

Appendix C – Additional Tables and Figures of Emissions

DPM

Tables and figures (attached zipped folders) are provided below with more detailed information on DPM emissions, in addition to the information presented in the main text of the report.

Table C-1 provides a summary of 2017 annual total DPM emissions from each category (on-road, off-road, area, and stationary) as well as their subcategories for each of the six air basins, in units of tons per year (tpy).

Spatial maps of annual total emissions of DPM from each subcategory for each of the six air basins are provided in the attached zipped folder named 'emis_maps_dpm'.

Table C-1. Air basin annual total DPM emissions by sub-categories (tpy).

Category		Sac	BA	SJV	SC	SD	IMP
On-road		270.21	349.28	542.51	743.82	160.42	33.76
Off-road	Commercial Harbor Craft	11.09	1.19	6.24	26.98	17.40	0.08
	Cargo Handling Equipment	0.02	0.00	0.03	10.49	0.22	0.00
	Locomotives	28.54	27.89	55.92	110.24	10.33	18.98
	Transport refrigeration units	16.35	30.76	18.76	55.43	11.45	0.92
	Ocean-going vessels	0.01	10.03	0.62	5.92	2.44	0.00
Area	Agriculture	362.32	75.42	923.29	47.86	41.90	36.70
	Construction	93.89	139.05	183.47	415.14	84.09	10.76
	Point without exact location	0.05	0.00	0.00	0.00	0.00	0.00

	Aggregated area-point	88.15	144.73	164.99	278.09	67.28	3.54
Stationary point		5.34	6.41	7.31	33.45	11.24	0.84

Heavy metals

Tables and figures (attached zipped folders) are provided below with more detailed information on emissions of heavy metals, in addition to the information presented in the main text of the report.

Table C-2 through Table C-7 provides summaries of 2017 annual total heavy metals emissions from each category (on-road, off-road, area, and stationary) as well as their subcategories for each of the six air basins, in units of tons per year (tpy).

Spatial maps of annual total emissions of each heavy metal species from each subcategory for each of the six air basins are provided in the attached zipped folder named 'emis_maps_metals'.

Table C-2. Annual total emissions of heavy metal species by sub-categories for Sacramento Valley Air Basin (tpy).

Category		PAS	PCD	PNI	PPB	CRVI
On-road		7.24E-03	7.58E-03	3.88E-01	6.61E-02	0.00E+00
Off-road	Commercial Harbor Craft	1.88E-05	3.05E-04	9.62E-05	1.08E-04	0.00E+00
	Cargo Handling Equipment	0.00E+00	3.39E-07	9.97E-08	1.10E-07	0.00E+00
	Locomotives	3.38E-04	1.80E-03	1.09E-04	1.70E-04	0.00E+00
	Transport refrigeration units	2.74E-05	4.52E-04	1.41E-04	1.58E-04	0.00E+00
	Ocean-going vessels	1.29E-05	1.16E-06	1.16E-06	1.29E-05	0.00E+00
Area	Agricultural burn	1.51E-03	4.26E-03	3.00E-04	1.72E-02	0.00E+00
	Agriculture	6.94E-04	1.01E-02	1.32E-02	1.36E-02	0.00E+00
	Charbroil	4.46E-04	4.46E-04	1.35E-02	6.79E-02	0.00E+00
	Construction	4.37E-02	4.61E-02	1.08E-01	9.13E-01	0.00E+00
	Point without exact location	0.00E+00	5.44E-05	5.86E-05	8.69E-07	0.00E+00
	Livestock	4.19E-04	5.58E-04	2.79E-04	2.79E-04	0.00E+00
	Managed burn	2.49E-03	6.35E-03	3.62E-04	3.54E-02	0.00E+00
	Aggregated area-point	9.88E-02	1.13E-01	6.58E-01	5.29E-01	0.00E+00
	Paved road dust	9.04E-03	0.00E+00	9.04E-03	8.14E-02	0.00E+00

