ANNUAL REPORT ON VOLATILE ORGANIC COMPOUND EMISSIONS FROM PESTICIDES: EMISSIONS FOR 1990 – 2010

REVISED

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EXECUTIVE SUMMARY

Preface

DPR originally published this report in March 2012. Since the report's release, DPR found an error in the pesticide use report data and volatile organic compound (VOC) emissions for a single product containing bifenthrin. This revised report corrects that error.

This report fulfills the requirements of Title 3, California Code of Regulations (3 CCR), section 6452.4 which requires the Director of 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, 2010, to October 31, 2010, the peak ozone season in California. In addition, data from the same months in 1990 are included for baseline comparisons, and from 2007, 2008 and 2009 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). Five regions in California – the Sacramento Metro area, the San Joaquin Valley, the Southeast Desert region, Ventura County and the South Coast area - exceed federal ozone standards and are therefore designated NAAs. SIPs require the control of emissions of nitrogen oxides and VOCs because they are precursors to ozone. Under California's SIP, approved by the U.S. Environmental Protection Agency (U.S. EPA) in 1997, DPR must track and control VOC emissions from pesticide products used in agriculture and by commercial structural applicators in these five NAAs. Under the SIP, California is expected to reduce pesticide VOCs by 12 percent in the San Joaquin Valley and 20 percent in the other four NAAs, compared to 1990 levels.

DPR's VOC emission inventory database includes only pesticide applications that are made between May 1 and October 31, the peak ozone season in California. The database is updated when annual pesticide use report data from the previous year becomes available, and contains data for every year since 1990. Each year contains about 2.5 million pesticide use records (PUR) and emission potential (EP) values for approximately 5,000 products. The EP is that fraction of a product that is assumed to contribute to atmospheric VOCs.

Beginning in 2008 DPR adopted regulations to reduce VOC emissions from fumigant pesticides. Section 6452.2, 3 CCR, includes specific emission target levels (VOC regulation benchmarks) for each of the five NAAs, equivalent to the SIP obligation of a 12 percent or 20 percent reduction. The regulations reduce VOC emissions by requiring low-emission fumigation methods in certain NAAs. In all NAAs but Ventura, if, in spite of these application method requirements, pesticide VOC emissions exceed 95 percent of the benchmark for a NAA, DPR will, as specified by the regulations, ensure that the benchmark is achieved by establishing a fumigant limit. A fumigant limit is required at least through 2012 in Ventura. The fumigant limit is determined by subtracting the estimated nonfumigant emissions from the regulatory benchmark, basing the nonfumigant emissions estimate on VOC emission inventory data from previous years.

Report Summary

VOC emissions in all five nonattainment areas increased in 2010, but in compliance with the SIP goals and below the VOC regulation benchmarks.

- Sacramento Metro NAA: VOC emissions decreased between 2006 and 2008, increased by less than one percent in 2009 and a further 7 percent in 2010. Pesticide VOC emissions in 2010 were 65 percent lower than the 1990 base year and remain well in compliance with the SIP goal and the VOC regulation benchmark. In 2010, 90 percent of emissions were derived from nonfumigants.
- San Joaquin Valley NAA: VOC emissions decreased between 2006 and 2009 and then increased by approximately 17 percent in 2010. Pesticide VOC emissions in 2010 were 24 percent lower than the 1990 base year and comply with the SIP goal and VOC regulation benchmark. Approximately three-quarters of pesticide emissions are derived from nonfumigants.
- Southeast Desert NAA: VOC emissions increased from 2006 to 2007, but then decreased in 2008 and 2009. There was an increase of more than twice the amount of pesticide VOC emissions from 2009 to 2010, but emissions in 2010 were 61 percent lower than the 1990 base year and comply with the SIP goal and VOC regulation benchmark. Emissions from fumigants account for more than one half of the total.
- Ventura NAA: The SIP goal and VOC regulation benchmark is phased in over several years for this NAA. VOC emissions increased in 2010 but continue to meet the SIP goal for 2010 as well as the final goal to be met beginning in 2012. Pesticide VOC emissions in 2010 were 31 percent lower than the 1990 base year. Eighty-two percent (82%) of emissions are derived from fumigants.
- South Coast NAA: VOC emissions increased in 2010 by more than 40 percent compared to 2009 but continue remain well below the emission targets. Pesticide VOC emissions in 2010 were 84 percent lower than the 1990 base year. More than three quarters of emissions are derived from nonfumigants

Section 6452.3 requires a 45-day public comment period of the draft report. Comments that were received during the comment period (November 17, 2011 – January 3, 2012) are included in Appendix 4.

Abbreviations and Definitions

AI	Active Ingredient
APCD	Air Pollution Control District
AMAF	Application Method Adjustment Factor
ARB	California Air Resources Board
EP	Emission Potential
GIS	Geographic Information System
MUF	Method Use Fraction
NAA	nonattainment area
PUR	pesticide use report
SIP	state implementation plan
TGA	thermogravimetric analysis
tpd	tons per day
VOC	Volatile Organic Chemical

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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 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 emission inventory to track pesticide Volatile Organic Chemical (VOC) emissions and to reduce emissions by 20 percent from a base year in four out of five California nonattainment areas (NAA), and by 12 percent in the fifth 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 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 emission 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 pesticide use report data used to calculate VOC emissions is given in Table 1. There are seven counties that are partially within NAAs. Because the locations of non-production agricultural and non-agricultural applications are only given down to the county level, these types of applications need to be allocated to the portions of those seven counties so that their contribution to NAA emissions can be accurately determined. Using a Geographic Information System (GIS) and surrogate data such as population, roadways, waterways and power lines, proportional estimates have been derived for structural and rights-of-way applications. Commodity fumigations are allocated based on information provided by the California County Agricultural Commissioners.

Table 1. Key information included in pesticide use reports that form the basis of DPR's VOC emission inventory.

Information	Production Agriculture Report (Each Application)	Non-Production Agriculture Report 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

* fumigant use reports only

California's five ozone NAAs included in the pesticide VOC emission 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 CFR 40 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 3 CCR section 6452.3 requiring an annual VOC emissions inventory report that includes the following information:

- report total agricultural and structural pesticide VOC emissions for the previous years,
- evaluate compliance with SIP goals (benchmarks specified in section 6452.2),
- establish fumigant emission limits for the upcoming year if necessary, according to section 6452.2, and
- establish an emission rating (or application method adjustment factor, the percentage of fumigant applied emitted to air) for each fumigation method

Section 6452.3 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 1990–2010 and fumigant limits for 2012.

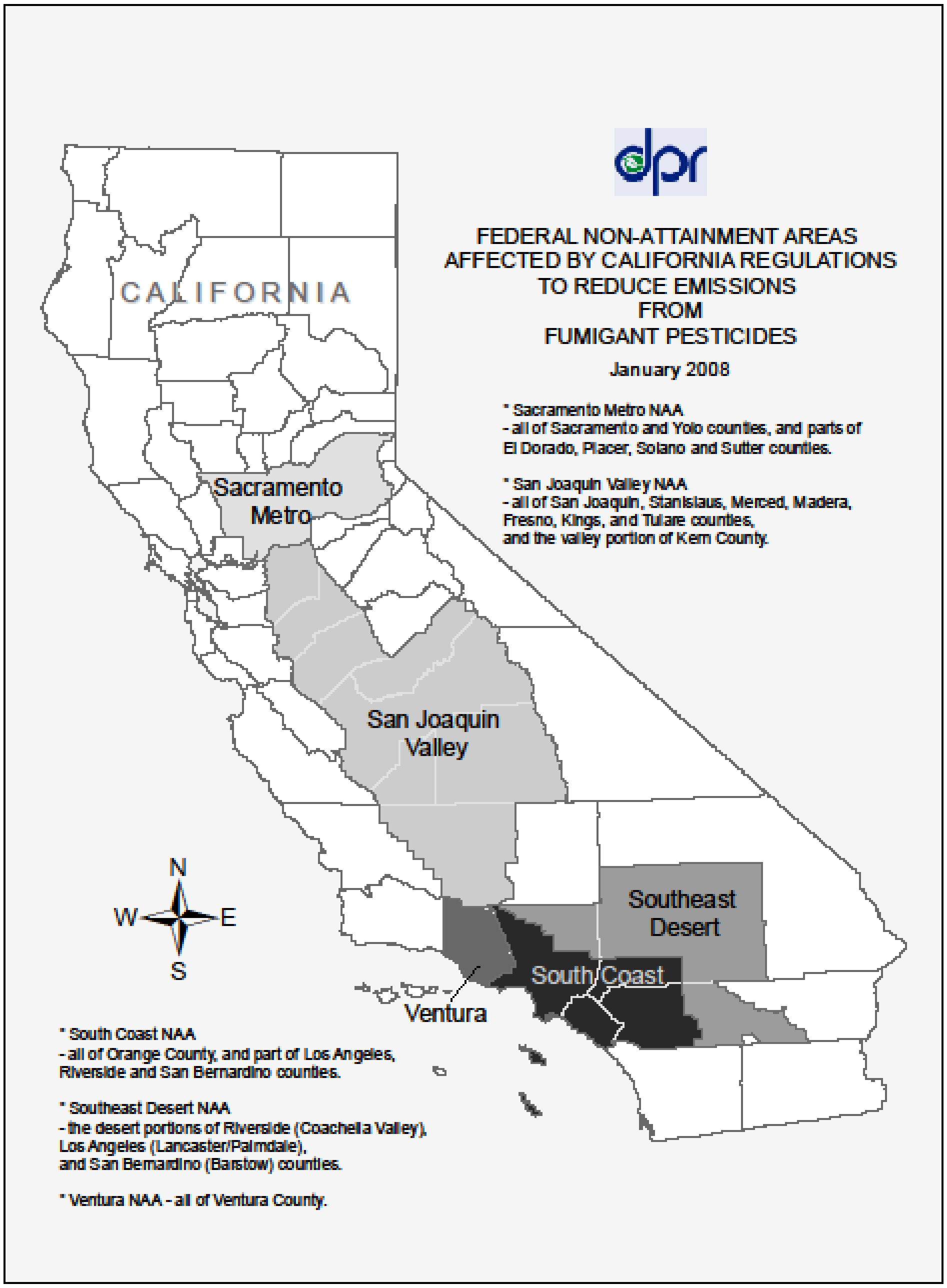


Figure 1. Federal nonattainment areas affected by California Regulations to reduce emissions from fumigant pesticides.

Table 2. A listing of counties wholly or partially within nonattainment areas 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 percent reduction from 1990 for the Sacramento Metro, Southeast Desert, and South Coast NAAs; a 12 percent reduction from 1990 for the San Joaquin Valley NAA; and a phase-in of the reductions for the Ventura NAA, with a final reduction for Ventura of 20 percent from 1990 by 2012.

Table 3. Nonattainment Area Goals for 2008 – 2012.

NAA	SIP Goal (tons/day) 2008 - 2012				
1 – Sacramento Metro	2.2				
2 – San Joaquin Valley	18.1				
3 – Southeast Desert	0.92				
4 – Ventura	**2008**	**2009**	**2010**	**2011**	**2012**
	4.3	4.0	3.6	3.3	3.0
5 – South Coast	8.7				

Procedure for Calculating Unadjusted and Adjusted VOC Emissions

Prior to 2008, DPR reported an unadjusted emission 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 percent. 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). The sum of all *MUFs* for any particular (NAA/fumigant AI) combination is one. Use practices change over time so that different *MUF*s are used for the baseline year (1990) as opposed to more recent inventory years. For 2007 and earlier years, *MUF*s are determined in a number of different ways. For 1,3-dichloropropene the *MUF*s are 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 *MUF*s are based on expert opinion and regulatory history. Finally, *MUF*s for dazomet and sodium tetrathiocarbonate equal one because the *AMAF*s 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).

The 2008 VOC regulations included a change to pesticide use reports that requires recording the specific application method for each fumigation within NAAs. The *MUFs* for 2008 and later years are calculated using the fumigation method documented in pesticide use reports rather than the surrogate data described above. The use of a fumigant code to identify the fumigant application method in the pesticide use report was implemented in 2009 (Ibewiro, 2008). For all NAAs combined, approximately six percent of the pesticide use reports for 2010 are missing the identification of the application method (fumigant code). In these cases, DPR used a conservative approach by assuming that the application method with the highest AMAF allowed by the regulations for that fumigant was used. Field fumigation methods (FFM), FFM codes for pesticide use reporting, and corresponding emission ratings, and the AMAFs and method use fractions for 1990, 2005, 2006, 2007 and 2008 in each of the NAAs are included in the appendix of this document (Tables A1 – 1 to A1 – 27, Appendix 1B).

