ANNUAL REPORT ON VOLATILE ORGANIC COUMPOUND EMISSIONS FROM PESTICIDES: EMISSIONS FOR 1990 – 2008

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EXECUTIVE SUMMARY

Preface

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, 2008, to October 31, 2008, the peak ozone season in California. In addition, data from the same months in 1990 are included for baseline comparisons, and from 2005, 2006 and 2007 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 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) 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 80 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 beginning in 2011. A fumigant limit is required at least through 2011 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

- Sacramento Metro NAA: VOC emissions increased between 2005 and 2006 but decreased in 2007 and 2008. Pesticide VOC emissions in 2008 were 64 percent lower than the 1990 base year and remain well in compliance with the SIP goal and the VOC regulation benchmark. In 2008, 94 percent of emissions were derived from nonfumigants.
- San Joaquin Valley NAA: VOC emissions increased in 2005 and 2006 and then decreased in 2007 and 2008. Pesticide VOC emissions in 2008 were 29 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: Except for an increase in 2007, VOC emissions decreased over the last several years, including 2008. Pesticide VOC emissions in 2008 were 75 percent lower than the 1990 base year and comply with the SIP goal and VOC regulation benchmark. Emissions from fumigants account for less 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 have decreased and meet the SIP goal for 2008 as well as the final goal to be met beginning in 2012. Pesticide VOC emissions in 2008 were 54 percent lower than the 1990 base year. More than 70 percent of emissions are derived from fumigants.
- South Coast NAA: VOC emissions decreased and remain well below the emission targets. Pesticide VOC emissions in 2008 were 88 percent lower than the 1990 base year.

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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The authors wish to thank the reviewers whose unique perspectives and experiences helped ensure the accuracy and readability of this report. We gratefully acknowledge the staff of DPR and cooperating federal, state, local, and private agencies for contributing to the database.

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 per cent 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 location 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

California's five ozone NAAs 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 1990–2008 and fumigant limits for 2010.

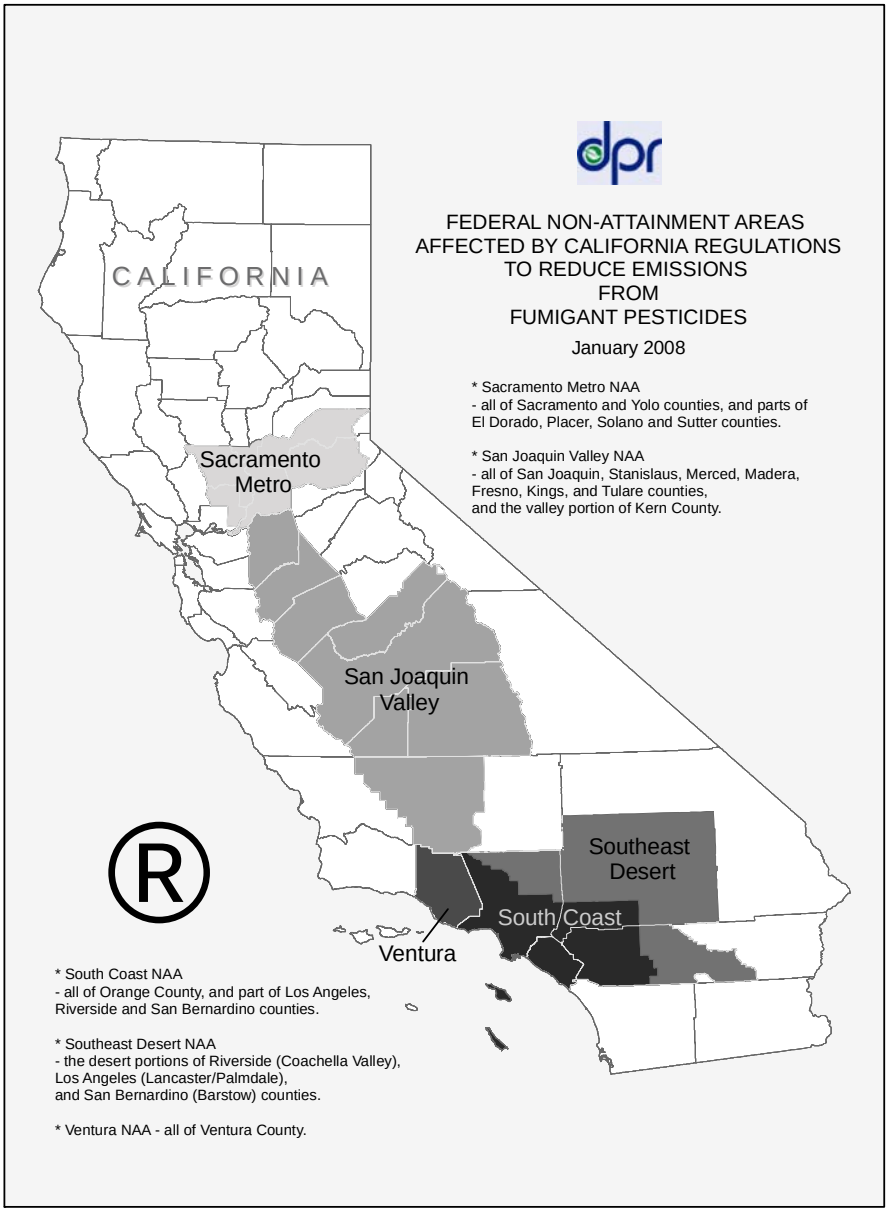


Figure 1. Federal nonattainment areas affected by California Regulations to reduce emissions from fumigant pesticides.

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).

$$emission = lbs\ of\ product\ used \times EP$$

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

$$emission = lbs\ of\ product\ used \times EP \times AMAF$$

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 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 - 26).

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 2005, 2006, 2007 and 2008 are included in this memo. 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 revised the AMAF for one fumigation method. DPR received a study documenting the emissions from a metam-sodium application made at night using a shank injection/compaction method. Based on this study, DPR has revised the AMAF for this method (Table 4). This study also included emission data for the same fumigation method for a daylight application. However, this daylight method apparently differs from the current daylight shank injection method. If so, the frequency this method is used is not documented, so total emissions for all fumigations with this method cannot be calculated. Additionally, the emissions documented in this study (one percent) are very different from the previous metam shank injection study (28 percent). DPR may revise the current AMAF or establish a new AMAF after further evaluation.

Table 4. Revised application method adjustment factors (emission ratings) for metam fumigation methods.

Method Description	Fumigation Method Code	Original AMAF (%)	Revised AMAF (%)
Night/Nontarpaulin/Shallow/Broadcast or Bed/Two Water Treatments	1455	28	13

DPR reviewed a study on post-fumigation water treatments to reduce emissions from 1,3-dichloropropene fumigations (Yates 2008). This study provides firm evidence that five daily water treatments following a deep-shank injection application of 1,3-dichloropropene reduces emissions. However, it's unlikely any grower or applicator would use this regime due to the high cost. DPR has not included this fumigation method.

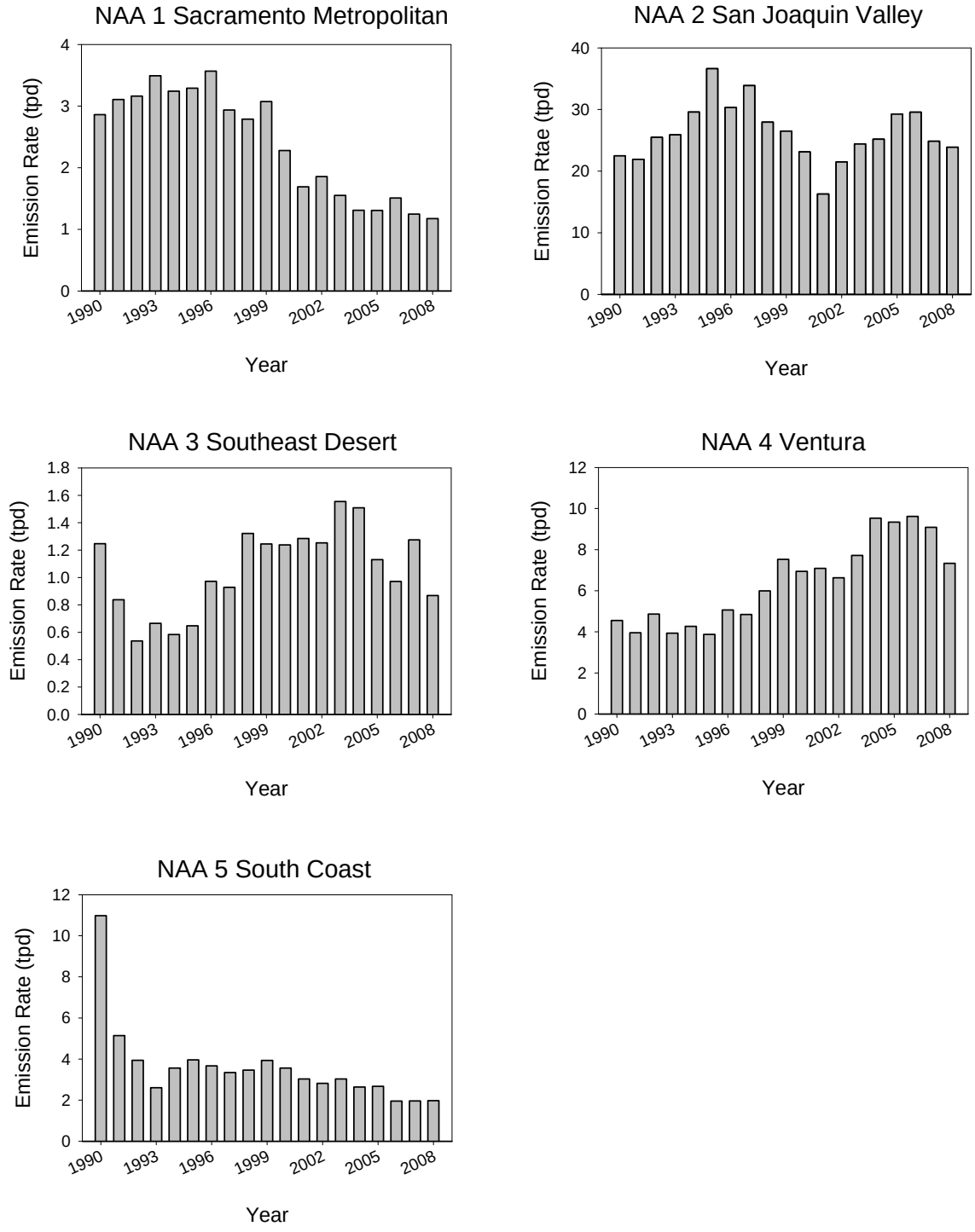
DPR has proposed a SIP revision with a commitment to ensure pesticide VOC emissions do not exceed 18.1 tons/day in the San Joaquin Valley NAA, equivalent to a 12 percent reduction from 1990 (Table 3). DPR will use the emissions estimation methodology described in this report to meet the SIP commitment. 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.

