ANNUAL REPORT ON VOLATILE ORGANIC COMPOUND EMISSIONS FROM PESTICIDES: EMISSIONS FOR 1990-2020

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California Environmental Protection Agency
Department of Pesticide Regulation
Environmental Monitoring Branch
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Executive Summary

This report fulfills the requirements of Title 3 California Code of Regulations (3 CCR) section 6881, requiring the Director of the Department of Pesticide Regulation (DPR) to issue an annual report on volatile organic compound (VOC) emissions from pesticides for the Sacramento Metro, San Joaquin Valley, South Coast, Southeast Desert, and Ventura ozone nonattainment areas (NAAs). It includes emissions data for May 1-October 31 of each year between 1990 and 2020, with an emphasis on the most recent four years of data.

In 2020, all five ozone NAAs were in compliance with the State Implementation Plan goals.

- Sacramento Metro: Emissions remain in compliance with the SIP goal of 2.2 tons per day (tpd) and were 57% lower than in the 1990 base year. 2020 emissions decreased by 2% (-0.027 tpd), from 1.227 tpd in 2019 to 1.200 tpd.

- San Joaquin Valley: Emissions remain in compliance with the SIP goal of 18.1 tpd and were 27% lower than in the 1990 base year. 2020 emissions decreased by 8% (-1.369 tpd), from 16.347 tpd in 2019 to 14.978 tpd. Prohibition of certain uses of high-VOC nonfumigant products went into effect in 2015 and must continue until at least two consecutive years of hypothetical emissions are less than the trigger level. The hypothetical emissions for 2020 are less than the trigger level. Because the hypothetical emissions for 2021 must also be less than the trigger level, DPR must estimate 2021 emissions before determining whether to lift prohibitions for 2023. The nonfumigant prohibitions that went into effect in 2015 remain active in 2022 in the San Joaquin Valley NAA.

- Southeast Desert: Emissions in 2020 remain in compliance with the SIP goal of 0.92 tpd and were 64% lower than the 1990 base year. 2020 emissions increased by 44% (0.126 tpd), from 0.284 tpd in 2019 to 0.410 tpd.

- Ventura: Emissions in 2020 remain in compliance with the SIP goal of 3.0 tpd and were 68% lower than the 1990 base year. 2020 emissions increased by 13% (0.135 tpd), from 1.077 tpd in 2019 to 1.212 tpd.

- South Coast: Emissions in 2020 remain in compliance with the SIP goal of 8.7 tpd and were 92% lower than the 1990 base year. 2020 emissions decreased by 5% (-0.042 tpd), from 0.926 tpd in 2019 to 0.884 tpd.

3 CCR section 6881(b) requires a 45-day public comment period of the draft report.

Abbreviations

AI	Active Ingredient
AMAF	Application Method Adjustment Factor
APCD	Air Pollution Control District
CAC	California Agricultural Commissioner
CEIDARS	California Emissions Inventory Development and Reporting System
CARB	California Air Resources Board
EC	Emulsifiable Concentrate
EP	Emission Potential
ER	Emission Rating
DPR	Department of Pesticide Regulation
FFM	Field Fumigation Methods
GIS	Geographic Information System
MUF	Method Use Fraction
NAA	Nonattainment Area
PUR	Pesticide Use Report
SIP	State Implementation Plan
TGA	Thermogravimetric Analysis
TIF	Totally Impermeable Film
tpd	Tons Per Day
VOC	Volatile Organic Compounds

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Introduction

Volatile Organic Compounds

Under the federal Clean Air Act, the United States Environmental Protection Agency (US EPA) develops National Ambient Air Quality Standards to limit the concentration of airborne pollutants and designates areas that do not attain the standards, called nonattainment areas (NAAs). In partnership with US EPA, states develop State Implementation Plans (SIPs) specifying how they plan to attain and maintain standards for these federal NAAs. The California Air Resources Board (CARB) coordinates the development of California's SIP, which includes measures for attaining ground-level ozone standards. Ground-level ozone, also known as smog, forms from the chemical interaction of nitrogen oxides, volatile organic compounds (VOCs), and sunlight. Because pesticides are a known source of atmospheric VOC emissions, the Department of Pesticide Regulation (DPR) maintains a VOC emissions inventory ("inventory") for specific uses of pesticide products and compares emissions to emissions-reduction targets ("SIP goals") for five ozone NAAs.

SIP Goals

DPR compares the results of its inventory to emissions reduction targets in the SIP, referred to hereafter as "SIP goals." The SIP requires 20% reductions in emissions relative to 1990 in four NAAs (Sacramento Metro, South Coast, Southeast Desert, and Ventura) and reduction to 18.1 tpd in the San Joaquin Valley NAA (US EPA 1997). Prior to US EPA approval of DPR's SIP amendment in 2012, the SIP goal for the San Joaquin Valley NAA was a 12% reduction relative to 1990 (US EPA 2012). The superseding SIP goal of 18.1 tpd is equivalent to the 12% reduction, calculated using a specific methodology. The same methodology must be used to calculate future emissions to ensure a legitimate comparison to SIP goals. Emission estimates for pesticide application methods that were used in 1990 cannot be modified, absent a SIP revision. Similarly, nonfumigant emission potentials (EPs) of formulations that were used in the base year cannot be changed, absent a SIP revision.

Compliance with the SIP goals is made possible by regulations that are part of the SIP. These regulations describe the information that must be included in the annual inventory report and provide enforcement mechanisms to limit emissions from fumigants and nonfumigants.

Regulatory Background

Annual Inventory Report

In 2008, DPR adopted Title 3 California Code of Regulations (3 CCR) section 6452.4 requiring an annual inventory report that includes the following information:

- Total agricultural and structural emissions for the previous years;
- Evaluation of whether emissions are in compliance with regulatory benchmarks (equivalent to the SIP goals) in 3 CCR section 6452.2;
- Fumigant emission limits for the upcoming year pursuant to 3 CCR section 6452.2;
- Emission ratings (ERs), also known as application method adjustment factors (AMAFs), for each fumigation method.

Section 6452.4 also requires a 45-day public comment period of the draft report.

In 2013, DPR amended the 2008 regulations, moving the requirements for the annual report from 3 CCR section 6452.4 to section 6881 and adding the following report elements:

- Prohibitions on use of high-VOC nonfumigant products pursuant to 3 CCR section 6452.2(f), and, if applicable, determination of whether prohibitions remain in effect pursuant to 3 CCR section 6884(c);
- A list of nonfumigant products that are designated as low-VOC pursuant to 3 CCR section 6880; and
- A list of actively registered nonfumigant products that are designated as high-VOC pursuant to 3 CCR section 6880.

This report contains all of the information specified above, including: 1) unadjusted emission estimates for 1990-2020; 2) adjusted emissions estimates for 1990 and 2004-2020; 3) whether 2020 emissions exceed levels that trigger fumigant limits or nonfumigant prohibitions; and 4) the status of previously enacted fumigant emissions limits or nonfumigant prohibitions.

Fumigants

The 2008 regulations that describe the content of the annual inventory report also included measures to limit emissions from fumigant applications. During the ozone season, fumigation methods with known application method adjustment factors (AMAFs)—the proportion of applied fumigant mass that contributes to VOC emissions under field conditions—are required within the five NAAs, and "low-emission" fumigant application methods are required within the San Joaquin Valley, Southeast Desert, and Ventura NAAs. Permissible and prohibited fumigant application methods are listed in Appendix 1b.

3 CCR section 6452 describes the interim and rulemaking processes that DPR uses to evaluate and approve new low-emission fumigant application methods. In April 2013, DPR granted interim approval allowing use of the US EPA-approved totally impermeable film (TIF) tarp method for certain fumigants. The regulation that gave permanent approval for TIF tarp methods became effective on April 1, 2016.

The continued increase in adoption of low-emission application methods and products by growers, registrants, and others significantly contributes to SIP compliance and reducing emissions.

If emissions equal or exceed a "trigger level" (equal to 95% of the SIP goal) for an NAA, DPR will ensure compliance with the SIP goal by establishing a fumigant limit equal to the difference between the SIP goal and calculated nonfumigant emissions, enforced by DPR and County Agricultural Commissioners (CACs) through grower allowances or other methods.[1]

Nonfumigants

Because a majority of emissions in the San Joaquin Valley NAA historically stemmed from nonfumigant use, the 2013 regulations replaced the San Joaquin Valley NAA's fumigant limit with prohibitions on certain uses of nonfumigant products designated as high-VOC.

Designation of High-VOC Nonfumigant Products

3 CCR section 6880 establishes EP thresholds for regulatory classification of nonfumigant products containing abamectin, chlorpyrifos, gibberellins, and/or oxyfluorfen:

Table 1. EP thresholds established in 3 CCR section 6880.

Primary AI	EP Threshold
ABAMECTIN	35%
CHLORPYRIFOS	25%
GIBBERELLINS	25%
OXYFLUORFEN	15%

DPR classifies products containing any of the four pesticides listed above into three groups:

- **High-VOC product:** (1) contains any of the four pesticides as a primary active ingredient (AI); (2) is labeled for agricultural use; and (3) the EP is greater than the threshold.
- **Low-VOC product:** (1) contains any of the four pesticides as a primary AI; (2) is labeled for agricultural use; and (3) the EP is equal to or less than the threshold.
- **Excluded product:** (1) contains any of the four pesticides, but not as a primary AI; or (2) is labeled for non-agricultural use only.

If a product contains multiple AIs, the primary AI(s) are those present at the highest percentage in a product. Products with a primary AI not listed in Table 1 (including products with multiple primary AIs) are excluded.

[1] The percentage(s) of the SIP goals that constitute the trigger level has historically changed as a result of subsequent regulations, court orders, and SIP revisions. The current value of 95% is included in the discussion of the 2008 regulations for simplicity.

Products labeled only for non-agricultural uses are also excluded. Non-agricultural uses include: a) home use; b) use in structural pest control; c) industrial or institutional use; d) control of an animal pest under the written prescription of a veterinarian; or e) vector control. All other uses are considered agricultural.

Appendix 4 lists the currently registered products designated as high-VOC or low-VOC.

Prohibitions on High-VOC Nonfumigant Products

When emissions in the San Joaquin Valley NAA exceed the trigger level, applications of high-VOC products to alfalfa, almonds, citrus, cotton, grapes, pistachios, or walnuts are prohibited in the San Joaquin Valley NAA between May 1 and October 31,[2] with the following exceptions:[3]

- Use of chlorpyrifos products to control aphids on cotton.
- Use of gibberellins products when applied at an application rate of 16 grams of AI per acre or less.
- Use of oxyfluorfen products when applied at an application rate of 0.125 (1/8) pounds of AI per acre or less.
- Uses for which US EPA has issued an emergency exemption from registration under Section 18 of the Federal Insecticide, Fungicide, and Rodenticide Act.
- Uses registered as a Special Local Need under Section 24(c) of the Federal Insecticide, Fungicide, and Rodenticide Act.
- Applications made by or under the direction of the US Department of Agriculture, the California Department of Food and Agriculture, or CACs to control, suppress, or eradicate pests.
- Applications using precision spray technology meeting the criteria of the California Office of the Natural Resources Conservation Service's Environmental Quality Incentives Program.

