IMPROVE Data and RHR Metrics

Scott Copeland

IMPROVE Steering Committee

11/19/2025

Update for version "_9_25":

- KPBO1 and LOND1 have new e95 thresholds for carbon based on the 2024 data, hence have updated impairment metrics for their respective data records. The only noted changes to MID values were KPBO1 2016 and LOND1 2017. Other years were not affected. (The same days were still chosen as "Most Impaired".)

- Three new sites were added to the Impairment Metrics files, PITT1, ATLA1, and SOGP1, which now have the required 5 complete years to calculate the necessary e95 values. The impairment maps will be updated to reflect the new sites' data back to 2018.

- A new "ZION_RHTS" data set has been added to the RHR metrics calculations. Like the other "_RHTS" sites, this is a combination of the ZION1 and ZICA1 data sets. This is the first case where data from ZION1 (old site) was scaled to be consistent with data from ZICA1.

- CAVE1, DINO1, FCPC1, KPBO1, LOND1, LTCC1, MAKA2, NOGA1, OWVL1, STIL1, SYCA2, and TOOL1 have updated default 2064 endpoints. Sites with fewer than 15 years of data are updated as data becomes available. The changes are minor[1].

IMPROVE Data - 2022 Second IMPROVE Algorithm

Non Rayleigh Mean of 20% Most Impaired

Total Non Rayleigh Extinction is Proportional to Area of Circles

Scott Copeland 9/2024

45 Mm-1

Urban Site

- Amsul_Bext
- Amnit_bext
- Org_bext
- Ecarb_bext
- Fsoil_bext
- Coars_bext
- Salt_bext
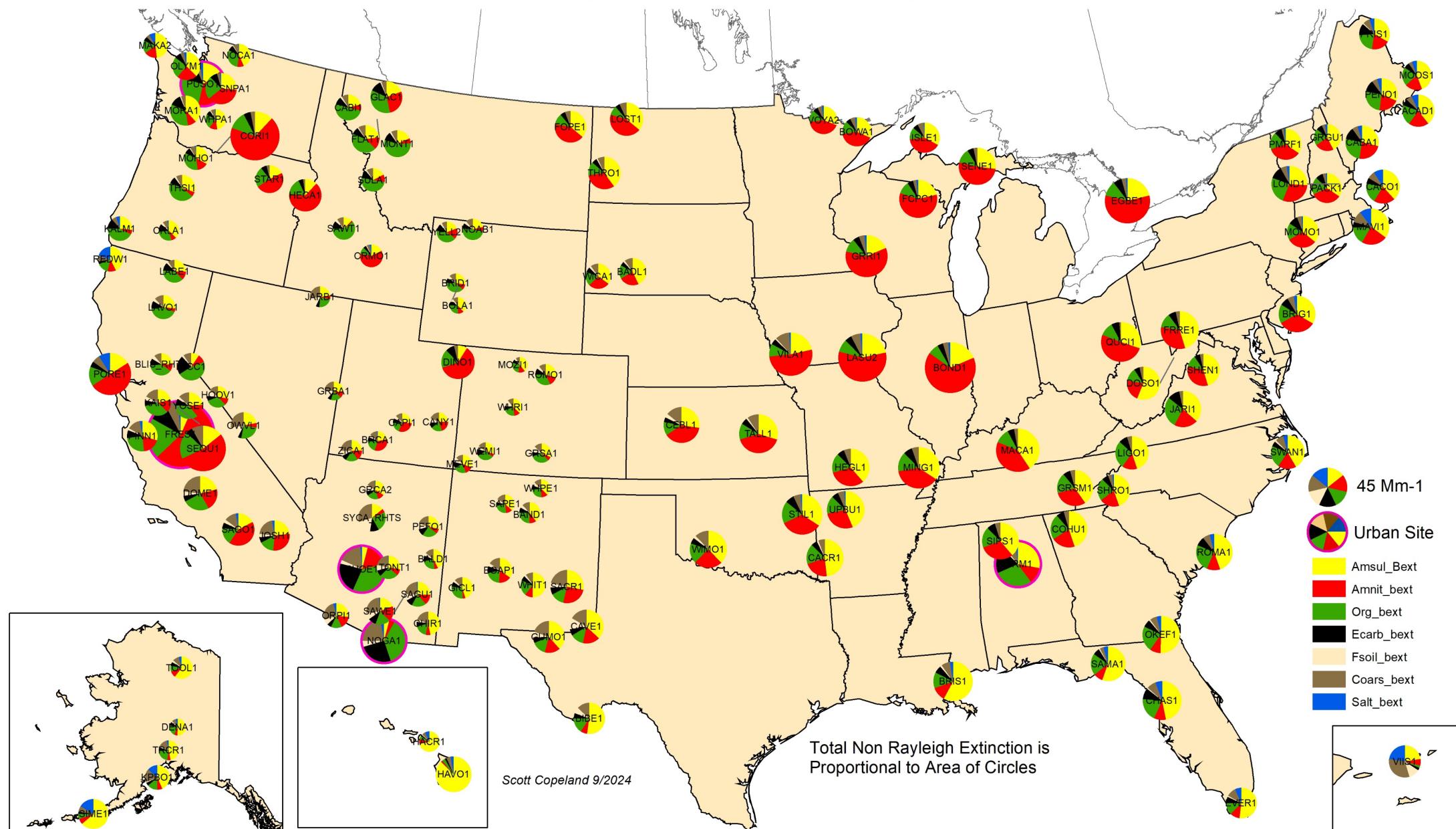
IMPROVE Data - 2023 Second IMPROVE Algorithm

