ANNUAL REPORT ON VOLATILE ORGANIC COMPOUND EMISSIONS FROM PESTICIDES: EMISSIONS FOR 1990 – 2017

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California Environmental Protection Agency
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EXECUTIVE SUMMARY

Preface

This report fulfills the requirements of Title 3, California Code of Regulations (3 CCR), section 6881, which requires the Director of the Department of Pesticide Regulation (DPR) to issue an annual emissions inventory report for the Sacramento Metro, San Joaquin Valley, South Coast, Southeast Desert, and Ventura ozone nonattainment areas (NAAs). This report presents data reported to or produced by DPR from May 1, 2017, to October 31, 2017, the peak ozone season in California. In addition, data from the same months in 1990 are included for baseline comparisons, and from 2014, 2015 and 2016 for trend analysis.

Background

Under the federal Clean Air Act, California must meet national standards for airborne pollutants and must specify how it plans to achieve these goals in a federally approved State Implementation Plan (SIP). SIPs require the control of emissions of nitrogen oxides and volatile organic compounds (VOCs) because they are precursors to ozone. Under California's SIP, approved by the U.S. Environmental Protection Agency (U.S. EPA), DPR must track and control VOC emissions from pesticide products used in agriculture and by commercial structural applicators in five regions that do not attain the federal air quality standard for ozone (*i.e.*, ozone NAAs). The SIP requires DPR to reduce emissions by 20% from the 1990 base year in four ozone NAAs—Sacramento Metro, South Coast, Southeast Desert, and Ventura, and by 12% in a fifth ozone NAA—San Joaquin Valley.

DPR's VOC emissions inventory database includes only pesticide applications that are made between May 1 and October 31, the peak ozone season in California. DPR updates its VOC emissions inventory when annual pesticide use report (PUR) data from the previous year becomes available. DPR's PUR database contains data for every year since 1990. Each year contains about 3.8 million pesticide use records and emission potential (EP) values for approximately 7,500 products. The EP is that fraction of a product that is assumed to contribute to atmospheric VOCs.

Beginning in 2008 DPR adopted a series of regulations to reduce VOC emissions from fumigant pesticides. 3 CCR section 6452.2 includes specific emission target levels (VOC regulation benchmarks) for each of the five NAAs, equivalent to the SIP obligation of a 12% or a 20% reduction. The regulations reduce VOC emissions by requiring low-emission fumigation methods in certain NAAs. If, in spite of these application method requirements, pesticide VOC emissions exceed 95% of the benchmark for a NAA, the regulations specify that DPR will ensure that the benchmark is achieved by establishing a fumigant limit. The fumigant limit is determined by subtracting the estimated nonfumigant emissions from the regulatory benchmark, basing the nonfumigant emissions estimate on VOC emissions inventory data from previous years.

Because a significantly higher proportion of emissions in the San Joaquin Valley NAA are from nonfumigants, in May 2013 (and effective November 1, 2013), DPR amended the VOC regulations by replacing the fumigant limit required when the 95% trigger level is exceeded in that NAA with prohibitions on the use of certain nonfumigant products designated as high-VOC.

Report Summary

In 2017, all five ozone NAAs were in compliance with the SIP goals and were below the VOC regulation benchmarks.

- Sacramento Metro NAA (1): 2017 adjusted VOC emissions increased slightly by 2% (0.021 tons per day [tpd]) from 1.346 tpd in 2016 to 1.366 tpd. Emissions in 2017 were 51% lower than the 1990 base year and remain in compliance with the SIP goal and the VOC regulation benchmark. In 2017, 89% of the emissions were derived from nonfumigants and 11% of emissions were derived from fumigants.

- San Joaquin Valley NAA (2): 2017 adjusted VOC emissions increased 10% (1.527 tpd), from 15.453 tpd in 2016 to 16.980 tpd, and are below the SIP goal by 1.120 tpd. Pesticide VOC emissions in 2017 were 17% lower than the 1990 base year and comply with the SIP goal and VOC regulation benchmark. Prohibitions on the use of certain nonfumigant products went into effect in 2015 (3 CCR section 6884) and pesticide applications subject to these restrictions accounted for 30% of the total nonfumigant emissions for that year, compared to 16% in 2017. As part of VOC regulations, which require DPR to calculate hypothetical emissions for 2017, the calculated 2017 hypothetical emissions exceed the trigger level of 95% of the SIP goal, or 17.2 tpd. As a result, the nonfumigant prohibitions that went into effect in 2015 are required to remain in effect during the May 1 through October 31 period for 2019 and 2020 in this NAA pertaining to 3 CCR section 6452.2[f].

- Southeast Desert NAA (3): 2017 adjusted VOC emissions increased by 32% (0.087 tpd) from 0.276 tpd in 2016 to 0.363 tpd in 2017. Emissions in 2017 were 69% lower than the 1990 base year and continue to comply with the SIP goal and VOC regulation benchmark. In 2017, emissions from fumigants increased by 45% and from nonfumigants by 27% in this NAA.

- Ventura NAA (4): 2017 adjusted VOC emissions decreased by 9% (0.125 tpd) from 1.365 tpd in 2016 to 1.240 tpd in 2017, which is 1.760 tpd below the SIP goal. Pesticide VOC emissions in 2017 were 67% lower than the 1990 base year. Fumigants contributed 58% of the estimated VOC emissions in 2017. The implementation of fumigation methods that use totally impermeable film (tarps assigned 60% buffer zone credit on labels) in this NAA continued to assist in fumigant emissions reductions in 2017.

- South Coast NAA (5): 2017 adjusted VOC emissions increased by 7% (0.072 tpd) from 1.053 tpd in 2016 to 1.125 tpd in 2017, and continue to remain well below the emission targets. VOC emissions in 2017 were 90% lower than the 1990 base year. Over 83% of the pesticide VOC emissions were derived from nonfumigants.

3 CCR section 6881(b) requires a 45-day public comment period of the draft report. No comments were received during the comment period ending on March 22, 2019.

Abbreviations and Definitions

AI	Active Ingredient
AMAF	Application Method Adjustment Factor
APCD	Air Pollution Control District
ARB	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 Chemical

PERSONNEL

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DISCLAIMER

The mention of commercial products, their source, or their use in this report is not to be construed as either an actual or an implied endorsement of such product.

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OVERVIEW

Introduction

The State Implementation Plan (SIP) for pesticides requires the California Department of Pesticide Regulation (DPR) to develop and maintain an emissions inventory to track pesticide volatile organic compound (VOC) emissions and to reduce emissions by 20% from a base year in four out of five California ozone nonattainment areas (NAAs), and by 12% in the fifth ozone NAA. These five NAAs are defined as areas that do not meet the National Ambient Air Quality Standards for ozone as designated in the Clean Air Act. The scope of the VOC emissions inventory allows DPR to estimate VOC emissions from agricultural and commercial structural pesticide applications within the state. To do this, DPR calculates emissions for each year beginning with 1990, and updates these calculations annually based on most recent data. The inventory focuses on the peak ozone period between May 1 and October 31 for each year.

The VOC emissions inventory is estimated based on pesticide use reports (PURs) that are collected by DPR. The inventory includes applications that are made for agricultural and structural use as defined by law. Included are all applications with the exception of home use, industrial use, institutional use, applications made for vector control purposes and veterinarian uses. Production agricultural use covers applications to approximately 400 commodities/crops. Non-production agricultural use includes applications to approximately 20 sites including cemeteries, golf courses, parks, rights-of-way, etc. Structural use includes all applications by structural pest control businesses, regardless of site treated.

The key PUR data used to calculate VOC emissions is given in Table 1.

Table 1. Key information included in pesticide use reports (PURs) that form the basis of DPR's volatile organic compound (VOC) emissions inventory.

Information	**Production Agriculture Reports** (Each Application)	**Non-Production Agriculture Reports and Non Agricultural Reports** (Monthly Summary of Applications)
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

California’s five ozone NAAs included in the pesticide VOC emissions inventory are Sacramento Metro (1), San Joaquin Valley (2), Southeast Desert (3), Ventura (4), and South Coast (5). The boundaries of these NAAs, as defined by Title 40 of the Code of Federal Regulations (CFR) Part 81, and a listing of counties that fall within the boundaries are shown in Figure 1 and Table 2, respectively.

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

- Total agricultural and structural pesticide VOC emissions for the previous years;
- Evaluation of whether emissions are in compliance with SIP goals (benchmarks specified in 3 CCR section 6452.2);
- Fumigant emission limits for the upcoming year, if necessary, according to 3 CCR section 6452.2;
- Emission ratings (or application method adjustment factors, the percentage of fumigant applied) for each fumigation method.

In May 2013 (and effective November 1, 2013), DPR amended the VOC regulations, moving the requirements for the annual report from 3 CCR section 6452.4 to 3 CCR section 6881, and adding the following report elements:

- Prohibitions on 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);
- List of nonfumigant products that are designated as low-VOC pursuant to 3 CCR section 6880;
- List of actively registered nonfumigant products that are designated as high-VOC pursuant to 3 CCR section 6880.

Section 6881 also requires a 45-day public comment period of the draft report. This report contains all of the information specified above, including emission estimates for 1990–2017 and whether the 2017 emissions exceed levels that trigger additional VOC restrictions.

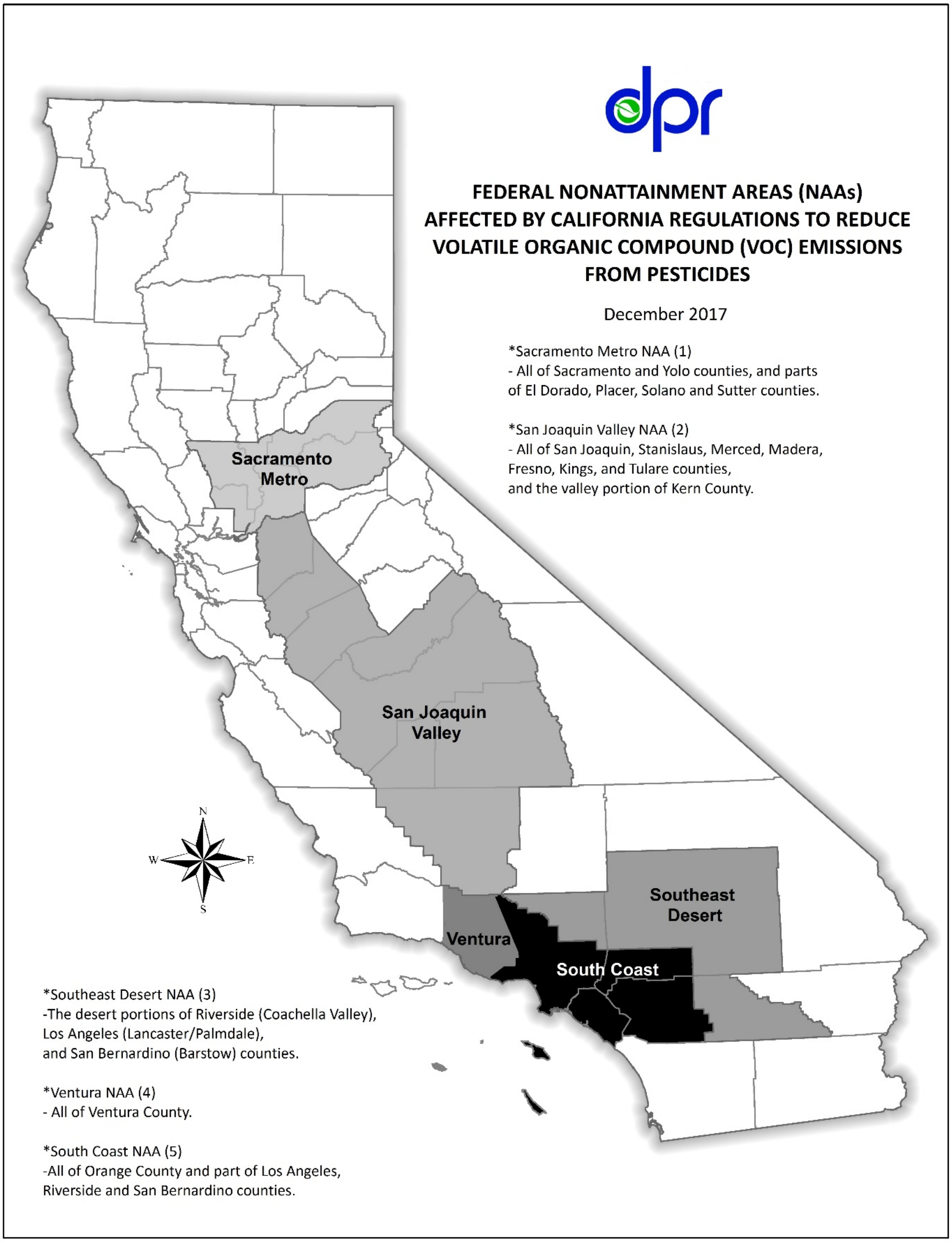

Figure 1. Federal ozone NAAs affected by California regulations to reduce volatile organic compound (VOC) emissions from pesticides.

Table 2. A listing of counties wholly or partially within five ozone NAAs in California.

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

Nonattainment Area Goals

The emissions in DPR's VOC inventory are compared to NAA goals listed in Table 3, which are described in California's original 1994 SIP (62 Fed. Reg. at 1170, 1997) and Appendix H to the 2007 SIP (73 Fed. Reg. 41277, 2008). These "SIP goals" are a 20% reduction from 1990 levels for the Sacramento Metro, Southeast Desert, Ventura and South Coast NAAs, and a 12% reduction from the 1990 baseline for the San Joaquin Valley NAA. In August 2012, U.S. EPA approved DPR's SIP amendment for the San Joaquin Valley. This amendment includes a SIP goal of 18.1 tons per day (tpd), equivalent to a 12% reduction relative to the 1990 baseline. Prior to the amendment, the SIP described the reduction commitment only as 12% less than the 1990 baseline. Because the 18.1 tpd represents the 12% reduction from the 1990 baseline calculated using a specific methodology, that methodology must continue to be used to calculate future emissions to assure a legitimate comparison to measure SIP compliance. Therefore, emission estimates for application methods that were used in 1990 cannot be modified, absent a SIP revision. Similarly, nonfumigant pesticide emission potentials of formulations that were used in the base year cannot be changed, absent a SIP revision.

The annual report includes DPR's determination if emissions exceed levels that trigger additional VOC restrictions. As specified in 3 CCR section 6452.2, additional restrictions are triggered if pesticide VOC emissions in a NAA exceed 95% of its SIP goal (Table 3). For the Sacramento Metro, Southeast Desert, South Coast, and Ventura NAAs the additional restrictions are a fumigant emissions limit, enforced by DPR and county agricultural commissioners through grower allowances or other methods. The 2013 regulations revised the additional restrictions for the San Joaquin Valley because nonfumigant products contribute more VOC emissions than fumigant products in this NAA; therefore, additional restrictions on nonfumigant products are a more efficient method to ensure that the SIP goal is achieved. If VOC emissions exceed the trigger level for the San Joaquin Valley, certain uses of high-VOC products are prohibited (3 CCR section 6884). For all five NAAs, the additional restrictions are triggered for the upcoming May–October period based on the emissions inventory for the previous year. For example, the 2017 emissions inventory is used to determine if additional VOC restrictions will go into effect for May–October 2019. Additional information on the 2013 regulations and changes to the additional restrictions is available at http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/reduce_nonfumigant.htm.

Table 3. Ozone NAA pesticide volatile organic compound (VOC) emission goals and trigger levels.

	NAA SIP Goal (tpd)	Trigger Levels 95 % of SIP Goal (tpd)
1 – Sacramento Metro	2.2	2.1
2 – San Joaquin Valley	18.1	17.2
3 – Southeast Desert	0.92	0.87
4 – Ventura	3.0	2.85
5 – South Coast	8.7	8.3

Procedure for Calculating Unadjusted and Adjusted Volatile Organic Compound Emissions

Prior to 2008, DPR reported an unadjusted emissions inventory that assumed the entire volatile portion of a fumigant product eventually volatilizes, contributing to atmospheric VOC loadings. However, 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 et al., 1999; Yagi et al., 1993). DPR has developed an adjustment procedure to account for the effect of application method on reducing fumigant VOC emissions.