VOLATILE ORGANIC COMPOUND INVENTORY RESULTS

The main text of this report summarizes the pesticide VOC emission inventory data for 2008 only. Adjusted and unadjusted emission data for 2005, 2006 and 2007, and unadjusted data for 2008 are summarized in Appendices 2 and 3. Previous inventory memos and the 2007 report 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 2008. These values are *unadjusted* and so do not take in to consideration MUFs and AMAFs that can only be applied to emissions in 2005 through 2008, and 1990. The figure is useful in that it compares emissions for the entire history of the inventory and shows trends in five NAAs.

Figure 2. Annual ***unadjusted*** ozone season pesticide VOC emissions by NAA from 1990 to 2008, inclusive.



Tables 5 and 6a and Figure 3 summarize the adjusted pesticide VOC emissions for 2004 through 2008, 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 2008. 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:

- Emissions in 2008 in the Sacramento Metro (1) continue to decline. Nonfumigants represented 94 percent of the total, and the total remaining well below the SIP goal.
- Emissions in the South Coast NAA (5) also decreased slightly over 2007 values and remain well below the SIP goal.
- In 2008, fumigants accounted for less than half of VOC emissions in the Southeast Desert (3), down significantly from 2007. Although total VOC emissions increased in 2007, there were reduced significantly in 2008, and continue to meet the SIP goal.
- 2008 VOC emissions in the Ventura NAA (4) decreased by almost 50 percent from the previous year due to a reduction in the use fumigant. 2008 emissions met the regulatory goal for 2010, 2011and 2012. About 70 percent of emissions come from fumigants.
- In the San Joaquin Valley NAA (2), nonfumigants accounted for approximately three quarters of the total VOC emissions in 2008. In this NAA, VOC emissions decreased from 2007 to 2008 by more than 15 percent, and are below the SIP goal.

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)
1 – Sacramento Metro	2.784	2.2	1.235	1.239	1.354	1.053	0.994
2 – San Joaquin Valley	20.517	18.1	17.329	20.754	21.324	17.230	14.475
3 – Southeast Desert	1.153	0.92	0.995	0.740	0.634	0.764	0.287
4 – Ventura	3.787	3.0 a	3.924	3.617	3.682	3.363	1.732
5 – South Coast	10.840	8.7	1.922	1.969	1.482	1.488	1.283

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

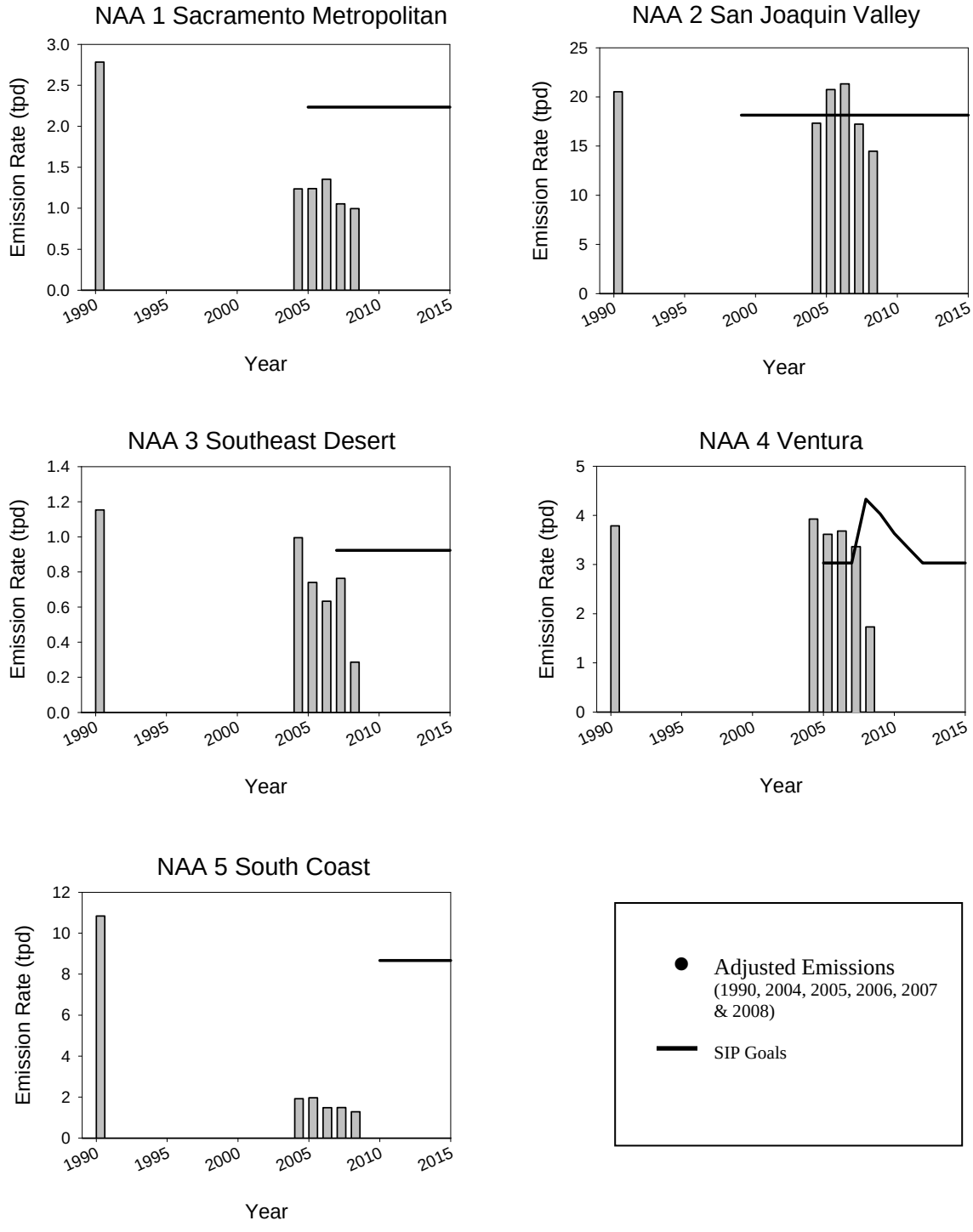
Table 6a. May–October (ozone season) ***adjusted*** fumigant and nonfumigant pesticide VOC emissions.

