

Appendix E

Interagency Monitoring of Protected Visual Environments (IMPROVE)

Overview

The Interagency Monitoring of Protected Visual Environments (IMPROVE) program is a cooperative measurement effort governed by a steering committee composed of representatives from Federal and regional-state organizations. The IMPROVE monitoring program was established in 1985 to aid the creation of Federal and State implementation plans for the protection of visibility in class I areas (156 national parks and wilderness areas).

The objectives of IMPROVE include:

- establishing current visibility and aerosol conditions in mandatory class I areas; and
- identifying chemical species and emission sources responsible for existing man-made visibility impairment.

The particulate monitoring portion of the IMPROVE program measures the concentration of the fine (PM_{2.5}) particles for mass, optical absorption, major and trace elements, organic and elemental carbon, and nitrate and of PM₁₀ particles for mass. Prior to 2000, IMPROVE sites collect two samples per week, on Wednesday and Saturday. With the implementation of the Regional Haze Rule the IMPROVE program changed to a 1-in-3 day schedule.

The data for this report was obtained from the website <http://vista.cira.colostate.edu/TSS/Results/HazePlanning.aspx>. The graphs in this report show the PM_{2.5} (fine) mass monitor values at selected IMPROVE monitoring locations. The data for the source emissions apportionment as well as the weighted emissions potential (WEP) are based on 2000-2004 data. As noted in Section II of the Staff Report, PM_{2.5} and precursor emissions in California have decreased significantly since that baseline period.

For most of the Class I areas downwind of California and near any potential receptor sites, the highest fractional contribution from California sources occurs on the 20 percent best visibility days (i.e., days characterized by the least amount of light-scattering particulate matter in the air). This illustrates the need for sufficient wind to transport pollutants from California up and over significant elevations to the monitors in these Class I areas.

E.1: IMPROVE Monitoring for PM_{2.5}

Improve Monitoring Locations On California Border Or Near Pm_{2.5} Receptors

Figure E.1.1: Selected IMPROVE Sites and PM_{2.5} Receptors



Table E.1.1: Selected IMPROVE sites

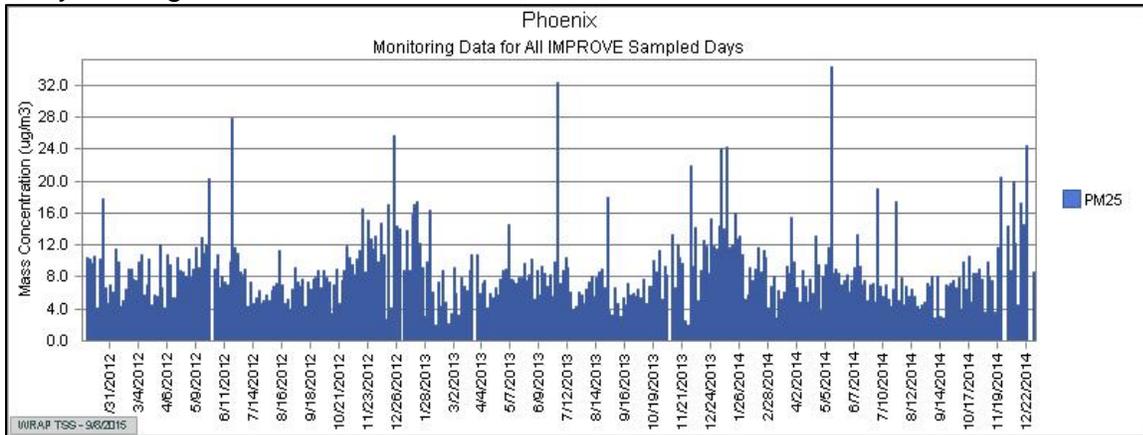
State	IMPROVE site
Arizona	PHOE1 Phoenix SAGU1 Saguaro TONT1 Tonto (Superstition)
California	BLIS1 Bliss State Park LABE1 Lava Beds REDW1 Redwood
Idaho	CRMO1 Craters of the Moon SAWT1 Sawtooth HECA1 Hells Canyon
Montana	CABI1 Cabinet Mountains GAMO1 Gates of the Mountains SULA1 Sula Peak
Nevada	JARB1 Jarbridge GRBA1 Great Basin
Oregon	CRLA1 Crater Lake KALM1 Kalmiopsis STAR1 Starkey THSI1 Three Sisters
Utah	BRCA1 Bryce Canyon ZION1 Zion Canyon

Arizona

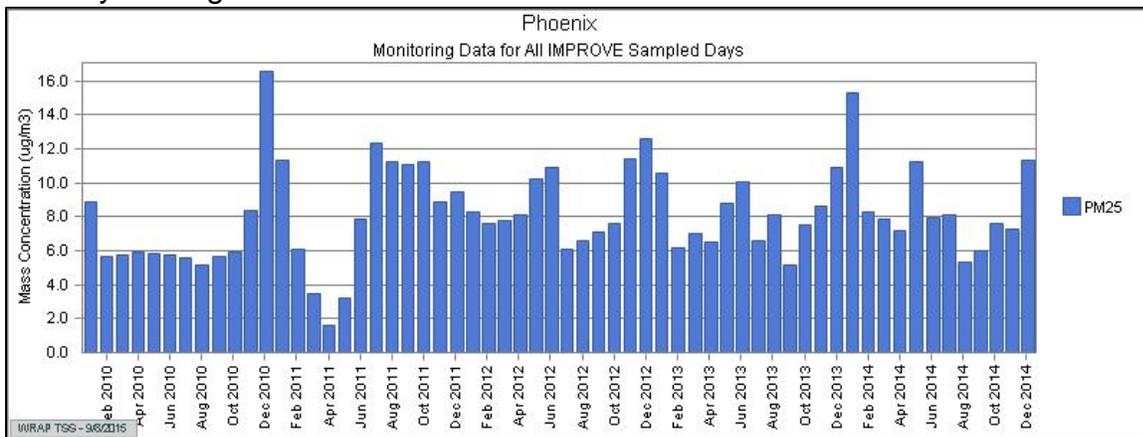
PHOE1 Phoenix

NO EMISSIONS OR SOURCE APPORTIONMENT FOR THIS SITE

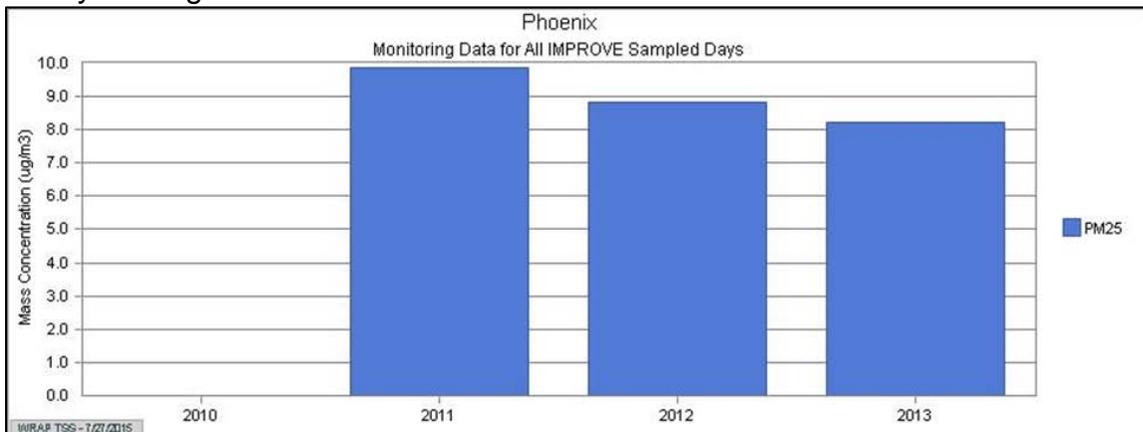
Daily Averages



Monthly Averages

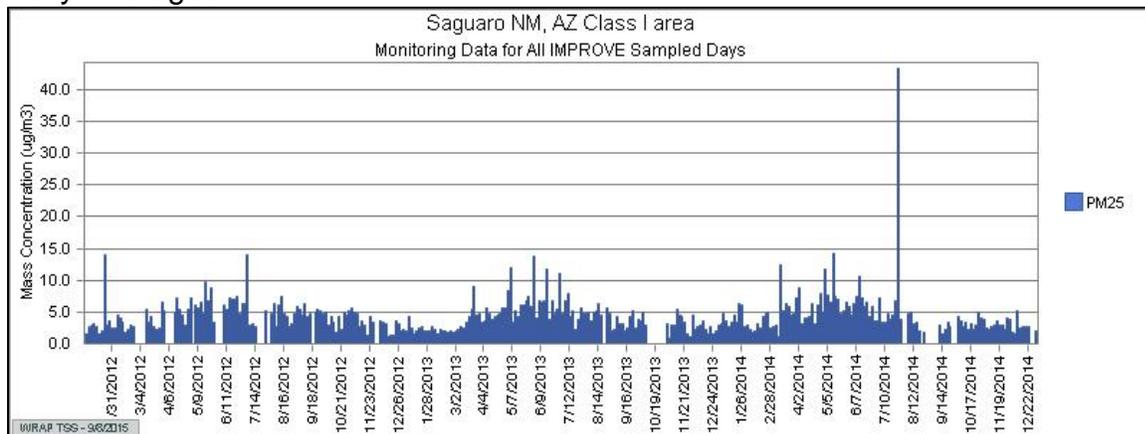


Yearly Averages

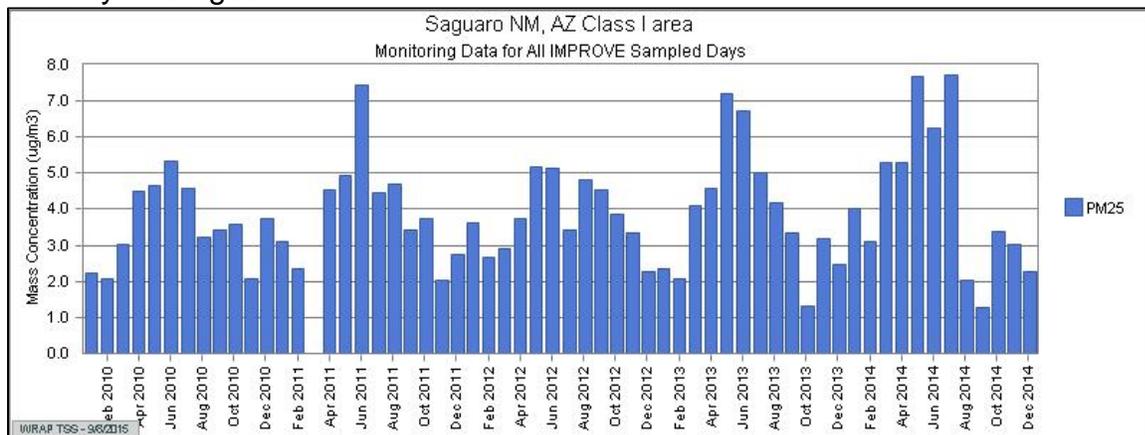


SAGU1 Saguro National Monument

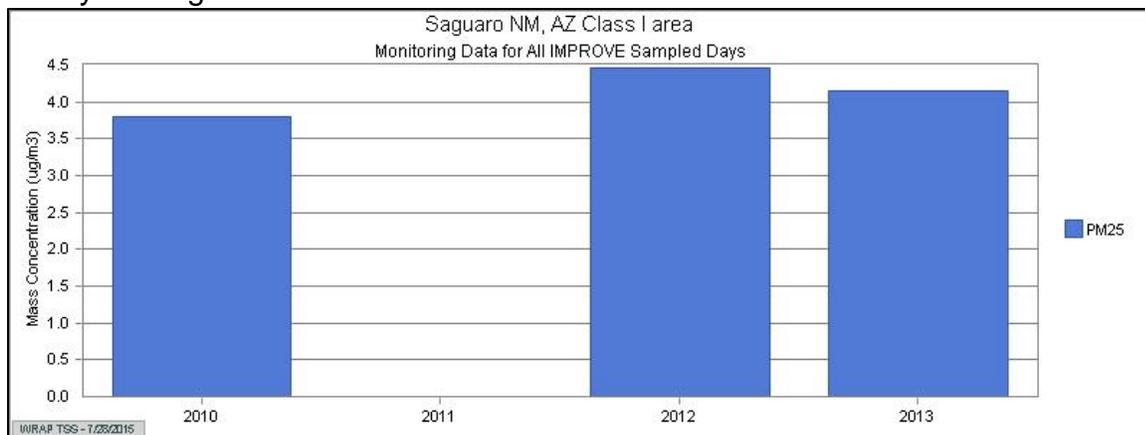
Daily Averages



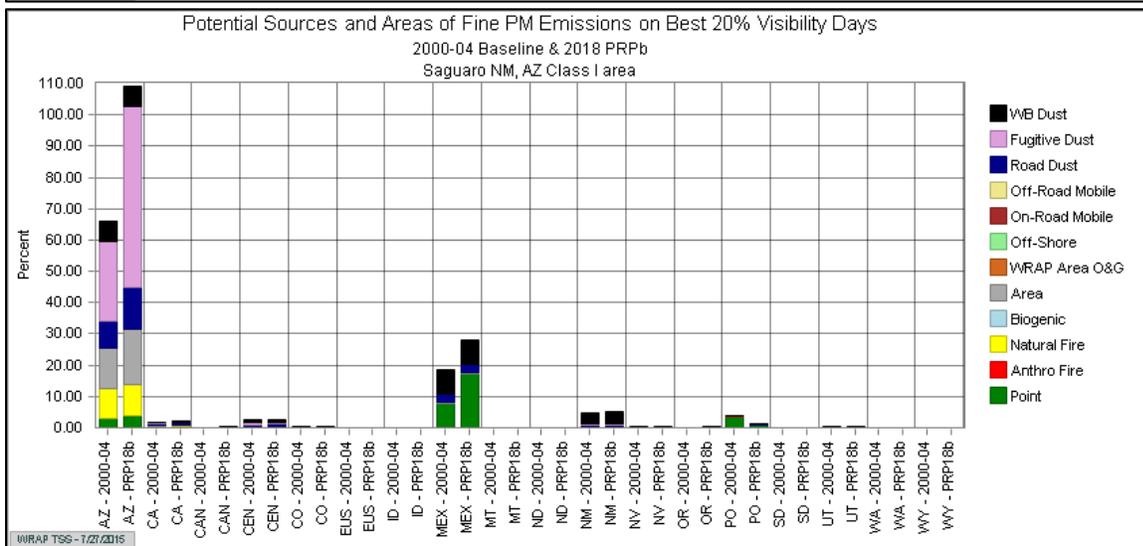
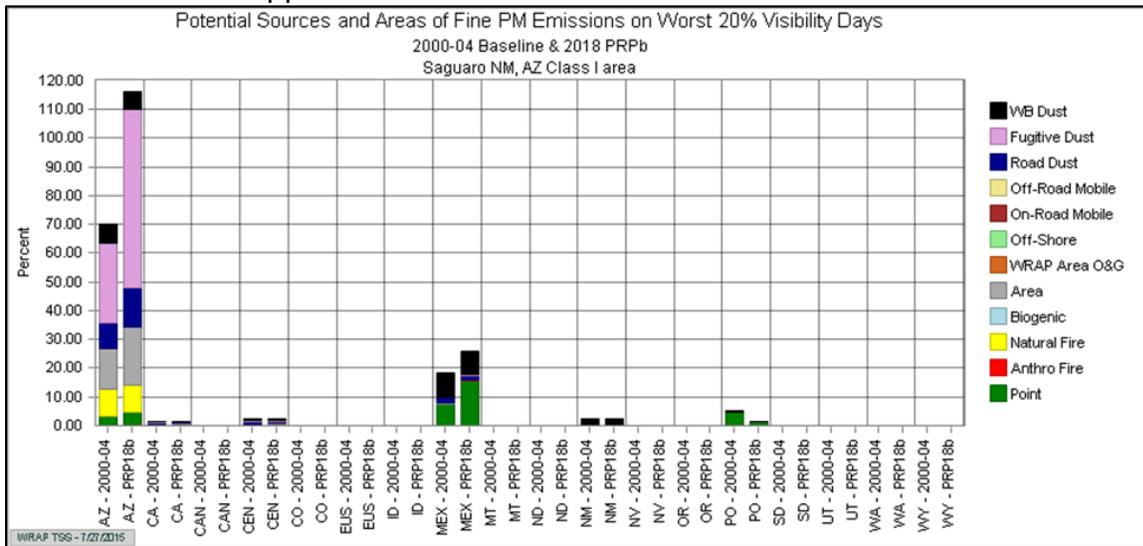
Monthly Averages



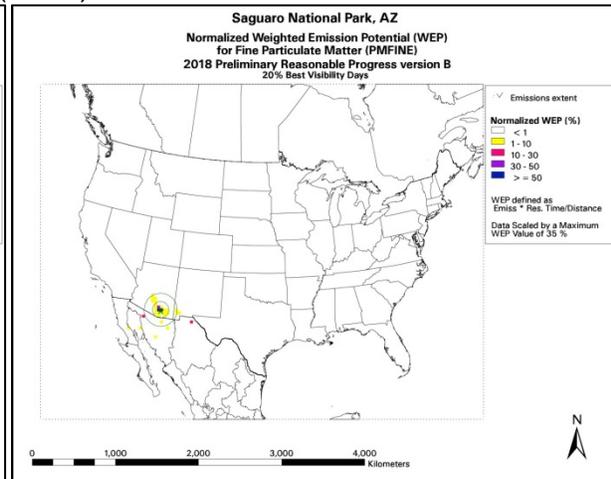
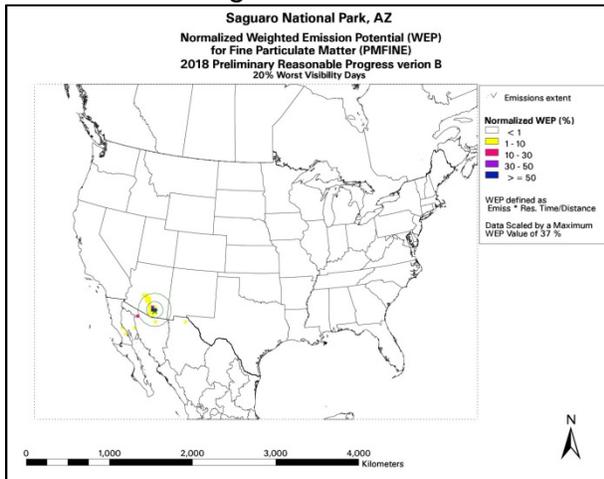
Yearly Averages



Potential Source Apportionment

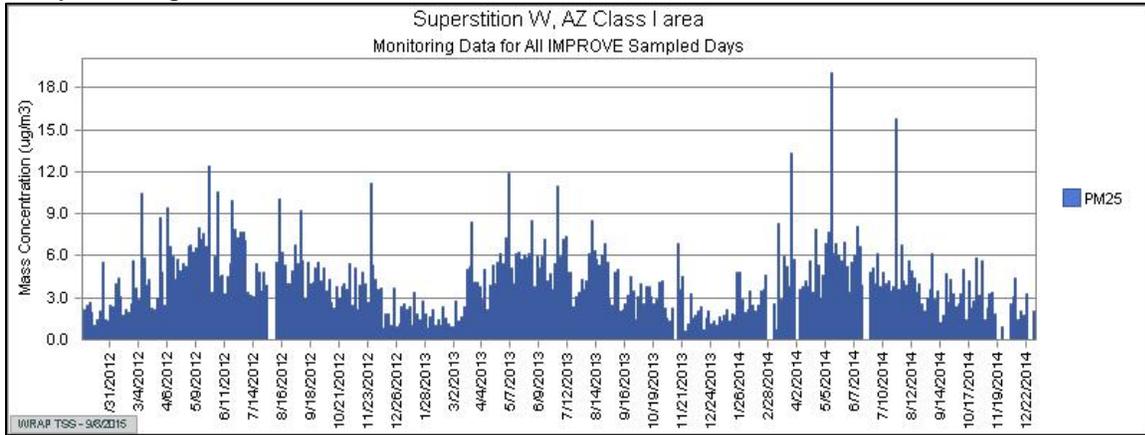


Normalized Weighted Emissions Potential (WEP)

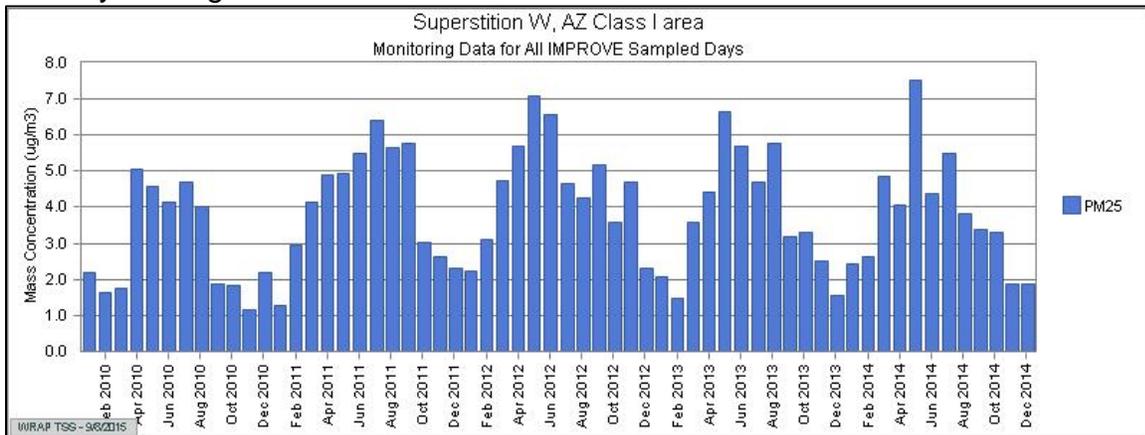


TONT1 Superstition Wilderness

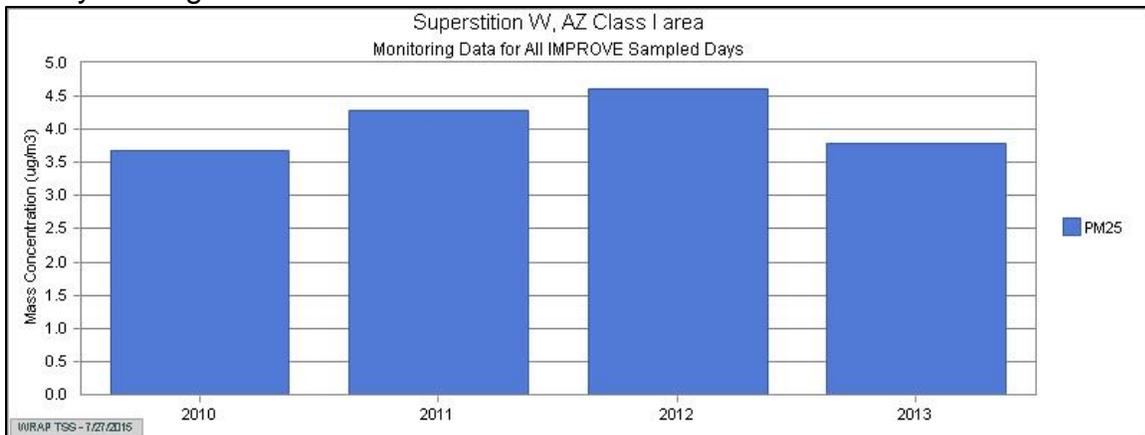
Daily Averages



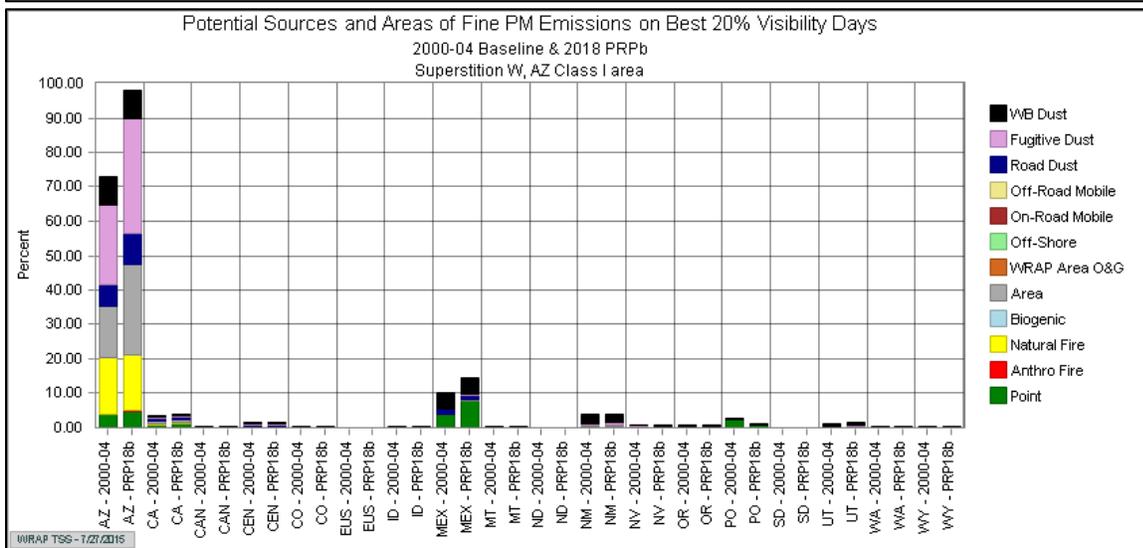
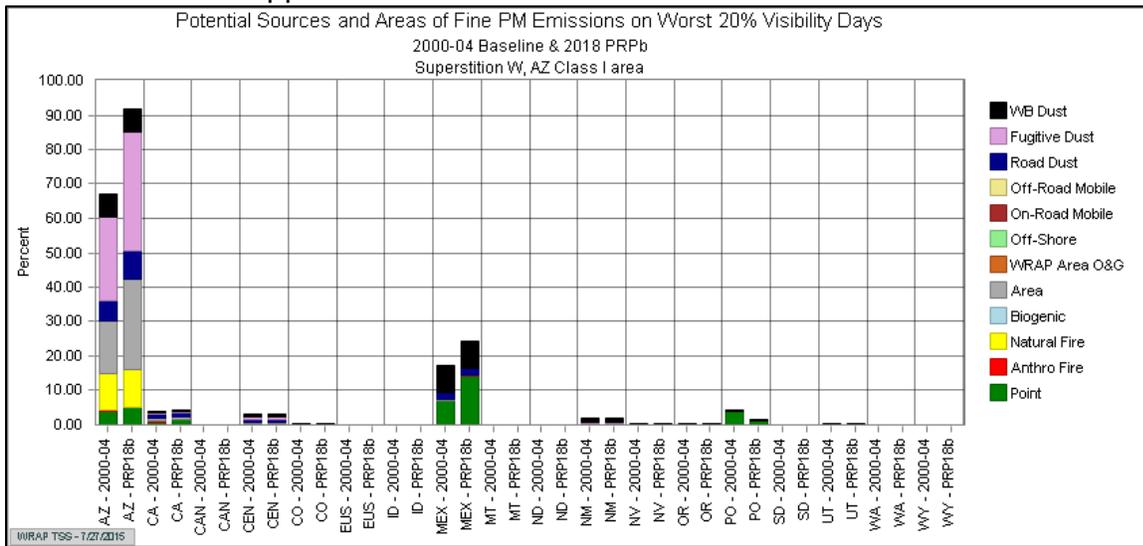
Monthly Averages



