Regional Haze Technical Analysis using the Colorado Emissions Trace

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June 4, 2008

Department of Public Health and Environment
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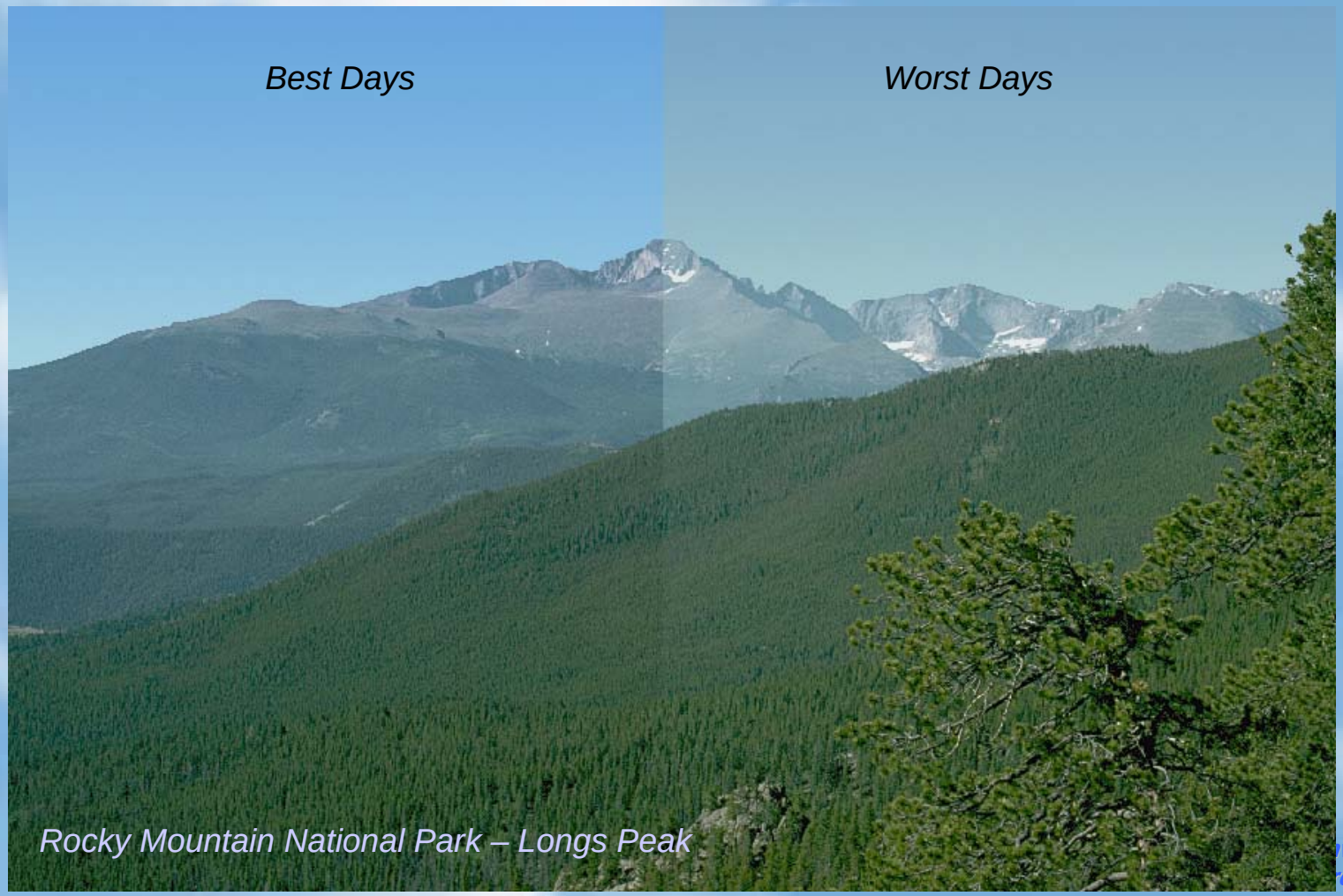
How does the ET relate to haze?

- The ET attempts to characterize air pollutant contributions and emission sources of haze at a particular Class I area



Rocky Mountain National Park – Longs Peak

Background

- Colorado Emissions Trace "ET"
  - Combines most of the Regional Haze technical information posted on the WRAP TSS
  - Specific to all Class I Areas associated with an IMPROVE monitor
  - Specific to each visibility impairing pollutant
    - Sulfate
    - Nitrate
    - Organic Carbon
    - Elemental Carbon
    - Fine Soil (Fine PM)
    - Coarse Mass (Coarse PM)
  - Created in MS Excel workbook

WRAP TSS Website

- Regional Haze IMPROVE monitoring data, WRAP emission inventories and modeling information can be downloaded

http://vista.cira.colostate.edu/tss/Results/HazePlanning.aspx

Sulfate ET

Great Sand Dunes National Park and Preserve

2018 PRP Sulfate Emissions Trace

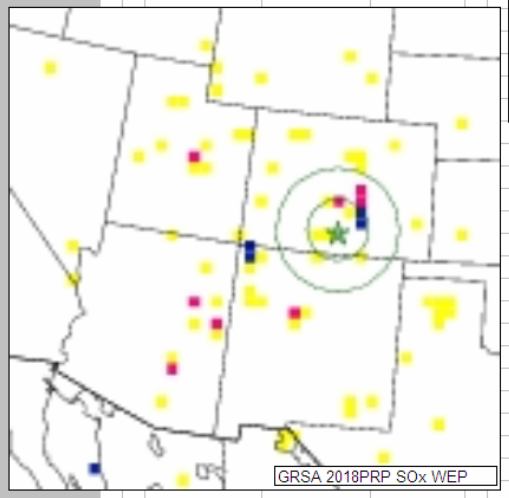
CAMx PM Source Apportionment (PSAT) Modeling for 2018 Worst Days

Statewide Emission Inventories for 2018

Analysis Tool		2018 SO4 PSAT		2018 SO4 PSAT		2018 SO4 PSAT	2018PRP PSO4 EI [tpy]		2018PRP PSO4 EI	2018PRP PSO4 EI [tpy]
GRSA Sulfate 21.2%	Natural	Secondary	2.9%						Natural Fire	53.1%	793
	Natural & Anthro	Primary	Very Small %	Colorado	?%		1,492		Off-Road Mobile	27.5%	410
	Anthro	Secondary	97.1%	Other States	?%			Particles	Area	10.3%	154
				BCI	?%						
				BCI	54.5%	Point	88.4%	56,978	-42%	External Combustion Boilers	88.4%	50,353
				Other States	35.7%	Area	4.7%	7,490	19%	Industrial Processes	10.5%	5,978
				Colorado	9.7%	Mobile	4.7%	939	-86%	Internal Combustion Engines	0.7%	413
										Waste Disposal	0.4%	228
								Gas		Industrial: Boilers and IC Engines (Distillate)	48.9%	3,665
										Commerical: All Boiler Types (Coal-Fired)	30.1%	2,260
										Commerical: Boilers and IC Engines (Distillate)	14.8%	1,108
										Residential: All Combustor Types (Wood)	2.5%	185
Baseline IMPROVE Data	Analysis Tool						2018PRP SO2 [tpy]	SO2 Delta 02d-18PRP [tpy]		Area Source Pivot	2018PRP SO2 EI [tpy]

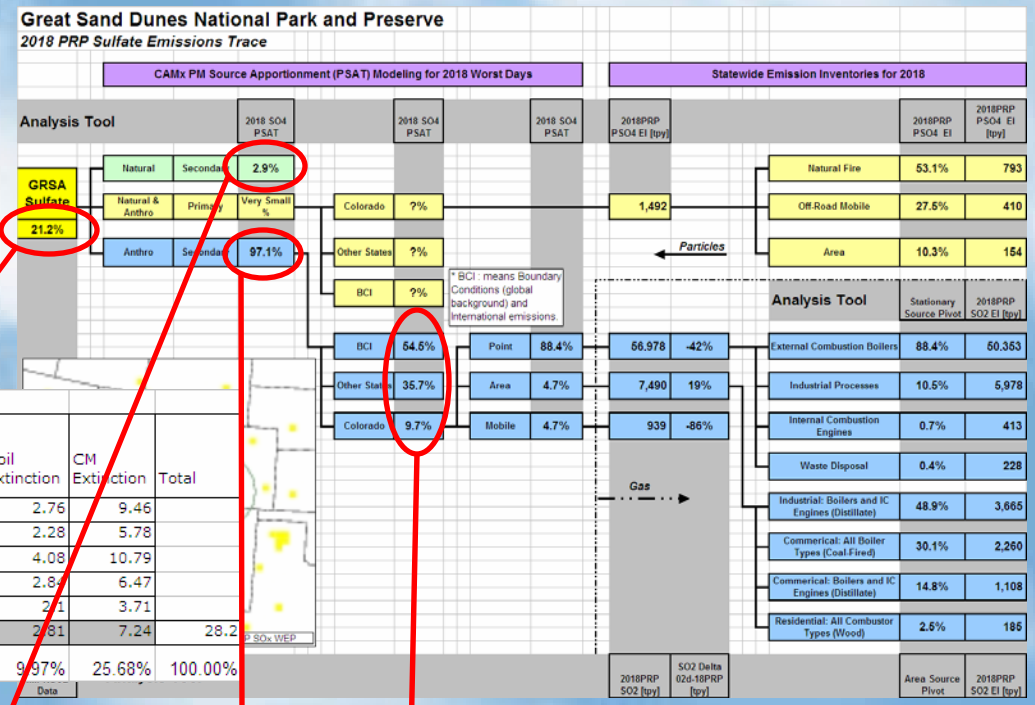
Analysis Tool: Stationary Source Pivot; 2018PRP SO2 EI [tpy]

* BCI : means Boundary Conditions (global background) and International emissions.