The unadjusted inventory is based on the premise that the VOC emission from a single application of fumigant or nonfumigant product is equal to the amount used times the Emission Potential (EP) (Spurlock, 2002; 2006).

emission = lbs of product used x EP

In the adjusted inventory, the emission from a single application of a *fumigant* active ingredient (AI) is reduced by an additional factor called the Application Method Adjustment Factor (AMAF), also referred to as the emission rating. AMAFs have been determined from field study data and are AI and application method specific (Barry et al., 2007). Since the AMAFs are based on field measured data for specific application methods and fumigants, they yield more refined estimates of fumigant VOC emissions than the previous unadjusted emission estimates.

emission = lbs of product used x EP x AMAF

In the adjusted inventory, *nonfumigant* product emissions are not currently adjusted for application method or other field factors due to a lack of data to support such adjustments. Consequently, their emissions are calculated using the same procedure as the unadjusted inventory.

Usually there are several different types of application methods used for a particular fumigant in any particular NAA. Each method of use (*e.g.*, drip, sprinkler, shank, tarp, etc.) represents a fraction of the total number of methods used and is referred to as the Method Use Fraction (MUF). Prior to 2008, field fumigations did not report application method; instead MUFs were derived from surrogate data and used in addition to AMAF to adjust emissions in these years. The sum of all MUFs for any particular (NAA/fumigant AI) combination is one. Use practices change over time so that different

MUFs are used for the baseline year (1990) and later years. MUFs for 2007 and earlier years were determined in a number of different ways. 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. A detailed discussion of how MUF and AMAFs were determined is given by Barry et al. (2007). Appendix 1a contains summaries of the AMAFs and MUFs used for emissions inventory data prior to 2009.

Additionally, regulations that went into effect in 2008 facilitated calculation of adjusted inventories by requiring reporting of each field fumigation's method (FFM), which along with the AI, uniquely determines an AMAF value. In 2017, two (<1%) of the 4,197 field fumigant applications in the five NAAs during the ozone season had no or a non-existent fumigation method code reported. Both of these records originated in the South Coast NAA (5). For these records, DPR used a conservative approach by assuming that the application method with the highest AMAF allowed by the regulations for that fumigant was used, creating a complete dataset from which adjusted emissions for both the AIs and application sites (or commodities) contributing to May–October 2017 ozone could be calculated (Table 4a). Appendix 1b contains current field fumigation methods (FFM), FFM codes for pesticide use reporting, and corresponding AMAFs.

Table 4a. Default application method adjustment factor (AMAF) fumigant codes assigned to fumigant applications with either no or non-existent fumigant 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%

In addition to the VOC 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 are non-volatile and so do not contribute to the EP of these products.

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 1). These 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 a 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 was updated to provide the most accurate estimated geographic distribution of VOC emissions, reflecting changes in California's population and transportation infrastructure. U.S. 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 county agricultural commissioners (Neal and Spurlock, 2012).

VOC emissions are calculated for each NAA and allocated by primary AI, application site, and emissions inventory category as defined by the Air Resources Board (ARB). The primary AI is defined as the pesticide AI present at the highest percentage in a product. If a pesticide product contains 20% of AI "A" and 10% of AI "B", all estimated emissions from that product are assigned to the primary AI "A".

Volatile Organic Compound Emissions by the ARB Emissions Inventory Classification

ARB defines four VOC 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 calculated for the May–October ozone season according to these categories, and are reported as U.S. tpd in this inventory report.

Data Revisions

DPR continually evaluates PUR data, EP values, MUFs, and AMAFs to ensure the VOC inventory includes the most reliable data. As requested by DPR, registrants provide thermogravimetric analysis (TGA) data, DPR's preferred 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 adjusted emissions inventory. Table 4b shows products that had EP values that changed significantly since the previous VOC inventory report as a result of recent TGA submissions.

Changes to a product's listed EP value can occur when EP values that have been determined by alternative methods are replaced by an EP value derived from registrant-submitted TGA data evaluated by DPR. If DPR finds the TGA data contains errors, DPR may request additional TGA data from the registrant in order to perform a re-evaluation of the data to verify or update the product's EP. In addition to these changes, data entry corrections in DPR's Product/Label database may change the product formulations of registered pesticide products. Products that do not have TGA data are assigned default EP values using the default median for the type of pesticide product formulation (*e.g.*, emulsifiable concentrate, flowable concentrate, etc.). Changes to estimated EP values that resulted from assigned default medians for corrected formulation codes are not included in Table 4b. Lastly, DPR staff continuously evaluates the emissions inventory data for any past errors in assigned EP values (*i.e.*, incorrect use of deficient TGA data, erroneous bridging of one product's EP data to another "substantially similar" product, etc.). If any such errors are discovered by DPR staff, registrants are requested by DPR to provide new TGA data for the product in question and a new EP determination is performed by DPR staff with the newly received TGA data. The updated EP values are updated in the following year's VOC inventory.

Table 4b. Substantial changes in emission potential (EP) values since the 2016 inventory.

Product	Primary Active Ingredient	2016 Inventory		2017 Inventory		Change in EP
		EP	method	EP	method	
DREXEL PHITICIDE	POTASSIUM PHOSPHITE	5.71	default_ median	0.28	TGA	-5.43
GALIGAN 2E HERBICIDE	OXYFLUORFEN	39.15	default_ median	66.15	TGA/ derived	27
2,4-DB 200 BY WINFIELD	4-(2,4-DB), DIMETHYLAMINE SALT	5.71	default_ median	8.29	Derived	2.58
DREXEL TRIFLURALIN 4EC	TRIFLURALIN	39.15	default_ median	49.92	TGA	10.77
ABBA ULTRA MITICIDE/INSECTICIDE	ABAMECTIN	39.15	default_ median	34.18	Derived	-4.97

VOLATILE ORGANIC COMPOUND INVENTORY RESULTS

The main text of this report summarizes the pesticide VOC emissions inventory data for 2017 only. *Unadjusted* and *adjusted* emission data for 2014-2017 are summarized by AI and application site (or commodity) in Appendices 2 and 3, respectively. Inventory data for prior years are in previous inventory reports are made available by DPR upon request.

Figure 2 illustrates the changes in *unadjusted* VOC emissions from 1990 to 2017. These values are *unadjusted* and so do not take in to consideration MUFs and AMAFs that are only applied to emissions in 2004 through 2017, and 1990 due to data limitations. The figure is useful in that it compares emissions for the entire history of the inventory and shows trends in five NAAs.

Tables 5, 6a, and Figure 3 summarize the *adjusted* pesticide VOC emissions for 2004 through 2017, and compare them to the SIP goals that are based on a percentage reduction from the 1990 baseline. Table 6b compares the *unadjusted* and *adjusted* fumigant VOC emissions for 2006 through 2017. Table 6c shows the amount of emissions that resulted from nonfumigant products with emulsifiable concentrate formulations compared to all other nonfumigant formulations. The emissions in the base year are also included to reflect any long-term decrease or increase. Generally, the tables and figures summarize information as follows:

- In the Sacramento Metro NAA (1), 2017 adjusted VOC emissions increased slightly, by 2% (0.021 tpd), from 1.346 tpd in 2016 to 1.366 tpd, and continue to be below the SIP goal of 2.2 tpd. Nonfumigants represented 89% of the total emissions, and remained at levels similar to 2016 levels. Adjusted fumigant emissions contributed 11% of the NAA emissions, and increased by 37% (0.039 tpd) from 0.106 tpd in 2016 to 0.145 tpd.

- In the San Joaquin Valley NAA (2), 2017 total adjusted VOC emissions increased by 10% (1.527 tpd), from 15.453 tpd in 2016 to 16.980 tpd. Total adjusted emissions were below the SIP goal of 18.1 tpd by 1.120 tpd. Nonfumigant emissions accounted for 75% of the total VOC emissions in the San Joaquin Valley NAA in 2017, with emissions from products with emulsifiable concentrate formulations accounting for 53% of the nonfumigant emissions for this NAA. VOC emissions from nonfumigants increased by 14% (1.544 tpd) from 11.217 tpd in 2016 to 12.761 tpd in 2017, whereas fumigant emissions were largely unchanged. Prohibitions on the use of certain nonfumigant products went into effect in 2015 (3 CCR section 6884) and pesticide applications subject to these restrictions accounted for 30% of the total nonfumigant emissions for that year, compared to 16% in 2017. However, the calculated hypothetical emissions for 2017 exceed the trigger level of 95% of the SIP goal, or 17.2 tpd. Therefore, VOC regulations require that the nonfumigant prohibitions that went into effect in 2015 remain in effect during the May 1 through October 31 period for 2019 and 2020 in the San Joaquin Valley NAA (3 CCR section 6452.2[f]).

- In the Southeast Desert NAA (3), 2017 adjusted VOC emissions increased by 32% (0.087 tpd) from 0.276 tpd in 2016 to 0.363 tpd, and remain well below the SIP goal of 0.92 tpd. Nonfumigants contributed 71% of the emissions in this NAA, with 41% of the nonfumigant emissions from emulsifiable concentrate formulations. Nonfumigant emissions from emulsifiable concentrate formulations increased by only 5%, whereas emissions from other nonfumigant formulations increased by 49% (0.050 tpd), from 0.102 tpd in 2016 to 0.152 tpd. Fumigants accounted for 29% of the total VOC emissions in this NAA, and increased by 45% (0.033 tpd) from 0.073 tpd in 2016 to 0.106 tpd.

- In the Ventura NAA (4), 2017 adjusted VOC emissions decreased by 9% (0.125 tpd) from 1.365 tpd in 2016 to 1.240 tpd in 2017, and continue to meet the SIP goal of 3.0 tpd. Fumigant emissions contributed 58% of the total emissions, and decreased by 23% (0.218 tpd), from 0.942 tpd in 2016 to 0.724 tpd.

- In the South Coast NAA (5), 2017 adjusted VOC emissions increased by 7% (0.072 tpd), from 1.053 tpd in 2016 to 1.125 tpd in 2017, and continue to be well below the SIP goal of 8.7 tpd. Nonfumigants contributed 83% (0.935 tpd) of the total adjusted VOC emissions in 2017, with 23% (0.212 tpd) of the nonfumigant emissions derived from products with emulsifiable concentrate formulations. Although emissions from emulsifiable concentrate formulations decreased 15% in this NAA, emissions from all other nonfumigant products increased 36% (0.193 tpd), from 0.531 tpd in 2016 to 0.724 tpd, resulting in a total increase of nonfumigant emissions by 20%.

Pesticide use varies from year to year depending on many factors, including weather, drought, pest problems, economics, and types of crops planted. Increases and decreases in pesticide use from one year to the next or in the span of a few years do not necessarily indicate a trend. Such variances are and will continue to be a normal occurrence. For example, extremely heavy rains result in excessive weeds, thus more pesticides may be used; drought conditions may give rise to fewer planted acres and less pesticide use. A more detailed explanation of pesticide use patterns is given in DPR's annual summary of pesticide use reports at http://www.cdpr.ca.gov/docs/pur/purmain.htm.

The 2013 and earlier VOC regulations include additional restrictions that are triggered if pesticide VOC emissions in a NAA exceed 95% of its SIP goal. None of the five NAAs exceeded their trigger levels in 2017. However, San Joaquin Valley NAA exceeded its trigger level in 2013, requiring certain uses of the designated high-VOC products to be prohibited during May–October for that NAA beginning in 2015 and remaining in effect for at least two years. In accordance with the VOC regulations, these prohibitions continue to remain in effect for the May–October (ozone season) during 2019 and 2020 (3 CCR 6452.2[f]).

The nonfumigant regulations designate certain products containing abamectin, chlorpyrifos, gibberellins, and oxyfluorfen as high-VOC products (3 CCR sections 6880, 6884). San Joaquin Valley growers must obtain a recommendation from a pest control adviser prior to certain uses of these high-VOC products, and pest control advisers are required to recommend low-VOC products when feasible (3 CCR sections 6883, 6884). DPR continues to register reformulated products with lower EPs, including products containing abamectin, chlorpyrifos, gibberellins, and oxyfluorfen that are major VOC contributors. The criteria and specific products designated as high-VOC and low-VOC are discussed in a later section.

DPR adopted additional fumigant regulations, which became effective on January 1, 2008, and required the use of specific "low-emission" fumigant application methods. Those regulations are also included in 3 CCR section 6452, which describes the interim and rulemaking process DPR can use to evaluate and approve new low-emission fumigant application methods. In April 2013, DPR granted interim approval that allowed the use of U.S. EPA-approved totally impermeable film (TIF) tarp method for certain fumigants. The regulation that gave permanent approval for TIF tarp methods was effective on April 1, 2016. The continued increase in adoption of lower emission application methods and products by growers, registrants, and others significantly contributes to SIP compliance and reducing VOC emissions.

Figure 2. *Unadjusted* **1990–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions, by NAA.

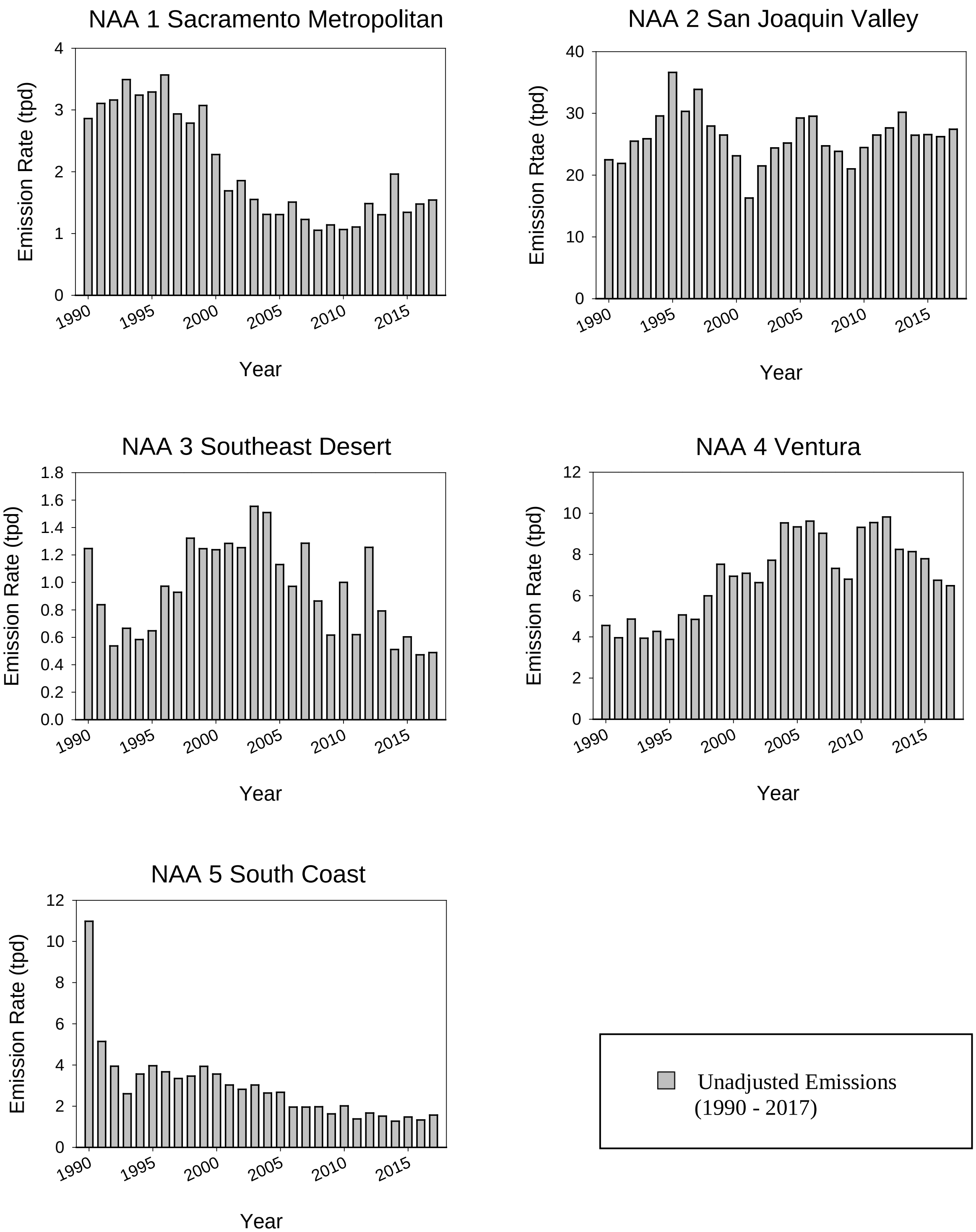

Table 5. *Adjusted* **1990** and **2006–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions and goals. Exceedance of the trigger level† requires additional VOC restrictions.