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)	
1 – Sacramento Metro												
Fumigants	0.384	(14%)	0.111	(9%)	0.085	(7%)	0.162	(12%)	0.189	(18%)	0.064	(6%)
Nonfumigants	2.400	(86%)	1.124	(91%)	1.154	(93%)	1.192	(88%)	0.864	(82%)	0.929	(94%)
2 - San Joaquin Valley												
Fumigants	5.536	(27%)	6.362	(37%)	6.910	(33%)	6.808	(32%)	6.123	(36%)	3.367	(23%)
Nonfumigants	14.981	(73%)	10.967	(63%)	13.844	(67%)	14.517	(68%)	11.107	(64%)	11.108	(77%)
3 - Southeast Desert												
Fumigants	0.840	(73%)	0.762	(77%)	0.474	(64%)	0.413	(65%)	0.575	(75%)	0.119	(41%)
Nonfumigants	0.313	(27%)	0.233	(23%)	0.266	(36%)	0.221	(35%)	0.189	(25%)	0.168	(59%)
4 - Ventura												
Fumigants	3.140	(83%)	3.302	(84%)	3.119	(86%)	3.175	(86%)	2.935	(87%)	1.247	(72%)
Nonfumigants	0.647	(17%)	0.622	(16%)	0.497	(14%)	0.508	(14%)	0.429	(13%)	0.484	(28%)
5 – South Coast												
Fumigants	9.372	(86%)	0.702	(37%)	0.594	(30%)	0.422	(28%)	0.411	(28%)	0.377	(29%)
Nonfumigants	1.468	(14%)	1.220	(63%)	1.375	(70%)	1.060	(72%)	1.076	(72%)	0.906	(71%)

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)
1 – Sacramento Metro						
Unadjusted Fumigants	0.461	0.186	0.151	0.315	0.383	0.245
Adjusted Fumigants	0.384	0.111	0.085	0.162	0.189	0.064
2 - San Joaquin Valley						
Unadjusted Fumigants	7.491	14.213	15.400	15.034	13.750	12.762
Adjusted Fumigants	5.536	6.362	6.910	6.808	6.123	3.367
3 - Southeast Desert						
Unadjusted Fumigants	0.933	1.275	0.863	0.750	1.086	0.701
Adjusted Fumigants	0.840	0.762	0.474	0.413	0.575	0.119
4 - Ventura						
Unadjusted Fumigants	3.909	8.916	8.841	9.113	8.658	6.855
Adjusted Fumigants	3.140	3.302	3.119	3.175	2.935	1.247
5 – South Coast						
Unadjusted Fumigants	9.514	1.418	1.301	0.898	0.883	1.071
Adjusted Fumigants	9.372	0.702	0.594	0.422	0.411	0.377

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) 2008 emissions are below those of the four previous years. Adjusted emissions in 2004 were 1.235 tpd, and these increased to 1.354 tpd in 2006, then decreased to 1.053 tpd in 2007 and 0.994 tpd in 2008. In 2008, 94 percent of emissions were attributable to nonfumigants. Fumigant emissions increased from seven percent (0.085 tpd) in 2005 to 18 percent in 2007 (0.189 tpd), but were reduced to 7 percent (0.064 tpd) in 2008 (Tables 6a, 6b, Figure 3, 4). Total VOC emissions continue to remain well below the SIP goal of 2.2 tpd.

Chlorpyrifos, a widely used insecticide, was a primary contributor and accounted for over twelve percent of the emissions in 2008 (Table 7). Emissions from chlorpyrifos use decreased from 0.186 tpd in 2005 to 0.116 tpd in 2007, but increased to 0.121 tpd in 2008. Emissions from the use of 1,3-dichloropropene increased steadily between 2005 (0.024 tpd) and 2007 (0.109 tpd), but dropped to 0.031 tpd in 2008, accounting for 3.09 percent of emissions. A similar decrease in emissions from the fumigants metam-sodium and methyl bromide occurred in 2008, metam-sodium dropping from 0.022 tpd in 2007 to 0.002 tpd in 2008, and methyl bromide emissions decreasing from 0.055 tpd in 2007 to 0.020 tpd in 2008. The rice herbicide molinate accounted for the second highest amount of emissions in 2005 (0.093 tpd), however use of this pesticide has been phased out which is reflected by a further reduction in emissions in 2008 to less than 0.001 tpd. Emissions from the use of bifenthirin increased markedly in 2008 from 0.025 tpd to 0.061 tpd. (Tables 7, A3-1a to A3-1d, Figure 5).

In 2008 rice and walnuts were the commodities/sites with the greatest unadjusted VOC emissions with over 25 percent of the total. Emissions from walnuts decreased by approximately 50 percent in 2008 (from 0.300 tpd to 0.148 tpd), whereas emissions from application to rice remained almost unchanged (0.160 tpd in 2007 and 0.161 tpd in 2008). Emissions from almonds increased from 0.026 tpd in 2007 to 0.121 tpd in 2008. Detailed analysis of the data indicates that the amount of VOC emissions derived from applications of 1,3-dichloropropene and methyl bromide to walnuts decreased by almost 75 percent from 2007 to 2008. Treated acres of almonds increased by approximately 25 percent in 2008, with increased emissions from nonfumigants such as abamectin, chlorpyrifos and oxyfluorfen. Emissions from rice, processing tomatoes, and structural pest control either stayed the same or only declined slightly in 2008 (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 remained steady at less than 0.001 tpd since 2005, but agricultural applications increased from 0.035 tpd in 2005 to 0.062 tpd in 2007 and then decreased to 0.041 tpd in 2008. These findings are consistent with the trend found for applications of methyl bromide to walnuts. Non-methyl bromide emissions from structural applications continue to decline from

approximately 0.22 tpd in 2005 and 2006 to 0.066 tpd in 2007 and 0.062 tpd in 2008 (Tables 9, A2-1i - A2-1l).

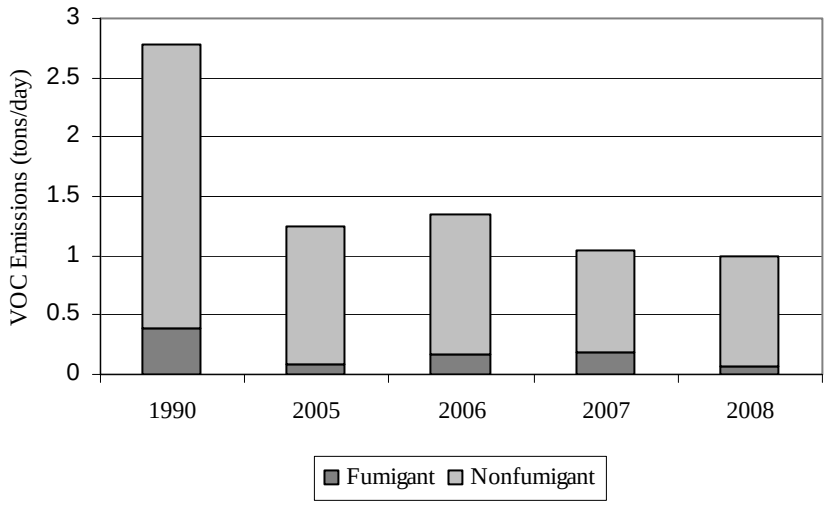


Figure 4. Pesticide VOC emissions for the Sacramento Metro NAA, May–October. Emissions for each year are divided into fumigants and nonfumigants. Fumigant emissions are *adjusted* to account for fumigation method.

Table 7. Top ten primary active ingredients contributing to **2008** 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 2008 Adjusted Emissions**
CHLORPYRIFOS	0.121	12.20
PHOSPHINE	0.083	8.31
BIFENTHRIN	0.061	6.09
THIOBENCARB	0.046	4.67
TRIFLURALIN	0.034	3.46
DIMETHOATE	0.031	3.16
1,3-DICHLOROPROPENE	0.031	3.09
PROPANIL	0.030	3.01
OXYFLUORFEN	0.028	2.80
LAMBDA-CYHALOTHRIN	0.027	2.73

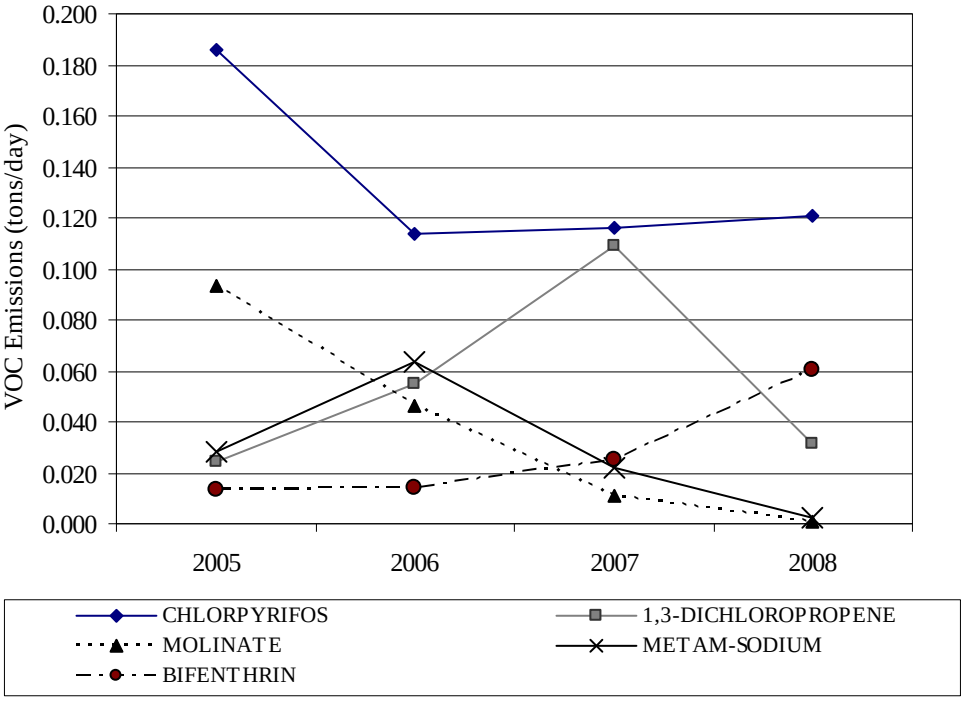


Figure 5. Changes in adjusted emissions of selected AIs in the Sacramento Metro NAA from 2005 to 2008.

Table 8. Top ten pesticide application sites contributing to **2008** May-October ozone season *unadjusted* VOC emissions in NAA 1.

