

# **Predictors of Pesticide Household Dust Levels in an Area with Intense Agriculture**

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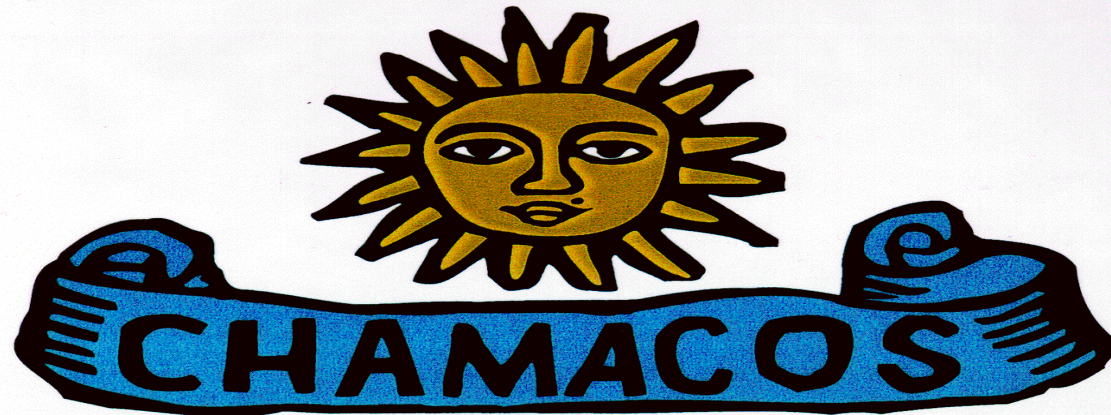
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**Robert McLaughlin**, *California Dept. Health Services*





**CENTER FOR THE HEALTH ASSESSMENT OF  
MOTHERS AND CHILDREN OF SALINAS**

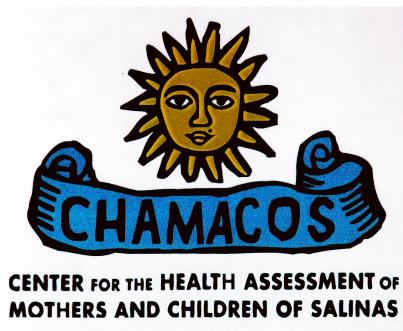
- ? Cohort study of 600 pregnant women and their children
- ? Two of five study aims:
  - To estimate sources and pathways of pesticide exposures to children living in an agricultural community.
  - To determine the relationship of pesticide exposure and:
    - ? neurodevelopment
    - ? growth
    - ? respiratory disease