	VOC Emissions (tpd)														
NAA	**1990**	**SIP Goal***	**Trigger Level†**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
1 – Sacramento Metro	2.784	*2.2*	*2.1*	1.354	1.041	0.903	0.910	0.980	1.004	1.303	1.175	1.332	1.192	1.346	1.366
2 – San Joaquin Valley	20.517	*18.1*	*17.2*	21.305	17.093	14.525	12.965	15.228	16.376	16.921	19.520	16.815	15.383	15.453	16.980
3 – Southeast Desert	1.153	*0.92*	*0.87*	0.634	0.762	0.286	0.284	0.460	0.215	0.473	0.370	0.289	0.357	0.276	0.363
4 – Ventura	3.787	*3.0*	*2.85*	3.682	3.363	1.739	2.174	2.789	3.003	3.063	1.707	1.620	1.668	1.365	1.240
5 – South Coast	10.840	*8.7*	*8.3*	1.482	1.487	1.283	1.240	1.740	1.121	1.374	1.312	1.167	1.336	1.053	1.125

* For Ventura, the SIP goal was phased in between 2008 and 2012, with a final goal of 3.0 tpd in 2012.

† Trigger level is 95% of SIP Goal.

Table 6a. *Adjusted* **1990** and **2006–2017** May–October (ozone season) fumigant and nonfumigant pesticide volatile organic compound (VOC) emissions.

	VOC Emissions (tpd)												
NAA	**1990**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
1 – Sacramento Metro													
Fumigants	0.384	0.162	0.189	0.064	0.134	0.097	0.061	0.083	0.068	0.246	0.098	0.106	0.145
	(14%)	(12%)	(18%)	(7%)	(15%)	(10%)	(6%)	(6%)	(6%)	(18%)	(8%)	(8%)	(11%)
Nonfumigants	2.400	1.192	0.851	0.838	0.775	0.883	0.944	1.221	1.106	1.086	1.095	1.239	1.221
	(86%)	(88%)	(82%)	(93%)	(85%)	(90%)	(94%)	(94%)	(94%)	(82%)	(92%)	(92%)	(89%)
2 – San Joaquin Valley													
Fumigants	5.536	6.808	6.123	3.370	3.078	3.700	4.001	4.265	4.353	4.026	4.777	4.237	4.219
	(27%)	(32%)	(36%)	(23%)	(24%)	(24%)	(24%)	(25%)	(22%)	(24%)	(31%)	(27%)	(25%)
Nonfumigants	14.981	14.498	10.970	11.154	9.887	11.528	12.375	12.656	15.167	12.789	10.606	11.217	12.761
	(73%)	(68%)	(64%)	(77%)	(76%)	(76%)	(76%)	(75%)	(78%)	(76%)	(69%)	(73%)	(75%)
3 – Southeast Desert													
Fumigants	0.840	0.413	0.575	0.119	0.137	0.273	0.078	0.258	0.169	0.085	0.095	0.073	0.106
	(73%)	(65%)	(75%)	(42%)	(48%)	(59%)	(36%)	(55%)	(46%)	(29%)	(27%)	(26%)	(29%)
Nonfumigants	0.313	0.221	0.187	0.167	0.146	0.186	0.137	0.215	0.201	0.204	0.262	0.203	0.257
	(27%)	(35%)	(25%)	(58%)	(52%)	(41%)	(64%)	(45%)	(54%)	(71%)	(73%)	(74%)	(71%)
4 – Ventura													
Fumigants	3.140	3.175	2.935	1.252	1.720	2.312	2.577	2.681	1.311	1.188	1.211	0.942	0.724
	(83%)	(86%)	(87%)	(72%)	(79%)	(83%)	(86%)	(88%)	(77%)	(73%)	(73%)	(69%)	(58%)
Nonfumigants	0.647	0.508	0.428	0.486	0.454	0.477	0.425	0.382	0.397	0.432	0.458	0.423	0.516
	(17%)	(14%)	(13%)	(28%)	(21%)	(17%)	(12%)	(12%)	(23%)	(27%)	(27%)	(31%)	(42%)
5 – South Coast													
Fumigants	9.372	0.422	0.411	0.377	0.312	0.375	0.196	0.381	0.285	0.208	0.257	0.273	0.190
	(86%)	(28%)	(28%)	(29%)	(25%)	(22%)	(17%)	(28%)	(22%)	(18%)	(19%)	(26%)	(17%)
Nonfumigants	1.468	1.060	1.075	0.906	0.927	1.365	0.926	0.993	1.027	0.959	1.079	0.779	0.935
	(14%)	(72%)	(72%)	(71%)	(75%)	(78%)	(83%)	(72%)	(78%)	(82%)	(81%)	(74%)	(83%)

Table 6b. *Unadjusted* and *adjusted* **1990** and **2006–2017** May–October (ozone season) fumigant pesticide volatile organic compound (VOC) emissions. VOC/applied (tons of VOCs emitted for each ton of fumigant applied) was calculated by dividing the adjusted fumigant emissions by the unadjusted fumigant emissions. The trends over time and between NAAs indicate if the fumigants and/or fumigation methods used are lower-emitting or higher-emitting.

	VOC Emissions												
NAA	**1990**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
1 – Sacramento Metro													
Unadjusted (tpd)	0.461	0.315	0.383	0.241	0.363	0.181	0.162	0.263	0.197	0.876	0.247	0.237	0.320
Adjusted (tpd)	0.384	0.162	0.189	0.064	0.134	0.097	0.061	0.083	0.068	0.246	0.098	0.106	0.145
VOC/applied (tons/ton)	0.834	0.514	0.493	0.266	0.369	0.536	0.375	0.314	0.346	0.281	0.395	0.449	0.454
2 – San Joaquin Valley													
Unadjusted (tpd)	7.491	15.034	13.750	12.620	11.119	12.944	14.116	14.969	15.002	13.666	15.937	14.990	14.663
Adjusted (tpd)	5.536	6.808	6.123	3.370	3.078	3.700	4.001	4.265	4.353	4.026	4.777	4.237	4.219
VOC/applied (tons/ton)	0.739	0.453	0.445	0.267	0.277	0.286	0.283	0.285	0.290	0.295	0.300	0.283	0.288
3 – Southeast Desert													
Unadjusted (tpd)	0.933	0.750	1.086	0.684	0.469	0.814	0.482	1.041	0.591	0.308	0.341	0.270	0.232
Adjusted (tpd)	0.840	0.413	0.575	0.119	0.137	0.273	0.078	0.258	0.169	0.085	0.095	0.073	0.106
VOC/applied (tons/ton)	0.901	0.550	0.530	0.174	0.293	0.336	0.162	0.248	0.286	0.275	0.280	0.270	0.456
4 – Ventura													
Unadjusted (tpd)	3.909	9.113	8.658	6.543	6.345	8.844	9.126	9.442	7.846	7.705	7.335	6.324	5.967
Adjusted (tpd)	3.140	3.175	2.935	1.252	1.720	2.312	2.577	2.681	1.311	1.188	1.211	0.942	0.724
VOC/applied (tons/ton)	0.803	0.348	0.339	0.191	0.271	0.261	0.282	0.284	0.167	0.154	0.165	0.149	0.121
5 – South Coast													
Unadjusted (tpd)	9.514	0.898	0.883	1.043	0.694	0.647	0.449	0.672	0.492	0.308	0.394	0.545	0.629
Adjusted (tpd)	9.372	0.422	0.411	0.377	0.312	0.375	0.196	0.381	0.285	0.208	0.257	0.273	0.190
VOC/applied (tons/ton)	0.985	0.470	0.466	0.361	0.450	0.580	0.435	0.566	0.580	0.674	0.651	0.501	0.302

Table 6c. 1990 and **2006–2017** May–October (ozone season) nonfumigant pesticide volatile organic compound (VOC) emissions derived from emulsifiable concentrate (EC) formulations and all other nonfumigants. The *adjusted* and *unadjusted* VOC emissions for nonfumigants are equivalent.

	Nonfumigant VOC Emissions (tpd, [percentage of total])												
NAA	**1990**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
1 – Sacramento Metro													
ECs	1.129	0.640	0.470	0.487	0.379	0.411	0.400	0.537	0.503	0.485	0.520	0.549	0.543
	(47%)	(54%)	(55%)	(58%)	(49%)	(47%)	(42%)	(44%)	(45%)	(45%)	(47%)	(44%)	(49%)
Others	1.271	0.552	0.382	0.351	0.397	0.472	0.543	0.684	0.603	0.601	0.575	0.688	0.571
	(53%)	(46%)	(45%)	(42%)	(51%)	(53%)	(58%)	(56%)	(55%)	(55%)	(53%)	(56%)	(51%)
2 – San Joaquin Valley													
ECs	12.162	10.119	7.547	7.491	5.921	6.608	6.854	7.263	8.760	7.298	6.037	6.295	6.754
	(81%)	(70%)	(69%)	(67%)	(60%)	(57%)	(55%)	(57%)	(58%)	(57%)	(57%)	(56%)	(53%)
Others	2.819	4.379	3.423	3.663	3.966	4.921	5.521	5.392	6.407	5.491	4.571	4.927	5.975
	(19%)	(30%)	(31%)	(33%)	(40%)	(43%)	(45%)	(43%)	(42%)	(43%)	(43%)	(44%)	(47%)
3 – Southeast Desert													
ECs	0.217	0.131	0.105	0.089	0.073	0.092	0.071	0.091	0.090	0.098	0.117	0.101	0.106
	(69%)	(59%)	(56%)	(53%)	(50%)	(49%)	(52%)	(42%)	(45%)	(48%)	(44%)	(50%)	(36%)
Others	0.096	0.091	0.083	0.078	0.074	0.094	0.066	0.124	0.111	0.106	0.146	0.102	0.184
	(31%)	(41%)	(44%)	(47%)	(50%)	(51%)	(48%)	(58%)	(55%)	(52%)	(56%)	(50%)	(64%)
4 – Ventura													
ECs	0.402	0.272	0.210	0.237	0.227	0.224	0.184	0.161	0.130	0.147	0.156	0.146	0.194
	(62%)	(54%)	(49%)	(49%)	(50%)	(47%)	(43%)	(42%)	(33%)	(34%)	(34%)	(34%)	(38%)
Others	0.245	0.236	0.218	0.250	0.227	0.253	0.242	0.221	0.267	0.285	0.301	0.278	0.317
	(38%)	(46%)	(51%)	(51%)	(50%)	(53%)	(57%)	(58%)	(67%)	(66%)	(66%)	(66%)	(62%)
5 – South Coast													
ECs	0.921	0.514	0.459	0.339	0.379	0.421	0.346	0.305	0.274	0.302	0.347	0.248	0.211
	(63%)	(48%)	(43%)	(37%)	(41%)	(31%)	(37%)	(31%)	(27%)	(32%)	(32%)	(32%)	(21%)
Others	0.547	0.546	0.616	0.567	0.548	0.944	0.580	0.688	0.753	0.657	0.732	0.530	0.803
	(37%)	(52%)	(57%)	(63%)	(59%)	(69%)	(63%)	(69%)	(73%)	(68%)	(68%)	(68%)	(79%)

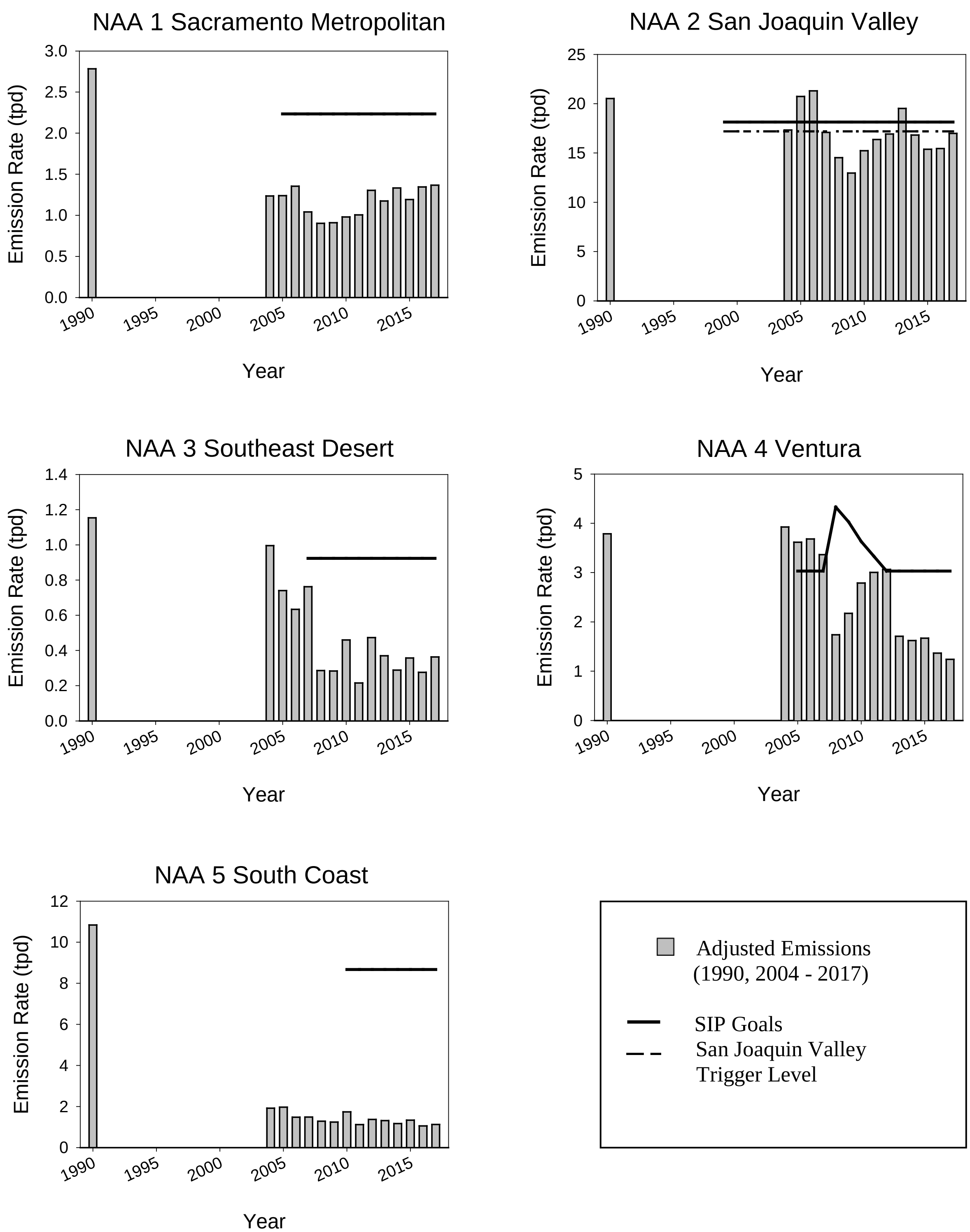

Figure 3. *Adjusted* **1990** and **2004–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions, by NAA. These figures show annual *adjusted* emissions and SIP goals (reduction goals from 1990 emissions)

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Sacramento Metro Area - NAA 1

In the Sacramento Metro NAA (1), adjusted 2017 ozone season VOC emissions increased 2% (0.021 tpd) from 1.346 tpd in 2016 to 1.366 tpd. Total adjusted VOC emissions remains below this NAA's SIP goal of 2.2 tpd (Figure 3; Table 5).

Figure 4 illustrates emissions in 1990 and 2013–2017, categorized as fumigants, nonfumigants with emulsifiable concentrate formulations, and all other nonfumigants. 2017 VOC emissions from nonfumigants decreased slightly, by 1% (0.018 tpd), from 1.239 tpd in 2016 to 1.221 tpd and remain the major contributors of VOC emissions. Nonfumigants contributed 89% of the emissions, and fumigant emissions contributed 11% of the total VOC emissions in this NAA. Although fumigant emissions have increased slightly each year from 2015 to 2017, and increased 37% (0.039 tpd), from 0.106 tpd in 2016 to 0.145 tpd, fumigant emissions remain below 2014 levels of 0.246 tpd (Figure 4; Table 6a).