Sulfate ET (continued)

- TSS data tables can be cut/paste into the ET spreadsheet



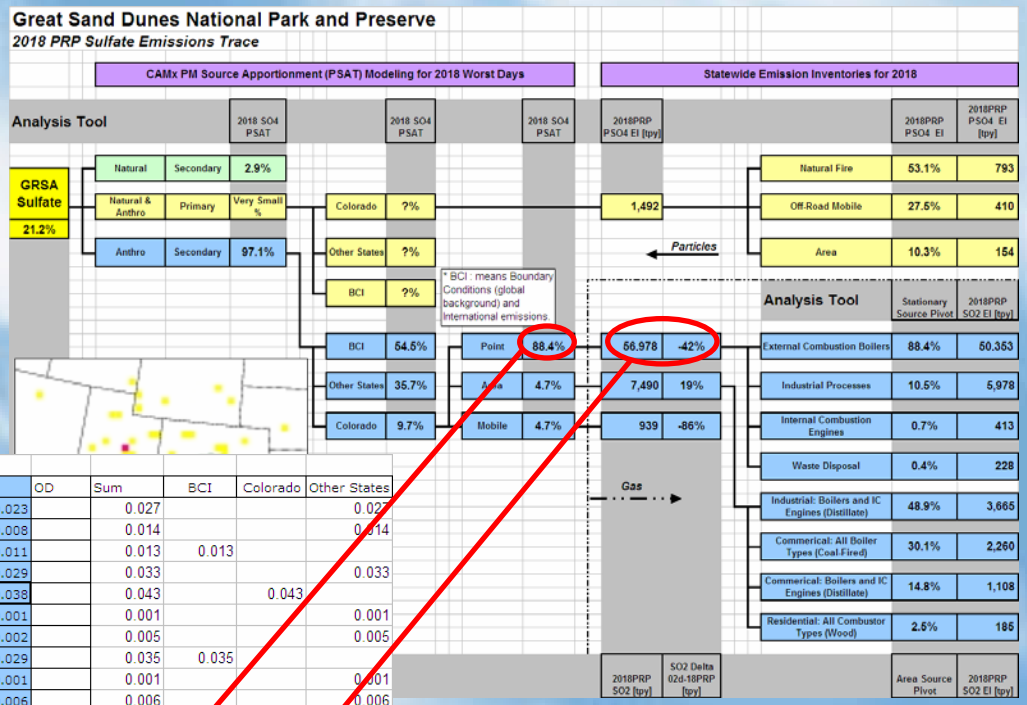
20% Worst Days

Site	Method	Year	N	SO4 Extinction	NO3 Extinction	OMC Extinction	EC Extinction	Soil Extinction	CM Extinction	Total
GRSA1	NIA	2000	20	6.21	1.72	10.64	2.24	2.76	9.46	
GRSA1	NIA	2001	23	7.04	1.75	5.07	1.22	2.28	5.78	
GRSA1	NIA	2002	23	5.15	2.51	10.76	1.99	4.08	10.79	
GRSA1	NIA	2003	24	6.27	1.09	9.06	1.93	2.84	6.47	
GRSA1	NIA	2004	24	5.2	2.74	6.82	1.32	2.1	3.71	
			average:	5.97	1.96	8.47	1.74	2.81	7.24	28.2
				21.18%	6.96%	30.04%	6.17%	9.97%	25.68%	100.00%

20% Worst Days

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	OD	Sum	BCI	Colorado	Other States
GRSA1	2018	base18b36	PS4	23	AZ	0.002	0	0.001	0.001	0.023		0.027			0.027
GRSA1	2018	base18b36	PS4	23	CA	0.002	0	0.002	0.002	0.008		0.014			0.014
GRSA1	2018	base18b36	PS4	23	CAN	0	0	0	0.002	0.011		0.013	0.013		
GRSA1	2018	base18b36	PS4	23	CEN	0	0	0	0.004	0.029		0.033			0.033
GRSA1	2018	base18b36	PS4	23	CO	0.001	0	0.002	0.002	0.038		0.043		0.043	
GRSA1	2018	base18b36	PS4	23	EUS	0	0	0	0	0.001		0.001			0.001
GRSA1	2018	base18b36	PS4	23	ID	0.003	0	0	0	0.002		0.005			0.005
GRSA1	2018	base18b36	PS4	23	MEX	0	0	0.001	0.005	0.029		0.035	0.035		
GRSA1	2018	base18b36	PS4	23	MT	0	0	0	0	0.001		0.001			0.001
GRSA1	2018	base18b36	PS4	23	ND	0	0	0	0	0.006		0.006			0.006
GRSA1	2018	base18b36	PS4	23	NM	0.001	0	0	0.004	0.031		0.036			0.036
GRSA1	2018	base18b36	PS4	23	NV	0	0	0	0.002	0.004		0.006			0.006
GRSA1	2018	base18b36	PS4	23	OR	0.001	0	0	0	0.001		0.002			0.002
GRSA1	2018	base18b36	PS4	23	PO	0	0	0	0.016	0.008		0.024	0.024		
GRSA1	2018	base18b36	PS4	23	SD	0	0	0	0	0		0			0
GRSA1	2018	base18b36	PS4	23	UT	0.002	0	0	0.001	0.012		0.015			0.015
GRSA1	2018	base18b36	PS4	23	WA	0	0	0	0	0.001		0.001			0.001
GRSA1	2018	base18b36	PS4	23	WY	0.001	0	0	0.001	0.009		0.011			0.011
GRSA1	2018	base18b36	PS4	23	OD						0.169	0.169	0.169		
					Sum	0.013					Sum	0.442	0.241	0.043	0.158
						2.9%						97.1%	54.5%	9.7%	35.7%
					CO Share			4.7%	4.7%	88.4%					

Sulfate ET (continued)



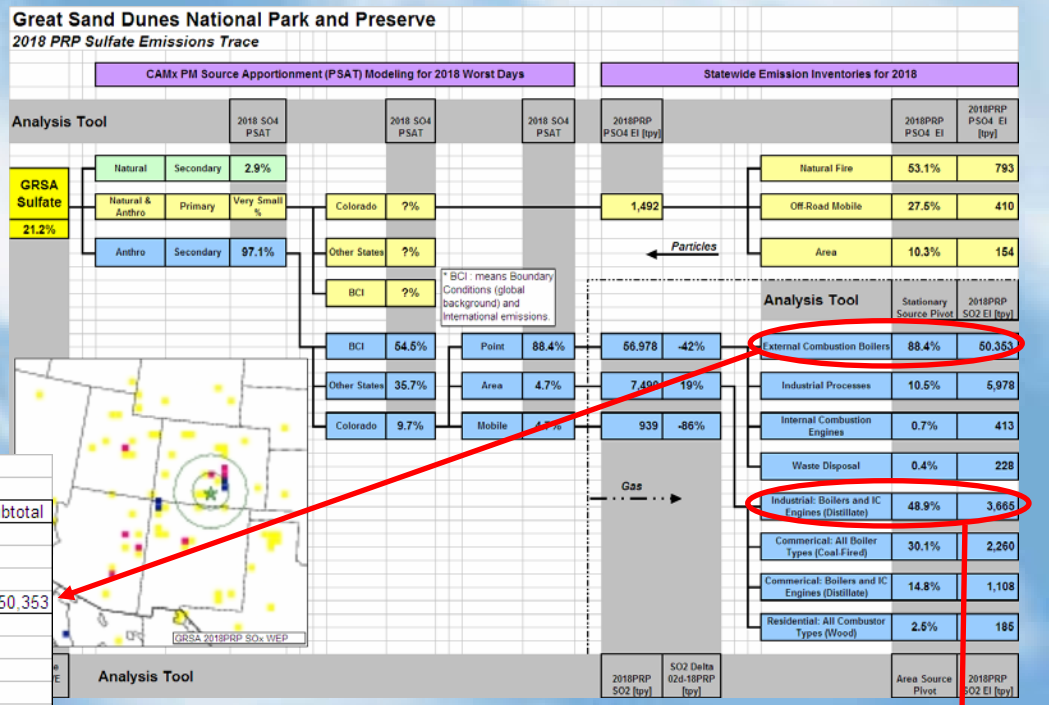
20% Worst Days

site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	OD	Sum	BCI	Colorado	Other States
GRSA1	2018	base18b36	PS4	23	AZ	0.002	0	0.001	0.001	0.023		0.027			0.027
GRSA1	2018	base18b36	PS4	23	CA	0.002	0	0.002	0.002	0.008		0.014			0.014
GRSA1	2018	base18b36	PS4	23	CAN	0	0	0	0.002	0.011		0.013	0.013		
GRSA1	2018	base18b36	PS4	23	CEN	0	0	0	0.004	0.029		0.033			0.033
GRSA1	2018	base18b36	PS4	23	CO	0.001	0	0.002	0.002	0.038		0.043		0.043	
GRSA1	2018	base18b36	PS4	23	EUS	0	0	0	0	0.001		0.001			0.001
GRSA1	2018	base18b36	PS4	23	ID	0.003	0	0	0	0.002		0.005			0.005
GRSA1	2018	base18b36	PS4	23	MEX	0	0	0.001	0.005	0.029		0.035	0.035		
GRSA1	2018	base18b36	PS4	23	MT	0	0	0	0	0.001		0.001			0.001
GRSA1	2018	base18b36	PS4	23	ND	0	0	0	0	0.006		0.006			0.006
GRSA1	2018	base18b36	PS4	23	NM	0.001	0	0	0.004	0.031		0.036			0.036
GRSA1	2018	base18b36	PS4	23	NV	0	0	0	0.002	0.004		0.006			0.006
GRSA1	2018	base18b36	PS4	23	OR	0.001	0	0	0	0.001		0.002			0.002
GRSA1	2018	base18b36	PS4	23	PO	0	0	0	0.016	0.008		0.024	0.024		
GRSA1	2018	base18b36	PS4	23	SD	0	0	0	0	0		0			0
GRSA1	2018	base18b36	PS4	23	UT	0.002	0	0	0.001	0.012		0.015			0.015
GRSA1	2018	base18b36	PS4	23	WA	0	0	0	0	0.001		0.001			0.001
GRSA1	2018	base18b36	PS4	23	WY	0.001	0	0	0.001	0.009		0.011			0.011
GRSA1	2018	base18b36	PS4	23	OD						0.169	0.169	0.169		
					Sum	0.013					Sum	0.442	0.241	0.043	0.158
						2.9%						97.1%	54.5%	9.7%	35.7%
					CO Share			4.7%	4.7%	88.4%					

Region	Scenario	Year	Point	Anthro Fire	Natural Fire	Biogenic	Area	WRAP Area O&G	Off-Shore	On-Road Mobile	Off-Road Mobile	Road Dust	Fugitive Dust	WB Dust	Total
Sulfur Dioxide															
CO	Plan02d	2002	97,978.5	91.8	2,541.9		6,299.2	118.2		4,146.8	2,468.8				
CO	Prp18a	2018	56,978.4	79.3	2,541.9		7,490.2	10.6		568.4	370.8				68,039.6
		delta	(41,000.1)	(12.5)	0.0	-	1,190.9	(107.5)	-	(3,578.5)	(2,098.0)	-	-	-	
		reduction	-41.8%	-13.6%	0.0%		18.9%	-91.0%		-86.3%	-85.0%				

Sulfate ET (continued)

- MS Excel pivot tables can be cut/paste into the ET spreadsheet



State	CO		
Sum of SumOfSO2_ANN			
SCC1_DESC	SCC3_DESC	Total	SCC1_Subtotal
External Combustion Boilers	Electric Generation	47,243	
	Industrial	2,872	
	Commercial/Institutional	236	
	Space Heaters	2	50,353
Industrial Processes	Mineral Products	2,737	
	Chemical Manufacturing	1,322	
	Petroleum Industry	1,274	
	Primary Metal Production	378	
	Food and Agriculture	100	
	Miscellaneous Manufacturing Industries	78	
	Oil and Gas Production	68	
	Pulp and Paper and Wood Products	11	
	Secondary Metal Production	10	5,978
Internal Combustion Engines	Electric Generation	250	
	Industrial	151	
	Commercial/Institutional	11	
	Engine Testing	1	413
Waste Disposal	Solid Waste Disposal - Government	166	
	Solid Waste Disposal - Commercial/Institutional	44	
	Solid Waste Disposal - Industrial	19	228
Petroleum and Solvent Evaporat	Organic Solvent Evaporation	5	
	Surface Coating Operations	1	6
Grand Total		56,979	56,979