In addition to the VOC emissions derived from fumigant active ingredients, inert ingredients for products that contain chloropicrin, methyl bromide, 1,3-dichloropropene and methyl iodide are assumed to be volatile and are included in the inventory calculations. For the highest use products containing those fumigants, DPR analyzes their confidential statements of formula to determine the composition of inerts and decides whether those inerts are nonvolatile. Inert ingredients used in products containing metam sodium, metam potassium, sodium tetrathiocarbonate and dazomet are non-volatile and so do not contribute to the emission potential of these products.

VOC emissions were calculated for each NAA and summed according to primary active ingredient, application site, and emission category as defined by the Air Resources Board (ARB). The primary active ingredient is defined as the pesticide active ingredient present at the highest percentage in a product. If a pesticide product contains 20 percent of active ingredient "A" and 10 percent of active ingredient "B", all estimated emissions from that product are assigned to the primary active ingredient "A". This approach prevents "double-counting" of emissions from products containing two active ingredients.

Both unadjusted and adjusted emission inventory data for the top ten primary active ingredients contributing to May-October ozone in 2007, 2008 and 2009 are included in this report. Appendix 2 contains summaries of emissions attributable to specific application sites (or commodities). These summary data are provided only for *unadjusted* emissions because it is not possible to allocate adjusted emissions to specific application sites with the currently available data.

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 were calculated for the May–October ozone season, and are reported as U.S. tons per day (tpd).

Data Revisions

DPR continually evaluates pesticide use report data, EP values, MUFs, and AMAFs to ensure the VOC inventory includes the most reliable data. Since the last annual report, DPR has completed review of several studies conducted under contract to ARB (Johnson 2011). These studies evaluated 1,3-dichloropropene deep-shank injection fumigation methods that included five post-fumigation water treatments and a composted green waste soil amendment. Based on these studies, DPR has established the AMAFs shown in Table 4. However, neither of these fumigation methods may be commercially feasible due to the high cost. Fumigation method codes will be assigned if and when these methods are used.

Table 4. Revised application method adjustment factors (emission ratings)

Method Description	Fumigation Method Code	Original AMAF (%)	Revised AMAF (%)
1,3-D, deep-shank w/ 5 water treatments	None	None	15
1,3-D deep shank w/ green waste	None	None	5

VOC emissions from inert ingredients in glyphosate products have increased in the last few years in several NAAs. Most if not all of the increase in emissions was due to Roundup Powermax Herbicide, first registered in 2007. Due to a lack of thermogravimetric analysis data, at that time DPR assigned an EP of 35.28 percent for this product. Most other glyphosate products have EPs of 0 to 6 percent. DPR then requested EP data from the product registrant, and has subsequently received, reviewed and approved that data that shows an EP of 0 percent for that product. Consequently the 2008 and 2009 inventories have been updated based on this new information.

DPR recently adopted a new procedure for estimating emission potentials (EP) of selected products with very high use when thermogravimetric analysis data are not available. That method is based on analysis of product confidential statements of formula as described by Oros and Spurlock (2011).

DPR has proposed a SIP revision with a commitment to ensure pesticide VOC emissions do not exceed 18.1 tons/day in the San Joaquin Valley NAA, equivalent to a 12 percent reduction from 1990 (Table 3). DPR will use the emissions estimation methodology described in this report to meet the SIP commitment. Emission ratings for application methods that were used in 1990 will not be modified, absent a SIP revision. Similarly, regarding nonfumigant pesticides, DPR will not revise the emission potentials of formulations that were used in the base year, absent a SIP revision.

Bifenthrin Data Error

DPR originally published this report in March 2012. Since the report's release, and with the assistance of the Department of Food and Agriculture, DPR found an error that primarily affects the pesticide VOC emissions for the San Joaquin Valley NAA in 2010. The data for the bifnethrin product, Fanfare 2EC (registration number 66222-99-AA), first registered in California in 2006 was incorrectly calculated which resulted in overestimates of the pesticide's use and VOC emissions. During the conversion from gallons to pounds applied, the product density was incorrectly assigned as 67.739 pounds per gallon. The correct product density is 8.13 pounds per gallon. The amount of product and active ingredient of Fanfare applied was 8.33x (67.739/8.13) too high.

For the San Joaquin Valley NAA during May-October 2010, DPR originally estimated that the VOC emissions from all bifenthrin products were 1.55 tons/day (2nd ranked pesticide VOC contributor). DPR now estimates that the VOC emissions from bifenthrin products were 0.24 tons/day. Bifenthrin products are no longer among the top 10 pesticide VOC contributors for the San Joaquin Valley. Total pesticide VOC emissions changed from 16.8 tons/day to 15.5 tons/day. Relative to the 1990 base year, total pesticide VOC emissions for 2010 changed from an 18 percent reduction to a 24 percent reduction. The goal in the pesticide element of the SIP is at least a 12 percent reduction from 1990, equivalent to emissions no greater than 18.1 tons/day. There are also changes for other years and other NAAs tracked by DPR, but use of Fanfare was much lower in other years and NAAs, so the differences are minor. Similar relative changes apply to the amount of bifenthrin active ingredient reported.

VOLATILE ORGANIC COMPOUND INVENTORY RESULTS

The main text of this report summarizes the pesticide VOC emission inventory data for 2010 only. Adjusted and unadjusted emission data for 2007, 2008 and 2009, and unadjusted data for 2010 are summarized in Appendices 2 and 3. Previous inventory memos and the 2007, 2008 and 2009 reports included a summary of pesticide VOC emissions by commodity/site. At this time it is not possible to determine the breakdown of adjusted emissions by commodity, so only the *unadjusted* emissions are shown by commodity. Tables for emissions calculated for active ingredients (adjusted and unadjusted) and application sites (unadjusted) contain information for the top ten contributors only.

Figure 2 illustrates the changes in *unadjusted* VOC emissions from 1990 to 2010. These values are *unadjusted* and so do not take in to consideration MUFs and AMAFs that can only be applied to emissions in 2004 through 2010, and 1990. The figure is useful in that it compares emissions for the entire history of the inventory and shows trends in five NAAs.

Tables 5 and 6a and Figure 3 summarize the adjusted pesticide VOC emissions for 2004 through 2010, and compare them to the SIP goals that based a percentage reduction from the 1990. Table 6b compares the unadjusted and adjusted fumigant VOC emissions for 2004 through 2010. Table 6c shows the amount of emissions that resulted from nonfumigant products with emulsifiable concentrate formulations compared to all other formulations. The emissions in the base year are also included to reflect the long term decrease or increase. Generally, what the tables and figure show can be summarized as follows:

- Adjusted emissions in 2010 in the Sacramento Metro (1) reversed the decline of 2006 to 2009 and increased to 0.970 tons per day. Nonfumigants represented 90 percent of the total, the latter remaining well below the SIP goal. Fourty-eight percent (0.418 tpd) of nonfumigant emissions were derived from products with emulsifiable concentrate formulations.
- Emissions in the South Coast NAA (5) increased by 42 percent over 2009 values but remain well below the SIP goal. More than three quarters of the total adjusted VOC emissions came from non-fumigants (1.359 tpd), of which less than one third are attributable to products with emulsifiable concentrate formulations.
- In 2010, fumigants accounted for more than half of VOC emissions in the Southeast Desert (3), up significantly from 2009. Total VOC emissions in 2010 increased by more than 60 percent from 2009 but continue to meet the SIP goal.
- 2010 VOC emissions in the Ventura NAA (4) increased by 0.517 tpd from the previous year but continue to meet the regulatory goal for 2010, 2011and 2012. Eighty-two percent of emissions came from fumigants.
- In the San Joaquin Valley NAA (2), nonfumigants accounted for almost three quarters of the total VOC emissions in 2010. In this NAA, VOC emissions increased from 2009 to 2010 by about 17 percent, but continue to be below the SIP goal by 2.52 tpd, and 2010 emissions were below the average level of 2004-2009. Nonfumigant emissions from products with emulsifiable concentrate formulations accounted for 44 percent of the total VOC emissions for this NAA and 59 percent of emissions from nonfumigants.

Pesticide use varies from year to year depending on many factors, including weather, 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 result in fewer planted acres, thus less pesticide may be used. A more detailed explanation of pesticide use patterns is given in DPR's annual summary of pesticide use reports available at: http://www.cdpr.ca.gov/docs/pur/pur10rep/chmrpt10.pdf .

While emissions increased in 2010, DPR, growers, registrants, and others have taken steps to reduce VOC emissions. In the last few years, DPR has registered several reformulated products with lower EPs, including products containing chlorpyrifos and abamectin that are major VOC contributors in the San Joaquin Valley. Many growers are switching to the reformulated products. For example, the reformulated chlopyrifos product with a lower EP was registered in 2008, and it was the chlorpyrifos product with the highest use in the San Joaquin Valley during 2010. DPR is drafting regulations to address nonfumigant VOC emissions for the San Joaquin Valley, so this trend should continue.

Figure 2. Annual ***unadjusted*** ozone season pesticide VOC emissions by NAA from 1990 to 2010, inclusive.

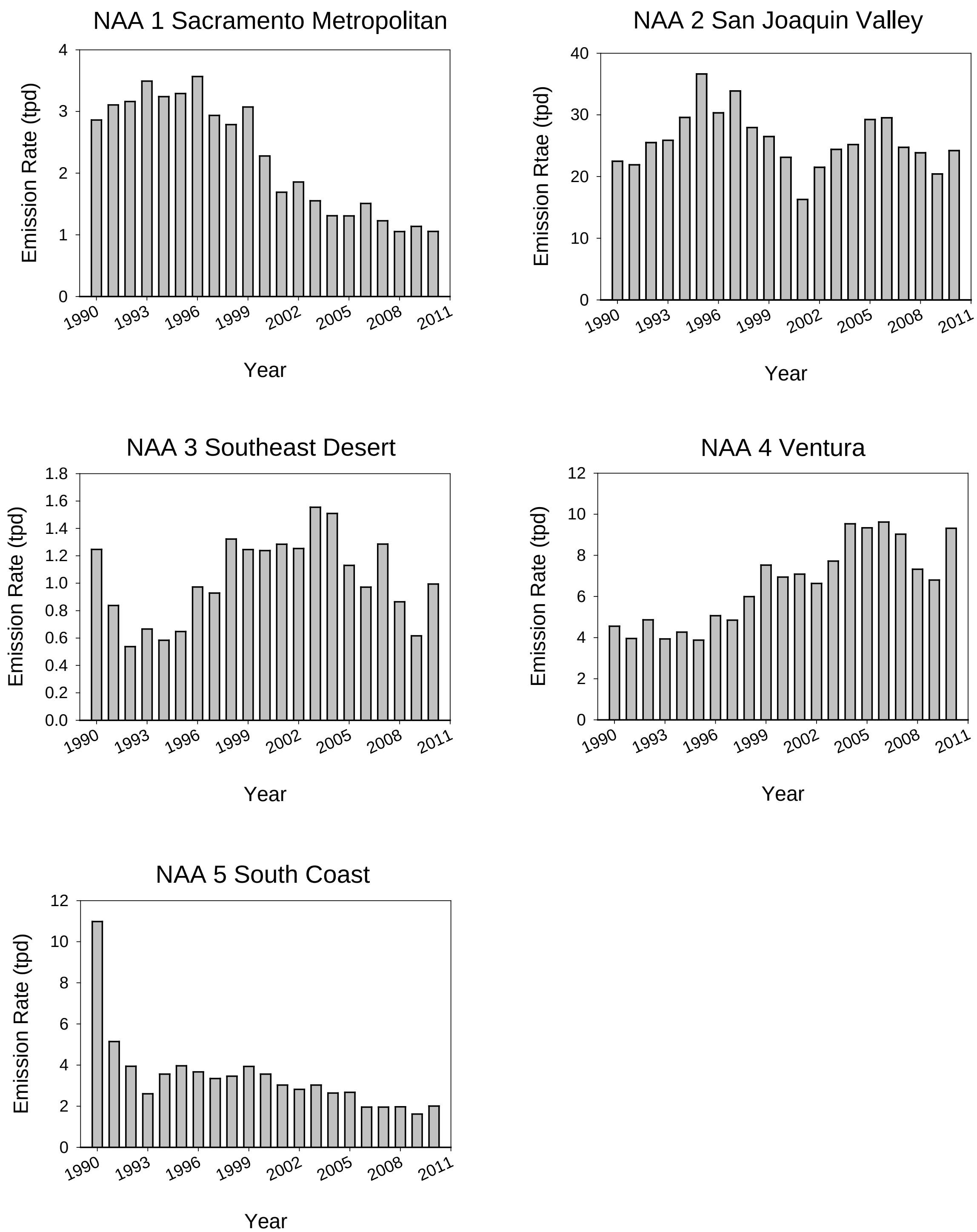


Table 5. May–October (ozone season) ***adjusted*** pesticide VOC emissions and goals.

