Department of Pesticide Regulation

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MEMORANDUM

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FROM:	Randy Segawa Special Advisor Pesticide Programs Division	*Original signed by*
	Rosemary Neal, Ph.D. Senior Environmental Scientist (Specialist) Environmental Monitoring Branch	*Original signed by Wofford for Neal*
	Pamela Wofford Environmental Program Manager Environmental Monitoring Branch	*Original signed by*
DATE:	August 20, 2014	
SUBJECT:	PRELIMINARY ESTIMATES OF VOLATILE ORGANIC COMPOUND EMISSIONS FROM PESTICIDES IN THE SAN JOAQUIN VALLEY: EMISSIONS FOR 1990 – 2013 SUMMARY	

Volatile organic compounds (VOCs) contribute to formation of ozone, a major air pollutant. As part of the state implementation plan (SIP) for the Clean Air Act, the Department of Pesticide Regulation (DPR) is required to publish an inventory of VOC emissions from pesticide products each year and achieve specified emissions levels. This memorandum summarizes the preliminary emissions inventory for the San Joaquin Valley based on data reported to or produced by DPR from May 1, 2013, to October 31, 2013, the peak ozone season in California. Pesticide VOC emissions increased from 16.2 tons/day (tpd) in 2012 to 18.2 tpd in 2013, and exceeded the 18.1 tpd SIP goal. Regulations to reduce VOC emissions from certain nonfumigant pesticide products are designed to keep VOC emissions below the SIP goal for the San Joaquin Valley. If DPR's pesticide VOC emissions inventory exceeds 17.2 tpd (95 percent of SIP goal), certain uses of designated high-VOC products are prohibited for the upcoming year. DPR's preliminary pesticide VOC emissions inventory exceeds both the trigger level and the SIP goal. While the final inventory may change slightly, <u>it is likely that certain uses of high-VOC products will be prohibited for May-October 2015, as well as May-October 2016.</u>

BACKGROUND

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

DPR's VOC emissions inventory database includes only pesticide applications that are made between May 1 and October 31, the peak ozone season in California. 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 (PURs) 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. The VOC emissions discussed in this memo are *adjusted* to account for fumigant emissions under field conditions.

Of the five NAAs tracked by DPR, two (Sacramento Metro and South Coast) have achieved their pesticide SIP goals for many years, and no further reduction measures are needed. For two other NAAs (Southeast Desert and Ventura), DPR adopted a series of regulations for fumigants beginning in 2008 that require low-emission fumigation methods. The regulations also set up a fumigant emissions limit that is triggered if low-emission fumigation methods do not result in targeted reductions. The fumigant emissions limit is currently in effect for the Ventura NAA.

The low-emission fumigation methods required in the 2008 regulations also apply to the fifth NAA, San Joaquin Valley. However, nonfumigant pesticide products, particularly emulsifiable concentrates, contribute more VOC emissions than fumigants in this NAA. Therefore, DPR adopted regulations for nonfumigant products in 2013. The nonfumigant regulations designate certain products containing abamectin, chlorpyrifos, gibberellins, and oxyfluorfen as high-VOC products. San Joaquin Valley growers must obtain a recommendation from a pest control adviser prior to certain uses of these high-VOC products, and pest control advisers are required to recommend low-VOC products when feasible. Instead of a fumigant limit as a backup measure, the regulations prohibit certain uses of high-VOC products in the San Joaquin Valley if pesticide VOC emissions exceed a trigger level.

VOC INVENTORY RESULTS: SAN JOAQUIN VALLEY

Tables 1 and 2, and Figure 1 summarize the pesticide VOC emissions for 2004 through 2013, and compare them to the SIP goal. Table 3 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.

In the San Joaquin Valley NAA, total VOC emissions increased from 2012 to 2013 by 13 percent, and exceed the SIP goal by 0.148 tpd. Nonfumigant emissions accounted for almost three-quarters of the total VOC emissions in the San Joaquin Valley in 2013, with emissions from products with emulsifiable concentrate formulations accounting for 41 percent of the total VOC emissions for this NAA. VOC emissions from emulsifiable concentrates increased by 14 percent, from 6.593 tpd in 2012 to 7.487 tpd in 2013 (Tables 2, 3, Figures 1, 2). Fumigant emissions increased by 7 percent from 4.129 tpd in 2012 to 4.409 tpd in 2013.