**South County Outreach Effort**



**Berkeley**  
University of California



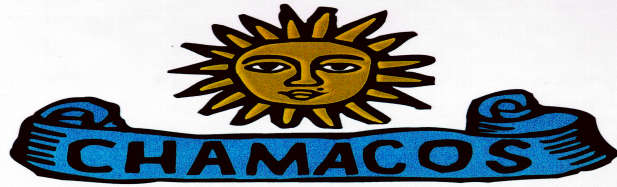
**A Community-University Partnership**

















**Batelle Laboratories**

**Community Rural Legal Assistance Grower Shipper Assoc.**

**Clinica de Salud del Valle de Salina**

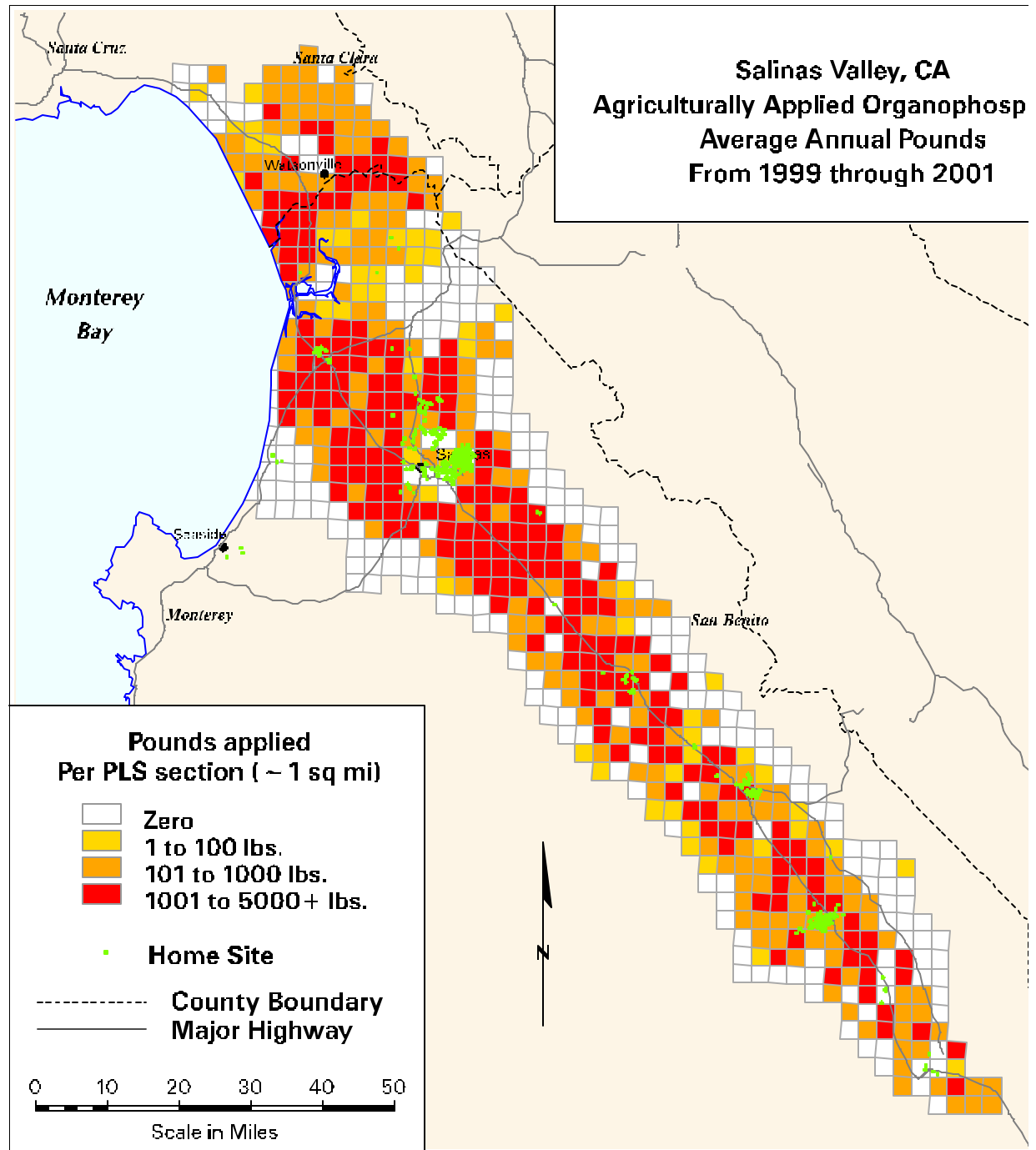


# Overview

	Enrollment	26-Weeks	Delivery	6-Months	12-Months	24-Months
<b>Questionnaire</b>						
<b>Neurodevelopment &amp; Growth Assessments</b>						
<b>Home inspection/ Environmental samples: e.g., dust</b>						
<b>Biological Specimens</b>	<b>Urine</b>	<b>Urine Blood</b>	<b>Urine Blood Cord Blood Breastmilk</b>	<b>Urine Breastmilk</b>	<b>Urine Blood</b>	<b>Urine Blood</b>

# Pesticide Use Reporting (PUR)

Annual Pounds of Organophosphates applied in Salinas Valley: 450,000



# Characteristics of CHAMACOS Mothers (N=601)

- ? 92% Spanish-speaking
- ? 54%  $\leq 5$  years in U.S.
- ? 44% 6<sup>th</sup> grade education
- ? 84% have agricultural workers in household



# Crops Grown in Salinas

- ? Lettuce
- ? Broccoli
- ? Cauliflower
- ? Other vegetable row crops
- ? Strawberries
- ? Vineyards



# Household Dust and Exposure

- Children have opportunity for direct exposure.
- Dust may be a “sink” or reservoir for pesticides that adhere to soil particles.
- Little opportunity for environmental breakdown, i.e., little uv light.