NAA	1990 Emissions (tons/day)	SIP Goal (tons/day)	2004 Emissions (tons/day)	2005 Emissions (tons/day)	2006 Emissions (tons/day)	2007 Emissions (tons/day)	2008 Emissions (tons/day)	2009 Emissions (tons/day)	2010 Emissions (tons/day)
1 – Sacramento Metro	2.784	2.2	1.235	1.239	1.354	1.041	0.903	0.907	0.970
2 – San Joaquin Valley	20.517	18.1	17.322	20.740	21.305	17.093	14.525	13.262	15.528
3 – Southeast Desert	1.153	0.92	0.995	0.740	0.634	0.762	0.286	0.283	0.453
4 – Ventura	3.787	3.0 a	3.924	3.617	3.682	3.363	1.739	2.080	2.597
5 – South Coast	10.840	8.7	1.922	1.969	1.482	1.487	1.283	1.220	1.734

a These numbers reflect the SIP goal for 2012 in Ventura, and do not reflect the phase in of reductions between 2008 and 2012.

Table 6a. May–October (ozone season) ***adjusted*** fumigant and nonfumigant pesticide VOC emissions.

NAA	1990 Emissions (tons/day)		2004 Emissions (tons/day)		2005 Emissions (tons/day)		2006 Emissions (tons/day)		2007 Emissions (tons/day)		2008 Emissions (tons/day)		2009 Emissions (tons/day)		2010 Emissions (tons/day)	
1 – Sacramento Metro																
Fumigants	0.384	(14%)	0.111	(9%)	0.085	(7%)	0.162	(12%)	0.189	(18%)	0.064	(7%)	0.133	(15%)	0.097	(10%)
Nonfumigants	2.400	(86%)	1.124	(91%)	1.154	(93%)	1.192	(88%)	0.851	(82%)	0.838	(93%)	0.773	(85%)	0.874	(90%)
2 - San Joaquin Valley																
Fumigants	5.536	(27%)	6.362	(37%)	6.910	(33%)	6.808	(32%)	6.123	(36%)	3.370	(23%)	3.424	(26%)	4.023	(26%)
Nonfumigants	14.981	(73%)	10.960	(63%)	13.831	(67%)	14.498	(68%)	10.970	(64%)	11.154	(77%)	9.838	(74%)	11.505	(74%)
3 - Southeast Desert																
Fumigants	0.840	(73%)	0.762	(77%)	0.474	(64%)	0.413	(65%)	0.575	(75%)	0.119	(42%)	0.138	(49%)	0.272	(60%)
Nonfumigants	0.313	(27%)	0.233	(23%)	0.266	(36%)	0.221	(35%)	0.187	(25%)	0.167	(58%)	0.145	(51%)	0.181	(40%)
4 - Ventura																
Fumigants	3.140	(83%)	3.302	(84%)	3.119	(86%)	3.175	(86%)	2.935	(87%)	1.252	(72%)	1.627	(78%)	2.122	(82%)
Nonfumigants	0.647	(17%)	0.622	(16%)	0.497	(14%)	0.508	(14%)	0.428	(13%)	0.486	(28%)	0.453	(22%)	0.475	(18%)
5 – South Coast																
Fumigants	9.372	(86%)	0.702	(37%)	0.594	(30%)	0.422	(28%)	0.411	(28%)	0.377	(29%)	0.297	(24%)	0.376	(22%)
Nonfumigants	1.468	(14%)	1.220	(63%)	1.375	(70%)	1.060	(72%)	1.075	(72%)	0.906	(71%)	0.922	(76%)	1.359	(78%)

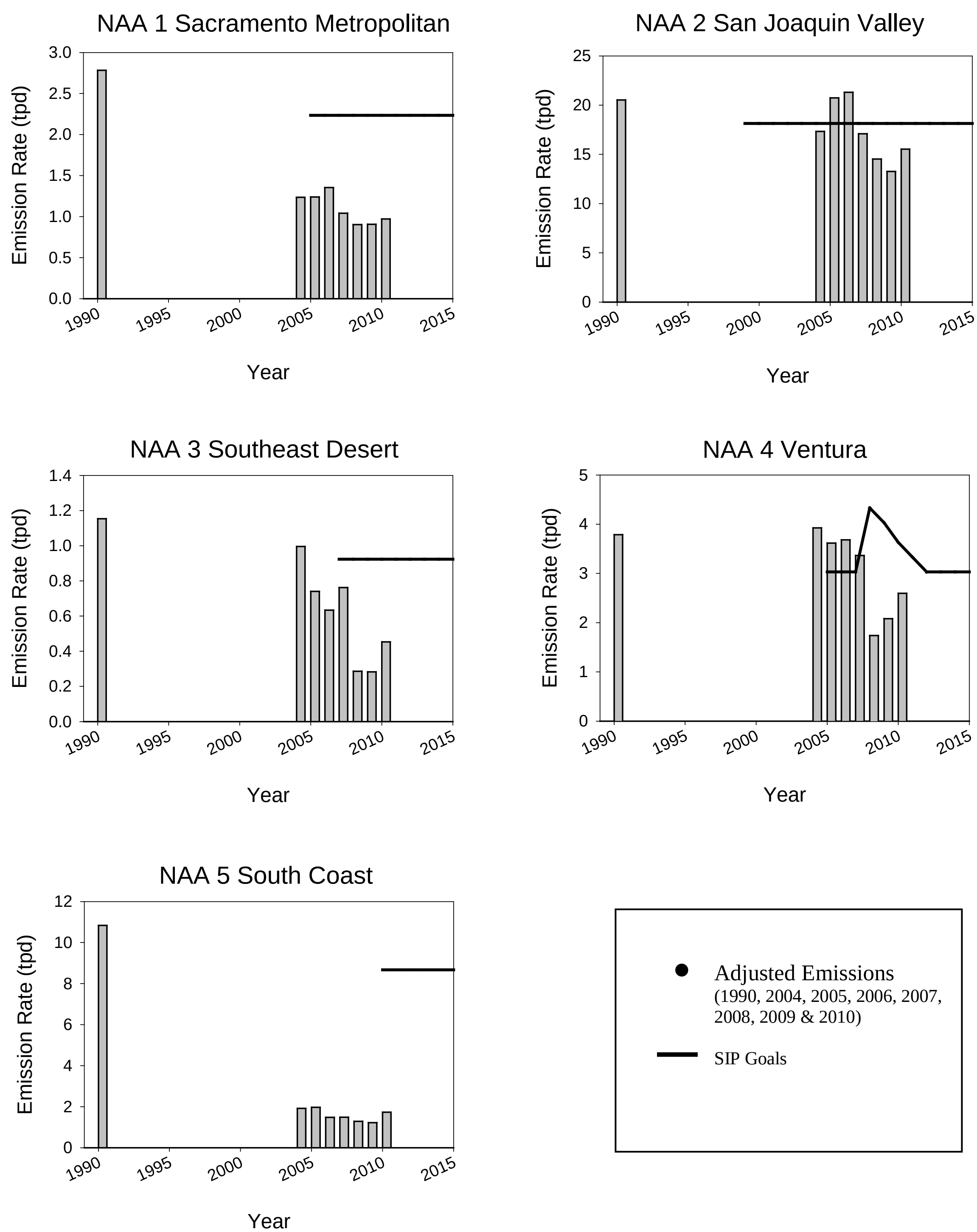
Table 6b. May–October (ozone season) ***unadjusted and adjusted*** fumigant pesticide VOC emissions.

NAA	1990 Emissions (tons/day)	2004 Emissions (tons/day)	2005 Emissions (tons/day)	2006 Emissions (tons/day)	2007 Emissions (tons/day)	2008 Emissions (tons/day)	2009 Emissions (tons/day)	2010 Emissions (tons/day)
1 – Sacramento Metro								
Unadjusted Fumigants	0.461	0.186	0.151	0.315	0.383	0.241	0.362	0.181
Adjusted Fumigants	0.384	0.111	0.085	0.162	0.189	0.064	0.133	0.097
2 - San Joaquin Valley								
Unadjusted Fumigants	7.491	14.213	15.400	15.034	13.750	12.620	10.559	12.696
Adjusted Fumigants	5.536	6.362	6.910	6.808	6.123	3.370	3.424	4.023
3 - Southeast Desert								
Unadjusted Fumigants	0.933	1.275	0.863	0.750	1.086	0.684	0.470	0.812
Adjusted Fumigants	0.840	0.762	0.474	0.413	0.575	0.119	0.138	0.272
4 - Ventura								
Unadjusted Fumigants	3.909	8.916	8.841	9.113	8.658	6.543	6.345	8.844
Adjusted Fumigants	3.140	3.302	3.119	3.175	2.935	1.252	1.627	2.122
5 – South Coast								
Unadjusted Fumigants	9.514	1.418	1.301	0.898	0.883	1.043	0.692	0.647
Adjusted Fumigants	9.372	0.702	0.594	0.422	0.411	0.377	0.297	0.376

Table 6c. May-October (ozone season) nonfumigant pesticide VOC emissions derived from Emulsifiable Concentrate formulations (ECs) and all Others. The adjusted and unadjusted VOC emissions for nonfumigants are the same.

NAA	1990 Emissions (tons/day)		2004 Emissions (tons/day)		2005 Emissions (tons/day)		2006 Emissions (tons/day)		2007 Emissions (tons/day)		2008 Emissions (tons/day)		2009 Emissions (tons/day)		2010 Emissions (tons/day)	
1 – Sacramento Metro																
ECs	1.129	(47%)	0.534	(47%)	0.642	(56%)	0.640	(54%)	0.470	(55%)	0.487	(58%)	0.390	(50%)	0.418	(48%)
Others	1.271	(53%)	0.590	(53%)	0.513	(44%)	0.552	(46%)	0.382	(45%)	0.351	(42%)	0.384	(50%)	0.456	(52%)
2 - San Joaquin Valley																
ECs	12.162	(81%)	8.613	(79%)	10.199	(74%)	10.119	(70%)	7.547	(69%)	7.491	(67%)	6.129	(62%)	6.831	(59%)
Others	2.819	(19%)	2.347	(21%)	3.632	(26%)	4.379	(30%)	3.423	(31%)	3.663	(33%)	3.710	(38%)	4.674	(41%)
3 - Southeast Desert																
ECs	0.217	(69%)	0.150	(64%)	0.185	(69%)	0.131	(59%)	0.105	(56%)	0.089	(53%)	0.073	(50%)	0.092	(51%)
Others	0.096	(31%)	0.083	(36%)	0.082	(31%)	0.091	(41%)	0.083	(44%)	0.078	(47%)	0.073	(50%)	0.089	(49%)
4 - Ventura																
ECs	0.402	(62%)	0.263	(42%)	0.286	(58%)	0.272	(54%)	0.210	(49%)	0.237	(49%)	0.242	(53%)	0.239	(50%)
Others	0.245	(38%)	0.360	(58%)	0.211	(42%)	0.236	(46%)	0.218	(51%)	0.250	(51%)	0.212	(47%)	0.236	(50%)
5 – South Coast																
ECs	0.921	(63%)	0.647	(53%)	0.762	(55%)	0.514	(48%)	0.459	(43%)	0.339	(37%)	0.371	(40%)	0.415	(31%)
Others	0.547	(37%)	0.573	(47%)	0.613	(45%)	0.546	(52%)	0.616	(57%)	0.567	(63%)	0.551	(60%)	0.944	(69%)

Figure 3. Annual ozone season pesticide VOC emissions by NAA. These figures show adjusted emissions and SIP goals (reductions from 1990 emissions).



