# Arizona Children's Environmental Health Project

# Children's Exposure to Pesticide in Yuma County, AZ

Mary Kay O'Rourke, Ph.D. and
Natalie Freeman, Ph.D.

Environmental and Community Health
The Mel and Enid Zuckerman Arizona College of Public Health
The University of Arizona
Tucson, Arizona

# Projects Described

- Two Children's Pesticide EPA STAR projects in Yuma Co. Arizona
- Arizona Department of Health Services/EPA funded PEP project

# Why?

- Community Concern
  - Poison
    - Depression of respiratory function & pulmonary edema (O'Malley, 1997, Eskenazi et al. 1999)
  - Morbidity
    - Cancer & Leukemia (EPA, 1998)
    - Developmental anomalies—transposition of great vessels of the heart (Loffredo, 2001), Neurological Development (Guillette et al, 1998)
  - Proximity


EPA (1998) The children's environmental health yearbook. Washington.

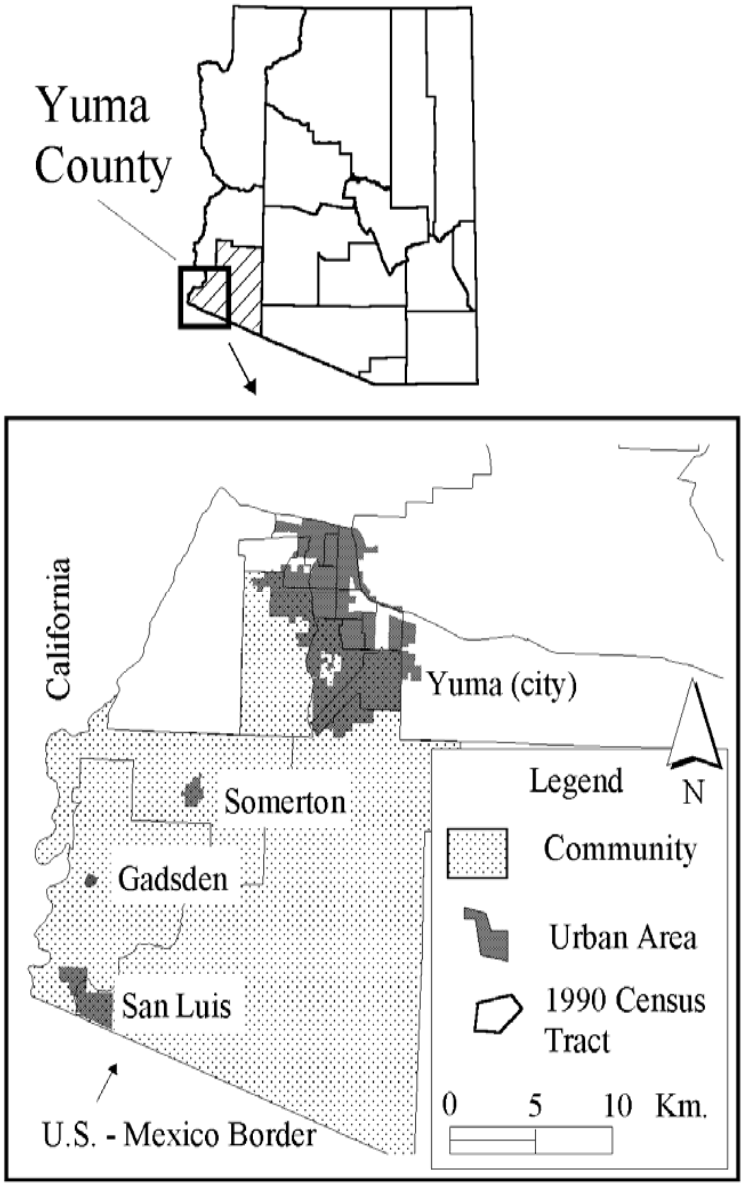
O'Malley, M. (1997) Clinical evaluation of pesticide exposure and poisonings. *Lancet* 349:11612-1166.

Eskenazi et al. (1999) Exposure of children to OP pesticides and their potential adverse health effects. *Environ. Health Persp*. 107 (Supplement 3) :409-419.

Loffredo, C. et al. (2001) Association of Transposition of the great arteries in infants with maternal exposures to herbicides and rodenticides. *Am. J. Epidemiol.* 153: 529-536.

Guillette et al. (1999) An anthropological approach to the evaluation of preschool children exposed to pesticides in Mexico. *Environ. Health Persp*. 106: 347-353.