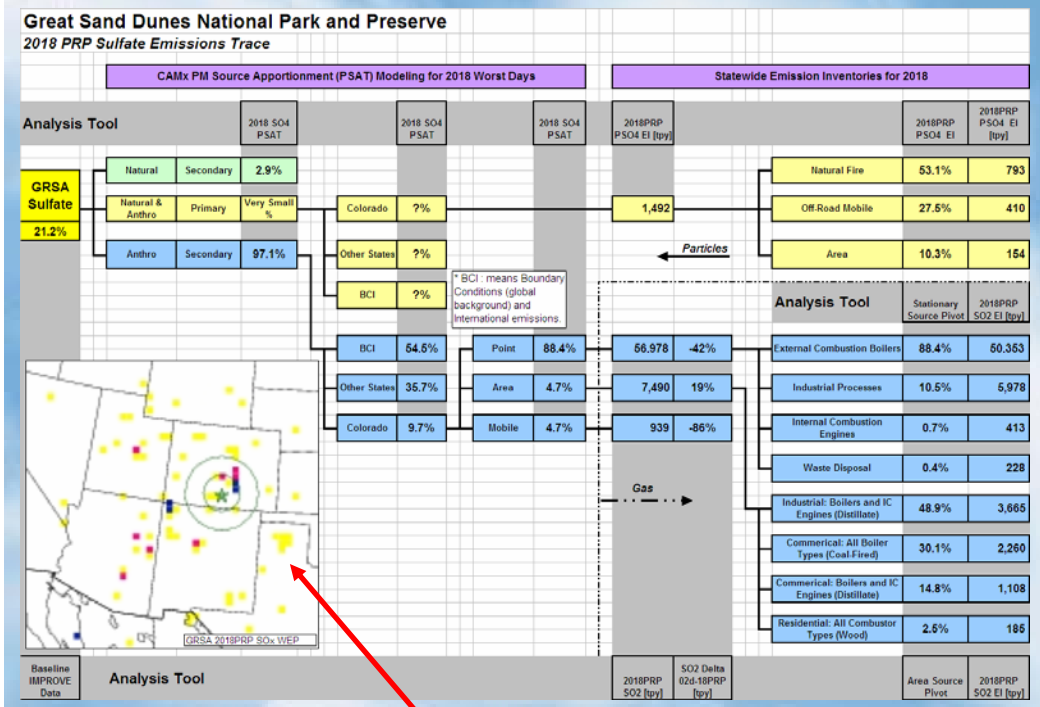
State	CO			
Sum of Emissions				Pollutant
SCC1_DESC	SCC3_DESC	SCC6_DESC	SCC8_DESC	SO2	Grand Total
Stationary Source Fuel Combustion	Industrial	Distillate Oil	Total: Boilers and IC Engines	3,665	3,665
		Kerosene	Total: All Boiler Types	6	6
	Commercial/Institutional	Bituminous/Subbituminous Coal	Total: All Boiler Types	2,260	2,260
		Distillate Oil	Total: Boilers and IC Engines	1,108	1,108
		Anthracite Coal	Total: All Boiler Types	71	71
		Kerosene	Total: All Combustor Types	9	9
		Natural Gas	Total: Boilers and IC Engines	7	7
		Liquified Petroleum Gas (LPG)	Total: All Combustor Types	1	1
	Residential	Wood	Fireplaces: Insert; non-EPA certified	46	46
			Fireplaces: General	42	42
			Woodstoves: General	41	41
			Fireplaces: Insert; EPA certified; non-catalytic	22	22
			Non-catalytic Woodstoves: EPA certified	19	19
			Fireplaces: Insert; EPA certified; catalytic	9	9
			Catalytic Woodstoves: General	0	0
		Bituminous/Subbituminous Coal	Total: All Combustor Types	85	85
		Natural Gas	Total: All Combustor Types	64	64
		Distillate Oil	Total: All Combustor Types	35	35
		Liquified Petroleum Gas (LPG)	Total: All Combustor Types	5	5
Industrial Processes	Oil and Gas Production	All Processes	Drill rigs	10	10
		Natural Gas Liquids	Tanks - Flashing & Standing/Working/Breathing: Uncontrolled	0	0
		Crude Petroleum	Pneumatic Devices	0	0
			Heaters	0	0
			Tanks - Flashing & Standing/Working/Breathing	0	0
		Natural Gas	CBM - Dewatering pump engines	0	0
			Heaters	0	0
			Pneumatic Devices	0	0
			Compressor Engines	0	0
			Dehydrators	0	0
			Completion - Flaring and venting	0	0
Grand Total				7,501	7,501

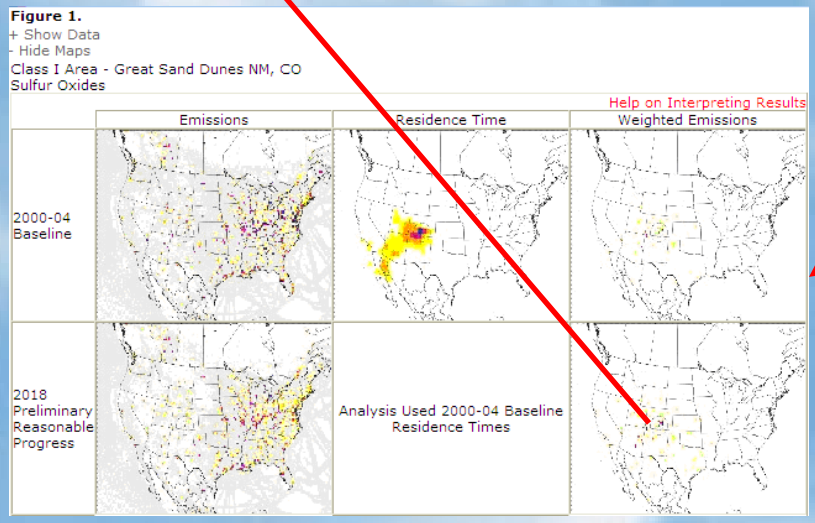
Pivot Tables on WRAP website:

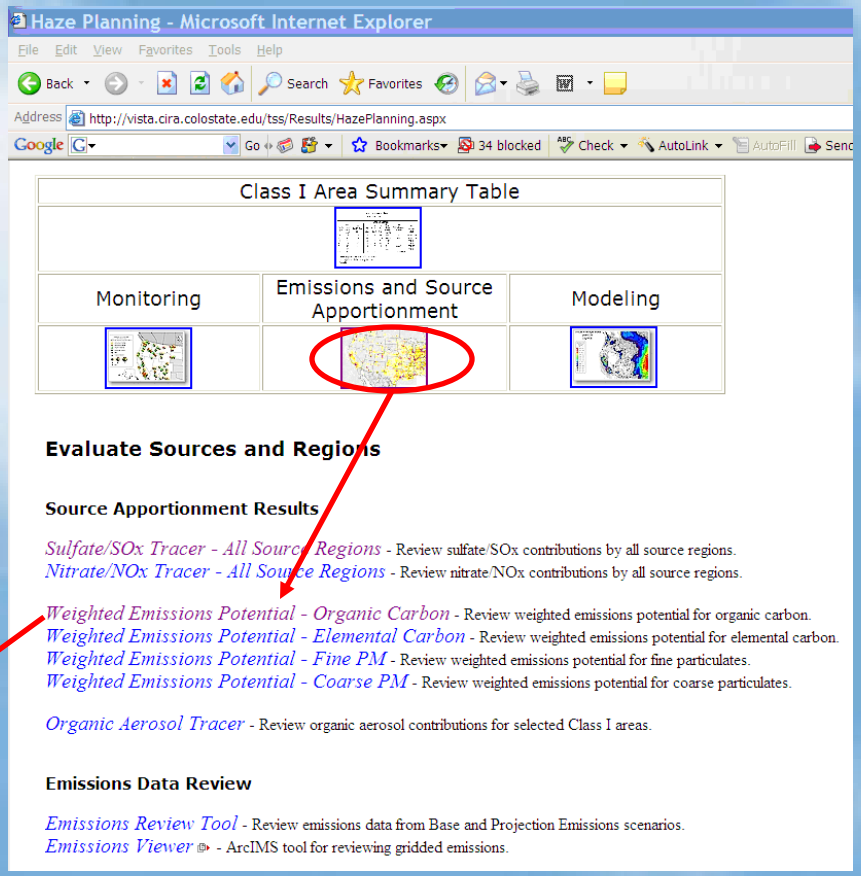
http://www.wrapair.org/forums/ssjf/pivot.html

Sulfate ET (continued)

- WEP Maps on TSS under Emissions & Source Apportionment







Nitrate ET

Great Sand Dunes National Park and Preserve

2018PRP Nitrate Emissions Trace

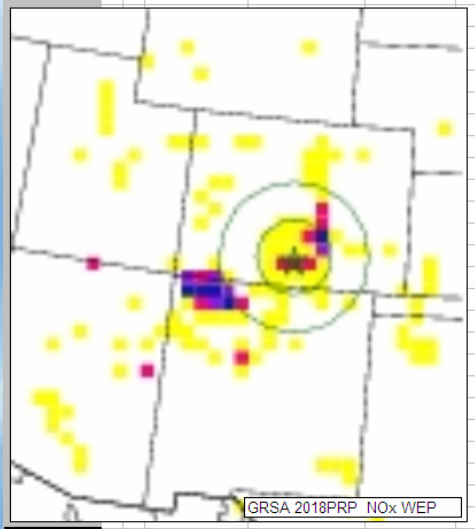
CAMx PM Source Apportionment (PSAT) Modeling for 2018 Worst Days