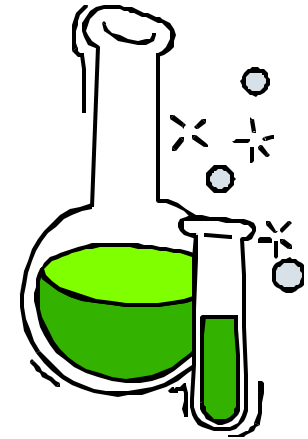


## Sampling Method

- ? Square meter in living area or living/kitchen area
- ? If no carpet, then furniture sampled.
- ? HSV sampling: deep dust.
- Home visit included:
  - GPS reading
  - reading any containers of pesticide used in the home
  - noting if any ag field was within 200 feet



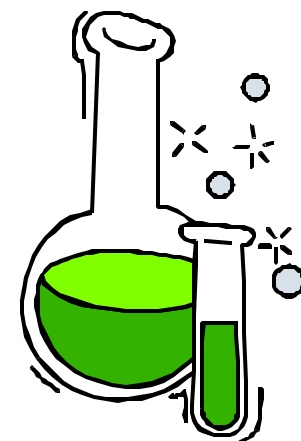
# Selection of Dust Samples for Laboratory Analysis



- ? 170 homes randomly selected from 380 homes with home visits at all three home visits:
  - ? baseline
  - ? child 6 months of age.
  - ? child 12 months of age
- ? Here, in this presentation, will present dust concentrations at 6 month visit

# Dust Analyte Selection

Lbs used agriculturally in  
Salinas Valley in 2001



## Analyte

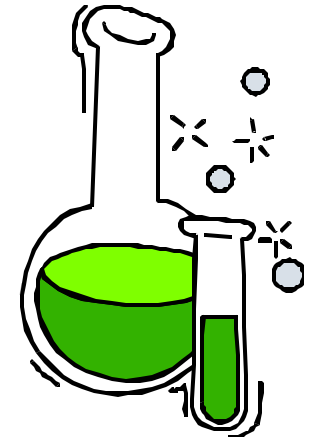
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<b>Diazinon<sup>(op)</sup></b>	<b>133,537</b>
<b>Malathion<sup>(op)</sup></b>	<b>96,520</b>
<b>Dacthal (aka: chlorthal- dimethyl, or DCPA)</b>	<b>74,349</b>
<b>Methomyl</b>	<b>65,366</b>
<b>Oxydemeton<sup>(op)</sup></b>	<b>57,859</b>
<b>Chlorpyrifos<sup>(op)</sup></b>	<b>54,945</b>
<b>Iprodione</b>	<b>45,700</b>
<b>Bensulide<sup>(op)</sup></b>	<b>32,669</b>
<b>Permethrin</b>	<b>30,187</b>
<b>Phosmet<sup>(op)</sup></b>	<b>3,166</b>
<b>Fenamiphos<sup>(op)</sup></b>	<b>1,839</b>
<b>Methamidophos<sup>(op)</sup></b>	<b>769</b>
<b>Azinphosmethyl<sup>(op)</sup></b>	<b>124</b>

# Laboratory Methods

Marcia Nishioka

Battelle Memorial Institute, Columbus, OH



? Extraction Method

• Cleanup Method

- remove major co-extractants of the dust matrix

? Detection Method

- GC/MS/MID or
- LC/MS/MS


? Method Validation

- Low level spike:  
50-250 ng to 0.5 g dust
- High level spike:  
500 ng-2.5 ?g to 0.5 g dust

