Concentrations and Loads of Current-Use Pesticides Entering the Sacramento/San Joaquin Delta

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Pesticide Fate Research Group

U.S. Geological Survey

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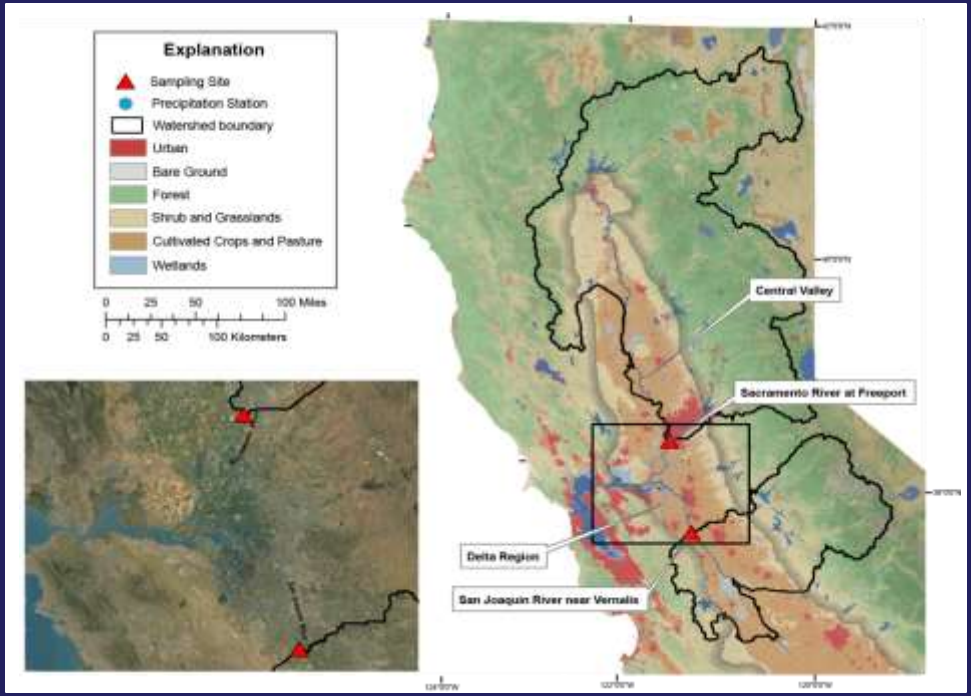
Freeport & Vernalis Monitoring

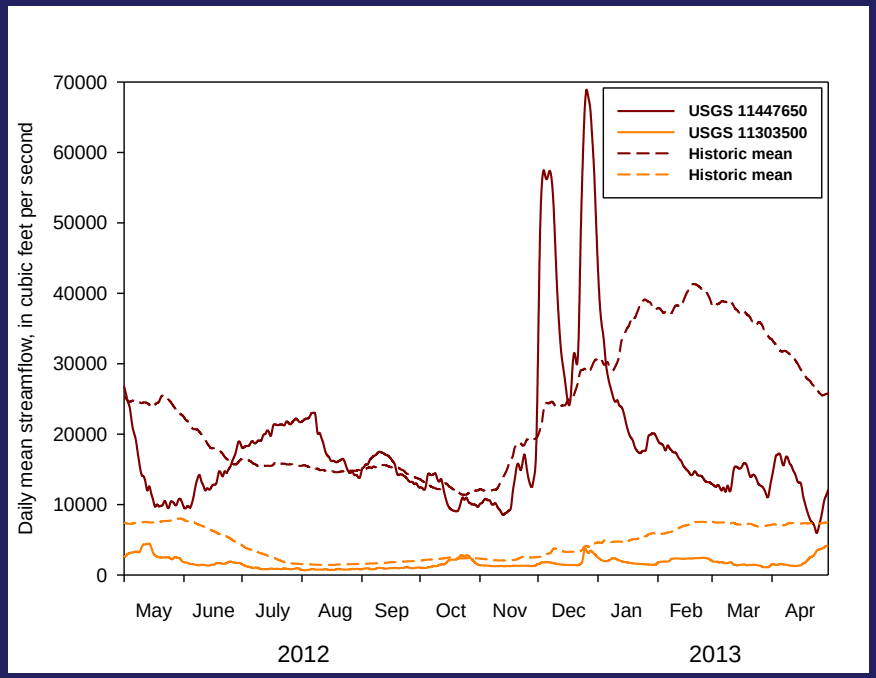
- Characterize occurrence of a large suite of current-use pesticides entering the Delta from it's 2 main riverine inputs
- Biweekly sampling at Freeport and Vernalis from May 2012 through April 2013 (+ storm samples*) (NAWQA)