Table 4 shows that VOC emissions from products containing 9 of the top 10 active ingredients increased between 2012 and 2013, and one decreased. Consistent with recent years, products containing chlorpyrifos, abamectin, and 1,3-dichloropropene were the top three pesticide VOC contributors in the San Joaquin Valley for 2013 (Table 4, Figures 3a and 3b). Among the top 10 contributors, fenpyroximate and glyphosate had the greatest relative increases from 2012 to 2013, 127 percent and 50 percent, respectively (Table 4). For 2013, VOC emissions from fenpyroximate products replaced metam-sodium in the top 10 contributors. VOC (as methyl isothiocyanate, MITC) emissions from metam-sodium products were among the top contributors for several years, but they are no longer in the top 10. However, MITC emissions from potassium N-methyl dithiocarbamate (metam-potassium) products continue to increase, offsetting the decreases from metam-sodium.

VOC emissions from pesticide products applied to the top 10 crops/sites are shown in Table 5. VOC emissions from pesticides applied to preplant soil sites and carrots are primarily from fumigant applications. VOC emissions for the remaining top 10 crops are primarily from nonfumigant applications.

The emissions discussed here are preliminary estimates and there are uncertainties in the data. First, the pesticide use report data are likely incomplete. Reports with apparent errors are excluded until they can be corrected. Additionally, the pesticide use data has been screened using some, but not all of DPR's validation procedures. Second, the emission potential values for several high-use products rely on default values based on their formulation category. DPR is requesting more accurate emission potential data from registrants, using DPR's standard thermogravimetric analysis method. DPR will recalculate the emissions inventory once all of the data are validated and entered. The pesticide VOC emissions inventory may increase or decrease slightly from this initial estimate. The recalculated emissions may not exceed the SIP goal, but the nonfumigant prohibitions will likely still be triggered.

NONFUMIGANT VOC REGULATIONS AND TRIGGER FOR USE PROHIBITIONS

DPR regulations to reduce VOC emissions from certain nonfumigant pesticide products are designed to keep VOC emissions below the SIP goal. The regulations establish criteria to designate certain products as high-VOC, and these products have restrictions on sales and use. A key restriction requires growers to obtain a recommendation from a pest control adviser for:

- High-VOC products containing abamectin, chlorpyrifos, gibberellins, or oxyfluorfen.
- Applied in the San Joaquin Valley.
- Between May 1 and October 31.
- To alfalfa, almonds, citrus, cotton, grapes, pistachios, or walnuts.

As shown in Tables 4 and 5 the products containing the four active ingredients and seven crops listed above were among the top nonfumigant VOC contributors for 2013, consistent with previous years. This is a primary reason these active ingredients and crops are included in the nonfumigant regulations.

In addition to the pest control adviser and other requirements, if a specified pesticide VOC emissions level is exceeded, most of the high-VOC applications described above are prohibited for the upcoming year. This trigger level for high-VOC prohibitions is 17.2 tpd or 95 percent of the SIP goal (95 percent of 18.1 = 17.2 tpd). DPR's preliminary estimate of 2013 emissions is 18.248 tpd. While the final inventory may change slightly, it is likely that applications of high-VOC products described above will be prohibited for May-October 2015. If triggered, the regulations require the high-VOC prohibitions to remain in effect for at least two years; the high-VOC prohibitions will likely be in effect for May-October 2016 as well. Additional information on the nonfumigant VOC regulations is available at <http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/reduce_nonfumigant.htm>.

ESTIMATED EMISSIONS FROM HIGH-VOC NONFUMIGANT PRODUCTS

Title 3, California Code of Regulations, section 6860 specifies the criteria to designate certain nonfumigant products as high-VOC. The criteria include the following threshold EP values.