Statewide Emission Inventories for 2018

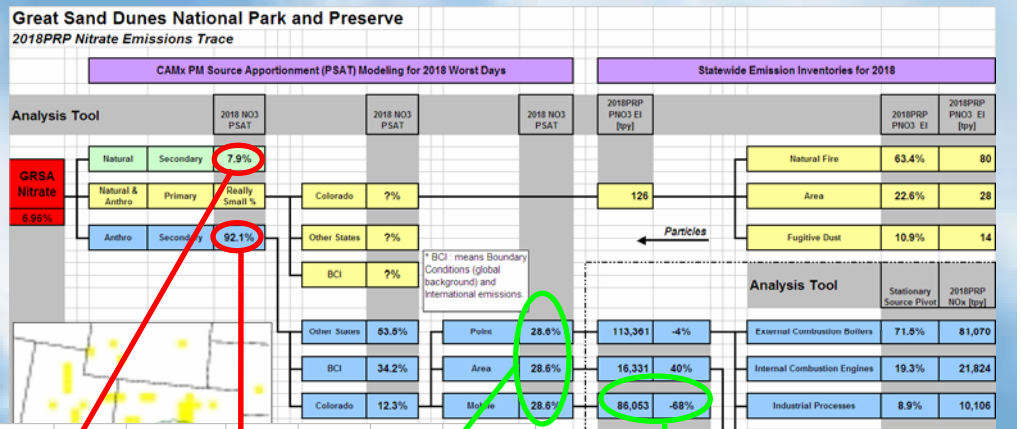
Analysis Tool			2018 NO3 PSAT		2018 NO3 PSAT		2018 NO3 PSAT	2018PRP PNO3 EI [tpy]		2018PRP PNO3 EI	2018PRP PNO3 EI [tpy]
GRSA Nitrate 6.96%	Natural	Secondary	7.9%							Natural Fire	63.4%	80
	Natural & Anthro	Primary	Really Small %	Colorado	?%			126		Area	22.6%	28
	Anthro	Secondary	92.1%	Other States	?%				Particles	Fugitive Dust	10.9%	14
				BCI	?%							
				Other States	53.5%	Point	28.6%	113,361	-4%	External Combustion Boilers	71.5%	81,070
				BCI	34.2%	Area	28.6%	16,331	40%	Internal Combustion Engines	19.3%	21,824
				Colorado	12.3%	Mobile	28.6%	86,053	-68%	Industrial Processes	8.9%	10,106
										Waste Disposal	0.2%	189
									Gas	O & G Natural Gas Heaters	45.9%	22,901
										Residental Fuel Combustion	20.5%	10,205
										O & G Drill Rigs	8.9%	4,413
										Commerical - Industrial Fuel Combustion	8.8%	4,393
Baseline IMPROVE Data	Analysis Tool							2018PRP NOx [tpy]	NOx Delta 02d-18PRP [tpy]		Area Source Pivot	2018PRP NOx EI [tpy]

Analysis Tool	Stationary Source Pivot	2018PRP NOx [tpy]

* BCI : means Boundary Conditions (global background) and International emissions.



Nitrate ET (continued)

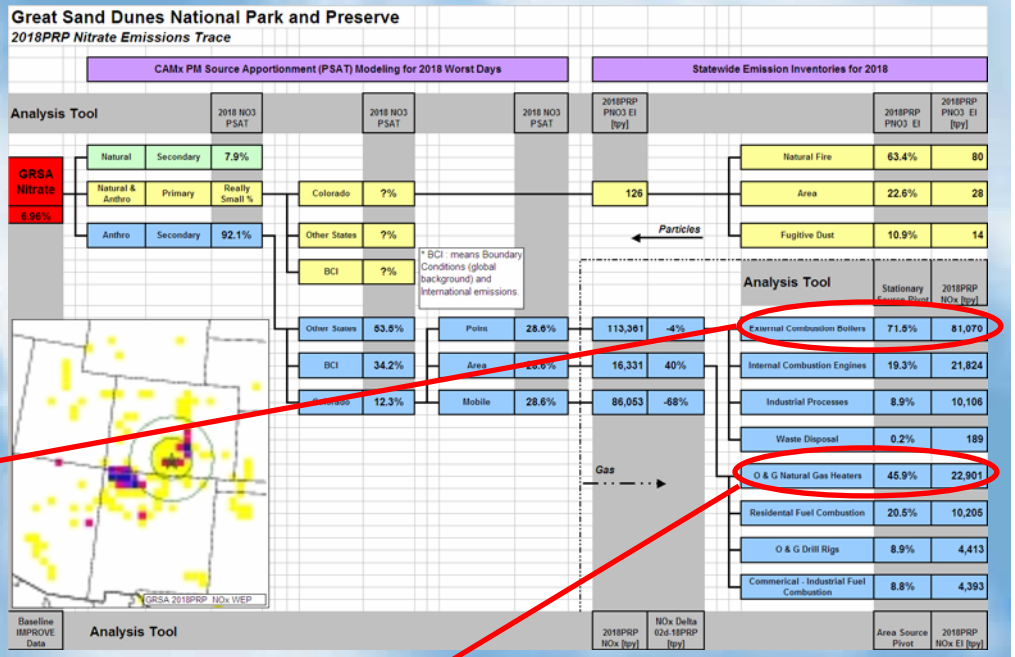


20% Worst Days															
site	Year	modelrun	param	N	SReg	Nat. Fires & Bio.	Anthro. Fires	Mobile	Area	Point	Outside Domai	sum	BCI	Colorado	Other States
GRSA1	2018	base18b36k	PN3	23	AZ	0.001	0	0.002	0	0.004		0.007			0.007
GRSA1	2018	base18b36k	PN3	23	CA	0	0	0.002	0.001	0		0.003			0.003
GRSA1	2018	base18b36k	PN3	23	CAN	0.001	0	0.002	0.001	0.001		0.005	0.005		
GRSA1	2018	base18b36k	PN3	23	CEN	0.003	0	0.002	0.001	0.004		0.01			0.01
GRSA1	2018	base18b36k	PN3	23	CO	0.002	0	0.004	0.004	0.004		0.014		0.014	
GRSA1	2018	base18b36k	PN3	23	EUS	0	0	0	0	0		0			0
GRSA1	2018	base18b36k	PN3	23	ID	0	0	0	0	0		0			0
GRSA1	2018	base18b36k	PN3	23	MEX	0	0	0	0	0		0	0		
GRSA1	2018	base18b36k	PN3	23	MT	0	0	0	0	0		0			0
GRSA1	2018	base18b36k	PN3	23	ND	0	0	0	0	0.001		0.001			0.001
GRSA1	2018	base18b36k	PN3	23	NM	0.001	0	0.002	0.016	0.012		0.031			0.031
GRSA1	2018	base18b36k	PN3	23	NV	0	0	0	0	0.001		0.001			0.001
GRSA1	2018	base18b36k	PN3	23	OR	0	0	0	0	0		0			0
GRSA1	2018	base18b36k	PN3	23	PO	0		0	0.001	0		0.001	0.001		
GRSA1	2018	base18b36k	PN3	23	SD	0.001	0	0	0	0		0.001			0.001
GRSA1	2018	base18b36k	PN3	23	UT	0	0	0.001	0.001	0.003		0.005			0.005
GRSA1	2018	base18b36k	PN3	23	WA	0	0	0	0	0		0			0
GRSA1	2018	base18b36k	PN3	23	WY	0	0	0	0.001	0.001		0.002			0.002
GRSA1	2018	base18b36k	PN3	23	OD						0.033	0.033	0.033		
						0.009						0.114	0.039	0.014	0.061
						7.9%						92.1%	34.2%	12.3%	53.5%
					CO Share			28.6%	28.6%	28.6%					

Region	Scenario	Year	Point	Anthro Fire	Natural Fire	Biogenic	Area	WRAP Area O&G	Off-Shore	On-Road Mobile	Off-Road Mobile	Road Dust	Fugitive Dust	WB Dust
Nitrogen Oxides (gas)														
CO	Plan02d	2002	118,666.4	516.6	9,297.4	37,348.8	11,699.7	23,517.8		141,883.5	62,447.8			
CO	Prp18a	2018	113,360.5	406.2	9,297.5	37,348.8	16,331.5	33,517.4		45,249.1	40,803.9			
		delta	(5,305.9)	(110.4)	0.0	-	4,631.8	9,999.6	-	(96,634.4)	(21,643.9)	-	-	-
		reduction	-4%	-21.4%	0.0%		39.6%	42.5%		-68.1%	-34.7%			

Nitrate ET (continued)

State	CO		
PLANT	(All)		
Sum of SumOfNOX_AN			
SCC1_DESC	SCC3_DESC	SCC6_DESC	Total
External Combustion Boilers			81,070
Internal Combustion Engines			21,824
Industrial Processes			10,106
Waste Disposal			189
Petroleum and Solvent Evaporation			171
Grand Total			113,361



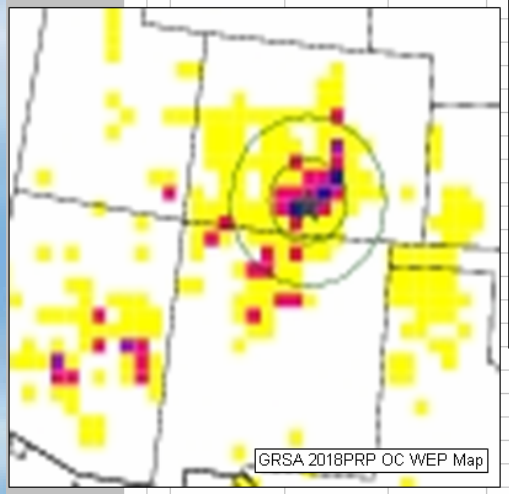
State	CO				
Sum of Em				Pollutar	
SCC1_D	SCC3_I	SCC6_DE	SCC8_DESC	NOX	Grand Tota
Industrial P	Oil and Ga	Natural Gas	Heaters	22,901	22,901
			Compressor Engines	4,006	4,006
			Completion - Flaring and ver	1,786	1,786
			CBM - Dewatering pump en	400	400
			Dehydrators	0	0
			Pneumatic Devices	0	0
		All Processes	Drill rigs	4,413	4,413
		Crude Petroleum		12	12
		Natural Gas Liquids		0	0
Stationary S	Residential			10,205	10,205
	Commercial/Institutional			4,393	4,393
	Industrial			1,723	1,723
Miscellaneo	Other Combustion			10	10
Grand Total				49,849	49,849

Organic Carbon ET

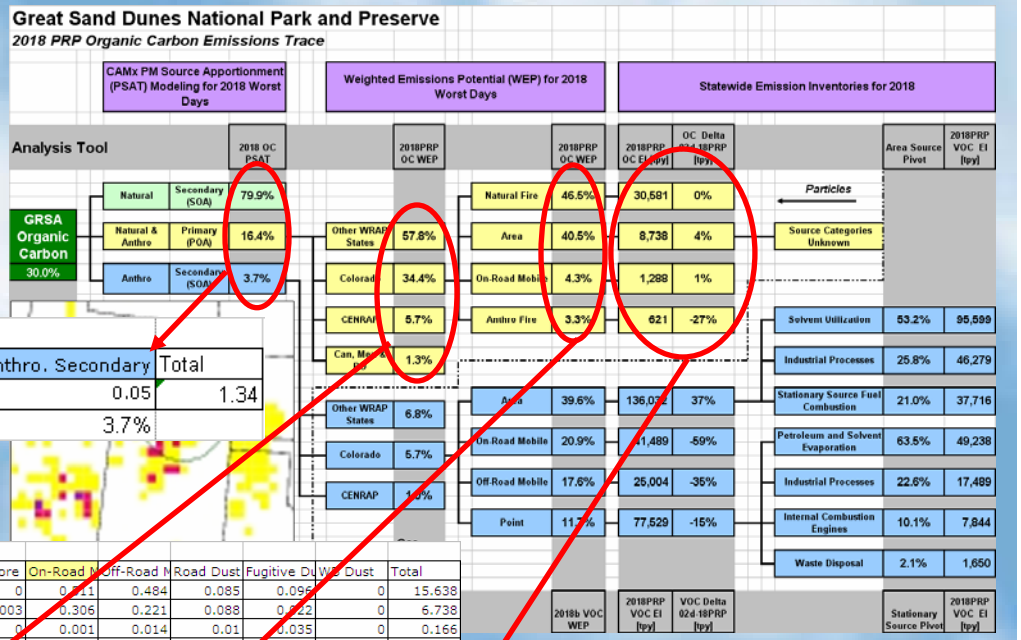
Great Sand Dunes National Park and Preserve