Freeport

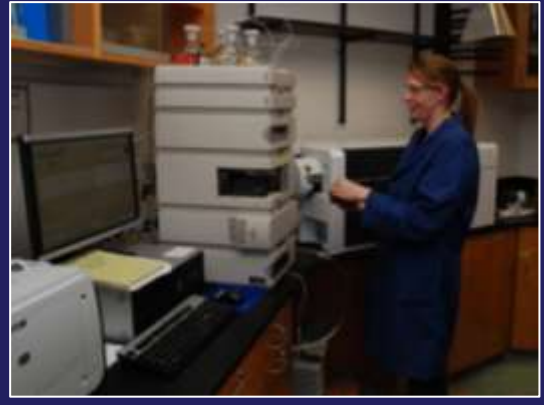
Vernalis

Freeport & Vernalis Monitoring





Water Analysis Methods
PFRG Laboratory



- SPE: Filtered 1 L samples using Oasis HLB cartridge

GC/MS

- 90 pesticides and degradates
- Including 34 fungicides
- Newer rice pesticides
- MDLs 0.9 - 10.5 ng/L

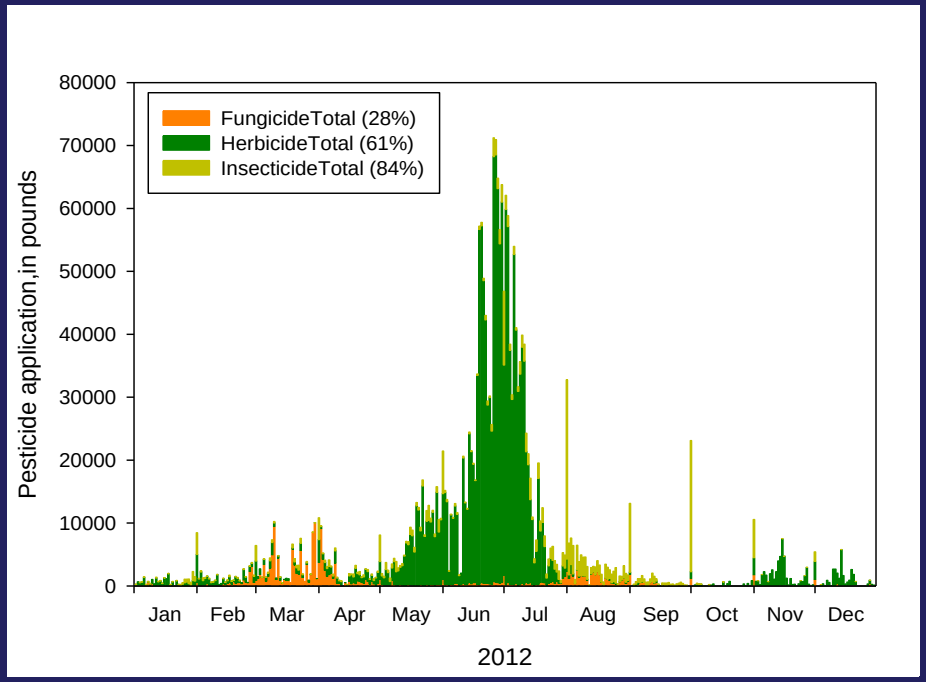
LC/MS/MS

- 10 pesticides and degradates
- Diuron and 3 degradates
- Neonicotinoid insecticides
- MDLs 3.0 – 6.2 ng/L