# Where? The Site



# Who?...

- Children
  - < 6 years of age
  - 53% of Children live in homes where at least 1 person works in the fields.
- The Pediatrician's Mantra

" Children are not just little adults."

  - They eat, breath and drink more proportional to body weight.
  - Their bodies are developing and environmental assaults may have greater impact than in adults.
  - Their stature and behaviors may promote greater exposure.

# Overarching Purposes

- To determine whether children in this area have elevated exposure
- To determine factors contributing to elevated pesticide exposure
- To identify pesticide exposure reduction strategies

# Background: Yuma Co. & Agriculture

- Pesticide Source
  - Environmental
    - Continuous Farming:  2-3 Crop rotations per year
      - Maximum Application:  July, August & September
    - Household Application: June-September
  - Transported
    - Paraoccupational
- Community Concern
  - Humans as Pesticide Receptors
    - Special concern for Children's Safety
  - Direct & Secondary Exposures

# Conditions

# Spring Crops

# Summer Crops

# Cotton

# Common Pesticides Used

- Chlorpyrifos:
  - Household:  in the past—termites, cockroaches, fleas
  - Agricultural: cattle dip, corn, cotton, soybeans, fruit, nuts, vegetables
- Diazinon:
  - Household:  cockroaches, garden applications
  - Agricultural: several crops including corn
- Malathion:
  - Household: topical application to humans for lice
  - Agricultural:  Mediterranean Fruit Fly--for Citrus
  - Regional:  Mosquito Control
- Pyrethroids
  - cis and trans permethrin Household pesticides, green leafy food