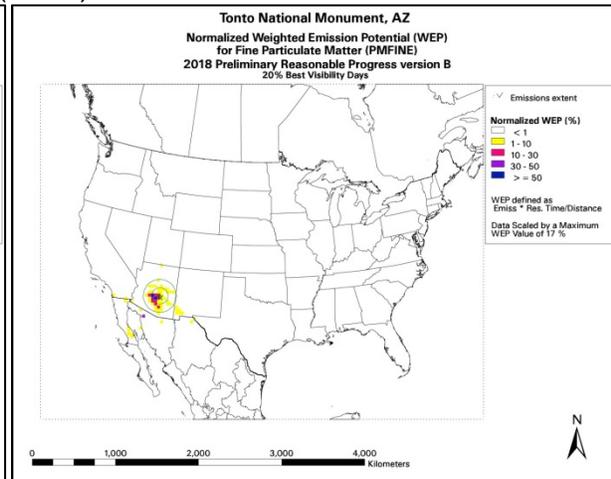
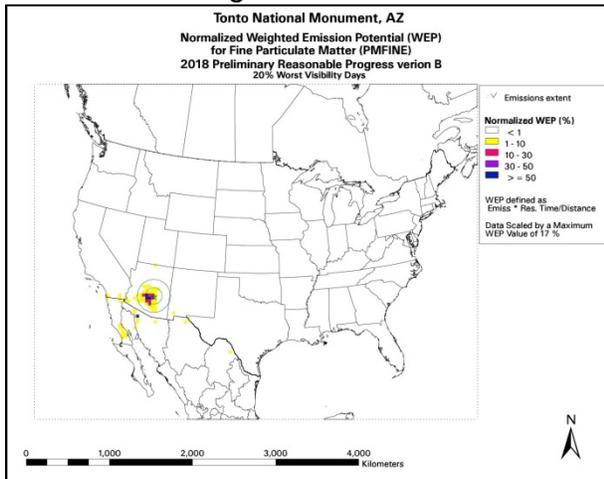
Yearly Averages



Potential Source Apportionment



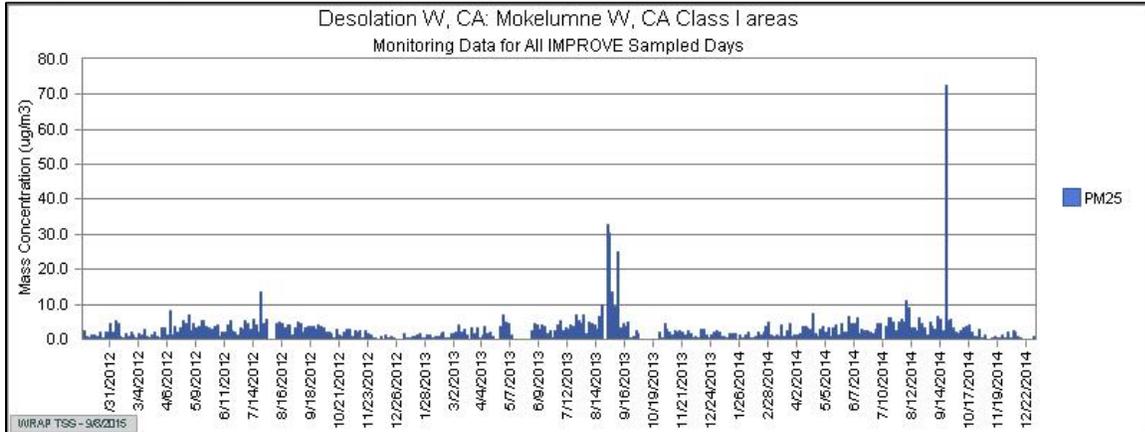
Normalized Weighted Emissions Potential (WEP)



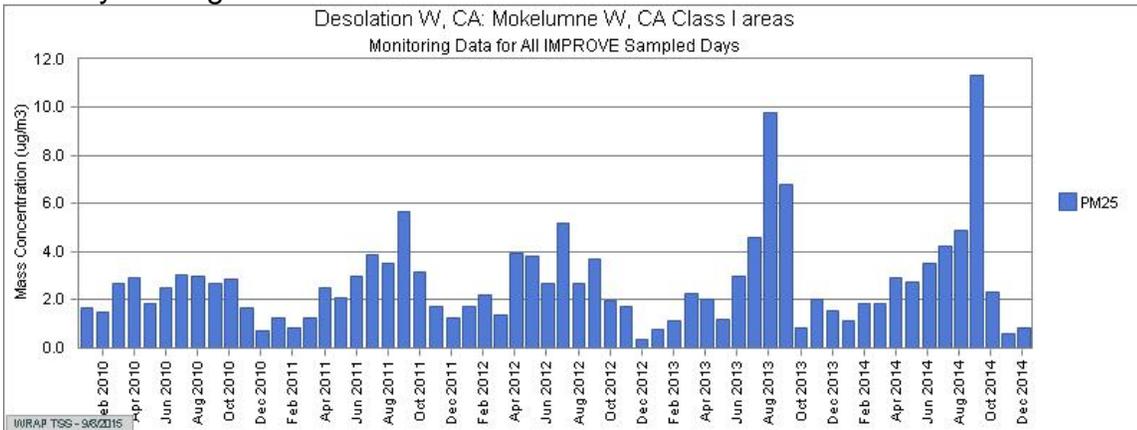
California

BLIS1 Bliss State Park; Desolation Wilderness; Mokelumne Wilderness

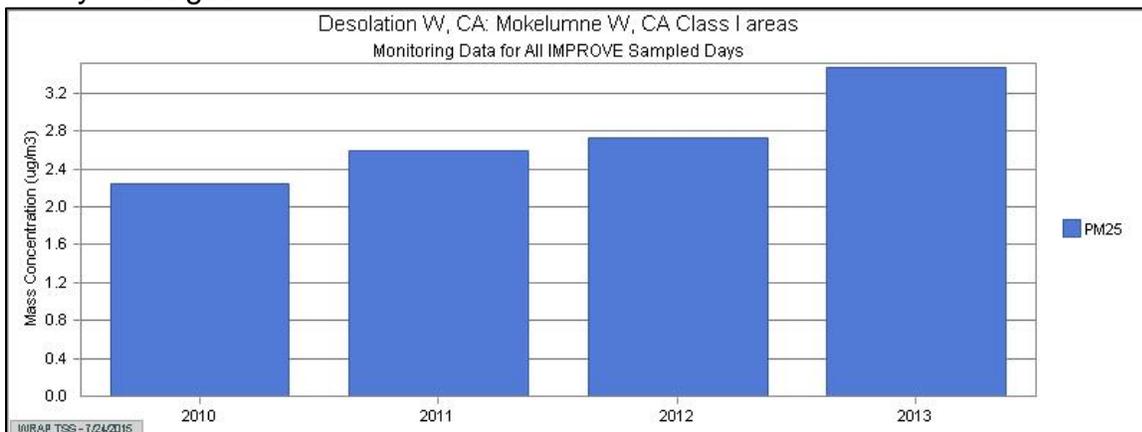
Daily Averages



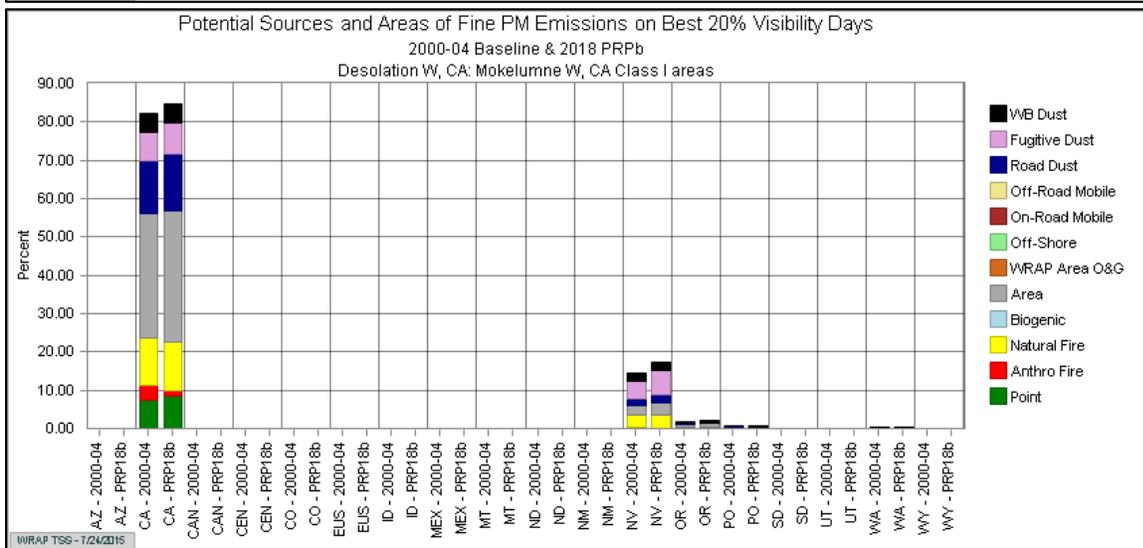
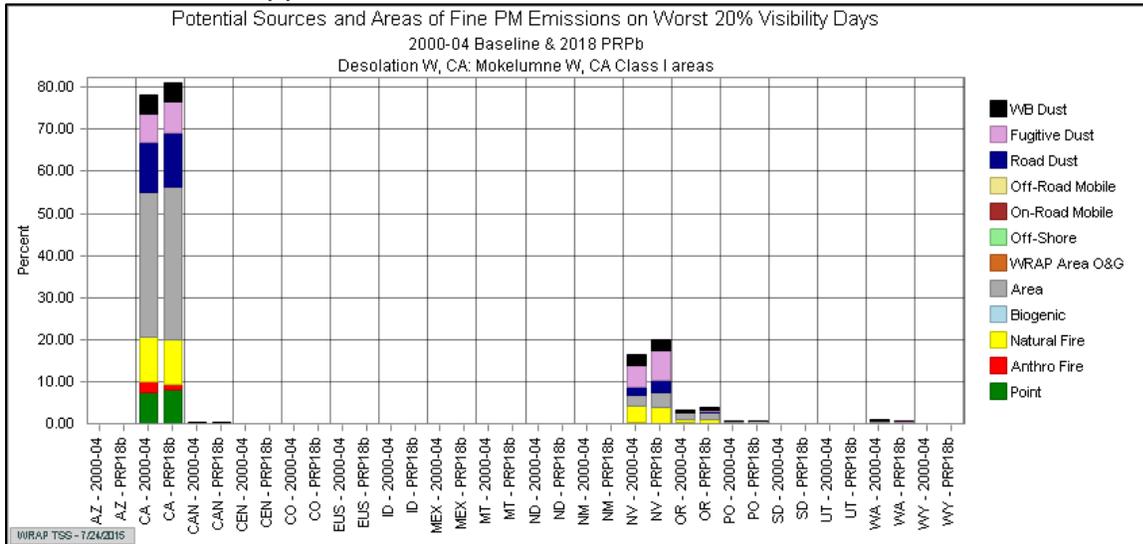
Monthly Averages



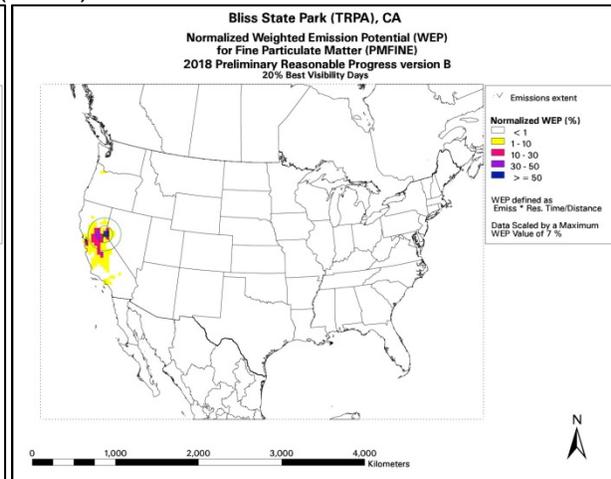
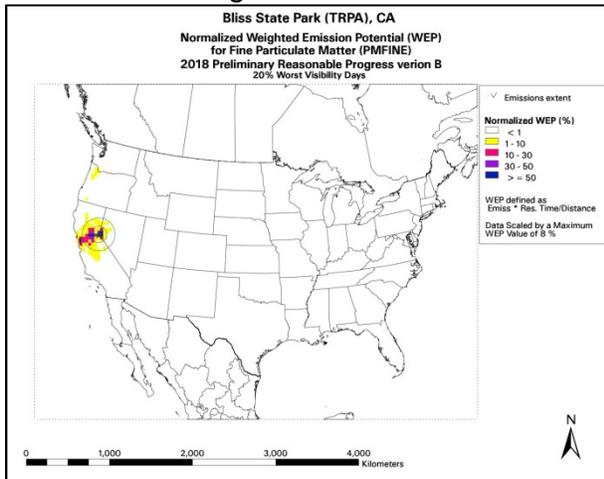
Yearly Averages



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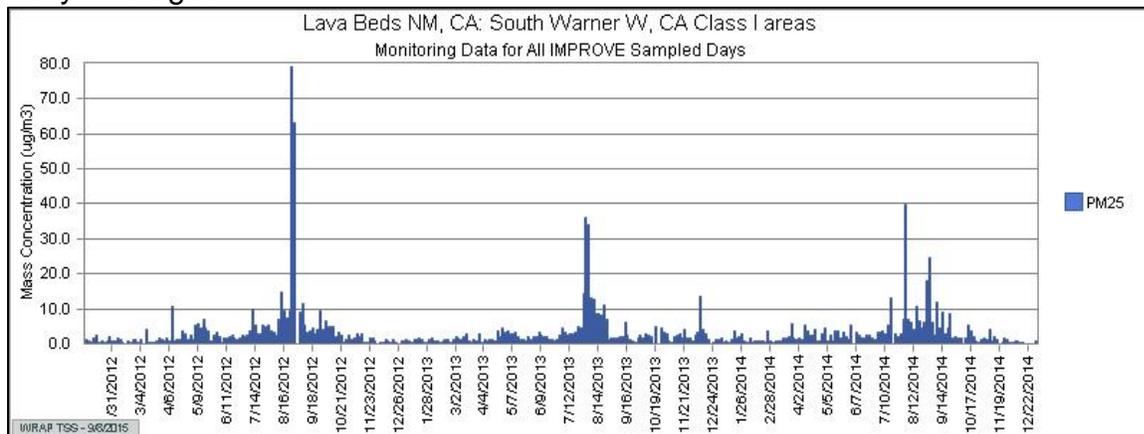


Normalized Weighted Emissions Potential (WEP)

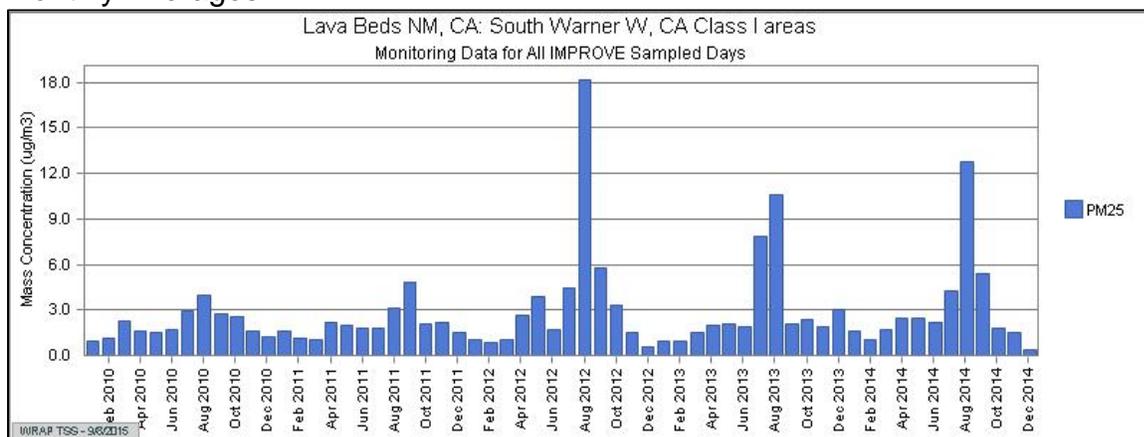


LABE1 Lava Beds National Monument; South Warner Wilderness

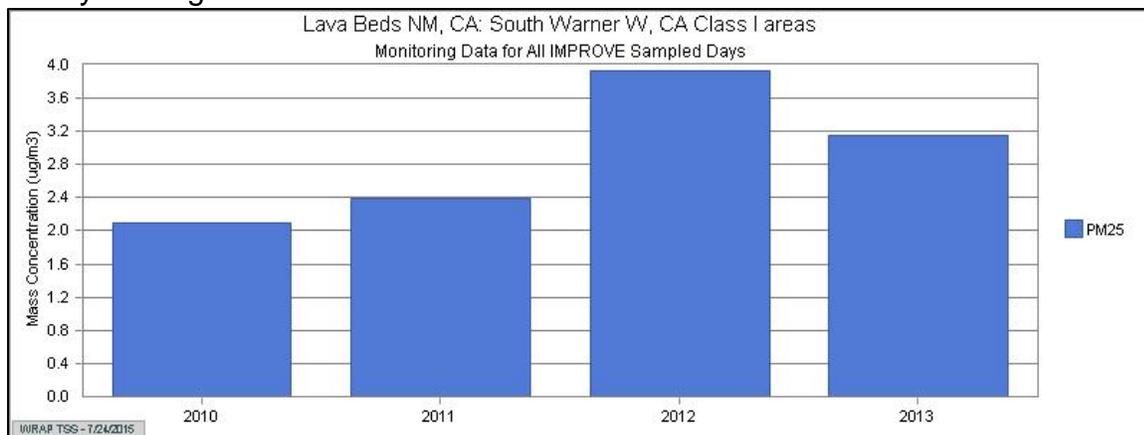
Daily Averages



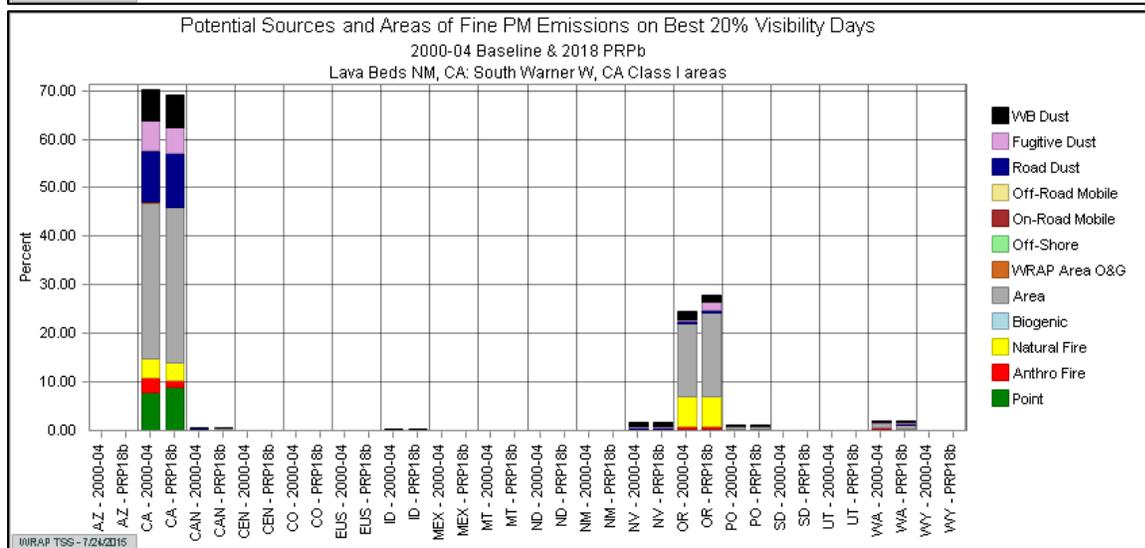
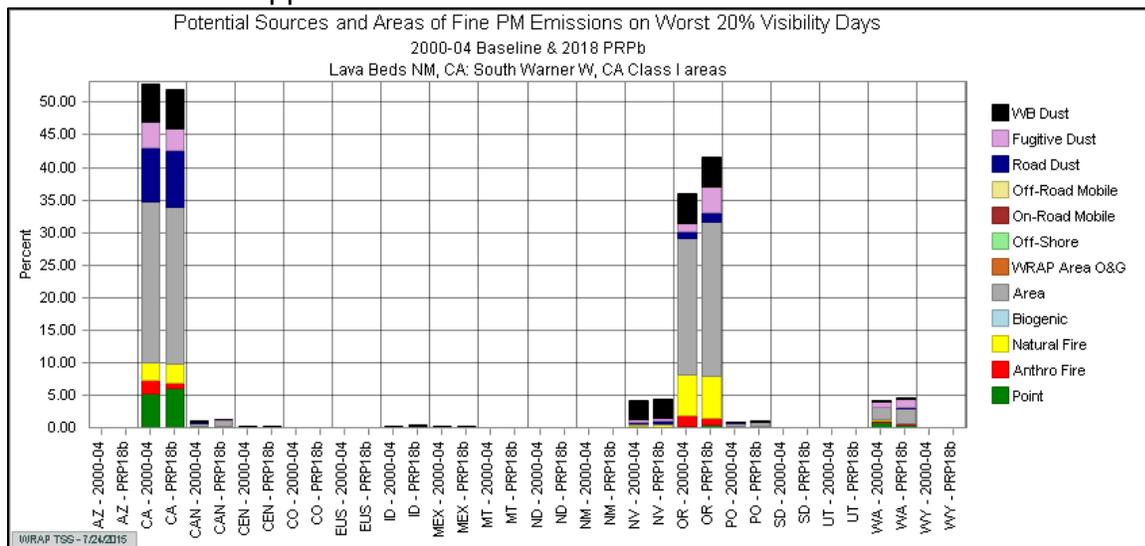
Monthly Averages



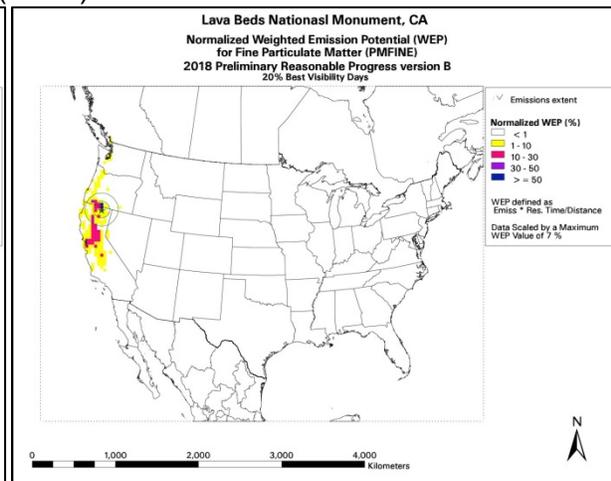
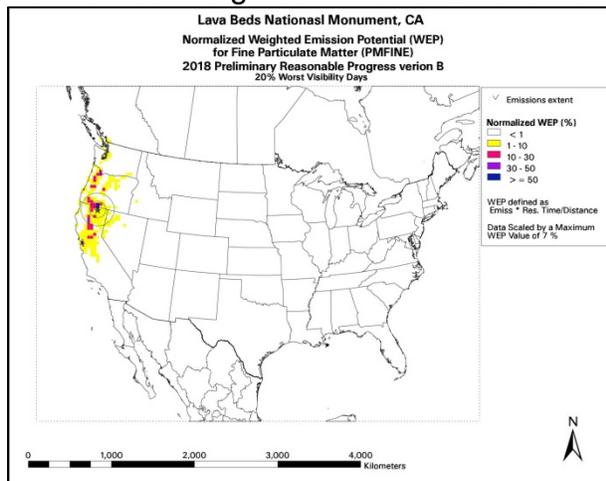
Yearly Averages