Property operators must obtain a written recommendation from a licensed pest control adviser before application.[4] In turn, pest control advisers cannot make a recommendation that violates any active high-VOC prohibitions. If an exception to a prohibition applies, the exception must be identified in the written recommendation.[5]

When prohibitions for high-VOC nonfumigant products are in effect, those prohibitions must remain in effect until the hypothetical VOC emissions detailed in the annual inventory report (see the section Emissions Relative to SIP Goals and Trigger Levels) are less than the trigger level for at least two consecutive years.[6]

[2] 3 CCR section 6884(a)
[3] 3 CCR section 6884(b)
[4] 3 CCR section 6883
[5] 3 CCR section 6558
[6] 3 CCR section 6884(c)

Emission Calculation

Input Data

The pesticide use report (PUR) dataset is one of two primary inputs to the inventory. The inventory includes all pesticide applications that are made for agricultural and commercial structural use, as defined by law, in five ozone NAAs, during the peak ozone period in California (May 1-October 31).[7] The inventory excludes applications outside of these NAAs, months, and uses.[8] DPR updates its inventory annually when PUR data from the previous year becomes available. For the period covered by this report, the data for each year consists of approximately 3.5 million pesticide use records. The key PUR data fields used to calculate emissions are shown in Table 2.

EP data form the other primary input of the inventory. The EP is the mass fraction of a pesticide product that contributes to atmospheric VOC emission. For the period covered by this report, the data for each year consists of EP values for approximately 5,600 products.

Other inputs to the inventory include geospatial data, due to its focus on specific NAAs within California. The boundaries of these NAAs and a listing of counties that fall within the boundaries are shown in Figure 1 and Table 3, respectively.

[7] Production agricultural use covers applications to approximately 400 commodities/crops. Non-production agricultural use includes applications to approximately 20 sites such as cemeteries, golf courses, parks, and rights-of-way. Structural use includes all applications by structural pest control businesses, regardless of site treated.

[8] The excluded uses are home use, industrial use, institutional use, applications made for vector control purposes, and veterinary use.

Table 2. Key information included in PURs that form the basis of DPR's VOC emissions inventory.

Information	Production Agriculture Reports	Non-production Agriculture and Non-agricultural Reports
Product Applied	Yes	Yes
Crop/Site Treated	Yes	Yes
Amount Applied	Yes - each application	Monthly Total
Date Applied	Date and Time	Month
Application Method	Yes	No
Acres/Units Treated	Yes	Monthly Total
Location of Application	Township/Range/Section	County
Fumigant Method Code	Yes*	No

* Field fumigant use reports only

Table 3. A listing of counties wholly or partially within the five ozone NAAs in California.

NAA	Counties within the NAA
Sacramento Metro	All of Sacramento, Yolo. Parts of Sutter, Solano, Placer, El Dorado.
San Joaquin Valley	All of Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, Tulare. Western Part of Kern.
Southeast Desert	Parts of Los Angeles, San Bernardino, Riverside.
Ventura	All of Ventura.
South Coast	All of Orange. Western Parts of Los Angeles, San Bernardino, Riverside.

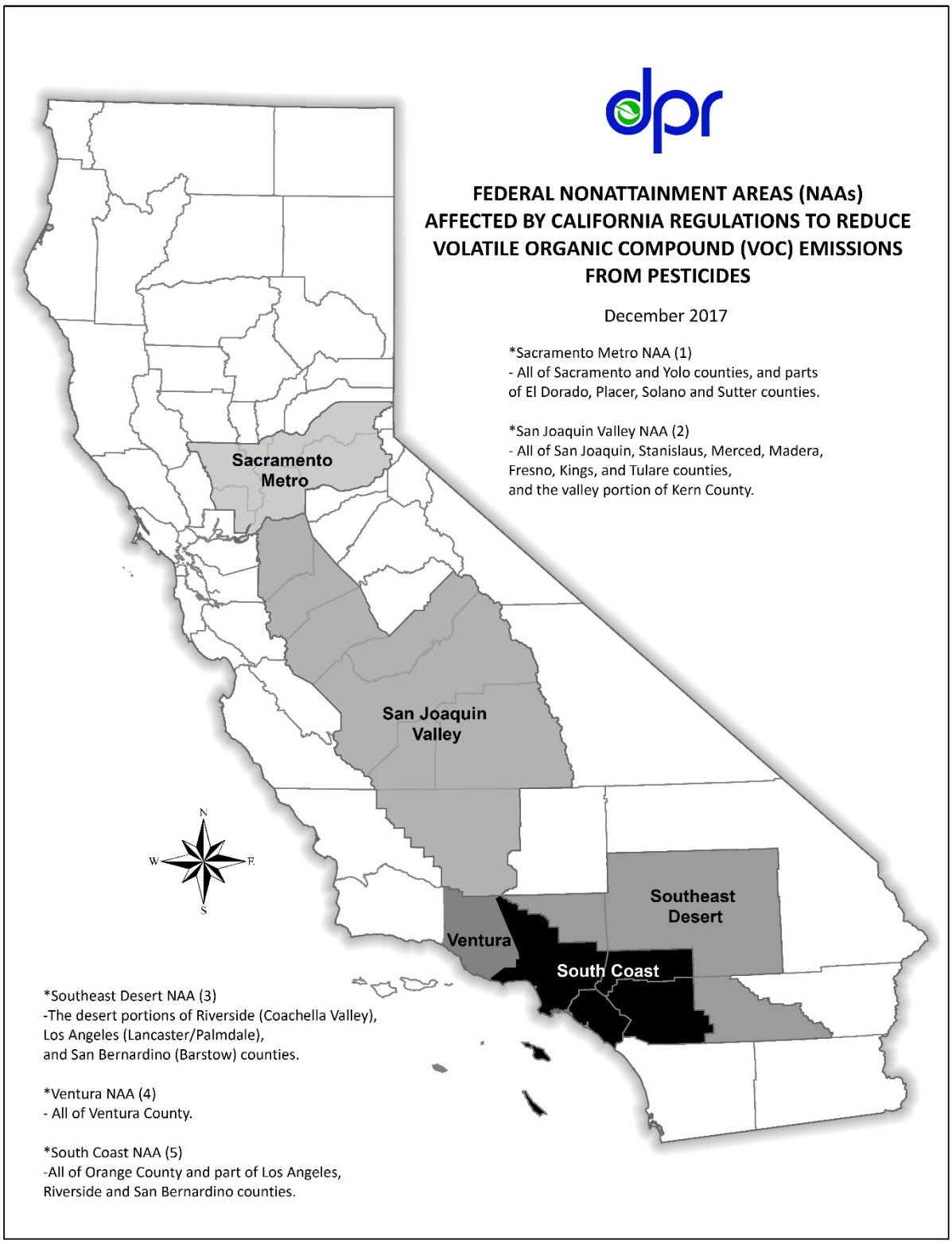

Figure 1. Federal ozone NAAs affected by California regulations to reduce VOC emissions from pesticides.

Data Revisions

DPR continually evaluates input data to the inventory for reliability. DPR thoroughly evaluates registrant-submitted thermogravimetric analysis (TGA) data to determine EPs for new and existing products. Previous inventories have shown that changes in a widely used product's EP can significantly influence the inventory. Table 4 contains products whose EP values changed significantly as a result of recent TGA submissions.

Changes to a product's EP can occur when an EP determined by alternative methods is replaced by an EP derived from TGA data. Products lacking TGA data are assigned default EP values based on the type of product formulation. Updates to DPR's Product/Label database may reflect changes in the product formulation and thus alter its default EP. Changes to default EP values are not included in Table 4.

DPR also evaluates the inventory data for past errors in TGA-based EP values (e.g., approval of deficient TGA data or erroneous bridging of one product's EP to another "substantially similar" product). If any such errors are discovered by DPR, DPR can request that the registrant provide new TGA data for a product, after which a new EP can be determined.

Table 4. Nonfumigant products with substantially changed EP values between the 2019 and 2020 annual inventories, and the estimated change in emissions in 2020 for the San Joaquin Valley NAA resulting from changes in EP for products. Products without use in 2020 are omitted.

Product	Registration Number	2019 Method	2020 Method	2020 EP	Change in EP	Change in Emissions (tpd)
WILLOWOOD GLUFOSINATE 280SL	87290-41-AA	Default median	TGA	18.71	13.00	0.082
DUPONT EXIREL INSECT CONTROL	352-859-AA	Default median	TGA	12.78	-26.37	-0.013
MERIVON XEMIUM BRAND FUNGICIDE	7969-310-AA	Default median	TGA	3.02	-2.69	-0.004
WILLOWOOD PARAQUAT 3SL	87290-35-AA	Default median	TGA	0.00	-5.71	-0.001
GALLERY SC	62719-658-AA	Default median	TGA	2.31	-3.40	<0.001
ZEUS HERBICIDE	279-3370-AA	Default median	Derived	9.07	4.27	<0.001
TIDE USA CLETHODIM 2EC	84229-33-AA	Default median	TGA	63.34	24.19	<0.001
DISMISS CA HERBICIDE	279-3370-ZC	Default median	Derived	9.07	4.27	<0.001
2,4-DB 200 BY WINFIELD	19713-676-AA-1381	Default median	Derived	8.29	2.58	<0.001
SHARPEN POWERED BY KIXOR HERBICIDE	7969-278-AA	Default median	TGA	5.62	-0.09	<0.001
ALLIGARE FLUMIGARD SC HERBICIDE	81927-78-AA	Default median	TGA	4.34	-1.37	<0.001
MUSTANG MAXX INSECTICIDE	279-3426-AA	Default median	TGA	67.15	28.00	<0.001

Emission Calculation Procedure

Prior to 2008, DPR reported an unadjusted inventory that assumed the entire volatile portion of a fumigant product eventually volatilizes, contributing to atmospheric VOC loadings. In the unadjusted inventory, VOC emissions from the application of a fumigant or nonfumigant product equals the applied product mass multiplied by the EP (Spurlock 2006).

$$\text{emissions} = \text{lbs of product used} \cdot \text{EP}$$

Several dozen field studies have shown that actual emissions from soil-applied fumigants such as methyl bromide vary by application method and are generally less than 100% (Majewski et al. 1995, Wang et al. 1997, Williams e al. 1999, Yagi et al. 1993). DPR has developed an adjustment procedure to account for the effect of application method on reducing fumigant emissions.[9]

In the adjusted inventory, the emissions from an applied fumigant product is the sum of the emission from each fumigant AI within the product.[10] The emission from each AI equals the applied product mass multiplied by the EP—generally the percent of the AI in the product—and an AMAF, which has been determined from field study data and is specific to a given combination of AI and application method (Barry et al. 2007).

$$\text{emission} = \text{lbs of product used} \cdot \text{EP} \cdot \text{AMAF}$$

The 2008 regulations facilitated adjusted calculations by requiring that each field fumigant application made within the ozone NAAs during the ozone season report the application method. In 2020, only one of the 2,535 field fumigant applications did not report an accurate field fumigation method (FFM) code. This missing record originated in the San Joaquin Valley NAA. For any such records, DPR uses a conservative approach by assuming that the application method with the highest AMAF allowed by the regulations for that fumigant was used (Table 5), creating a complete dataset from which adjusted emissions can be calculated. Appendix 1b contains current FFMs and corresponding AMAFs.