Non Rayleigh Mean of 20% Most Impaired

Total Non Rayleigh Extinction is
Proportional to Area of Circles

Scott Copeland 9/2024

45 Mm-1

Urban Site

Amsul_Bext
Amnit_bext
Org_bext
Ecarb_bext
Fsoil_bext
Coars_bext
Salt_bext
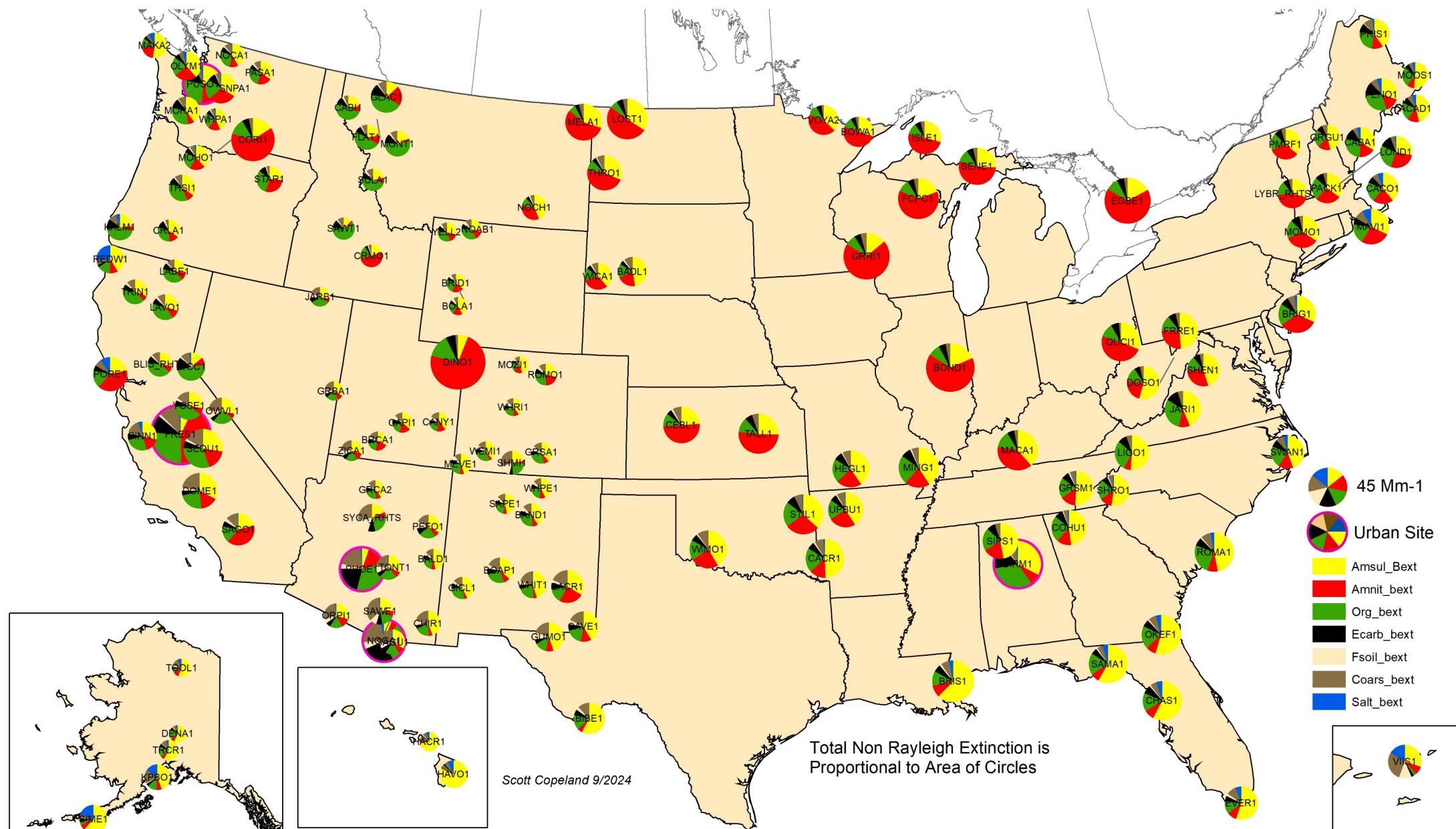
IMPROVE Data - 2024 Second IMPROVE Algorithm