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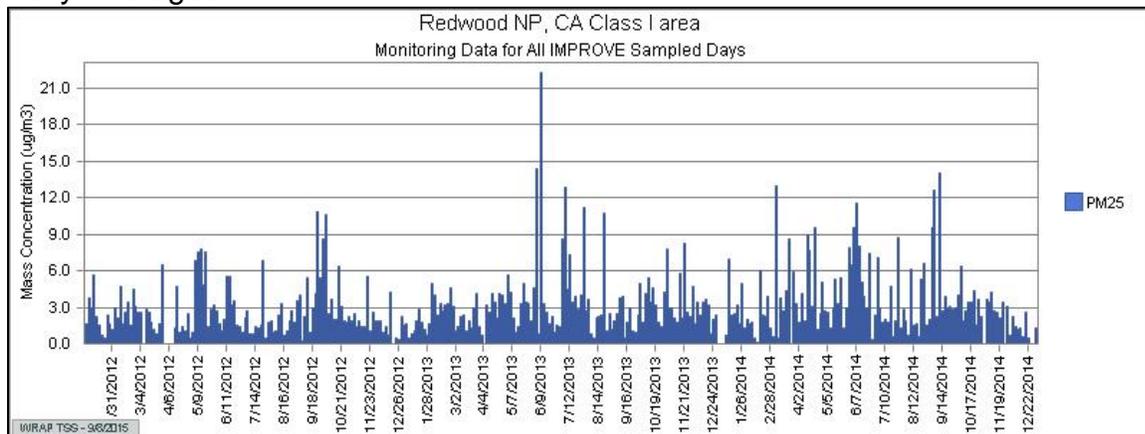


Normalized Weighted Emissions Potential (WEP)

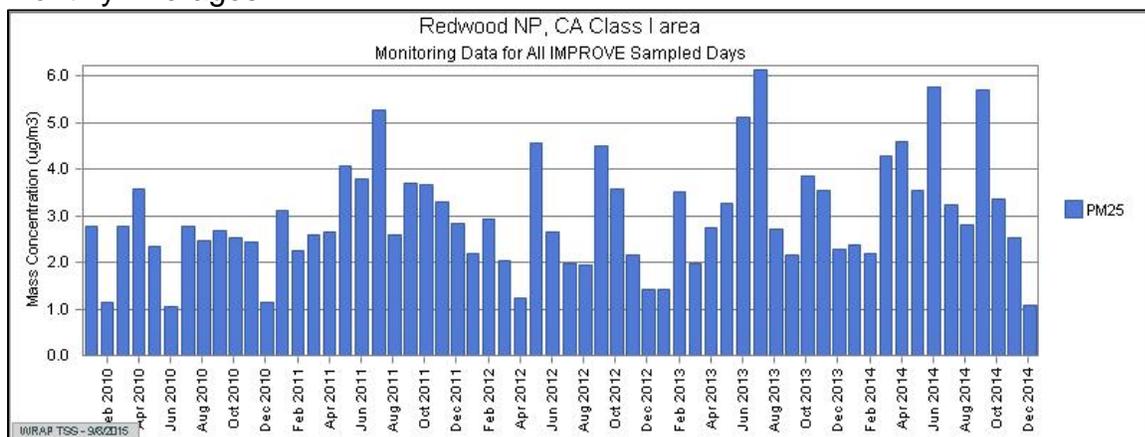


REDW1 Redwood National Park

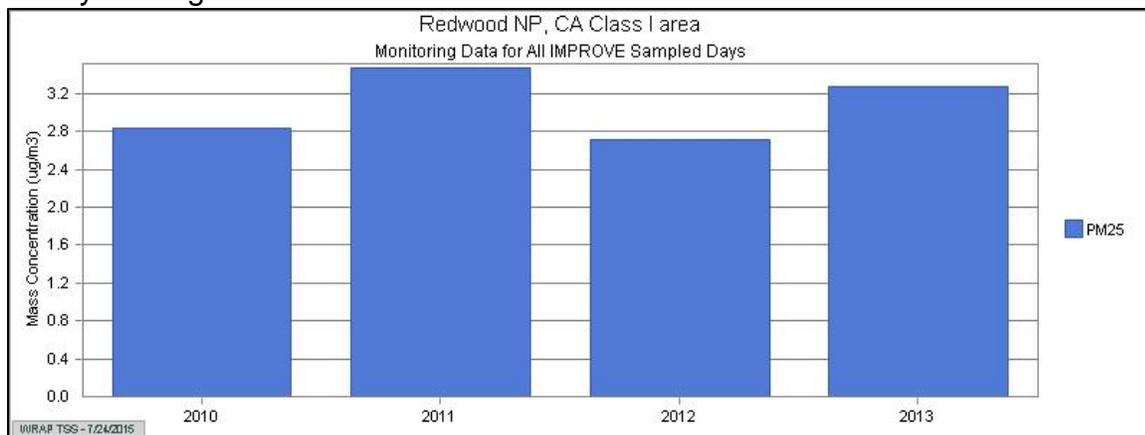
Daily Averages



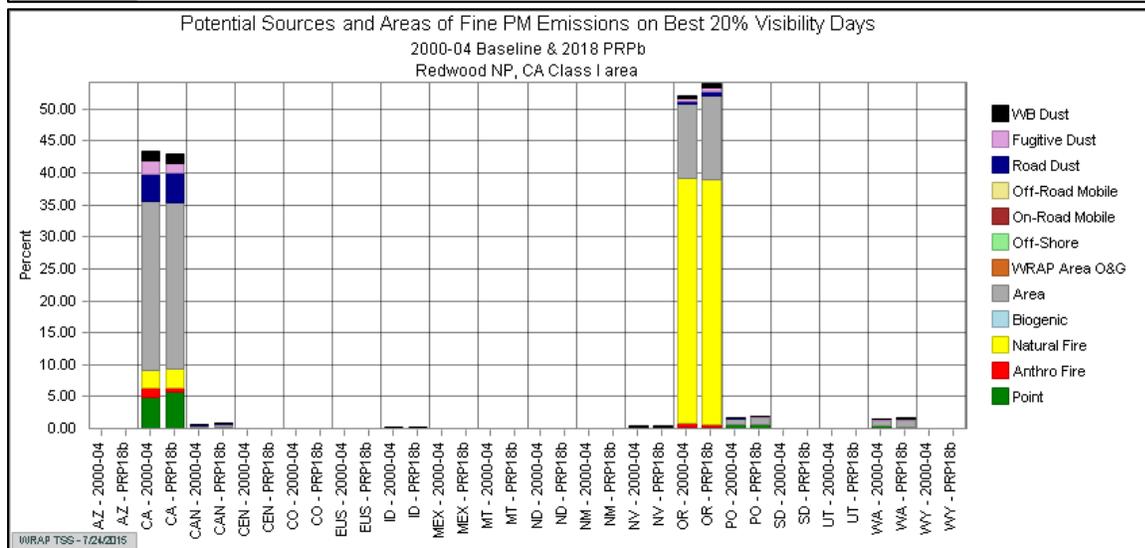
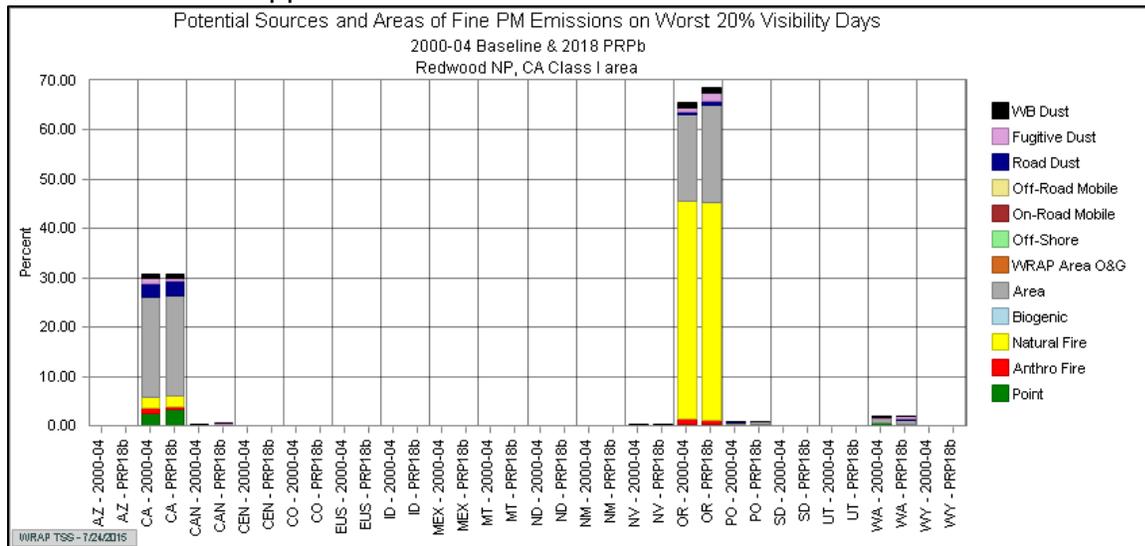
Monthly Averages



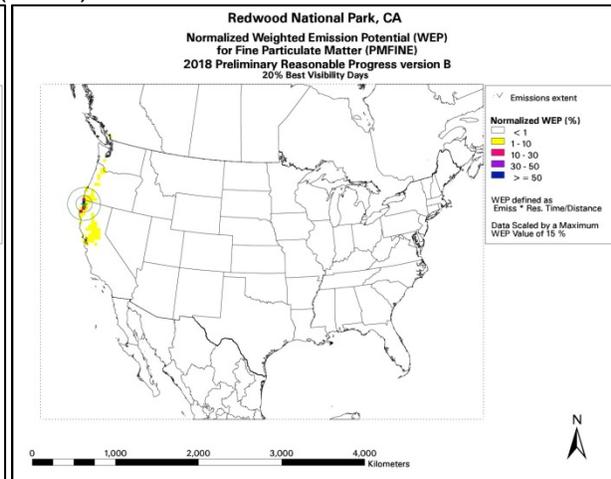
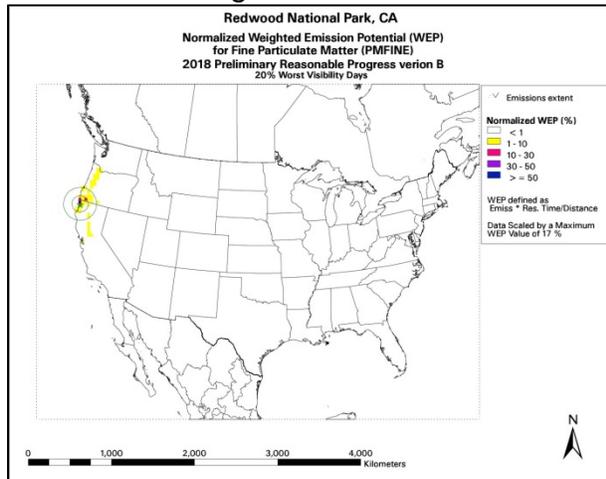
Yearly Averages



Potential Source Apportionment



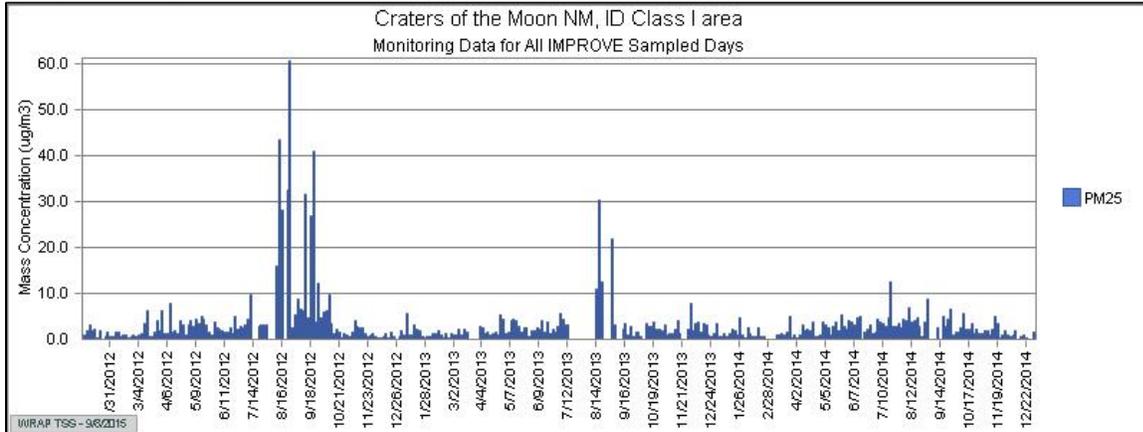
Normalized Weighted Emissions Potential (WEP)



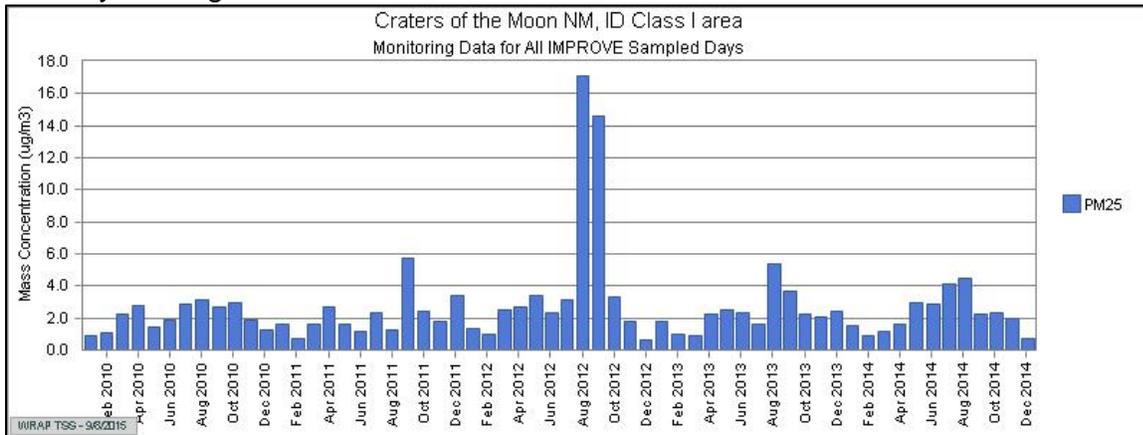
Idaho

CRMO1 Craters of the Moon National Monument

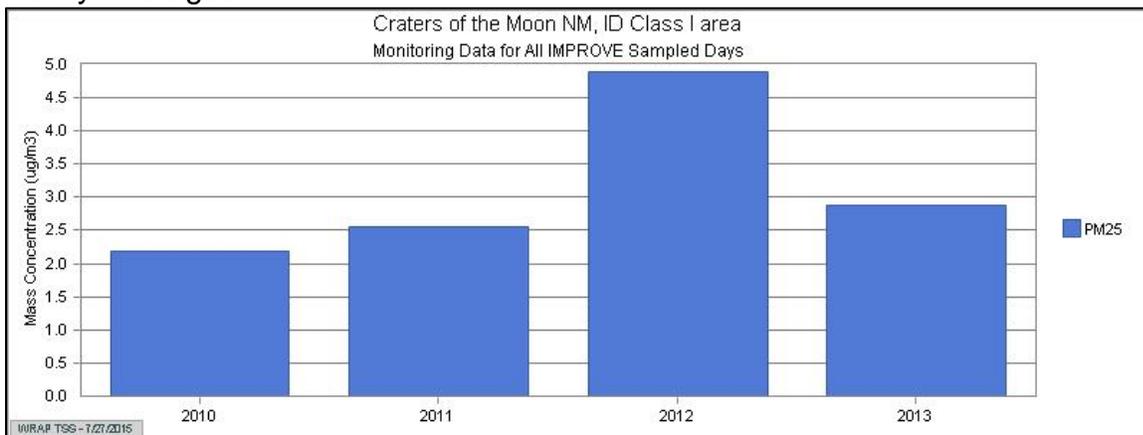
Daily Averages



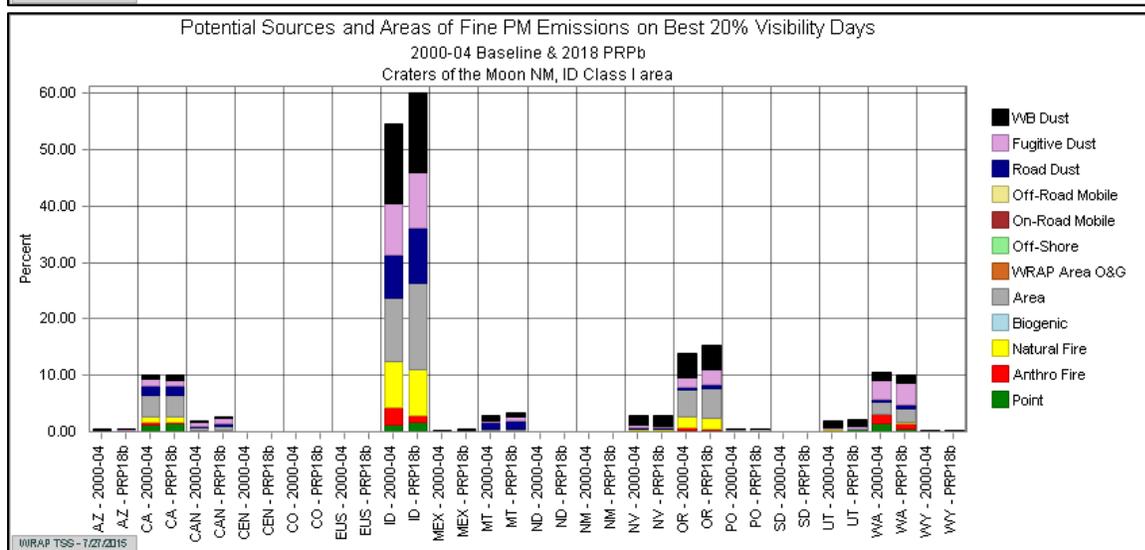
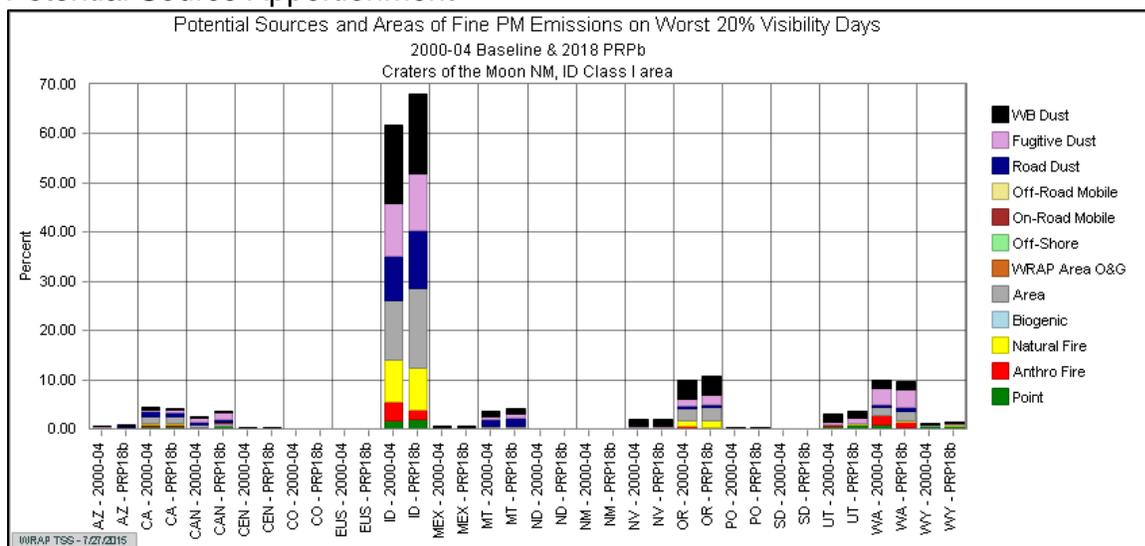
Monthly Averages



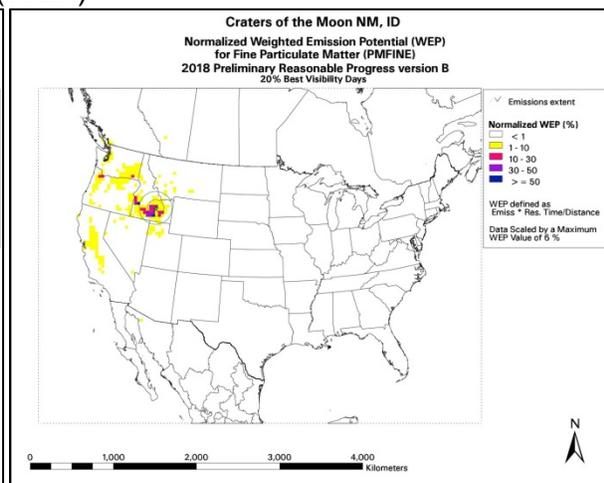
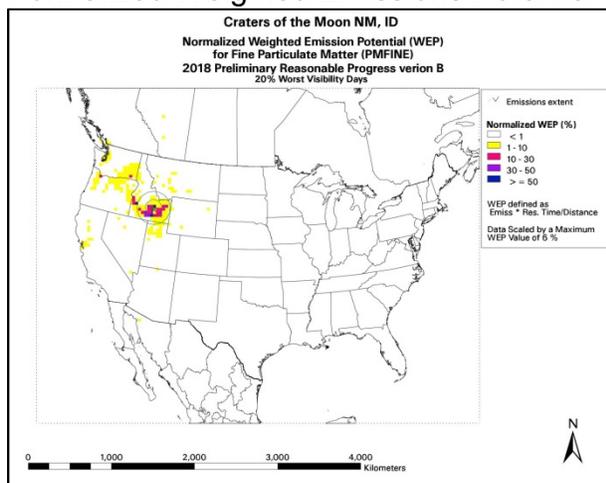
Yearly Averages



Potential Source Apportionment

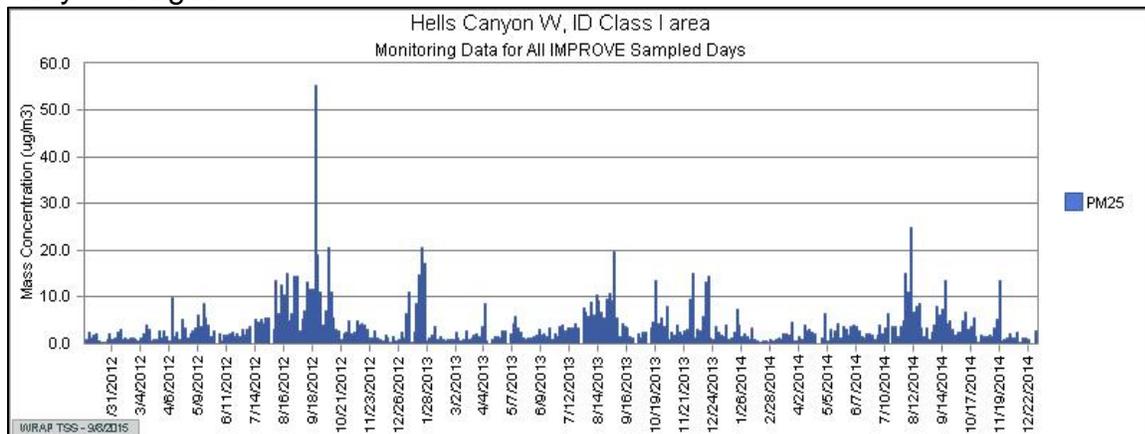


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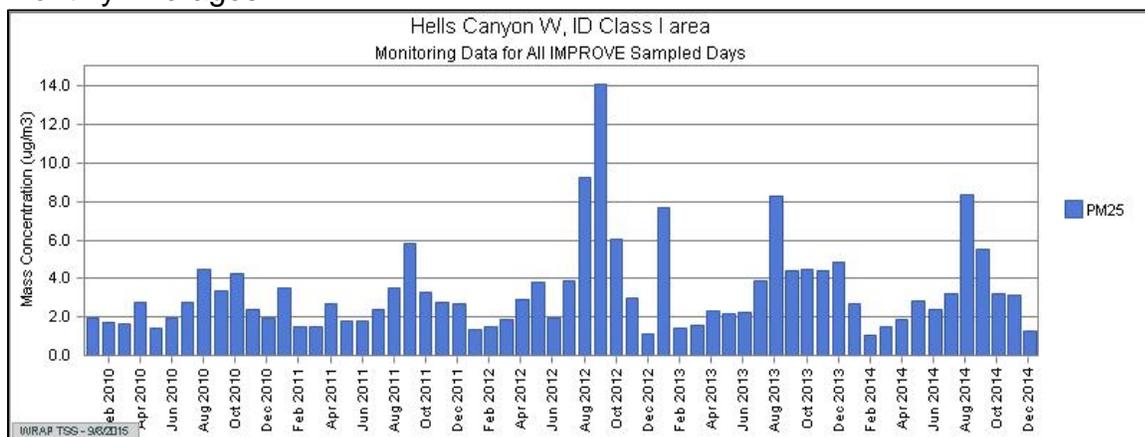