Sacramento Metro Area - NAA 1

The Sacramento Metro NAA (NAA 1) 2010 adjusted emissions increased to above the levels of the two previous years. Adjusted emissions in 2007 were 1.041 tpd which decreased to 0.903 tpd in 2008, increased to 0.907 tpd in 2009, and increased again to 0.970 tpd in 2010. Fumigant emissions, accounting for 18 percent of adjusted emissions in 2007 (0.189 tpd), were reduced to 7 percent (0.064 tpd) in 2008, increased in 2009 to 0.133 tpd and decreased to 0.097 tpd in 2010. In 2010, 90 percent of emissions were attributable to nonfumigants, 48 percent (0.418 tpd) of which were from products with emulsifiable concentrate formulations. Total adjusted VOC emissions (0.970 tpd) continue to remain well below the SIP goal of 2.2 tpd. (Tables 6a, 6b, 6c, Figures 3, 4).

Emissions from chlorpyrifos use decreased to 0.086 tpd in 2009 and 0.076 tpd in 2010, the latter accounting for over seven percent of the total emissions in 2010 (Table 7). Emissions from the use of 1,3-dichloropropene, which doubled from 2008 to 2009, decreased to 0.035 tpd in 2010 accounting for 3.59 percent of emissions, and emissions from methyl bromide use increased from 0.031 tpd in 2009 to 0.045 tpd in 2010. Emissions from bifenthrin, a pyrethroid insecticide used on a range of crops, have increased every year from 0.016 tpd in 2007 to 0.029 tpd in 2010, as have emissions from abamectin, which have almost quadrupled from 0.011 tpd in 2007 to 0.042 tpd in 2010. (Tables 7, A3-1a to A3-1d, Figure 5).

In 2010 combined emissions from tomatoes and walnuts increased by approximately 0.84 tpd (0.115 tpd in 2009 to 0.153 tpd in 2010, and 0.115 tpd in 2009 to 0.161 tpd in 2010, respectively). These two commodities/sites accounted for over 30 percent of the total emissions in the Sacramento Metro Area NAA, with emissions from rice accounting for an additional 19.57 percent, an increase from 0.192 tpd in 2009 to 0.206 tpd in 2010. Emissions from wine grapes fell sharply from 0.177 tpd in 2009 to 0.055 tpd in 2010. It should be noted that in 2010 use of the category “soil application” as a site/commodity was substantially reduced from previous years. Correspondingly, emissions from this category fell from 0.128 tpd in 2009 to less than 0.001 tpd in 2010. The “soil application” category is often used when a field is treated before a commodity has been planted. In 2010 it is most likely that the category has been replaced by more specific annual commodities such as tomatoes, sunflowers, strawberries, alfalfa, etc. (Tables 8, A2-1e to A2-1h, Figure 6).

Since this NAA has complied with the SIP goal for several years, most provisions of the 2008 fumigant regulations do not apply. Therefore, the fumigant regulations had little or no impact on emissions in this NAA.

Using the ARB emission inventory classification, emissions from structural applications of methyl bromide continue to be less than 0.001 tpd. Agricultural applications decreased from 0.062 tpd in 2007 to 0.035 tpd in 2009, but increased to 0.057 tpd in 2010. Non-methyl bromide emissions from structural applications continue to decline from 0.066 tpd in 2007, 0.062 tpd in 2008 and 0.053 tpd in 2009, to 0.047 tpd in 2010 (Tables 9, A2-1i - A2-1l).

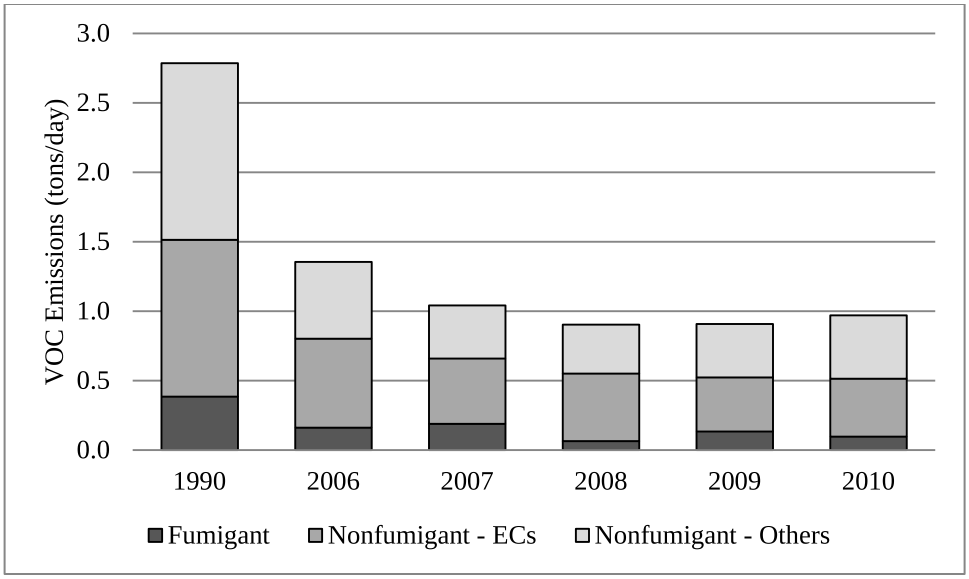


Figure 4. Pesticide VOC emissions for the Sacramento Metro NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method.

Table 7. Top ten primary active ingredients contributing to **2010** May-October ozone season *adjusted* VOC emissions in NAA 1, the Sacramento Metro Area.

Primary AI	**Total Product Adjusted Emissions (tons/day)**	**Percent of All NAA 1 May – Oct 2010 Adjusted Emissions**
CHLORPYRIFOS	0.076	7.78
TRIFLURALIN	0.054	5.57
THIOBENCARB	0.048	4.91
METHYL BROMIDE	0.045	4.62
ABAMECTIN	0.042	4.34
PROPANIL	0.038	3.88
PENOXSULAM	0.037	3.80
1,3-DICHLOROPROPENE	0.035	3.59
ETHALFLURALIN	0.030	3.13
CLOMAZONE	0.030	3.12

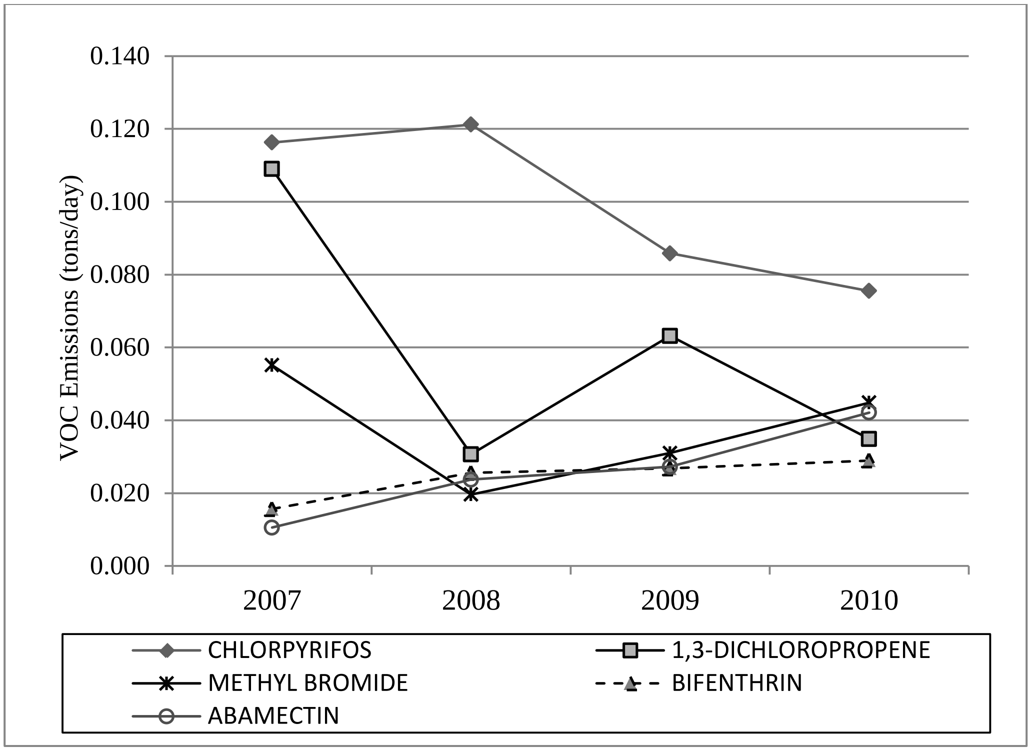


Figure 5. Changes in adjusted emissions of selected AIs in the Sacramento Metro NAA from 2007 to 2010.

Table 8. Top ten pesticide application sites contributing to **2010** May-October ozone season *unadjusted* VOC emissions in NAA 1.

Application Site	**Emissions (tons/day)**	**Percent of all NAA 1 May – Oct 2010 emissions**
RICE	0.206	19.57
WALNUT	0.161	15.22
TOMATOES, FOR PROCESSING/CANNING	0.153	14.52
RIGHTS OF WAY	0.059	5.61
GRAPES, WINE	0.055	5.21
STRUCTURAL PEST CONTROL	0.046	4.41
LANDSCAPE MAINTENANCE	0.046	4.34
ALMOND	0.038	3.57
COMMODITY FUMIGATION	0.034	3.23
N-OUTDR CONTAINER/FLD GRWN PLANTS	0.033	3.12

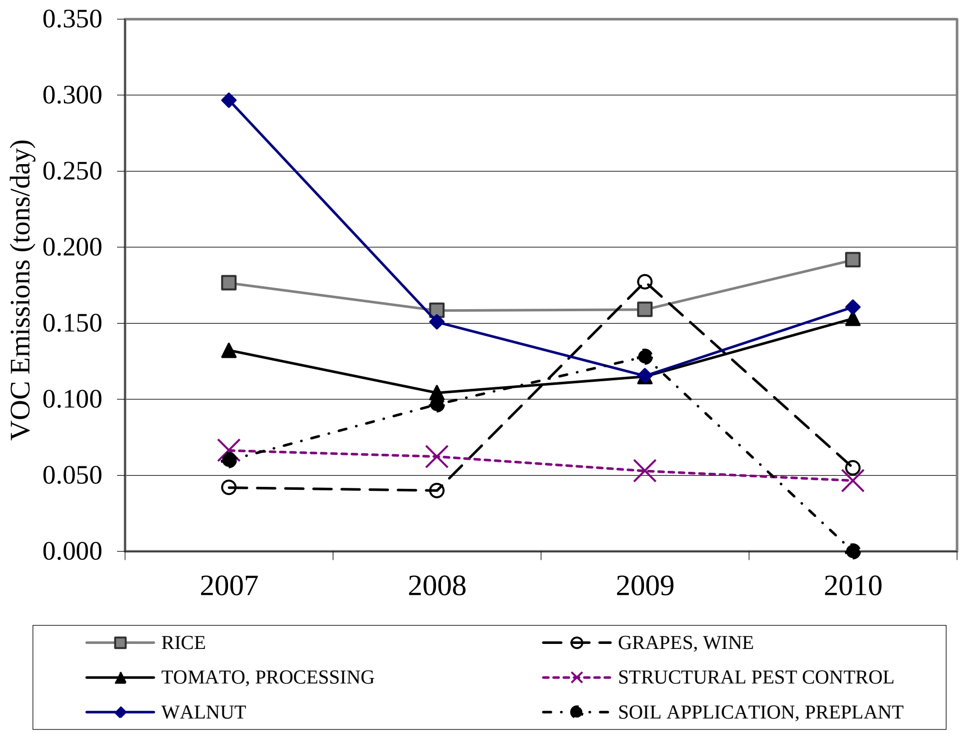


Figure 6. Changes in unadjusted emissions from selected commodities/sites in the Sacramento Metro NAA from 2007 to 2010.

Table 9. *Unadjusted* **2010** May–October VOC emissions in NAA1 by ARB emission inventory classification (tons per day, tpd).

NAA 1 - 2010	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	0.057	0.000
NON-METHYL BROMIDE EMISSIONS	0.945	0.047

San Joaquin Valley - NAA 2

Adjusted emissions in 2010 increased from 13.262 tpd in 2009 to 15.528 tpd in 2010, a 17 percent increase. As with the 2009 emissions, the 2010 emissions are below the SIP goal of 18.1 tpd (Tables 6a, 6b, Figure 3, 7).