Non Rayleigh Mean of 20% Most Impaired

Scott Copeland 9/2025

Total Non Rayleigh Extinction is Proportional to Area of Circles

45 Mm-1

Urban Site

Amsul_Bext
Amnit_bext
Org_bext
Ecarb_bext
Fsoil_bext
Coars_bext
Salt_bext
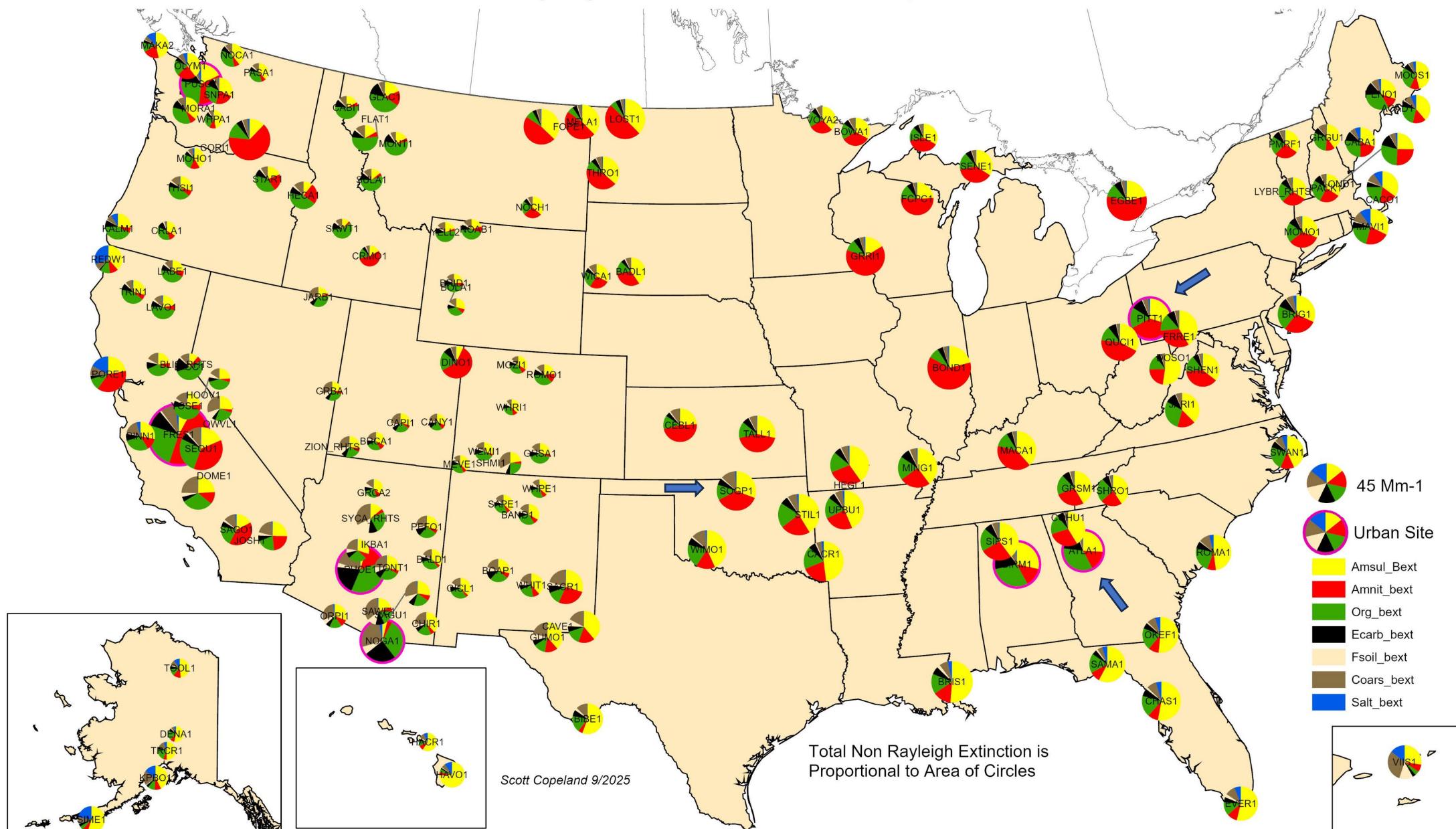
IMPROVE Data - 2002 Second IMPROVE Algorithm