Table 7 shows increasing VOC emissions from products containing five of the top ten contributing primary AIs in the Sacramento Metro NAA (1) in 2017. The most noticeable changes in emissions were the increases for each of the three highest contributors in 2017 (methyl bromide, deltamethrin, and ethalfluralin). Emissions from products containing these three primary AIs collectively contributed 20% of emissions in this NAA. Figure 5 shows changes in VOC emissions from 2013–2017 for selected primary AIs. The largest percent change in emissions was observed for deltamethrin, which increased 318% (0.062 tpd), from 0.020 tpd in 2016 to 0.082 tpd. Methyl bromide emissions increased 108% (0.055 tpd), and emissions from ethalfluralin products increased 165% (0.049 tpd) from 2016 levels. The largest percent reduction in emissions was observed for propanil products, which decreased 58% (0.071 tpd), from 0.122 tpd to 0.051 tpd. With the exception of propanil products, AIs with decreasing emissions exhibited relative changes of <10% (Figure 5; Tables 7, A3-1a to A3-1d).

Table 8 shows increased emissions from eight of the top ten contributing crops/sites in 2017, compared to 2016 levels and Figure 6 shows changes in emissions from 2013–2017 for selected crops/sites. In the Sacramento Metro Area NAA (1), the most noticeable contribution to 2017 emissions was from rice (15% of total emissions), with substantial contributions from many other sites: structural pest control (11%), walnuts (11%), processing tomatoes (9%), wine grapes (9%), almonds (8%), and uncultivated agricultural areas (7%). Notable percent increases in adjusted emissions since 2016 include a 164% (0.061 tpd) increase in emissions from uncultivated agricultural areas, and a 26% (0.030 tpd) increase from structural pest control. In 2017, adjusted emissions from rice decreased by 42% (0.149 tpd), from 0.354 tpd in 2016 to 0.205 tpd; rice remained the highest contributor of this NAA's VOC emissions (Figure 6; Tables 8, A3-1e to A3-1h).

Table 9 shows this NAA's unadjusted 2017 ozone season VOC emissions using the ARB California Emissions Inventory Data and Research System (CEIDARS) emissions inventory classifications. In 2017, unadjusted emissions from agricultural applications of methyl bromide increased by 124% (0.120 tpd), from 0.097 tpd in 2016 to 0.217 tpd. In contrast, unadjusted emissions from agricultural applications of non-methyl bromide products decreased 9% (0.111 tpd), from 1.233 tpd in 2016 to 1.122 tpd. In 2017, unadjusted emissions from structural applications of non-methyl bromide products increased 26% (0.030 tpd), from 0.117 tpd in 2016 to 0.147 tpd. (Tables 9, A2-1i to A2-1l).

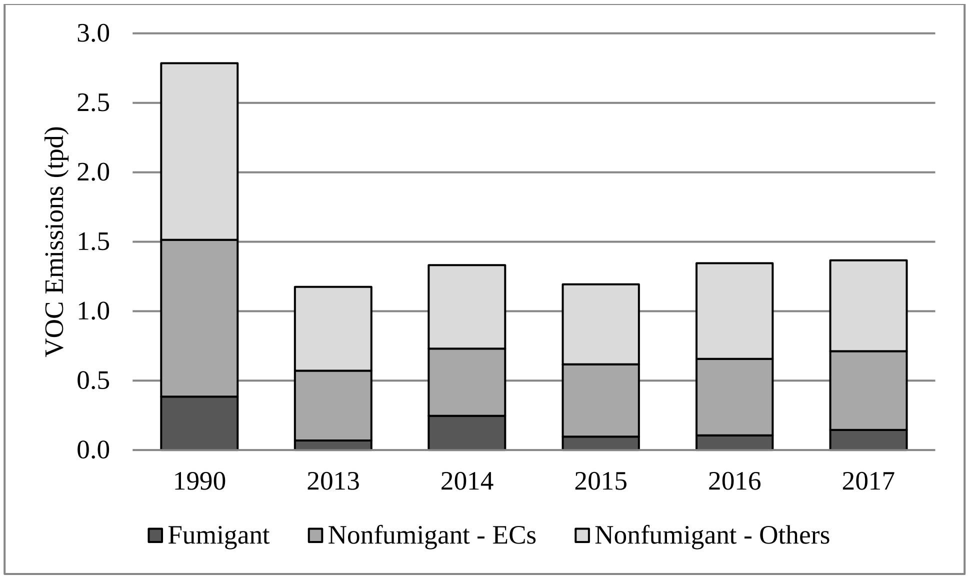

Figure 4. *Adjusted* **1990** and **2013–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions for the Sacramento Metro **NAA (1)**. Emissions for each year are categorized as fumigants, nonfumigants with emulsifiable concentrate formulations (ECs), and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method. The *adjusted* and *unadjusted* VOC emissions for nonfumigants are equivalent.

Table 7. Top ten primary active ingredients contributing to *adjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the Sacramento Metro **NAA (1)**.

Primary AI	2017 Total Product Adjusted Emissions (tpd)	Percent of 2017 Adjusted Emissions	Percent Change from 2016 to 2017	Change from 2016 to 2017 (tpd)
METHYL BROMIDE	0.107	7.814	108	0.055
DELTAMETHRIN	0.082	6.023	318	0.062
ETHALFLURALIN	0.078	5.738	165	0.049
TRIFLURALIN	0.074	5.414	38	0.020
THIOBENCARB	0.071	5.185	-4	-0.003
ABAMECTIN	0.071	5.184	-6	-0.005
BIFENTHRIN	0.053	3.859	25	0.010
PROPANIL	0.051	3.726	-58	-0.071
OXYFLUORFEN	0.041	3.002	-9	-0.004
HEXYTHIAZOX	0.041	2.996	-5	-0.002

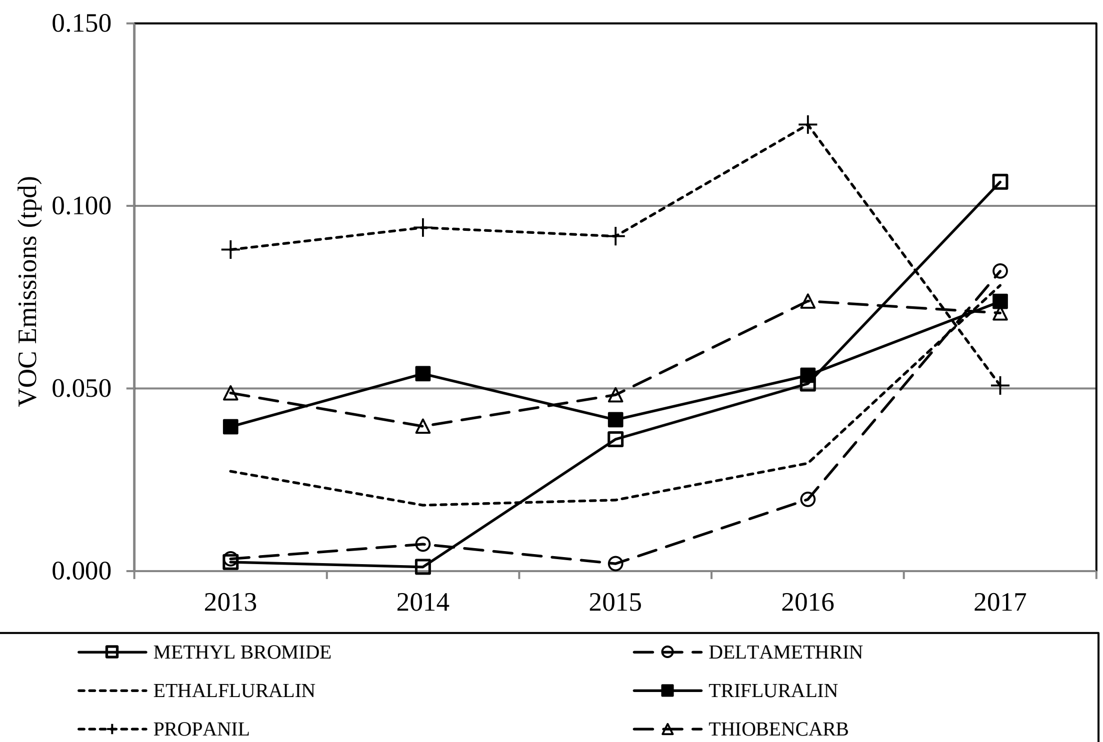

Figure 5. Changes in *adjusted* **2013-2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions from products containing selected primary active ingredients (AIs) in the Sacramento Metro **NAA (1)**.

Table 8. Top ten pesticide application sites contributing to *adjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the Sacramento Metro **NAA (1)**.

Application Site	2017 Total Product Adjusted Emissions (tpd)	Percent of 2017 Adjusted Emissions	Percent Change from 2016 to 2017	Change from 2016 to 2017 (tpd)
RICE (ALL OR UNSPECIFIED)	0.205	15.01	-42	0.055
STRUCTURAL PEST CONTROL	0.147	10.79	26	0.062
WALNUT (ENGLISH, PERSIAN)	0.146	10.68	4	0.049
TOMATOES, FOR PROCESSING/CANNING	0.122	8.90	3	0.020
GRAPES, WINE	0.117	8.54	-2	-0.003
ALMOND	0.111	8.12	2	-0.005
UNCULTIVATED AGRICULTURAL AREAS*	0.098	7.15	164	0.010
SUNFLOWER, GENERAL	0.075	5.52	230	-0.071
SOIL APPLICATION, PREPLANT-OUTDOOR*	0.065	4.78	907	-0.004
LANDSCAPE MAINTENANCE	0.050	3.64	23	0.055

*Treatment of an area prior to a crop being planted.

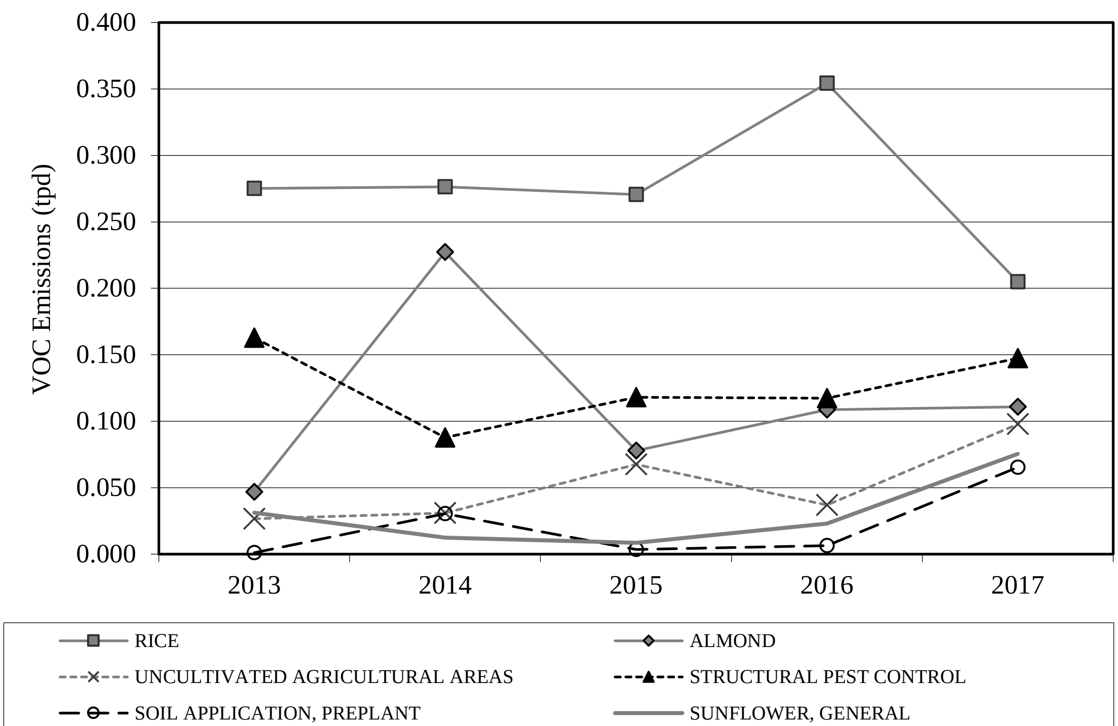

Figure 6. Changes in *adjusted* **2013-2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions from selected crops/sites in the Sacramento Metro **NAA (1)**.

Table 9. *Unadjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the Sacramento Metro **NAA (1)**, by the Air Resources Board (ARB) emissions inventory classification (tpd).

NAA 1 - 2017	Agricultural Applications	Structural Applications
METHYL BROMIDE EMISSIONS	0.217	0.000
NON-METHYL BROMIDE EMISSIONS	1.122	0.147

San Joaquin Valley - NAA 2

The San Joaquin Valley NAA (2) adjusted 2017 ozone season VOC emissions increased by 10% (1.527 tpd), from 15.453 tpd in 2016 to 16.980 tpd in 2017. The 2017 VOC emissions are 6% (1.120 tpd) below this NAA's SIP goal of 18.1 tpd and 1% (0.220 tpd) below the regulatory trigger level, which is 95% of SIP goal, or 17.2 tpd (Figure 3, Table 5).

Figure 7 illustrates emissions in 1990 and 2013–2017, categorized as fumigants, nonfumigants with emulsifiable concentrate formulations, and all other nonfumigants. Nonfumigant emissions accounted for 75% of the total VOC emissions in this NAA in 2017, and increased by 14% (1.544 tpd), from 11.217 tpd in 2016 to 12.761 tpd. Emissions from products with emulsifiable concentrate formulations accounted for 53% (6.754 tpd) of the nonfumigant VOC emissions and 40% of the total VOC emissions for this NAA. From 2016 to 2017, VOC emissions from emulsifiable concentrates increased by 8% (0.475 tpd), from 6.289 tpd in 2016 to 6.764 tpd, while emissions from all other nonfumigant products increased by 22% (1.069 tpd), from 4.928 tpd in 2016 to 5.997 tpd. Conversely, fumigant emissions remained relatively unchanged from 2016 levels (Figure 7; Tables 5, 6a, 6c).

Table 10 shows that VOC emissions from products containing seven of the top ten contributing primary AIs increased between 2016 and 2017. Figure 8 shows changes in emissions from 2013–2017 for selected primary AIs. Together, use of the top ten contributing primary AIs resulted in approximately half of the total VOC emissions in the San Joaquin Valley NAA (2) in 2017. 1,3-dichloropropene products continue to be the single biggest contributors to VOC emissions and accounted for 12% of the total emissions in this NAA (Figure 8; Tables 10, A3-2a to A3-2d).

The largest increase was observed for emissions from potassium n-methyldithiocarbamate, which increased by 45% (0.250 tpd) from 2016 levels. In contrast, VOC emissions from the fumigants methyl bromide and 1,3-dichloropropene, and from nonfumigant products with hexythiazox as the main AI, have decreased since 2016. Products containing these three primary AIs continue to be major contributors to the total adjusted VOC emissions for this NAA, and produced a combined 19% of the total NAA (2) emissions in 2017 (Figure 8; Tables 10, A3-2a to A3-2d).

In 2015, DPR enacted regulations prohibiting certain uses of high-VOC products that contain four primary AIs (abamectin, chlorpyrifos, gibberellins, and oxyfluorfen) in the San Joaquin Valley NAA (2) during the ozone season (3 CCR section 6452.2). In 2017, emissions from abamectin products increased 32% (0.243 tpd), from 0.758 tpd in 2016 to 1.001 tpd. Abamectin products accounted for 6% of this NAA's total emissions. Emissions from chlorpyrifos increased 13% (0.097 tpd), from 0.754 tpd in 2016 to 0.852 tpd, and contributed 5% of this NAA's total emissions. Emissions from products containing oxyfluorfen decreased 3% from 2016 levels, and contributed 2% of the total emissions in this NAA. In addition, emissions from products primarily containing gibberellins decreased by 36% from 2016 levels and contributed <1% of the emissions in this NAA. These decreases may correspond to the prohibition of certain uses of high-VOC products containing these two primary AIs in this NAA (Figure 8; Tables 10, 24, A3-2a to A3-2d). The impact of the prohibitions on products containing these four AIs is discussed further in a later section beginning on page 48.

Total VOC emissions from all glyphosate products increased by 31% (0.224 tpd), from 0.731 tpd in 2016 to 0.955 tpd, and contributed 6% of this NAA's total emissions in 2017. The vast majority (96%) of emissions from glyphosate products in this NAA were from products primarily containing the isopropylamine salt of glyphosate.