	Residential wood combustion	3.80E-03	1.52E-02	0.00E+00	4.94E-02	0.00E+00
	Unpaved road dust	1.12E-02	1.12E-02	2.23E-02	8.92E-02	0.00E+00
	Aircraft	0.00E+00	0.00E+00	2.00E-02	2.51E+00	0.00E+00
	Prescribed burn	1.88E-02	4.22E-03	9.89E-05	3.73E-02	0.00E+00
	Wildland fire use	1.93E-03	2.76E-04	0.00E+00	2.76E-03	0.00E+00
	Wildfire	1.74E-01	4.01E-02	1.06E-03	3.49E-01	0.00E+00
Stationary point		4.72E-01	2.87E-01	2.28E+00	7.18E-01	2.05E-03

Table C-3. Annual total emissions of heavy metal species by sub-categories for San Francisco Bay Area Air Basin (tpy).

Category		PAS	PCD	PNI	PPB	CRVI
On-road		1.20E-02	6.81E-01	1.15E-01	9.80E-03	0.00E+00
Off-road	Commercial Harbor Craft	1.68E-06	3.33E-05	1.05E-05	1.17E-05	0.00E+00
	Cargo Handling Equipment	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Locomotives	3.30E-04	1.75E-03	1.09E-04	1.63E-04	0.00E+00
	Transport refrigeration units	5.29E-05	8.56E-04	2.70E-04	3.00E-04	0.00E+00
	Ocean-going vessels	2.57E-02	2.34E-03	2.34E-03	2.57E-02	0.00E+00
Area	Agricultural burn	9.92E-05	2.45E-04	1.63E-05	1.39E-03	0.00E+00
	Agriculture	1.37E-04	2.10E-03	4.55E-03	4.64E-03	0.00E+00
	Charbroil	6.70E-04	6.70E-04	2.03E-02	1.02E-01	0.00E+00
	Construction	1.78E-02	2.14E-02	1.11E-01	4.36E-01	0.00E+00
	Point without exact location	0.00E+00	0.00E+00	2.90E-07	9.66E-08	0.00E+00
	Livestock	1.78E-04	2.37E-04	1.19E-04	1.19E-04	0.00E+00
	Managed burn	9.41E-07	3.06E-06	1.21E-07	1.80E-05	0.00E+00
	Aggregated area-point	2.31E-02	3.26E-02	9.68E-01	5.61E-01	0.00E+00
	Paved road dust	1.52E-02	0.00E+00	1.52E-02	1.37E-01	0.00E+00

	Residential wood combustion	2.84E-03	1.14E-02	0.00E+00	3.69E-02	0.00E+00
	Unpaved road dust	1.78E-03	1.78E-03	3.55E-03	1.42E-02	0.00E+00
	Aircraft	0.00E+00	0.00E+00	6.27E-02	3.94E+00	0.00E+00
	Prescribed burn	1.03E-03	3.93E-04	1.71E-05	3.04E-03	0.00E+00
	Wildland fire use	8.81E-06	1.26E-06	0.00E+00	1.26E-05	0.00E+00
	Wildfire	5.36E-03	1.60E+00	0.00E+00	1.95E-01	0.00E+00
Stationary point		1.84E+00	2.00E+00	3.52E+00	3.02E+00	1.49E-02

Table C-4. Annual total emissions of heavy metal species by sub-categories for San Joaquin Valley Air Basin (tpy).

Category		PAS	PCD	PNi	PPB	CRVI
On-road		9.86E-03	1.08E-02	5.02E-01	8.32E-02	0.00E+00
Off-road	Commercial Harbor Craft	7.64E-06	1.70E-04	5.03E-05	5.72E-05	0.00E+00
	Cargo Handling Equipment	2.53E-08	5.99E-07	1.50E-07	1.66E-07	0.00E+00
	Locomotives	6.56E-04	3.52E-03	2.15E-04	3.27E-04	0.00E+00
	Transport refrigeration units	2.82E-05	5.15E-04	1.56E-04	1.74E-04	0.00E+00
	Ocean-going vessels	2.53E-03	2.30E-04	2.30E-04	2.53E-03	0.00E+00