Abamectin	35 percent
Chlorpyrifos	25 percent
Gibberellins	25 percent
Oxyfluorfen	15 percent

Most agricultural products containing these active ingredients with EP's above the threshold value are designated as high-VOC, and most high-VOC products have EPs of 50-90 percent (http://www.cdpr.ca.gov/docs/emon/vocs/vocproj/nonfum_voc_prod_list.pdf). Table 6 shows that emissions from the high-VOC products containing these four active ingredients accounted for 4.428 tpd, or 32 percent of the San Joaquin Valley pesticide VOC emissions inventory in 2013. Table 7 shows a subset of the emissions from these high-VOC products consisting of the seven crops included in the regulations. High-VOC product use on the seven crops accounted for 3.999 tpd, or 90 percent of the 4.428 tpd emissions of the high-VOC products used for all crops and 22 percent of the 18.248 tpd total pesticide VOC emissions. Table 7 also shows that with the exception of chlorpyrifos, more than 90 percent of the 2013 emissions came from use of high-VOC products, not low-VOC products, for the seven crops. These data indicate that triggering the high-VOC prohibitions will achieve the SIP goal because:

- Most low-VOC products contain less than half the VOCs of high-VOC products.
- The seven crops account for 90 percent of the emissions from the high-VOC products.
- The regulations will require most applications to the seven crops to switch from high-VOC to low-VOC products.

Attachments

cc: Chris Reardon (w/Attachments)
Polly Frenkel (w/Attachments)
Chuck Andrews (w/Attachments)
David Duncan (w/Attachments)

Table 1. May–October (ozone season) pesticide VOC emissions and goals.

NAA	VOC Emissions (tons/day)											
	1990	**SIP Goal**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
2 – San Joaquin Valley	20.517	18.1	17.322	20.740	21.305	17.093	14.525	12.965	15.228	16.376	16.158	18.248

Table 2. May–October (ozone season) fumigant and nonfumigant pesticide VOC emissions.

NAA	VOC Emissions (tons/day)										
	1990	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
San Joaquin Valley											
Fumigants	5.536 (27%)	6.362 (37%)	6.910 (33%)	6.808 (32%)	4.399 (26%)	3.370 (23%)	3.078 (24%)	3.700 (24%)	4.001 (24%)	4.129 (26%)	4.409 (24%)
Nonfumigants	14.981 (73%)	10.960 (63%)	13.831 (67%)	14.498 (68%)	12.375 (74%)	11.154 (77%)	9.887 (76%)	11.528 (76%)	12.375 (76%)	12.028 (74%)	13.839 (76%)

Table 3. May-October (ozone season) nonfumigant pesticide VOC emissions derived from Emulsifiable Concentrate formulations (ECs) and all Others.

NAA	VOC Emissions tons/day (percentage of total)										
	1990	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
San Joaquin Valley											
ECs	12.162 (81%)	8.613 (79%)	10.199 (74%)	10.119 (70%)	7.547 (69%)	7.491 (67%)	5.921 (60%)	6.608 (57%)	6.854 (55%)	6.593 (55%)	7.487 (54%)
Others	2.819 (19%)	2.347 (21%)	3.632 (26%)	4.379 (30%)	3.423 (31%)	3.663 (33%)	3.966 (40%)	4.921 (43%)	5.521 (45%)	5.436 (45%)	6.352 (46%)

Table 4. Top ten primary active ingredients contributing to May-October ozone season VOC emissions in the San Joaquin Valley.

Primary AI	2013 Total Product Emissions (tons/day)	Percent of 2013 Emissions	Percent Change from 2012 to 2013
CHLORPYRIFOS	1.880	11.64	36
ABAMECTIN	1.869	11.57	6
1,3-DICHLOROPROPENE	1.767	10.94	5
GLYPHOSATE, ISOPROPYLAMINE SALT	1.051	6.51	50
POTASSIUM N-METHYLDITHIOCARBAMATE	0.947	5.86	47*
OXYFLUORFEN	0.883	5.47	15
METHYL BROMIDE	0.870	5.38	11
FENPYROXIMATE	0.663	4.10	127
GIBBERELLINS	0.662	4.09	-5
BIFENTHRIN	0.584	3.61	11

* VOC (MITC) emissions from metam-sodium products decreased by 35 percent (from 0.594 tpd in 2012 to 0.384 tpd in 2013), partially offsetting the increase in MITC emissions from potassium N-methyldithiocarbamate products.

Table 5. Top ten crops/sites contributing to May-October ozone season pesticide VOC emissions in the San Joaquin Valley.