2018 PRP Organic Carbon Emissions Trace

CAMx PM Source Apportionment (PSAT) Modeling for 2018 Worst Days			Weighted Emissions Potential (WEP) for 2018 Worst Days			Statewide Emission Inventories for 2018					
Analysis Tool		2018 OC PSAT		2018PRP OC WEP		2018PRP OC WEP	2018PRP OC EI [tpy]	OC Delta 02d-18PRP [tpy]		Area Source Pivot	2018PRP VOC EI [tpy]
GRSA Organic Carbon 30.0%	Natural	Secondary (SOA)	79.9%			Natural Fire	46.5%	30,581	0%	*Particles*	
	Natural & Anthro	Primary (POA)	16.4%	Other WRAP States	57.8%	Area	40.5%	8,738	4%	Source Categories Unknown	
	Anthro	Secondary (SOA)	3.7%	Colorado	34.4%	On-Road Mobile	4.3%	1,288	1%		
				CENRAP	5.7%	Anthro Fire	3.3%	621	-27%	Solvent Utilization	53.2% 95,599
				Can, Mex & PO	1.3%					Industrial Processes	25.8% 46,279
				Other WRAP States	6.8%	Area	39.6%	136,032	37%	Stationary Source Fuel Combustion	21.0% 37,716
				Colorado	5.7%	On-Road Mobile	20.9%	41,489	-59%	Petroleum and Solvent Evaporation	63.5% 49,238
				CENRAP	1.0%	Off-Road Mobile	17.6%	25,004	-35%	Industrial Processes	22.6% 17,489
						Point	11.7%	77,529	-15%	Internal Combustion Engines	10.1% 7,844
				Gas						Waste Disposal	2.1% 1,650
Baseline IMPROVE Data	**Analysis Tool**			2018b VOC WEP		2018b VOC WEP	2018PRP VOC EI [tpy]	VOC Delta 02d-18PRP [tpy]		Stationary Source Pivot	2018PRP VOC EI [tpy]



OC ET (continued)



OC-PSAT for worst days							
Scenario	Site	year	N	Anthro. & Bio. Primary	Biogenic Secondary	Anthro. Secondary	Total
2018b Base Case	GRSA1	2018	23	0.22	1.07	0.05	1.34
				16.4%	79.9%	3.7%	

GRSA OC WEP															
Site	Param	SReg	Year	Point	Anthro Fire	Natural Fire	Biogenic	Area	WRAP Area	Off-Shore	On-Road M	Off-Road M	Road Dust	Fugitive Du	WB Dust	Total
GRSA1	Organic Carbon	AZ	2018 PRP	0.095	0.172	12.262	0	1.933	0	0	0.511	0.484	0.085	0.096	0	15.638
GRSA1	Organic Carbon	CA	2018 PRP	0.145	0.129	4.666	0	1.158	0	0.003	0.306	0.221	0.088	0.022	0	6.738
GRSA1	Organic Carbon	CAN	2018 PRP	0.023	0	0.004	0	0.079	0	0	0.001	0.014	0.01	0.035	0	0.166
GRSA1	Organic Carbon	CEN	2018 PRP	1.298	0.108	0.002	0	3.156	0	0	0.067	0.346	0.321	0.439	0	5.737
GRSA1	Organic Carbon	CO	2018 PRP	0.023	1.136	15.984	0	13.911	0	0	1.485	1.056	0.21	0.569	0	34.381
GRSA1	Organic Carbon	EUS	2018 PRP	0.02	0.028	0.001	0	0.036	0	0.002	0.002	0.013	0.002	0.001	0	0.105
GRSA1	Organic Carbon	ID	2018 PRP	0.006	0.08	0.639	0	0.024	0	0	0.01	0.012	0.006	0.008	0	0.785
GRSA1	Organic Carbon	MEX	2018 PRP	0.037	0.001	0.015	0	0.52	0	0	0.053	0.083	0.067	0.004	0	0.7[illegible]
GRSA1	Organic Carbon	MT	2018 PRP	0.001	0.016	0.32	0	0.026	0	0	0.004	0.003	0.012	0.006	0	0.388
GRSA1	Organic Carbon	ND	2018 PRP	0.001	0.002	0.012	0	0.006	0	0	0.001	0.002	0.001	0.009	0	0.034
GRSA1	Organic Carbon	NM	2018 PRP	0.147	0.367	15.58	0	2.485	0	0	0.468	0.252	0.103	0.233	0	19.635
GRSA1	Organic Carbon	NV	2018 PRP	0.01	0.001	0.834	0	0.031	0	0	0.02	0.022	0.006	0.019	0	0.944
GRSA1	Organic Carbon	OR	2018 PRP	0.004	0.086	1.184	0	0.256	0	0	0.01	0.009	0.002	0.004	0	1.555
GRSA1	Organic Carbon	PO	2018 PRP	0.068	0	0.007	0	0.119	0	0.028	0.042	0.047	0.009	0.001	0	0.321
GRSA1	Organic Carbon	SD	2018 PRP	0	0.001	0.08	0	0.027	0	0	0.004	0.006	0.005	0.017	0	0.14
GRSA1	Organic Carbon	UT	2018 PRP	0.109	0.053	9.237	0	0.135	0	0	0.124	0.098	0.013	0.028	0	10.497
GRSA1	Organic Carbon	WA	2018 PRP	0.009	0.071	0.076	0	0.204	0	0	0.014	0.012	0.002	0.01	0	0.398
GRSA1	Organic Carbon	WY	2018 PRP	0.029	0.027	0.884	0	0.067	0	0	0.01	0.016	0.001	0.005	0	1.039
				Totals												
			Other WRAP States	57.8												
			CO	34.4												
			CEN	5.7												
			CAN, MEX & PO	1.3												
			CO [%]	0.07%	3.30%	46.49%	0.00%	40.46%	0.00%	0.00%	4.32%	3.07%	0.63%	1.65%	0.00%	

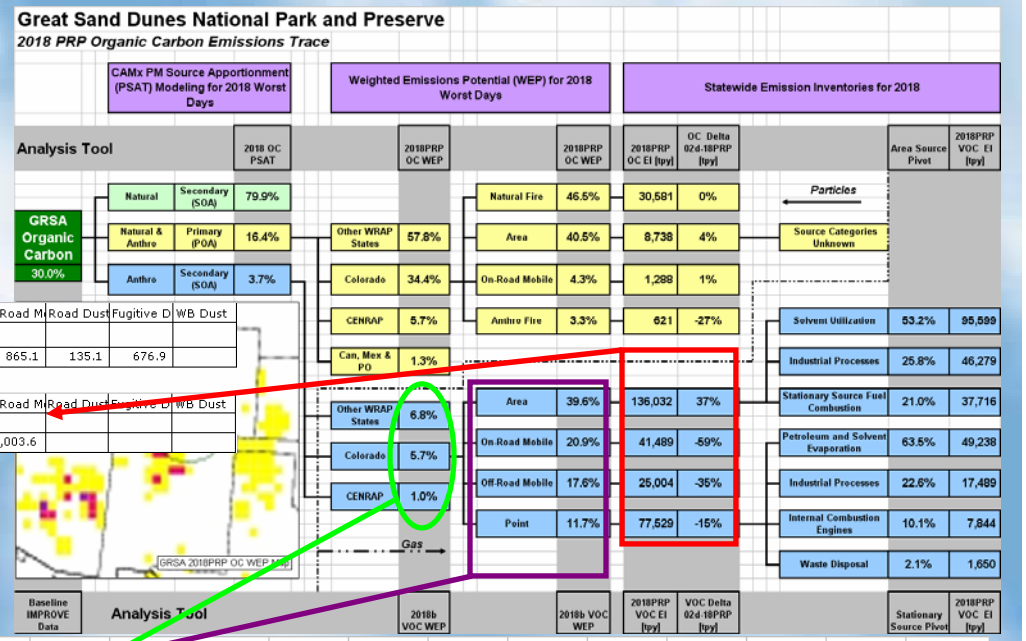
Region	Scenario	Year	Point	Anthro Fir	Natural Fire	Biogenic	Area	WRAP Area	Off-Shore	On-Road Mo	Off-Road M	Road Dust	Fugitive D	WB Dust
Organic Carbon														
CO	Prp18a	2018	3.0	620.8	30,580.7		8,737.9	-		1,288.1	865.1	135.1	676.9	

Region	Scenario	Year	Point	Anthro Fir	Natural Fire	Biogenic	Area	WRAP Area	Off-Shore	On-Road Mo	Off-Road M	Road Dust	Fugitive D	WB Dust
Volatile Organic Carbon														
CO	Prp18a	2018	77,529.0	665.5	20,404.1	804,776.8	136,032.1	43,639.3		41,488.8	25,003.6			

OC ET (continued)

Region	Scenario	Year	Point	Anthro Fir	Natural Fire	Biogenic	Area	WRAP Area	Off-Shore	On-Road Mo	Off-Road M	Road Dust	Fugitive D	WB Dust
Organic Carbon														
CO	Prp18a	2018	3.0	620.8	30,580.7		8,737.9	-		1,288.1	865.1	135.1	676.9	

Region	Scenario	Year	Point	Anthro Fir	Natural Fire	Biogenic	Area	WRAP Area	Off-Shore	On-Road Mo	Off-Road M	Road Dust	Fugitive D	WB Dust
Volatile Organic Carbon														
CO	Prp18a	2018	77,529.0	665.5	20,404.1	804,776.8	136,032.1	43,639.3		41,488.8	25,003.6			