Table 11 displays the adjusted 2017 VOC emissions from pesticide products applied to the top-ten contributing crops/sites, which shows that emissions from five of the top ten crops/sites increased and four of the crops/sites decreased from 2016 levels. Figure 9 shows changes in emissions from 2013–2017 for selected crops/sites. The most noticeable increase in emissions were from applications to cotton, which increased 59% (0.759 tpd) from 2016 levels (Figure 9; Tables 11, A3-2e to A3-2h).

Table 12 shows this NAA's unadjusted 2017 VOC emissions using the ARB CEIDARS emissions inventory classifications. In 2017, unadjusted emissions from agricultural applications of methyl bromide decreased 12% (0.133 tpd), from 1.086 tpd in 2016 to 0.952 tpd. In contrast, unadjusted emissions from agricultural applications of non-methyl bromide products increased 5% (1.350 tpd), from 24.760 tpd in 2016 to 26.110 tpd. Emissions from structural applications of methyl bromide continued to be below a reportable level and unadjusted emissions from structural applications of non-methyl bromide products decreased 3% (0.035 tpd), from 0.242 tpd in 2016 to 0.207 tpd. (Tables 12, A2-2i to A2-2l).

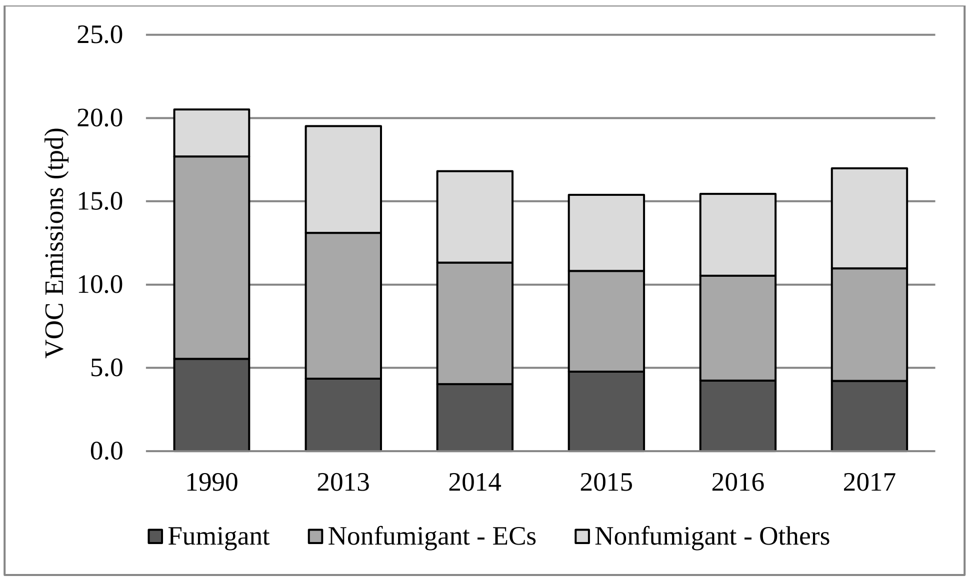

Figure 7. *Adjusted* **1990** and **2013–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions for the San Joaquin Valley **NAA (2)**. Emissions for each year are categorized as fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method. The *adjusted* and *unadjusted* VOC emissions for nonfumigants are equivalent.

Table 10. Top ten primary active ingredients (AIs) contributing to *adjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the San Joaquin Valley **NAA (2)**.

Primary AI	2017 Total Product Adjusted Emissions (tpd)	Percent of 2017 Adjusted Emissions	Percent Change from 2016 to 2017	Change from 2016 to 2017 (tpd)
1,3-DICHLOROPROPENE	1.987	11.86	-8	-0.182
ABAMECTIN	1.001	5.97	32	0.243
GLYPHOSATE, ISOPROPYLAMINE SALT	0.913	5.45	31	0.216
CHLORPYRIFOS	0.852	5.08	13	0.097
POTASSIUM N-METHYLDITHIOCARBAMATE	0.803	4.79	45	0.250
BIFENTHRIN	0.723	4.31	10	0.066
HEXYTHIAZOX	0.645	3.85	-6	-0.042
GLUFOSINATE-AMMONIUM	0.637	3.80	25	0.128
METHYL BROMIDE	0.546	3.26	-10	-0.062
MINERAL OIL	0.450	2.68	52	0.153

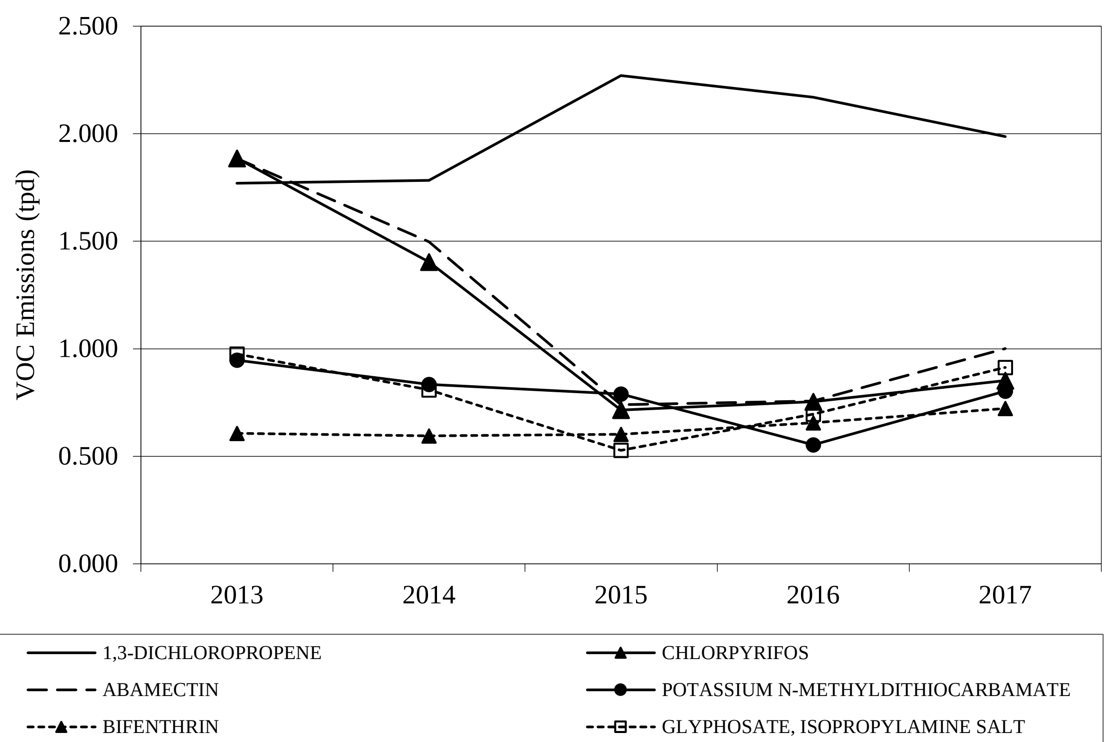

Figure 8. Changes in *adjusted* **2013–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions of selected active ingredients (AIs) in the San Joaquin Valley **NAA (2)**.

Table 11. Top ten pesticide application sites contributing to *adjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the San Joaquin Valley **NAA (2)**.

Application Site	2017 Total Product Adjusted Emissions (tpd)	Percent of 2017 Adjusted Emissions	Percent Change from 2016 to 2017	Change from 2016 to 2017 (tpd)
ALMOND	4.836	28.48	11	0.050
COTTON, GENERAL	2.042	12.03	59	0.027
PISTACHIO	0.974	5.73	21	0.017
CARROTS, GENERAL	0.733	4.32	-12	0.010
ORANGE (ALL OR UNSPECIFIED)	0.732	4.31	-3	0.003
GRAPES	0.716	4.22	29	-0.005
SOIL APPLICATION, PREPLANT-OUTDOOR*	0.674	3.97	-8	0.012
WALNUT (ENGLISH, PERSIAN)	0.662	3.90	0	0.000
TOMATOES FOR PROCESSING/CANNING	0.473	2.79	-15	0.004
GRAPES, WINE	0.450	2.65	3	-0.001

*Treatment of an area prior to a crop being planted.

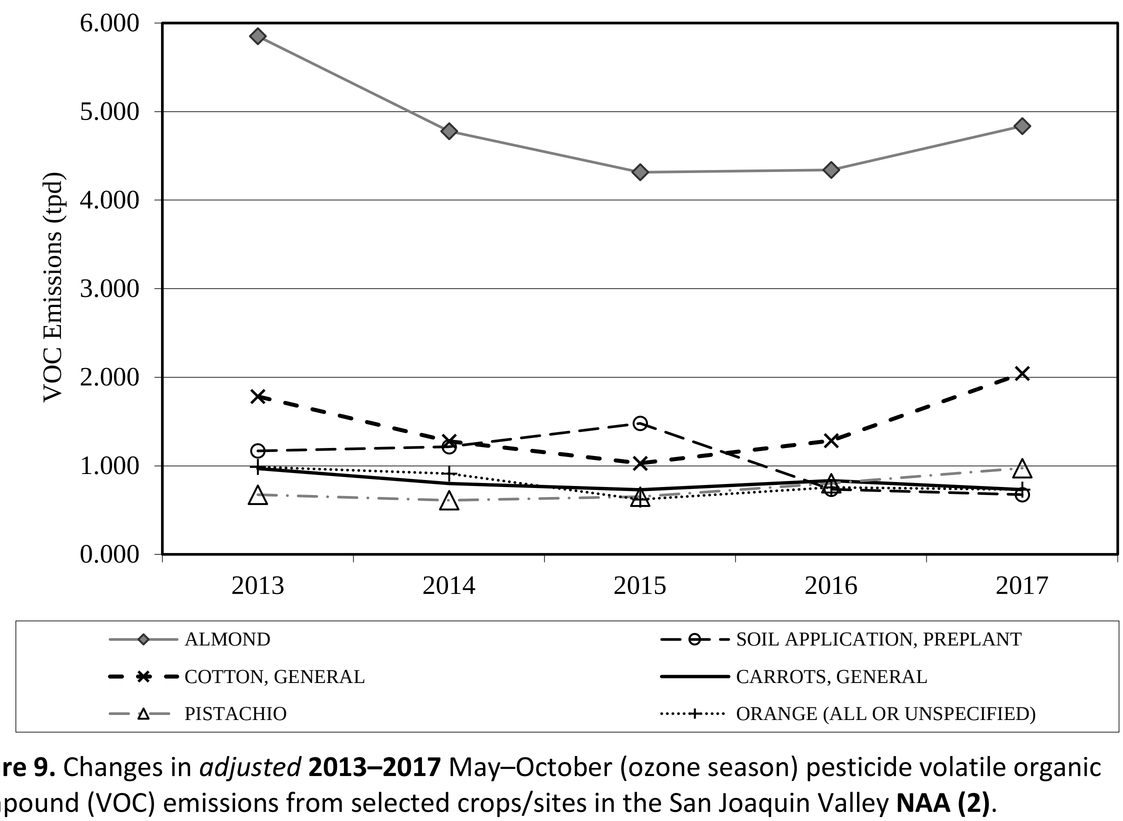

Figure 9. Changes in *adjusted* **2013–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions from selected crops/sites in the San Joaquin Valley **NAA (2)**.

Table 12. *Unadjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the San Joaquin Valley **NAA (2)**, by the Air Resources Board (ARB) emissions inventory classification (tpd).

NAA 2 - 2017	Agricultural Applications	Structural Applications
METHYL BROMIDE EMISSIONS	0.952	0.000
NON-METHYL BROMIDE EMISSIONS	26.110	0.207

Southeast Desert - NAA 3

In the Southeast Desert NAA (3), adjusted 2017 ozone-season VOC emissions increased 32% (0.087 tpd) from 0.276 tpd in 2016 to 0.363 tpd. Total adjusted VOC emissions continue to remain below this NAA's SIP goal of 0.92 tpd (Figure 3; Table 5).

Figure 10 illustrates emissions in 1990 and 2013–2017, categorized as fumigants, nonfumigants with emulsifiable concentrate formulations, and all other nonfumigants. 2017 VOC emissions from nonfumigants increased by 27% (0.055 tpd), from 0.203 tpd in 2016 to 0.257 tpd and remain the major contributors of VOC emissions. Nonfumigants contributed 71% of the emissions, and fumigant emissions contributed 29% of the total VOC emissions in this NAA (Figure 10; Table 6a).

Table 13 shows increasing VOC emissions from eight of the top ten contributing primary AIs in the Southeast Desert NAA (3) in 2017. The most noticeable changes were the relative increases in emissions for each of the three product AIs contributing the highest proportion of emissions in 2017 (metam-sodium, n-octyl bicycloheptene dicarboximide, and the isopropylamine salt of glyphosate). Products containing these three primary AIs collectively contributed 37% of the emissions in this NAA (Table 13). Figure 11 shows changes in VOC emissions from 2013–2017 for selected primary AIs.

Figure 12 shows changes in VOC emissions from 2013–2017 for crops/sites, and Table 14 shows increased emissions from eight of the top ten contributing crops/sites in 2017 compared to 2016 levels. In the Southeast Desert NAA, the most noticeable contribution to 2017 emissions was from structural pest control applications (23% of total emissions), with substantial contributions from fruiting peppers (19%), rights-of-way (10%), landscape maintenance (7%), and ornamental turf (6%).

Table 15 shows this NAA's unadjusted 2017 ozone season VOC emissions using the ARB CEIDARS emissions inventory classifications. In 2017, unadjusted emissions from agricultural applications of methyl bromide decreased by 21% (0.009 tpd), from 0.043 tpd in 2016 to 0.034 tpd. In contrast, unadjusted emissions from agricultural applications of non-methyl bromide products slightly increased 1% (0.003 tpd), from 0.369 tpd in 2016 to 0.372 tpd. In 2017, emissions from structural applications of methyl bromide continued to be unreported, and unadjusted emissions from structural applications of non-methyl bromide products increased 39% (0.0.023 tpd), from 0.059 tpd in 2016 to 0.082 tpd. (Tables 15, A2-3i to A2-3l).

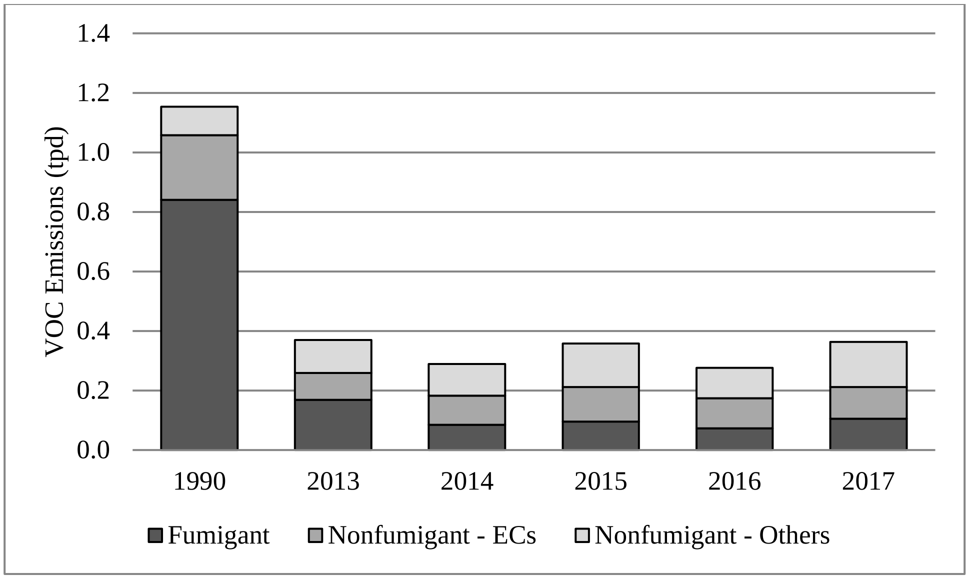

Figure 10. *Adjusted* **1990** and **2013-2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions for the Southeast Desert **NAA (3)**. Emissions for each year are categorized as fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method. The *adjusted* and *unadjusted* VOC emissions for nonfumigants are equivalent.

Table 13. Top ten primary active ingredients (AIs) contributing to *adjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the Southeast Desert **NAA (3)**.