HECA1 Hells Canyon Wilderness

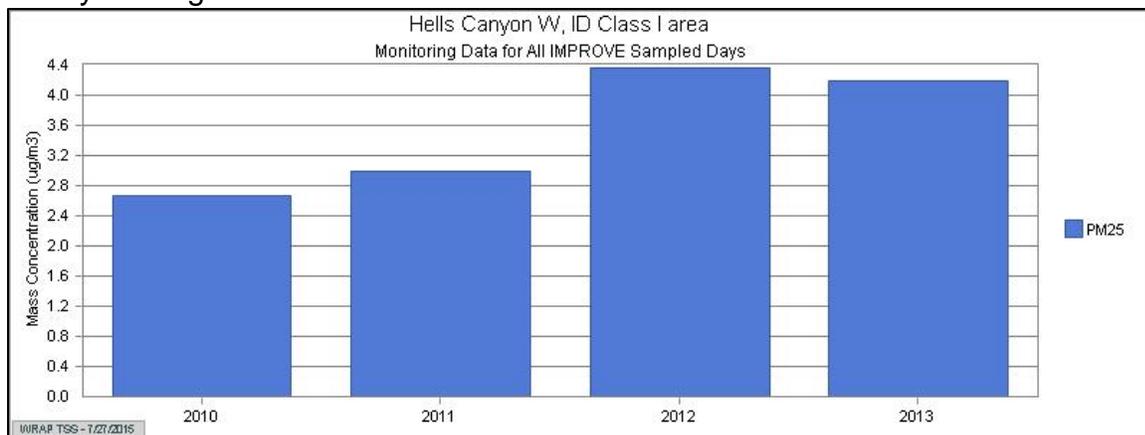
Daily Averages



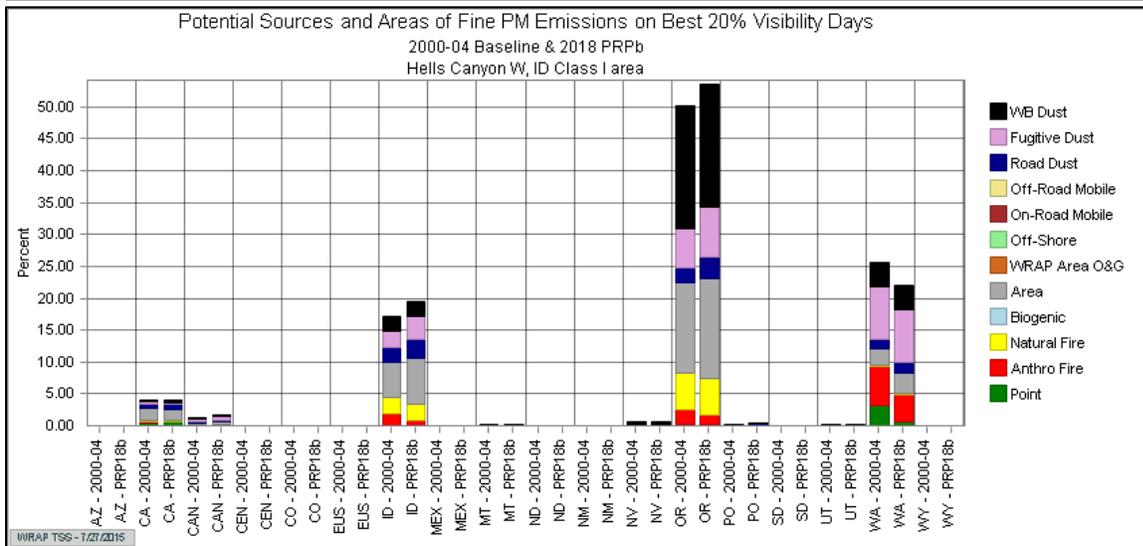
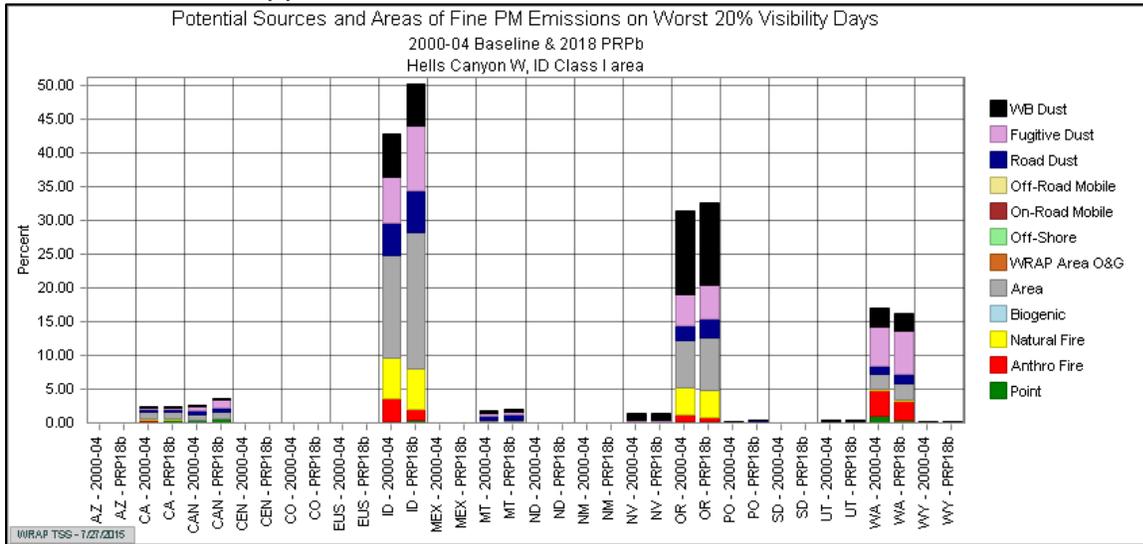
Monthly Averages



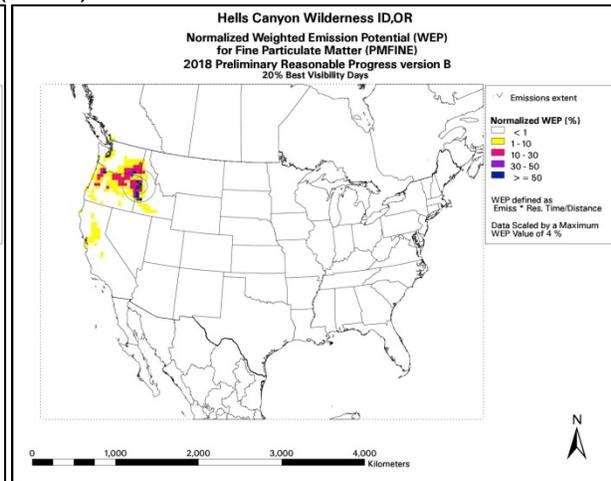
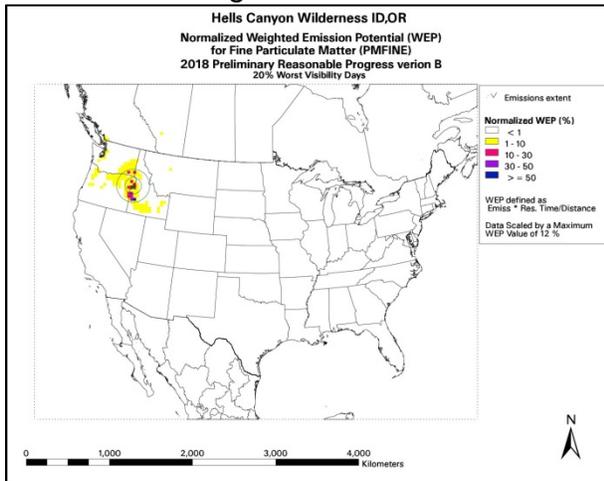
Yearly Averages



Potential Source Apportionment

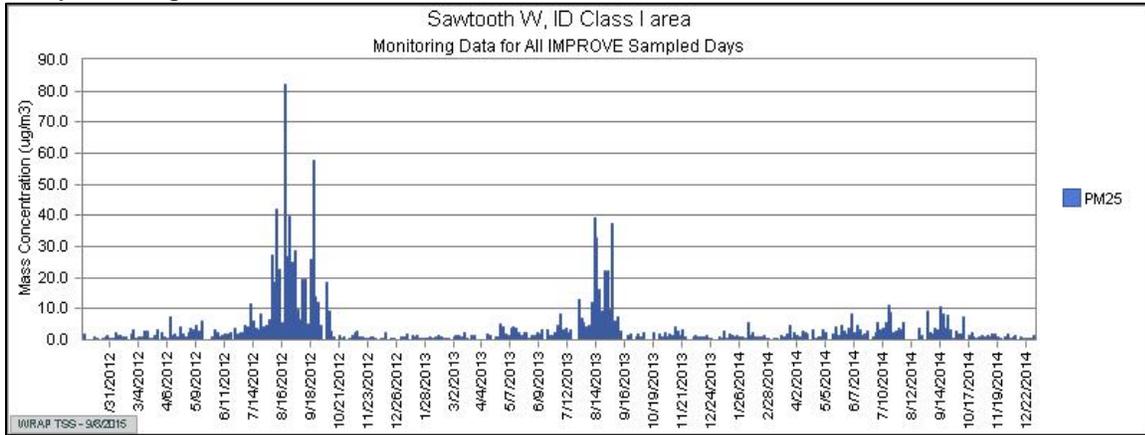


Normalized Weighted Emissions Potential (WEP)

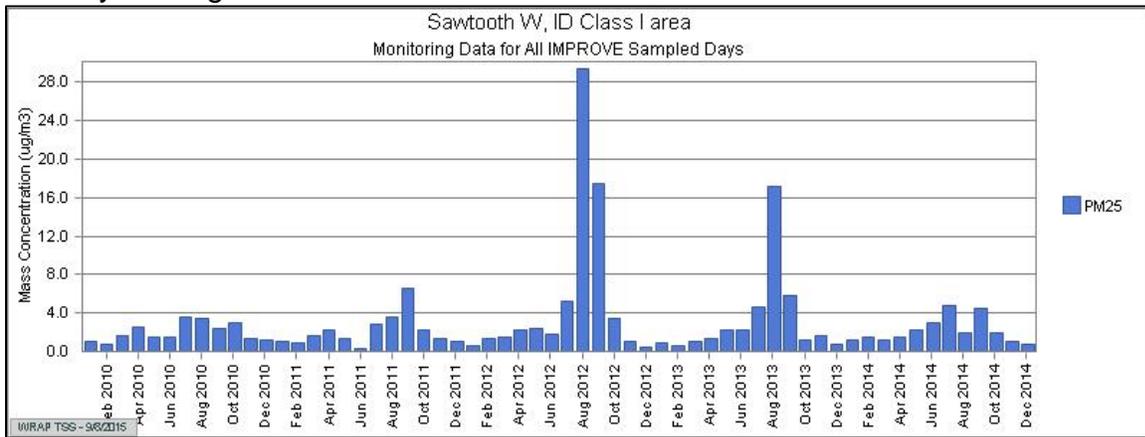


SAWT1 Sawtooth Wilderness

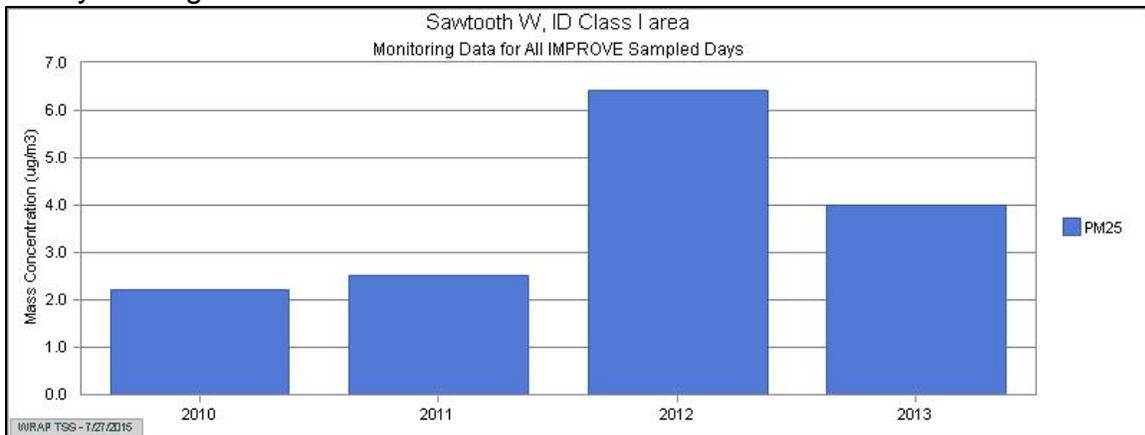
Daily Averages



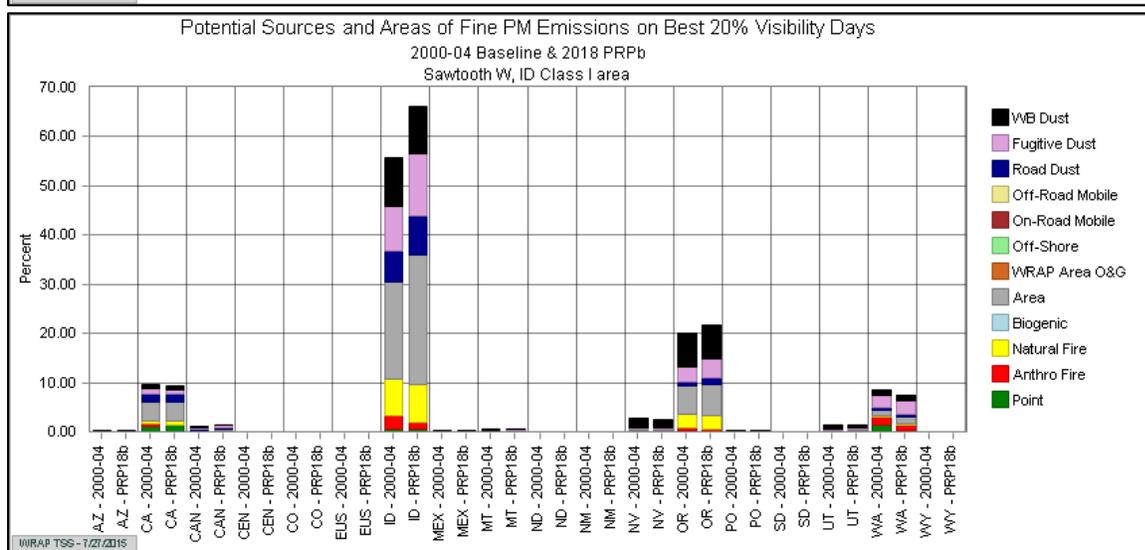
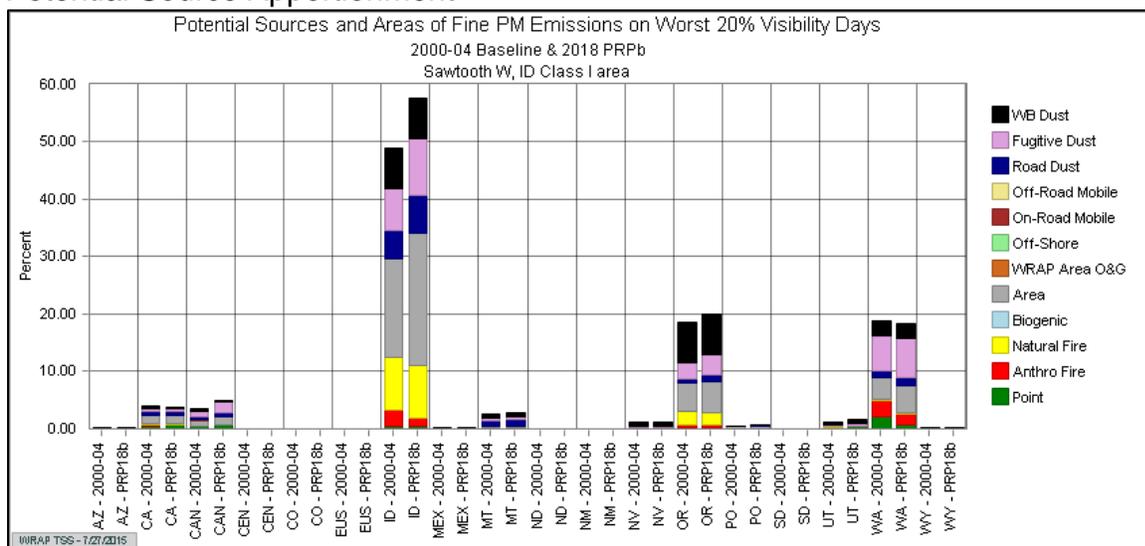
Monthly Averages



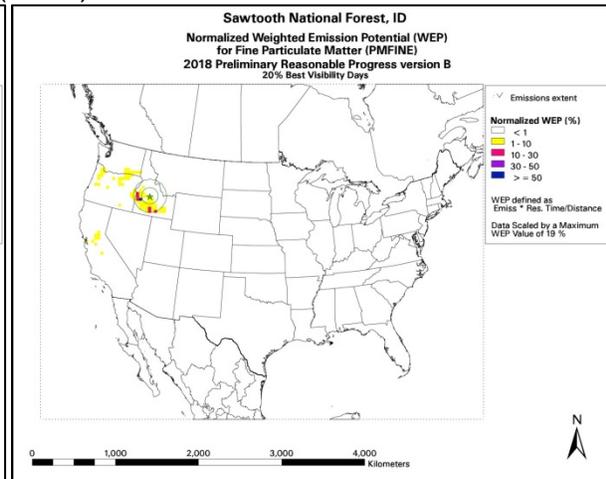
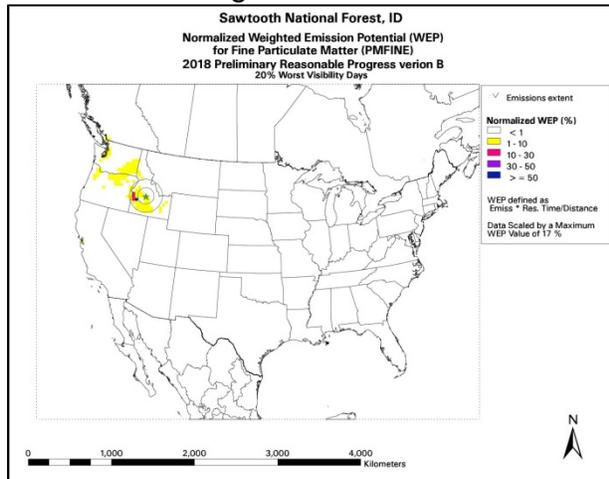
Yearly Averages



Potential Source Apportionment



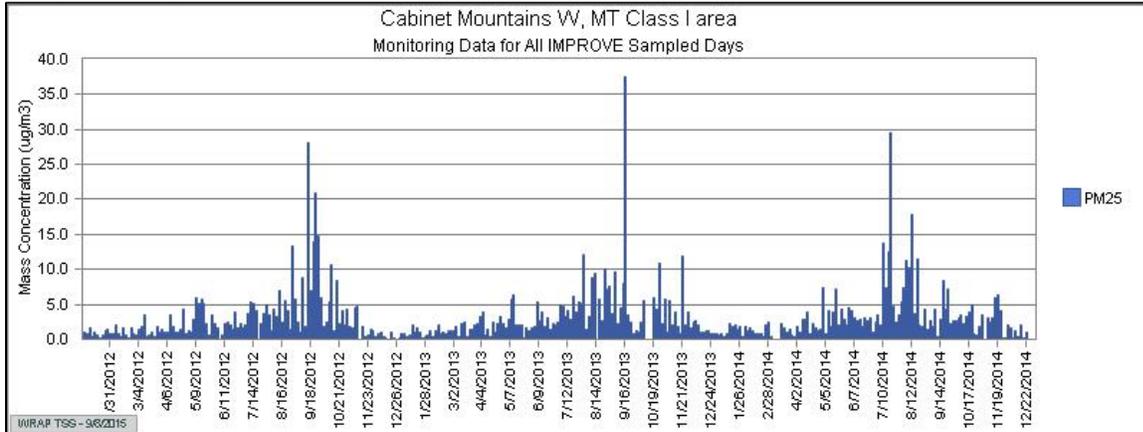
Normalized Weighted Emissions Potential (WEP)



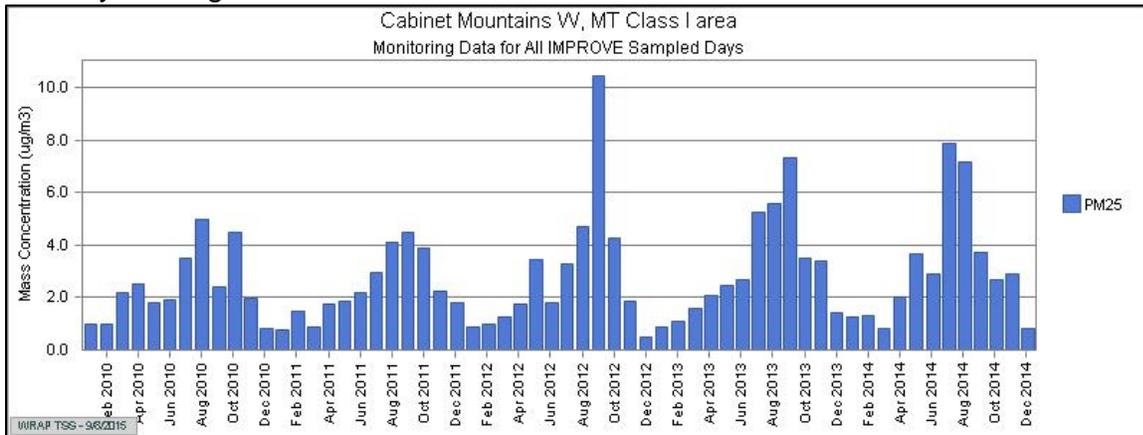
Montana

CABI1 Cabinet Mountains Wilderness

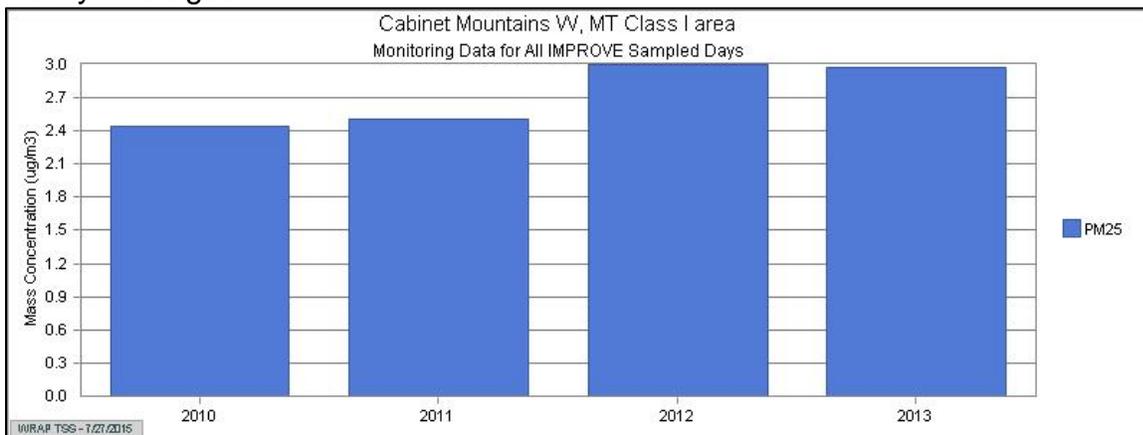
Daily Averages



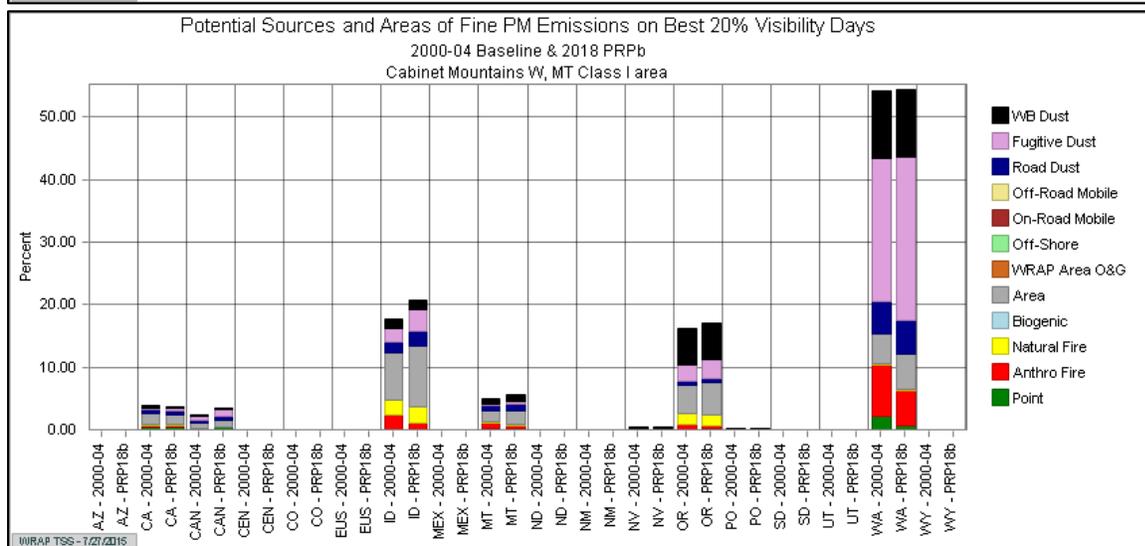
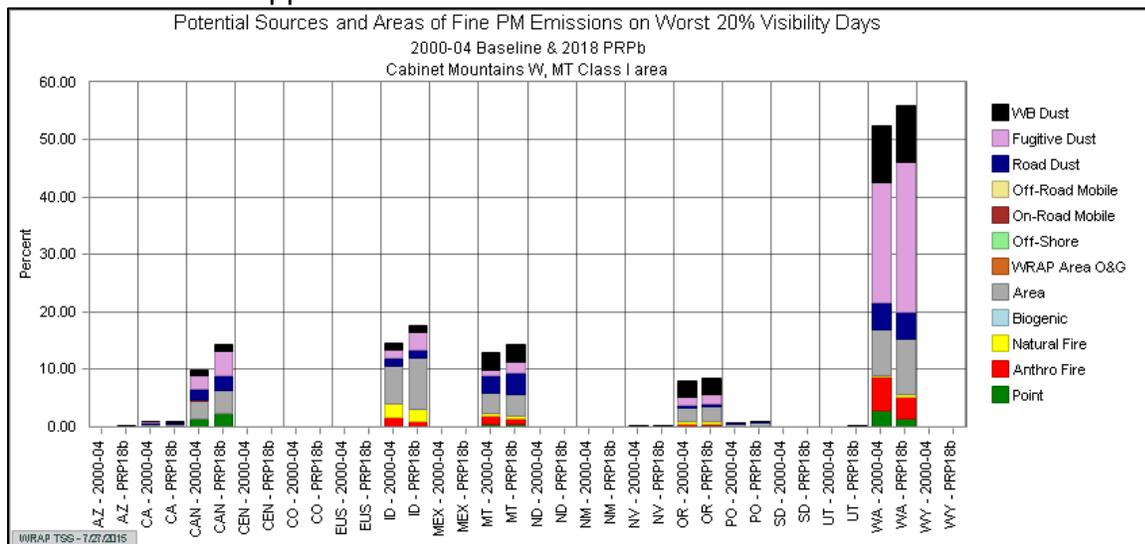
Monthly Averages