Primary AI	2013 Total Product Emissions (tons/day)	Percent of 2013 Emissions	Percent Change from 2012 to 2013
ALMOND	4.861	26.64	Not available
COTTON	1.623	8.90	Not available
SOIL APPLICATION, PREPLANT	1.179	6.46	Not available
CARROTS	0.967	5.30	Not available
ORANGE	0.962	5.27	Not available
GRAPES	0.856	4.69	Not available
TOMATOES, FOR PROCESSING/CANNING	0.850	4.66	Not available
PISTACHIO	0.646	3.54	Not available
GRAPES, WINE	0.625	3.42	Not available
WALNUT	0.582	3.19	Not available

Table 6. Emissions from 2013 applications of high-VOC products for abamectin, chlorpyrifos, gibberellins and oxyfluorfen on all commodity sites.

Primary AI	2013 Total Emissions from High VOC Products (tons/day)	Percent of 2013 Emissions from All Products with this Active Ingredient	Percent of 2013 Total Nonfumigant Emissions
ABAMECTIN	1.776	95.0	13
CHLORPYRIFOS	1.149	61.1	8
GIBBERELLINS	0.646	97.8	5
OXYFLUORFEN	0.856	96.9	6
COMBINED	4.428	83.6	32

Table 7. Emissions from 2013 applications high-VOC products for abamectin, chlorpyrifos, gibberellins and oxyfluorfen on alfalfa, almonds, citrus, cotton, grapes, pistachios, or walnuts.

Primary AI	2013 Total Emissions from High VOC Products, tons/day (Percent of Emissions from All Products with this Active Ingredient)							
	Alfalfa	**Almond**	**Citrus***	**Cotton**	**Grape†**	**Pistachio**	**Walnut**	**Total**
ABAMECTIN	<0.001 (67%)	0.796 (95%)	0.102 (88%)	0.170 (97%)	0.339 (96%)	0.003 (100%)	0.134 (96%)	1.545
CHLORPYRIFOS	0.042 (26%)	0.409 (62%)	0.211 (56%)	0.349 (88%)			0.055 (46%)	1.066
GIBBERELLINS		<0.001 (100%)	0.308 (98%)		0.306 (98%)			0.614
OXYFLUORFEN	<0.001 (100%)	0.478 (97%)	0.003 (98%)	0.010 (77%)	0.108 (100%)	0.113 (98%)	0.062 (96%)	0.774
TOTAL	0.043	1.683	0.624	0.529	0.753	0.116	0.252	3.999

*Citrus comprises the following commodity sites reported in 2013: citrus fruits; grapefruit; lemon; lime; orange; pomelo; tangelo; tangerine (mandarin, satsuma, murcott, etc.).
†Grape comprises the following commodity sites reported in 2013: grapes; grapes, wine.

Figure 1. Annual ozone season pesticide VOC emissions in the San Joaquin Valley NAA. These figures show emissions , the 18.1 tpd SIP goal , and 17.2 tpd trigger level - - -.

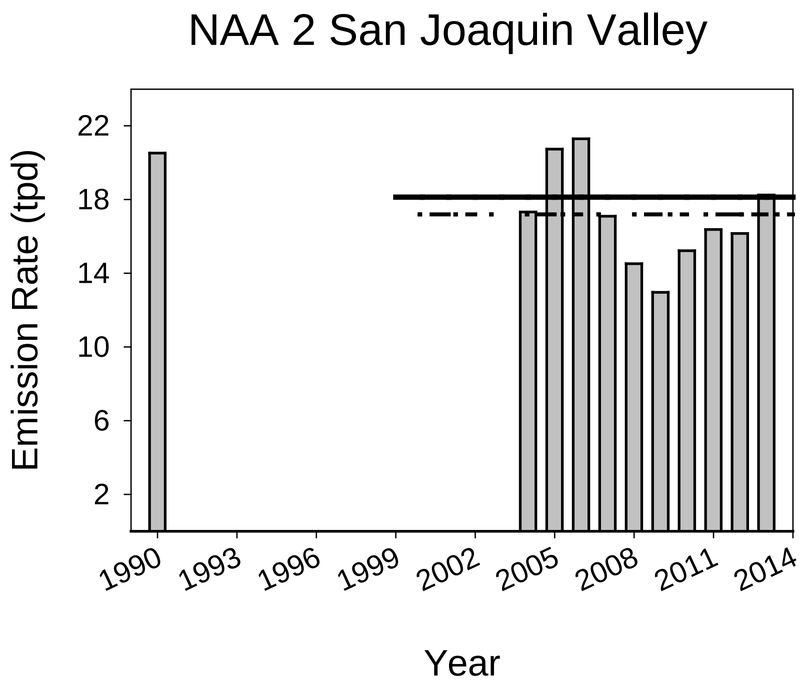

Figure 2. Pesticide VOC emissions for the San Joaquin Valley NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others).