Primary AI	2017 Total Product Adjusted Emissions (tpd)	Percent of 2017 Adjusted Emissions	Percent Change from 2016 to 2017	Change from 2016 to 2017 (tpd)
METAM-SODIUM	0.074	20.51	206	0.023
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	0.032	8.89	500	0.047
GLYPHOSATE, POTASSIUM SALT	0.027	7.57	169	0.000
GLYPHOSATE, ISOPROPYLAMINE SALT	0.024	6.67	69	0.002
BENSULIDE	0.017	4.72	19	0.001
METHYL BROMIDE	0.016	4.53	-22	0.013
DISODIUM OCTABORATE TETRAHYDRATE	0.016	4.43	338	-0.002
DAZOMET	0.014	3.94	2	0.008
CAPRYLIC ACID	0.008	2.27	95	0.012
BIFENTHRIN	0.008	2.18	-8	-0.004

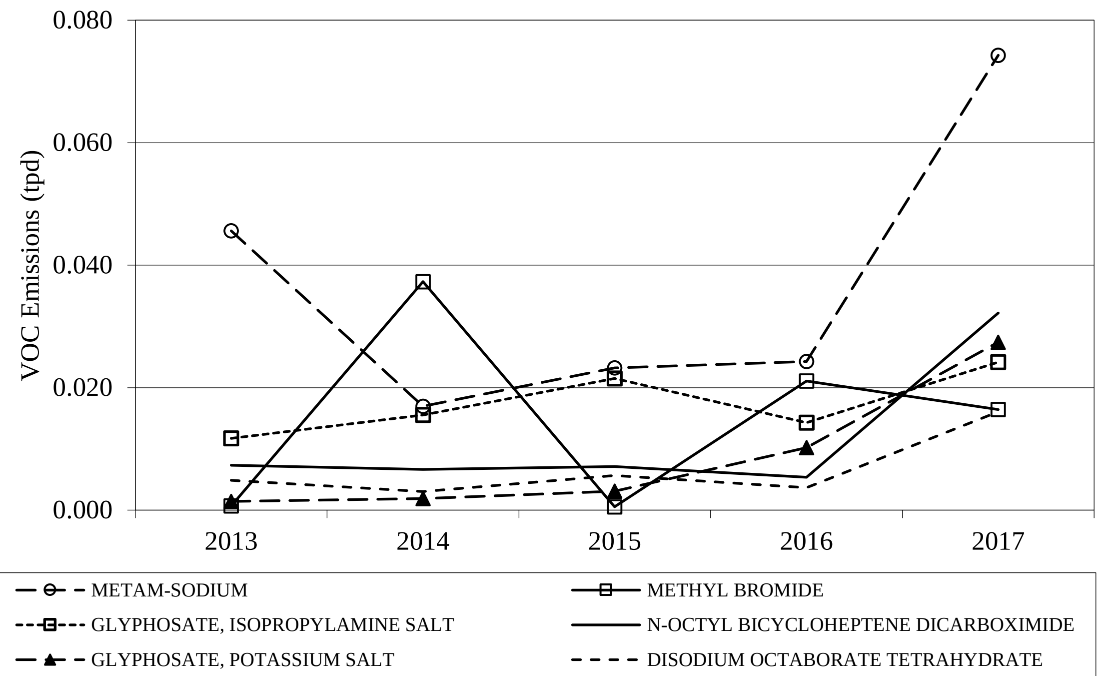

Figure 11. Changes in *adjusted* **2013-2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions of selected active ingredients (AIs) in the Southeast Desert **NAA (3)**.

Table 14. Top ten pesticide application sites contributing to *adjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the Southeast Desert **NAA (3)**.

Application Site	2017 Total Product Adjusted Emissions (tpd)	Percent of 2017 Adjusted Emissions	Percent Change from 2016 to 2017	Change from 2016 to 2017 (tpd)
STRUCTURAL PEST CONTROL	0.082	22.70	39	0.023
PEPPERS (FRUITING VEGETABLE)	0.066	18.28	242	0.047
RIGHTS-OF-WAY	0.035	9.59	<1	<0.001
LANDSCAPE MAINTENANCE	0.024	6.60	9	0.002
ORNAMENTAL TURF	0.023	6.31	4	0.001
LETTUCE, LEAF (ALL OR UNSPECIFIED)	0.020	5.64	166	0.013
CARROTS, GENERAL	0.020	5.49	-7	-0.002
UNCULTIVATED AGRICULTURAL AREAS*	0.016	4.36	109	0.008
ALFALFA (FORAGE - FODDER) (HAY)	0.015	4.01	519	0.012
LEMON	0.010	2.77	-27	-0.004

*Treatment of an area prior to a crop being planted.

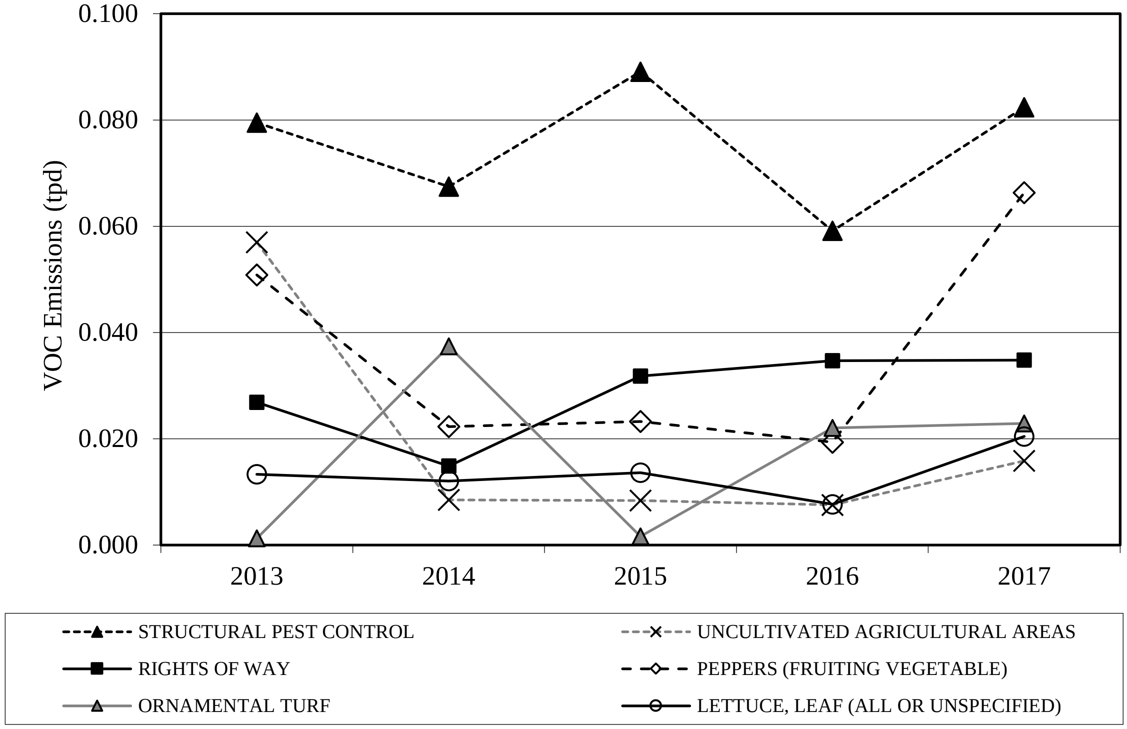

Figure 12. Changes in *adjusted* **2013–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions from selected crops/sites in the Southeast Desert **NAA (3).**

Table 15. *Unadjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the Southeast Desert **NAA (3)**, by the Air Resources Board (ARB) emissions inventory classification (tpd).

NAA 3 - 2017	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	0.034	0.000
NON-METHYL BROMIDE EMISSIONS	0.372	0.082

Ventura - NAA 4

Ventura NAA (4) adjusted 2017 ozone season VOC emissions decreased by 9% (0.125 tpd), from 1.365 tpd in 2016 to 1.240 tpd in 2017. Pesticide VOC emissions in 2017 were 67% lower than the 1990 base year and remained well below this NAA's SIP goal of 3.0 tpd (Figure 3, Table 5).

Figure 13 shows that fumigants contributed 58% of this NAA's VOC emissions in 2017. Fumigant emissions decreased by 23% (0.218 tpd), from 0.942 tpd in 2016 to 0.724 tpd, which is the lowest amount recorded since adjusted emissions calculations began in 2004. Nonfumigant emissions increased by 22% (0.093 tpd), from 0.423 tpd in 2016 to 0.516 tpd (Figure 13; Tables 5, 6a). Table 16 shows that eight of the top ten primary AIs contributing to this NAA's VOC emissions increased from 2016 levels. In 2017, 43% of this NAA's emissions were attributed to applications of chloropicrin (32%) and 1,3-dichloropropene (11%).

Figure 14 shows changes in VOC emissions from 2013–2017 for selected primary AIs. A sharp reduction was observed for methyl bromide emissions, by 97% (0.199 tpd), from 0.204 tpd in 2016 to 0.005 tpd. This was due to the expiration of the 2016 critical use exemption for methyl bromide use on California strawberries. Emissions of methyl bromide in this NAA (4) in 2016 were contributed almost entirely (97%) by strawberry applications. In contrast, no use of methyl bromide was reported on strawberries in this NAA during the 2017 ozone season (Figure 14; Tables 16, A3-4a to A3-4d).

Table 17 shows that six of the top ten contributing crops/sites had increasing emissions in 2017, compared to 2016 levels and Figure 15 shows changes in VOC emissions from 2013–2017 for selected crops/sites. Other notable crops/sites for emissions in 2017 include avocados, rights-of-way, landscape maintenance, and celery (Figure 15; Tables 17, A3-4e to A3-4g).

Table 18 shows this NAA's unadjusted 2017 VOC emissions using the ARB CEIDARS emissions inventory classifications. In 2017, unadjusted emissions from agricultural applications of methyl bromide decreased 99% (0.419 tpd), from 0.425 tpd in 2016 to 0.006 tpd. In contrast, unadjusted emissions from agricultural applications of non-methyl bromide products increased 8% (0.500 tpd), from 5.951 tpd in 2016 to 6.451 tpd.

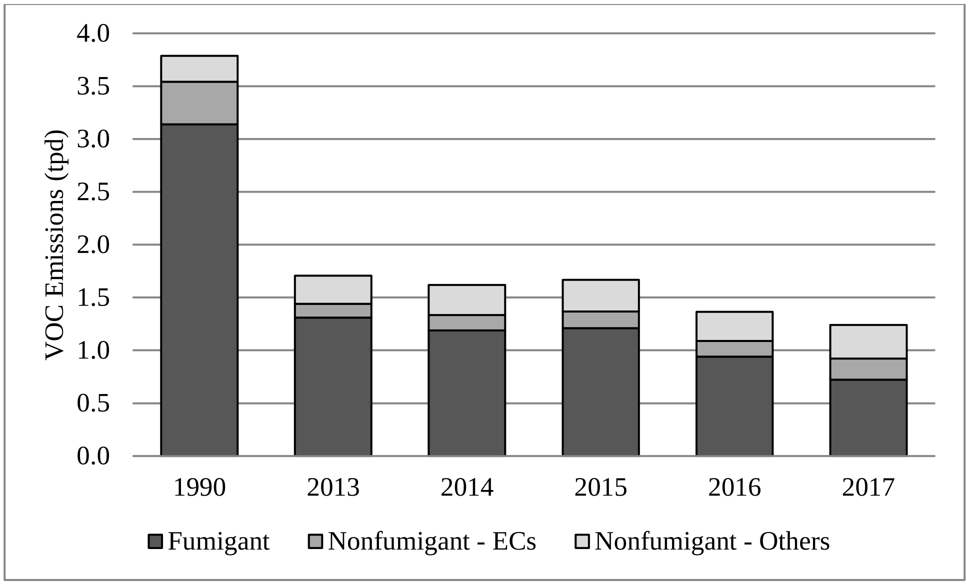

Figure 13. *Adjusted* **1990** and **2013–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions for the Ventura **NAA (4)**. Emissions for each year are categorized as fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method. The *adjusted* and *unadjusted* VOC emissions for nonfumigants are equivalent.

Table 16. Top ten primary active ingredients contributing to *adjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the Ventura **NAA (4)**.

Primary AI	2017 Total Product Adjusted Emissions (tpd)	Percent of 2017 Adjusted Emissions	Percent Change from 2016 to 2017	Change from 2016 to 2017 (tpd)
CHLOROPICRIN	0.329	31.98	-5	-0.019
1,3-DICHLOROPROPENE	0.114	11.08	-16	-0.022
MINERAL OIL	0.068	6.60	0	0.000
ABAMECTIN	0.067	6.51	234	0.047
CHLORPYRIFOS	0.038	3.71	16	0.005
METAM-SODIUM	0.036	3.52	61	0.014
THIRAM	0.028	2.70	804	0.025
POTASSIUM N-METHYLDITHIOCARBAMATE	0.021	2.03	171	0.013
GLYPHOSATE, ISOPROPYLAMINE SALT	0.017	1.68	113	0.009
CAPTAN	0.017	1.63	59	0.006

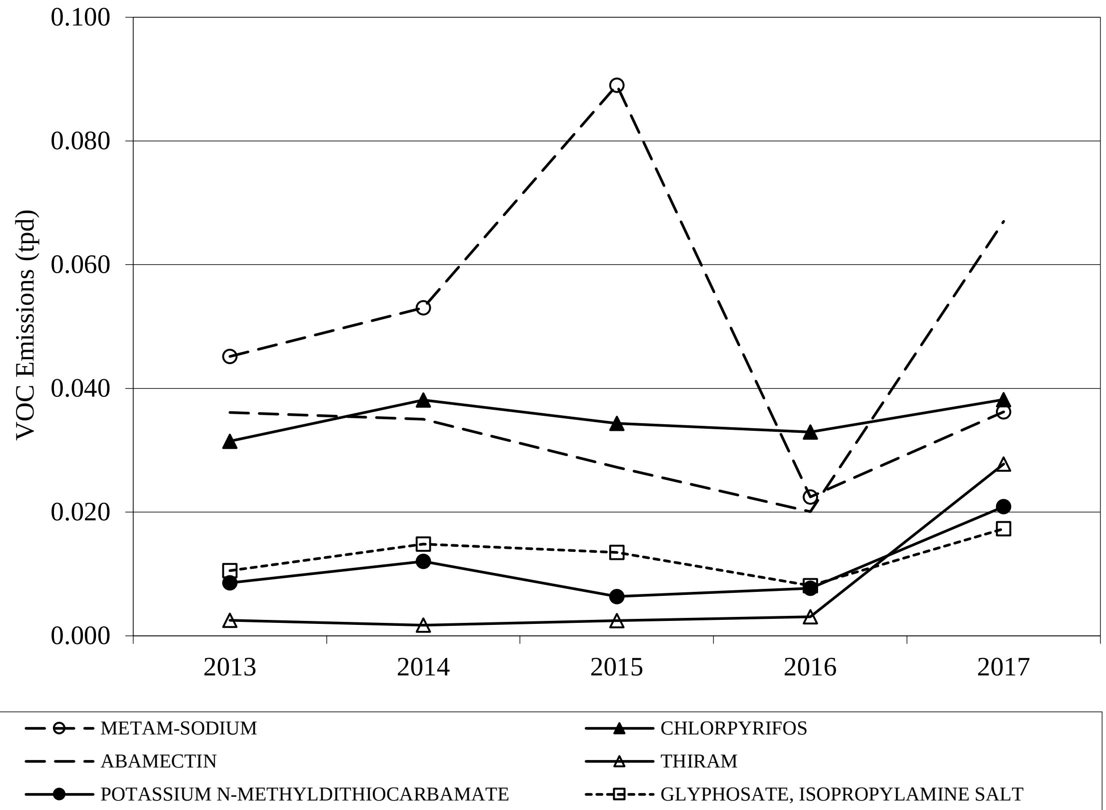

Figure 14. Changes in *adjusted* **2013–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions of selected active ingredients (AIs) in the Ventura **NAA (4)**.

Table 17. Top ten pesticide application sites contributing to *adjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the Ventura **NAA (4)**.