Nonfumigants continue to account for the largest portion of adjusted emissions, with more than 74 percent of the total in 2010 (11.505 tpd). Overall, nonfumigant emissions increased by 1.667 tpd (23 percent) in 2010, bringing emissions back to a level not seen since before 2007. In 2010, 59 percent of nonfumigant emissions was from products with emulsifiable concentrate formulations (6.831 tpd), an increase of 0.702 tpd from 2009 (Table 6c). The top emission contributor for 2007 through 2010 was the nonfumigant, chlorpyrifos, which accounted for 2.263 tpd in 2007, 2.221 tpd in 2008, 1.389 tpd in 2009 and 1.828 tpd in 2010. (Tables 10, A3-2a to A3-2d, Figure 7). In 2010 more than 25 percent of emissions from chlorpyrifos came from use on almonds, with another 55 percent of emissions from chlorpyrifos from the combined use on cotton, oranges and alfalfa. Fumigant use on carrots, in the form of metam-sodium, 1,3-dichloropropene and potassium N-methyldithiocarbamate, accounted for more than 98 percent of emissions from this commodity (Tables 11, A2- 2e to A2-2h, Figure 9). Total adjusted emissions from metam-sodium increased from 1.120 tpd in 2009 to 1.148 tpd in 2010 from use on onions, head lettuce and tomatoes. Emissions from products containing bifenthrin increased by over 200 percent from 0.075 tpd in 2009 to 0.244 tpd in 2010, due in large part to increased use on almonds and pistachios (Figure 8).

Although the 2008 fumigant regulations continued to maintain lower emissions from fumigants, adjusted fumigant emissions increased by 0.599 tpd (18 percent) between 2009 and 2010. Use (unadjusted emissions) of fumigants increased by 20 percent (Table 6b). The increase in fumigant emissions is primarily due to increased product use overall, as the use of low-emission fumigation methods required by the 2008 regulations is now well established.

Using the ARB emission inventory classification, emissions from structural applications of methyl bromide decreased significantly in 2010 going from 0.012 tpd in 2009 to less than 0.001 tpd in 2010. Agricultural applications increased by approximately 15 percent from 0.908 tpd in 2009 to 1.044 tpd in 2010. Non-methyl bromide emissions from agricultural applications increased from 19.020 tpd in 2009 to 22.583 tpd in 2010, and structural applications increased from 0.190 tpd in 2009 to 0.239 tpd in 2010. (Tables 12, A2-2i to A2-2l).

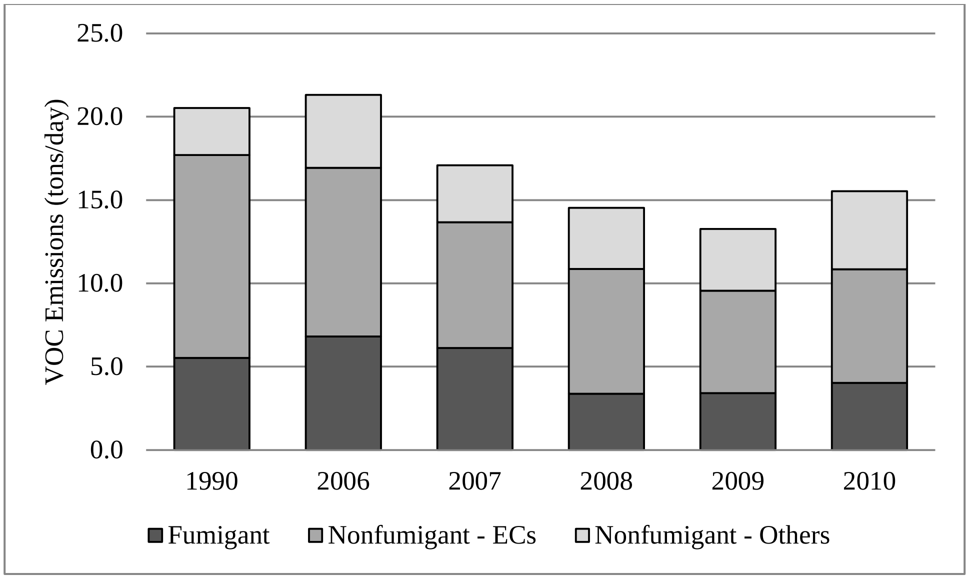


Figure 7. Pesticide VOC emissions for the San Joaquin Valley NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method.

Table 10. Top ten primary active ingredients contributing to **2010** May-October ozone season *adjusted* VOC emissions in NAA 2, the San Joaquin Valley.

Primary AI	**Total Product Adjusted Emissions (tons/day)**	**Percent of All NAA 2 May – Oct 2010 Adjusted Emissions**
CHLORPYRIFOS	1.828	11.77
1,3-DICHLOROPROPENE	1.488	9.59
METAM-SODIUM	1.148	7.40
ABAMECTIN	1.064	6.85
OXYFLUORFEN	0.687	4.42
GIBBERELLINS	0.684	4.40
METHYL BROMIDE	0.581	3.74
GLYPHOSATE, ISOPROPYLAMINE SALT	0.459	2.96
POTASSIUM N-METHYLDITHIOCARBAMATE	0.436	2.81
GLUFOSINATE-AMMONIUM	0.433	2.79

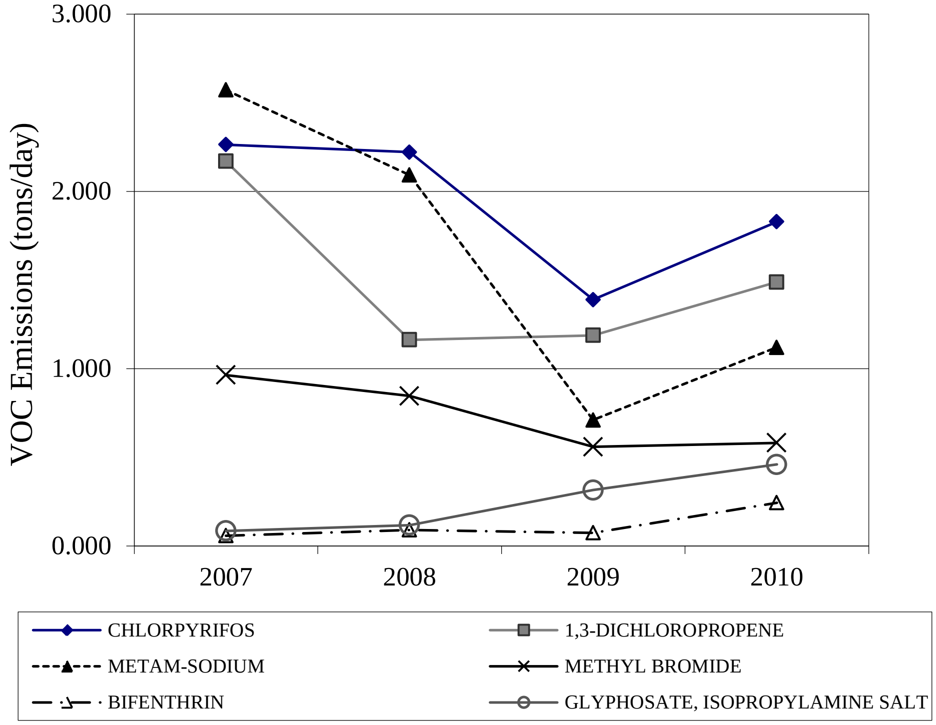


Figure 8. Changes in adjusted emissions of selected AIs in the San Joaquin Valley NAA from 2007 to 2010.

Table 11. Top ten pesticide application sites contributing to **2010** May-October ozone season *unadjusted* VOC emissions in NAA 2.

Application Site	**Emissions (tons/day)**	**Percent of all NAA 2 May – Oct 2010 emissions**
ALMOND	3.842	15.88
CARROTS	3.604	14.89
COTTON	1.487	6.15
SOIL APPLICATION, PREPLANT-OUTDOOR	1.303	5.38
GRAPES	1.274	5.27
TOMATOES, FOR PROCESSING/CANNING	1.224	5.06
ORANGE	1.020	4.22
N-OUTDR CONTAINER/FLD GRWN PLANTS	1.017	4.20
WALNUT	0.897	3.71
POTATO	0.872	3.60

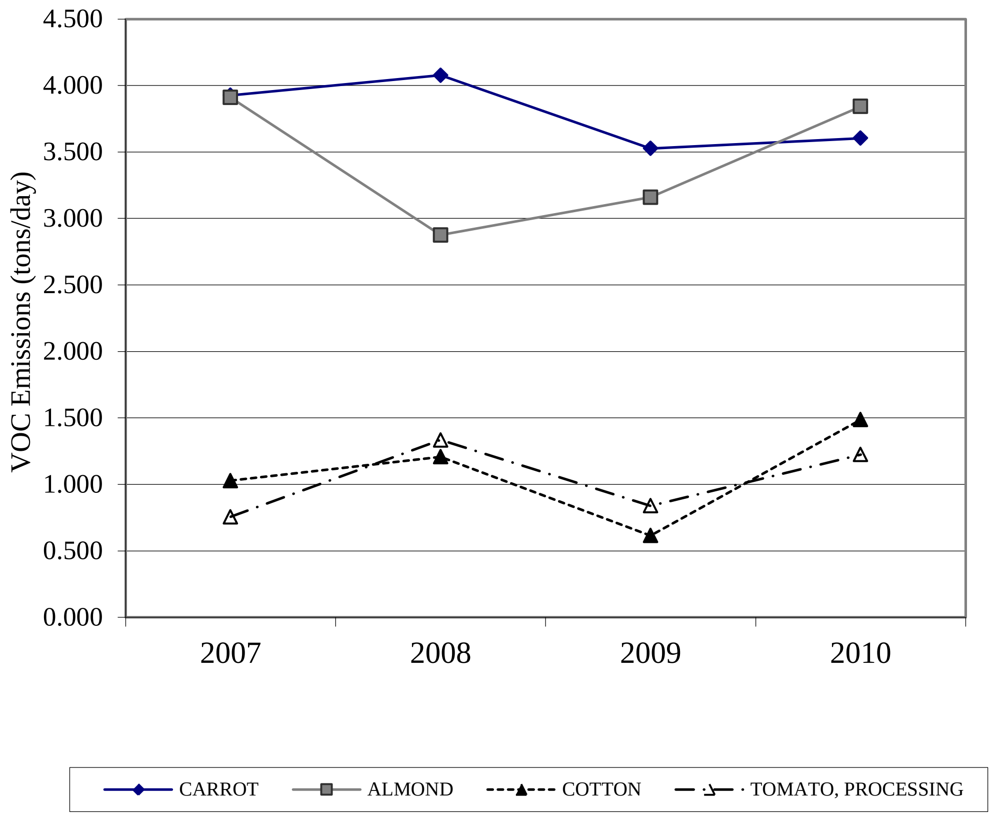


Figure 9. Changes in unadjusted emissions from selected commodities/sites in the San Joaquin Valley NAA from 2007 to 2010.

Table 12. *Unadjusted* **2010** May–October VOC emissions in NAA 2 by ARB emission inventory classification (tons per day, tpd).

NAA 2 - 2010	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	1.044	0.000
NON-METHYL BROMIDE EMISSIONS	22.583	0.239

Southeast Desert - NAA 3

In 2010 total adjusted emissions for the Southeast Desert increased from 0.283 tpd in 2009 to 0.453 tpd in 2010. The 2010 rate is well below the SIP goal of 0.92 tpd, (Tables 6a, 6b, Figure 3, 10).

Fumigants accounted for 60 percent of the emissions in this NAA in 2010, increasing to 0.272 tpd, almost double that of the previous year. Metam-sodium continues to be the primary contributor, accounting for 35 percent of emissions in 2010 (0.160 tpd), up from 0.074 tpd in 2009. Emissions from four other fumigants, chloropicrin, 1,3-dichloropropene, dazomet and methyl bromide accounted for an additional 22 percent of the total. Emissions from the use of 1,3- dichloropropene increased from 0.001 tpd in 2009 to 0.038 tpd in 2010, while methyl bromide and dazomet declined (Tables 13, A3-3a to A3-3d, Figure 11). Approximately half of emissions from nonfumigants came from products with emulsifiable concentrate formulations (Table 6c). Unadjusted emissions from commodities during the ozone season in 2010 was varied. Emissions from potatoes, peppers and strawberries increased, while those from carrots and ornamental turf declined. The use of metam-sodium on peppers and watermelon correlates to the increase in emissions from this fumigant (Tables 14, A2- 3d to A2-3h, Figure 12).

The 2008 fumigant regulations caused a decrease in emissions in Southeast Desert NAA in 2009. However, fumigant emissions almost doubled between 2009 and 2010, from 0.138 tpd to 0.272 tpd. Approximately three-quarters of the increased emissions were due to increased use, as indicated by the change in unadjusted and adjusted fumigant emissions shown in Table 6b. Fumigants accounted for almost two-thirds of the pesticide emissions in 2010 for this NAA, but accounted for less than half the emissions in 2009 (Figure 10).