Application Site	**Emissions (tons/day)**	**Percent of all NAA 1 May – Oct 2008 emissions**
RICE	0.161	13.73
WALNUT	0.148	12.64
TOMATO, PROCESSING	0.136	11.55
ALMOND	0.121	10.32
SOIL FUMIGATION/PREPLANT	0.098	8.34
RIGHTS OF WAY	0.079	6.74
STRUCTURAL PEST CONTROL	0.062	5.29
LANDSCAPE MAINTENANCE	0.041	3.46
GRAPE, WINE	0.040	3.44
ALFALFA	0.031	2.63

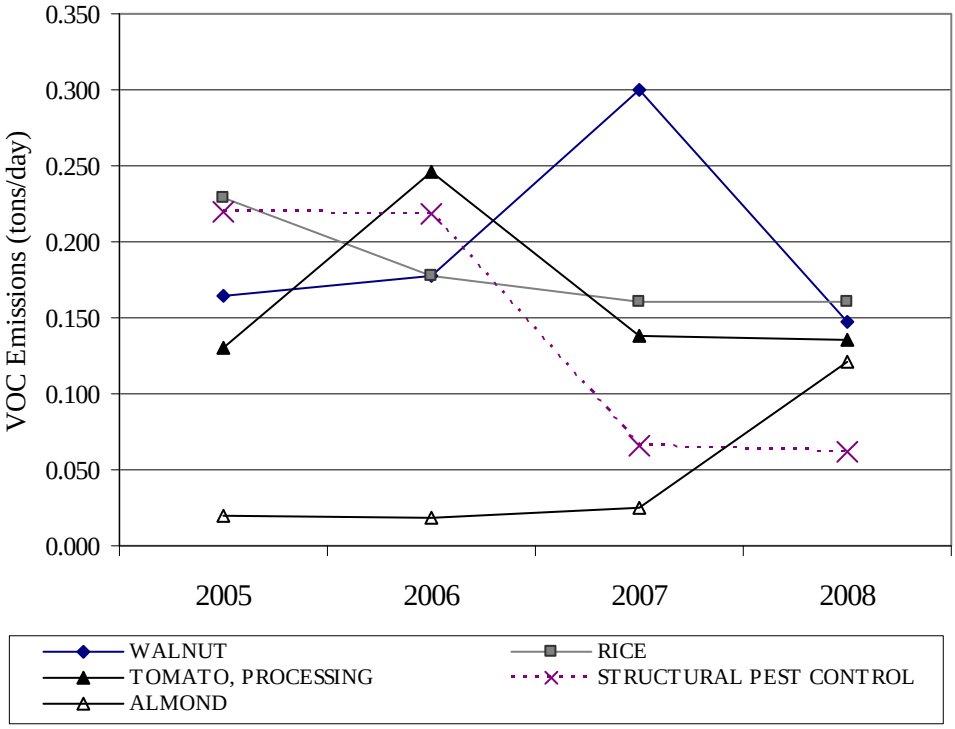


Figure 6. Changes in unadjusted emissions from selected commodities/sites in the Sacramento Metro NAA from 2005 to 2008.

Table 9. *Unadjusted* **2008** May–October VOC emissions in NAA1 by ARB emission inventory classification (tons per day, tpd).

NAA 1 - 2008	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	0.041	0.000
NON-METHYL BROMIDE EMISSIONS	1.066	0.062

San Joaquin Valley - NAA 2

Adjusted emissions in 2008 decreased from 17.230 tpd in 2007 to 14.475 tpd in 2008. As with the 2007 emissions, the 2008 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 77 percent of the total in 2008 (11.108 tpd). The top emission contributor for 2005 through 2008 was the nonfumigant, chlorpyrifos, which accounted for 3.869 tpd in 2005, 3.990 tpd in 2006, 2.263 tpd in 2007, and 2.220 tpd in 2008. (Tables 10, A3-2a to A3-2d, Figure 7). In 2008 almost 30 percent of emissions from chlorpyrifos came from use on almonds, with almost 20 percent from emissions on oranges and 15 percent from alfalfa. The cotton contribution to chlorpyrifos emissions increased from 2007 to 2008, but were still only one fifth of those seen in 2005. 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). Products containing fenpyroximate are among the top 10 pesticide VOC contributors for the first time. Fenpyroximate is an insecticide/miticide used primarily on almonds and grapes, and VOC emissions from these products have increased steadily since it was first registered in 2002 (Figure 8).

As expected, the 2008 fumigant regulations caused a decrease in emissions. Fumigant emissions decreased by 45 percent between 2007 and 2008. Use (unadjusted emissions) of fumigants decreased by seven percent (Table 6b). Some of the decrease in emissions may also be due to more accurate estimates of the 2008 MUFs based on pesticide use reports instead of surveys or other surrogate data used for earlier years. However, the majority of the decrease in fumigant emissions was probably due the use of low-emission fumigation methods required by the 2008 regulations. In addition, the decrease in fumigant emissions more than offset a slight increase in nonfumigant emissions.

Using the ARB emission inventory classification, emissions from structural applications of methyl bromide showed a slight increase in 2008 going from 0.012 tpd in 2007 to0.014 tpd in 2008. Agricultural applications decreased from around 2 tpd in 2005 – 2007 to 1.737 tpd in 2008. Non-methyl bromide emissions from agricultural applications decreased in 2008 to 21.324 tpd while structural applications increased from 0.292 tpd in 2007 to 0.323 tpd in 2008. (Tables 12, A2-2i to A2-2l).

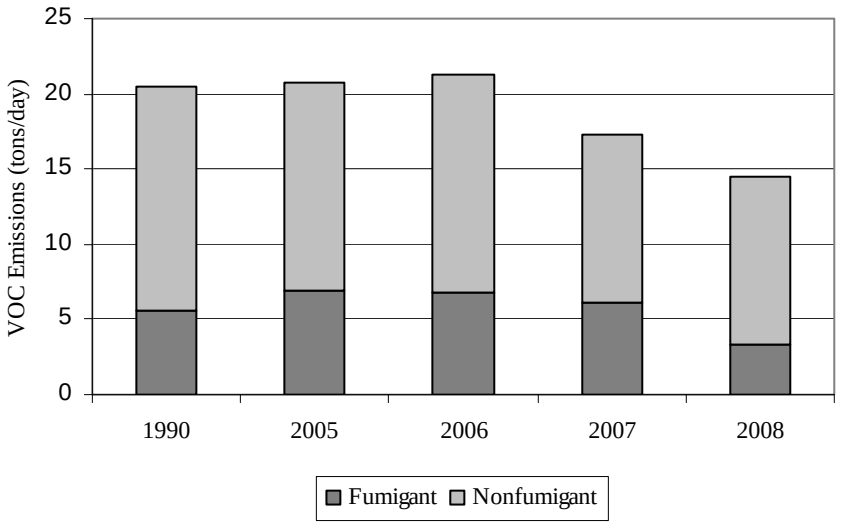


Figure 7. Pesticide VOC emissions for the San Joaquin Valley NAA, May–October. Emissions for each year are divided into fumigants and nonfumigants. Fumigant emissions are *adjusted* to account for fumigation method.

Table 10. Top ten primary active ingredients contributing to **2008** 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 2008 Adjusted Emissions
CHLORPYRIFOS	2.220	15.34
1,3-DICHLOROPROPENE	1.163	8.03
METHYL BROMIDE	0.843	5.83
OXYFLUORFEN	0.828	5.72
METAM-SODIUM	0.711	4.91
GIBBERELLINS	0.648	4.48
DIMETHOATE	0.606	4.18
ABAMECTIN	0.526	3.63
FENPYROXIMATE	0.402	2.78
ACROLEIN	0.400	2.76

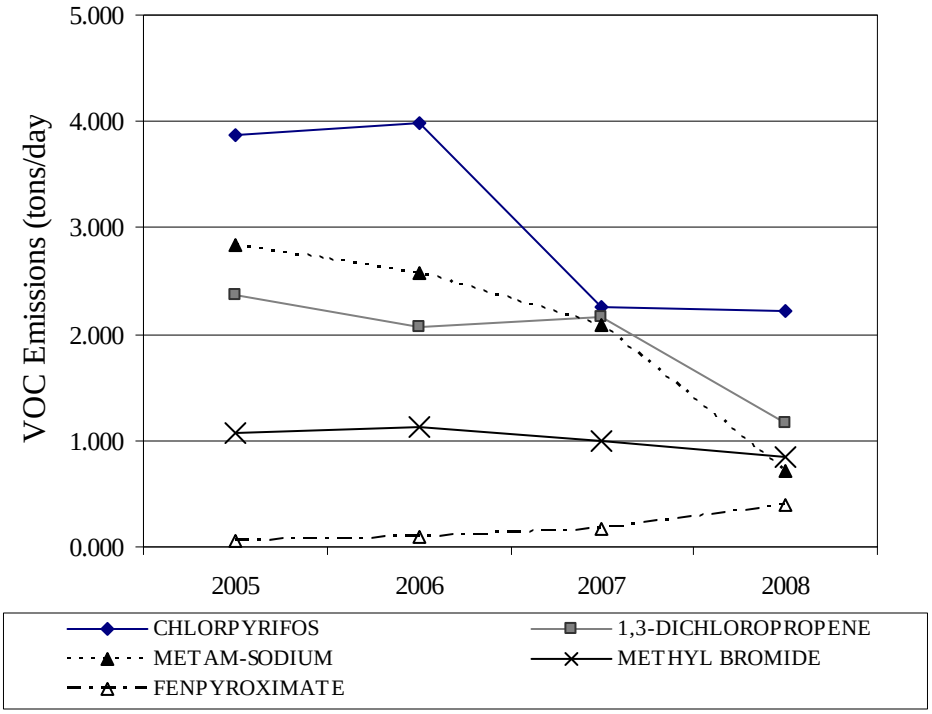


Figure 8. Changes in adjusted emissions of selected AIs in the San Joaquin Valley NAA from 2005 to 2008.