Non Rayleigh Mean of 20% Most Impaired

Total Non Rayleigh Extinction is Proportional to Area of Circles

Scott Copeland 4/2022

45 Mm-1

Urban Site

Amsul_Bext
Amnit_bext
Org_bext
Ecarb_bext
Fsoil_bext
Coars_bext
Salt_bext
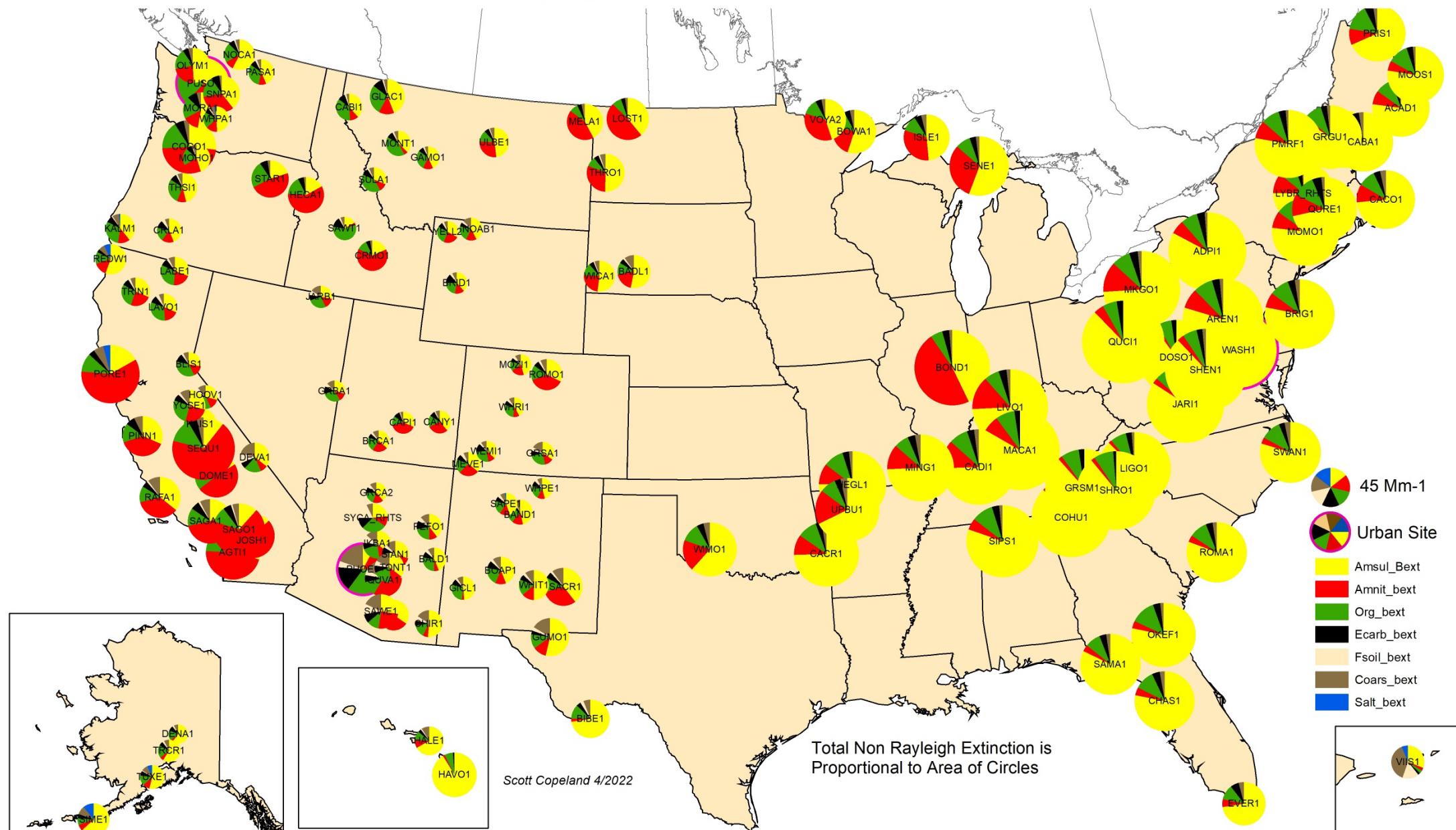
Annual Extinction Composition on the Most Impaired Days - Bridger Wilderness

1989 - 2024
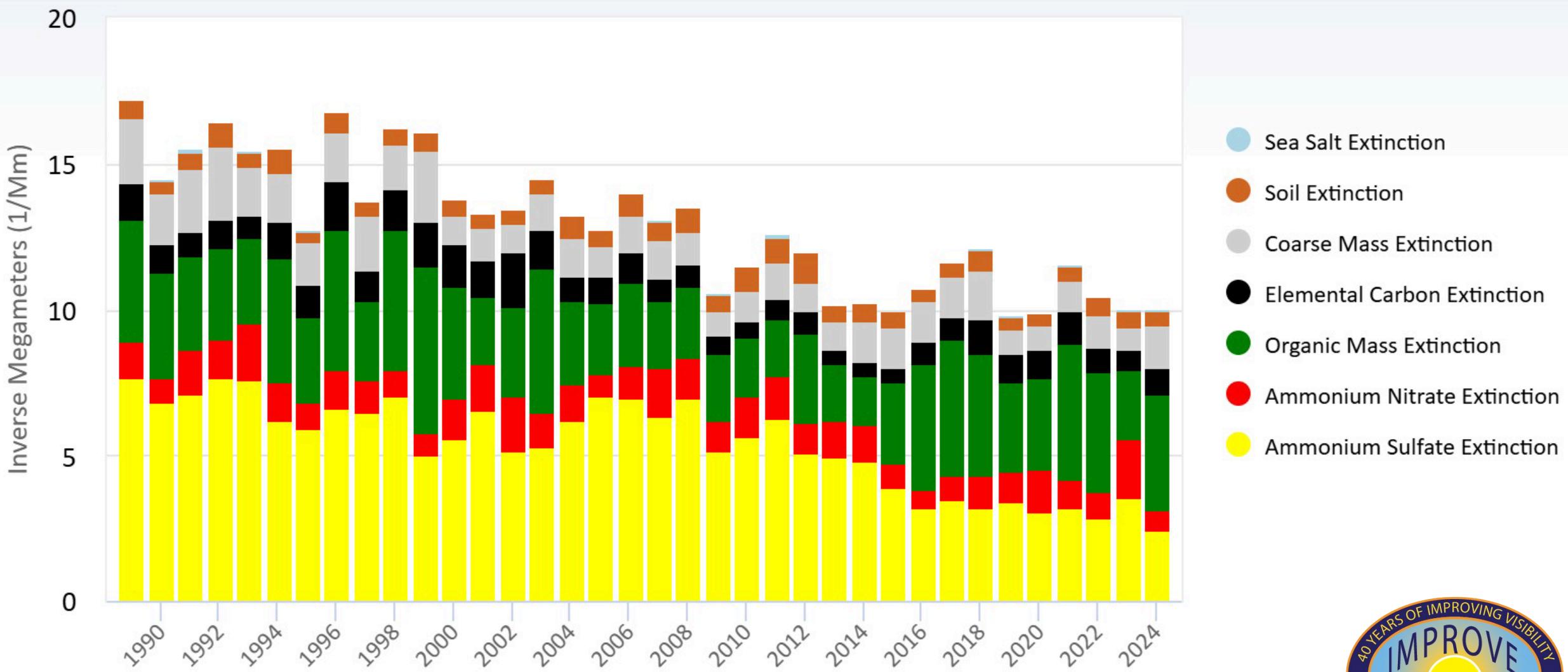
IMPROVE Monitor: Bridger Wilderness (BRID1)