Area	Agricultural burn	2.17E-02	9.14E-03	1.52E-04	5.50E-01	0.00E+00
	Agriculture	1.77E-03	2.58E-02	2.98E-02	3.08E-02	0.00E+00
	Charbroil	1.01E-03	1.01E-03	3.03E-02	1.53E-01	0.00E+00
	Construction	2.51E-02	2.98E-02	7.51E-02	5.33E-01	0.00E+00
	Livestock	2.74E-02	3.66E-02	1.83E-02	1.83E-02	0.00E+00
	Managed burn	4.01E-04	1.18E-03	2.06E-05	6.96E-03	0.00E+00
	Aggregated area-point	1.97E-01	3.23E-01	1.10E+00	9.54E-01	0.00E+00
	Paved road dust	2.45E-02	0.00E+00	2.45E-02	2.21E-01	0.00E+00
	Residential wood combustion	7.96E-04	3.18E-03	0.00E+00	1.04E-02	0.00E+00
	Unpaved road dust	9.35E-03	9.35E-03	1.87E-02	7.48E-02	0.00E+00
	Aircraft	0.00E+00	0.00E+00	5.35E-02	2.78E+00	0.00E+00
	Prescribed burn	3.46E-02	6.44E-03	1.10E-04	5.15E-02	0.00E+00
	Wildland fire use	8.29E-04	1.18E-04	0.00E+00	1.18E-03	0.00E+00
	Wildfire	1.32E+00	2.34E-01	3.19E-03	2.02E+00	0.00E+00
Stationary point		1.40E+00	3.90E-01	2.35E+00	1.91E+00	2.41E-04

Table C-5. Annual total emissions of heavy metal species by sub-categories for South Coast Air Basin (tpy).

Category		PAS	PCD	PNI	PPB	CRVI
On-road		3.12E-02	2.31E-02	1.81E+00	3.18E-01	0.00E+00
Off-road	Commercial Harbor Craft	5.40E-05	7.55E-04	2.43E-04	2.70E-04	0.00E+00
	Cargo Handling Equipment	2.10E-05	2.94E-04	9.44E-05	1.05E-04	0.00E+00
	Locomotives	1.32E-03	6.94E-03	4.41E-04	6.61E-04	0.00E+00
	Transport refrigeration units	1.11E-04	1.55E-03	4.99E-04	5.54E-04	0.00E+00
	Ocean-going vessels	4.40E-02	4.00E-03	4.00E-03	4.40E-02	0.00E+00
Area	Agricultural burn	3.27E-07	9.10E-07	6.41E-08	3.80E-06	0.00E+00
	Agriculture	9.57E-05	1.34E-03	4.20E-03	4.26E-03	0.00E+00
	Charbroil	3.05E-03	3.05E-03	9.16E-02	4.61E-01	0.00E+00
	Construction	3.22E-02	4.30E-02	1.90E-01	7.72E-01	0.00E+00
	Livestock	6.49E-04	8.66E-04	4.33E-04	4.33E-04	0.00E+00
	Aggregated area-point	2.93E-02	6.27E-01	1.84E+00	1.17E+00	0.00E+00
	Paved road dust	3.41E-02	0.00E+00	3.41E-02	3.07E-01	0.00E+00
	Residential wood combustion	1.90E-03	7.58E-03	0.00E+00	2.47E-02	0.00E+00

	Unpaved road dust	2.14E-03	2.14E-03	4.29E-03	1.72E-02	0.00E+00
	Aircraft	0.00E+00	0.00E+00	1.20E-01	7.13E+00	0.00E+00
	Prescribed burn	1.29E-03	1.84E-04	0.00E+00	1.84E-03	0.00E+00
	Wildfire	1.07E-01	1.53E-02	0.00E+00	1.53E-01	0.00E+00
Stationary point		1.19E+00	1.33E+00	3.39E+00	2.18E+00	4.90E-02

Table C-6. Annual total emissions of heavy metal species by sub-categories for San Diego Air Basin (tpy).