Using the ARB emission inventory classification, emissions from structural applications of methyl bromide have been less than 0.001 tpd since 2005. Agricultural applications peaked at 0.286 tpd in 2007, and have since decreased to 0.012 tpd in 2010. These findings are consistent with the trend found for the decline in use of methyl bromide on turf/sod. Non-methyl bromide emissions from agricultural applications increased by 88 percent from 0.494 tpd in 2009 to 0.930 tpd in 2010. Structural non-methyl bromide emissions also increased from 0.045 tpd in 2009 to 0.051 tpd in 2010 (Tables 15, A2-3i to A2-3l).

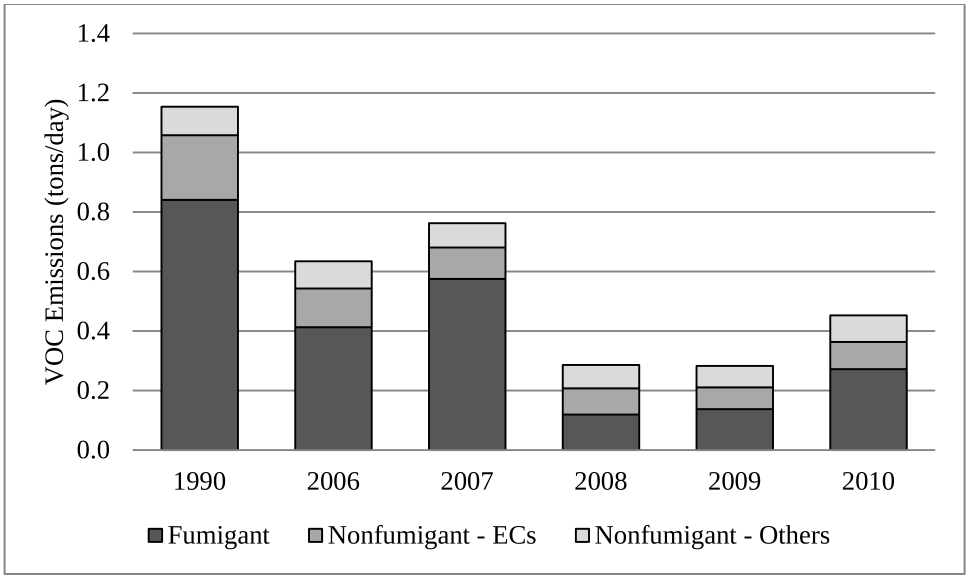


Figure 10. Pesticide VOC emissions for the Southeast Desert NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method.

Table 13. Top ten primary active ingredients contributing to **2010** May-October ozone season *adjusted* VOC emissions in NAA 3, the Southeast Desert

Primary AI	**Total Product Adjusted Emissions (tons/day)**	**Percent of All NAA 3 May – Oct 2010 Adjusted Emissions**
METAM-SODIUM	0.160	35.31
CHLOROPICRIN	0.038	8.34
1,3-DICHLOROPROPENE	0.038	8.28
BENSULIDE	0.032	7.16
DAZOMET	0.012	2.75
METHYL BROMIDE	0.012	2.69
EPTC	0.011	2.54
GLYPHOSATE, ISOPROPYLAMINE SALT	0.010	2.28
GIBBERELLINS	0.010	2.22
CYFLUTHRIN	0.009	1.94

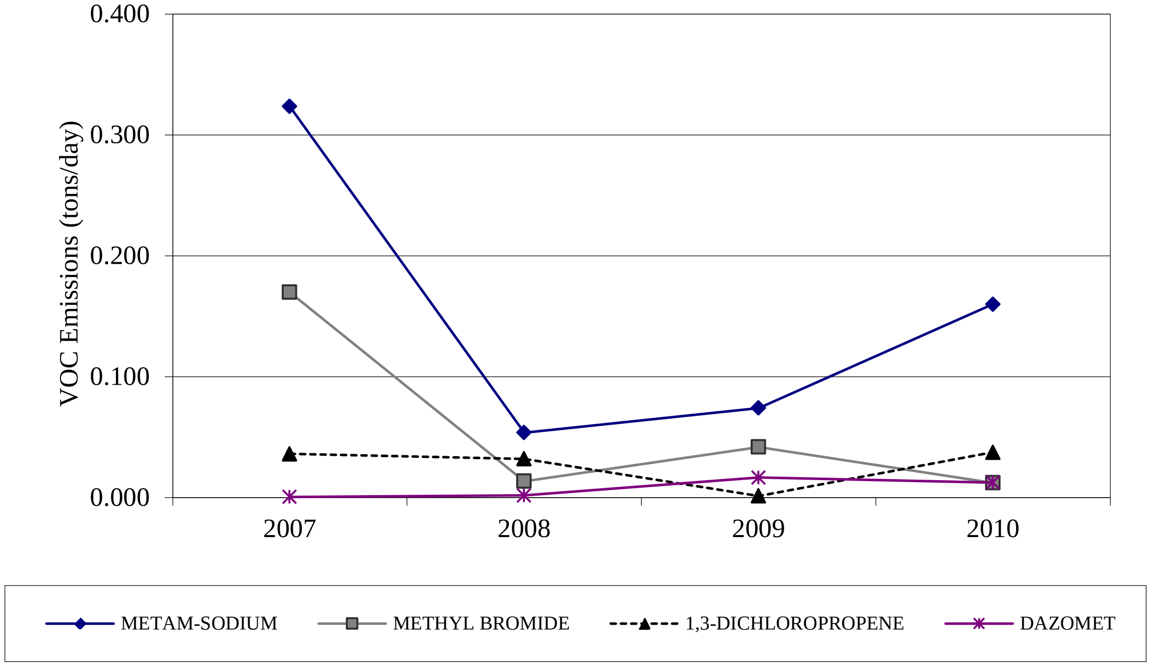


Figure 11. Changes in adjusted emissions of selected AIs in the Southeast Desert NAA from 2007 to 2010.

Table 14. Top ten pesticide application sites contributing to **2010** May-October ozone season *unadjusted* VOC emissions in NAA 3.

Application Site	Emissions (tons/day)	Percent of all NAA 3 May – Oct 2010 emissions
PEPPERS	0.275	27.73
STRAWBERRY	0.149	14.97
CARROTS	0.087	8.72
WATERMELONS	0.079	7.94
LETTUCE, LEAF	0.056	5.64
UNCULTIVATED AGRICULTURAL AREAS*	0.053	5.32
STRUCTURAL PEST CONTROL	0.051	5.11
CAULIFLOWER	0.029	2.92
POTATO	0.028	2.81
GRAPES	0.027	2.68

* Treatment of an area prior to determining which crop will be planted.

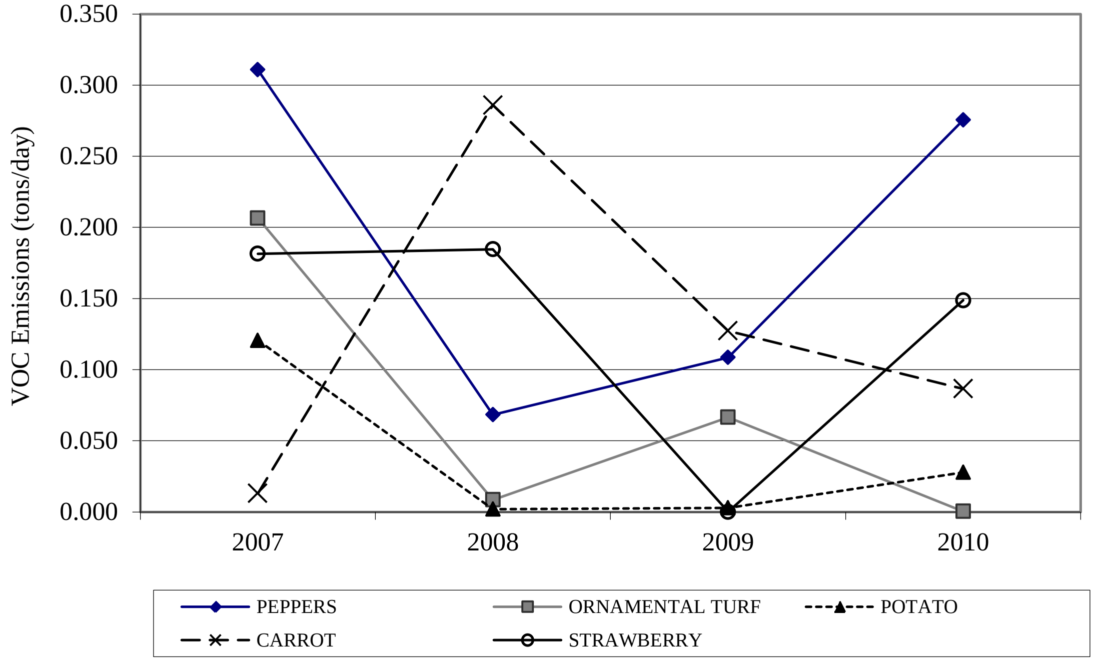


Figure 12. Changes in unadjusted emissions from selected commodities/sites in the Southeast Desert NAA from 2007 to 2010.

Table 15. *Unadjusted* **2010** May–October VOC emissions in NAA 3 by ARB emission inventory classification (tons per day, tpd).

NAA 3 - 2010	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	0.012	0.000
NON-METHYL BROMIDE EMISSIONS	0.930	0.051

Ventura - NAA 4

Ozone season adjusted emissions in the Ventura NAA (NAA 4) increased by 0.518 tpd from 2.080 tpd in 2009 to 2.597 tpd in 2010 (25 percent). Emissions continued to meet the SIP goal for 2012 (3.0 tpd). (Tables 6a, 6b, Figure 3, 13).

As in previous years, fumigants dominate the pesticide inventory for this NAA. In 2010 fumigants accounted for 82 percent of the emissions, up from 78 percent in 2009 and 72 percent in 2008. The most heavily used fumigants in NAA 4 in 2010 were chloropicrin, methyl bromide, and 1,3-dichloropropene, which together accounted for over 65 percent of emissions (Tables 16, A3-4a to A3-4d, Figure 14). Emissions from 1,3-dichloropropene and chloropicrin increased in 2010, while emissions from methyl bromide declined slightly from 0.544 tpd in 2009 to 0.515 tpd in 2010, but were above emission levels in 2008 (0.277 tpd). In 2010 over 96 percent of chloropicrin emissions and over 89 percent of methyl bromide emissions came from applications to strawberries or "soil application/preplant". It should be noted that the commodity/site description "soil fumigation/preplant" refers to applications that are made before the grower has made a decision about which commodity to plant. These sites may be re-identified at a later time as any number of commodities including strawberries, peppers, raspberries, herbs, etc., but it is beyond the scope of this inventory to be able to identify which commodities these are. Other major commodities/sites in 2010 include raspberries, lemons, and tomatoes. (Tables 17, A2-4e to A2-4h, Figure 15). In 2010 50 percent of nonfumigant emissions, which account for less than 20 percent of this NAA's total adjusted emissions, were from products with emulsifiable concentrate formulations (0.239 tpd) (Table 6c).

Using the ARB emission inventory classification, emissions from structural applications were below 0.001 tpd in 2010. Emissions from agricultural applications of methyl bromide decreased from 1.134 tpd in 2009 to 1.073 tpd in 2010. These findings are consistent with the trend found for the use of methyl bromide to strawberries and soil fumigation/preplant. Non-methyl bromide emissions from agricultural applications increased from 5.160 tpd in 2009 to 7.633 tpd in 2010. Structural non-methyl bromide emissions were less than 0.025 tpd (Tables 18, A2-4i to A2-4l).