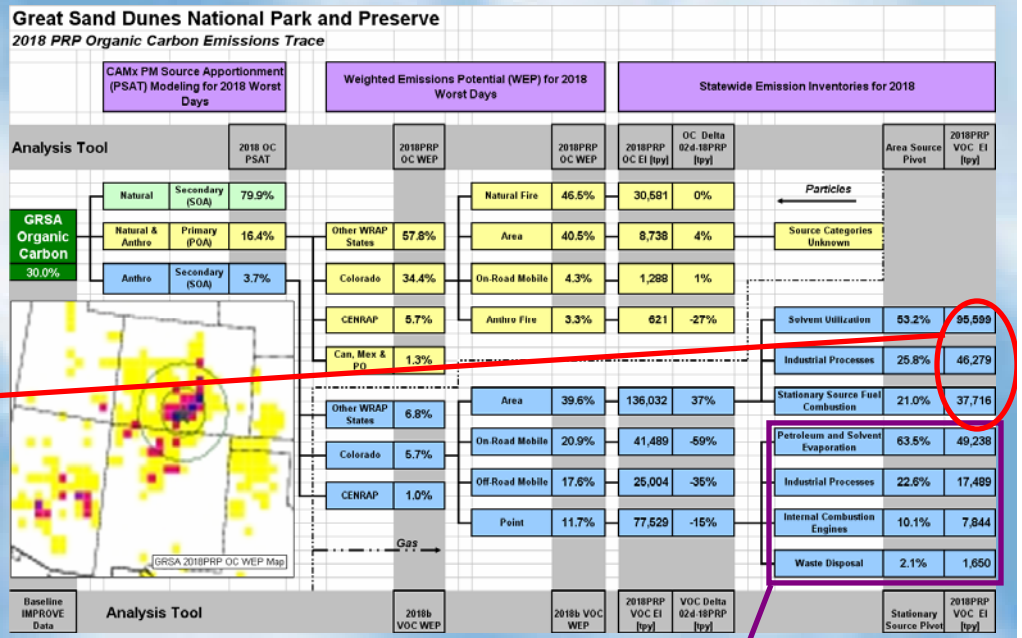
Great Sand Dunes National Monument, CO

Weighted Emissions Potential for 2018 Worst Days - WRAP Base18b Emission Inventory

Species	Source Category	AZ	CA	CO	CO%	ID	MT	NV	NM	ND	OR	SD	UT	WA	WY	PO	CENRAP	East US	Mex	Can	Sub
VOC	Point	0.0537	0.0343	0.5545	11.7%	0.001	0.0012	0.0033	0.1528	0.0002	0.0065	0.0003	0.0426	0.0036	0.0147	0.0195	0.143	0.0042	0.013	0.0014	170.2262
VOC	Area	0.7218	0.2233	1.8773	39.6%	0.0682	0.0076	0.0481	0.7057	0.0029	0.0708	0.0077	0.1348	0.0364	0.0136	0.036	0.5932	0.0169	0.1767	0.0408	603.1569
VOC	WRAP Area O&G	0.0003	0.009	0.4691	9.9%	0	0.0004	0	2.8306	0.0004	0	0	0.12	0	0.0915	0.0009	0.005	0	0	0	444.8753
VOC	Off-Shore	0	0.0122	0	0.0%	0	0	0	0	0	0	0	0	0	0	0.127	0.0001	0.0057	0	0	18.2968
VOC	On-Road Mobile	0.2411	0.0945	0.9918	20.9%	0.0038	0.0027	0.0233	0.1736	0.0002	0.0075	0.001	0.0546	0.0073	0.0026	0.0136	0.13	0.006	0.0782	0.0069	231.9268
VOC	Off-Road Mobile	0.1819	0.0778	0.8326	17.6%	0.0045	0.0013	0.0201	0.1125	0.0005	0.0054	0.0018	0.049	0.0057	0.0044	0.013	0.0794	0.005	0.013	0.0025	177.9494
VOC	Road Dust	0	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOC	Fugitive Dust	0	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOC	WB Dust	0	0	0	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOC	Anthro Fire	0.003	0.0025	0.0137	0.3%	0.0011	0.0002	0	0.0037	0	0.0013	0	0.001	0.0028	0.0003	0	0.0475	0.0004	0.0001	0	10.0498
VOC	Natural Fire	0.0451	0.0008	0.0042		0.0006	0.0004	0.0001	0.0139	0	0.0008	0.0004	0.0091	0.0001	0.0004	0	0	0	0	0.0001	9.5976
VOC	Biogenic	7.5251	2.3298	52.5425		0.2464	0.1773	0.8519	11.108	0.0145	0.2586	0.1329	3.9441	0.1105	0.2867	0.1345	3.2865	0.1109	3.5838	0.1025	10946.72
Natural SOA	86.87%	7.5702	2.3746	52.5467	0	0.247	0.1777	0.852	11.1219	0.0145	0.2594	0.1333	3.9532	0.1106	0.2871	0.1345	3.2865	0.1109	3.5838	0.1026	12612.799
Colorado	5.74%			4.741	100%																
Can, Mex & PO	0.54%															0.21			0.281	0.0516	
Other WRAP States	6.81%	1.2018	0.4536			0.0789	0.0134	0.0948	4.2789	0.0042	0.0915	0.0108	0.402	0.0558	0.1271						
CENRAP	1.00%																0.9982				

OC ET (continued)

State	CO				
Sum of Emiss				Pollutant	
SCC1_DES	SCC3_D	SCC6	SCC8_DE	VOC	Grand Tot
Solvent Utilization				95,599	95,599
Industrial Processes				46,279	46,279
Stationary Source Fuel Combustion				37,716	37,716
Miscellaneous Area Sources				80	80
Grand Total				179,674	179,674



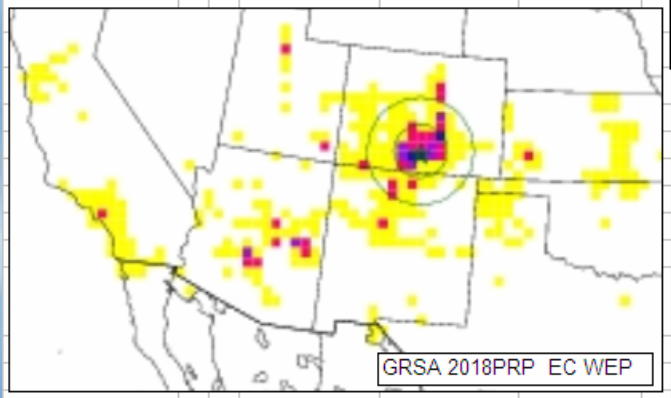
State	CO			
Sum of SumOfVOC				
SCC1_DESC	SCC3_DESC	SCC6	PLANT	Total
Petroleum and Solvent Evaporation				49,238
Industrial Processes				17,489
Internal Combustion Engines				7,844
Waste Disposal				1,650
External Combustion Boilers				1,307
Grand Total				77,529

Elemental Carbon ET

Great Sand Dunes National Park and Preserve

2018PRP Elemental Carbon Emissions Trace

Baseline IMPROVE Data	2018 Elemental Carbon Weighted Emissions Potential (WEP) for 2018 Worst Days									Statewide Emission Inventories for 2018	
	Analysis Tool				2018PRP EC WEP		2018PRP EC WEP		2018PRP EC EI [tpy]	EC Delta 02d-18PRP [tpy]
GRSA Elemental Carbon 6.2%	Natural	Secondary	Really Small ?%	Other WRAP States	41.5%	Natural Fire	39.7%		6,337	0%
	Anthro	Secondary	Really Small ?%	Colorado	27.3%	Area	28.7%		1,325	5%
	Natural & Anthro	Primary	100%	CENRAP	5.6%	Off-Road Mobile	22.8%		1,431	-55%
				Can, Mex & PO	2.2%	On-Road Mobile	6.0%		408	-72%

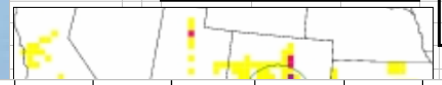


Elemental Carbon ET

Great Sand Dunes National Park and Preserve

2018PRP Elemental Carbon Emissions Trace

Baseline IMPROVE Data	Analysis Tool				2018 Elemental Carbon Weighted Emissions Potential (WEP) for 2018 Worst Days					Statewide Emission Inventories for 2018	
						2018PRP EC WEP		2018PRP EC WEP		2018PRP EC EI [tpy]	EC Delta 02d-18PRP [tpy]
GRSA Elemental Carbon 6.2%	Natural	Secondary	Really Small ?%	Other WRAP States	41.5%	Natural Fire	39.7%	6,337	0%
	Anthro	Secondary	Really Small ?%	Colorado	27.3%	Area	28.7%	1,325	5%
	Natural & Anthro	Primary	100%	CENRAP	5.6%	Off-Road Mobile	22.8%	1,431	-55%
				Can, Mex & PO	2.2%	On-Road Mobile	6.0%	408	-72%



Region	Scenario	Year	Point	Anthro Fire	Natural Fir	Biogenic	Area	WRAP Area	Off-Shore	On-Road Mo	Off-Road Mo	Road Dust	Fugitive Du	WB Dust
Elemental Carbon														
CO	Plan02d	2002	0	92.4	6,336.8		1,263.8	-		1,448.1	3,175.0	8.6	52.7	
CO	Prp18a	2018	0	74.2	6,336.8		1,325.3	-		407.6	1,430.7	11.4	46.0	
		delta	-	(18.2)	0.0	-	61.5	-	-	(1,040.5)	(1,744.3)	2.9	(6.8)	-
		reduction		-19.7%	0.0%		4.9%			-71.8%	-54.9%	33.3%	-12.8%	

