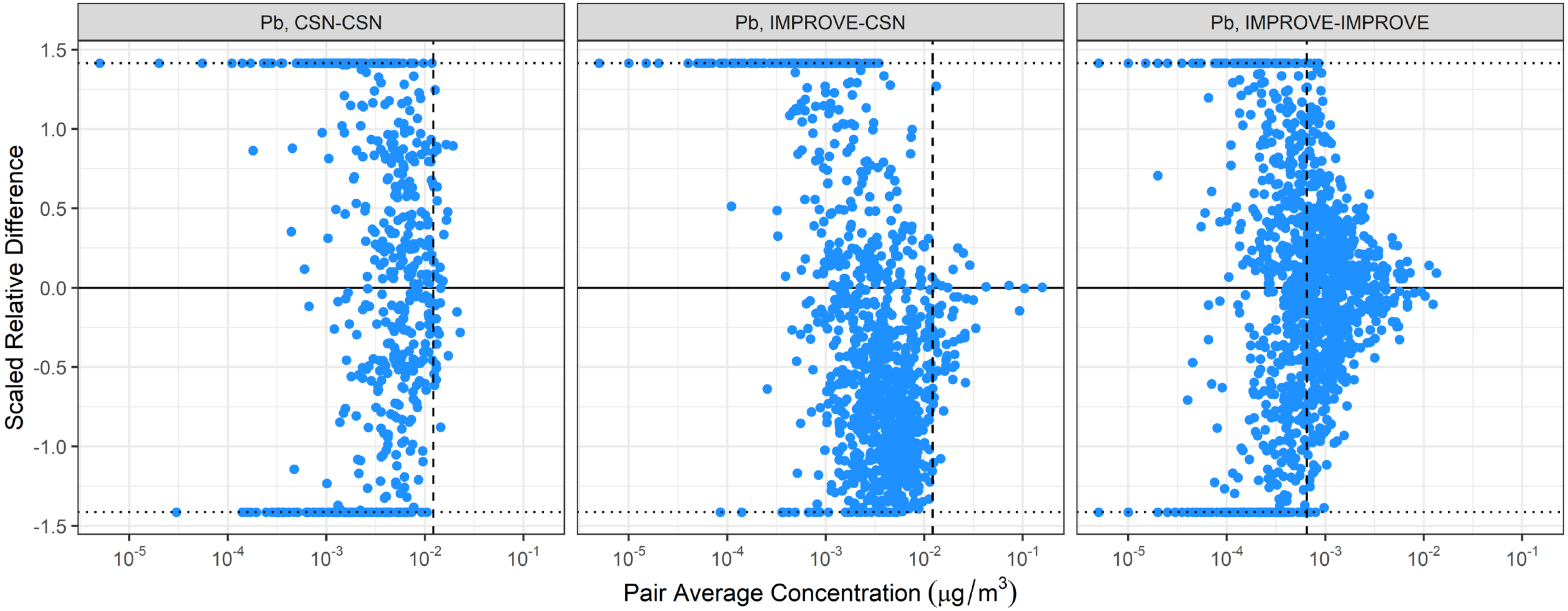


CSN measurements lower than IMPROVE at low concentrations; lab differences (?).

CSN measurements higher than IMPROVE at high concentrations; sample deposit loadings (?).

Both CSN and IMPROVE use IMPROVE_A TOA, artifact correction, and the same flow rate. CSN higher than IMPROVE; transport temp (?).

Species measured near the MDL



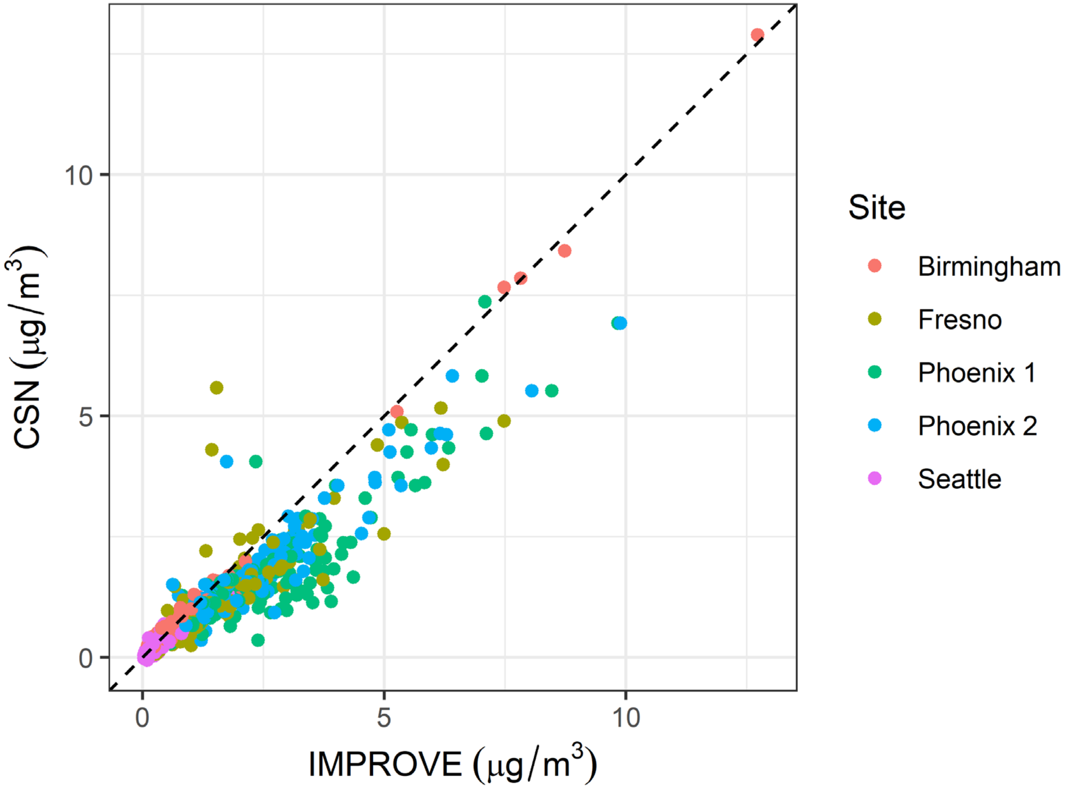
CSN MDLs higher than IMPROVE MDLs.