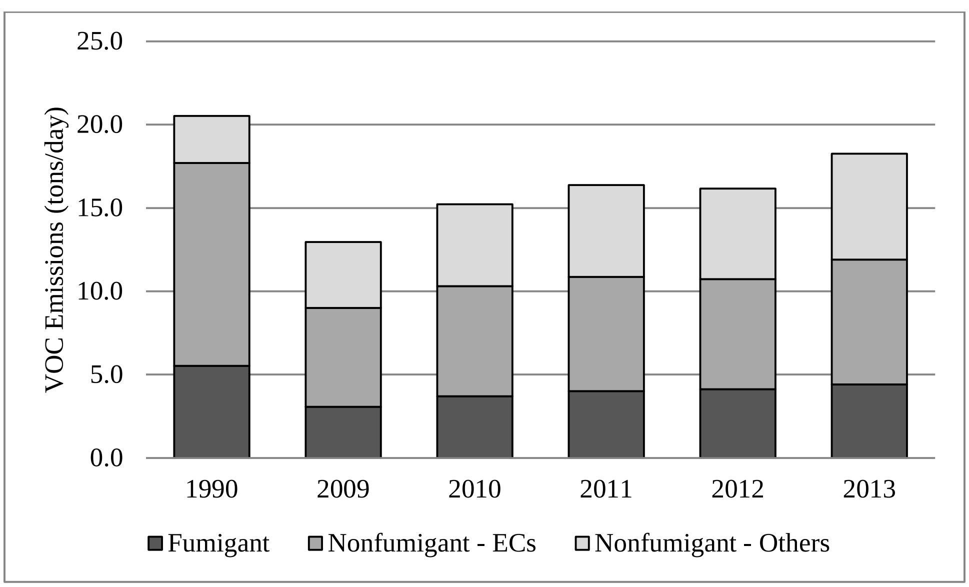

Figure 1. Annual ozone season pesticide VOC emissions in the San Joaquin Valley NAA. These figures show emissions [legend box], the 18.1 tpd SIP goal [solid line], and 17.2 tpd trigger level [dashed line].

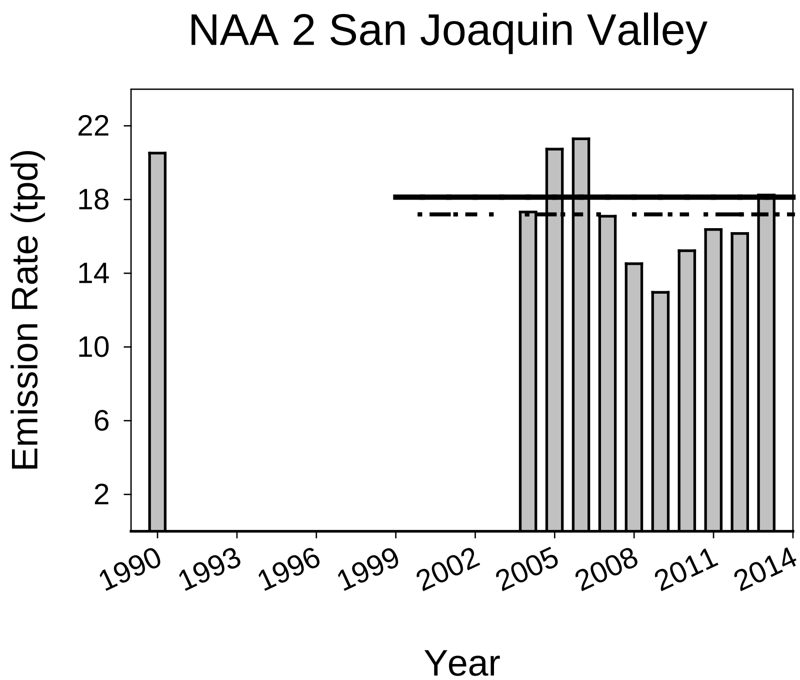

Figure 2. Pesticide VOC emissions for the San Joaquin Valley NAA, May–October. Emissions for each year are divided into fumigants, nonfumigants with emulsifiable concentrate formulations (ECs) and other nonfumigants (Others).