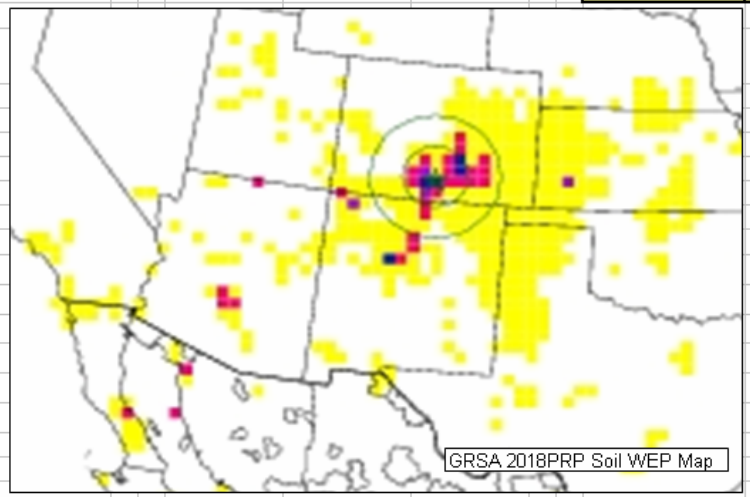
Site	Param	SReg	Year	Point	Anthro Fire	Natural Fire	Biogenic	Area	WRAP Area O&G	Off-Shore	On-Road Mobile	Off-Road Mobile	Road Dust	Fugitive Dust	WB Dust	Colorado	Can, Mex & PO	CENRAP	Other WRAP States	East US
GRSA1	Elemental Carbon	AZ	2018 PRP	0.028	0.113	8.104	0	0.574	0	0	0.504	1.4	0.023	0.022	0				10.768	
GRSA1	Elemental Carbon	CA	2018 PRP	0.09	0.046	3.189	0	0.545	0	0.042	0.636	0.814	0.025	0.003	0				5.393	
GRSA1	Elemental Carbon	CAN	2018 PRP	0.014	0	0.002	0	0.044	0	0	0.002	0.127	0.003	0.008	0		0.2			
GRSA1	Elemental Carbon	CEN	2018 PRP	0.146	0.182	0	0	3.81	0	0.001	0.217	1.105	0.081	0.098	0			5.64		
GRSA1	Elemental Carbon	CO	2018 PRP	0	0.591	10.816	0	7.825	0	0	1.624	6.222	0.050	0.127	0	27.264				
GRSA1	Elemental Carbon	EUS	2018 PRP	0.011	0.014	0	0	0.018	0	0.03	0.005	0.046	0	0	0					0.124
GRSA1	Elemental Carbon	ID	2018 PRP	0.002	0.034	0.436	0	0.027	0	0	0.01	0.07	0.002	0.002	0				0.583	
GRSA1	Elemental Carbon	MEX	2018 PRP	0.041	0	0.01	0	0.236	0	0	0.175	0.802	0.016	0.001	0		1.281			
GRSA1	Elemental Carbon	MT	2018 PRP	0.001	0.011	0.212	0	0.013	0	0	0.005	0.029	0.003	0.001	0				0.275	
GRSA1	Elemental Carbon	ND	2018 PRP	0	0.001	0.008	0	0.004	0	0	0.001	0.021	0	0.002	0				0.037	
GRSA1	Elemental Carbon	NM	2018 PRP	0.05	0.248	10.5	0	1.136	0	0	0.485	1.427	0.028	0.052	0				13.926	
GRSA1	Elemental Carbon	NV	2018 PRP	0.002	0	0.571	0	0.016	0	0	0.02	0.114	0.002	0.004	0				0.729	
GRSA1	Elemental Carbon	OR	2018 PRP	0.003	0.05	0.789	0	0.154	0	0	0.011	0.046	0	0.001	0				1.054	
GRSA1	Elemental Carbon	PO	2018 PRP	0.04	0	0.005	0	0.044	0	0.366	0.087	0.17	0.003	0	0		0.715			
GRSA1	Elemental Carbon	SD	2018 PRP	0	0	0.044	0	0.016	0	0	0.004	0.049	0.001	0.004	0				0.118	
GRSA1	Elemental Carbon	UT	2018 PRP	0.037	0.027	6.776	0	0.019	0	0	0.123	0.542	0.004	0.006	0				7.534	
GRSA1	Elemental Carbon	WA	2018 PRP	0.005	0.018	0.052	0	0.094	0	0	0.014	0.056	0	0.002	0				0.241	
GRSA1	Elemental Carbon	WY	2018 PRP	0.015	0.016	0.603	0	0.038	0	0	0.012	0.163	0	0.001	0				0.848	
																27.3%	2.2%	5.6%	41.5%	0.1%
		All	2018 PRP subtotal:	0.485	1.351	42.117	0	14.613	0	0.439	3.935	13.203	0.25	0.337	0					
		CO	2018 PRP	0.00%	2.17%	39.67%	0.00%	28.70%	0.00%	0.00%	5.96%	22.82%	0.22%	0.47%	0.00%					

Fine Soil ET

Great Sand Dunes National Park and Preserve

2018PRP Fine Soil Emissions Trace

Baseline IMPROVE Data	Analysis Tool			2018 PM Fine (Soil) Weighted Emissions Potential (WEP) for 2018 Worst Days					Statewide Emission Inventories for 2018	
					2018PRP Fine PM WEP		2018PRP Fine PM WEP		2018PRP Fine PM EI [tpy]	Fine PM Delta 02d-18PRP [tpy]
GRSA Fine Soil 10.0%	Natural	Secondary	Really small ?0%	Colorado	36.7%	WB Dust	47.7%		15,105	0%
	Anthro	Secondary	Really small ?0%	Other WRAP States	35.8%	Fugitive Dust	23.8%		11,679	-12.9%
	Natural & Anthro	Primary	100%	CENRAP	25.9%	Area	17.8%		4,311	3.4%
				Can, Mex & PO	7.9%	Road Dust	5.9%		1,435	32.6%

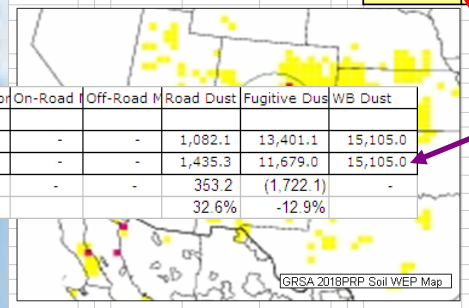


Fine Soil ET

Great Sand Dunes National Park and Preserve

2018PRP Fine Soil Emissions Trace

Baseline IMPROVE Data	Analysis Tool				2018PRP Fine PM WEP		2018PRP Fine PM WEP	2018 PM Fine (Soil) Weighted Emissions Potential (WEP) for 2018 Worst Days	Statewide Emission Inventories for 2018: 2018PRP Fine PM Emis [tpy]	Fine PM Delta 02d-18PRP [tpy]
GRSA Fine Soil 10.0%	Natural	Secondary	Really small ?0%	Colorado	36.7%	WB Dust	47.7%		15,105	0%
	Anthro	Secondary	Really small ?0%	Other WRAP States	35.8%	Fugitive Dust	23.8%		11,679	-12.9%
	Natural & Anthro	Primary	100%	CENRAP	25.9%	Area	17.8%		4,311	3.4%
				Can, Mex & PO	7.9%	Road Dust	5.9%		1,435	32.6%



Region	Scenario	Year	Point	Anthro Fire	Natural Fire	Biogenic	Area	WRAP Area	Off-Shor	On-Road	Off-Road M	Road Dust	Fugitive Dus	WB Dust
Fine Particulate Matter														
CO	Plan02d	2002	5.6	252.9	1,948.0		4,169.6	-		-	-	1,082.1	13,401.1	15,105.0
CO	Prp18a	2018	84.8	168.6	1,948.0		4,311.1	-		-	-	1,435.3	11,679.0	15,105.0
		delta	79.2	(84.3)	0.0	-	141.5	-	-	-	-	353.2	(1,722.1)	-
		reduction		-33.3%	0.0%		3.4%					32.6%	-12.9%	

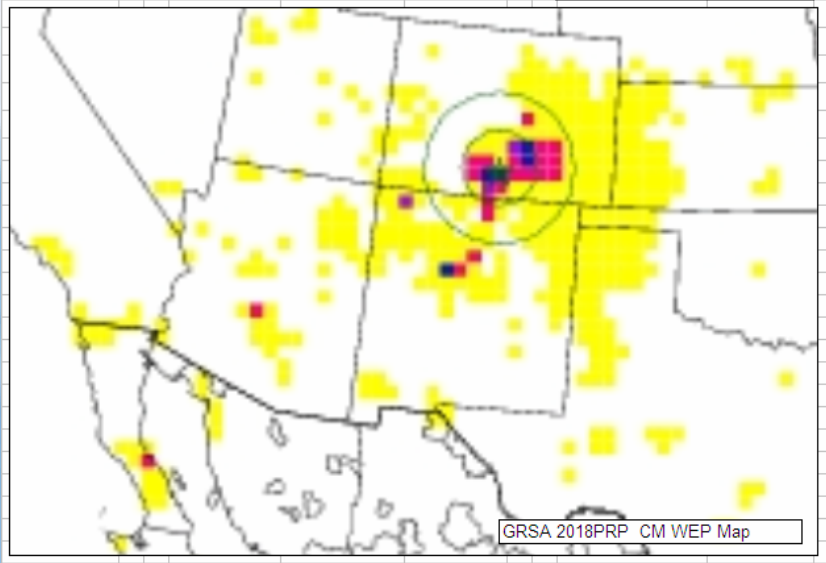
Site	Param	SReg	Year	Point	Anthro Fire	Natural Fire	Biogenic	Area	WRAP Area O&G	Off-Shore	On-Road Mobile	Off-Road Mobile	Road Dust	Fugitive Dust	WB Dust	Colorad	Can, Mex & P	CENRAP	Other WRAP States	East US
GRSA1	Fine PM	AZ	2018 PRP	0.962	0.013	0.868	0	1.589	0	0	0	0	0.913	2.198	1.49				8.042	
GRSA1	Fine PM	CA	2018 PRP	0.636	0.034	0.263	0	0.634	0.005	0	0	0	0.774	0.328	0.299				2.973	
GRSA1	Fine PM	CAN	2018 PRP	0.049	0	0.002	0	0.092	0	0	0.001	0.002	0.117	0.527	0.177		0.967			
GRSA1	Fine PM	CEN	2018 PRP	2.574	0.098	0	0	3.277	0	0.003	0.099	0.035	3.962	7.092	3.723			25.863		
GRSA1	Fine PM	CO	2018 PRP	0.629	0.182	0.97	0	6.522	0	0	0	0	2.182	8.722	17.494	36.701				
GRSA1	Fine PM	EUS	2018 PRP	0.077	0.005	0	0	0.028	0	0.075	0.003	0.002	0.022	0.018	0.02					0.25
GRSA1	Fine PM	ID	2018 PRP	0.014	0.018	0.037	0	0.158	0	0	0	0	0.083	0.124	0.181				0.615	
GRSA1	Fine PM	MEX	2018 PRP	1.475	0	0.001	0	0.183	0	0	0.007	0	0.878	0.062	2.784		5.39			
GRSA1	Fine PM	MT	2018 PRP	0.002	0.001	0.022	0	0.021	0	0	0	0	0.177	0.105	0.323				0.651	
GRSA1	Fine PM	ND	2018 PRP	0.004	0.001	0.001	0	0.006	0	0	0	0	0.013	0.047	0.076				0.248	
GRSA1	Fine PM	NM	2018 PRP	0.942	0.023	0.973	0	2.615	0	0	0.002	0	1.11	4.05	6.332				16.047	
GRSA1	Fine PM	NV	2018 PRP	0.118	0	0.046	0	0.035	0	0	0	0	0.068	0.318	0.349				0.934	
GRSA1	Fine PM	OR	2018 PRP	0.005	0.01	0.08	0	0.164	0	0	0	0	0.023	0.073	0.168				0.523	
GRSA1	Fine PM	PO	2018 PRP	1.277	0	0.001	0	0.056	0	0	0	0	0.075	0.019	0.125		1.553			
GRSA1	Fine PM	SD	2018 PRP	0	0	0.011	0	0.026	0	0	0	0	0.065	0.3	0.681				1.083	
GRSA1	Fine PM	UT	2018 PRP	0.77	0.009	0.57	0	0.036	0	0	0	0	0.099	0.504	1.42				3.408	
GRSA1	Fine PM	WA	2018 PRP	0.027	0.023	0.005	0	0.142	0	0	0	0	0.027	0.157	0.054				0.435	
GRSA1	Fine PM	WY	2018 PRP	0.454	0.003	0.051	0	0.05	0	0	0	0	0.009	0.099	0.187				0.853	
																36.7%	7.9%	25.9%	35.8%	0.3%
		All	2018 PRP subtotal:	10.015	0.42	3.901	0	15.634	0.005	0.078	0.112	0.039	10.597	24.843	40.892					
		CO	2018 PRP	1.71%	0.50%	2.64%	0.00%	17.77%	0.00%	0.00%	0.00%	0.00%	5.95%	23.77%	47.67%					