"SD" Samples Summerish (Month = 4 6 7 8 9 10)
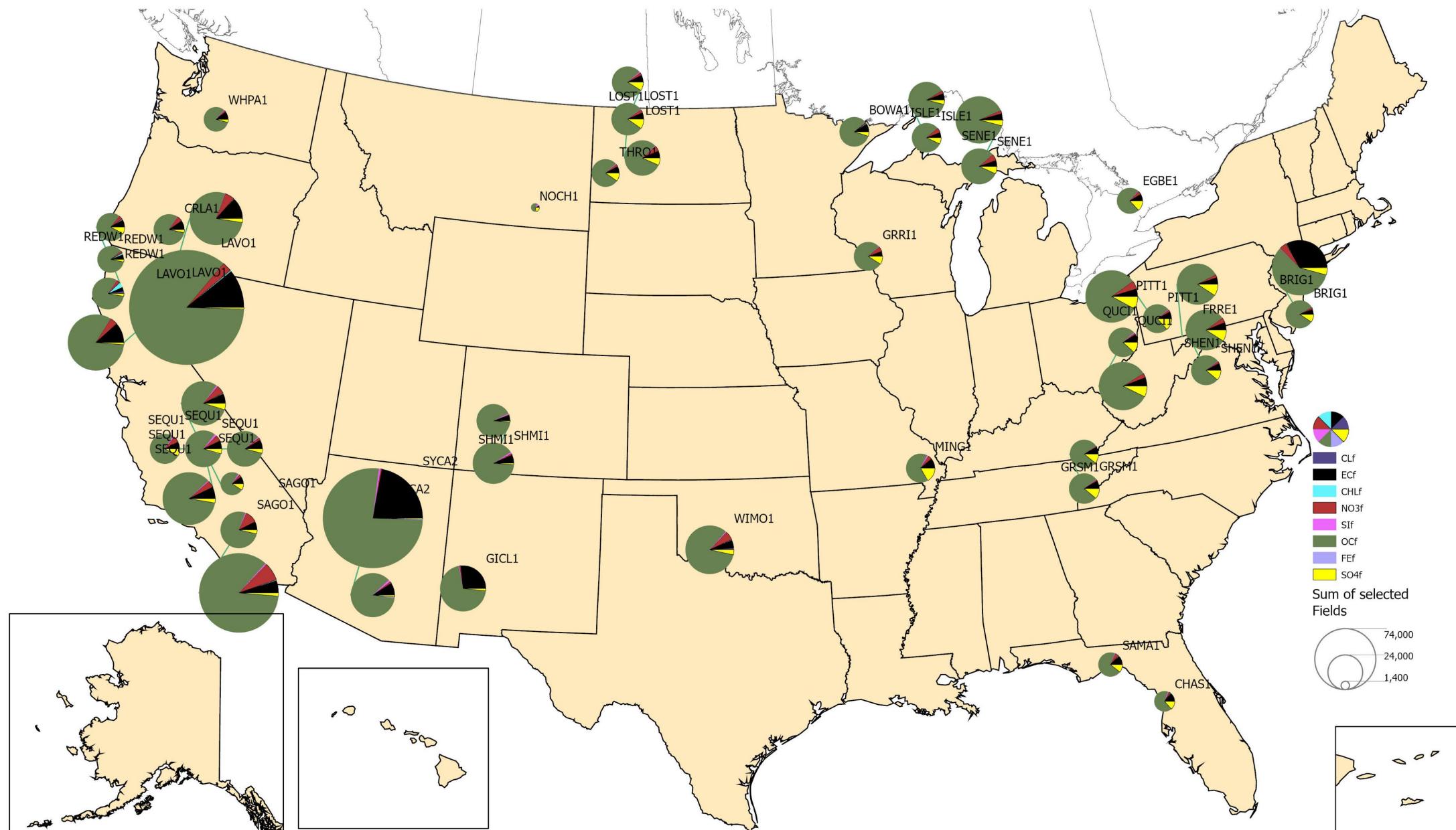
"SD" Samples Winter (month = 1 2 11 12)