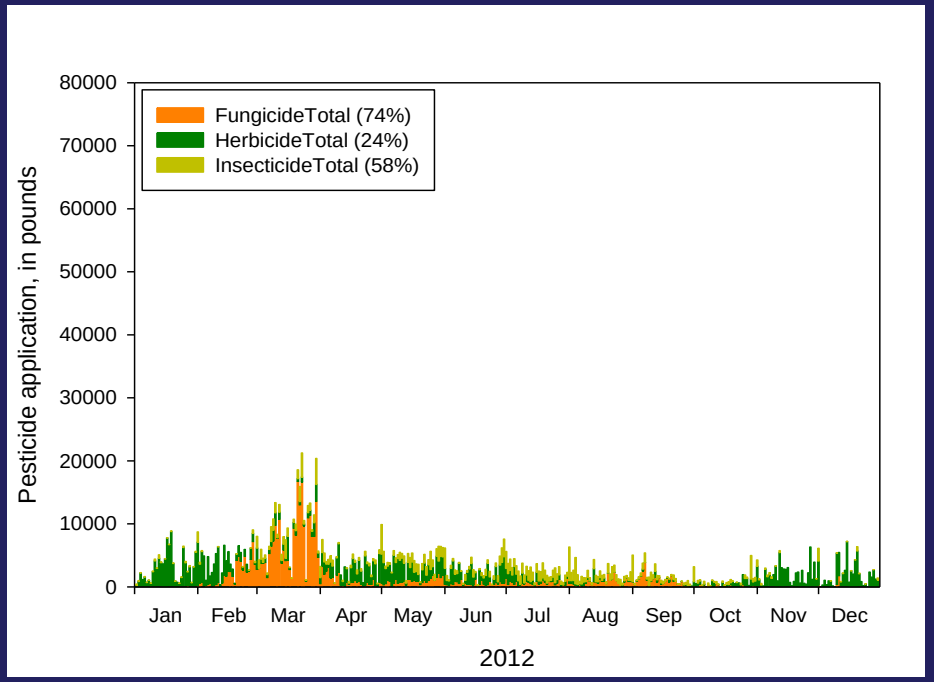
Pesticide Use

- Synthetic organic fungicides, herbicides and insecticides
- Rice in the Sacramento Valley 1.7 M lbs
- Urban uses as well