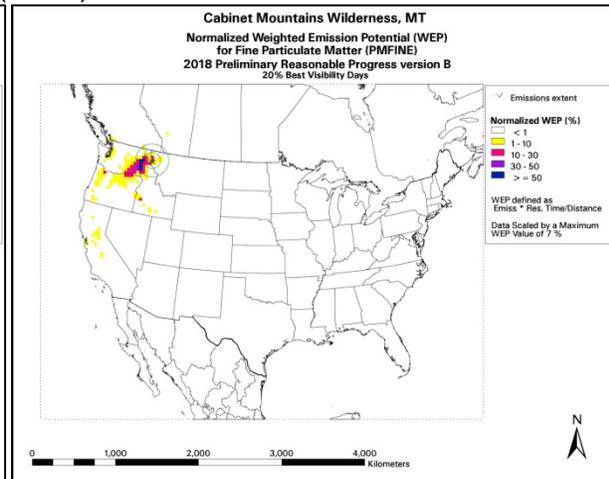
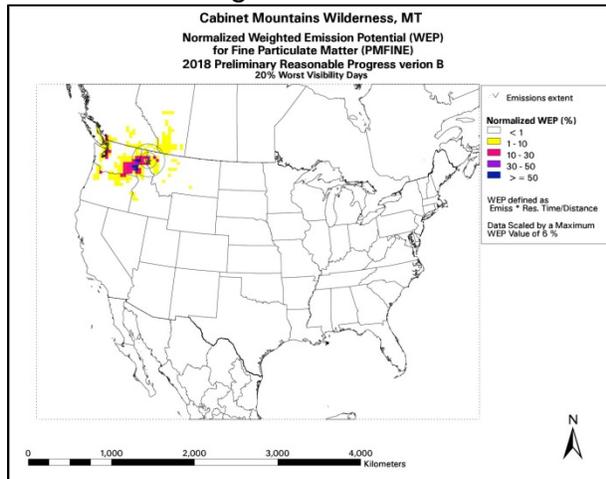
Yearly Averages



Potential Source Apportionment

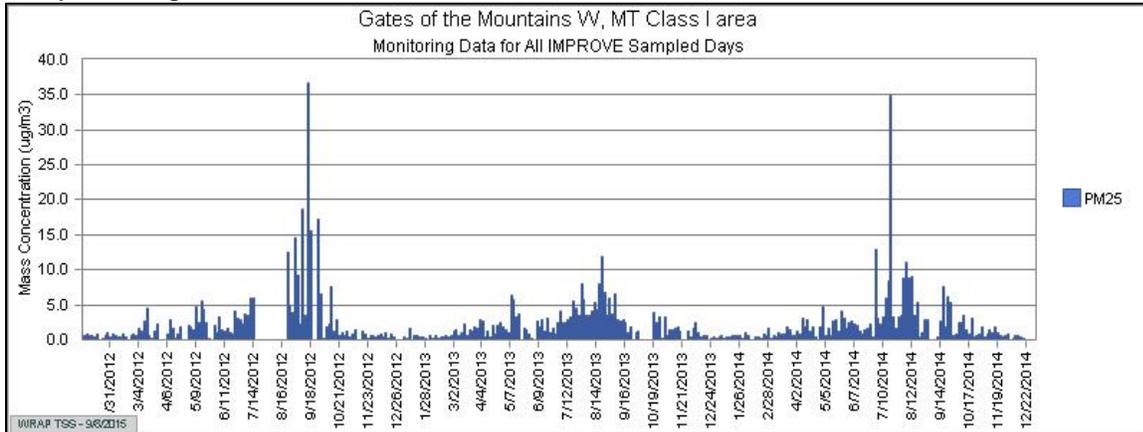


Normalized Weighted Emissions Potential (WEP)

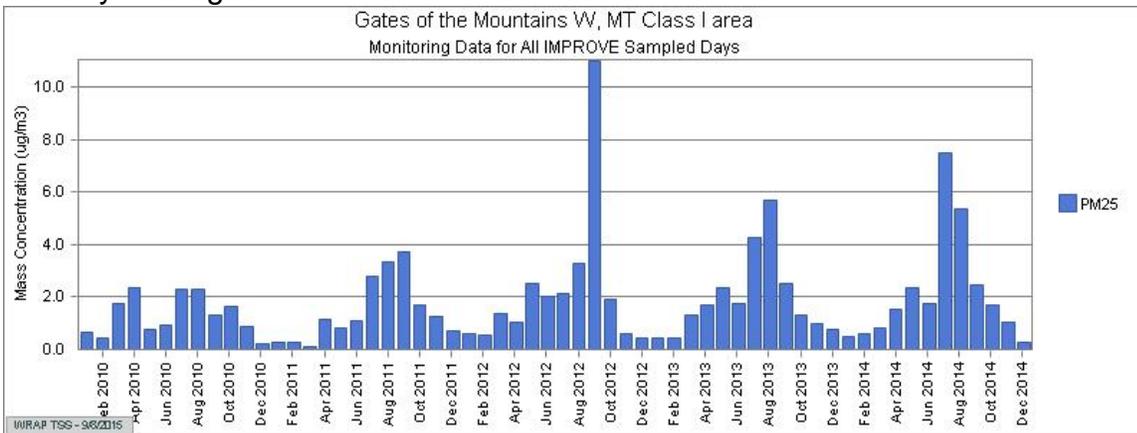


GAMO1 Gates of the Mountains Wilderness

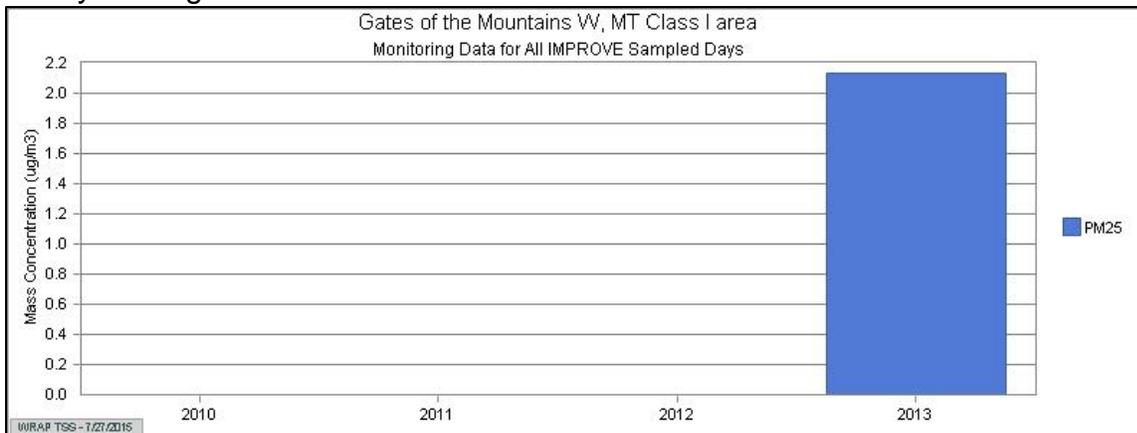
Daily Averages



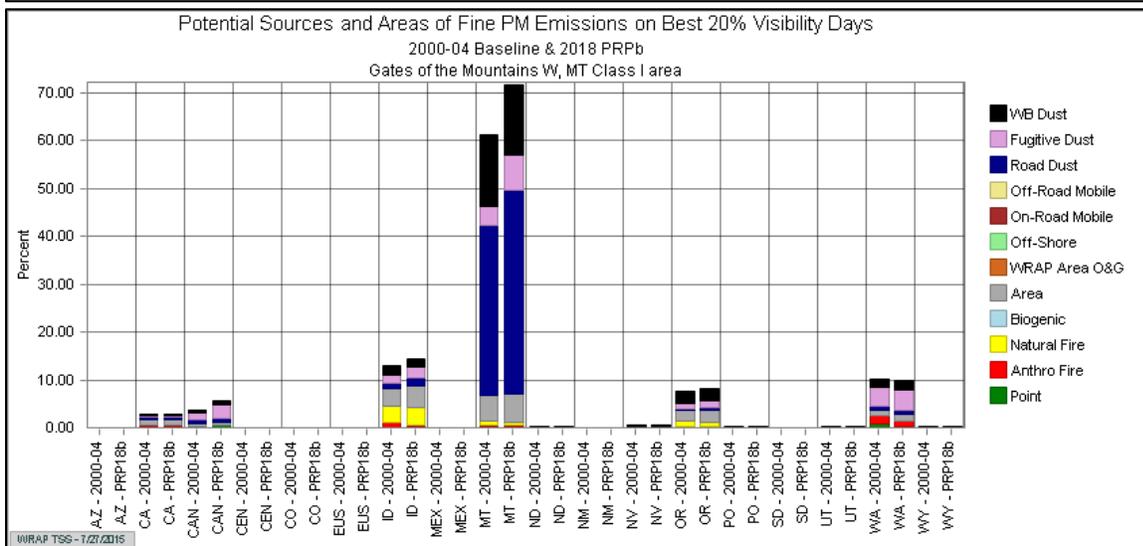
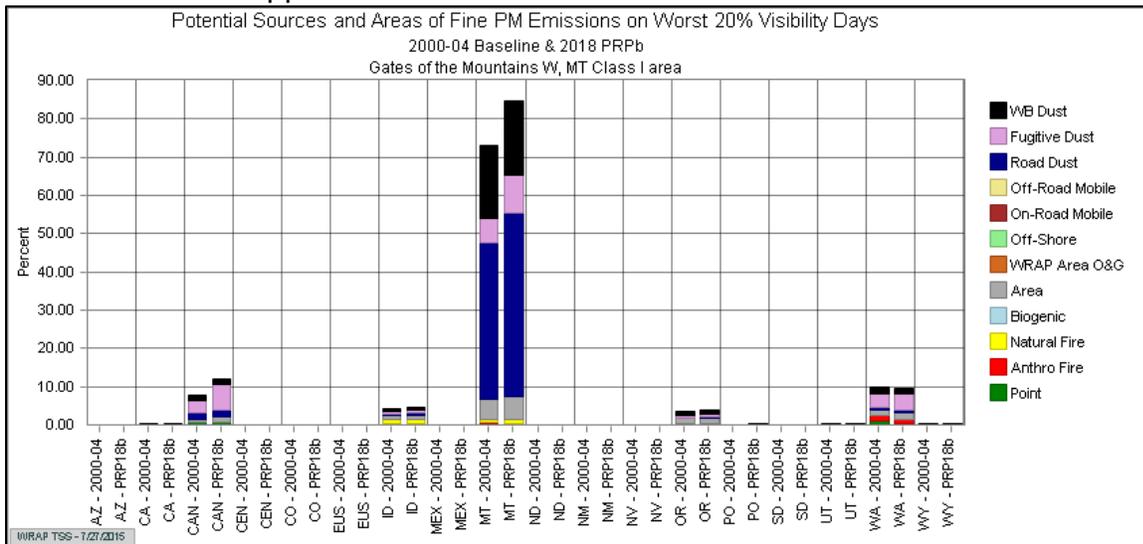
Monthly Averages



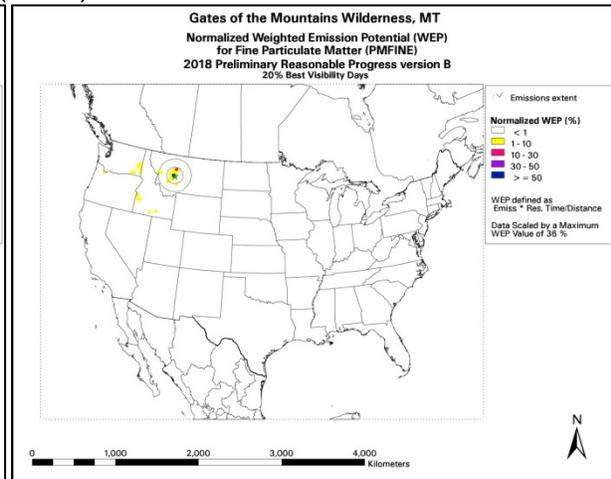
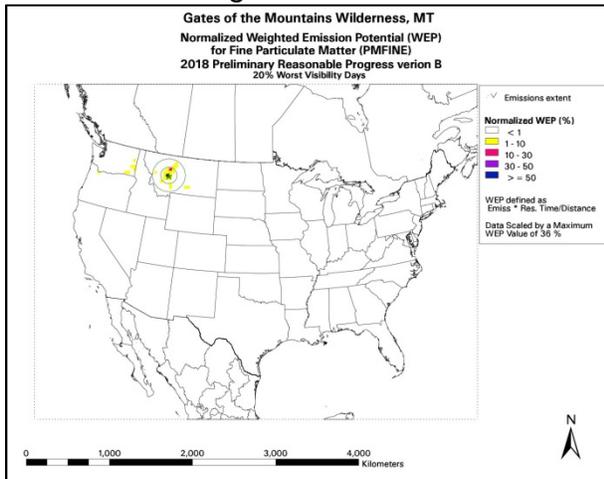
Yearly Averages



Potential Source Apportionment

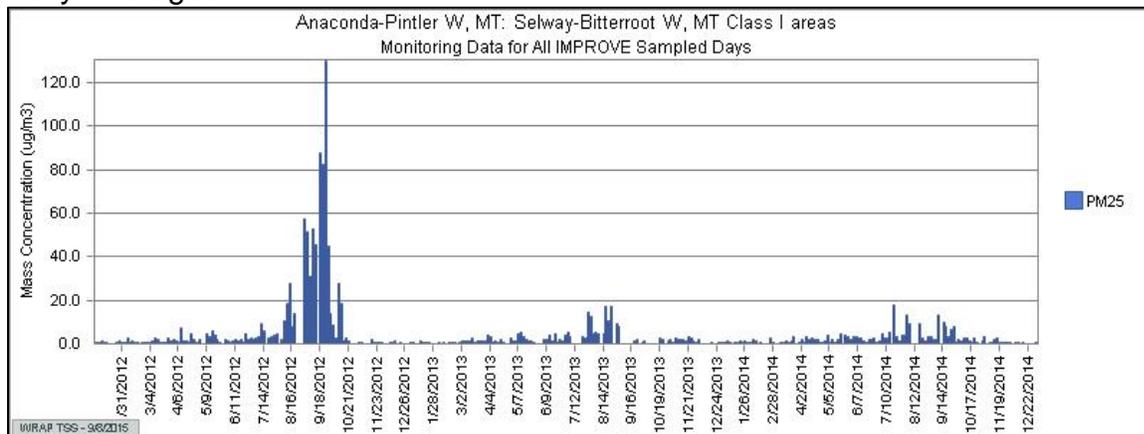


Normalized Weighted Emissions Potential (WEP)

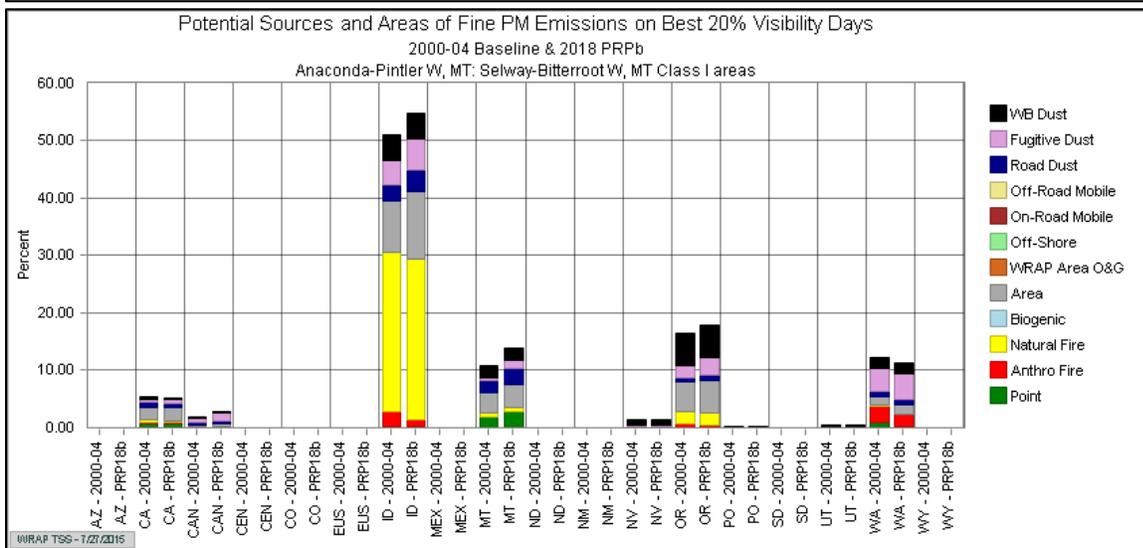
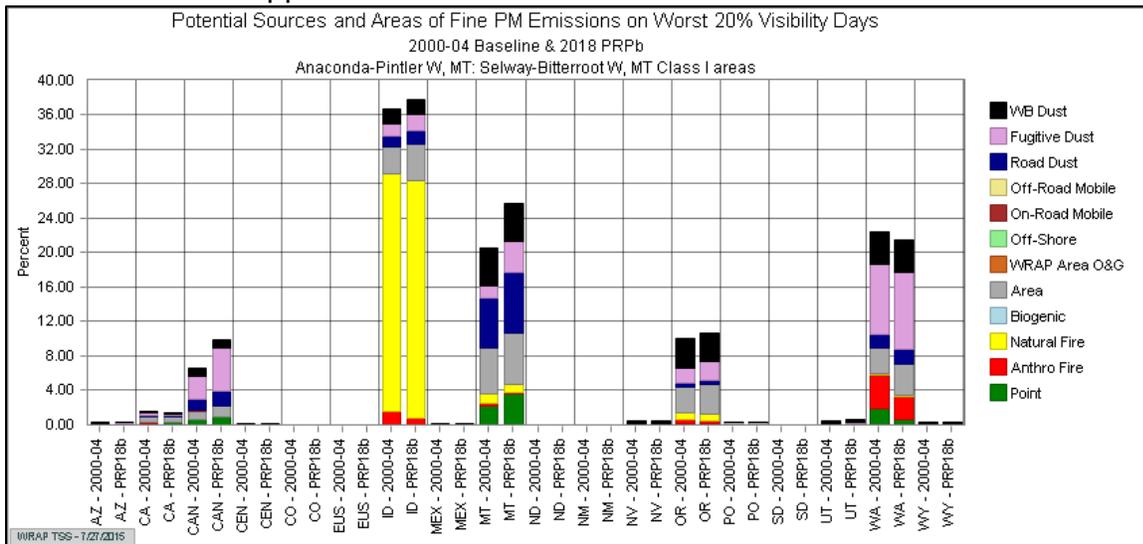


SULA1 Sula Peak; Anaconda-Pintler Wilderness; Selway-Bitterroot Wilderness

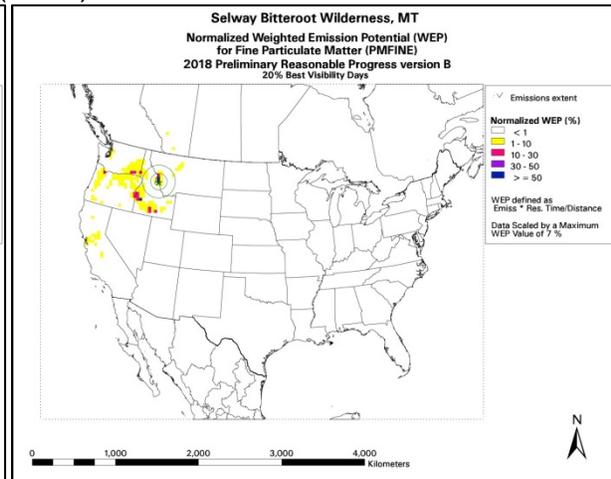
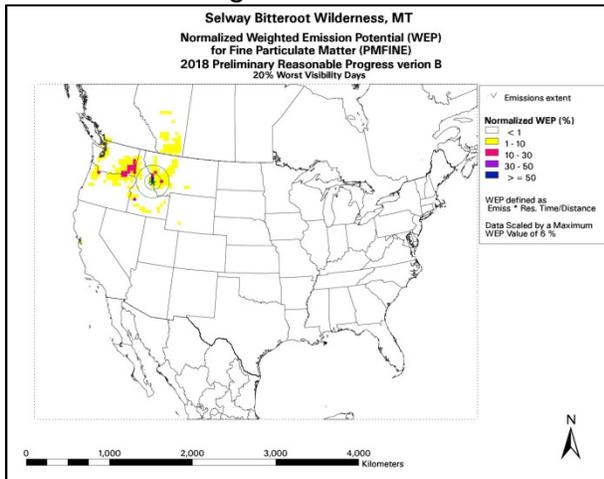
Daily Averages



Potential Source Apportionment



Normalized Weighted Emissions Potential (WEP)