[9] Nonfumigant product emissions are calculated using the unadjusted inventory procedure, due to a lack of data to support adjusted calculations.

[10] In addition to the emissions derived from fumigant AIs, inert ingredients for products that contain chloropicrin, methyl bromide, and 1,3-dichloropropene are assumed to be volatile and are included in the inventory calculations. For the highest use products containing metam sodium, metam potassium, sodium tetrathiocarbonate, and dazomet, analysis of their confidential statements of formula determined that the composition of inerts is non-volatile and so does not contribute to the EP of these products.

Table 5. Default AMAFs (highest allowed by the regulations) assigned to fumigant applications with missing or invalid FFM codes.

Active Ingredient	Default AMAF
Methyl Bromide with or without Chloropicrin	48%
1,3-Dichloropropene with or without Chloropicrin	44%
Chloropicrin Only	44%
Metam-Sodium or Potassium N-Methyldithiocarbamate	28%
Dazomet	17%
Sodium Tetrathiocarbonate	10%

Prior to 2008, fumigant applications did not report FFM codes. DPR developed an alternative procedure to adjust the total emissions—across all applications in a given year and NAA—of each fumigant AI, rather than the emission of an AI from a single application of a fumigant product. This procedure relies on Method Use Fractions (MUFs), which are the fraction of a fumigant AI's total applied mass that uses a specific fumigation method. MUF values are specific to combinations of fumigant AI, NAA, and year, reflecting differences in fumigant use patterns across time and space. Total adjusted emissions from all applications of an AI made using a specific fumigation method equals the product of total mass, MUF, and AMAF. Summation of these totals across all fumigation methods and fumigant AIs yields total adjusted emissions from fumigant products. Equivalently, adjusted fumigant emissions can be calculated by multiplying total AI mass by an average emission factor that equals the sum across all methods of MUF multiplied by AMAF, then summing across all AIs.

Appendix 1a contains MUFs and AMAFs for 2008 and earlier years. For 2008, MUFs were derived from information available in the PUR database. For 2007 and earlier years, surrogate data were used to estimate MUFs. The type of surrogate data differed for different AIs. For 1,3-dichloropropene, the MUFs were determined from use data collected by the registrant in support of DPR's township application caps. For metam sodium and metam potassium, grower/applicator surveys were conducted to determine types of applications for different crops and areas. Methyl bromide and chloropicrin MUFs were based on expert opinion and regulatory history. Finally, MUFs for dazomet and sodium tetrathiocarbonate equal one because the AMAFs for each of these two fumigants are constant, independent of application method (Barry et al. 2007).

Non-production agriculture and non-agricultural pesticide applications are reported to DPR as "monthly summary data" with no geographic location information beyond the county of application (Table 3). These applications include commercial structural, landscape maintenance, rights-of-way, and commodity fumigations. In cases where two or more air basins, one of which may be in an NAA, are present within a single county, these applications must be proportionally allocated. DPR allocates these monthly summary applications using surrogate data that are assumed to have similar geographic distributions. In 2012, the surrogate data were updated to provide the most accurate estimated geographic distribution of emissions, reflecting changes in California's population and transportation infrastructure. US Census data for the 2010 decennial census together with TIGER/Line shapefiles for roads, rail roads, and linear hydrography were used as surrogates for commercial structural, landscape

maintenance, and rights-of-way applications. Commodity fumigation data were provided by California CACs (Neal and Spurlock 2012).

Emissions are aggregated from individual PUR records at various levels: by year, NAA, primary AI, commodity or application site, and emissions category as defined by the CARB. The primary AI is defined as the AI present at the highest percentage in a pesticide product. If a product contains 20% of AI "A" and 10% of AI "B", all calculated emissions from that product are assigned to the primary AI "A". CARB defines four emission categories: methyl bromide emissions from agricultural applications, non-methyl bromide emissions from agricultural applications, methyl bromide emissions from structural applications, and non-methyl bromide emissions from structural applications.

Emissions are reported as US tons per day (tpd) throughout this report.

Results

Emissions Relative to SIP Goals and Trigger Levels

Restrictions are triggered if emissions in an NAA exceed its trigger level (95% of its SIP goal). For the Sacramento Metro, Southeast Desert, South Coast, and Ventura NAAs the restrictions are a fumigant emissions limit. If emissions exceed the trigger level for the San Joaquin Valley NAA, certain uses of high-VOC products are prohibited until at least two consecutive years of hypothetical emissions are less than the trigger level. More information about the calculation of hypothetical emissions can be found in Appendix 3. For all five NAAs, restrictions are triggered for the upcoming ozone season based on the most recent inventory. For example, the 2020 inventory is used to determine if restrictions will go into effect on May 1, 2022.

As shown in Table 6, 2020 emissions in all five NAAs were less than their trigger levels and SIP goals.

Table 6. SIP goals, trigger levels, and 2020 emissions.

NAA	SIP Goal (tpd)	Trigger Level (95% of SIP Goal) (tpd)	2020 Emissions (tpd)
Sacramento Metro	2.2	2.1	1.200
San Joaquin Valley	18.1	17.2	14.978
Southeast Desert	0.92	0.87	0.410
Ventura	3.0	2.85	1.212
South Coast	8.7	8.3	0.884

Emissions reported in the 2013 annual inventory report for the San Joaquin Valley NAA exceeded the SIP goal by 0.183 tpd. In the 2014 annual inventory report, revised emissions calculations for 2013 yielded 19.518 tpd (1.418 tpd above the SIP Goal). This increase was largely due to revised TGA-based EP values for fenpyroximate and hexythiazox products with emulsifiable concentrate (EC) formulations. Therefore, DPR enacted prohibitions on high-VOC nonfumigant products from May 1 through October 31 of 2015 and 2016. When nonfumigant prohibitions are in effect, those prohibitions must remain in effect until the hypothetical emissions detailed in the annual inventory report are less than the trigger level for at least two consecutive years. Because this condition has not yet been met, annual inventory reports continue to calculate hypothetical emissions to determine whether nonfumigant prohibitions can be lifted for upcoming years.

The total hypothetical emissions for 2020 are equal to 16.587 tpd, which is 3.6% (-0.613 tpd) less than the trigger level of 17.2 tpd.[11] DPR must estimate 2021 emissions before determining whether to lift prohibitions for 2023. Therefore, the prohibitions on high-VOC products that went into effect during 2015 remain in effect between May 1 and October 31, 2022.

[11] See the text under Table A3-5 in Appendix 3 for the calculation of 2020 total hypothetical emissions.

Emissions in the Ozone NAAs

In 2020, all five ozone NAAs were in compliance with the SIP goals.

- Sacramento Metro: 2020 emissions decreased by 2% (-0.027 tpd), from 1.227 tpd in 2019 to 1.200 tpd. Emissions remain in compliance with the SIP goal of 2.2 tpd and were 57% lower than in the 1990 base year.
- San Joaquin Valley: 2020 emissions decreased by 8% (-1.369 tpd), from 16.347 tpd in 2019 to 14.978 tpd. Emissions remain in compliance with the SIP goal of 18.1 tpd and were 27% lower than in the 1990 base year.
- Southeast Desert: 2020 emissions increased by 44% (0.126 tpd), from 0.284 tpd in 2019 to 0.410 tpd. Emissions in 2020 remain in compliance with the SIP goal of 0.92 tpd and were 64% lower than the 1990 base year.
- Ventura: 2020 emissions increased by 13% (0.135 tpd), from 1.077 tpd in 2019 to 1.212 tpd. Emissions in 2020 remain in compliance with the SIP goal of 3.0 tpd and were 68% lower than the 1990 base year.
- South Coast: 2020 emissions decreased by 5% (-0.042 tpd), from 0.926 tpd in 2019 to 0.884 tpd. Emissions in 2020 remain in compliance with the SIP goal of 8.7 tpd and were 92% lower than the 1990 base year.

Total emissions for all available years of data are shown in Figures 2 and 3. Appendix 2 lists this data in table form, as well as additional emissions data discussed below.[12]

Pesticide use varies from year to year due to weather, drought, pest problems, economics, and types of crops planted. Increases and decreases in pesticide use in the span of a few years do not necessarily indicate a trend. Such variances are and will continue to be a normal occurrence. A more detailed explanation of pesticide use patterns is given in DPR's annual summary of PURs, which is available at http://www.cdpr.ca.gov/docs/pur/purmain.htm.

[12] Table A2-1-1 is interpreted as Appendix 2, NAA 1, Table 1. Tables in Appendix 3 are similar, though they are not specific to an NAA; e.g., Table A3-1 is interpreted as Appendix 3, Table 1. These formats are standard throughout this report.