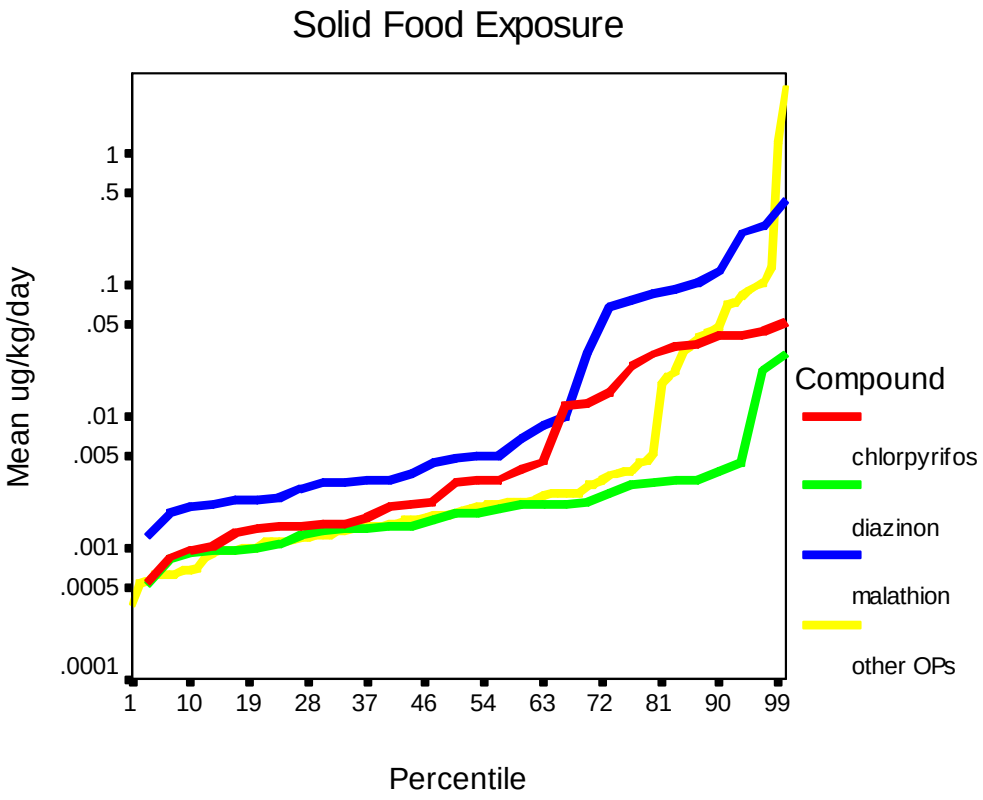
# Results--Demographics

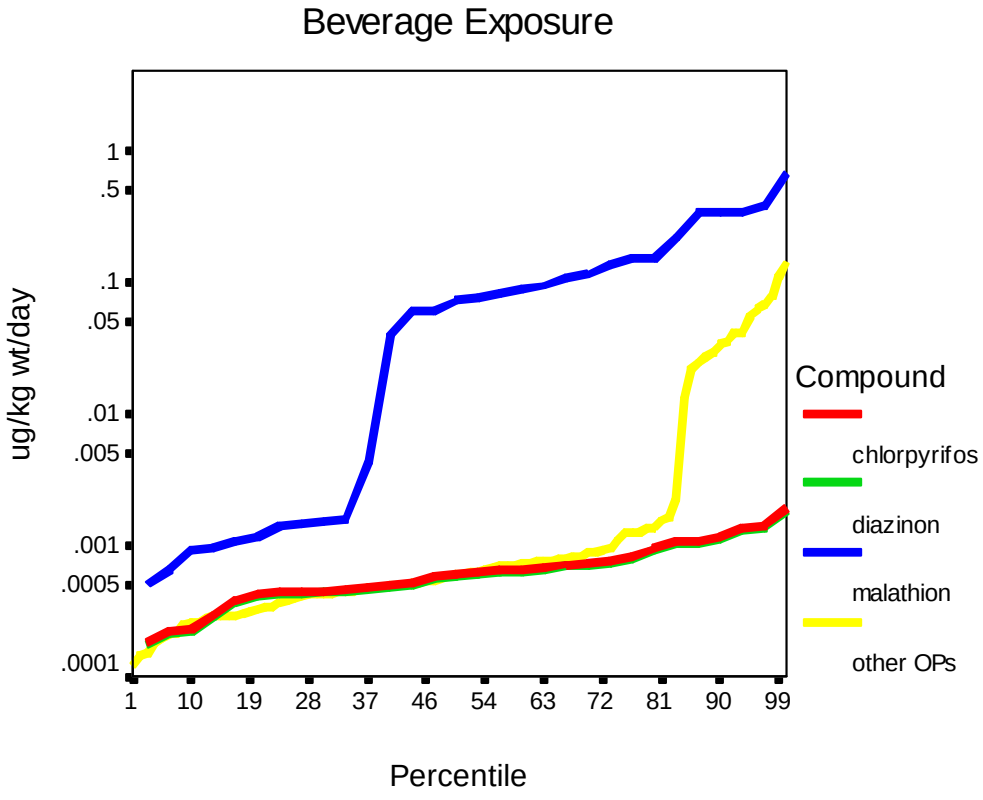
- KPI
  - 154 children ≤ 6 & 38 children >6 ≤11)
    - Environmental work in 30 Households
  - Gender = 53% male & 47% female
  - Ethnicity = 100% Hispanic
- KPII
  - 209 children ≤ 6 years
    - Environmental work in 45 Households
  - Gender = 52% male & 48% Female