Sacramento River at Freeport
4.1 million lbs
> fungicides and herbicides

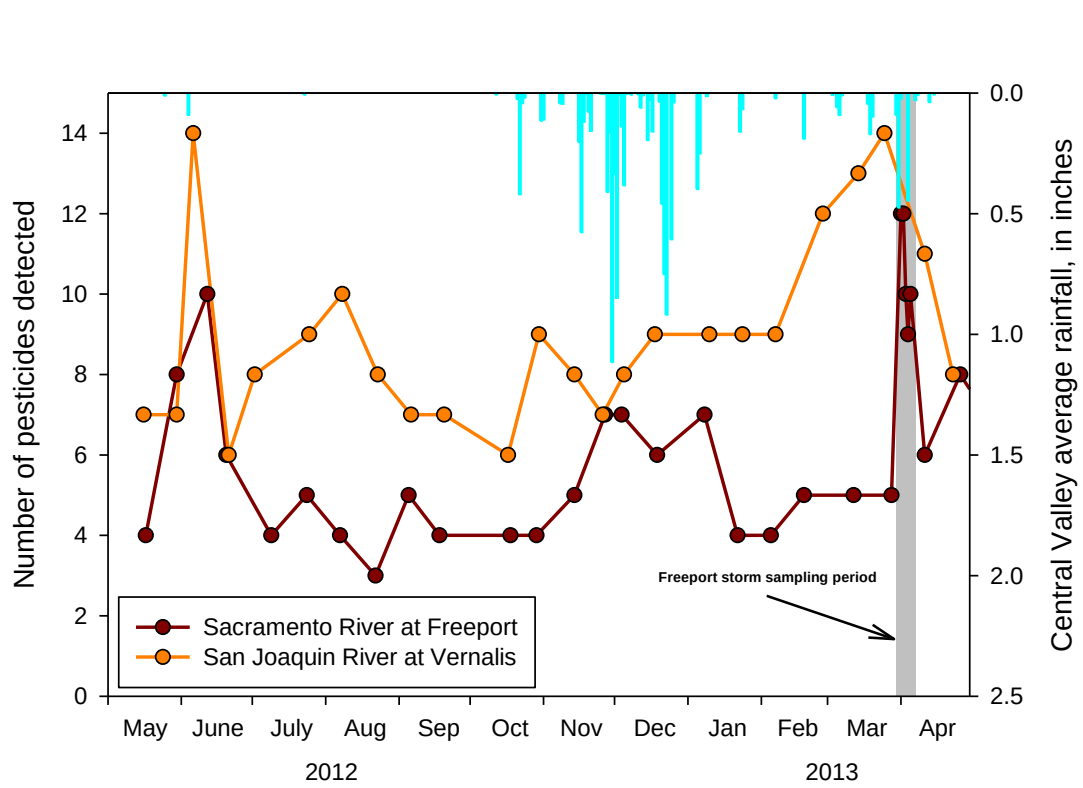


San Joaquin River at Vernalis
3.3 million lbs
> insecticides



Monitoring Results

- All samples contained mixtures of multiple pesticides



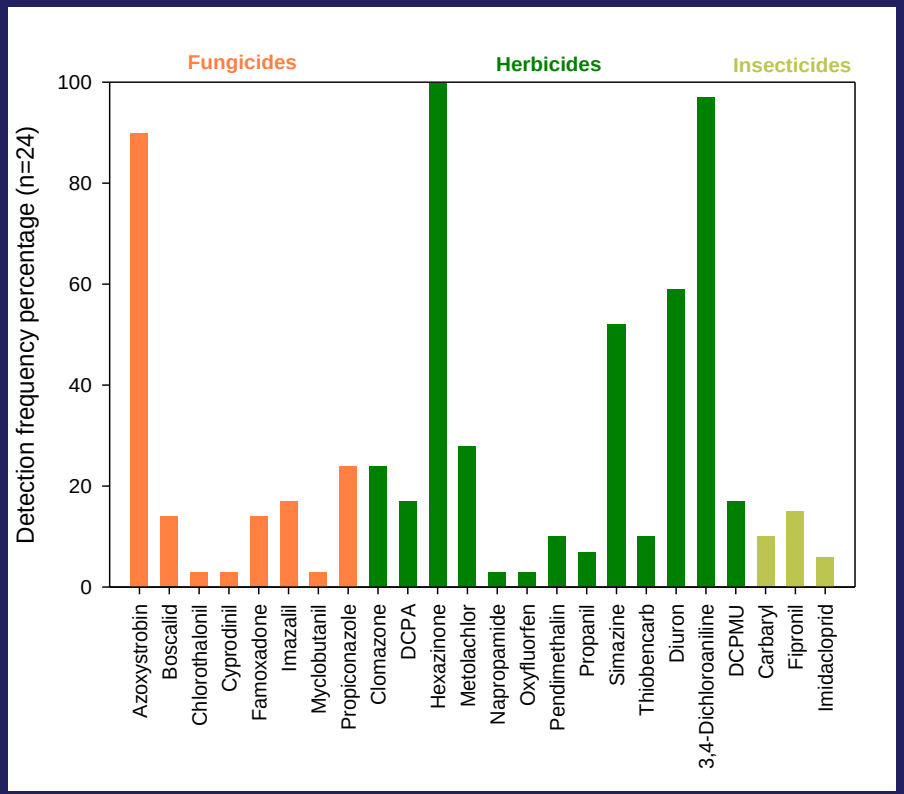
Freeport **Maximum = 12*** **Average = 6**

Vernalis **Maximum = 14** **Average = 9**

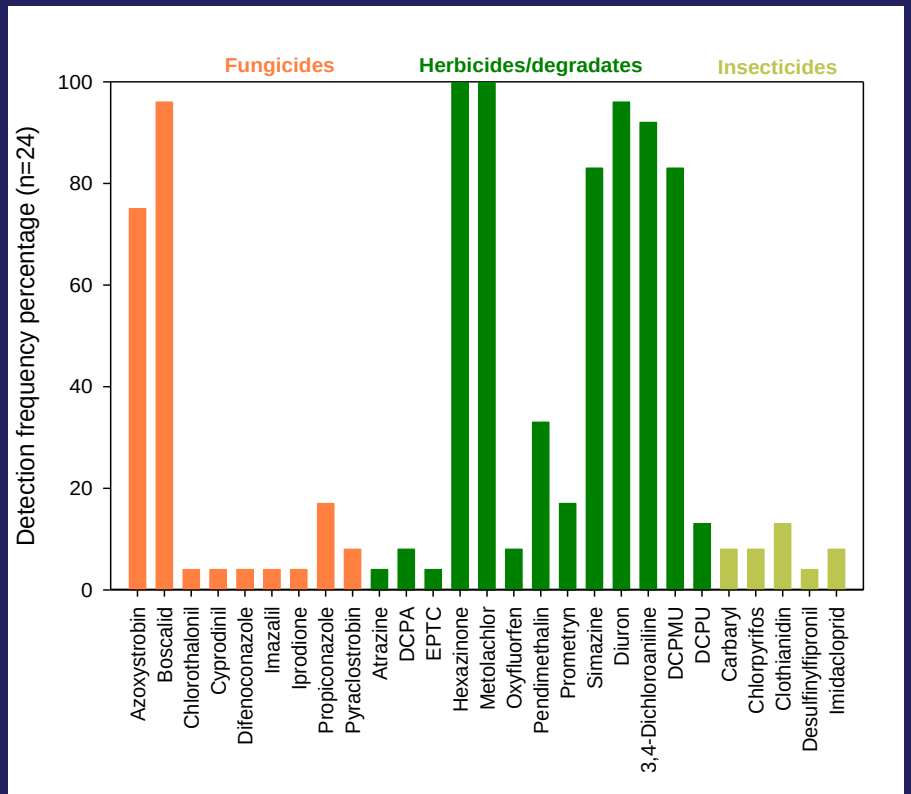
Detections By Basin

- Detected 34 pesticides/degradates (17 herbicides, 11 fungicides, 6 insecticides)
- Similar pesticides detected with exception of rice pesticides in the Sacramento River