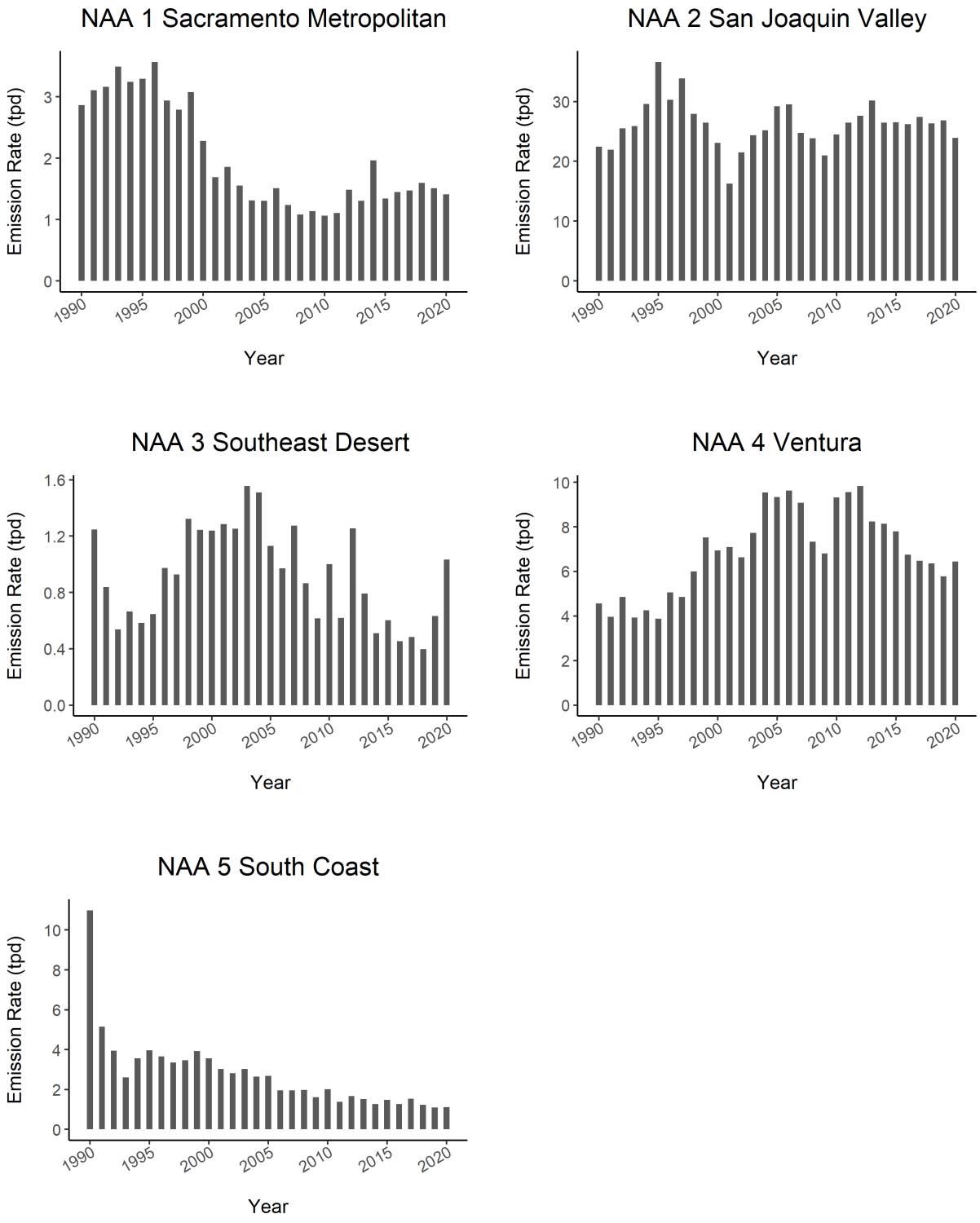

Figure 2. Total unadjusted emissions in each NAA from 1990 to 2020.

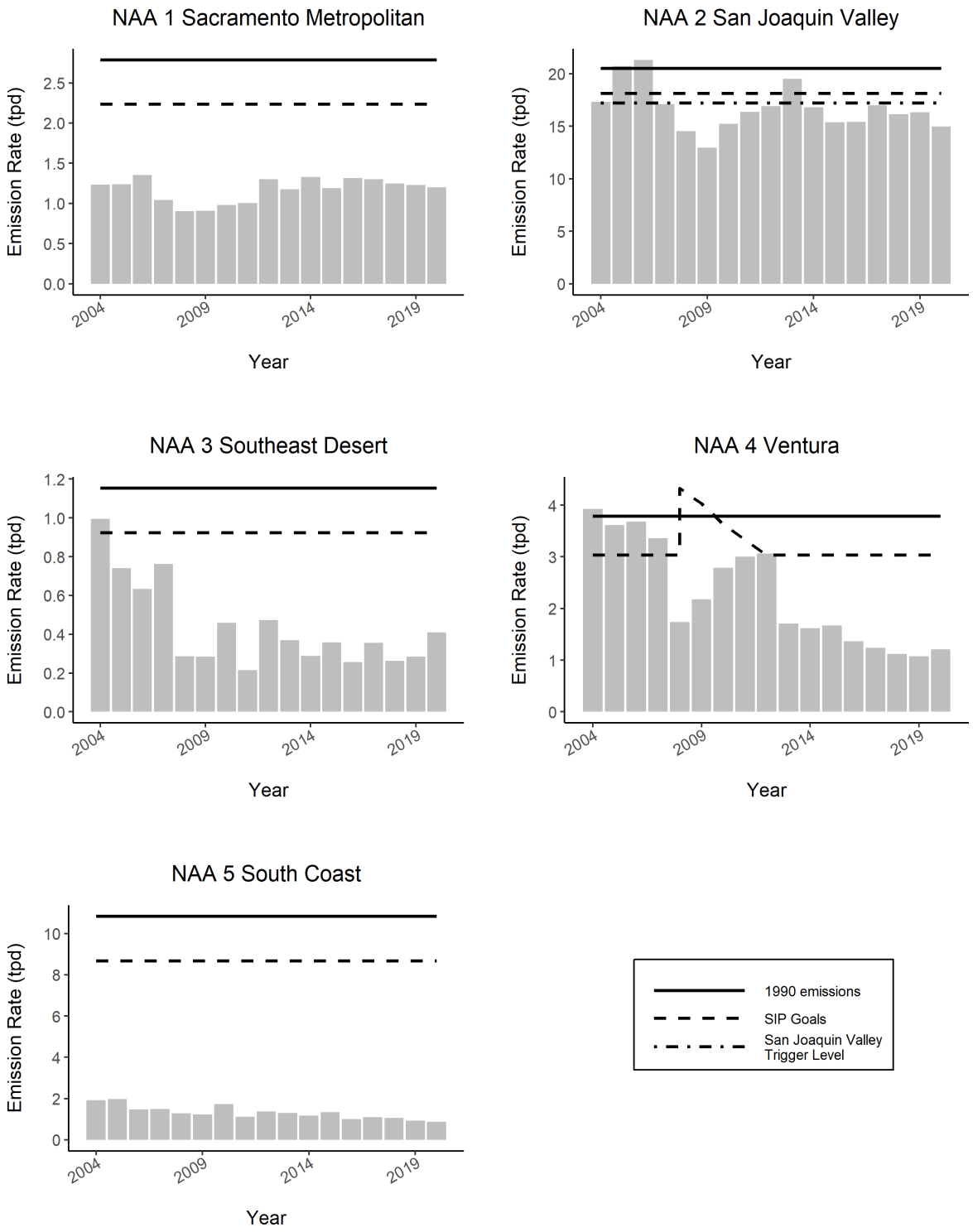

Figure 3. Total adjusted emissions in each NAA from the earliest available year of adjusted emissions data (2004) to 2020, in comparison to 1990 emissions, the SIP goals, and the San Joaquin Valley NAA trigger level. The 2007 SIP revision temporarily increased Ventura's SIP goal above 4 tpd in 2008, then gradually reduced the goal each year until 2012. Since 2012, the goal for Ventura remains 3 tpd.

Sacramento Metro

In the Sacramento Metro NAA, 2020 emissions decreased by 2% (-0.027 tpd) from 1.227 tpd in 2019 to 1.200 tpd. Emissions in 2020 were 43% (-0.890 tpd) below the regulatory trigger level (95% of the SIP goal) of 2.1 tpd (Figure 3).

Figure 4 and Tables A2-1-1 and A2-1-2 show emissions in 1990 and 2017-2020, categorized as fumigants, nonfumigants with EC formulations, and all other nonfumigants. In 2020, nonfumigant products contributed 89% of emissions and fumigant products contributed 11% of emissions. Nonfumigant product emissions decreased by <1% (-0.002 tpd), from 1.075 tpd in 2019 to 1.074 tpd. Fumigant product emissions decreased by 17% (-0.025 tpd), from 0.152 tpd in 2019 to 0.127 tpd. Products with EC formulations accounted for 37% and 33%, respectively, of nonfumigant and total emissions. Emissions from these products decreased by 7% (-0.031 tpd), from 0.424 tpd in 2019 to 0.393 tpd.

Figure 5 and Table A2-1-3 aggregate product emissions by primary AI. The top 10 AIs comprise 49% of total emissions. At 9% of total emissions, bifenthrin products had the highest emissions (0.103 tpd) of any AI used in this NAA.

Figure 6 and Table A2-1-4 aggregate emissions by commodity. The top 10 commodities comprise 84% of total emissions. At 23% of total emissions, products applied to rice had the highest emissions (0.276 tpd) of any commodity treated in this NAA.

Table A2-1-5 shows this NAA's unadjusted 2020 emissions using the CARB California Emissions Inventory Development and Reporting System (CEIDARS) classifications. Unadjusted emissions from agricultural applications of methyl bromide decreased 4% (-0.001 tpd), from 0.036 tpd in 2019 to 0.034 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased 10% (-0.136 tpd), from 1.384 tpd to 1.248 tpd. Emissions from structural applications of methyl bromide continued to be below a reportable level. Unadjusted emissions from structural applications of non-methyl bromide products increased 47% (0.037 tpd), from 0.079 tpd to 0.116 tpd.

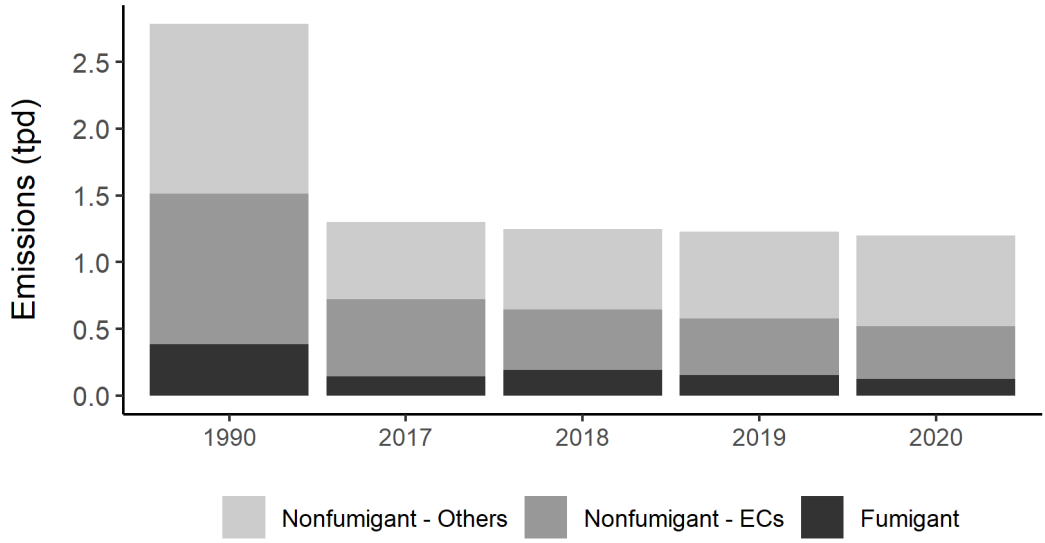

Figure 4. Emissions for the Sacramento Metro NAA during 1990 and 2017-2020, categorized as fumigants, nonfumigants with ECs, and other nonfumigants (Others).