  - Ethnicity = 100% Hispanic

# Study Design

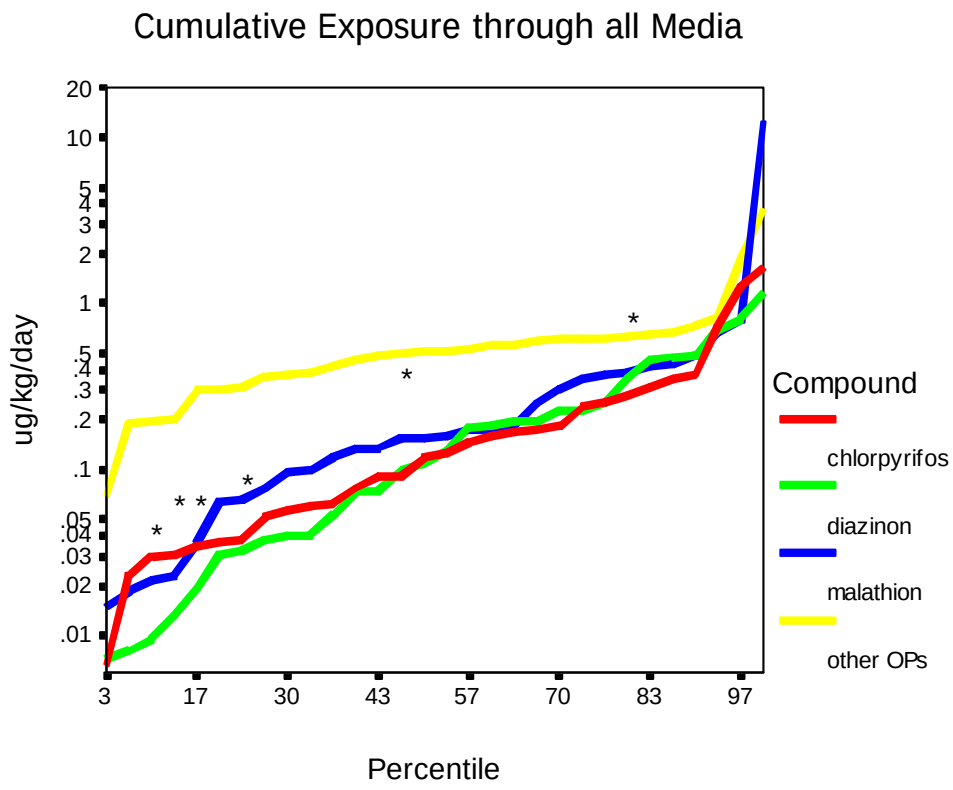
- Samples Collected
  - Air (Indoor, Outdoor, $PM_{10}$ and $PM_{2.5}$)
  - Floor Dust
  - Composite Yard Soil
  - Food & Beverage
  - Dermal Wipe Sample
  - Repeat Urine from Child < 6 years
  - Urine sample from sibling <12 years & > 6 years
  - Videotape (2-6 hours)