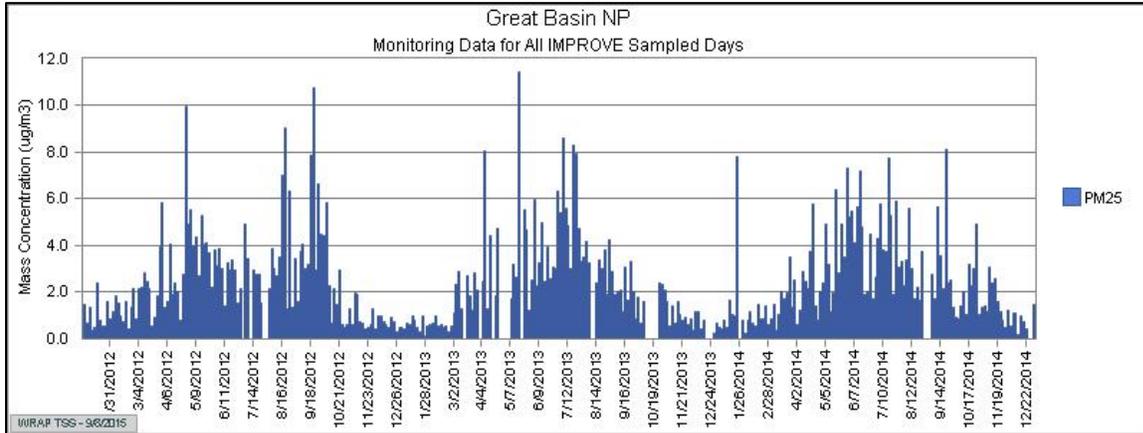


Nevada

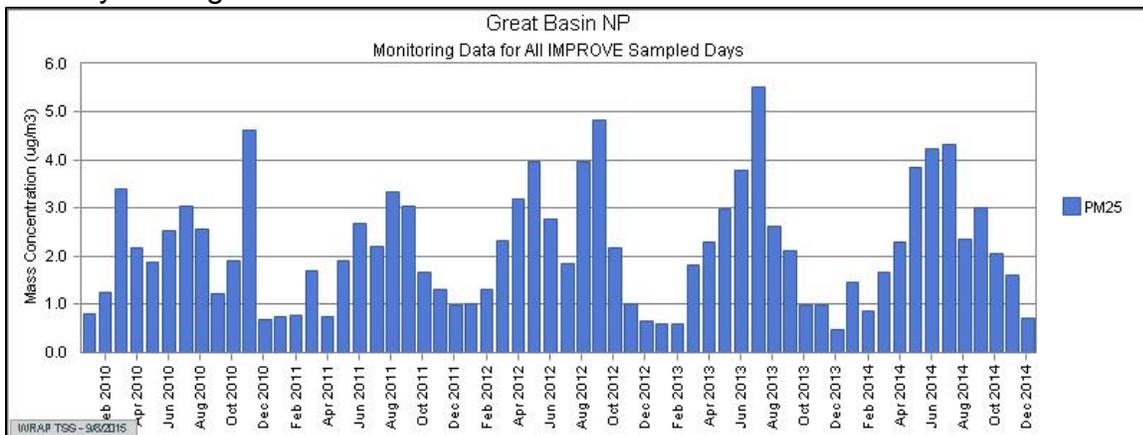
GRBA1 Great Basin National Park

NO EMISSIONS OR SOURCE APPORTIONMENT FOR THIS SITE

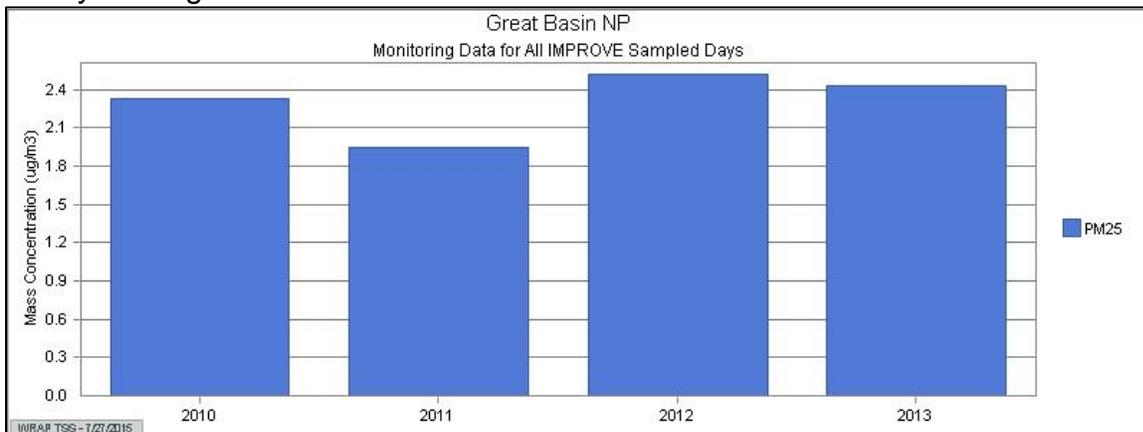
Daily Averages



Monthly Averages

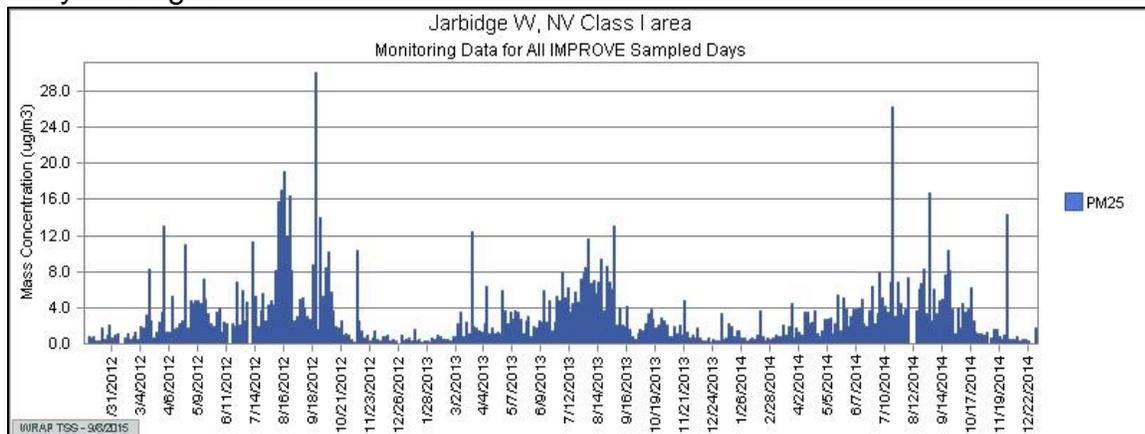


Yearly Averages

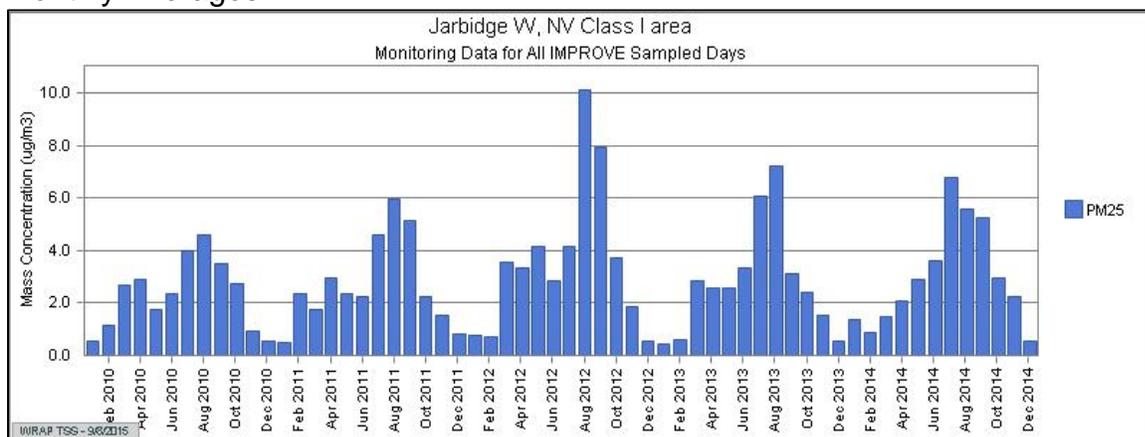


JARB1 Jarbridge Wilderness

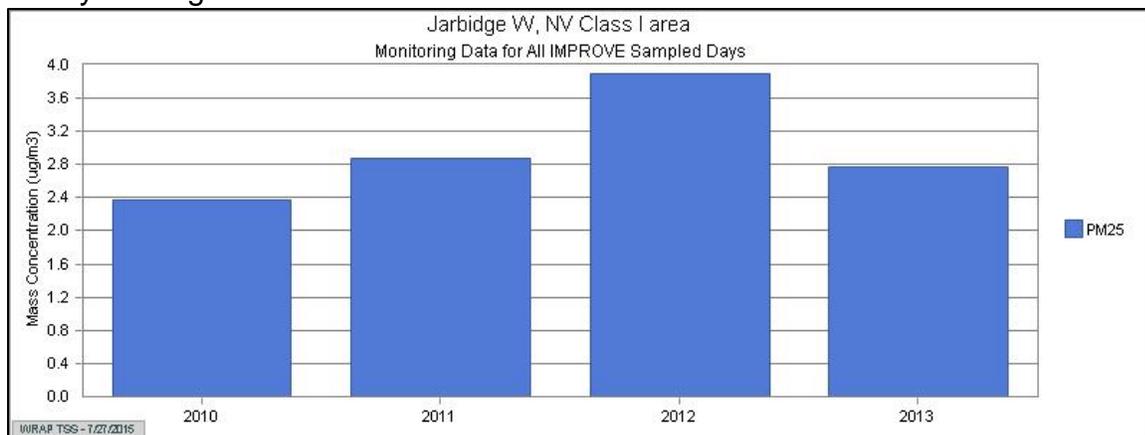
Daily Averages



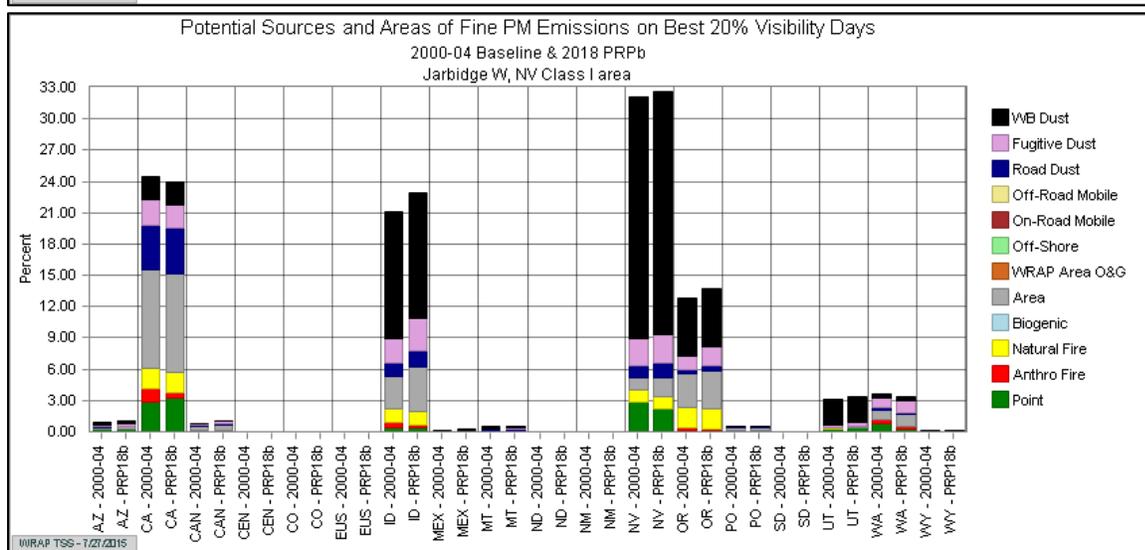
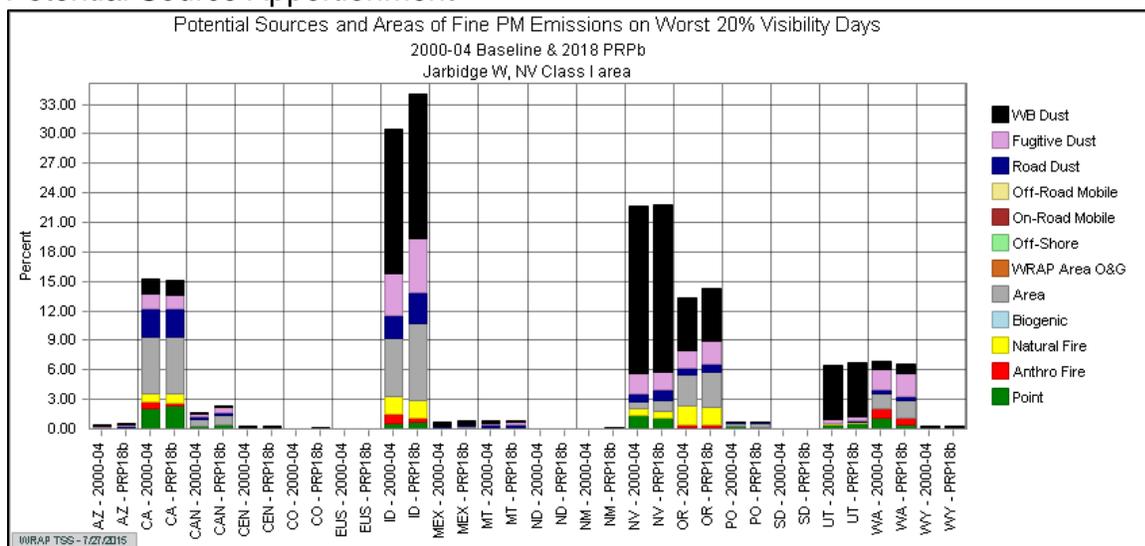
Monthly Averages



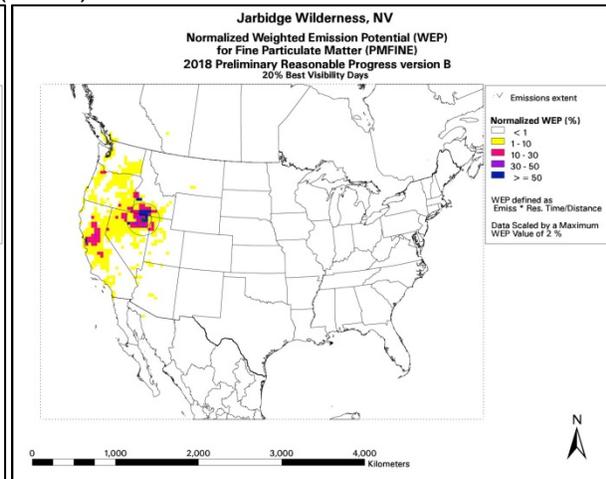
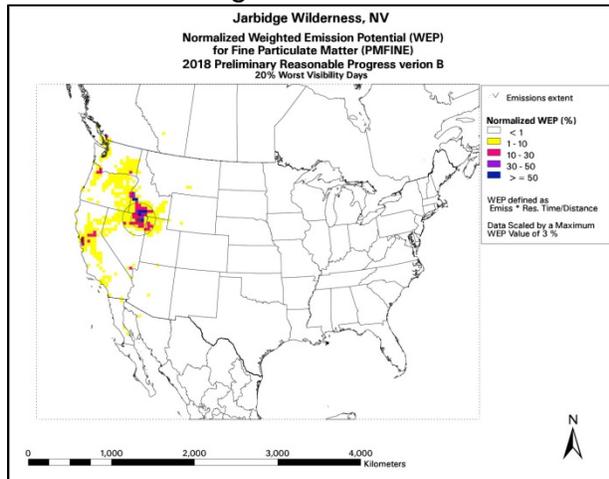
Yearly Averages



Potential Source Apportionment



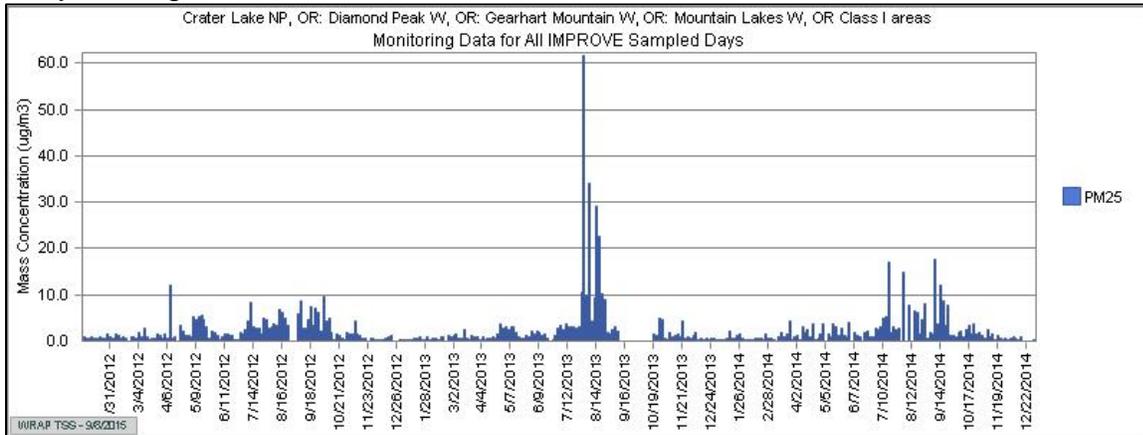
Normalized Weighted Emissions Potential (WEP)



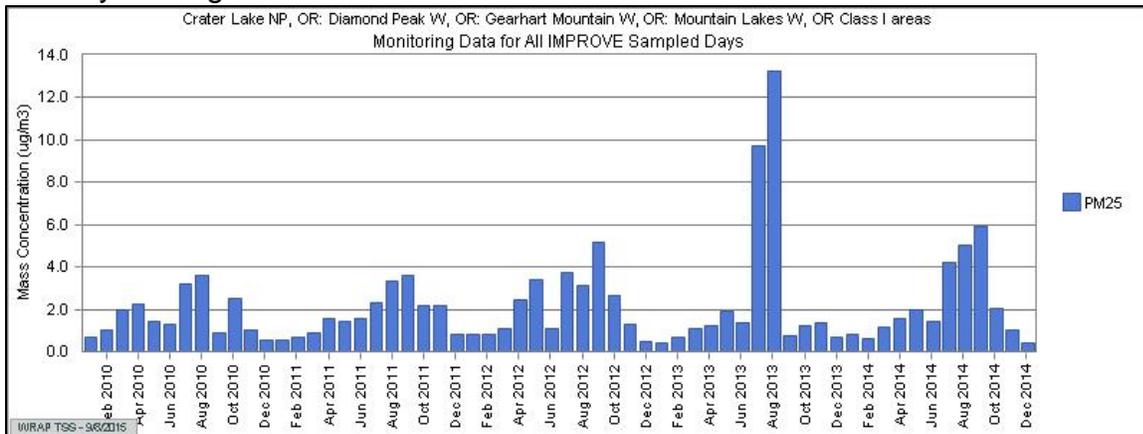
Oregon

CRLA1 Crater Lake National Park; Diamond Peak Wilderness; Gearhart Mountain Wilderness; Mountain Lakes Wilderness

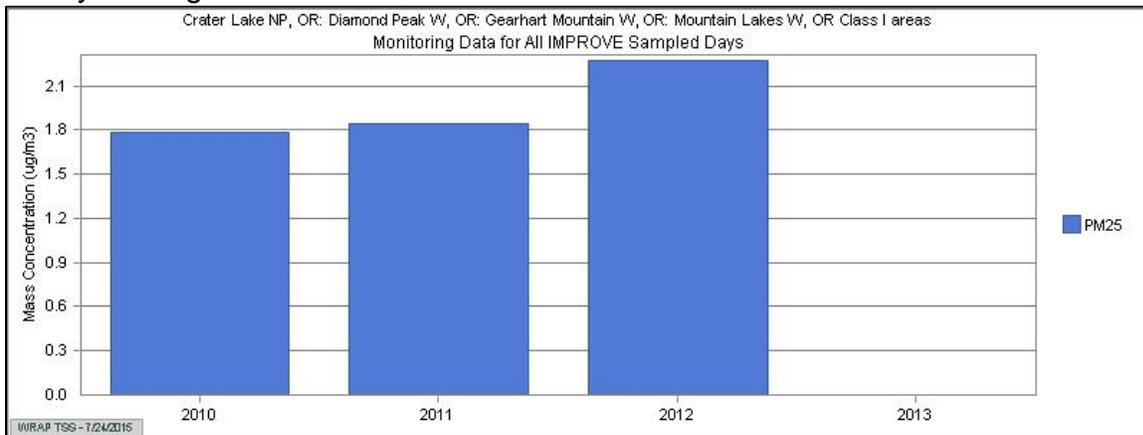
Daily Averages



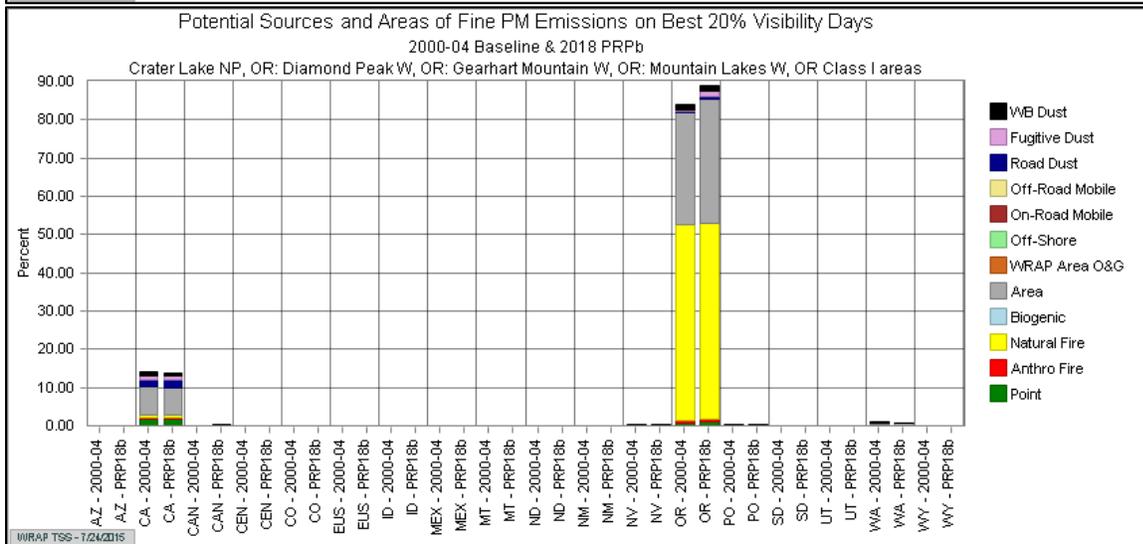
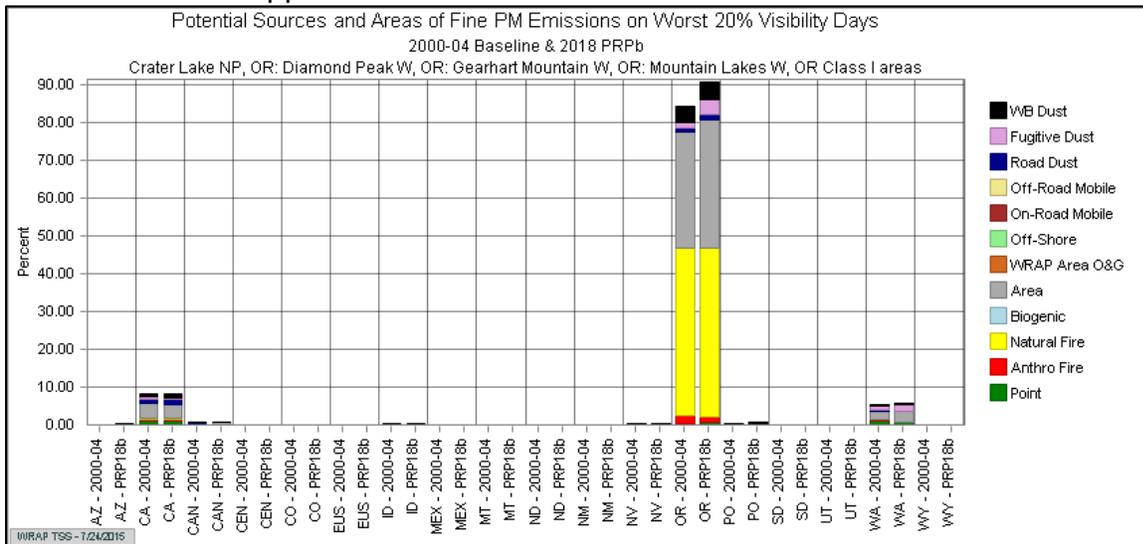
Monthly Averages



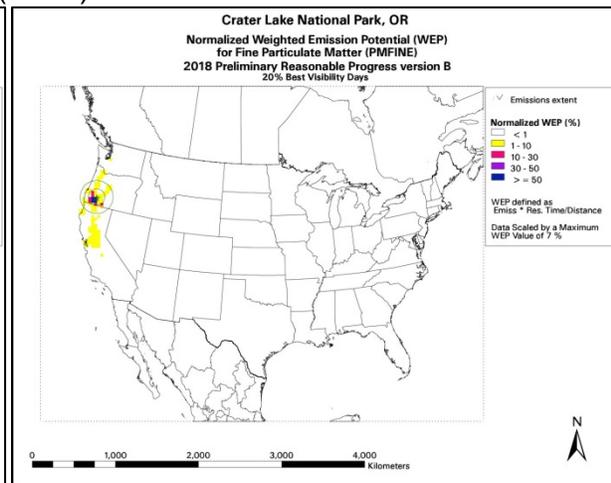
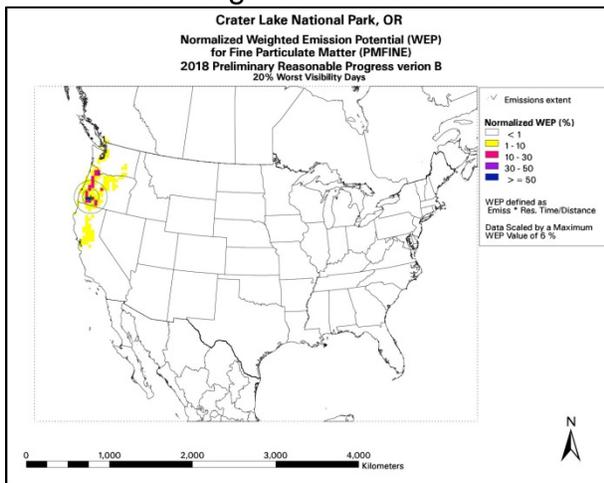
Yearly Averages



Potential Source Apportionment

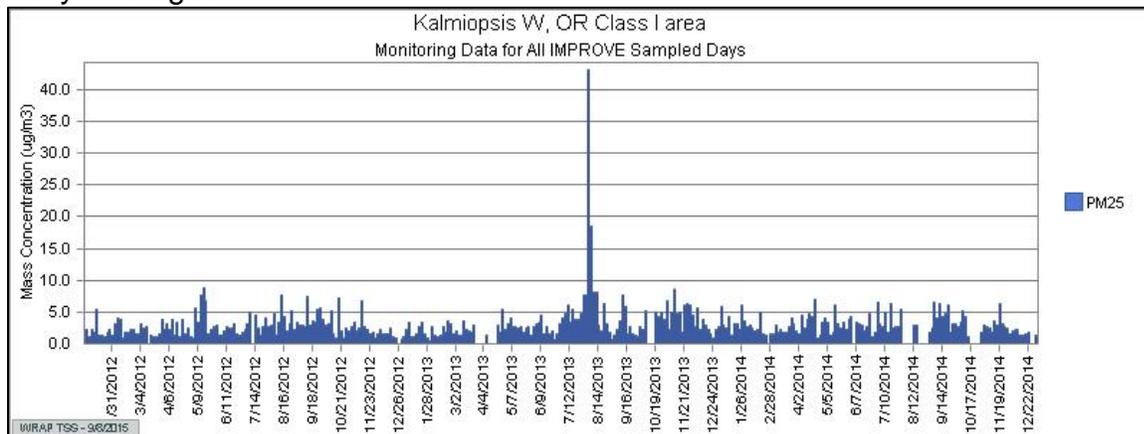


Normalized Weighted Emissions Potential (WEP)