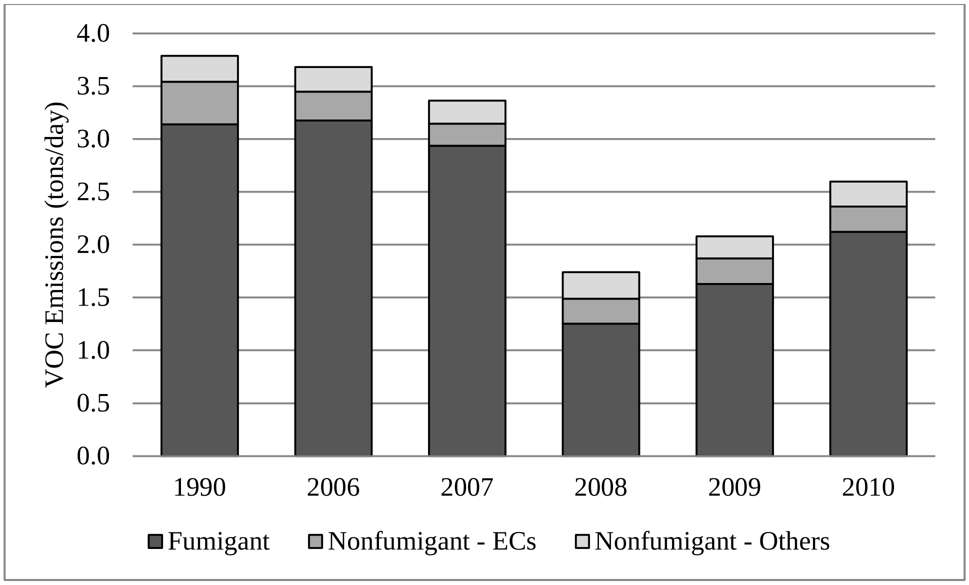


Figure 13. Pesticide VOC emissions for the Ventura NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method.

Table 16. Top ten primary active ingredients contributing to **2010** May-October ozone season *adjusted* VOC emissions in NAA 4, Ventura.

Primary AI	Total Product Adjusted Emissions (tons/day)	Percent of All NAA 4 May – Oct 2010 Adjusted Emissions
CHLOROPICRIN	0.804	30.94
METHYL BROMIDE	0.515	19.84
1,3-DICHLOROPROPENE	0.380	14.61
METAM-SODIUM	0.056	2.18
CHLORPYRIFOS	0.043	1.64
MINERAL OIL	0.037	1.44
ABAMECTIN	0.036	1.38
PETROLEUM OIL, UNCLASSIFIED	0.029	1.10
OXAMYL	0.022	0.85
METALDEHYDE	0.021	0.79

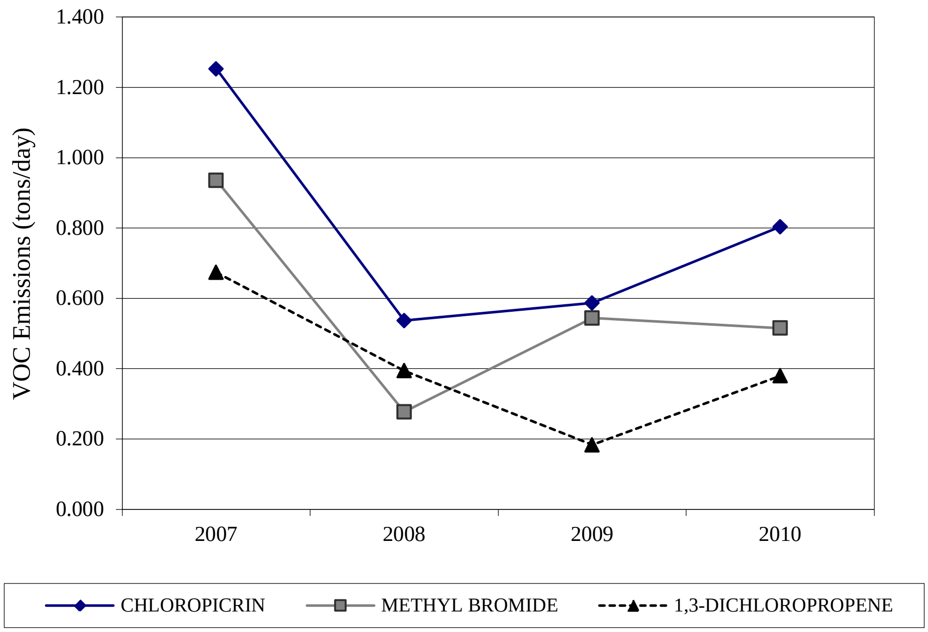


Figure 14. Changes in adjusted emissions of selected AIs in the Ventura NAA from 2006 to 2009.

Table 17. Top ten pesticide application sites contributing to **2010** May-October ozone season *unadjusted* VOC emissions in NAA 4.

Application Site	Emissions (tons/day)	Percent of all NAA 4 May – Oct 2010 emissions
STRAWBERRY	7.493	80.41
SOIL APPLICATION, PREPLANT-OUTDOOR	0.981	10.53
RASPBERRY	0.160	1.72
LEMON	0.159	1.70
TOMATO	0.149	1.60
N-OUTDR GRWN CUT FLWRS OR GREENS	0.085	0.92
PEPPERS	0.036	0.39
AVOCADO	0.033	0.35
STRUCTURAL PEST CONTROL	0.025	0.27
CELERY	0.024	0.25

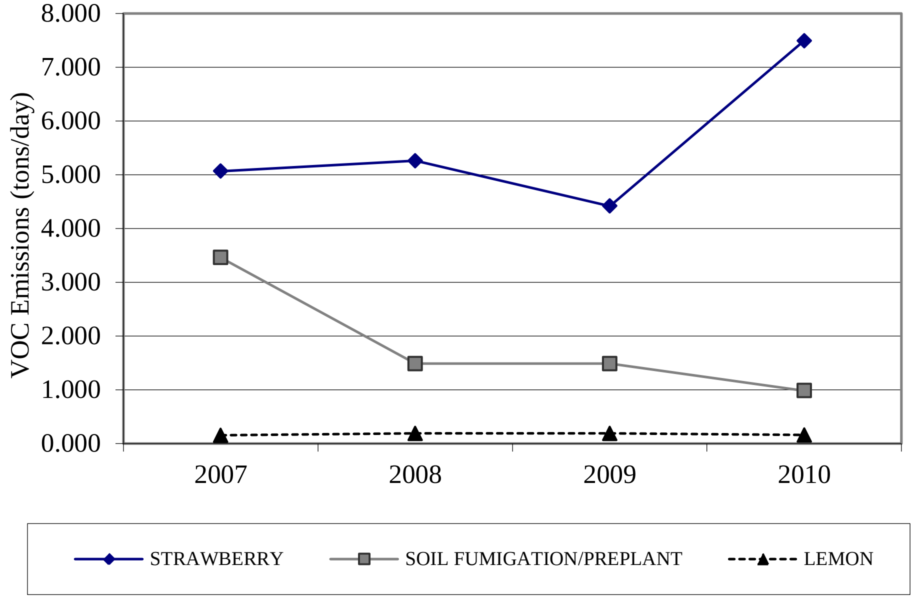


Figure 15. Changes in unadjusted emissions from selected commodities/sites in the Ventura NAA from 2007 to 2010.

Table 18. *Unadjusted* **2010** May–October VOC emissions in NAA 4 by ARB emission inventory classification (tons per day, tpd).

NAA 4 - 2010	Agricultural Applications	Structural Applications
METHYL BROMIDE EMISSIONS	1.073	0.000
NON-METHYL BROMIDE EMISSIONS	7.633	0.025

South Coast - NAA 5

In the South Coast NAA, adjusted emissions increased from 1.220 tpd in 2009 to 1.734 tpd in 2010, well below the SIP goal of 8.7 tpd. In 2010, emissions from nonfumigants accounted for more than 78 percent of the total for the South Coast NAA. Emissions from nonfumigants with emulsifiable concentrate formulations accounted for 0.415 tpd, which is 24 percent of the nonattainment area's total adjusted emissions (Tables 6a, 6b, 6c, Figure 3, 16).

The fumigants methyl bromide, chloropicrin, and 1,3-dichloropropene, contributed to 18.86 percent of 2010 adjusted emissions. Emissions from methyl bromide decreased from 2009 by 0.005 tpd, but chloropicrin and 1,3-dichloropropene emissions increased from 0.058 tpd and 0.025 in 2009 to 0.106 and 0.071 tpd in 2010, respectively. Cyfluthrin and permethrin, pyrethroid insecticides used in structural pest control, landscape maintenance and on a wide range of nursery commodities, were the largest nonfumigant contributors to the adjusted inventory accounting for 28.26 percent (0.265 tpd and 0.226 tpd, respectively) of emissions, up from 0.066 tpd and 0.203 tpd in 2009 (Tables 19, A3-5a to A3-5d, Figure 17). Limonene, an oil extracted from citrus that is used almost exclusively in structural pest control, decreased in emissions in 2010 (0.024 tpd), one third those from 2009 (0.070 tpd). Over seventy-six percent of emissions in NAA 5 came from fumigant and nonfumigant use in structural pest control and on strawberries, with landscape maintenance accounting for another 8.21 percent (0.165 tpd). Emissions from dazomet, primarily used on rights-of-way, decreased from 0.037 tpd in 2009 to 0.021 tpd in 2010 to (Tables 20, A2-5e to A2-5h, Figure 18).

Since this NAA has complied with the SIP goal for several years, most provisions of the 2008 fumigant regulations do not apply. Therefore, the fumigant regulations had little or no impact on emissions in this NAA.

Using the ARB emission inventory classification, emissions from structural applications of methyl bromide remained at 0.002 tpd in 2010. Agricultural applications decreased from 0.227 tpd in 2009 to 0.189 tpd in 2010. Non-methyl bromide emissions from agricultural applications increased from 0.655 tpd in 2009 to 0.757 tpd in 2010. Structural non-methyl bromide emissions increased from 0.658 tpd in 2009 to 1.018 tpd in 2010 (Tables 21, A2-5i to A2-5l).

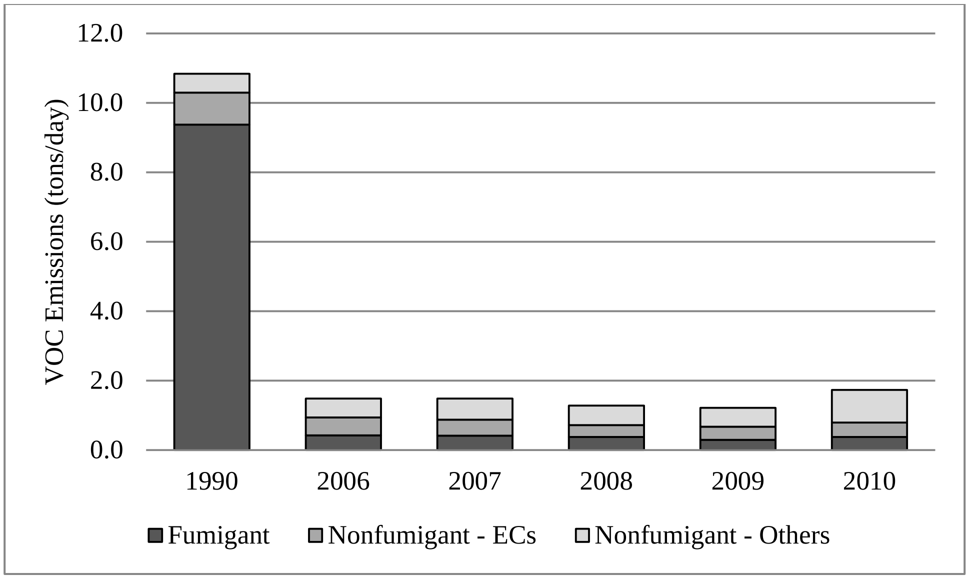


Figure 16. Pesticide VOC emissions for the South Coast NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others). Fumigant emissions are *adjusted* to account for fumigation method.

Table 19. Top ten primary active ingredients contributing to **2010** May-October ozone season *adjusted* VOC emissions in NAA 5, South Coast.