Legend — Fields:
- CLf
- ECf
- CHLf
- NO3f
- SIf
- OCf
- FEf
- SO4f

Sum of selected Fields
- 74,000
- 24,000
- 1,400

Location labels: GLAC1, MONT1, LAVO1, LTCC1, FRES1, SYCA2, PHOE1, NOGA1, MOMO1, JARI1, LIGO1, TALL1, UPBU1, CACR1, BIRM1, ROMA1, OKEF1, CHAS1, EVER1
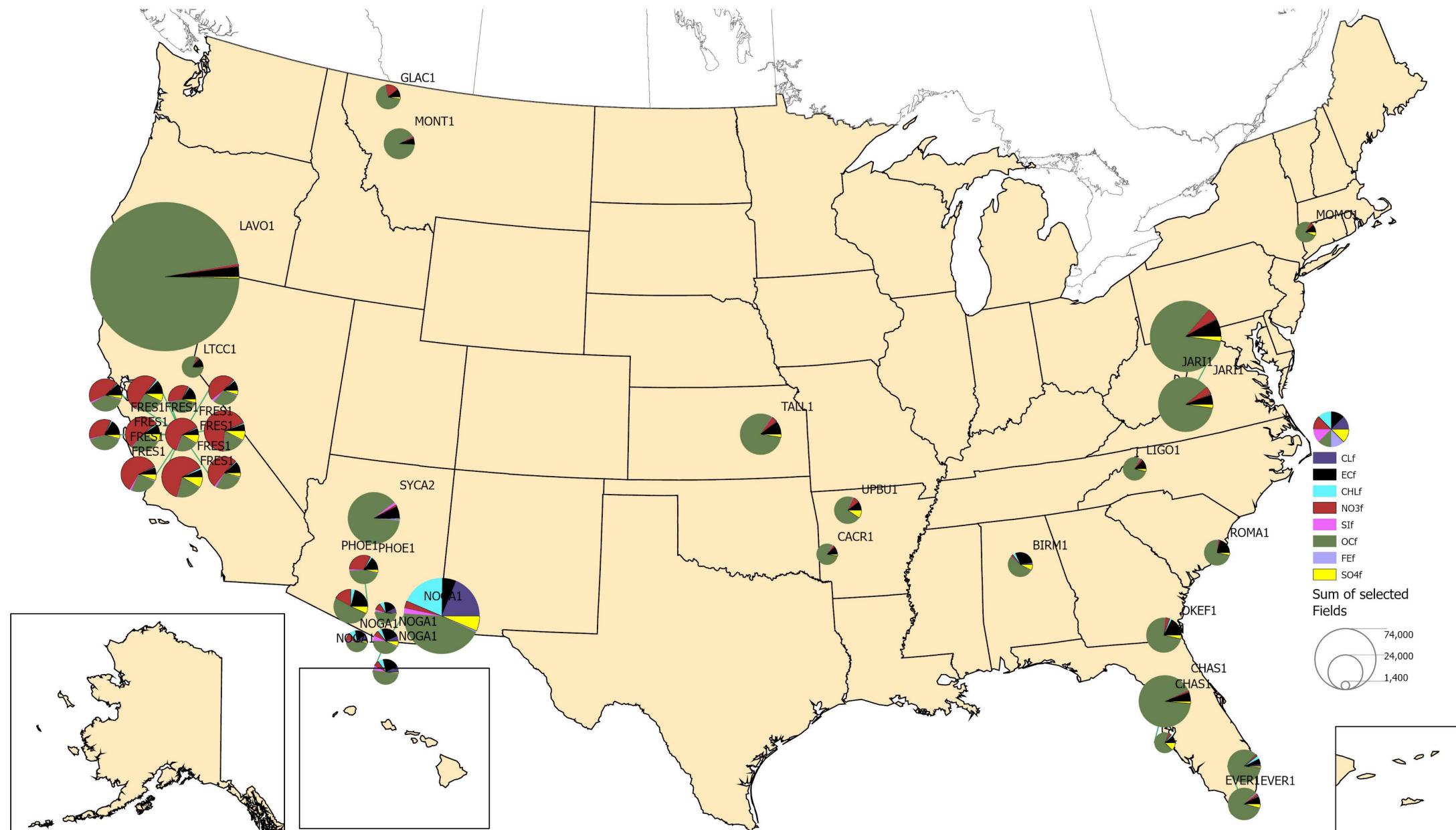
Short Duration "SD" Data

-Flow shut off before 16 hours to prevent filter damage or out of bounds flow rates.
-These samples are a fascinating look at the outer extreme of measured concentrations.
-First "SD" code was PHOE1 , 12/25/22.
-Prior to this, samples would be coded "CL" and not analyzed.
-Module A tends to be the first to clog.
-The range of concentrations required to cause and "SD" flag is highly variable.
-Importantly, these samples tend to be dominated by OC, and hence would be unlikely to be included in MID metric.
-None were caused by dust.
-This technique might be applied to other networks if clogging occurs!