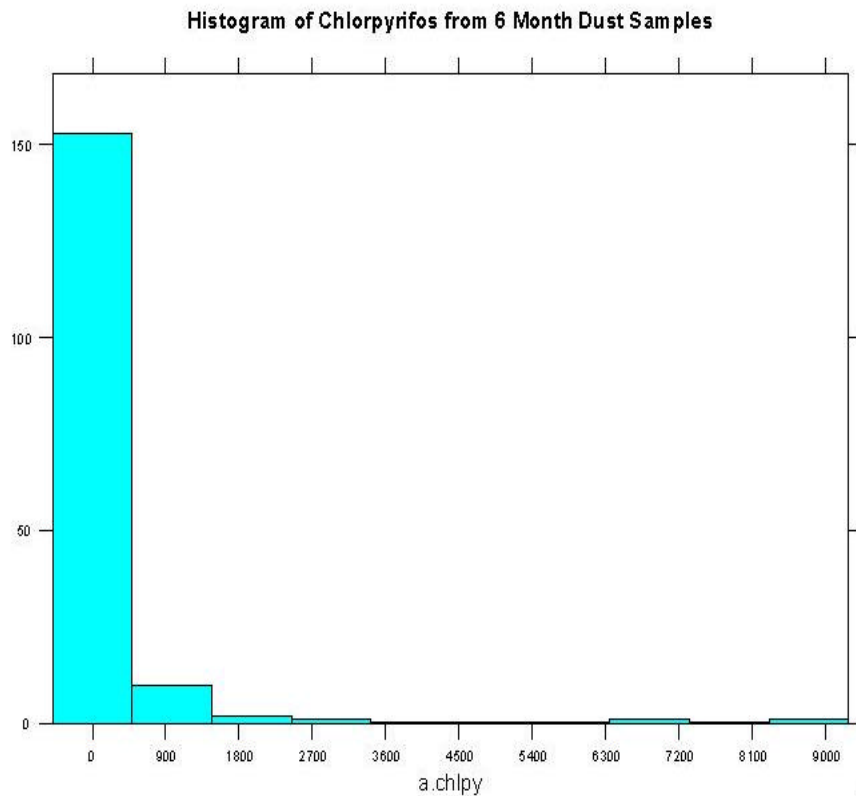
• Sample Analysis: QA/QC

- full calibration curve (5-7 points with each sample set)
- QC samples: solvent method and reference dust blanks and spikes.
- One replicate sample per sample set
- recoveries based on surrogate standards (between 70-130%)

# Household Dust: Quantification Limits (QL)

Analyte	Range of QLs (ng/g)		 % of Samples Above QL
	QL for highest mass(.5 g)	QL for lowest mass(.01 g)	
Permethrins	2	50	99%
Dacthal	2	20	93%
Chlorpyrifos <sup>(OP)</sup>	2	20	86%
Diazinon <sup>(OP)</sup>	1	20	87%
Oxydemeton <sup>(OP)</sup>	1	50	67%
Malathion <sup>(OP)</sup>	3	100	49%
Iprodione	3	100	44%
Methomyl	15	600	41%
Bensulide <sup>(OP)</sup>	5	300	17%
Methamidophos <sup>(OP)</sup>	1	50	9%
Phosmet <sup>(OP)</sup>	3	100	5%
Azinphosmethyl <sup>(OP)</sup>	100	2000	4%
Fenamiphos <sup>(OP)</sup>	1	50	5%

# Normality of Distributions?



Chlorpyrifos Dust Conc (ng/g)

**Pesticides with  
>70% Above DL**

**Shapiro-Wilk Test for  
Normality of **Logged  
Concentrations****

Chlorpyrifos<sup>(OP)</sup>

**P<0.001, Failed**

Dachtal

**P=0.04, Failed**

Diazinon<sup>(OP)</sup>

**P<0.0002, Failed**

Permethrin cis

**P=0.08, Failed**

Permethrin trans

**P=0.06, Failed**

# Pesticides with High % of Detects: Median Concentrations (ng/g)

		Permeth rin-cis	Dacthal	Chlorpy- rifos <sup>(OP)</sup>	Diazi- non <sup>(OP)</sup>
<b>Any Ag Worker in household</b>	N (%)				
No	50 (30%)	295	18	53	25
Yes	118(70%)	353	<b>32*</b>	74	31
<b>Ag field: 200 feet from house</b>					
No	151 (90%)	320	24	68	31
Yes	17 (10%)	453	<b>80*</b>	38	26

\* p<0.05

# Pesticides With Fewer Detects Percentage Above QL

chi-square test (\*p<0.05)

	N	Ipro- dione	Mala- thion <sup>(OP)</sup>	Oxyde- meton <sup>(OP)</sup>	Metho- myl
<b>Any Ag Worker in household</b>					
No	50	24%	6%	51%	24%
Yes	118	<b>49%*</b>	13%	59%	28%
<b>Ag field: 200 feet from house</b>					
No	151	41%	12%	54%	25%
Yes	17	47%	0%	<b>86%*</b>	43%