Table 11. Top ten pesticide application sites contributing to **2008** May-October ozone season *unadjusted* VOC emissions in NAA 2.

Application Site	Emissions (tons/day)	Percent of all NAA 2 May – Oct 2008 emissions
CARROT	4.092	17.14
ALMOND	2.894	12.13
TOMATO, PROCESSING	1.355	5.67
ORANGE	1.354	5.67
N-OUTDR PLANTS IN CONTAINERS	1.248	5.23
COTTON	1.211	5.07
POTATO	1.065	4.46
SOIL FUMIGATION/PREPLANT	1.020	4.27
GRAPE	0.912	3.82
ALFALFA	0.879	3.68

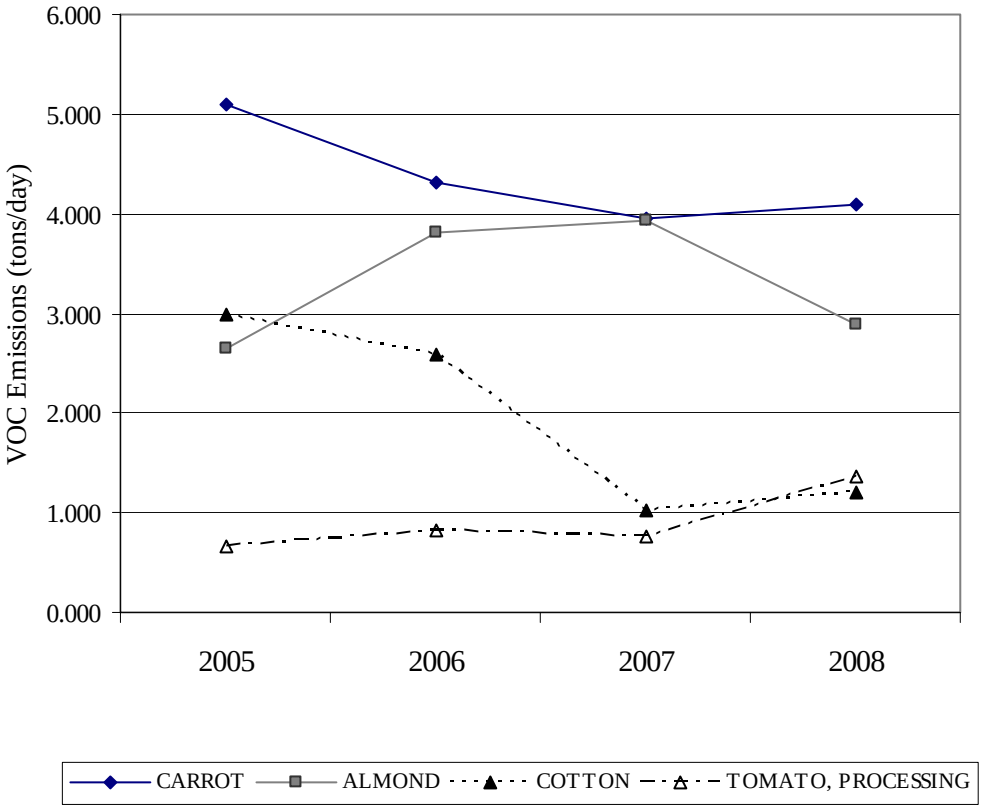


Figure 9. Changes in unadjusted emissions from selected commodities/sites in the San Joaquin Valley NAA from 2005 to 2008.

Table 12. *Unadjusted* **2008** May–October VOC emissions in NAA 2 by ARB emission inventory classification (tons per day, tpd).

NAA 2 - 2008	Agricultural Applications	Structural Applications
METHYL BROMIDE EMISSIONS	1.737	0.014
NON-METHYL BROMIDE EMISSIONS	21.324	0.323

Southeast Desert - NAA 3

In 2008 total adjusted emissions for the Southeast Desert declined, reversing the increase seen in 2007 and declined from 0.764 tpd in 2007 to 0.287 tpd in 2008. The 2008 rate is well below the SIP goal of 0.92 tpd, (Tables 6a, 6b, Figure 3, 10).

Fumigants account for approximately 40 percent of the emissions in this NAA. Metam-sodium continues to be the primary contributor although it accounted for only 18.73 percent of emissions in 2008, down significantly from the average 46 percent of adjusted emissions over the previous four years. Methyl bromide emissions jumped from less than 0.008 tpd in 2006 to 0.170 tpd in 2007, but declined in 2008 to 0.014 tpd (Tables 13, A3-3a to A3-3d, Figure 11). Emissions from fumigants metam-sodium, methyl bromide, and chloropicrin all declined sharply in 2008. Unadjusted emissions from carrots during the ozone season increased from 0.013 tpd in 2007 to 0.287 tpd in 2008. Methyl bromide emissions decreased sharply in 2008 from 0.170 tpd in 2007 to 0.014 tpd, due to decreased use on turf/sod, pepper (fruiting) and herbs, although there was an increase in emissions from methyl bromide use on outdoor plants in containers (Tables 14, A2- 3d, A2-3e, A2-3f, Figure 12).

The 2008 fumigant regulations caused a decrease in emissions in Southeast Desert NAA. Fumigant emissions decreased by 79 percent between 2007 and 2008. Fumigants accounted for two-thirds to three-quarters of the pesticide emissions in previous years for this NAA, but accounted for less than half the emissions in 2008 (Figure 10). Use of fumigants decreased by 35 percent (Table 6b). Again, some of the decrease may be due to more accurate estimates of the 2008 MUFs based on pesticide use reports instead of surveys or other surrogate data used for earlier years. However, the majority of the decrease in fumigant emissions was probably due the use of low-emission fumigation methods required by the 2008 regulations.

Using the ARB emission inventory classification, emissions from structural applications of methyl bromide remained steady at less than 0.001 tpd since 2005, but agricultural applications increased significantly from 0.013 tpd in 2006 to 0.286 tpd in 2007, and then decreased to 0.028 tpd in 2008. These findings are consistent with the trend found for the use of methyl bromide to turf/sod. Non-methyl bromide emissions from agricultural applications remained consistently around 0.89 tpd between 2005 and 2007 and were slightly reduced in 2008 (0.794 tpd). Structural non-methyl bromide emissions continue to follow a downward trend falling from 0.061 tpd in to 0.046 tpd in 2008 (Tables 15, A2-3i to A2-3l).

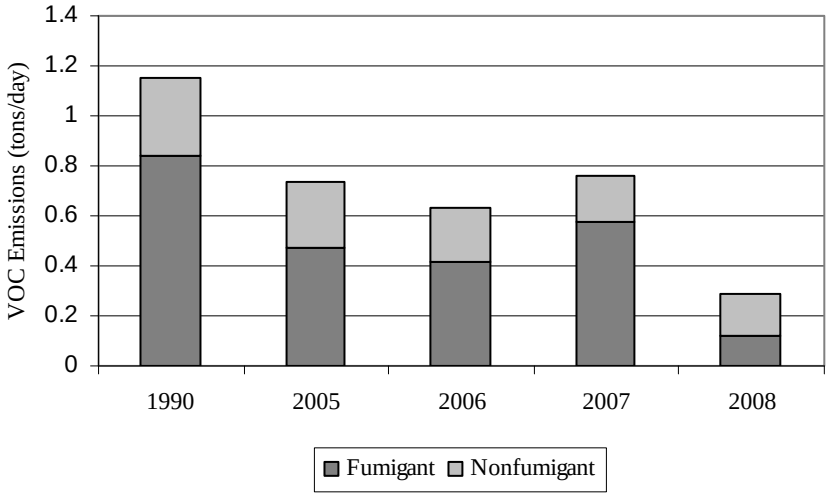


Figure 10. Pesticide VOC emissions for the Southeast Desert NAA, May–October. Emissions for each year are divided into fumigants and nonfumigants. Fumigant emissions are *adjusted* to account for fumigation method.