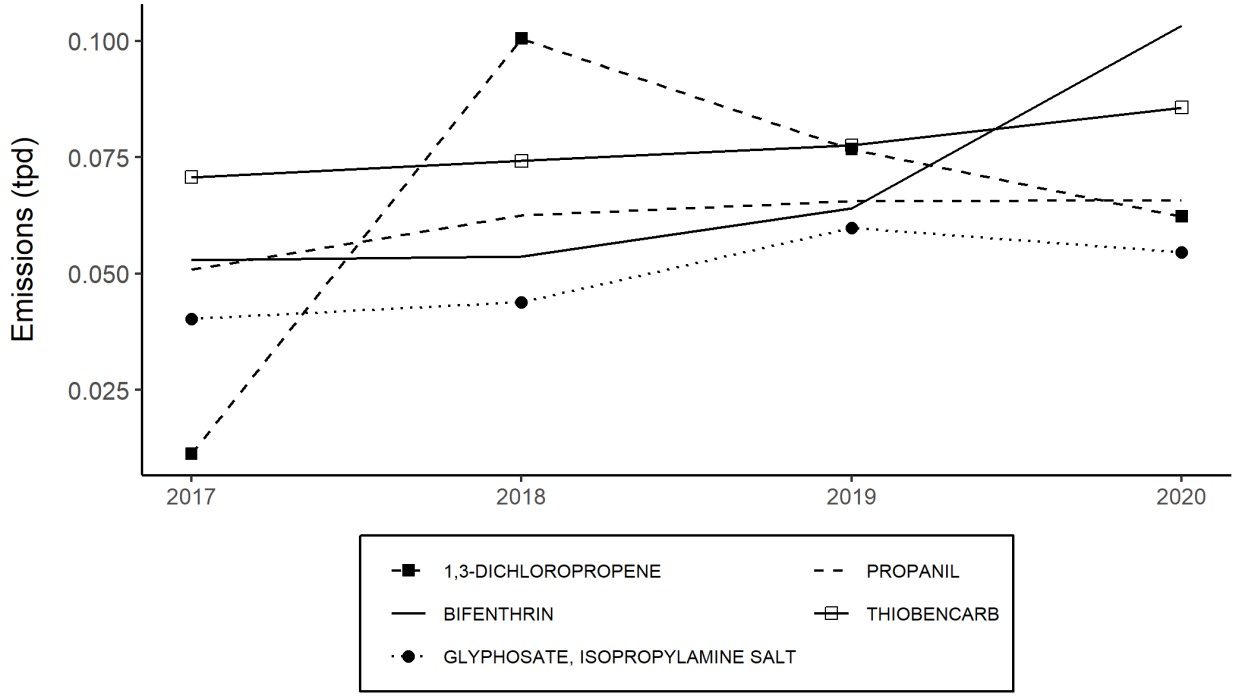

Figure 5. Emissions from products containing the top five AIs by emissions in the Sacramento Metro NAA from 2017 to 2020.

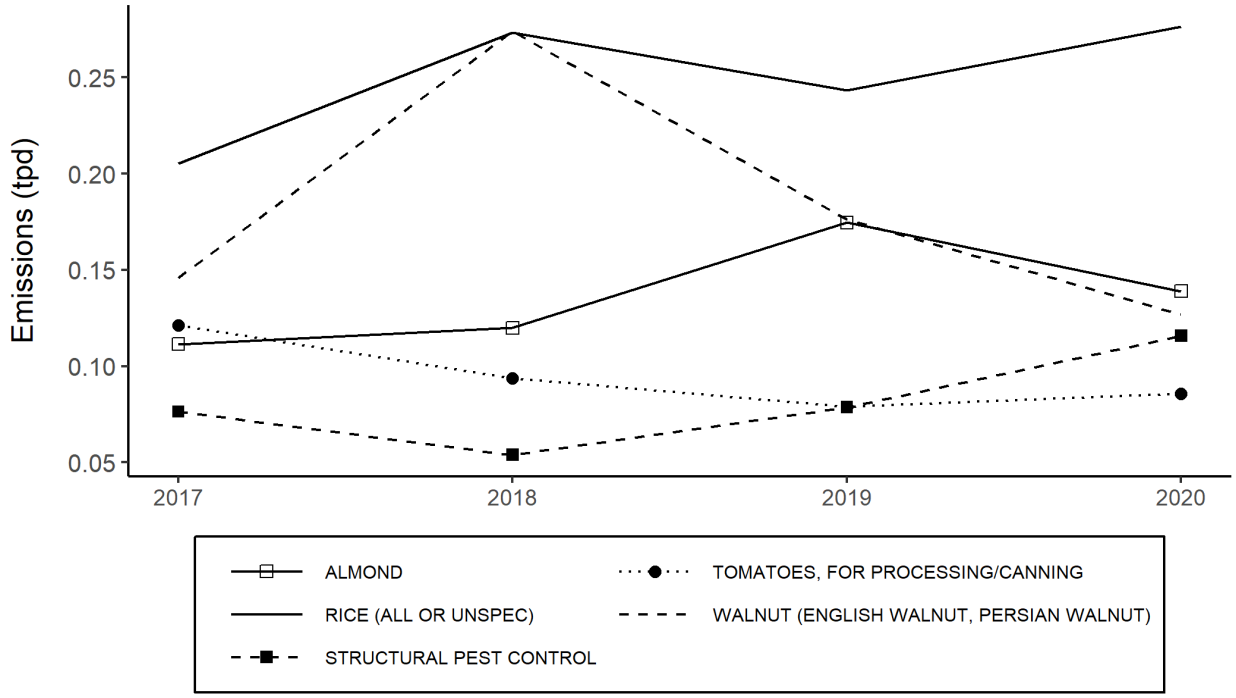

Figure 6. Emissions from the top five commodities by emissions in the Sacramento Metro NAA from 2017 to 2020.

San Joaquin Valley

In the San Joaquin Valley NAA, 2020 emissions decreased by 8% (-1.369 tpd) from 16.347 tpd in 2019 to 14.978 tpd. Emissions in 2020 were 13% (-2.217 tpd) below the regulatory trigger level (95% of the SIP goal) of 17.2 tpd (Figure 3).

Figure 7 and Tables A2-2-1 and A2-2-2 show emissions in 1990 and 2017-2020, categorized as fumigants, nonfumigants with EC formulations, and all other nonfumigants. In 2020, nonfumigant products contributed 74% of emissions and fumigants contributed 26% of emissions. Nonfumigant product emissions decreased by 7% (-0.845 tpd), from 11.922 tpd in 2019 to 11.076 tpd. Fumigant product emissions decreased by 12% (-0.524 tpd), from 4.426 tpd in 2019 to 3.902 tpd. Products with EC formulations accounted for 45% and 33%, respectively, of nonfumigant and total emissions. Emissions from these products decreased by 10% (-0.555 tpd), from 5.523 tpd in 2019 to 4.967 tpd.

Figure 8 and Table A2-2-3 aggregate product emissions by primary AI. The top 10 AIs comprise 54% of total emissions. While emissions from 1,3-dichloropropene products were lower than the previous three years, at 12% of total emissions 1,3-dichloropropene products had higher emissions (1.826 tpd) than any AI used in this NAA.

Figure 9 and Table A2-2-4 aggregate emissions by commodity. The top 10 commodities comprise 77% of total emissions. At 35% of total emissions, products applied to almonds had the highest emissions (5.249 tpd) of any commodity treated in this NAA.

Table A2-2-5 shows this NAA's unadjusted 2020 emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide decreased 16% (-0.144 tpd), from 0.918 tpd in 2019 to 0.774 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased 11% (-2.707 tpd), from 25.635 tpd to 22.928 tpd. Emissions from structural applications of methyl bromide continued to be below a reportable level. Unadjusted emissions from structural applications of non-methyl bromide products decreased 16% (-0.033 tpd), from 0.204 tpd to 0.171 tpd.

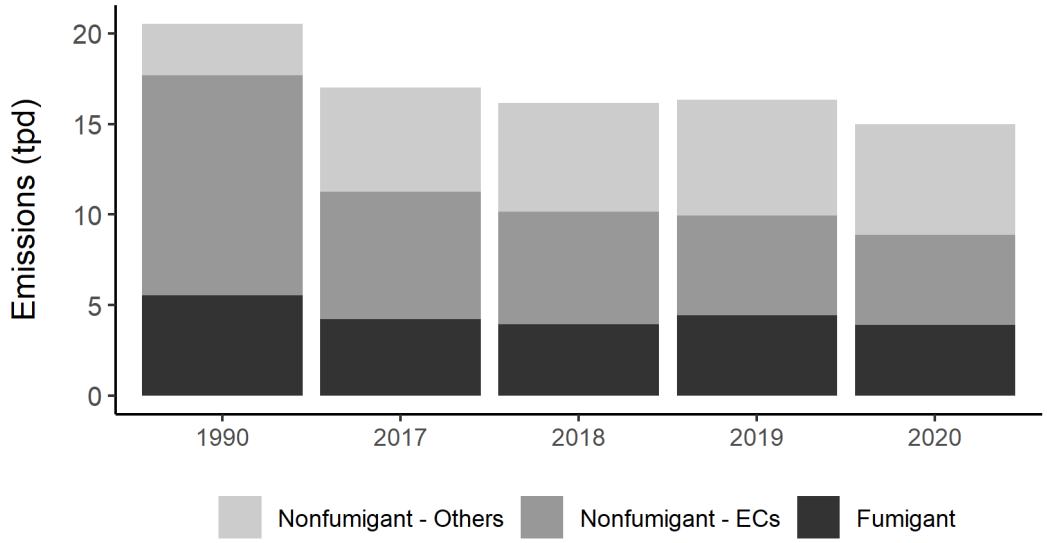

Figure 7. Emissions for the San Joaquin Valley NAA during 1990 and 2017-2020, categorized as fumigants, nonfumigants with ECs, and other nonfumigants (Others).

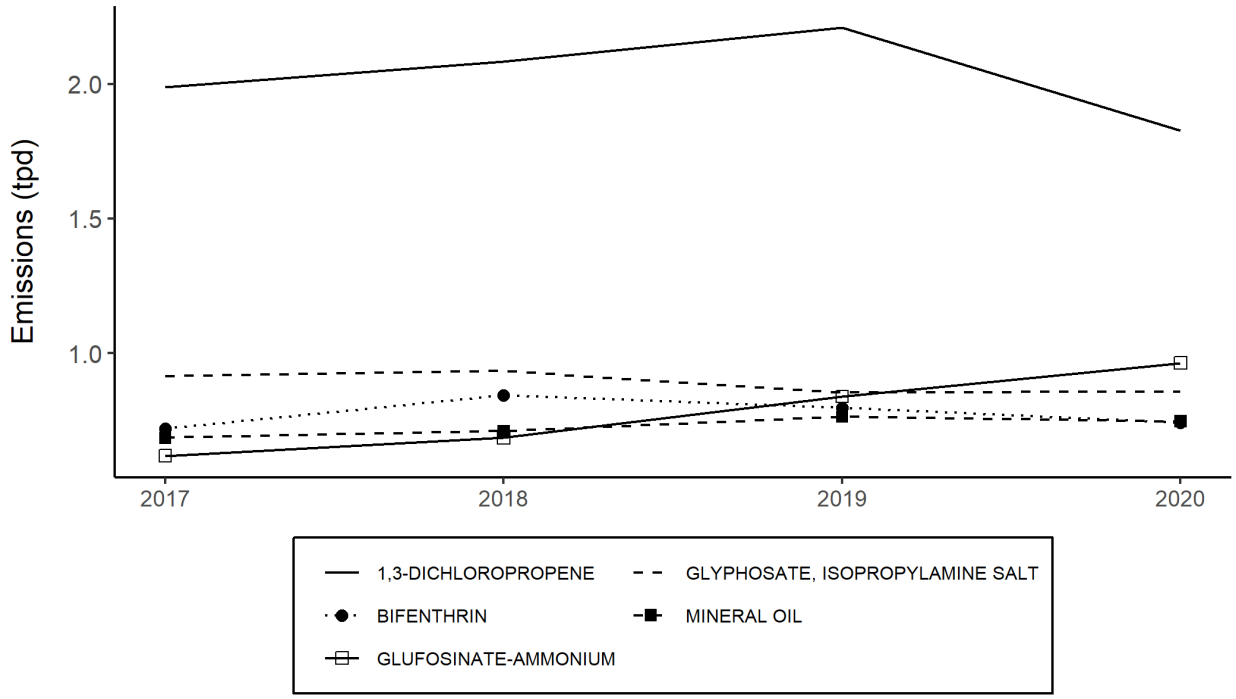

Figure 8. Emissions from products containing the top five AIs by emissions in the San Joaquin Valley NAA from 2017 to 2020.