Coarse Mass ET

Great Sand Dunes National Park and Preserve

2018PRP Coarse Mass Emissions Trace

Baseline IMPROVE Data	Analysis Tool				2018PRP CM WEP		2018PRP CM WEP	2018 PM Coarse (Coase Mass) Weighted Emissions Potential (WEP) for 2018 Worst Days	Statewide Emission Inventories for 2018	
									2018PRP PM10 EI [tpy]	PM10 Delta 02d-18PRP [tpy]
GRSA Coarse Mass 25.7%	Natural	Secondary	Really small ?0%	Colorado	41.2%	WB Dust	58.6%		135,945	0.0%
	Anthro	Secondary	Really small ?0%	Other WRAP States	34.5%	Fugitive Dust	19.8%		67,910	0.4%
	Natural & Anthro	Primary	100%	CENRAP	24.2%	Point	12.9%		28,200	33.7%
				Can, Mex & PO	6.7%	Road Dust	6.9%		11,826	32.4%



Coarse Mass ET

Great Sand Dunes National Park and Preserve

2018PRP Coarse Mass Emissions Trace

2018 PM Coarse (Coase Mass) Weighted Emissions Potential (WEP) for 2018 Worst Days

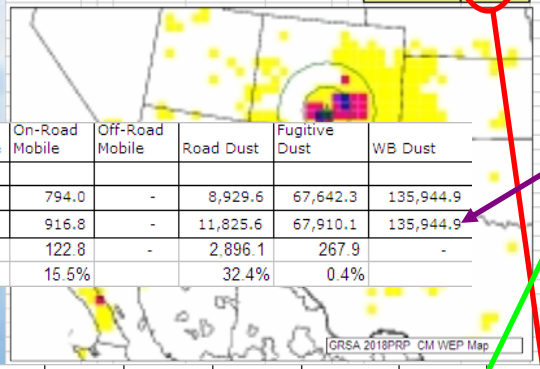
Statewide Emission Inventories for 2018

Baseline IMPROVE Data

Analysis Tool

GRSA Coarse Mass 26.7%

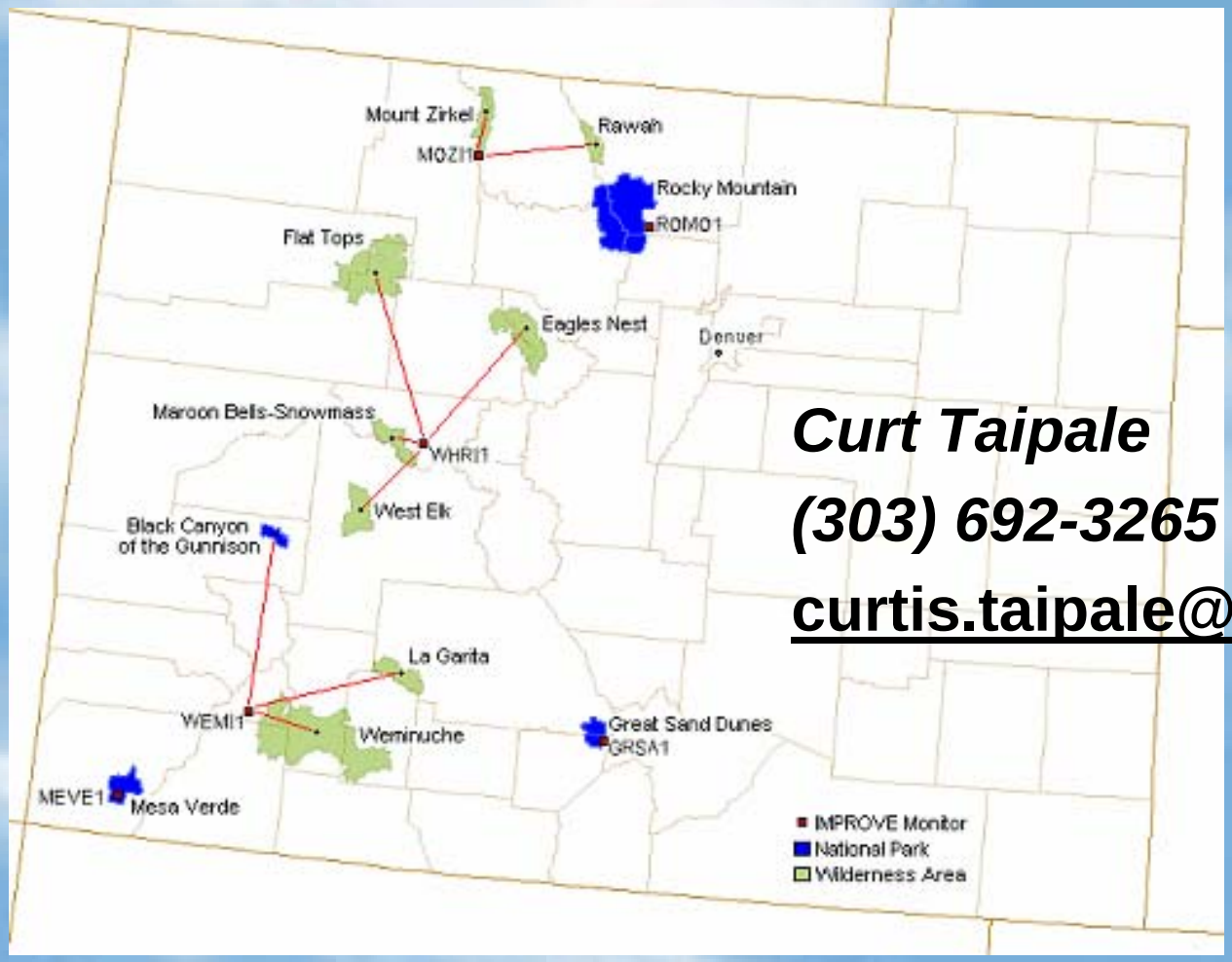
				2018PRP CM WEP		2018PRP CM WEP	2018PRP PM10 EI [tpy]	PM10 Delta 02d-18PRP [tpy]
Natural	Secondary	Really small ?0%	Colorado	41.2%	WB Dust	58.6%	135,945	0.0%
Anthro	Secondary	Really small ?0%	Other WRAP States	34.5%	Fugitive Dust	19.8%	67,910	0.4%
Natural & Anthro	Primary	100%	CENRAP	24.2%	Point	12.9%	28,200	33.7%
			Can, Mex & PO	6.7%	Road Dust	6.9%	11,826	32.4%



Region	Scenario	Year	Point	Anthro Fire	Natural Fire	Biogenic	Area	WRAP Area O&G	Off-Shore	On-Road Mobile	Off-Road Mobile	Road Dust	Fugitive Dust	WB Dust
Coarse Particulate Matter														
CO	Plan02d	2002	21,096.2	51.2	5,972.7		1,363.1	-		794.0	-	8,929.6	67,642.3	135,944.9
CO	Prp18a	2018	28,200.3	32.1	5,972.7		1,388.0	-		916.8	-	11,825.6	67,910.1	135,944.9
		delta	7,104.1	(19.1)	0.0	-	24.9	-	-	122.8	-	2,896.1	267.9	-
		reduction	33.7%	-37.2%	0.0%		1.8%			15.5%		32.4%	0.4%	

Site	Param	SReg	Year	Point	Anthro Fire	Natural Fire	Biogenic	Area	WRAP Area	Off-Shore	On-Road M	Off-Road Mo	Road Dust	Fugitive Dust	WB Dust	Colorado	Can, Mex &	CENRAP	Other WRA	East US
GRSA1	Coarse PM	AZ	2018 PRP	0.373	0	0.352	0	0.058	0	0	0.049	0.024	1.215	2.773	2.068				6.912	
GRSA1	Coarse PM	CA	2018 PRP	0.075	0.002	0.153	0	0.049	0	0	0.045	0.012	1.068	0.379	0.413				2.196	
GRSA1	Coarse PM	CAN	2018 PRP	0.008	0	0	0	0.009	0	0	0	0.001	0.166	0.383	0.244		0.811			
GRSA1	Coarse PM	CEN	2018 PRP	0.809	0.007	0	0	0.279	0	0	0.03	0.009	5.698	5.307	12.028			24.167		
GRSA1	Coarse PM	CO	2018 PRP	5.313	0.016	0.446	0	0.143	0	0	0.141	0.032	2.828	8.14	24.123	41.182				
GRSA1	Coarse PM	EUS	2018 PRP	0.009	0	0	0	0.002	0	0	0.001	0	0.031	0.017	0.027					0.087
GRSA1	Coarse PM	ID	2018 PRP	0.008	0.001	0.039	0	0.012	0	0	0.001	0	0.117	0.129	0.249				0.556	
GRSA1	Coarse PM	MEX	2018 PRP	0.394	0	0	0	0.014	0	0	0.002	0.002	1.27	0.052	3.839		5.573			
GRSA1	Coarse PM	MT	2018 PRP	0.012	0	0.01	0	0.001	0	0	0	0	0.258	0.097	0.445				0.818	
GRSA1	Coarse PM	ND	2018 PRP	0.001	0	0	0	0	0	0	0	0	0.019	0.107	0.105				0.232	
GRSA1	Coarse PM	NM	2018 PRP	0.655	0.01	1.018	0	0.105	0	0	0.045	0.008	1.476	5.003	8.731				17.451	
GRSA1	Coarse PM	NV	2018 PRP	0.042	0	0.026	0	0.004	0	0	0.002	0.001	0.089	0.463	0.481				1.108	
GRSA1	Coarse PM	OR	2018 PRP	0.019	0.001	0.034	0	0.006	0	0	0.001	0	0.032	0.074	0.231				0.398	
GRSA1	Coarse PM	PO	2018 PRP	0.013	0	0	0	0.006	0	0.003	0.006	0.002	0.103	0.027	0.172		0.332			
GRSA1	Coarse PM	SD	2018 PRP	0.002	0	0.002	0	0	0	0	0	0	0.094	0.233	0.938				1.269	
GRSA1	Coarse PM	UT	2018 PRP	0.27	0.001	0.29	0	0.06	0	0	0.012	0.003	0.111	0.385	1.958				3.09	
GRSA1	Coarse PM	WA	2018 PRP	0.008	0.001	0.002	0	0.005	0	0	0.001	0	0.037	0.139	0.074				0.267	
GRSA1	Coarse PM	WY	2018 PRP	0.168	0	0.027	0	0.003	0	0	0.001	0	0.011						0.21	
																41.2%	6.7%	24.2%	34.5%	0.1%
		All	2018 PRP subtotal:	8.179	0.039	2.399	0	0.756	0	0.003	0.337	0.094	14.023	24.103	56.126					
		CO	2018 PRP	12.90%	0.04%	1.08%	0.00%	0.35%	0.00%	0.00%	0.34%	0.08%	6.87%	19.77%	58.58%					

Questions



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