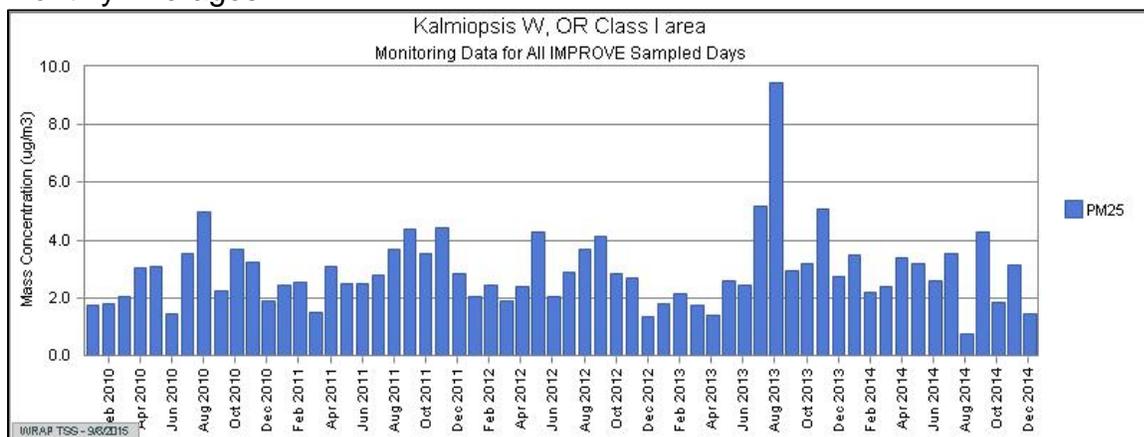


KALM1 Kalmiopsis Wilderness

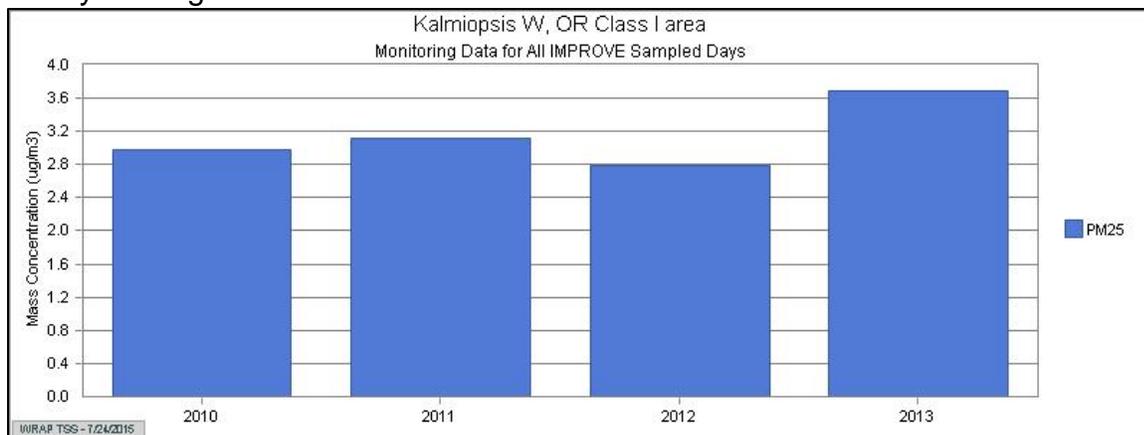
Daily Averages



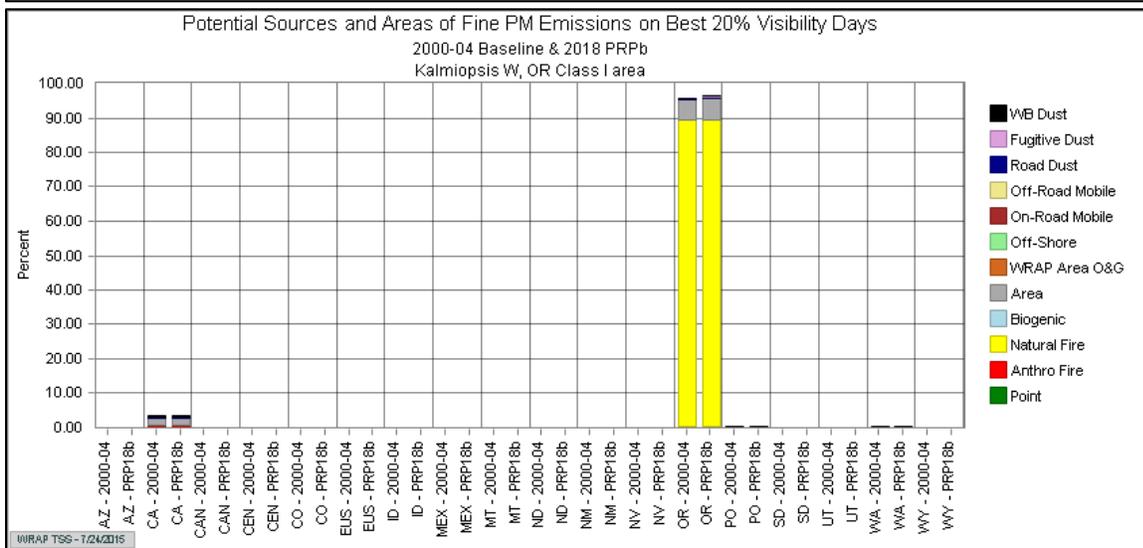
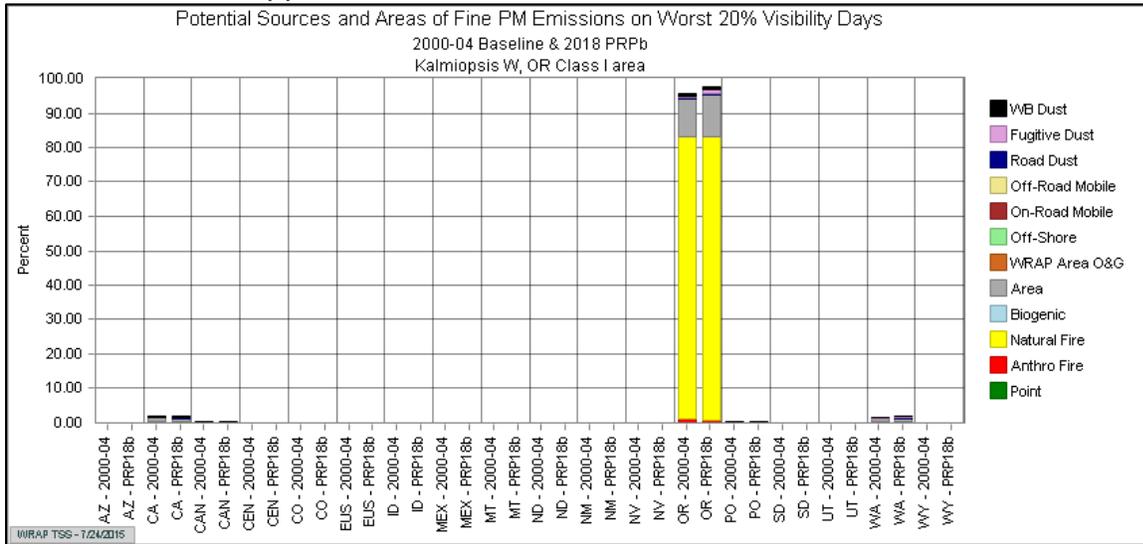
Monthly Averages



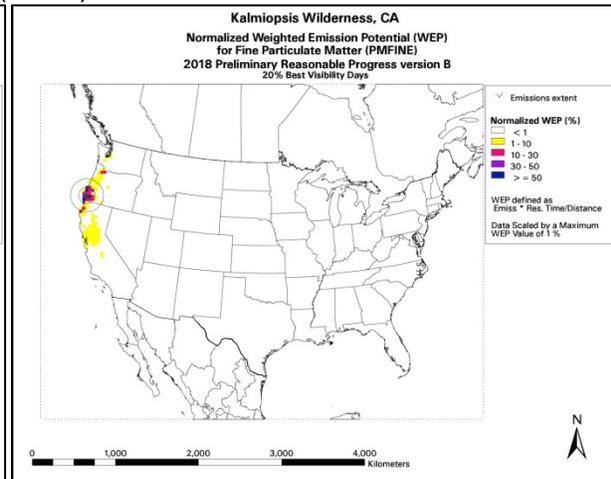
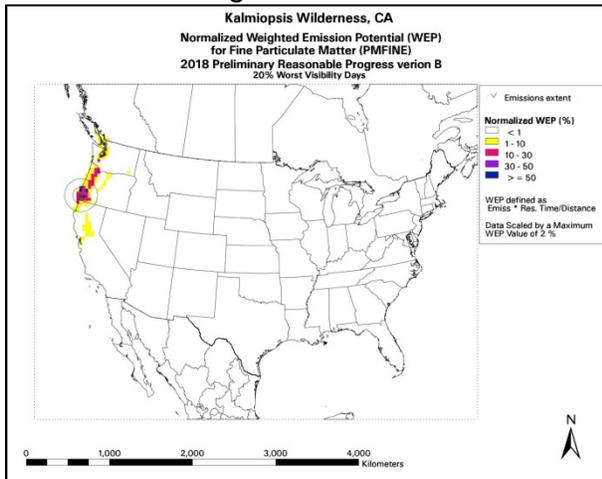
Yearly Averages



Potential Source Apportionment

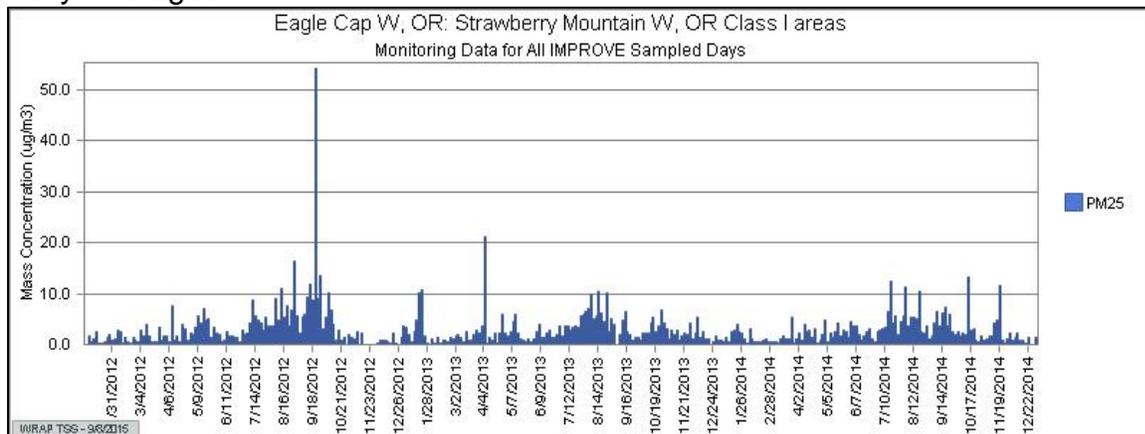


Normalized Weighted Emissions Potential (WEP)

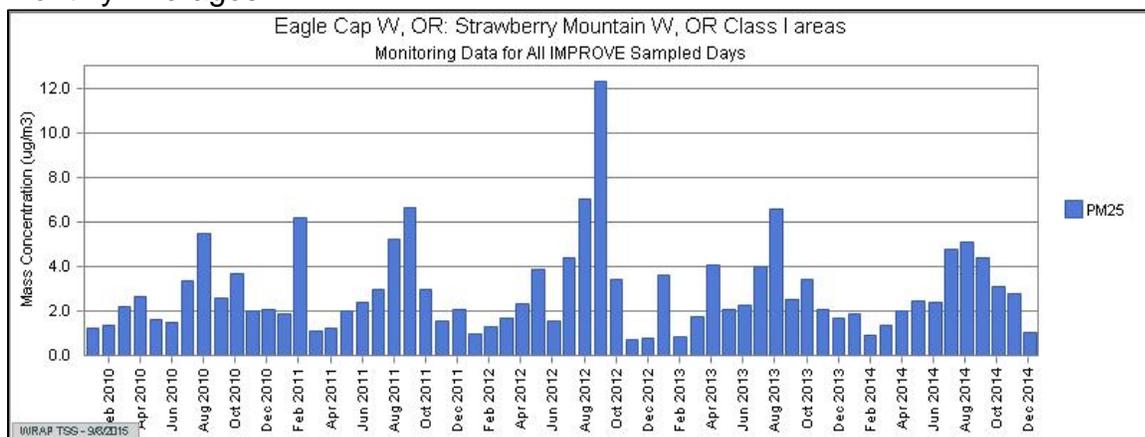


STAR1 Starkey; Eagle Cap Wilderness; Strawberry Mountain Wilderness

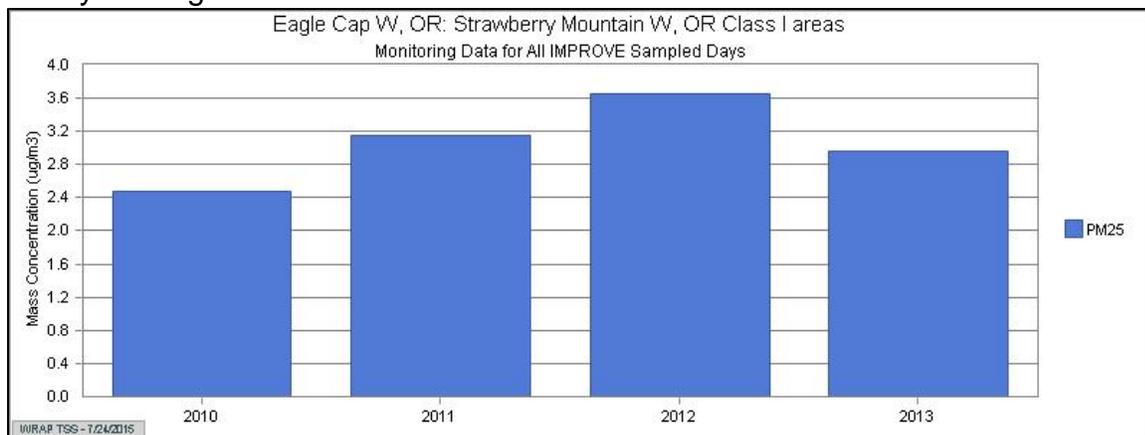
Daily Averages



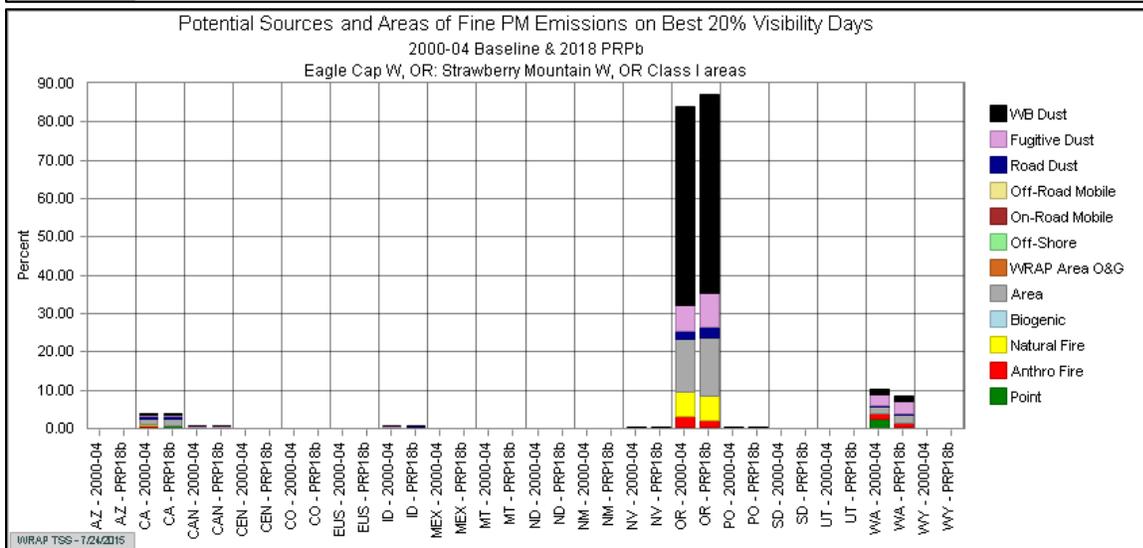
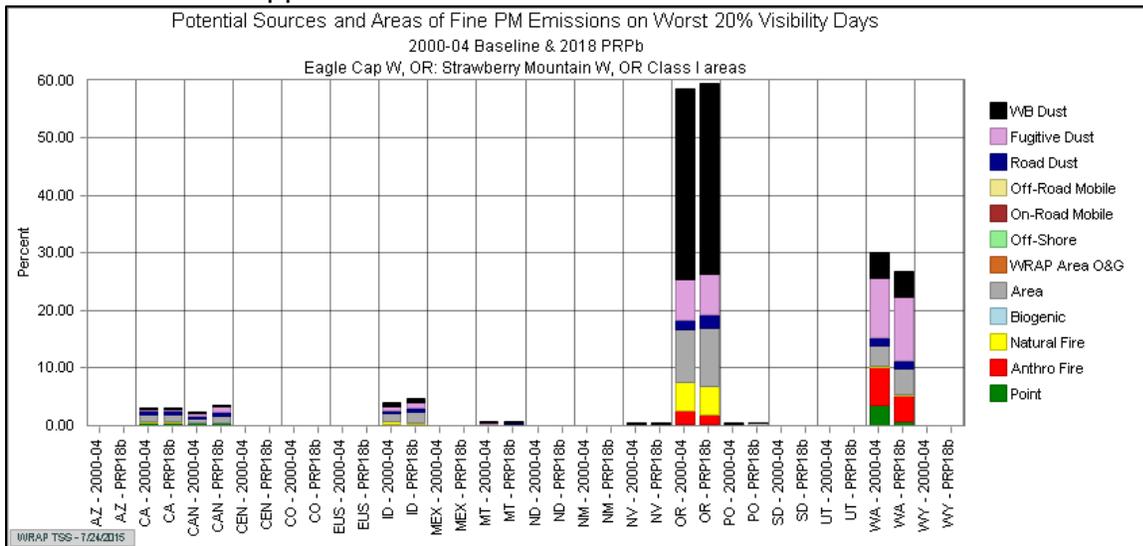
Monthly Averages



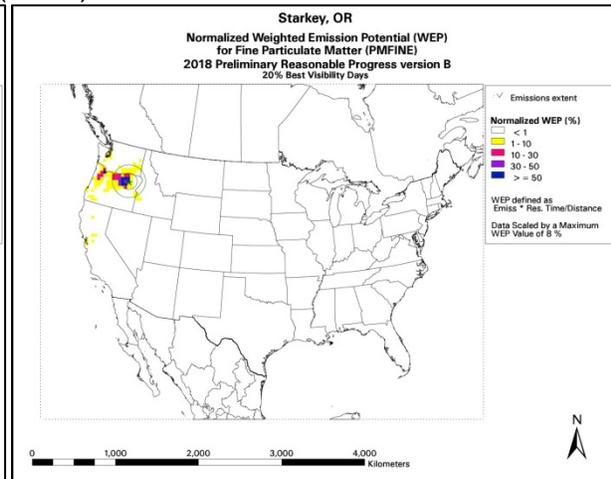
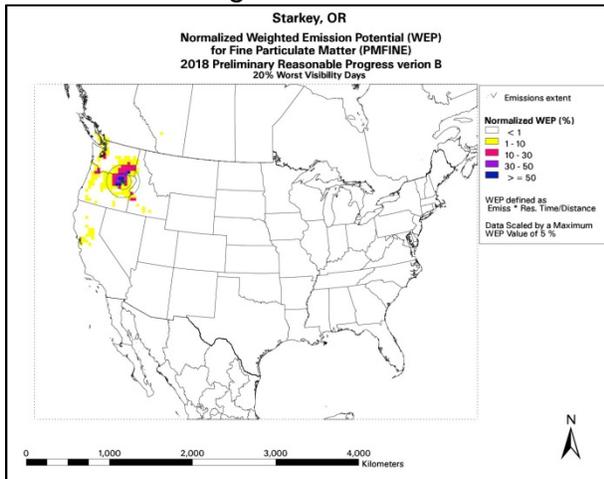
Yearly Averages



Potential Source Apportionment

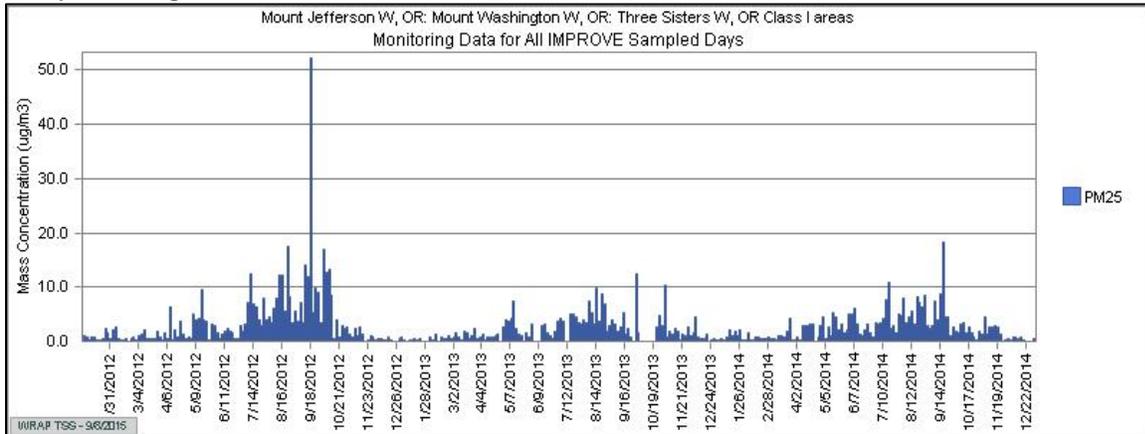


Normalized Weighted Emissions Potential (WEP)

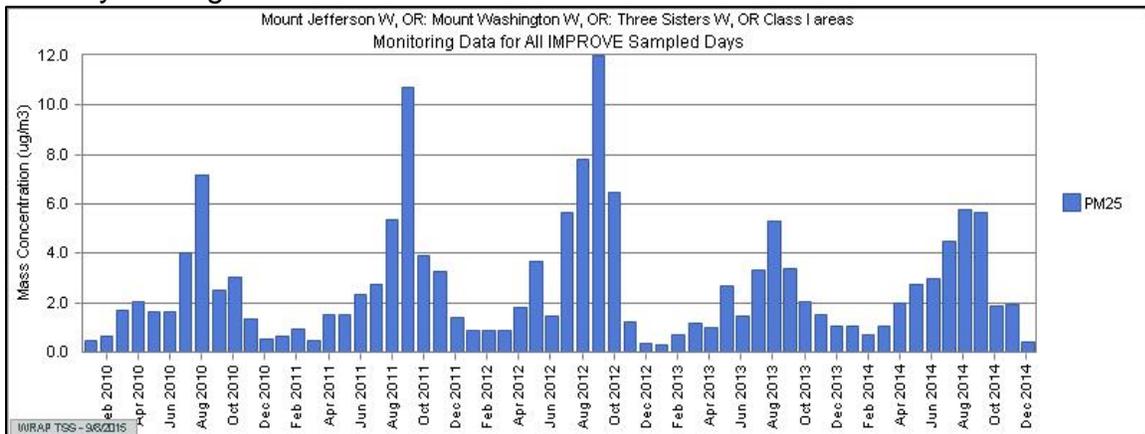


THS1 Three Sisters Wilderness; Mount Jefferson Wilderness; Mount Washington Wilderness