Application Site	2017 Total Product Adjusted Emissions (tpd)	Percent of 2017 Adjusted Emissions	Percent Change from 2016 to 2017	Change from 2016 to 2017 (tpd)
STRAWBERRY (ALL OR UNSPECIFIED)	0.760	61.29	-19	-0.184
LEMON	0.119	9.63	-3	-0.003
AVOCADO (ALL OR UNSPECIFIED)	0.067	5.44	299	0.050
RASPBERRY (ALL OR UNSPECIFIED)	0.029	2.30	-19	-0.007
CELERY, GENERAL	0.025	2.05	67	0.010
STRUCTURAL PEST CONTROL	0.025	2.03	40	0.007
PEPPERS (FRUITING VEGETABLE)	0.021	1.72	-56	-0.027
LANDSCAPE MAINTENANCE	0.020	1.63	102	0.010
CABBAGE	0.017	1.34	21	0.003
RIGHTS-OF-WAY	0.016	1.27	455	0.013

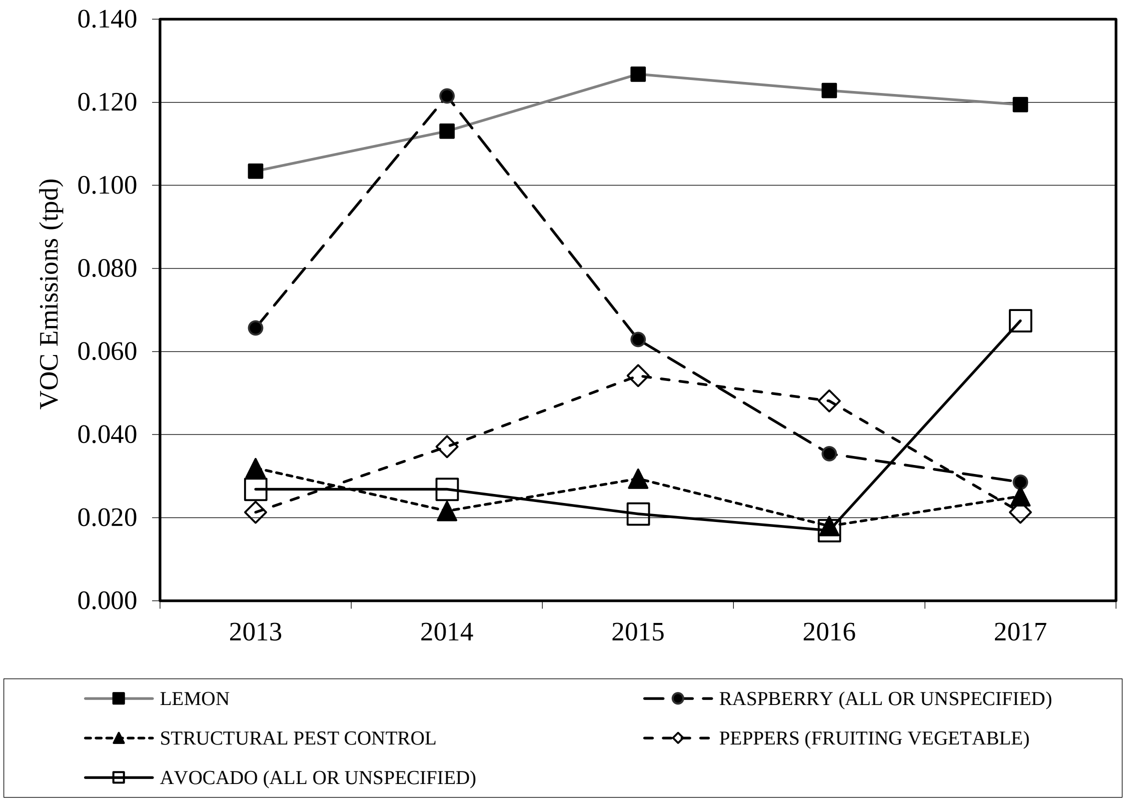

Figure 15. Changes in *adjusted* **2013–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions from selected crops/sites in the Ventura **NAA (4)**.

Table 18. *Unadjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the Ventura **NAA (4)**, by the Air Resources Board (ARB) emissions inventory classification (tpd)**.**

NAA 4 - 2017	Agricultural Applications	Structural Applications
METHYL BROMIDE EMISSIONS	0.006	0.000
NON-METHYL BROMIDE EMISSIONS	6.451	0.025

South Coast - NAA 5

South Coast NAA (5) adjusted 2017 ozone-season VOC emissions increased by 7% (0.072 tpd), from 1.053 tpd in 2016 to 1.125 tpd, which is well below this NAA's SIP goal of 8.7 tpd (Figure 3, Table 5).

Figure 16 shows that nonfumigant products continued to dominate the South Coast NAA (5) VOC emissions, in contrast to the large proportion of the emissions contributed by fumigants in the baseline year, 1990. In 2017, emissions from nonfumigants accounted for 83% of this NAA's emissions, increasing 20% (0.156 tpd), from 0.779 tpd in 2016 to 0.935 tpd (Figure 16; Table 6a).

Table 19 shows that three of the top ten primary AIs contributing to this NAA's VOC emissions increased from 2016 levels. The largest increase was a 181% (0.156 tpd) increase in emissions from N-octyl bicycloheptene dicarboximide. Figure 17 shows changes in VOC emissions from 2013–2017 for selected primary AIs and Figure 18 shows changes in emissions for selected crops/sites.

Table 20 shows increasing emissions from seven of the top ten contributing crops/sites compared to 2016 levels. Structural pest control pesticide applications contributed 54% of this NAA's emissions, which increased 19% (0.098 tpd), from 0.515 tpd in 2016 to 0.612 tpd in 2017 (Table 20).

Table 21 shows this NAA's unadjusted 2017 VOC emissions using the ARB CEIDARS emissions inventory classifications. In 2017, unadjusted emissions from agricultural applications of methyl bromide decreased 72% (0.167 tpd), from 0.232 tpd in 2016 to 0.065 tpd. In contrast, unadjusted emissions from agricultural applications of non-methyl bromide products increased 107% (0.458 tpd), from 0.428 tpd in 2016 to 0.886 tpd. Emissions from structural applications of methyl bromide continued to be unreported and unadjusted emissions from structural applications of non-methyl bromide products increased 19% (0.098 tpd), from 0.515 tpd in 2016 to 0.613 tpd. (Tables 21, A2-5i to A2-5l).

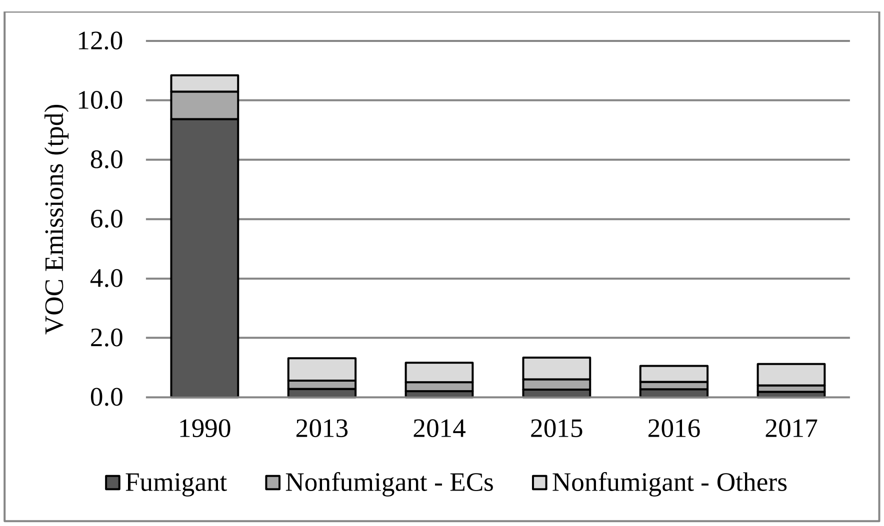

Figure 16. *Adjusted* **1990** and **2013–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions for the South Coast **NAA (5)**. Emissions for each year are categorized as fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method. The *adjusted* and *unadjusted* VOC emissions for nonfumigants are equivalent.

Table 19. Top ten primary active ingredients contributing to *adjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the South Coast **NAA (5)**.

Primary AI	2017 Total Product Adjusted Emissions (tpd)	Percent of 2017 Adjusted Emissions	Percent Change from 2016 to 2017	Change from 2016 to 2017 (tpd)
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	0.242	21.62	181	0.156
DISODIUM OCTABORATE TETRAHYDRATE	0.090	8.00	29	0.020
METHYL BROMIDE	0.065	5.82	-58	-0.089
METAM-SODIUM	0.063	5.64	-25	-0.022
BIFENTHRIN	0.049	4.35	-17	-0.010
PIPERONYL BUTOXIDE	0.037	3.35	-9	-0.004
GLYPHOSATE, POTASSIUM SALT	0.037	3.30	27	0.008
CYFLUTHRIN	0.028	2.53	-10	-0.003
IMIDACLOPRID	0.026	2.37	-9	-0.003
PERMETHRIN	0.024	2.18	-41	-0.017

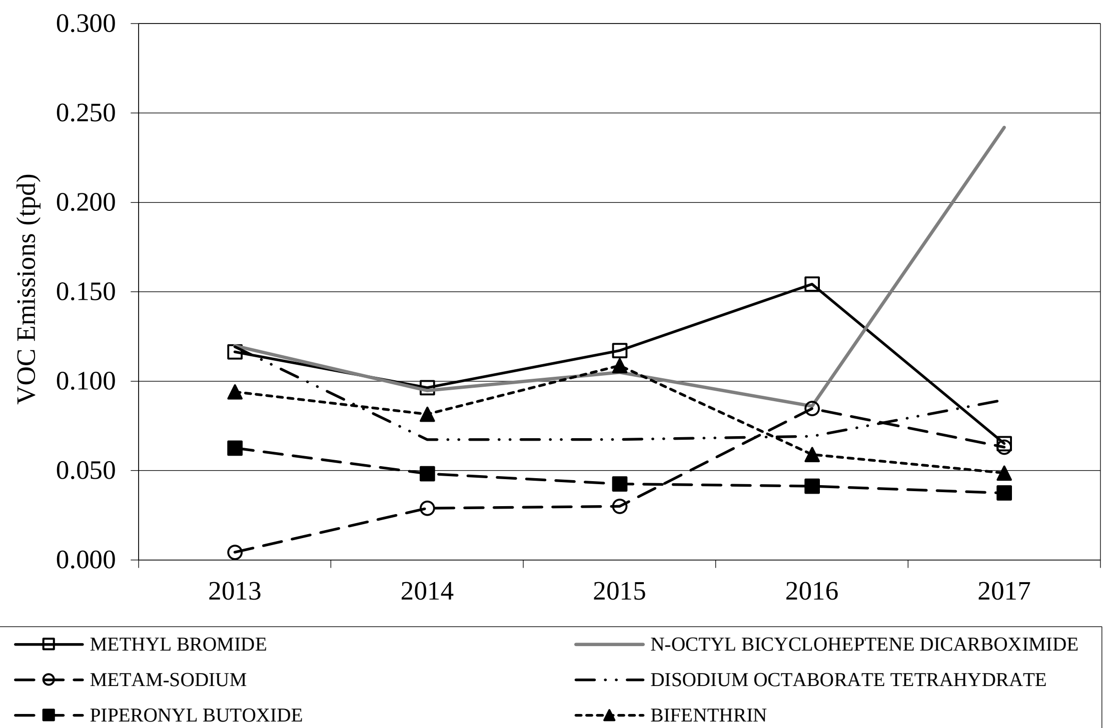

Figure 17. Changes in *adjusted* **2013–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions of selected active ingredients (AIs) in the South Coast **NAA (5)**.

Table 20. Top ten pesticide application sites contributing to *adjusted* **2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions in the South Coast **NAA (5)**.

Application Site	2017 Total Product Adjusted Emissions (tpd)	Percent of 2017 Adjusted Emissions	Percent Change from 2016 to 2017	Change from 2016 to 2017 (tpd)
STRUCTURAL PEST CONTROL	0.612	54.42	19	0.098
LANDSCAPE MAINTENANCE	0.189	16.80	27	0.040
RIGHTS-OF-WAY	0.103	9.17	25	0.020
FUMIGATION, OTHER	0.040	3.55	-31	-0.018
STRAWBERRY (ALL OR UNSPECIFIED)	0.039	3.48	-56	-0.051
CARROTS, GENERAL	0.026	2.29	-52	-0.028
COMMODITY FUMIGATION	0.025	2.25	2	0.001
N-OUTDR CONTAINER/FIELD GRWN PLANTS	0.015	1.35	18	0.002
AVOCADO (ALL OR UNSPECIFIED)	0.010	0.93	45	0.003
GRAPEFRUIT	0.009	0.84	140	0.006

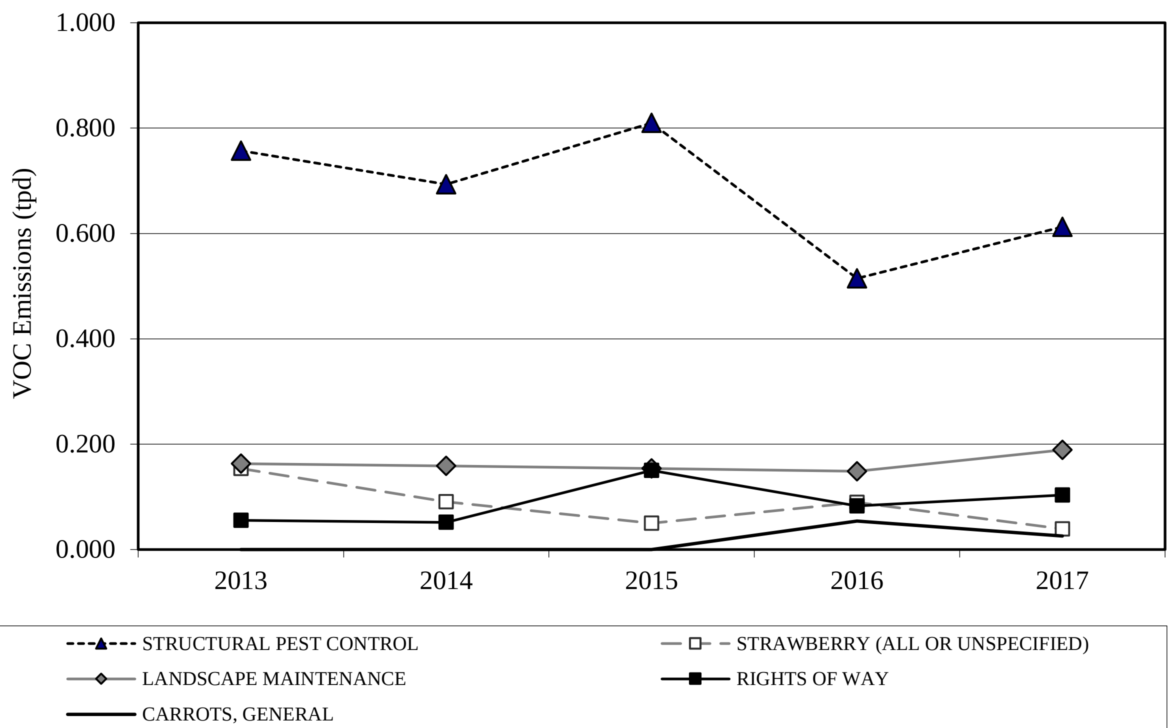

Figure 18. Changes in *adjusted* **2013–2017** May–October (ozone season) pesticide volatile organic compound (VOC) emissions from selected commodities/sites in the South Coast **NAA (5)**.

Table 21. *Unadjusted* **2017** May–October (ozone season) volatile organic compound (VOC) emissions in the South Coast **NAA (5)**, by the Air Resources Board (ARB) emissions inventory classification (tpd).

NAA 5 - 2017	Agricultural Applications	Structural Applications
METHYL BROMIDE EMISSIONS	0.065	0.000
NON-METHYL BROMIDE EMISSIONS	0.886	0.613

VOLATILE ORGANIC COMPOUND EMISSIONS RELATIVE TO LEVELS THAT TRIGGER ADDITIONAL RESTRICTIONS

DPR is required to implement additional VOC restrictions if pesticide VOC emissions exceed 95% of the benchmarks specified in 3 CCR section 6452.2. As shown in Table 22, pesticide VOC emissions in 2017 were less than 95% of the SIP goal benchmarks that trigger additional restrictions in all five NAAs.

Table 22. Trigger levels and **2017** pesticide volatile organic compound (VOC) emissions.