Flow Code Frequency by Gravimetric Fine Mass Category, All 2023-2024 Samples

Legend:
- No Clogging
- Moderate Clogging ("CG")
- "SD" Shut off

X-axis categories: 0-10 ug/m3, 10-50 ug/m3, 50-100 ug/m3, 100-200 ug/m3, 200-500 ug/m3, 500+ ug/m3
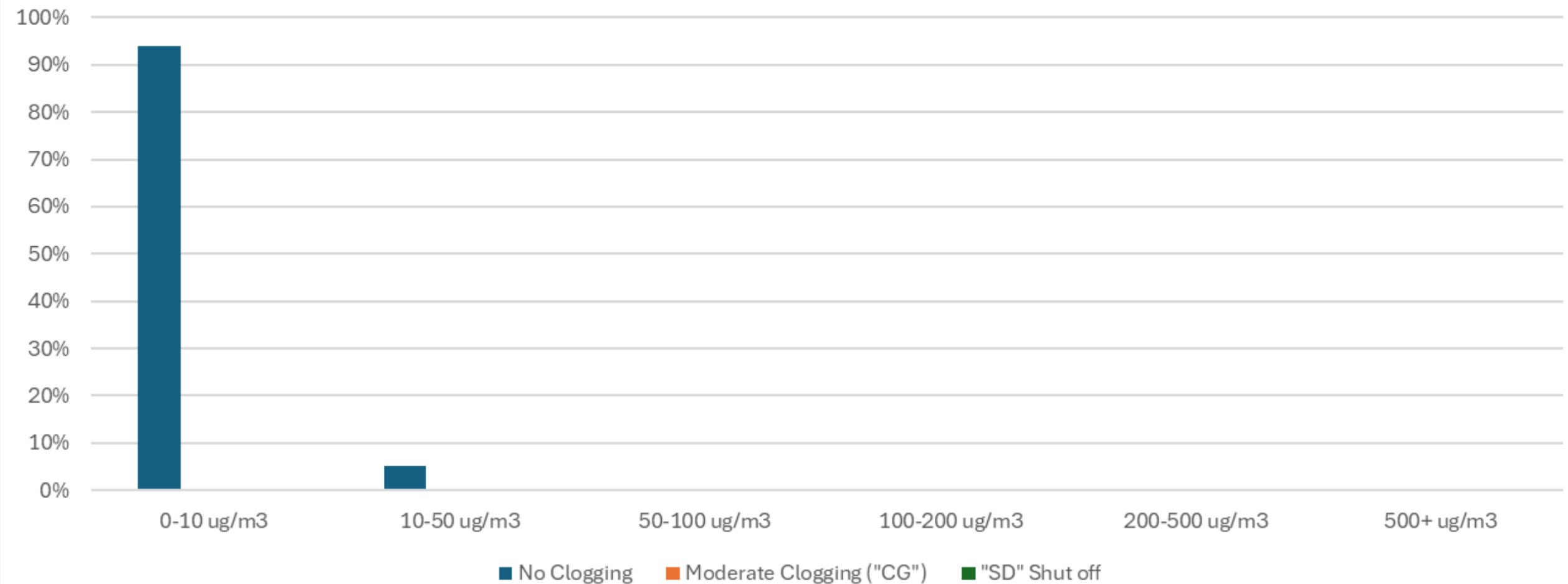
Flow Distrbution by Gravimetric Fine Mass Category, All 2023-2024 Samples
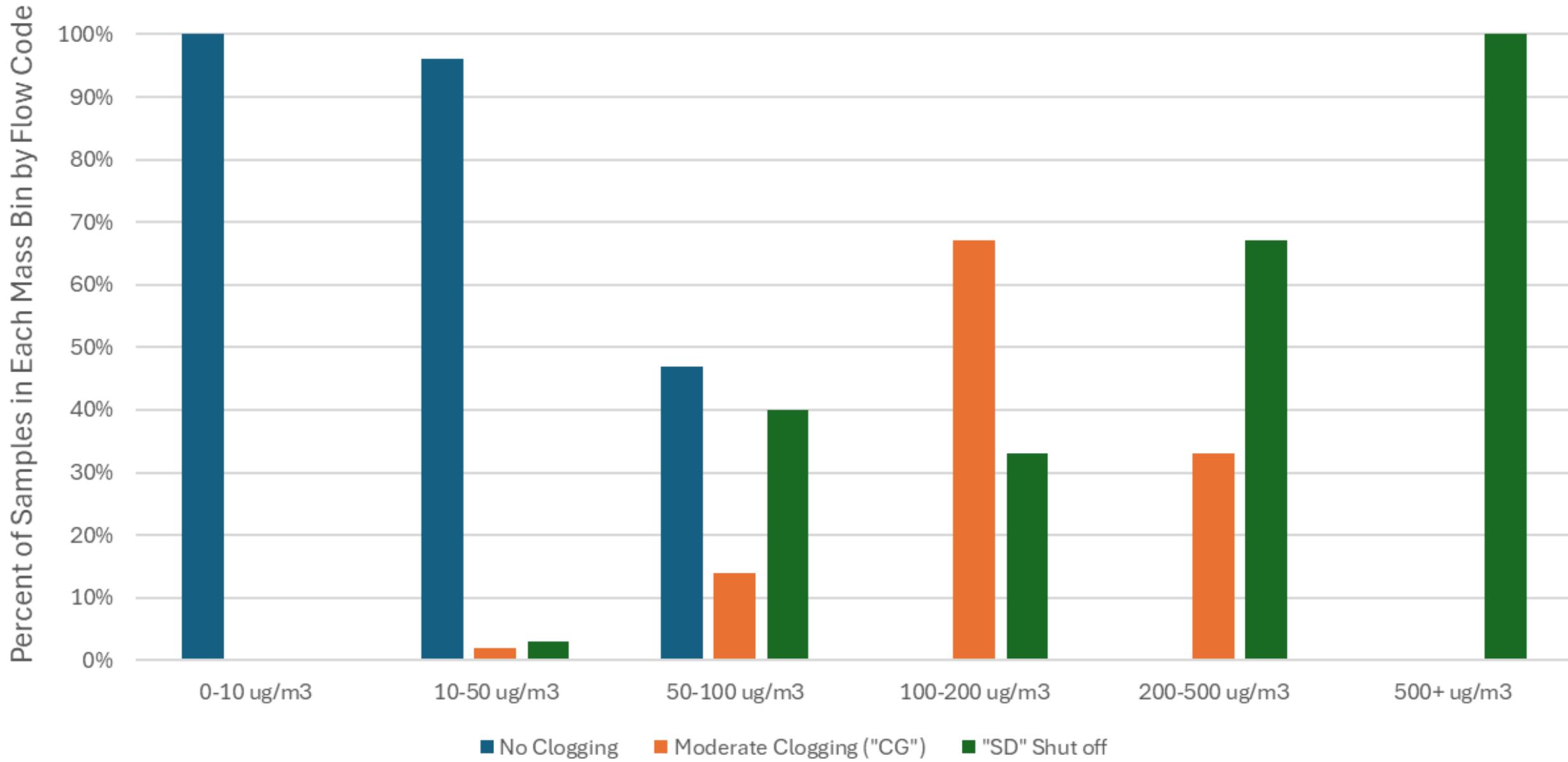
1.41E+08	2051070	NOCH1	RT	6/14/2023	SD	ET	1003	-999	-999	min	-999	B
1.41E+08	2051077	NOCH1	RT	6/14/2023	SD	ET	1003	-999	-999	min	-999	C
1.41E+08	2051070	NOCH1	RT	6/14/2023	SD	Flow	22.17	-999	-999	LPM	-999	B
1.41E+08	2051077	NOCH1	RT	6/14/2023	SD	Flow	22.78	-999	-999	LPM	-999	C
1.41E+08	2051063	NOCH1	RT	6/14/2023	SD	ET	1003	-999	-999	min	-999	A