Table 13. Top ten primary active ingredients contributing to **2008** 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 2008 Adjusted Emissions**
METAM-SODIUM	0.054	18.73
1,3-DICHLOROPROPENE	0.032	11.19
METHYL BROMIDE	0.014	4.71
PERMETHRIN	0.013	4.62
BENSULIDE	0.012	4.35
EPTC	0.011	3.73
CHLOROPICRIN	0.008	2.93
POTASSIUM N-METHYLDITHIOCARBAMATE	0.008	2.73
MEFENOXAM	0.008	2.66
MALATHION	0.006	2.13

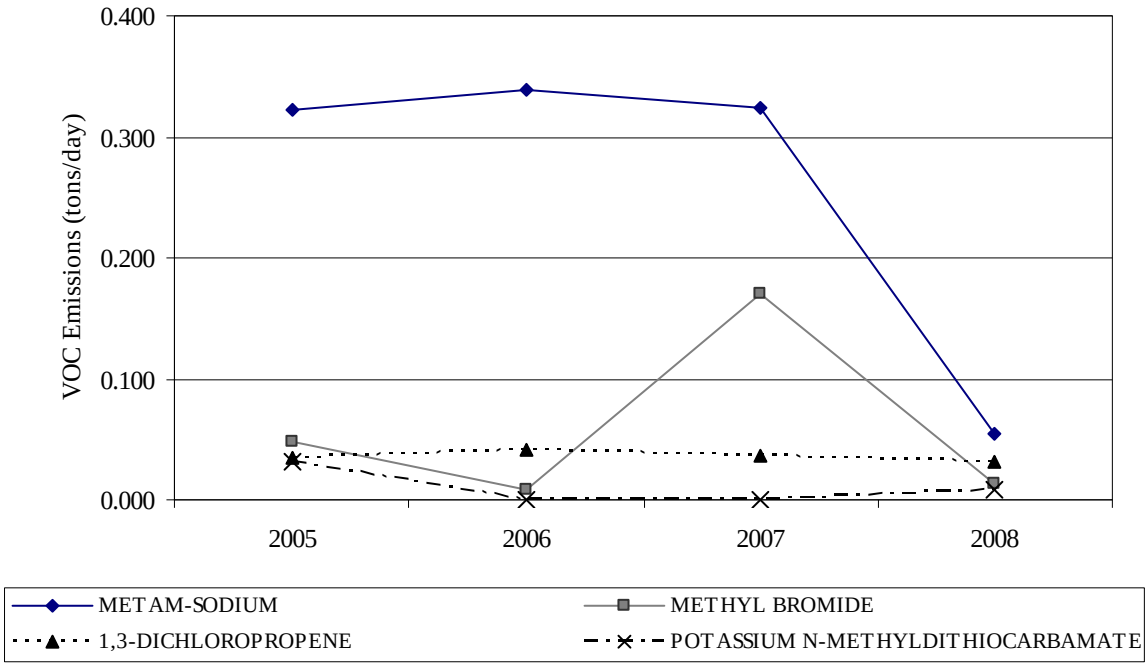


Figure 11. Changes in adjusted emissions of selected AIs in the Southeast Desert NAA from 2005 to 2008.

Table 14. Top ten pesticide application sites contributing to **2008** May-October ozone season *unadjusted* VOC emissions in NAA 3.

Application Site	**Emissions (tons/day)**	**Percent of all NAA 3 May – Oct 2008 emissions**
CARROT	0.287	32.99
STRAWBERRY	0.187	21.57
UNCULTIVATED AG	0.100	11.50
PEPPER, FRUITING	0.069	7.94
STRUCTURAL PEST CONTROL	0.045	5.15
WATERMELON	0.030	3.43
LANDSCAPE MAINTENANCE	0.025	2.92
GRAPE	0.018	2.10
RIGHTS OF WAY	0.018	2.04
N-OUTDR PLANTS IN CONTAINERS	0.015	1.70

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

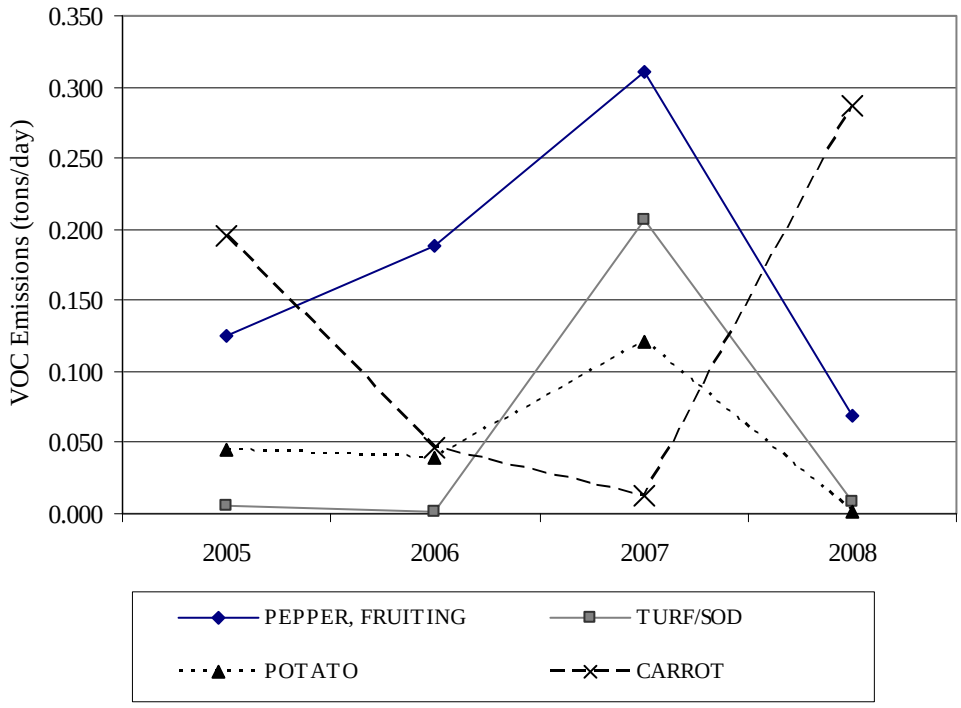


Figure 12. Changes in unadjusted emissions from selected commodities/sites in the Southeast Desert NAA from 2005 to 2008.

Table 15. *Unadjusted* **2008** May–October VOC emissions in NAA 3 by ARB emission inventory classification (tons per day, tpd).

NAA 3 - 2008	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	0.028	0.000
NON-METHYL BROMIDE EMISSIONS	0.794	0.046

Ventura - NAA 4

Ozone season adjusted emissions in the Ventura NAA (NAA 4) decreased by 1.633 tpd from 3.363 tpd in 2007 to 1.732 tpd in 2008 (21 percent). For the first time emissions have met 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, but in 2008 fumigants accounted for less than 73 percent of the emissions, compared to more than 85 percent from 2004 to 2007. The most heavily used fumigants in NAA 4 in 2008 were chloropicrin, 1,3-dichloropropene, and methyl bromide, which together accounted for almost 70 percent of emissions (Tables 16, A3-4a to A3-4d, Figure 14), however, overall emissions for these fumigants decreased sharply. In 2006, 2007, and 2008 almost 100 percent of chloropicrin emissions came from applications to strawberries or “soil fumigation/preplant”. In 2008 just over one percent of chloropicrin came from applications to tomatoes. Emissions from methyl bromide applications decreased sharply in 2008. Over 95 percent of emissions from methyl

bromide came from strawberries and “soil fumigation/preplant” applications. 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 2008 include lemons, tomatoes, and peppers (Tables 17, A2-4e to A2-4h, Figure 15).

In the Ventura NAA the 2008 fumigant regulations caused a decrease in emissions. Fumigant emissions decreased by 58 percent between 2007 and 2008. Use (unadjusted emissions) of fumigants decreased by 21 percent (Table 6b). Part of the decrease in use was likely due to the fumigant emission allowance system required by the 2008 regulations for the Ventura NAA. As with the other NAAs some of the decrease may be due to more accurate estimates of the 2008 MUFs based on pesticide use reports instead of surveys or other surrogate data used for earlier years. Part of the decrease in fumigant emissions was also due to a switch to lower emission products and low-emission fumigation methods.

Using the ARB emission inventory classification, emissions from structural applications of methyl bromide remained steady at less than 0.001 tpd since 2005, but agricultural applications continued their decrease from 2.556 tpd in 2005 to 2.537 tpd in 2006 to 1.949 tpd in 2007 and further to 0.577 tpd in 2008. 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 continued to increase in 2008 reaching 6.392 tpd from 6.049 tpd in 2007, as reflected by the overall increased use of nonfumigant products from 13 percent in 2007 to 28 percent in 2008. Structural non-methyl bromide emissions were less than 0.04tpd (Tables 18, A2-4i to A2-4l).

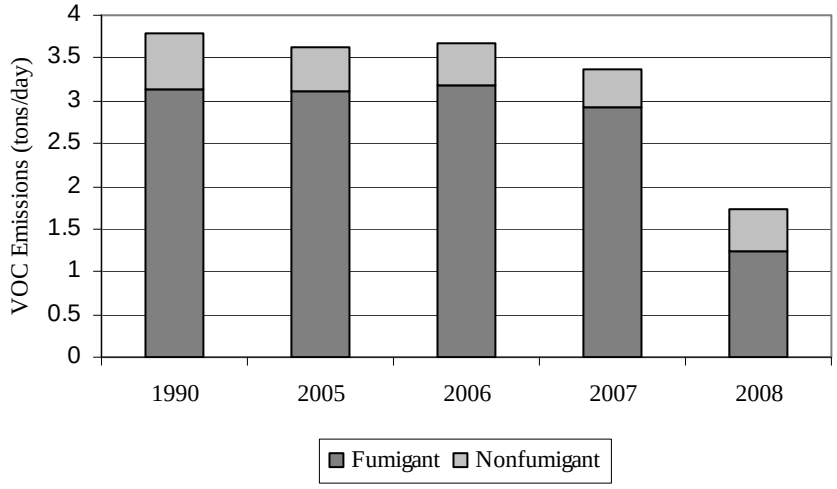


Figure 13. Pesticide VOC emissions for the Ventura NAA, May–October. Emissions for each year are divided into fumigants and nonfumigants. Fumigant emissions are *adjusted* to account for fumigation method.