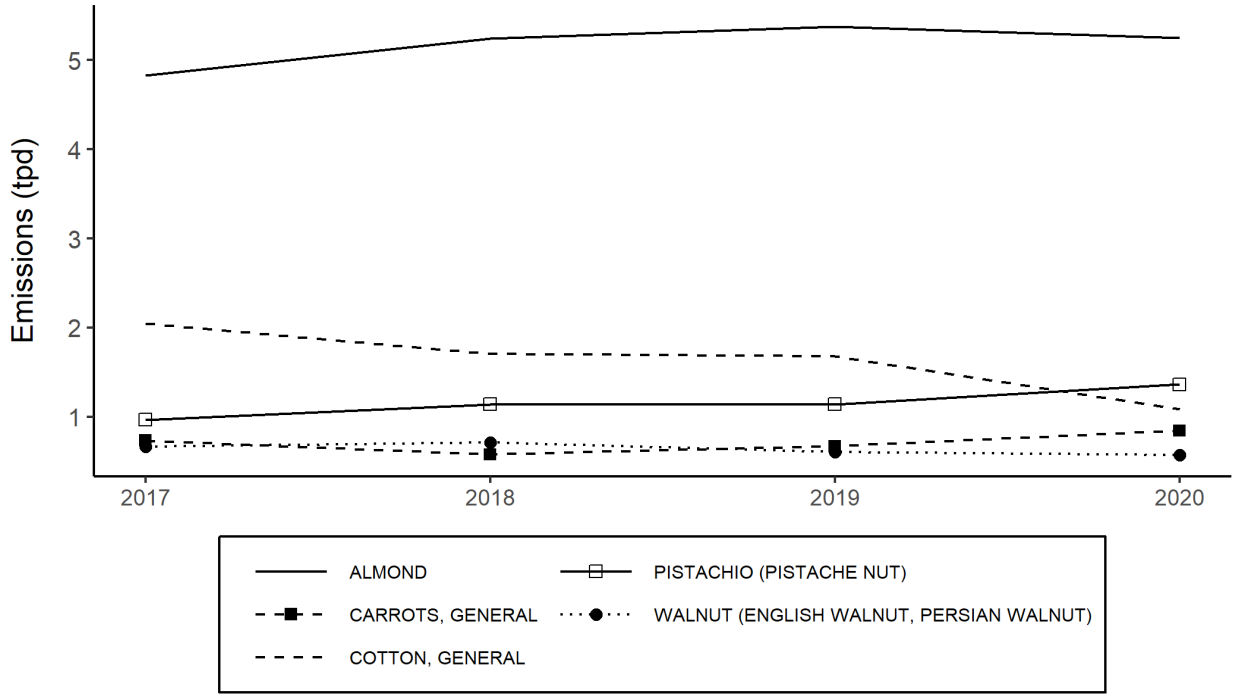

Figure 9. Emissions from the top five commodities by emissions in the San Joaquin Valley NAA from 2017 to 2020.

Southeast Desert

In the Southeast Desert NAA, 2020 emissions increased by 44% (0.126 tpd) from 0.284 tpd in 2019 to 0.410 tpd. Emissions in 2020 were 53% (-0.464 tpd) below the regulatory trigger level (95% of the SIP goal) of 0.87 tpd (Figure 3).

Figure 10 and Tables A2-3-1 and A2-3-2 show emissions in 1990 and 2017-2020, categorized as fumigants, nonfumigants with EC formulations, and all other nonfumigants. In 2020, nonfumigant products contributed 57% of emissions and fumigant products contributed 43% of emissions. Nonfumigant product emissions increased by 1% (0.002 tpd), from 0.231 tpd in 2019 to 0.233 tpd. Fumigant product emissions increased by 234% (0.124 tpd), from 0.053 tpd in 2019 to 0.177 tpd. Products with EC formulations accounted for 41% and 24%, respectively, of nonfumigant and total emissions. Emissions from these products decreased by 14% (-0.016 tpd), from 0.113 tpd in 2019 to 0.097 tpd.

Figure 11 and Table A2-3-3 aggregate product emissions by primary AI. The top 10 AIs comprise 66% of total emissions. Although the emissions from fumigants in this NAA were significantly lower than other NAAs, metam-sodium and 1,3-dichloropropene products each contributed 20% of total emissions and were essentially tied for the highest emissions (0.082 tpd) of any AI used in this NAA. It should be noted that there was no use of, or emissions from, 1,3-dichloropropene products between 2017 and 2019.

Figure 12 and Table A2-3-4 aggregate emissions by commodity. The top 10 commodities comprise 86% of total emissions. At 24% of total emissions, products applied to grapes had the highest emissions (0.100 tpd) of any commodity treated in this NAA.

Table A2-3-5 shows this NAA's unadjusted 2020 emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide decreased >99% (-0.005 tpd), from 0.005 tpd in 2019 to <0.001 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products increased 70% (0.407 tpd), from 0.584 tpd to 0.991 tpd. Emissions from structural applications of methyl bromide continued to be below a reportable level. Unadjusted emissions from structural applications of non-methyl bromide products decreased <1% (<0.001 tpd), from 0.043 tpd to 0.043 tpd.

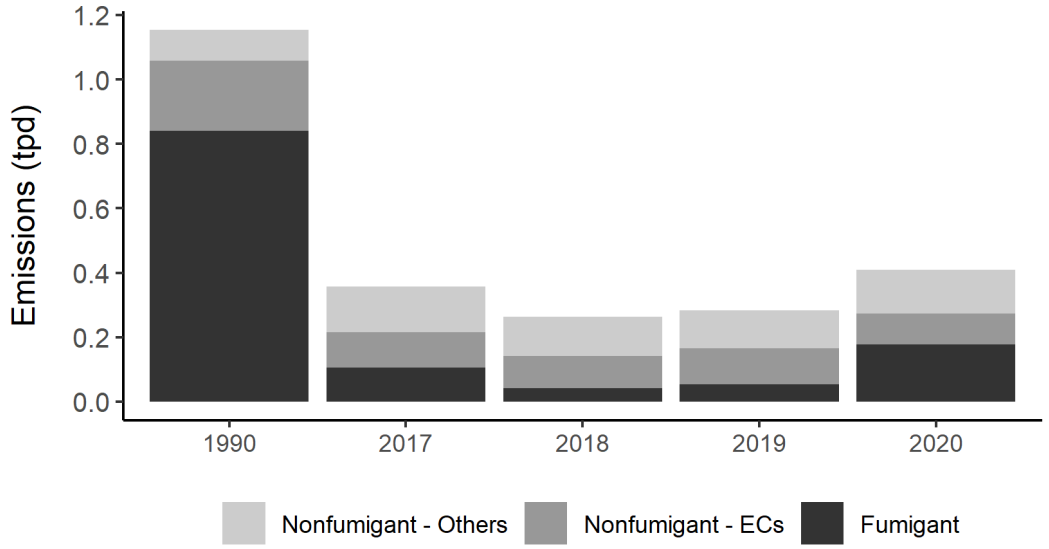

Figure 10. Emissions for the Southeast Desert NAA during 1990 and 2017-2020, categorized as fumigants, nonfumigants with ECs, and other nonfumigants (Others).

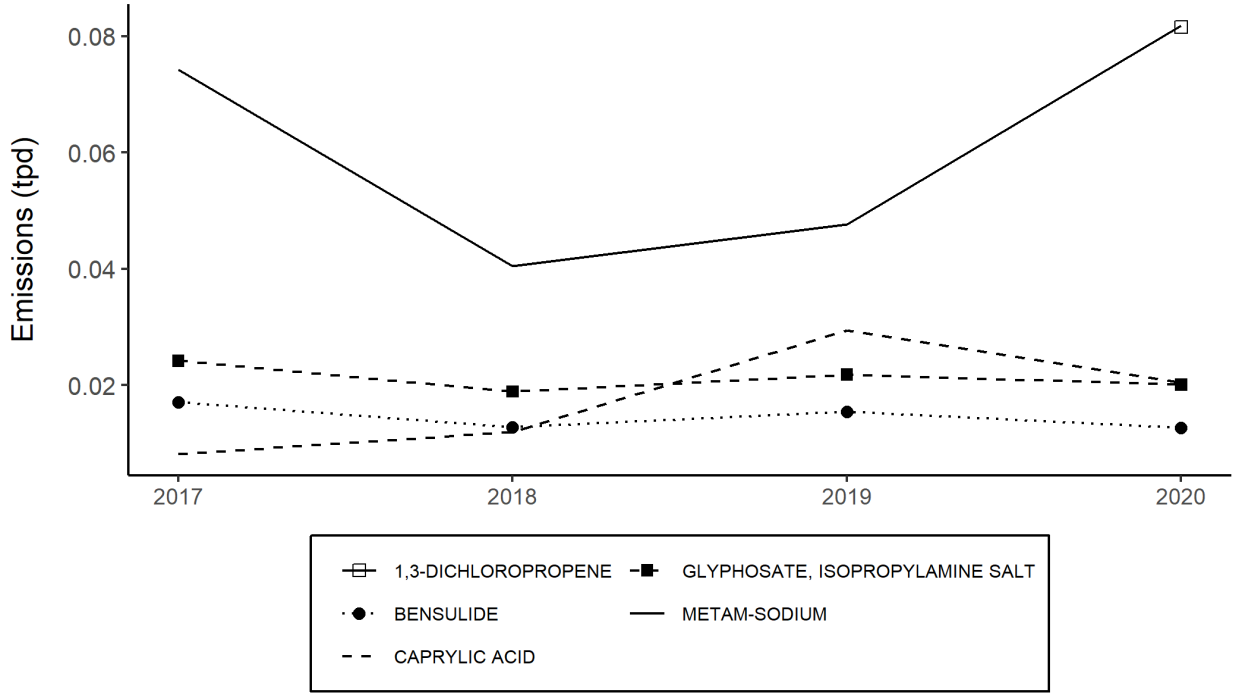

Figure 11. Emissions from products containing the top five AIs by emissions in the Southeast Desert NAA from 2017 to 2020. Note: There was no use of 1,3-D in the years 2017 to 2019.