Category		PAS	PCD	PNI	PPB	CRVI
On-road		6.64E-03	3.76E-01	6.79E-02	5.71E-03	0.00E+00
Off-road	Commercial Harbor Craft	3.48E-05	4.87E-04	1.57E-04	1.74E-04	0.00E+00
	Cargo Handling Equipment	4.47E-07	6.26E-06	2.01E-06	2.23E-06	0.00E+00
	Locomotives	1.24E-04	6.51E-04	4.13E-05	6.20E-05	0.00E+00
	Transport refrigeration units	2.29E-05	3.21E-04	1.03E-04	1.15E-04	0.00E+00
	Ocean-going vessels	5.00E-04	4.55E-05	4.55E-05	5.00E-04	0.00E+00
Area	Agricultural burn	1.32E-04	5.29E-04	3.87E-05	6.09E-04	0.00E+00
	Agriculture	8.38E-05	1.17E-03	2.34E-03	2.39E-03	0.00E+00
	Charbroil	9.87E-04	9.87E-04	2.96E-02	1.49E-01	0.00E+00
	Construction	4.96E-02	5.18E-02	1.29E-01	1.04E+00	0.00E+00
	Livestock	4.13E-05	5.51E-05	2.75E-05	2.75E-05	0.00E+00
	Aggregated area-point	3.96E-01	4.67E-02	6.60E-01	6.99E-01	0.00E+00
	Paved road dust	7.55E-03	0.00E+00	7.55E-03	6.79E-02	0.00E+00
	Residential wood combustion	6.48E-04	2.59E-03	0.00E+00	8.42E-03	0.00E+00

	Unpaved road dust	4.53E-03	4.53E-03	9.06E-03	3.62E-02	0.00E+00
	Aircraft	0.00E+00	0.00E+00	6.31E-03	2.45E+00	0.00E+00
	Prescribed burn	5.61E-03	8.01E-04	0.00E+00	8.01E-03	0.00E+00
	Wildfire	3.47E-03	4.28E-03	0.00E+00	2.49E-02	0.00E+00
Stationary point		1.10E-01	5.11E-02	6.29E-01	4.79E-01	7.12E-03

Table C-7. Annual total emissions of heavy metal species by sub-categories for Imperial (tpy).

Category		PAS	PCD	PNI	PPB	CRVI
On-road		6.42E-04	6.61E-04	3.35E-02	5.82E-03	0.00E+00
Off-road	Commercial Harbor Craft	0.00E+00	9.66E-08	0.00E+00	0.00E+00	0.00E+00
	Locomotives	2.29E-04	1.19E-03	7.43E-05	1.12E-04	0.00E+00
	Transport refrigeration units	1.15E-06	2.45E-05	7.19E-06	8.14E-06	0.00E+00
Area	Agricultural burn	9.67E-04	4.36E-03	3.17E-04	1.61E-03	0.00E+00
	Agriculture	6.11E-05	1.03E-03	1.32E-03	1.36E-03	0.00E+00
	Charbroil	2.89E-05	2.89E-05	8.74E-04	4.40E-03	0.00E+00
	Construction	4.59E-03	4.87E-03	9.99E-03	9.46E-02	0.00E+00
	Livestock	5.67E-03	7.56E-03	3.78E-03	3.78E-03	0.00E+00
	Aggregated area-point	2.73E-01	4.19E-01	9.75E-01	1.13E+01	0.00E+00
	Paved road dust	8.56E-04	0.00E+00	8.56E-04	7.70E-03	0.00E+00
	Residential wood combustion	1.52E-05	6.09E-05	0.00E+00	1.98E-04	0.00E+00
	Unpaved road dust	3.26E-02	3.26E-02	6.53E-02	2.61E-01	0.00E+00
	Aircraft	0.00E+00	0.00E+00	4.83E-03	1.35E-01	0.00E+00
	Wildfire	0.00E+00	0.00E+00	4.96E-07	4.83E-05	0.00E+00

Stationary point	2.81E+00	8.13E-01	3.54E-01	4.25E+00	5.12E-04
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VOCs

As detailed in the main report, California has several air basins that are known for their poor air quality and high levels of pollution. Four of the most polluted air basins including the South Coast Air Basin, San Joaquin Valley (SJV), San Francisco Bay Area (SF), and Sacramento Valley (SV), and two southernmost air basins including San Diego (SD) and Imperial County (IMP) that share border with Mexico were considered for simulations in this study. Six toxic VOCs were simulated separately at 2-km horizontal resolution for the entire 2017 in six modeling domains encompassing each of these air basins. Gridded total annual toxic VOCs emissions were redistributed to Census Tract (CT) level corresponding to the people living within the tract. Air basin-wide emissions were calculated for tracts that fall within the boundary of the air basin. Similarly, the emissions within California were calculated for the CTs that fall within the combined extent of the six modeling domains.