Sacramento River at Freeport

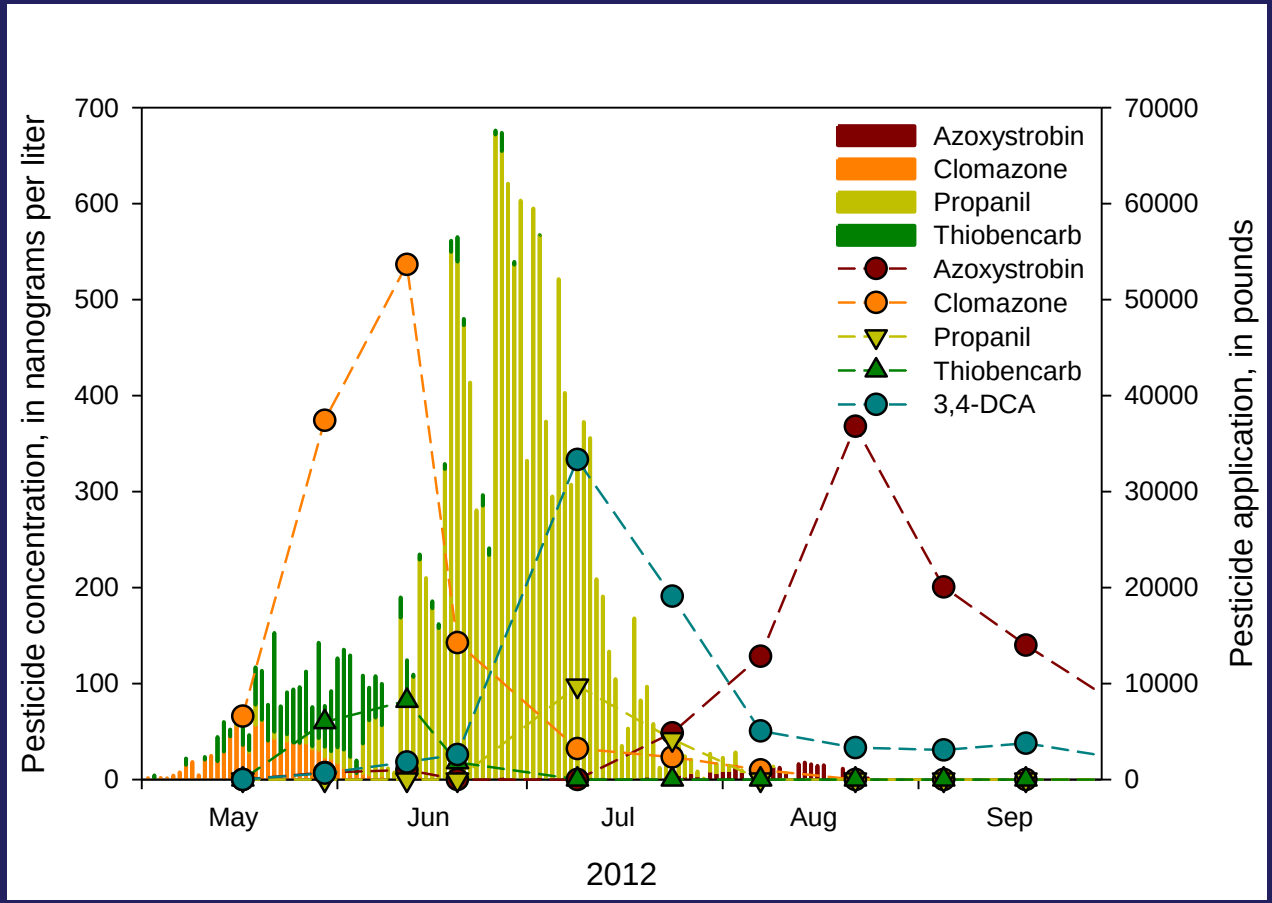


San Joaquin River at Vernalis

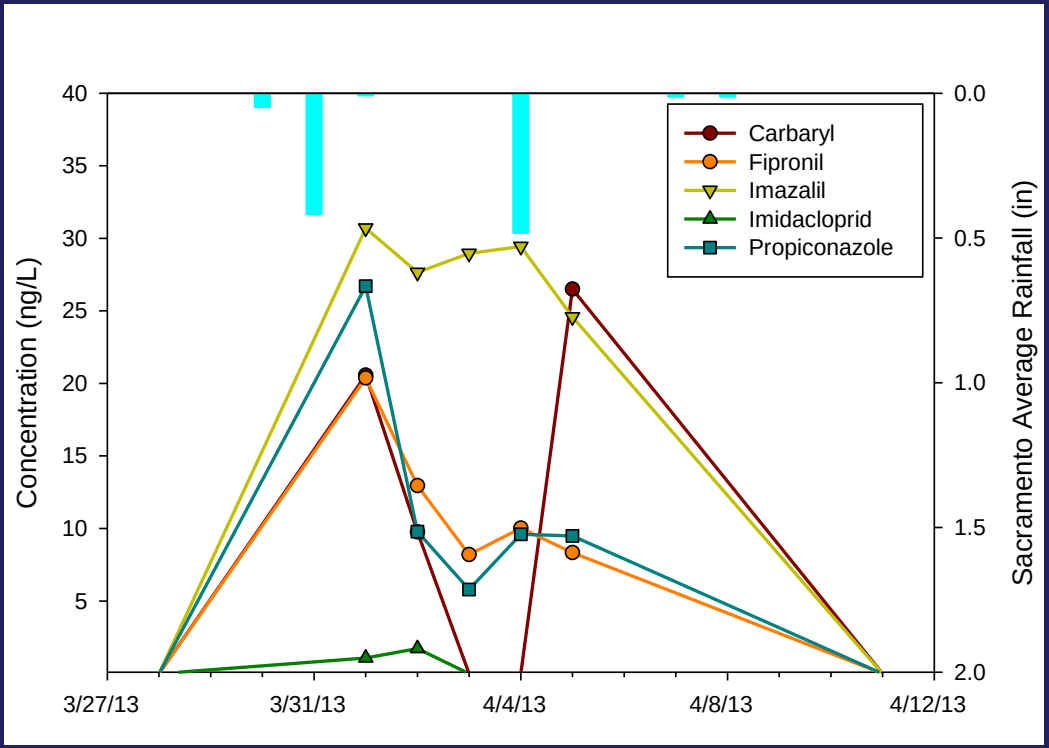


Rice Pesticides

- Detected distinct pulses of rice pesticides. Timing corresponds to use in the watershed.