NAA	Benchmark and SIP Goal (tpd)	Trigger Level (95% of Benchmark) (tpd)	2017 Emissions (tpd)
1 – Sacramento Metro	2.2	2.1	1.366
2 – San Joaquin Valley	18.1	17.2	16.980
3 – Southeast Desert	0.92	0.87	0.363
4 – Ventura	3.0	2.85	1.240
5 – South Coast	8.7	8.3	1.125

Adjusted emissions reported in the 2013 VOC Emissions Inventory Report for the San Joaquin Valley NAA exceeded the trigger level by 0.183 tpd. Inventory calculations for 2013 emissions in the San Joaquin Valley NAA as calculated in the 2014 VOC Inventory increased to 19.518 tpd, which is 2.318 tpd above the trigger level. This increase was largely due to revised thermogravimetrically derived EP values for fenpyroximate and hexythiazox products with emulsifiable concentrate formulations. Exceedance of the trigger level as reflected for San Joaquin Valley NAA (2) in the 2013 VOC emissions inventory required a prohibition of certain uses of designated nonfumigant high-VOC products. These prohibitions are discussed in the next section.

NONFUMIGANT PRODUCTS DESIGNATED AS HIGH-VOC AND LOW-VOC AND RESTRICTIONS FOR THE SAN JOAQUIN VALLEY

Regulations to reduce VOC emissions from certain nonfumigant pesticide products establish criteria to designate certain agricultural products as high-VOC, and these products have restrictions on sales and prohibitions on use when emission limits are triggered. 3 CCR section 6880 establishes the following EP thresholds to designate agricultural products as high-VOC or low-VOC:

Table 23. Emission potential (EP) thresholds for agricultural products with abamectin, chlorpyrifos, gibberellins or oxyfluorfen as the primary active ingredient (AI).

Primary AI	EP Threshold (%)
Abamectin	35
Chlorpyrifos	25
Gibberellins	25
Oxyfluorfen	15

If a product contains more than one AI, the primary AI is the one present at the highest percentage in a product. These criteria do not apply to products that contain an AI listed above, but not as the primary AI, including products with one or more AIs present at the same percentage.

Products labeled only for non-agricultural uses are excluded from the proposed regulations. 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. DPR classifies products containing any of the four pesticides listed above into three groups:

High-VOC product: a) contains any of the four pesticides as a primary AI; and b) labeled for agricultural use; and c) the EP is greater than the threshold.

Low-VOC product: a) contains any of the four pesticides as a primary AI; and b) labeled for agricultural use; and c) the EP is equal to or less than the threshold.

Excluded product: a) contains any of the four pesticides, but not as a primary AI; or b) labeled for non-agricultural use only.

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

A key restriction (3 CCR section 6883) requires growers to obtain a recommendation from a pest control adviser for the following:

- High-VOC products containing abamectin, chlorpyrifos, gibberellins, or oxyfluorfen; and
- Applied in San Joaquin Valley; and
- Applied between May 1 and October 31; and
- Application made to alfalfa, almonds, citrus, cotton, grapes, pistachios, or walnuts.

DPR's 2013 pesticide VOC emissions inventory for the San Joaquin Valley NAA (2) exceeded both the SIP goal and the VOC regulation benchmark. Therefore, in 2014, DPR enacted prohibitions of certain uses of designated high-VOC products during the periods May 1 through October 31 of 2015 and 2016, as required by 3 CCR section 6452.2(f), with the following exceptions included in the regulations:

- 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 (⅛) pounds of AI per acre or less.
- Uses for which the U.S. 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 U.S. Department of Agriculture, the California Department of Food and Agriculture, or county agricultural commissioner 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.

Prohibitions on the use of high-VOC products with abamectin, chlorpyrifos, gibberellins and oxyfluorfen AIs on alfalfa, almonds, citrus, cotton, grapes, pistachios and walnuts were in effect between May 1 and October 31 during 2016 and 2017.

Table 24 shows contributions of each of the four primary AIs (abamectin, chlorpyrifos, gibberellins, and oxyfluorfen) subject to San Joaquin Valley NAA (2) nonfumigant regulations. These four primary AIs contributed a combined 16% of the total VOC emissions in this NAA in 2017.

Table 25 shows the 2016 and 2017 total ozone season pesticide VOC emissions from products designated as high- and low-VOC for each primary active ingredient subject to the nonfumigant regulations (3 CCR section 6880), as well as the combined the high- and low-VOC product emissions totals. In 2017, combined emissions from high-VOC products increased 6% (0.035 tpd), from 0.608 tpd in 2016 to 0.643 tpd. During the same period, combined emissions from low-VOC products increased by 42% (0.253 tpd), from 1.431 tpd in 2016 to 1.684 tpd (Table 25).

Table 26 shows 2016 and 2017 emissions from high- and low-VOC products applied to seven target crops/sites subject to the nonfumigant regulatory restrictions in the San Joaquin Valley NAA (2). The greatest reductions in high-VOC product emissions included a 27% (0.041 tpd) decrease in emissions from applications of gibberellins products on citrus. The largest increases in high-VOC product emissions included a 146% (0.064 tpd) increase in high-VOC emissions for chlorpyrifos products on cotton and a 270% (0.016 tpd) increase in emissions from chlorpyrifos products (Table 26).

Table 27 shows increases in the use of abamectin and chlorpyrifos in 2016, compared to 2017 levels. In 2017, over 3.3 million pounds of products containing abamectin, chlorpyrifos, gibberellin and oxyfluorfen as the primary AI were used in the San Joaquin Valley NAA (2), compared to 2.9 million pounds in 2016.

Table 24. Abamectin, chlorpyrifos, gibberellins and oxyfluorfen contributions to **2017** May–October ozone season *adjusted* volatile organic compound (VOC) emissions in the San Joaquin Valley **NAA (2)**.

Primary AI	2017 Total Product Adjusted Emissions (tpd)	Percent of 2017 Adjusted Emissions	Percent Change from 2016 to 2017
ABAMECTIN	1.001	5.97	32
CHLORPYRIFOS	0.852	5.08	13
GIBBERELLINS	0.067	0.40	-36
OXYFLUORFEN	0.408	2.43	-3

Table 25. Emissions from **2016** and **2017** applications of high- and low-VOC products containing the active ingredients (AIs) abamectin, chlorpyrifos, gibberellins and oxyfluorfen on all commodity sites in the San Joaquin Valley **NAA (2)**.

Primary AI	Total Emissions (tpd)		Percent of Emissions from All Products with this Active Ingredient		Percent of Total Nonfumigant Emissions	
	2016	2017	2016	2017	2016	2017
ABAMECTIN						
High-VOC	0.114	0.130	15.1%	13.0%	1.0%	1.0%
Low-VOC	0.643	0.871	84.9%	87.0%	5.7%	6.8%
CHLORPYRIFOS						
High-VOC	0.063	0.136	8.4%	15.9%	0.6%	1.1%
Low-VOC	0.691	0.716	91.6%	84.1%	6.2%	5.6%
GIBBERELLINS						
High-VOC	0.054	0.010	51.0%	14.5%	0.5%	0.1%
Low-VOC	0.051	0.057	49.0%	85.5%	0.5%	0.4%
OXYFLUORFEN						
High-VOC	0.377	0.368	89.3%	90.2%	3.4%	2.9%
Low-VOC	0.045	0.040	10.7%	9.8%	0.4%	0.3%
COMBINED						
High-VOC	0.608	0.643	29.8%	27.6%	5.4%	5.0%
Low-VOC	1.431	1.684	70.2%	72.4%	12.8%	13.2%

Table 26. Emissions from **2016** and **2017** applications of high- and low-VOC products containing the active ingredients (AIs) abamectin, chlorpyrifos, gibberellins and oxyfluorfen on alfalfa, almonds, citrus, cotton, grapes, pistachios, and walnuts in the San Joaquin Valley **NAA (2)**.

Primary AI	Total Emissions from High- and Low- VOC Products (tpd)																	
	Alfalfa		Almond		Citrus*		Cotton		Grape[†]		Pistachio		Walnut		Total		All Crops	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	**2016**	**2017**
High-VOC																		
ABAMECTIN	<0.001	<0.001	0.020	0.023	0.021	0.028	0.004	0.002	0.013	0.012	<0.001	<0.001	0.001	<0.001	0.059	0.066	0.114	0.130
CHLORPYRIFOS	<0.001	0.001	0.006	0.022	0.009	<0.001	0.044	0.108		<0.001			0.001	0.001	0.060	0.132	0.063	0.136
GIBBERELLINS					0.005	0.001			0.048	0.008					0.053	0.009	0.054	0.010
OXYFLUORFEN	<0.001	<0.001	0.263	0.249	0.001	0.001	0.001	0.002	0.010	0.013	0.029	0.028	0.036	0.037	0.338	0.329	0.377	0.368
TOTAL	<0.001	0.001	0.289	0.294	0.035	0.030	0.049	0.112	0.071	0.033	0.029	0.028	0.038	0.039	0.511	0.536	0.608	0.643
Low-VOC																		
ABAMECTIN	<0.001	<0.001	0.291	0.401	0.046	0.051	0.067	0.140	0.109	0.127	0.001	0.004	0.053	0.048	0.566	0.772	0.643	0.871
CHLORPYRIFOS	0.058	0.067	0.108	0.144	0.296	0.255	0.093	0.132	0.052	0.053			0.060	0.048	0.668	0.699	0.691	0.716
GIBBERELLINS			<0.001		0.034	0.038			0.017	0.017		<0.001			0.051	0.055	0.051	0.057
OXYFLUORFEN			0.021	0.019	<0.001	<0.001	0.001	0.001	0.005	0.006	0.007	0.005	0.003	0.004	0.038	0.034	0.045	0.040
TOTAL	0.059	0.067	0.420	0.563	0.376	0.344	0.161	0.272	0.182	0.204	0.009	0.009	0.116	0.100	1.323	1.560	1.431	1.684

*Citrus comprises the following commodity sites reported in 2017: citrus fruits, grapefruit, lemon, lime, orange, pomelo, tangelo, tangerine (mandarin, satsuma, murcott, etc.).

[†]Grape comprises the following commodity sites reported in 2017: grapes; grapes, wine.

Table 27. Pounds of product and active ingredient (AI) used and volatile organic compound (VOC) emissions in the San Joaquin Valley **NAA (2)** from **2016** to **2017**.

Primary AI		**2016**	**2017**	**Change**
ABAMECTIN	Products (lbs x 10^3)	1,027	1,348	321
	Active Ingredient (lbs x 10^3)	25	34	9
	VOC/product (lbs/lb)	0.270	0.272	0.002 (1%)
CHLORPYRIFOS	Products (lbs x 10^3)	1,305	1,437	132
	Active Ingredient (lbs x 10^3)	516	574	58
	VOC/product (lbs/lb)	0.212	0.217	0.005 (3%)
GIBBERELLINS	Products (lbs x 10^3)	154	156	1
	Active Ingredient (lbs x 10^3)	14	13	<1
	VOC/product (lbs/lb)	0.250	0.158	-0.092 (-37%)
OXYFLUORFEN	Products (lbs x 10^3)	418	389	-29
	Active Ingredient (lbs x 10^3)	124	116	-8
	VOC/product (lbs/lb)	0.370	0.384	0.014 (4%)
COMBINED	**Products (lbs x 10^3)**	2,903	3,329	425
	Active Ingredient (lbs x 10^3)	679	737	57
	VOC/product (lbs/lb)	0.257	0.256	-0.001 (-1%)

If prohibitions for high-VOC nonfumigant products are in effect, those prohibitions must remain in effect until the hypothetical VOC emissions shown in the Annual VOC Emissions Inventory Report comply with the limit specified in 3 CCR section 6452.2(f) for at least two consecutive years. The hypothetical VOC emissions during a year of prohibitions shall be calculated for each AI used on each crop specified in 3 CCR section 6884. The hypothetical emissions shall be calculated by assuming the relative mixture of high- and low-VOC products used in the current year of prohibitions would have been the same as in the most recent year without prohibitions. The VOC emissions are then calculated using that product mixture for the amount of AI used in the current year.

The following formula is used to calculate the hypothetical VOC emissions described above for each pesticide-crop combination:

$$\text{Hypothetical emissions for a pesticide-crop combination listed in section 6884 during May–Oct for the year of prohibitions } \textbf{\textit{(Table 28 column D)}} = \frac{\text{Emissions for the pesticide-crop combination during May–Oct for the most current year without prohibitions } \textbf{\textit{(Table 28 column A)}} \times \text{Pounds active ingredient for the crop during May–Oct for the year of prohibitions } \textbf{\textit{(Table 28 column B)}}}{\text{Pounds active ingredient for the crop during May–Oct for the most current year without prohibitions } \textbf{\textit{(Table 28 column C)}}}$$

Table 28 details the hypothetical emissions for 2017 calculated using the formula above. The total hypothetical emissions for the pesticides and crops listed in section 6880 for 2017 are 4.259 tpd, which is 2.163 tpd more than the actual inventory emissions. Total hypothetical VOC emissions equal the sum of the hypothetical emissions for each pesticide-crop combination, plus the actual VOC emissions for the remaining pesticides and crops not listed in section 6880:

Total hypothetical VOC emissions = 4.259 + 16.980 – 2.096 tpd

Therefore, the total 2017 hypothetical VOC emissions are equal to 19.143 tpd, which exceeds the SIP Goal, and exceeds the VOC regulation benchmark of 17.2 tpd, by 11% (1.943 tpd).

The high-VOC prohibitions were not in effect during 2014, so the actual and hypothetical pesticide VOC emissions are the same for that year, 16.811 tpd. As specified in 3 CCR section 6452.2(f), the hypothetical emissions must be less than the trigger level for at least two consecutive years before DPR can lift the high-VOC prohibitions. DPR made a preliminary estimate of 2017 VOC emissions of 19.097 tpd in October 2018 (Craig, 2018). Since that preliminary report, additional PUR data has been received and the hypothetical emissions for 2017 have been calculated as 19.143 tpd, which exceeds the regulatory trigger level of 17.2 tpd. Therefore, the prohibition on the use of high-VOC products for abamectin, chlorpyrifos, gibberellins, and oxyfluorfen on certain crops in the San Joaquin Valley NAA as specified in 3 CCR section 6884 that went into effect during 2015 remain in effect between the May 1 through October 31 period during 2019 and 2020.

Table 28. Calculation of hypothetical volatile organic compound (VOC) emissions in the San Joaquin Valley **NAA (2)**, as described in Title 3, California Code of Regulations, section 6884(c): (D) = ((A) x (B))/(C).

Active Ingredient	Crop	2014 Emissions (tpd)	2017 Pounds AI (lbs)	2014 Pounds AI (lbs)	2017 Hypothetical Emissions (tpd)	2017 Actual Emissions (tpd)	Difference between Hypothetical and Actual (tpd)
		(A)	(B)	(C)	(D)		
ABAMECTIN	ALFALFA	<0.001	98	69	<0.001	<0.001	<0.001
	ALMOND	0.687	15,557	10,288	1.040	0.424	0.615
	CITRUS	0.074	2,505	1,151	0.160	0.080	0.080
	COTTON	0.109	4,189	1,509	0.302	0.142	0.160
	GRAPES	0.325	4,648	4,743	0.318	0.139	0.179
	PISTACHIO	0.002	274	25	0.019	0.004	0.015
	WALNUT	0.108	2,223	1,719	0.139	0.048	0.091
CHLORPYRIFOS	ALFALFA	0.138	32,947	59,071	0.077	0.067	0.010
	ALMOND	0.403	117,528	181,926	0.260	0.166	0.094
	CITRUS	0.408	178,576	172,834	0.421	0.255	0.166
	COTTON	0.255	149,656	95,094	0.401	0.240	0.161
	GRAPES	0.025	42,636	20,173	0.054	0.054	<0.001
	WALNUT	0.113	35,937	65,398	0.062	0.049	0.013
GIBBERELLINS	CITRUS	0.255	5,635	6,287	0.229	0.039	0.189
	GRAPES	0.250	6,640	8,702	0.191	0.025	0.166
OXYFLUORFEN	ALFALFA	<0.001	10	10	<0.001	<0.001	<0.001
	ALMOND	0.469	65,873	80,138	0.386	0.268	0.118
	CITRUS	0.002	335	224	0.002	0.001	0.001
	COTTON	0.014	1,639	4,752	0.005	0.003	0.002
	GRAPES	0.072	12,630	10,302	0.088	0.018	0.069
	PISTACHIO	0.063	11,472	17,802	0.041	0.032	0.008
	WALNUT	0.065	11,247	11,268	0.065	0.041	0.024
TOTAL		3.835	702,256	753,484	4.259	2.096	2.163

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