# Questionnaire Variables and Dust Levels: Sig ( $p < 0.05$ ) Association?

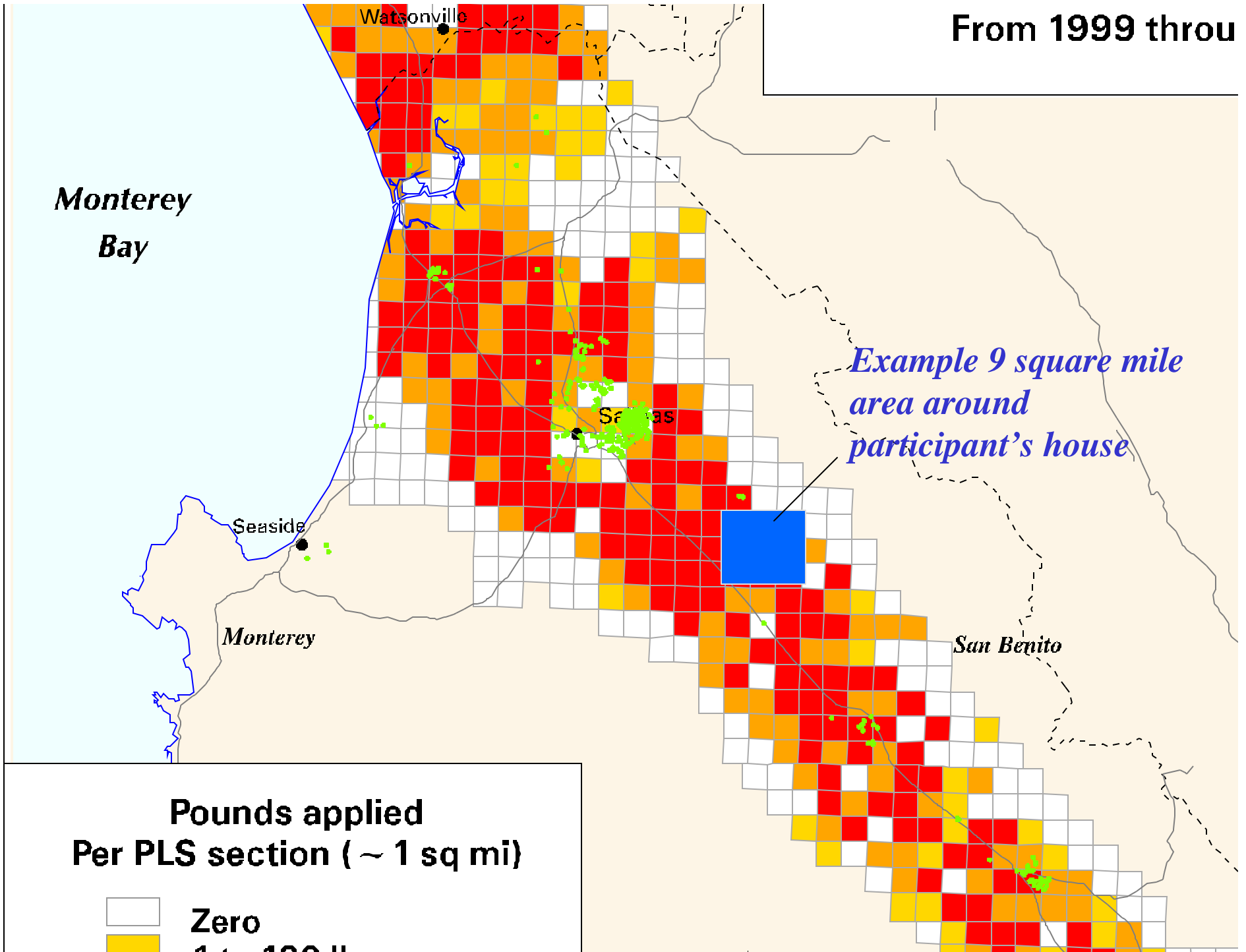
	Permethrin	Dacthal	Chlorpyrifos <sup>(OP)</sup>	Diazinon <sup>(OP)</sup>	Oxydemeton <sup>(OP)</sup>	Malathion <sup>(OP)</sup>	Iprodione
Housekeeping Quality	No	No	No	No	Yes	No	Yes
Ag Worker Store Clothes in house	Yes	Yes	No	No	No	No	Yes
Mother's country of birth	No	No	No	No	No	No	Yes
Sample Collected from Furniture	No	No	No	No	Yes	No	No

# **Questionnaire Variables:**

## **No apparent association with dust**

- ? Home OP pesticide use (number with yes =5)
- ? Professionally applied pesticides
- ? Season of dust collection
- ? Family at or below poverty level
- ? Mother's age