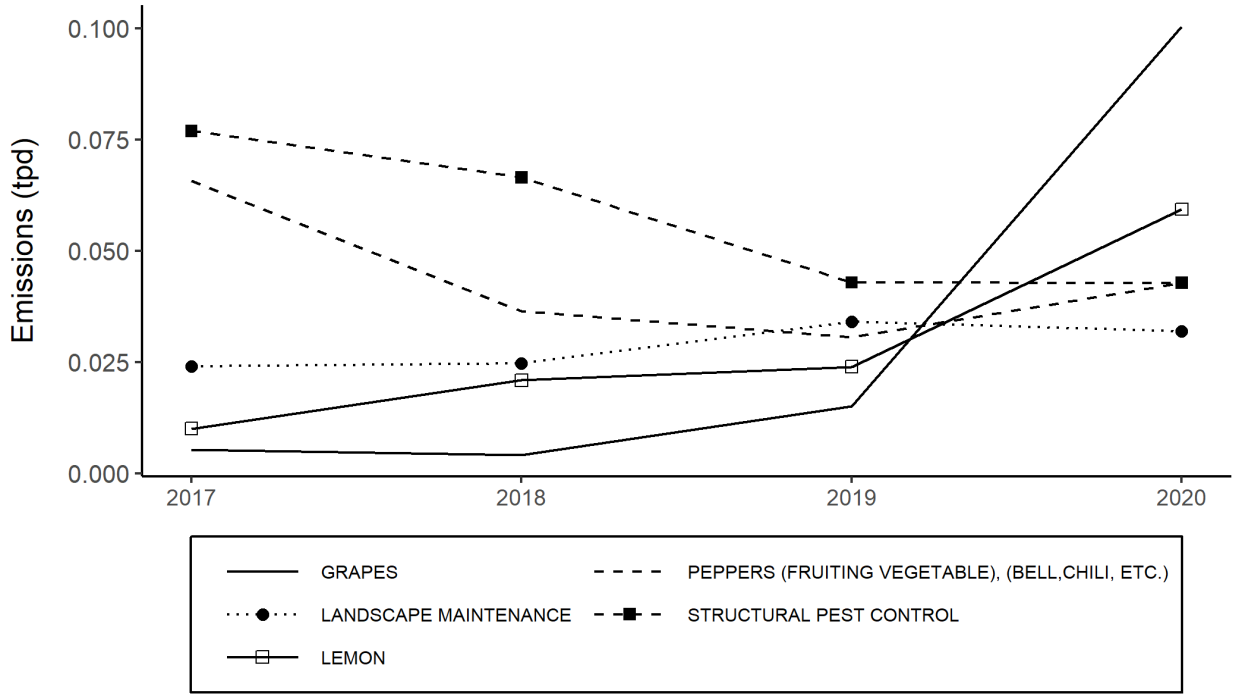

Figure 12. Emissions from the top five commodities by emissions in the Southeast Desert NAA from 2017 to 2020.

Ventura

In the Ventura NAA, 2020 emissions increased by 13% (0.135 tpd) from 1.077 tpd in 2019 to 1.212 tpd. Emissions in 2020 were 57% (-1.638 tpd) below the regulatory trigger level (95% of the SIP goal) of 2.85 tpd (Figure 3).

Figure 13 and Tables A2-4-1 and A2-4-2 show emissions in 1990 and 2017-2020, categorized as fumigants, nonfumigants with EC formulations, and all other nonfumigants. In 2020, nonfumigant products contributed 34% of emissions and fumigant products contributed 66% of emissions. Nonfumigant product emissions increased by 8% (0.032 tpd), from 0.386 tpd in 2019 to 0.418 tpd. Fumigant product emissions increased by 15% (0.103 tpd), from 0.691 tpd in 2019 to 0.794 tpd. Products with EC formulations accounted for 42% and 14%, respectively, of nonfumigant and total emissions. Emissions from these products increased by 6% (0.010 tpd), from 0.164 tpd in 2019 to 0.174 tpd.

Figure 14 and Table A2-4-3 aggregate product emissions by primary AI. The top 10 AIs comprise 76% of total emissions. At 32% of total emissions, chloropicrin products had the highest emissions (0.309 tpd) of any AI used in this NAA.

Figure 15 and Table A2-4-4 aggregate emissions by commodity. The top 10 commodities comprise 92% of total emissions. At 70% of total emissions, products applied to strawberries had the highest emissions (0.847 tpd) of any commodity treated in this NAA.

Table A2-4-5 shows this NAA's unadjusted 2020 emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide increased 3% (<0.001 tpd), from 0.006 tpd in 2019 to 0.006 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products increased 12% (0.680 tpd), from 5.746 tpd to 6.426 tpd. Emissions from structural applications of methyl bromide continued to be below a reportable level. Unadjusted emissions from structural applications of non-methyl bromide products decreased 22% (-0.005 tpd), from 0.024 tpd to 0.019 tpd.

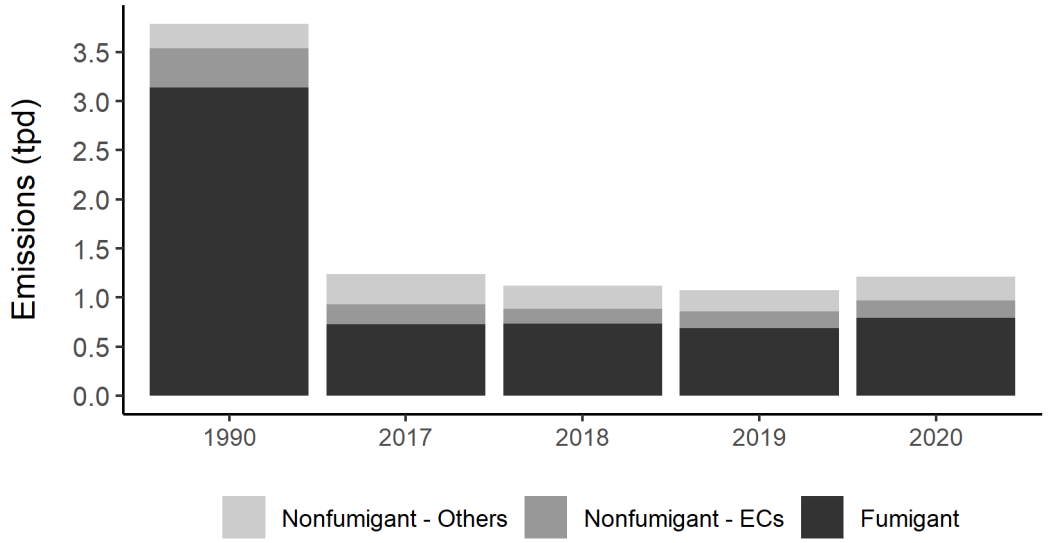

Figure 13. Emissions for the Ventura NAA during 1990 and 2017-2020, categorized as fumigants, nonfumigants with ECs, and other nonfumigants (Others).

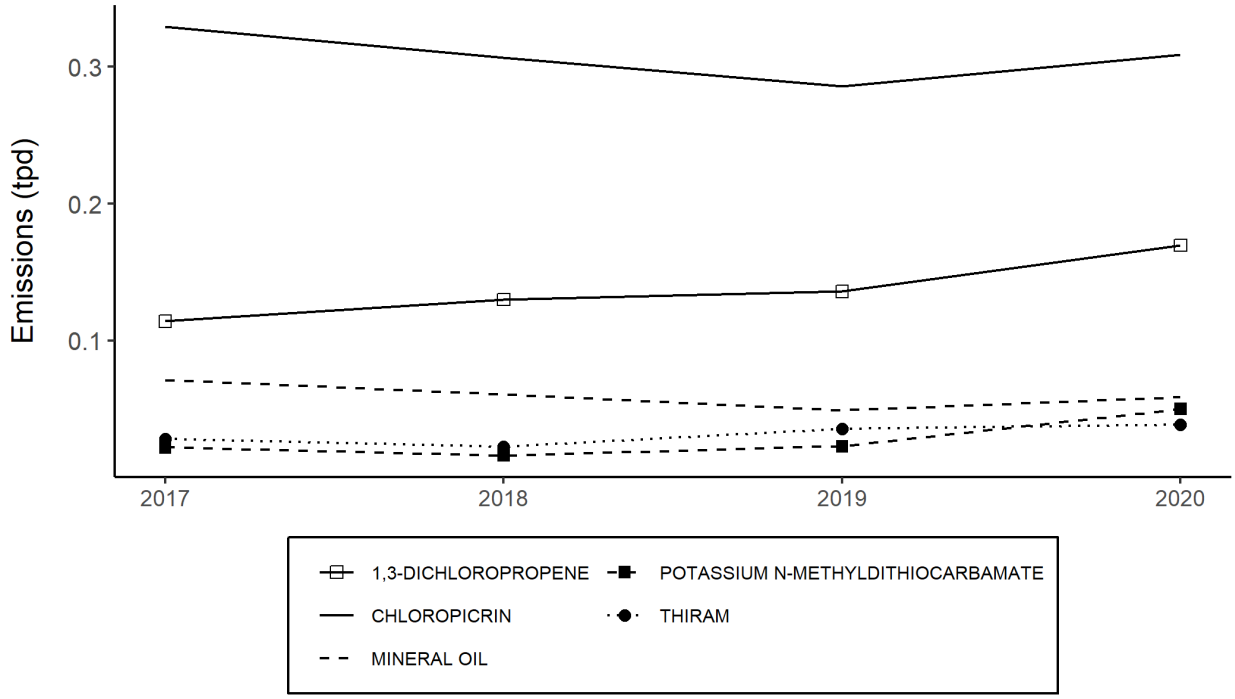

Figure 14. Emissions from products containing the top five AIs by emissions in the Ventura NAA from 2017 to 2020.

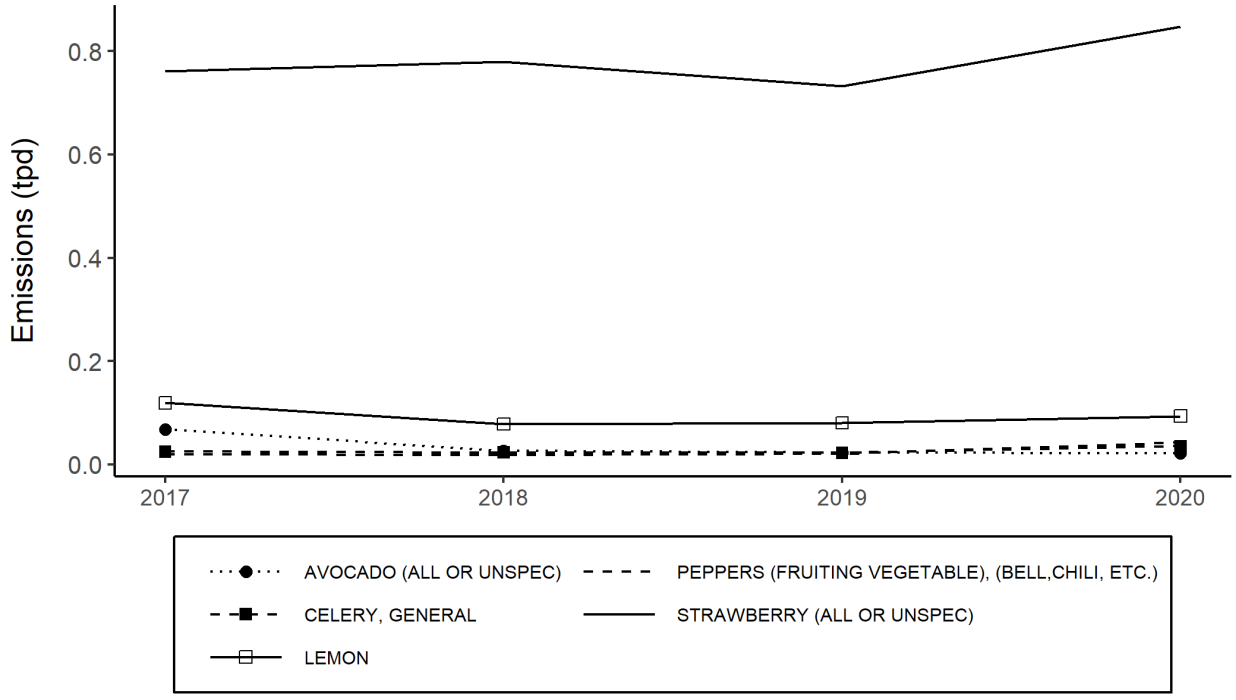

Figure 15. Emissions from the top five commodities by emissions in the Ventura NAA from 2017 to 2020.