Table 16. Top ten primary active ingredients contributing to **2008** 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 2008 Adjusted Emissions
CHLOROPICRIN	0.534	30.83
1,3-DICHLOROPROPENE	0.393	22.72
METHYL BROMIDE	0.277	15.99
CHLORPYRIFOS	0.079	4.59
MINERAL OIL	0.037	2.16
METAM-SODIUM	0.036	2.07
OXAMYL	0.036	2.06
PETROLEUM OIL, UNCLASSIFIED	0.035	2.02
CLARIFIED HYDROPHOBIC EXTRACT OF NEEM OIL	0.029	1.69
ABAMECTIN	0.021	1.18

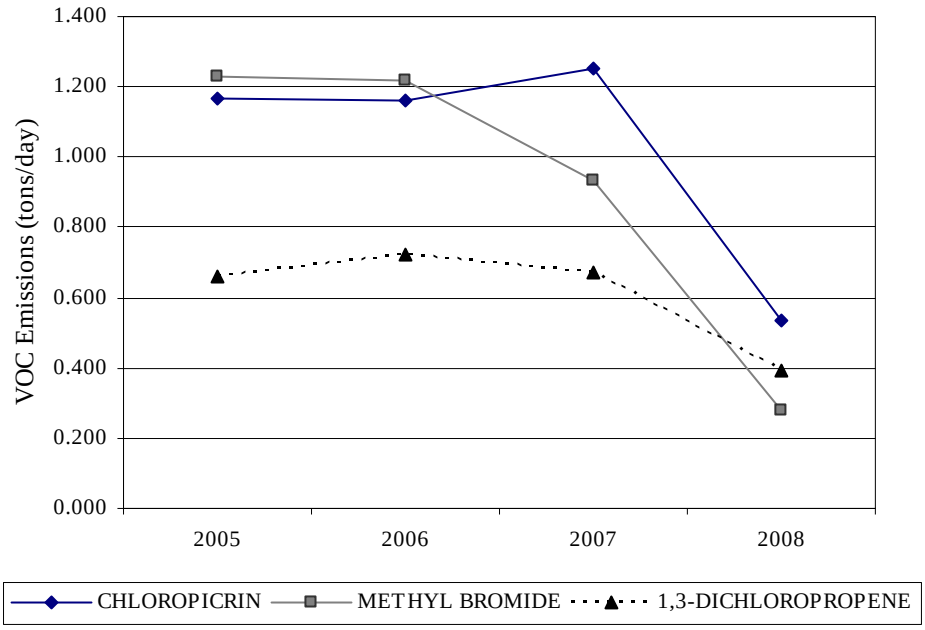


Figure 14. Changes in adjusted emissions of selected AIs in the Ventura NAA from 2005 to 2008.

Table 17. Top ten pesticide application sites contributing to **2008** May-October ozone season *unadjusted* VOC emissions in NAA 4.

Application Site	Emissions (tons/day)	Percent of all NAA 4 May – Oct 2008 emissions
STRAWBERRY	5.274	71.86
SOIL FUMIGATION/PREPLANT	1.489	20.29
LEMON	0.186	2.54
TOMATO	0.109	1.49
PEPPER, FRUITING	0.035	0.48
STRUCTURAL PEST CONTROL	0.033	0.44
N-OUTDR FLOWER	0.027	0.37
AVOCADO	0.024	0.33
CELERY	0.021	0.29
TURF/SOD	0.019	0.26

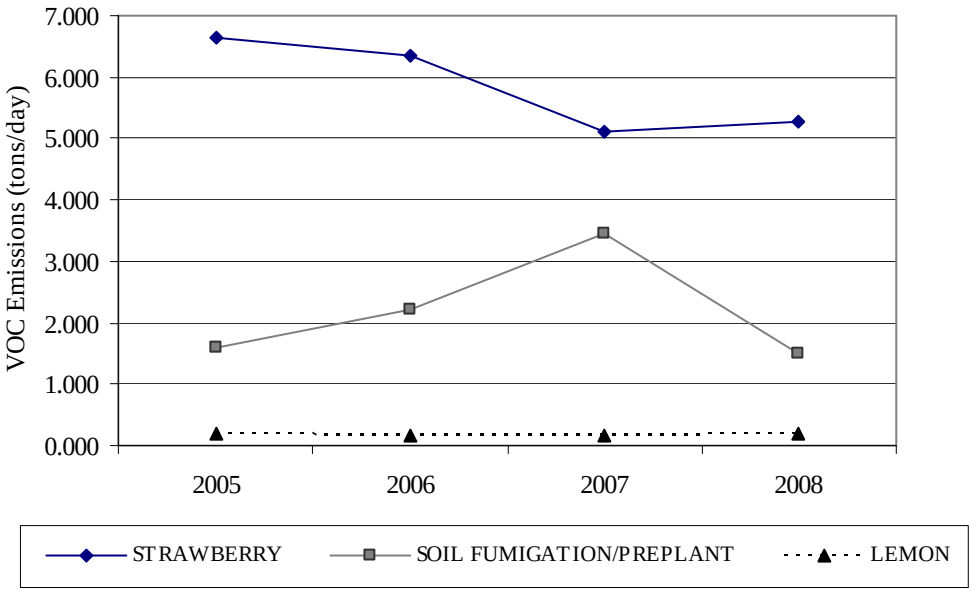


Figure 15. Changes in unadjusted emissions from selected commodities/sites in the Ventura NAA from 2005 to 2008.

Table 18. *Unadjusted* **2008** May–October VOC emissions in NAA 4 by ARB emission inventory classification (tons per day, tpd).

NAA 4 - 2008	Agricultural Applications	Structural Applications
METHYL BROMIDE EMISSIONS	0.577	0.000
NON-METHYL BROMIDE EMISSIONS	6.392	0.033

South Coast - NAA 5

In the South Coast NAA, adjusted emissions have declined steadily from1.922 tpd in 2004, and although they increased slightly to 1.969 tpd in 2005 and 1.488 tpd in 2007, they decreased to 1.283 tpd in 2008, well below the SIP goal of 8.7 tpd. In 2008, emissions from nonfumigants accounted for more than 70 percent of the total for the South Coast NAA (Tables 6a, 6b, Figure 3, 16).

The fumigants methyl bromide, chloropicrin, and 1,3-dichloropropene, contributed to 28.31 percent of 2008 adjusted emissions, up from 2007 due to increased use of methyl bromide. Methyl bromide emissions increased from 0.235 tpd in 2007 to 0.258 tpd in 2008. Permethrin, an insecticide used in structural pest control, landscape maintenance and on a wide range of nursery commodities, was the largest nonfumigant contributor to the adjusted inventory accounting for 14.38 percent (0.184 tpd) of emissions, down from 0.278 tpd in 2007 (Tables 19, A3-5a to A3-5d, Figure 17). Limonene, an oil extracted from citrus that is used almost exclusively in structural pest control, has shown a decrease in emissions in 2008 (0.037 tpd), nearly a two-thirds reduction from 0.121 tpd in 2007. For the first time since 2004 emissions from applications to strawberries in 2008 (0.735 tpd) exceeded those from structural pest control (0.634 tpd). Almost 70 percent of emissions in NAA 5 came from fumigant and nonfumigant use in structural pest control and strawberries, with commodity fumigation landscape maintenance accounting for another 20 percent (0.232 tpd and 0.180 tpd, respectively) (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 2008. Agricultural applications increased from 0.343 tpd in 2007 to 0.552 tpd in 2008, and non-methyl bromide emissions from agricultural applications also increased from 0.699 tpd in 2007 to 0.705 tpd in 2008. Structural non-methyl bromide emissions declined from 0.788 tpd in 2007 to 0.637 tpd in 2008 (Tables 21, A2-5i to A2-5l).

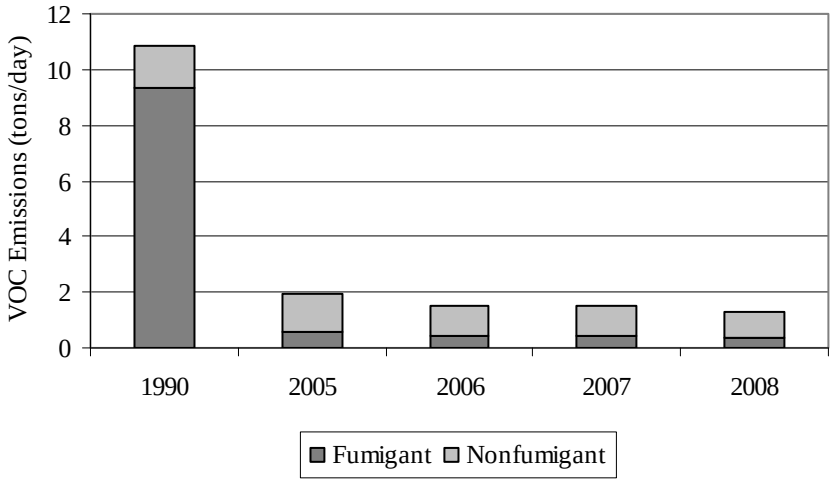


Figure 16. Pesticide VOC emissions for the South Coast NAA, May–October. Emissions for each year are divided into fumigants and nonfumigants. Fumigant emissions are *adjusted* to account for fumigation method.