From 1999 throu



# PUR vs Dust Concentrations

## Spearman Correlation Coefficients

Days 1-14 is dust collection day plus the 13 days prior

Days 1-90 is dust collection day plus the 89 days prior

	<i>DAYS 1-14</i>		<i>DAYS 1-90</i>	
	<b>PUR Median (lbs/9 miles<sup>2</sup>)</b>	<b>Spearman Coefficient</b>	<b>PUR Median (lbs/9 miles<sup>2</sup>)</b>	<b>Spearman Coefficient</b>
<b>Permethrin cis</b>	5.8	0.04	75	0.01
<b>Dachtal</b>	<b>0.0</b>	<b>0.32***</b>	<b>64</b>	<b>0.49***</b>
<b>Chlorpyrifos<sup>(OP)</sup></b>	8.4	0.07	83	0.10
<b>Diazinon<sup>(OP)</sup></b>	37	0.003	334	-0.07
<b>Oxydemeton<sup>(OP)</sup></b>	1.0	0.08	116	0.08
<b>Malathion<sup>(OP)</sup></b>	0.0	0.07	61	-0.02
<b>Iprodione</b>	<b>2.1</b>	<b>0.30***</b>	<b>135</b>	<b>0.33***</b>
<b>Methomyl</b>	22	-0.04	232	0.11

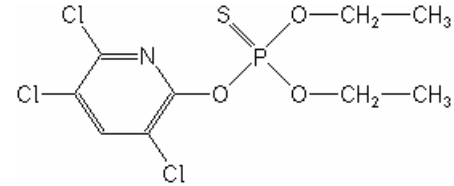
\*\*\*p,<0.0001

## Result Summary

- *Within 200 feet of ag field* associated with **dacthal**, **iprodione**, oxydemeton (OP)
- *Any ag worker in house* associated with **dacthal**, **iprodione**
- *Ag worker clothes in house* associated with **dacthal**, **iprodione**, permethrins
- *Agricultural pesticide use (PUR)* correlated with **dacthal**, **iprodione**

- **Chlorpyrifos:**

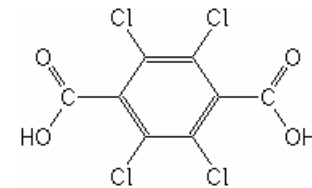
- broad spectrum OP insecticide
- vapor pressure:  $2 \times 10^{-5}$  mm hg
- half-life in air: 4 hours (ref: HSDB)



- **Dacthal (aka: chlorthal-dimethyl or DCPA)**

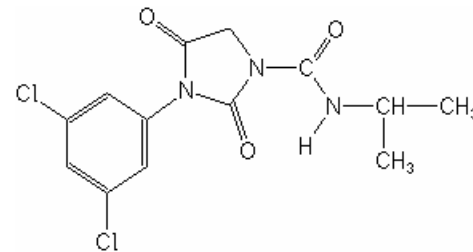
- herbicide, chlorinated phthalate
- vapor pressure:  $3 \times 10^{-6}$  mm hg
- half-life in air: 36 days (ref: HSDB)

*Dimethyl ester of:*



- **Iprodione**

- fungicide,
- vapor pressure:  $4 \times 10^{-9}$  mm hg
- not expected to vaporize: (ref: HSDB)