The South Coast Air Basin (SC) includes the heavily populated areas of Los Angeles, Orange, Riverside, and San Bernardino counties. The San Joaquin Valley (SJV) covers an area of about 25,000 square miles and includes the cities of Fresno, Bakersfield, and Stockton. The valley is known for its high levels of ozone, particulate matter, and other pollutants including air toxics. The San Francisco Bay Area (SF) is home to about 7 million people, and it covers an area of approximately 5,000 square miles. The Sacramento Valley (SV) is also a heavily polluted air basin. It covers an area of about 20,000 square miles and includes the cities of Sacramento, Chico, and Redding. The San Diego County (SD) air basin is in the southern part of California. The basin covers an area of approximately 4,200 square miles and includes the cities of San Diego, Chula Vista, Carlsbad, Oceanside, Escondido, and many others. The population of the San Diego County is over 3 million people, making it the second most populous county in California after Los Angeles County. The Imperial County Air Pollution Control District (ICAPCD) is in the southeastern part of the state, bordering Mexico and Arizona. The county covers an area of approximately 4,600 square miles and has a population of over 180,000 people. Both San Diego and Imperial counties face unique air pollution challenges due to their location near the border with Mexico, which can lead to high levels of toxic VOCs emissions.

Transportation is one of the largest sources of toxic VOCs emissions in California. Vehicle exhaust contains a variety of harmful VOCs, including benzene, formaldehyde, 1,3-butadiene, and acetaldehyde. These toxic VOCs also come from many industrial processes such as petroleum refineries, chemical manufacturing facilities, and printing operations. Many household and consumer products contain VOCs, including paints, solvents, and cleaning products. These products can release large quantities of VOCs into the air when they are used, stored, or disposed of improperly. For example, p-dichlorobenzene is released into the environment when it is used as a moth repellent and deodorant for closets and other