Table 19. Top ten primary active ingredients contributing to **2008** 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 2008 Adjusted Emissions**
METHYL BROMIDE	0.258	20.09
PERMETHRIN	0.184	14.38
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	0.112	8.76
CHLOROPICRIN	0.068	5.29
DISODIUM OCTABORATE TETRAHYDRATE	0.060	4.70
BIFENTHRIN	0.053	4.13
1,3-DICHLOROPROPENE	0.038	2.92
LIMONENE	0.037	2.92
CYFLUTHRIN	0.035	2.72
PIPERONYL BUTOXIDE	0.031	2.44

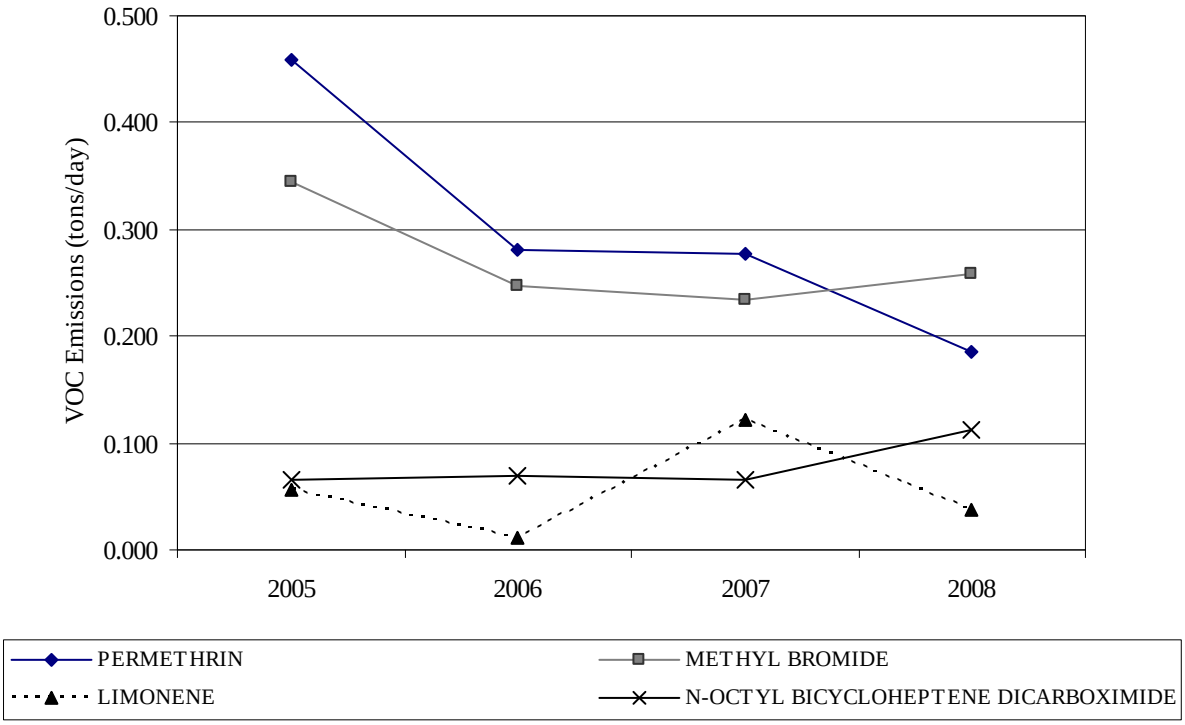


Figure 17. Changes in adjusted emissions of selected AIs in the South Coast NAA from 2005 to 2008.

Table 20. Top ten pesticide application sites contributing to **2008** May-October ozone season *unadjusted* VOC emissions in NAA 5.

Application Site	**Emissions (tons/day)**	**Percent of all NAA 5 May – Oct 2008 emissions**
STRAWBERRY	0.735	37.17
STRUCTURAL PEST CONTROL	0.634	32.09
COMMODITY FUMIGATION	0.232	11.71
LANDSCAPE MAINTENANCE	0.180	9.11
FUMIGATION, OTHER	0.064	3.24
RIGHTS OF WAY	0.035	1.76
N-OUTDR PLANTS IN CONTAINERS	0.032	1.64
SOIL FUMIGATION/PREPLANT	0.010	0.52
CABBAGE	0.006	0.28
AVOCADO	0.005	0.24

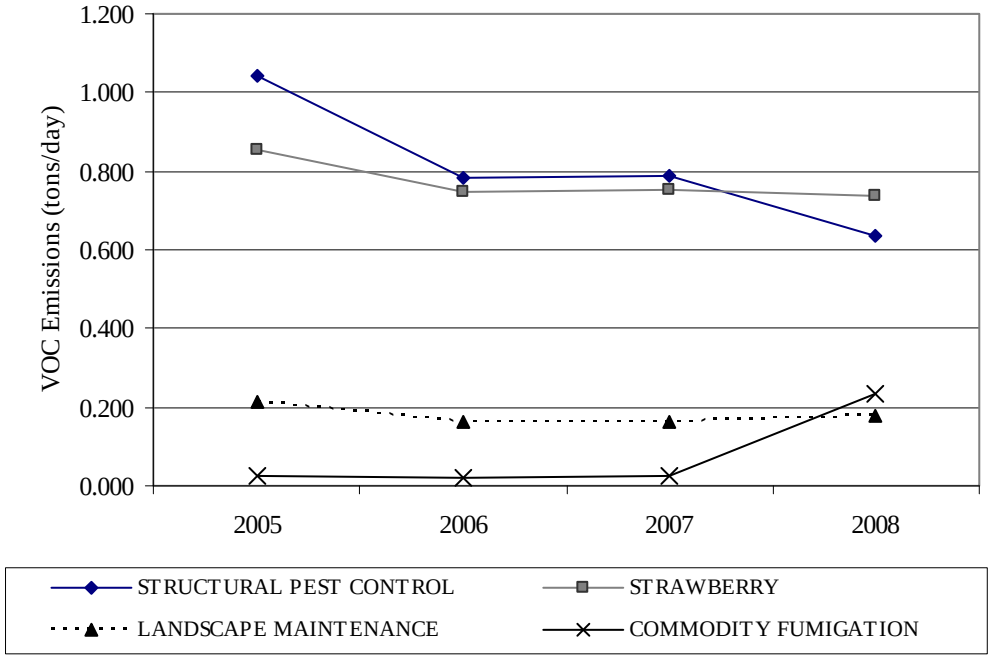


Figure 18. Changes in unadjusted emissions from selected commodities/sites in the South Coast NAA from 2005 to 2008.

Table 21. *Unadjusted* **2008** May–October VOC emissions in NAA 5 by ARB emission inventory classification (tons per day, tpd).

NAA 5 - 2008	**Agricultural Applications**	**Structural Applications**
METHYL BROMIDE EMISSIONS	0.552	0.002
NON-METHYL BROMIDE EMISSIONS	0.705	0.637

PROJECTION OF 2010 VOC EMISSIONS AND FUMIGANT LIMIT FOR THE VENTURA NONATTAINMENT AREA.

DPR is required to limit VOC emissions of volatile organic compounds from pesticides in Ventura County during each annual May–October ozone season. The maximum allowable annual Ventura County 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.

DPR developed a forecasting method to estimate future nonfumigant emissions in the Ventura NAA 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, is used to calculate allowable fumigant emissions and fumigant use as described above. Table 22 compares 2004–2008 NAA 4 nonfumigant ozone seasons emissions, while Table 23 provides the forecast 2010 nonfumigant emissions and resultant allowable fumigant emissions based on the regulatory benchmark and the SIP goal.

Table 22. 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)	Mean Percent of Total Emissions
4 – Ventura						
Nonfumigants	0.622 (16%)	0.497 (14%)	0.508 (14%)	0.429 (13%)	0.484 (28%)	17%

Table 23. Projection for 2010 NAA 4 VOC emissions. The 2010 fumigant emission limit was determined by subtracting the forecast 2010 nonfumigant emissions from the SIP goal and VOC regulation benchmark (Tao, 2009).

Non-Attainment Area	SIP Goal and VOC Regulation Benchmark (tons/day)	Forecast 2010 Nonfumigant Emissions (tons/day)	2010 Fumigant Limit (tons/day)	2010 Fumigant Limit (pounds)	2008 Adjusted Fumigant Emissions (tons/day)
4 - Ventura	3.6 a	0.493	3.107	1,143,000	1.247

a The Ventura SIP Goal and VOC Regulation Benchmark for 2010 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.

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. December 23, 2009 memorandum to Randy Segawa. Time Series Analysis and Forecasting fo Ventura County Nonfumigant Pesticide Volatile Organic Compound Ozone Season Emisssions-2009 Update. *On-line:*
http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/2189_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.