Primary AI	**Total Product Adjusted Emissions (tons/day)**	**Percent of All NAA 5 May – Oct 2010 Adjusted Emissions**
CYFLUTHRIN	0.265	15.25
PERMETHRIN	0.226	13.01
DISODIUM OCTABORATE TETRAHYDRATE	0.156	9.01
METHYL BROMIDE	0.149	8.62
CHLOROPICRIN	0.106	6.11
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	0.087	5.01
1,3-DICHLOROPROPENE	0.071	4.12
IMIDACLOPRID	0.067	3.88
PIPERONYL BUTOXIDE	0.054	3.10
BIFENTHRIN	0.041	2.39

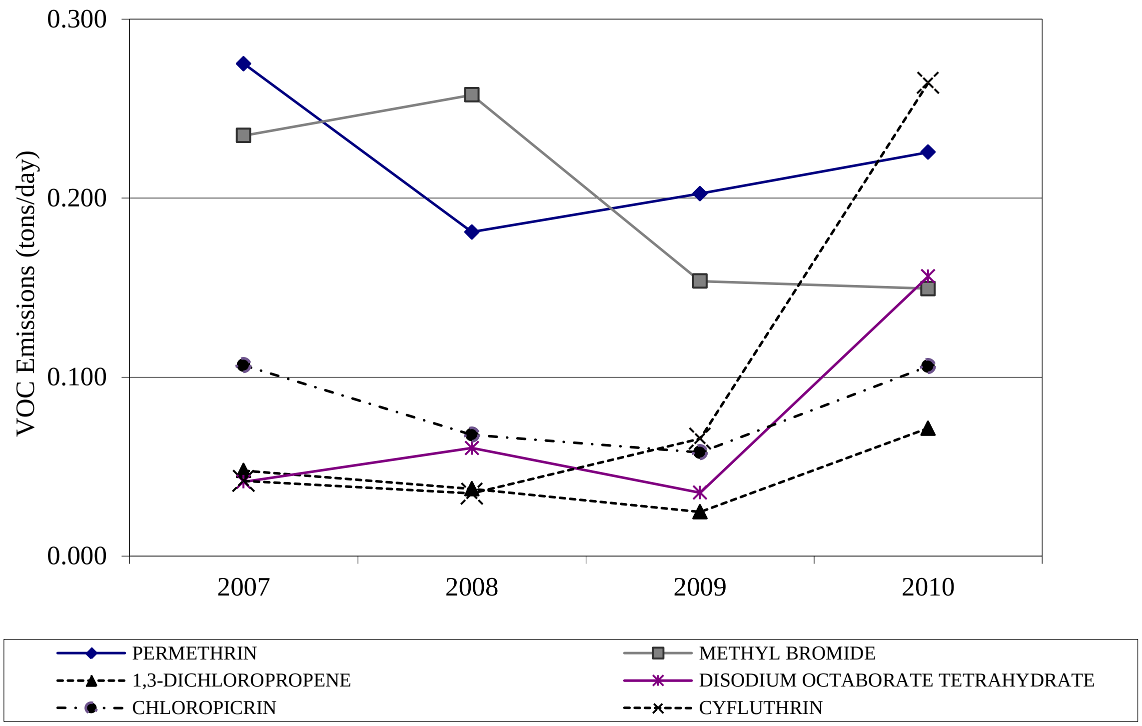


Figure 17. Changes in adjusted emissions of selected AIs in the South Coast NAA from 2007 to 2010.

Table 20. Top ten pesticide application sites contributing to **2010** May-October ozone season *unadjusted* VOC emissions in NAA 5.

Application Site	Emissions (tons/day)	Percent of all NAA 5 May – Oct 2010 emissions
STRUCTURAL PEST CONTROL	1.019	50.79
STRAWBERRY	0.512	25.52
LANDSCAPE MAINTENANCE	0.165	8.21
FUMIGATION, OTHER	0.085	4.23
N-OUTDR GRWN CUT FLWRS OR GREENS	0.077	3.85
RIGHTS OF WAY	0.039	1.97
N-OUTDR CONTAINER/FLD GRWN PLANTS	0.026	1.27
COMMODITY FUMIGATION	0.019	0.95
AVOCADO	0.008	0.42
ORANGE	0.008	0.41

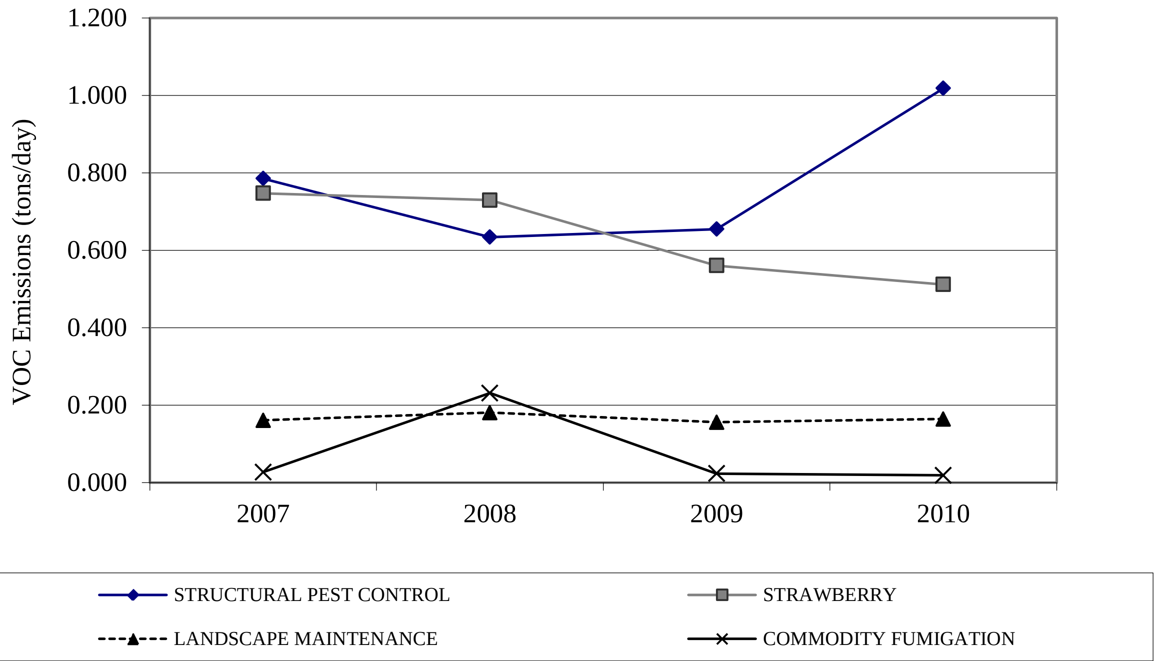


Figure 18. Changes in unadjusted emissions from selected commodities/sites in the South Coast NAA from 2007 to 2010.

Table 21. *Unadjusted* **2010** May–October VOC emissions in NAA 5 by ARB emission inventory classification (tons per day, tpd).

NAA 5 - 2010	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	0.189	0.002
NON-METHYL BROMIDE EMISSIONS	0.757	1.018

PROJECTION OF 2012 VOC EMISSIONS AND FUMIGANT LIMITS

DPR is required to limit VOC emissions of volatile organic compounds from pesticides in Ventura County during each annual May–October ozone season, and for the other NAAs if pesticide VOC emissions exceed 95 percent of the benchmarks specified in 3 CCR section 6452.2. As shown in Table 22, pesticide VOC emissions are less than 95 percent of the benchmarks that trigger fumigant limits in the Sacramento Metro, San Joaquin Valley, Southeast Desert and South Coast NAAs.

Table 22. Fumigant limit triggers and 2010 pesticide VOC emissions.

NAA	Benchmark and SIP Goal (tons/day)	Fumigant Limit Trigger (95% of Benchmark) (tons/day)	2010 Emissions (tons/day)
1 – Sacramento Metro	2.2	2.1	0.970
2 – San Joaquin Valley	18.1	17.2	15.528
3 – Southeast Desert	0.92	0.87	0.453
5 – South Coast	8.7	8.3	1.734

The maximum allowable annual ozone season pesticide VOC emissions (VOC_{MAX}) are defined in regulation 3 CCR, section 6452.2. DPR limits emissions by restricting use of the highest VOC contributing pesticides. These are the fumigants methyl bromide, 1,3-dichloropropene, chloropicrin, metam-sodium, metam-potassium, dazomet and sodium tetrathiocarbonate. DPR calculates the maximum allowable fumigant emissions (VOC_{FUM}) as the difference between VOC_{MAX} and projected nonfumigant pesticide emissions (VOC_{NF}) during the ozone season.

[1] $$VOC_{FUM} = VOC_{MAX} - VOC_{NF}$$

The allowable fumigant use is then calculated from VOC_{FUM} using the most recent method use fractions and application method adjustment factors as originally described in Barry et al. (2007). This procedure is defined in regulation (3 CCR section 6452.2) and requires DPR to develop an estimate of nonfumigant emissions in advance of an upcoming ozone season. For 2012, the 2010 method use fraction data and the application method adjustment factors used to determine allowable fumigant use from VOC_{FUM} are given in Appendix 1.

DPR developed a forecasting method to estimate Ventura NAA NOC_{NF} based on a statistical time series analysis (Spurlock, 2009). The time series model is updated each year to include the most recent available pesticide use report data. After updating, the revised time series model is used to forecast nonfumigant emissions which, in turn, are used to calculate allowable fumigant emissions and fumigant use as described above. Table 23 compares 2004–2010 NAA 4 nonfumigant ozone seasons emissions, while Table 24 provides the forecast 2012 nonfumigant emissions and resultant allowable fumigant emissions based on the regulatory benchmark and the SIP goal.

Table 23. May–October (ozone season) nonfumigant pesticide VOC emissions and percent of total adjusted emissions.

NAA	2004 Emissions (tons/day)	2005 Emissions (tons/day)	2006 Emissions (tons/day)	2007 Emissions (tons/day)	2008 Emissions (tons/day)	2009 Emissions (tons/day)	2010 Emissions (tons/day)	Mean Percent of Total Emissions
4 – Ventura								
Nonfumigants	0.622 (16%)	0.497 (14%)	0.508 (14%)	0.428 (13%)	0.486 (28%)	0.453 (22%)	0.475 (18%)	18%

Table 24. Projection for 2012 NAA 4 VOC emissions. The 2012 fumigant emission limit was determined by subtracting the forecast 2012 nonfumigant emissions from the SIP goal and VOC regulation benchmark (Tao, 2011).

Non-Attainment Area	SIP Goal and VOC Regulation Benchmark (tons/day)	Forecast 2012 Nonfumigant Emissions (tons/day)	2012 Fumigant Limit (tons/day)	2012 Fumigant Limit (pounds)	2010 Adjusted Fumigant Emissions (tons/day)
4 - Ventura	3.0 a	0.440	2.56	942,000	2.122

a The Ventura SIP Goal and VOC Regulation Benchmark for 2012 is shown.

REFERENCES

Barry, T., F. Spurlock and R. Segawa. September 29, 2007, memorandum to J. Sanders: Pesticide Volatile Organic Compound Emission Adjustments For Field Conditions And Estimated Volatile Organic Compound Reductions–Revised Estimates. *On-line: http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/1955_sanders.pdf*

Barry, T. 2008. September 28, 2008, memorandum to Randy Segawa: Development of Sub-Chronic Air Concentration Estimates Associated with Single Fumigant Application.

Federal Register. 1997. January 8, 1997, page 1170, Emission Reductions.

Federal Register. 2008. July 18, 2008, page 41277, Revisions to the California State Implementation Plan; Pesticide Element; Ventura County.

Ibewiro, B. 2008. How to File Pesticide Use Reports for Field Fumigant Applications. On-line: http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/factshts/voc_pur.pdf

Johnson, B. 2011. October 11, 2011. Memorandum to R Segawa. Evaluation of 1,3-Dichloropropene and Chloropicrin Field Studies With Regard to Volatile Organic Compound Program.

Neal, R. H, F. Spurlock, and R. Segawa. 2010. Annual report on volatile organic compound emissions from pesticides: emissions for 1990 – 2009.
On-line: http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/2009annual_rpt.pdf

Oros, D. and Spurlock, F. 2011. Estimating Pesticide Product Volatile Organic Compound Ozone Reactivity. Part 1: Speciating TGA-Based Volatile Organic Compound Emissions Using Confidential Statements of Formula.
http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/2286_segawa.pdf

Spurlock, F. 2009. July 16, 2009. Memorandum to R. Segawa. Time Series Analysis and Forecasting of Ventura County Nonfumigant Pesticide Volatile Organic Compound Emissions. *On-line:*
http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/2151_segawa.pdf

Spurlock, F., 2006. July 18, 2006, memorandum to J. Sanders: 2006 Revisions to Procedures for Estimating Volatile Organic Compound Emissions from Pesticides. *On-line: http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/voc_calc_revision071805.pdf*

Spurlock, F. January 7, 2002 memorandum to J. Sanders. Methodology for determining VOC emission potential of pesticide products. *On-line:*
http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/intro.pdf

Tao, J. November 1, 2011, Memorandum to Randy Segawa. Time Series Analysis and Forecasting for Ventura County Nonfumigant Pesticide Volatile Organic Compound Ozone Season Emisssions-2011 Update. *On-line:* http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/2350_segawa.pdf

Yates, S.R., J. Knuteson, F.F. Ernst, W. Zheng, and Q. Wang. 2008. Effect of Sequential Surface Irrigations on Field-Scale Emissions of 1,3-Dichloropropene. Environ. Sci. Technol. 42 (23): 8753-8758.