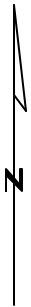
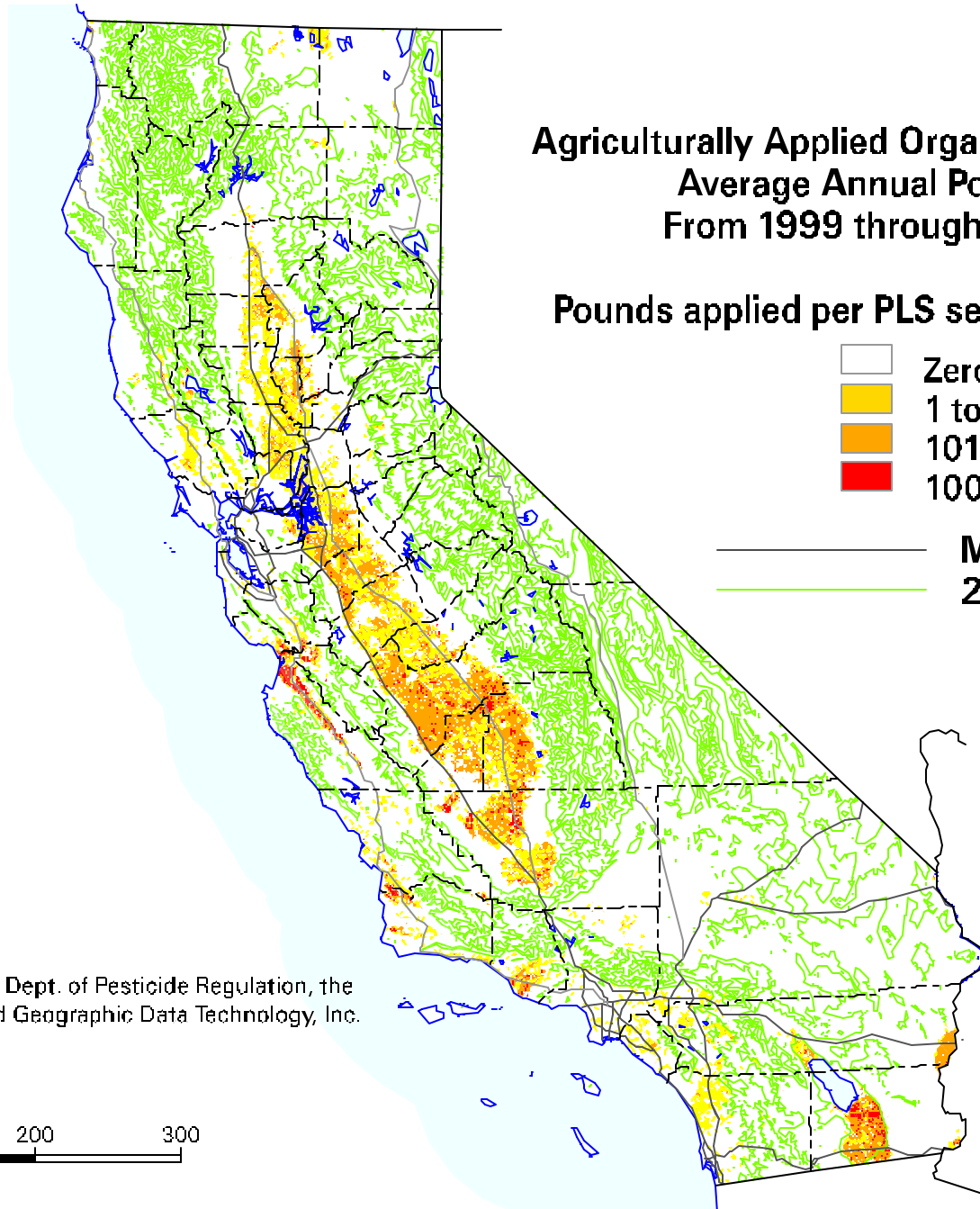
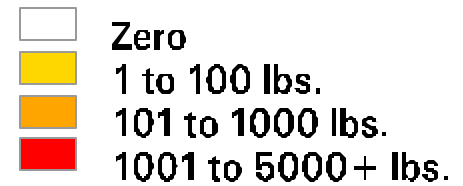
## Next Steps:

- Other Variables
  - questionnaire, home visit
  - PUR, e.g., other spatial scales, crop, pesticide product, air or ground applied
- Loading (ng/m<sup>2</sup>)
- Multivariate analysis, including repeated measures
- Public Health Impact



# Agriculturally Applied Organophosphates Average Annual Pounds From 1999 through 2001

Pounds applied per PLS section (~ 1 sq mi)



Data sources: California Dept. of Pesticide Regulation, the US Geologic Survey, and Geographic Data Technology, Inc. September 2003





# Funders



U.S. Environmental Protection Agency



National Institute of Environmental Health Sciences

# Health Risk

Hazard Quotient

Ratio of: Estimated Intake / Reference Dose

$$\text{Estimated Intake (mg/kg/day)} = \frac{\text{Conc in Dust} \times \text{Exposure Factors}}{\text{Reference Dose}}$$

see Bradman et al; J Exposure Analysis and Env Epi: 7, no 2, 1997, pg 217-234.

HQs for Chlorpyrifos are lower than one