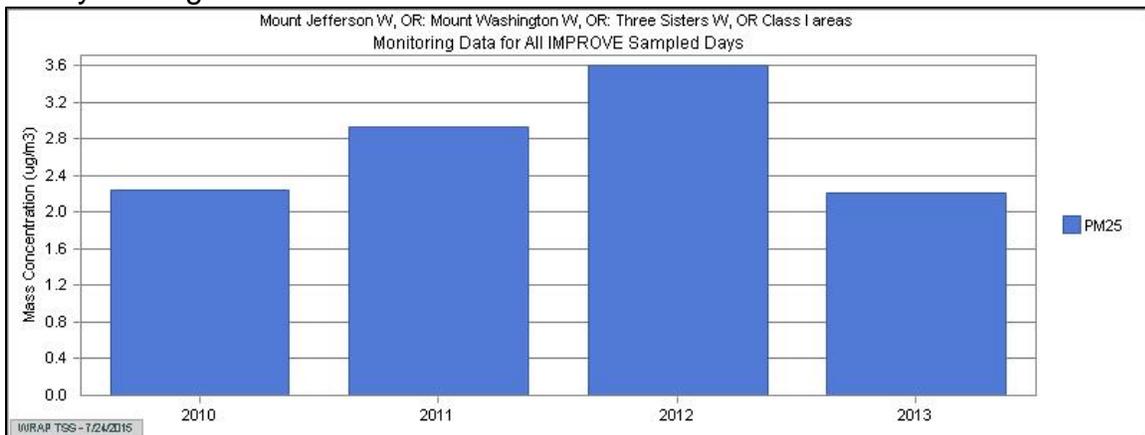
Daily Averages



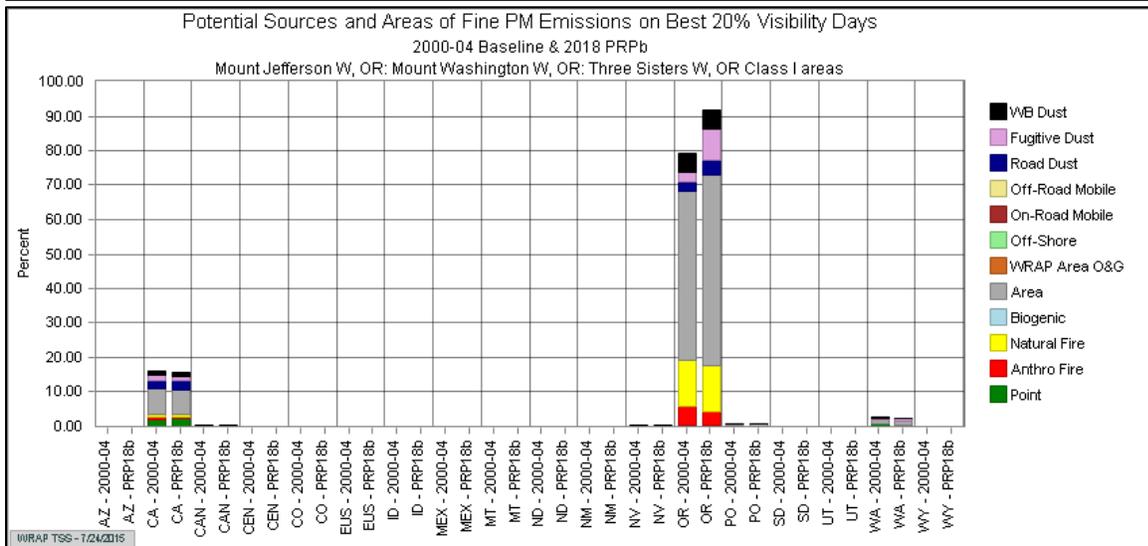
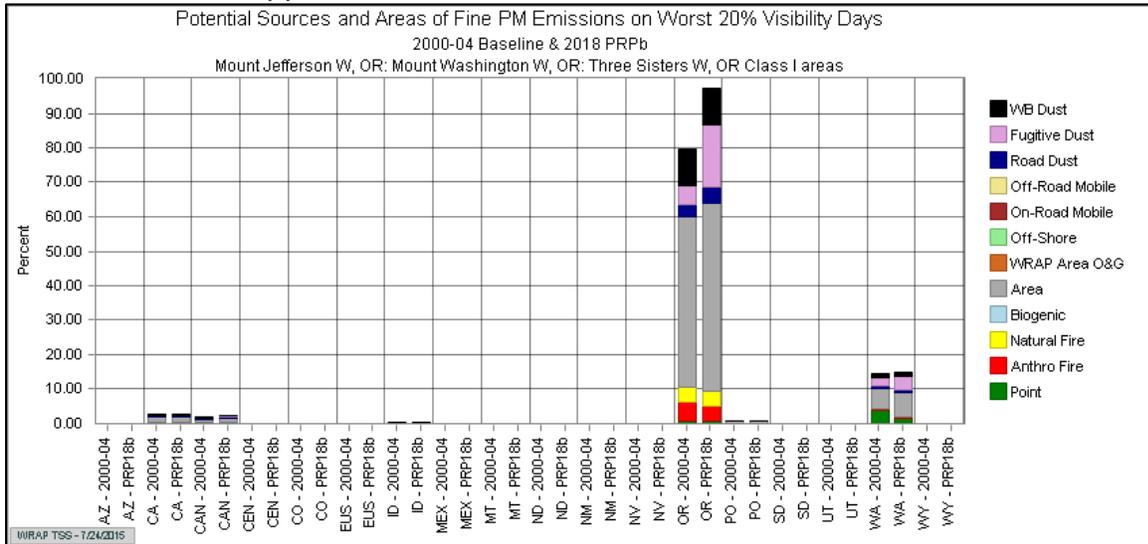
Monthly Averages



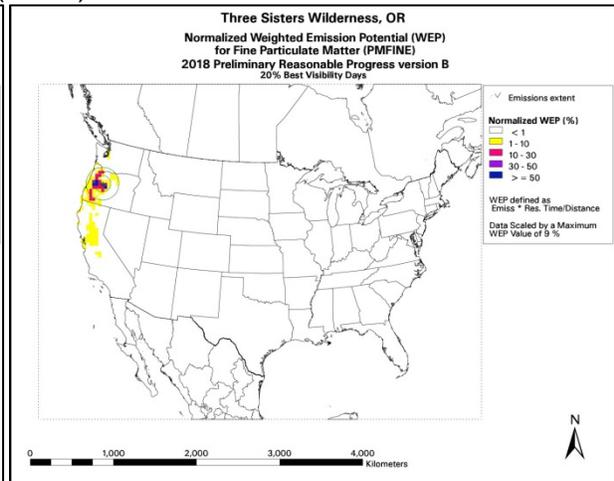
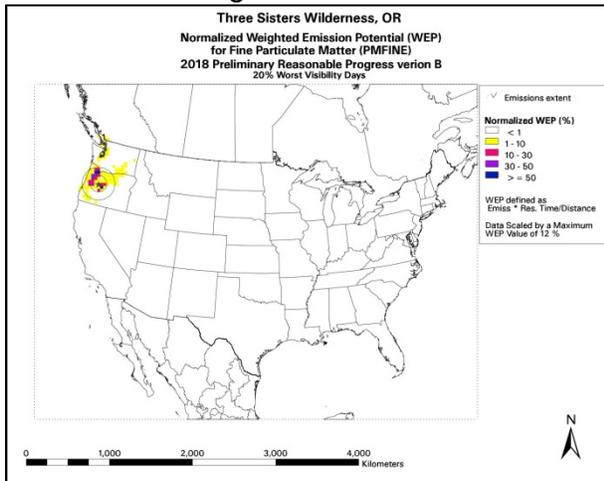
Yearly Averages



Potential Source Apportionment



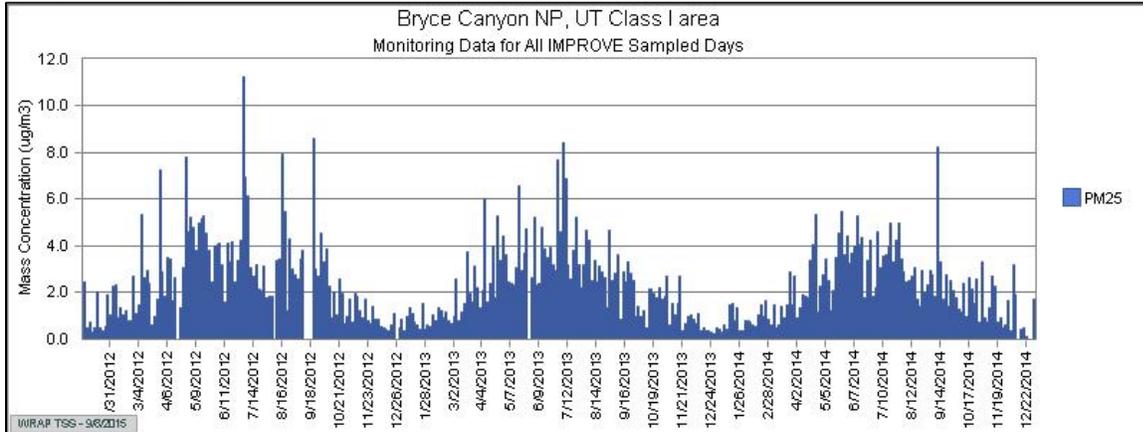
Normalized Weighted Emissions Potential (WEP)



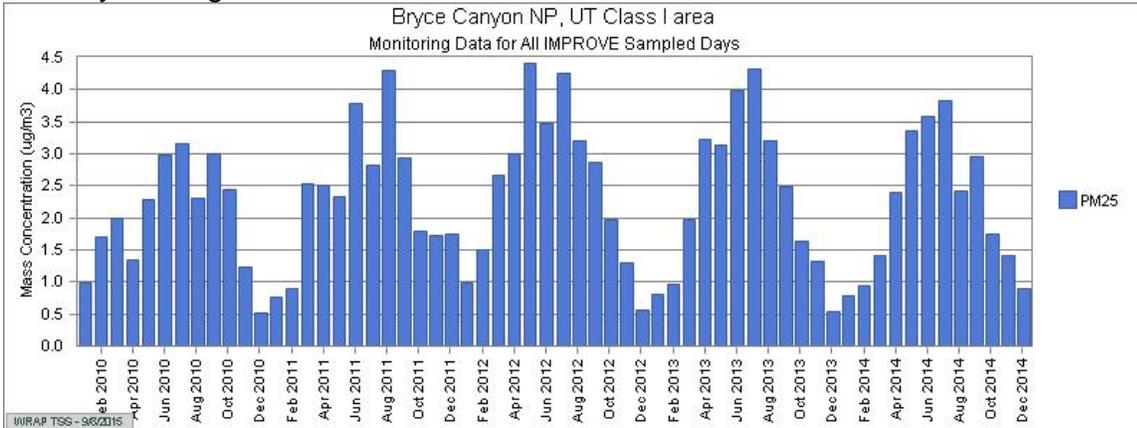
Utah

BRCA1 Bryce Canyon National Park

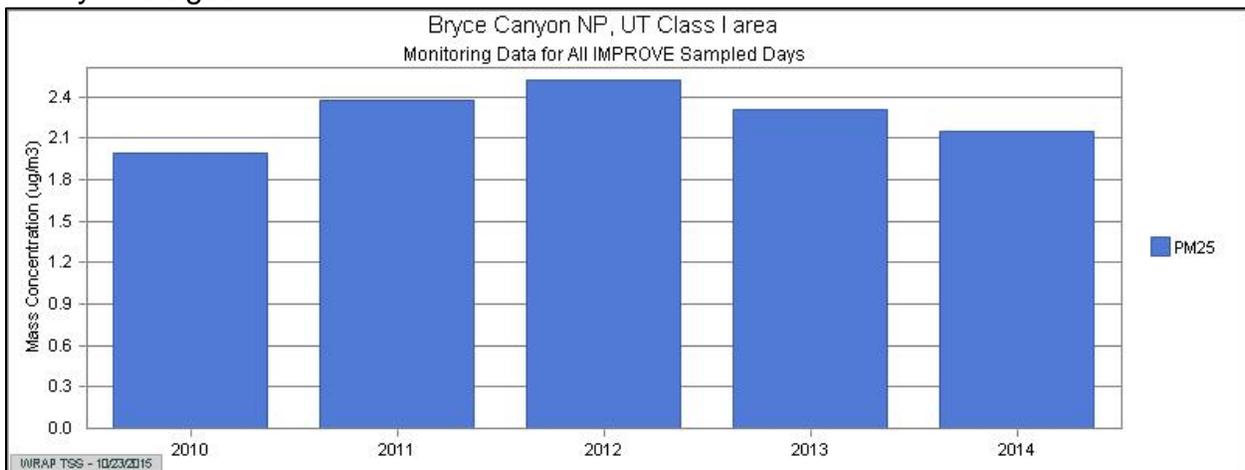
Daily Averages



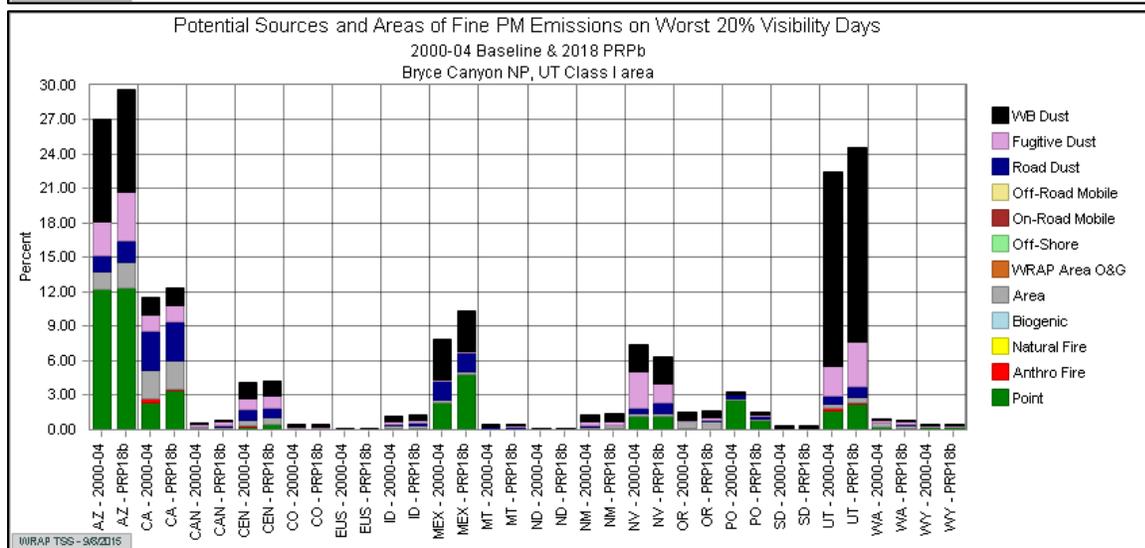
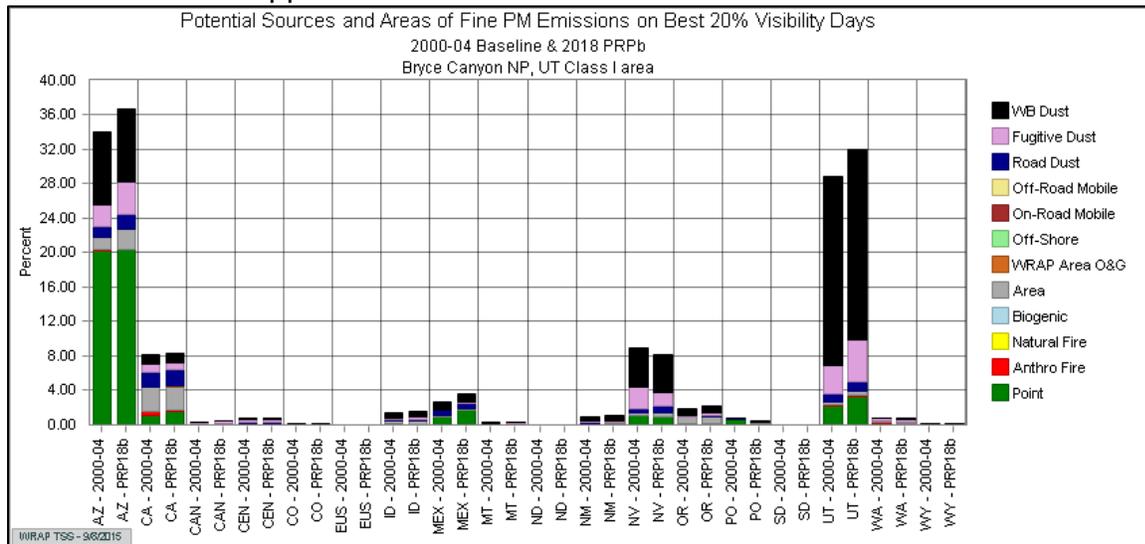
Monthly Averages



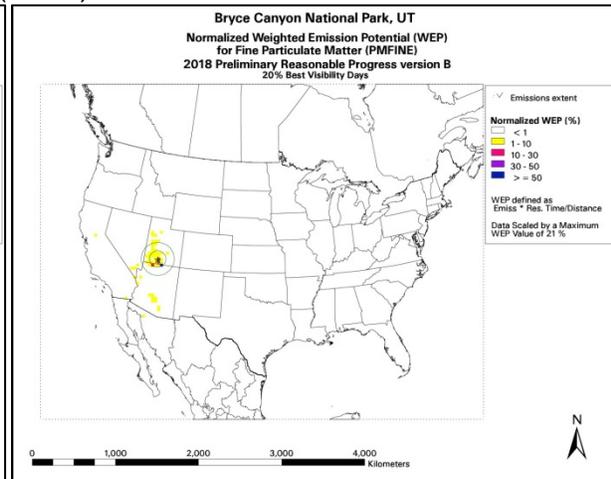
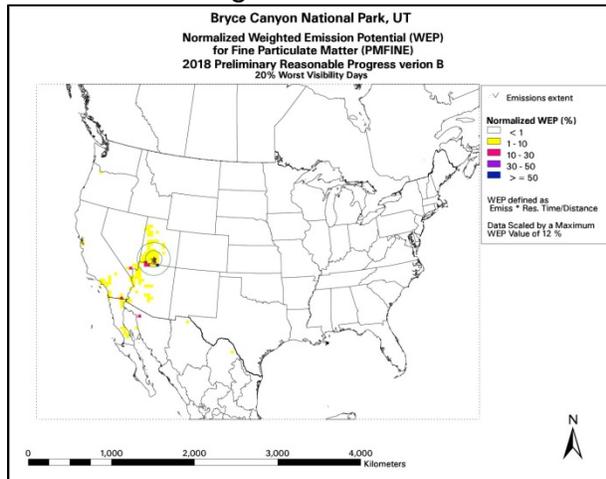
Yearly Averages



Potential Source Apportionment



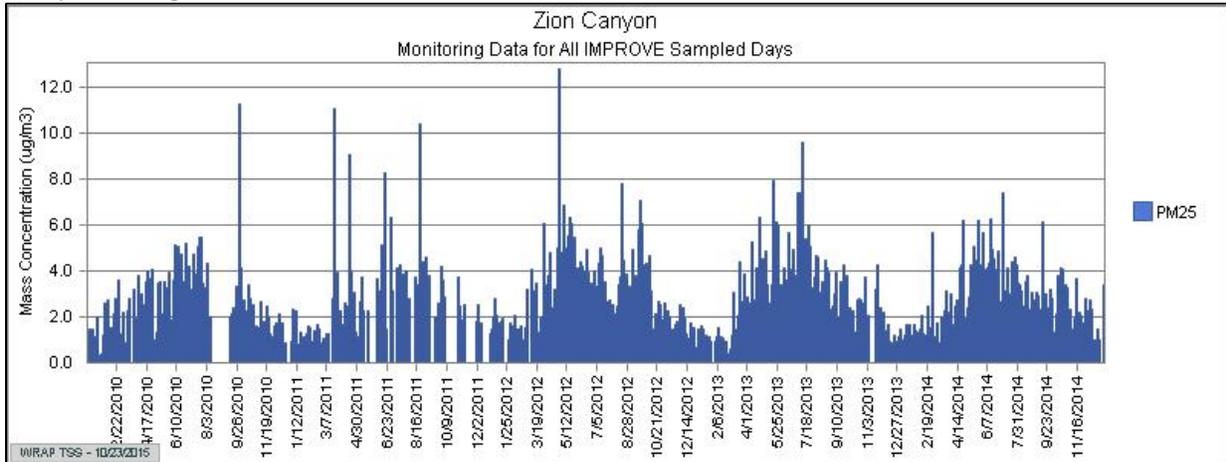
Normalized Weighted Emissions Potential (WEP)



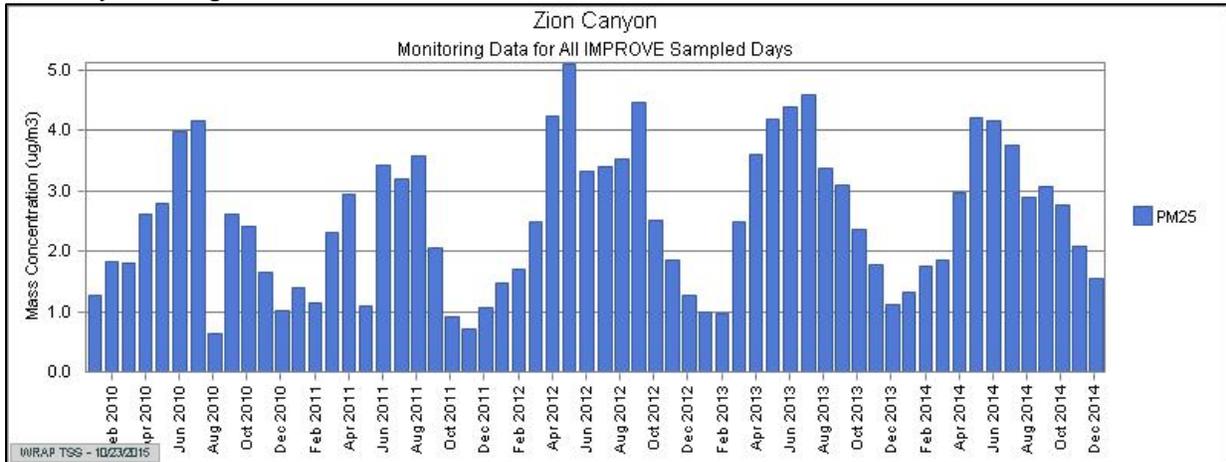
ZION1 Zion Canyon

NO EMISSIONS OR SOURCE APPORTIONMENT FOR THIS SITE

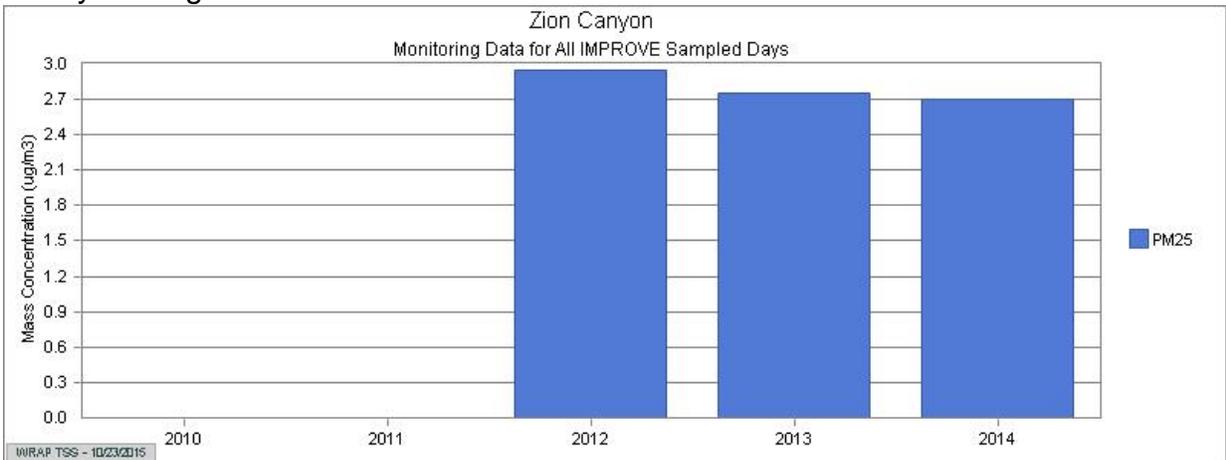
Daily Averages



Monthly Averages



Yearly Averages



E.2: IMPROVE Monitoring for SO₂

Figure E.2.1: Selected IMPROVE Sites with Sulfate Monitoring



Table E.2.1: 2012-2014 Daily Mean and Median Sulfate Concentrations at IMPROVE sites

	Site ID	Mean ($\mu\text{g}/\text{m}^3$)	Median ($\mu\text{g}/\text{m}^3$)	# of Samples
Oregon	CRLA1	0.3	0.2	342
	HECA1	0.4	0.3	354
	KALM1	0.3	0.3	338
	MOHO1	0.3	0.2	345
	STAR1	0.3	0.3	351
	THSI1	0.3	0.2	352
California	AGTI1	1.0	0.9	305
	BLIS1	0.4	0.3	344
	DEVA1	0.6	0.4	151
	DOME1	0.7	0.7	346
	FRES1	1.0	1.0	342
	HOOV1	0.4	0.3	315
	JOSH1	0.7	0.6	353
	KAIS1	0.5	0.4	347
	LABE1	0.3	0.3	357
	LAVO1	0.5	0.4	351
	LTCC1	0.4	0.4	100
	OWVL1	0.4	0.4	176
	PINN1	0.6	0.5	357
	PORE1	0.7	0.6	322
	RAFA1	0.7	0.6	310
	REDW1	0.4	0.3	351
	SAGA1	0.6	0.5	350
	SAGO1	0.6	0.6	350
	SEQU1	0.9	0.9	360
	TRIN1	0.3	0.3	331
WRIG1	0.7	0.6	96	
YOSE1	0.5	0.5	355	
Nevada	JARB1	0.4	0.3	338
	GRBA1	0.3	0.3	352
Arizona	BALD1	0.5	0.4	321
	CHIR1	0.7	0.6	356
	DOUG1	0.8	0.7	350
	GRCA2	0.5	0.4	360
	IKBA1	0.6	0.6	343
	INGA1	0.5	0.5	152
	MEAD1	0.6	0.5	313
	ORPI1	0.9	0.8	359
	PEFO1	0.5	0.5	328
	PHOE1	0.9	0.8	360
	PHOE5	0.9	0.8	362
	QUVA1	0.8	0.7	356
	SAGU1	0.8	0.7	330
	SAWE1	0.9	0.7	351
	SIAN1	0.6	0.5	301
	SYCA1	0.5	0.5	306
TONT1	0.8	0.7	355	