Most CSN lead (Pb) collocated measurements are below the MDL.

Agreement when CSN-IMPROVE measurements are above the MDL.

CSN and IMPROVE soil

Soil = 2.2 × Al + 2.49 × Si + 1.63 × Ca + 2.42 × Fe + 1.94 × Ti

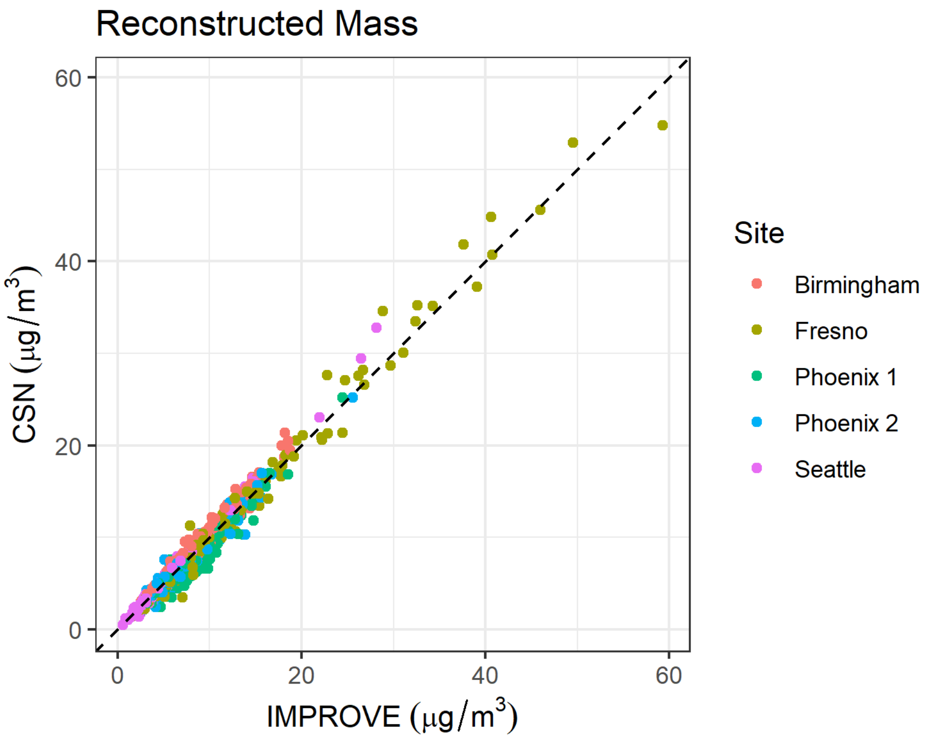


CSN and IMPROVE show agreement at Seattle and Birmingham.

CSN is lower than IMPROVE at Phoenix and Fresno. Different flow rates and cyclones could result in cut point discrepancies. If the IMPROVE cyclone is less efficient, coarse particles could be sampled that are excluded for CSN.

CSN and IMPROVE reconstructed mass

$$RCM = (4.125 \times S) + (1.29 \times NO_3^-) + (1.4 \times OC) + (EC) + (2.2 \times Al + 2.49 \times Si + 1.63 \times Ca + 2.42 \times Fe + 1.94 \times Ti) + (1.8 \times Cl^-)$$



CSN and IMPROVE show agreement at all collocated sites, suggesting that bulk species are comparable across networks.

Conclusions

There are some biases present between CSN and IMPROVE data; be aware of data limitations and network operational differences.

CSN MDLs are greater than those for IMPROVE, and many species – particularly for CSN – are measured at concentrations below the MDL; use caution when using or comparing data near the MDL.

Both networks are effective at quantifying bulk species.

AGU 2019 Fall Meeting

A33D: Ground-Based Atmospheric Monitoring Networks I, December 11 (Wed) afternoon

A34D: Ground-Based Atmospheric Monitoring Networks II, December 11 (Wed) afternoon

A43P: Ground-Based Atmospheric Monitoring Networks III Posters, December 12 (Thur) afternoon

Ground-based networks for monitoring of atmospheric chemical composition and meteorology improve our understanding of local, regional, and continental scale atmospheric events and long-term trends, and inform decisions critical to air quality, climate change, weather forecasting, and human health. Monitoring networks serve an important role within the research community, providing a backbone of data to support modeling, satellite data product validation, and short-term measurement campaigns. Ongoing collaboration, communication, and promotion of monitoring network developments and data products is necessary in order to fully leverage the benefit from such networks. This session explores how U.S. and international ground-based atmospheric monitoring networks can be utilized to,

(1) promote cross-network and -discipline engagement;

(2) develop and test new technologies and sensors;

(3) expand quality assurance methods and techniques; and

(4) support modelling and satellite data products.

thank you

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