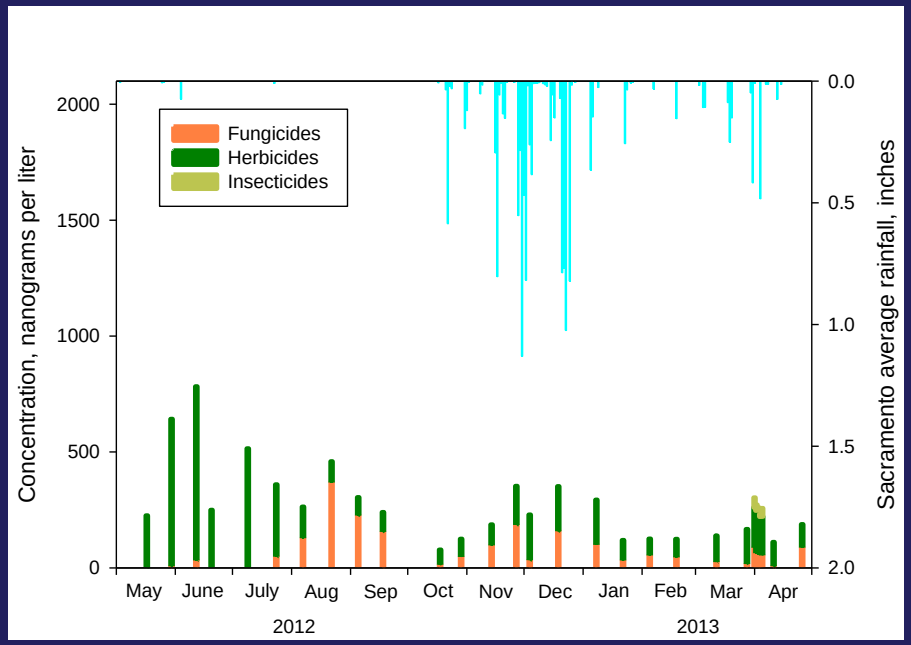
Sacramento Urban Storm Runoff



- 5 urban/home use pesticides only detected in urban runoff
- Fipronil exceeded EPA chronic invert benchmark (11 ng/L)
- These were the only detections of insecticides at Freeport