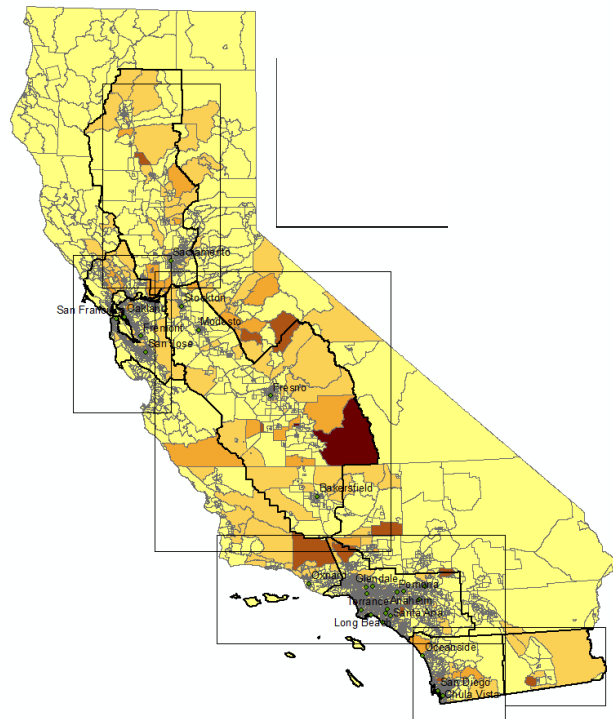
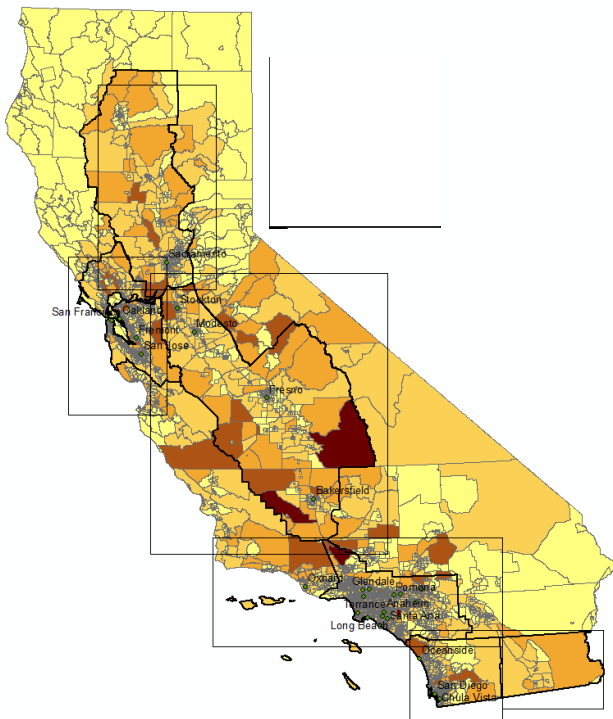
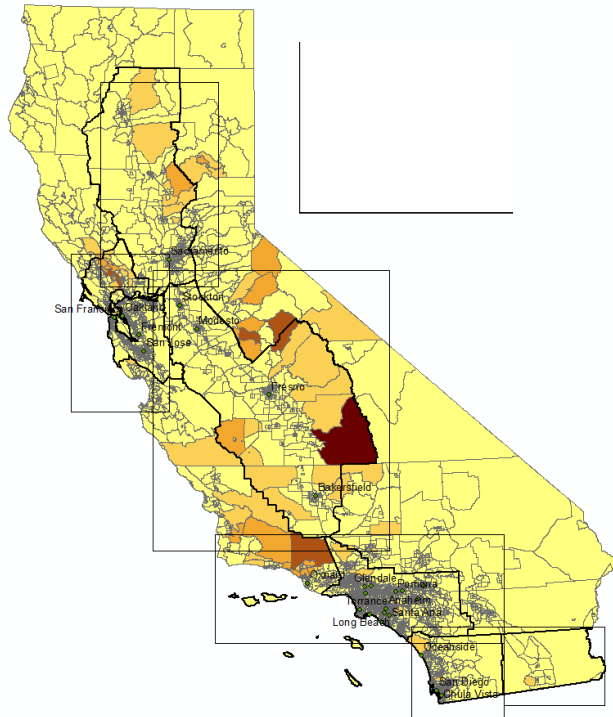
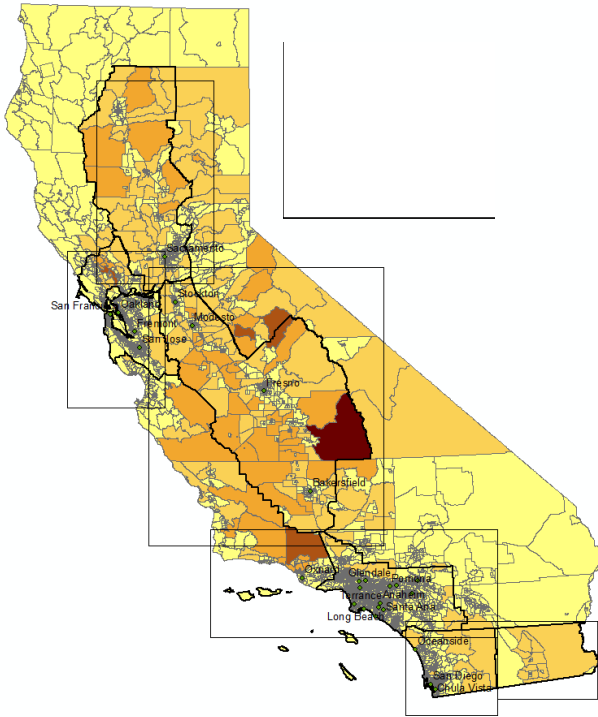
enclosed spaces. Perchloroethylene is commonly used in dry cleaning operations and as a solvent in various industrial applications. In recent years California has witnessed increased levels of wildfires which are also significant sources of toxic VOCs including formaldehyde, acetaldehyde, and benzene.

Table C-8 contains total annual emissions of toxic VOCs in tons per year (tpy) for 2017 within six air basins and in California. Overall, formaldehyde and acetaldehyde emissions of about 19000 tpy and 27000 tpy, respectively are the topmost emitted toxic VOCs which also include natural sources such as wildfires in California. Significant emissions of benzene in the SC, SF, SJV, SV, and SD indicate large sources of transportation.