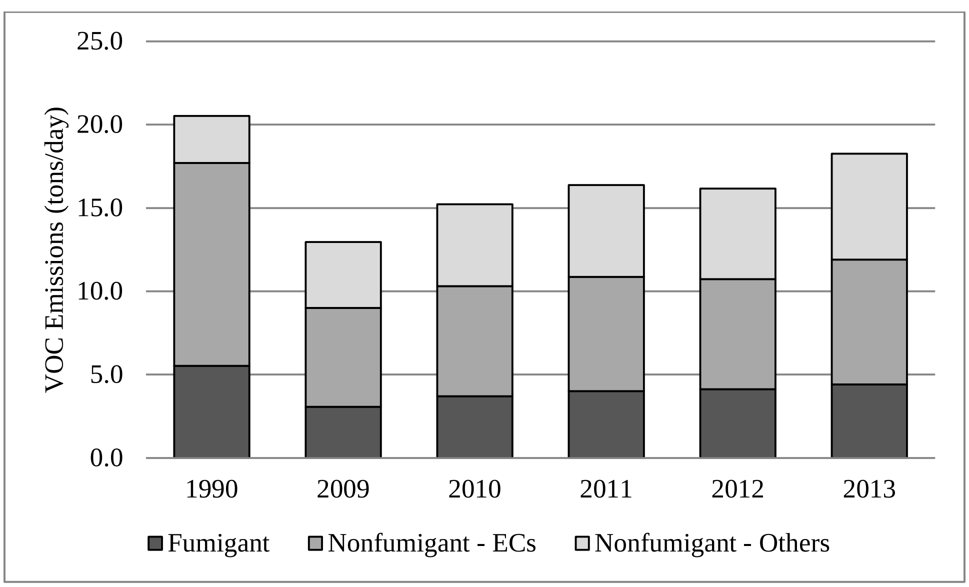

Figure 3a. Changes in emissions of top 5 AIs in the San Joaquin Valley NAA from 2010 to 2013.

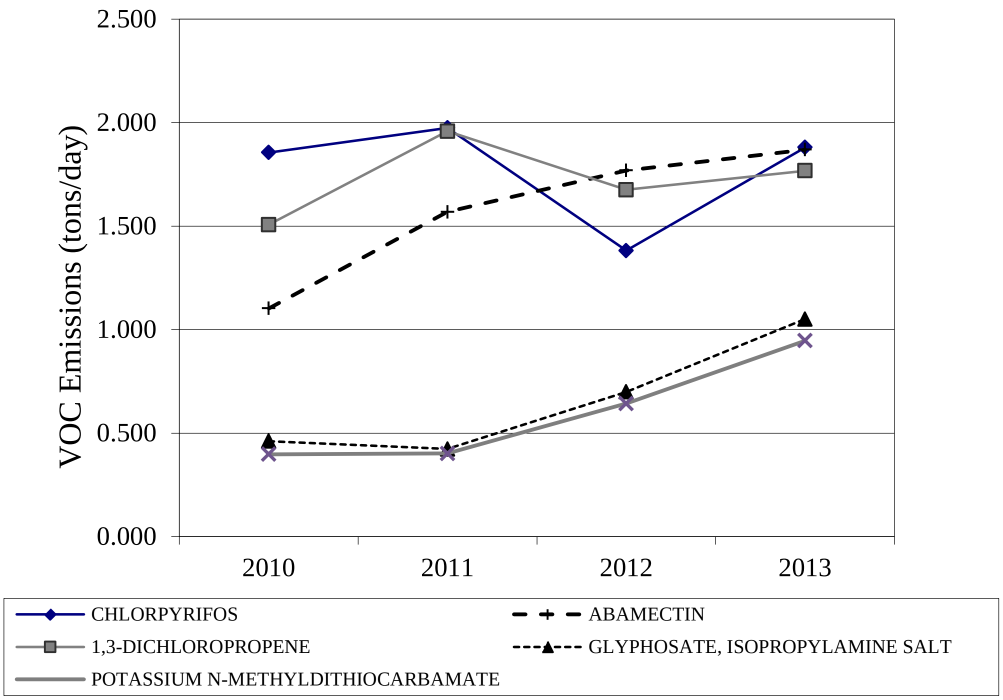

Figure 3b. Changes in emissions of top 6 - 10 AIs in the San Joaquin Valley NAA from 2010 to 2013.