Total Concentrations

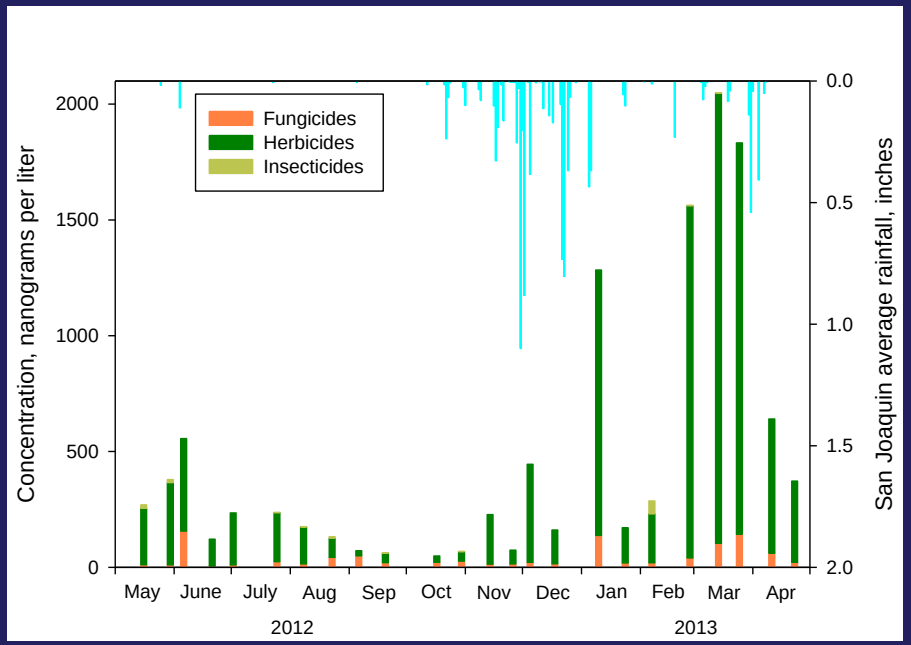
Sacramento River at Freeport



Average Contribution

Herbicides 71%
Fungicides 28%
Insecticides 1%

San Joaquin River at Vernalis

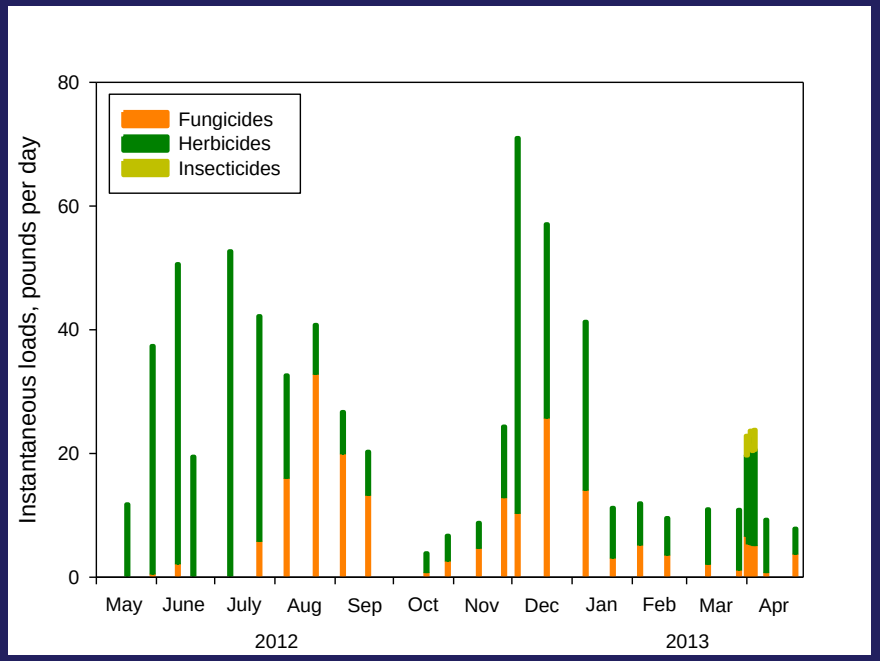


Average Contribution

Herbicides 83%
Fungicides 16%
Insecticides 2%

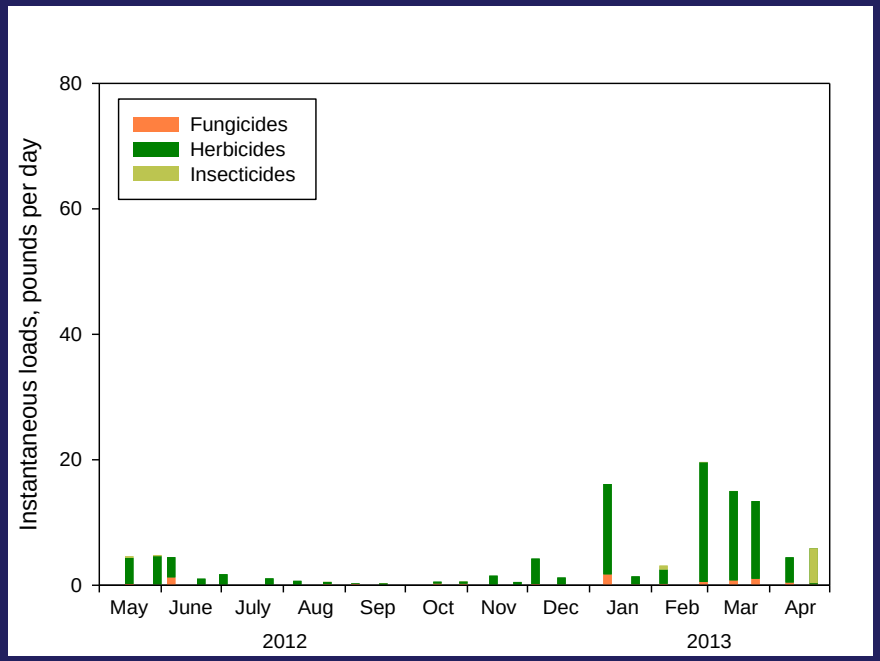
Pesticide Loads

Sacramento River at Freeport



Herbicides	**69%**	**517 lbs**	**6175 lbs**
Fungicides	**30%**	**207 lbs**	**2712 lbs**
Insecticides	**<1%**	**10 lbs**	**23 lbs**