Table C-8. Annual total emissions of VOCs in tons per year (tpy) within air basins and modeling domains in California for the year 2017.

Toxics species	Sacramento Valley	San Francisco Bay	San Joaquin Valley	South Coast	San Diego	Imperial	Across domains within CA
Acetaldehyde	2499.5	1994.8	6425.6	1660.7	734.5	332.7	18990.2
Formaldehyde	2096.3	4460.4	6939.5	3338.9	888.9	144.5	26649.6
Benzene	561.2	953.1	795.3	1914.9	457.7	51.5	5658.5
1,3-Butadiene	123.2	191.0	206.9	445.4	136.3	14.4	1313.0
p-Dichlorobenzene	243.8	1007.2	1518.2	173.4	30.1	2.2	5138.5
Perchloroethylene	223.3	112.6	337.1	1547.7	238.2	15.3	2737.9

Figure C-1 shows the patterns of distributions of toxic VOCs within the modeling domains, air basin boundaries, and California at census tract level.



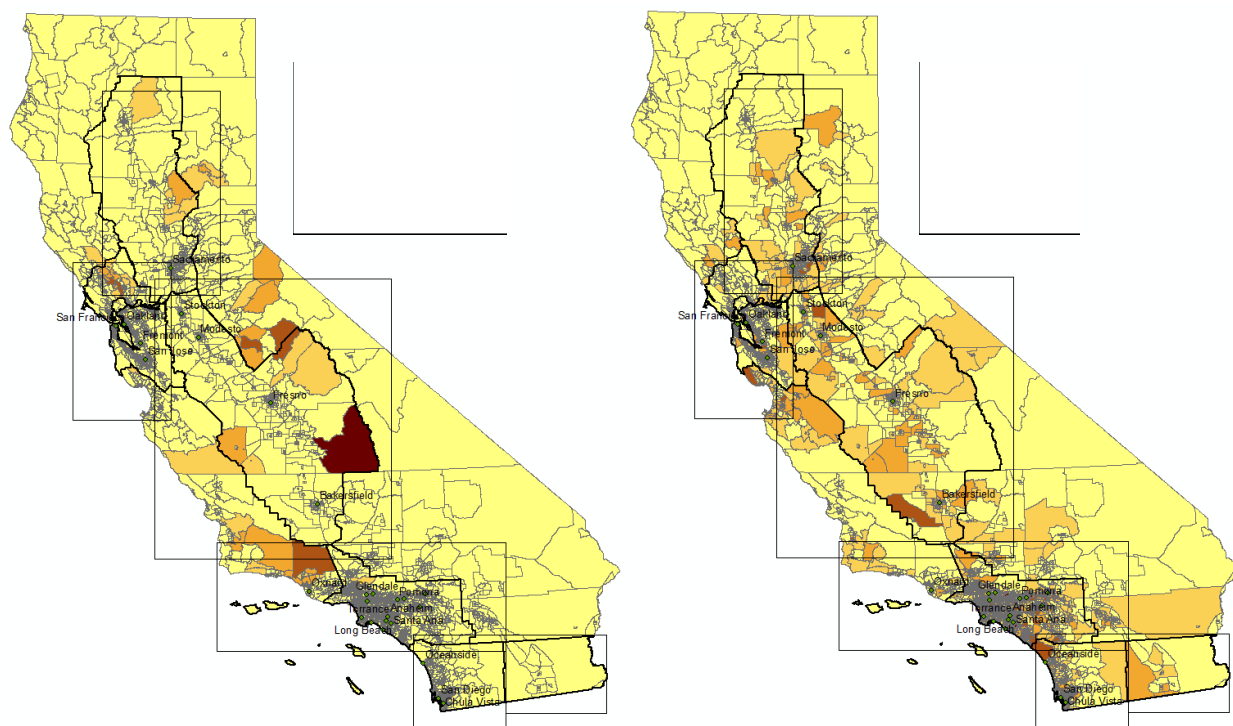


Figure C-1. Distributions of annual emissions (tpy) of major toxic VOCs in California for 2017.