1.41E+08	2051063	NOCH1	RT	6/14/2023	SD	Flow	23.09	-999	-999	LPM	-999	A
1.41E+08	2051084	NOCH1	RT	6/14/2023	SD	ET	1003	-999	-999	min	-999	D
1.41E+08	2051084	NOCH1	RT	6/14/2023	SD	Flow	17.22	-999	-999	LPM	-999	D
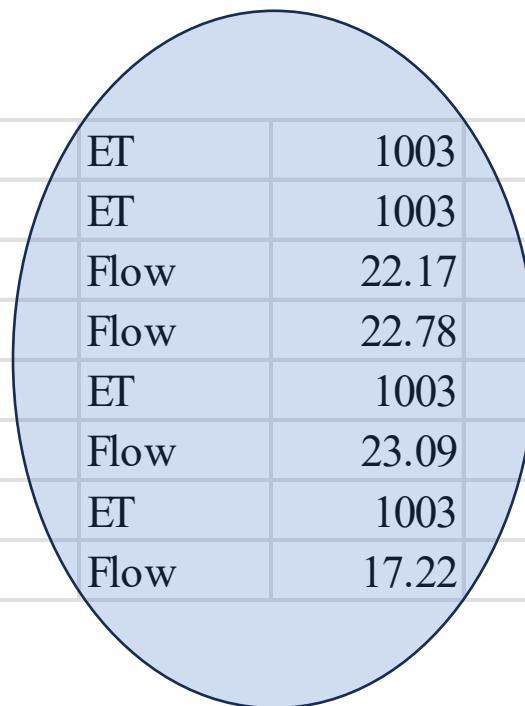
Regional Haze Maps and Metrics

- Impairment metrics here:
  https://drive.google.com/drive/folders/0Bxfj1vyyXeDYWVpfeUo4NEYtTU0?resourcekey=0-d0Bn5HHHEkgbiHZvIQWaLQ&usp=sharing

- Haziest Day metrics here:
  https://drive.google.com/drive/folders/0Bxfj1vyyXeDYTjNLeIIwUUx0TTg?resourcekey=0-yt0EY9maDLhRmcE8s5tC6A&usp=sharing

- History of RHR metric changes since 10/2019.
  https://docs.google.com/presentation/d/16i5fwc6aVAjqNQRAvhd5jIIxeiyfCsQQ/edit?usp=drive_link&ouid=116534812255078445612&rtpof=true&sd=true