San Joaquin River at Vernalis



Herbicides	**91%**	**98 lbs**	**1398 lbs**
Fungicides	**8%**	**9 lbs**	**123 lbs**
Insecticides	**1%**	**1 lb**	**16 lbs**

* Pesticide use on rice accounted for approx. 30% herbicide and 40% fungicide loads

Loads Compared to 2012 Use

Sacramento River at Freeport

	May 1 – Dec 31 Use in lbs	Integrated Load lbs	Load as % of use
Azoxystrobin	30,466	2,214.2	7.3%
Boscalid	670	9.5	1.4%
Clomazone	87,962	933.9	1.1%
Diuron + degs	18,718	185.5	1.0%
Hexazinone	11,767	1,332.8	11.3%
Metolachlor	14,521	122.3	0.8%
Propanil + deg	1,346,262	1,762.0	0.1%
Simazine	19,808	599.0	3.0%
Thiobencarb	156,009	119.7	0.1%

San Joaquin River at Vernalis

	May 1 – Dec 31 Use in lbs	Integrated Load lbs	Load as % of use
Azoxystrobin	15,755	21.2	0.1%
Boscalid	6,596	32.4	0.5%
Diuron + degs	19,566	115.6	0.6%
Hexazinone	3,987	99.0	2.5%
Metolachlor	43,380	74.1	0.2%
Simazine	14,244	136.2	1.0%

- May through Dec 2012 comparison does not cover entire study period (Spring 2013)

What's Missing?

	Freeport	Vernails	Cache/Yolo	East Side Tribs	Within Delta	Sum Minors
Azoxystrobin	34%	26%	34%	3%	2%	40%
Bifenthrin	19%	37%	19%	11%	14%	44%
Boscalid	9%	53%	15%	18%	6%	39%
Carbaryl	13%	22%	26%	11%	28%	65%
Chlorothalonil	23%	41%	24%	5%	8%	36%
Chlorpyrifos	33%	34%	15%	11%	8%	33%
Clomazone	65%	0%	35%	0%	0%	35%
Cyhalothrin	25%	27%	18%	19%	12%	48%
Cyprodinil	27%	42%	12%	13%	5%	31%
Diazinon	35%	15%	30%	10%	10%	50%
Difenoconazole	8%	41%	35%	9%	6%	50%
Diuron	26%	28%	17%	9%	20%	46%
Esfenvalerate	33%	34%	13%	10%	10%	33%
Ethalfluralin	25%	7%	60%	3%	4%	68%
Hexazinone	30%	16%	31%	3%	21%	55%
Imidacloprid	5%	28%	10%	38%	19%	67%
Iprodione	9%	59%	10%	20%	3%	33%
Malathion	9%	40%	14%	24%	13%	51%
Metconazole	19%	48%	27%	5%	1%	32%
Methyl parathion	27%	9%	4%	60%	0%	65%
Metolachlor	10%	28%	36%	4%	22%	61%
Oxyflurofen	18%	44%	18%	14%	6%	38%
Pendimethalin	11%	49%	17%	12%	12%	41%
Permethrin	40%	34%	12%	9%	5%	26%
Phosmet	56%	17%	5%	20%	2%	27%
Propanil	61%	1%	37%	0%	1%	38%
Propiconazole	26%	54%	12%	7%	1%	20%
Pyraclostrobin	10%	44%	20%	15%	11%	46%
Simazine	29%	29%	10%	20%	12%	42%
Thiobencarb	53%	1%	43%	2%	1%	46%
Trifloxystrobin	17%	16%	14%	51%	2%	67%
Trifluralin	16%	36%	26%	3%	19%	48%

- Data from 2012 PUR

Summary

- Mixtures of multiple pesticides were detected throughout the year
- Herbicides/degradates were detected most frequently and generally at the highest concentrations
- Fungicides accounted for 20-30% of the pesticide burden
- Insecticides were rarely detected
- Concentrations were generally higher in San Joaquin River while loads to Delta were greater from the Sacramento River
- In Sacramento River, rice pesticides accounted for approx. 30% herbicide load and 40% fungicide load
- Characterized major inputs however the story is more complex

For more information….

- Data are available at……..

  http://waterdata.usgs.gov/ca/nwis

- Detailed project report…….

  http://pubs.usgs.gov/ds/0876/