South Coast

In the South Coast NAA, 2020 emissions decreased by 5% (-0.042 tpd) from 0.926 tpd in 2019 to 0.884 tpd. Emissions in 2020 were 89% (-7.381 tpd) below the regulatory trigger level (95% of the SIP goal) of 8.3 tpd (Figure 3).

Figure 16 and Tables A2-5-1 and A2-5-2 show emissions in 1990 and 2017-2020, categorized as fumigants, nonfumigants with EC formulations, and all other nonfumigants. In 2020, nonfumigant products contributed 87% of emissions and fumigant products contributed 13% of emissions. Nonfumigant product emissions decreased by 5% (-0.042 tpd), from 0.811 tpd in 2019 to 0.769 tpd. Fumigant product emissions increased by <1% (<0.001 tpd), from 0.115 tpd in 2019 to 0.115 tpd. Products with EC formulations accounted for 30% and 26%, respectively, of nonfumigant and total emissions. Emissions from these products increased by 4% (0.009 tpd), from 0.221 tpd in 2019 to 0.230 tpd.

Figure 17 and Table A2-5-3 aggregate product emissions by primary AI. The top 10 AIs comprise 53% of total emissions. At 11% of total emissions, n-octyl bicycloheptene dicarboximide products had the highest emissions (0.100 tpd) of any AI used in this NAA.

Figure 18 and Table A2-5-4 aggregate emissions by commodity. The top 10 commodities comprise 95% of total emissions. At 49% of total emissions, structural pest control products had the highest emissions (0.437 tpd) of any commodity treated in this NAA.

Table A2-5-5 shows this NAA's unadjusted 2020 emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide decreased 18% (-0.013 tpd), from 0.070 tpd in 2019 to 0.057 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products increased 11% (0.062 tpd), from 0.554 tpd to 0.615 tpd. Emissions from structural applications of methyl bromide continued to be below a reportable level. Unadjusted emissions from structural applications of non-methyl bromide products decreased 7% (-0.031 tpd), from 0.468 tpd to 0.437 tpd.

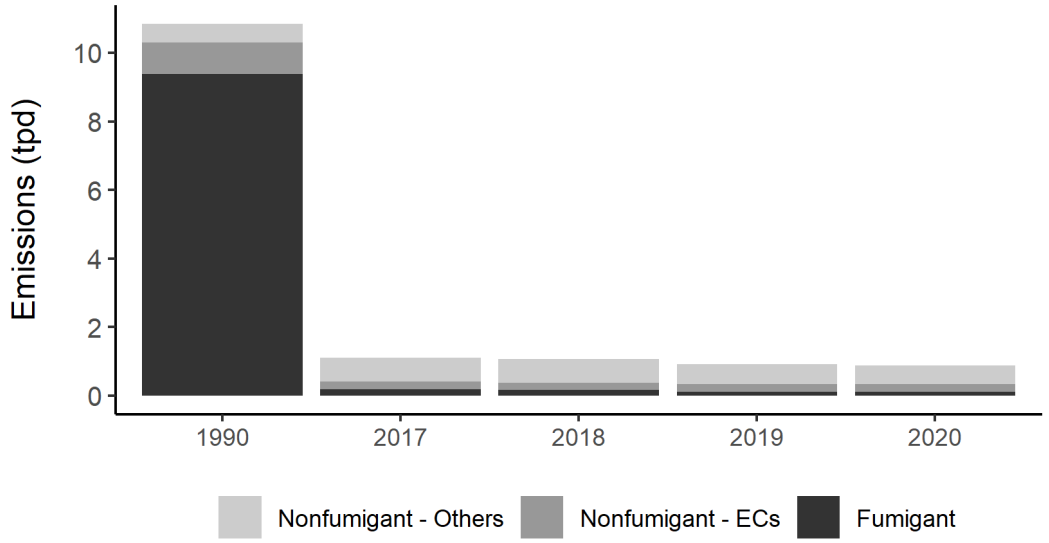

Figure 16. Emissions for the South Coast NAA during 1990 and 2017-2020, categorized as fumigants, nonfumigants with ECs, and other nonfumigants (Others).

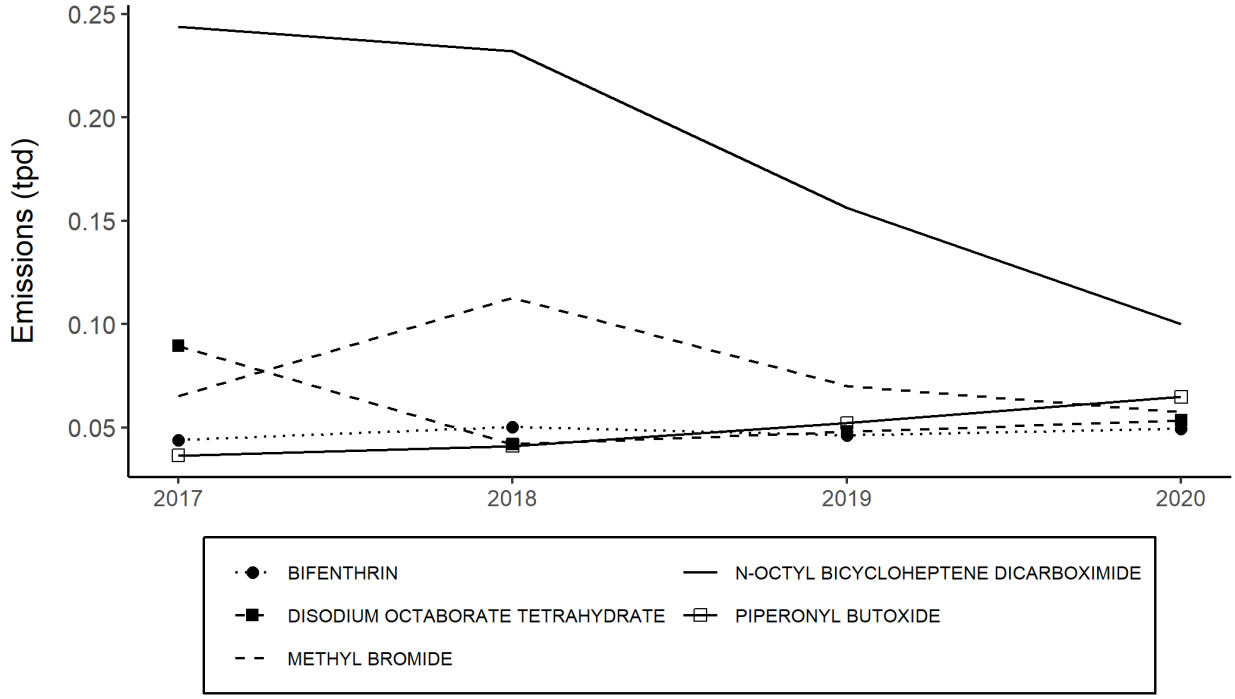

Figure 17. Emissions from products containing the top five AIs by emissions in the South Coast NAA from 2017 to 2020.

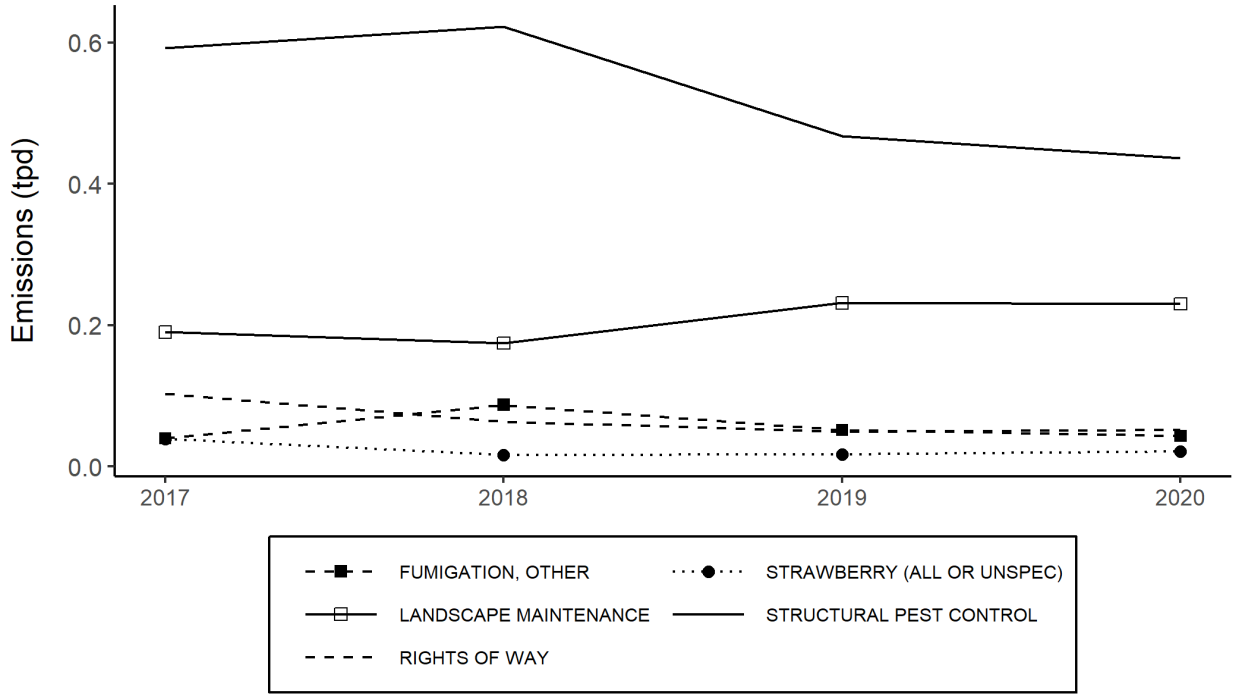

Figure 18. Emissions from the top five commodities by emissions in the South Coast NAA from 2017 to 2020.

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