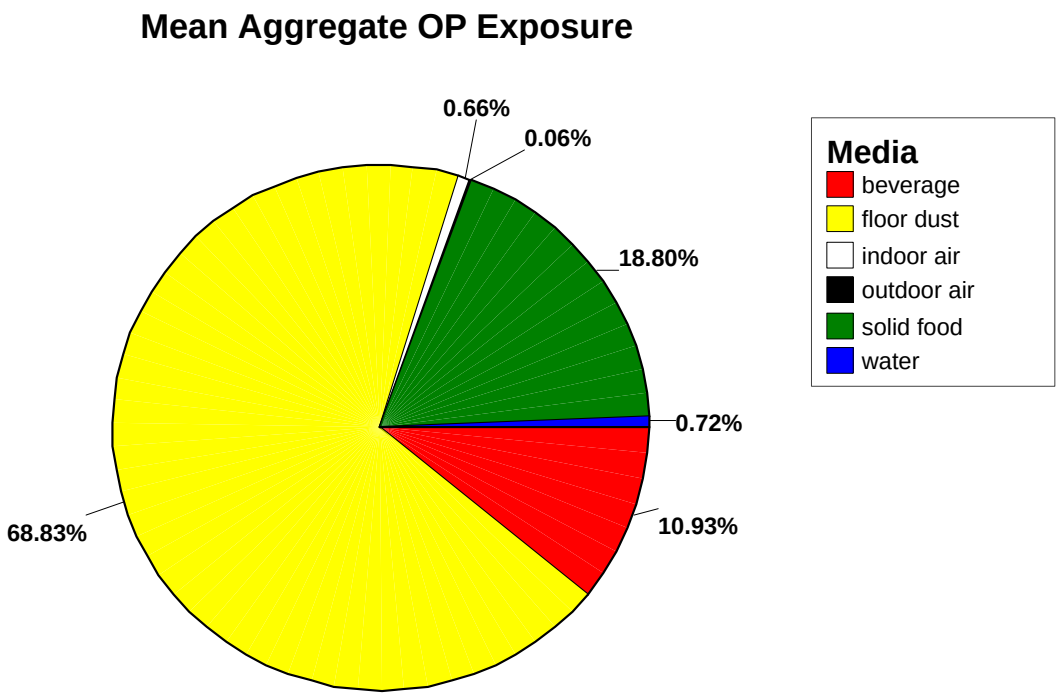
# Ingestion Dose



# Aggregate Dose



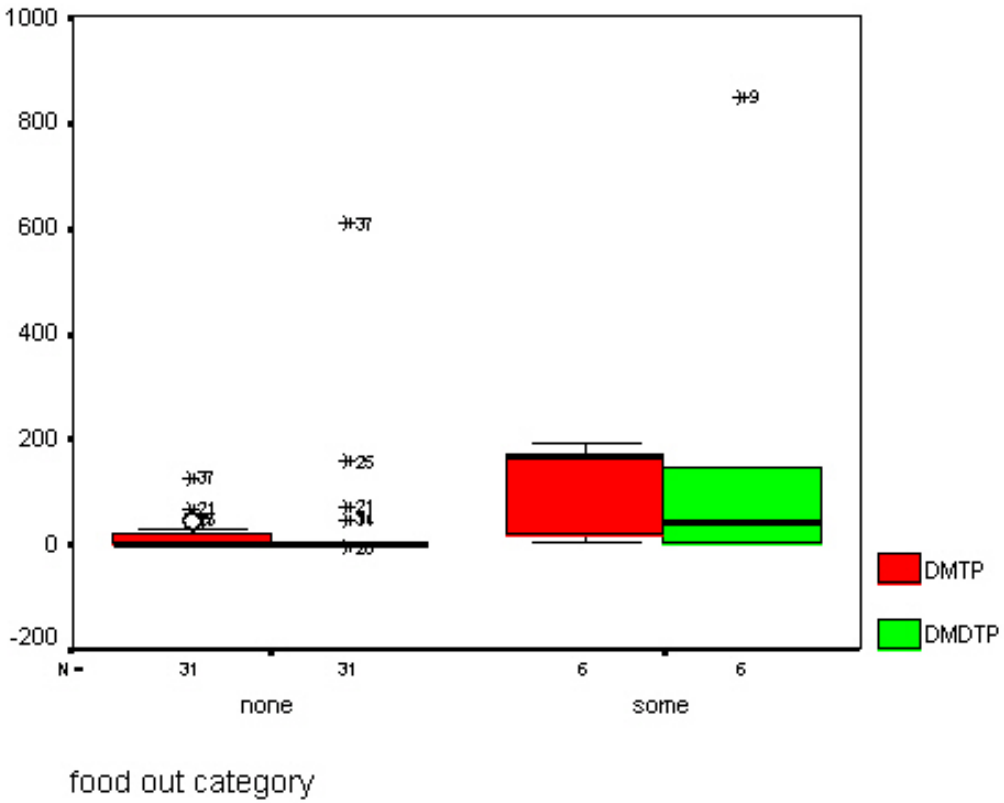



# What children touched

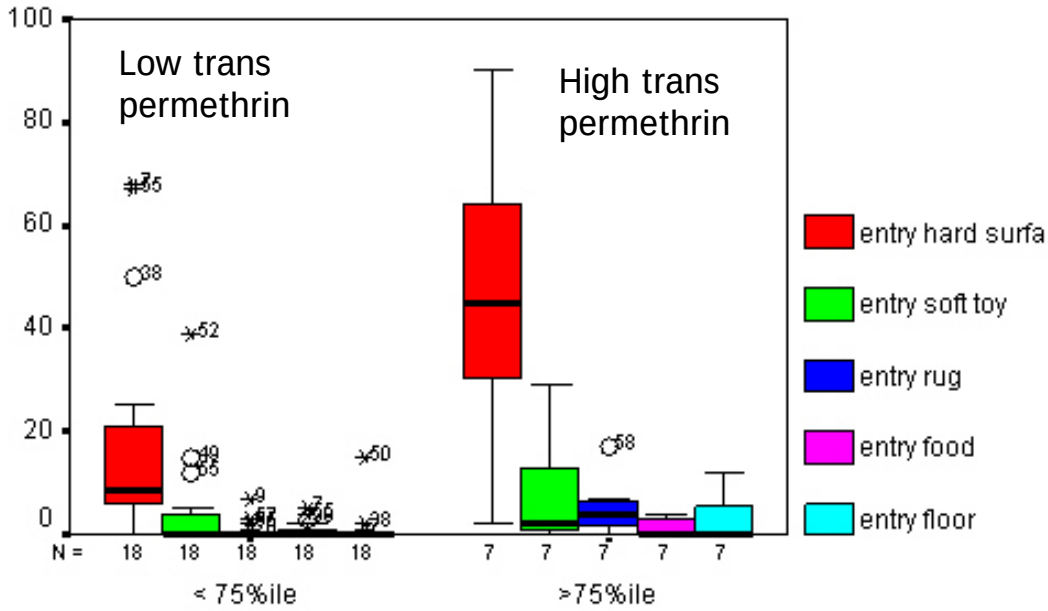
| | hourly contact rates | max. |
|---|---|---|
| Hard surfaces | 120 +/- 46 | 241 |
| Skin | 67 +/- 30 | 124 |
| Hard toys | 50 +/- 48 | 143 |
| Clothing | 44 +/- 21 | 103 |
| Bedding | 37 +/- 43 | 147 |
| Upholstered furniture | 36 +/- 25 | 110 |
| Paper | 33 +/- 21 | 71 |
| Hair | 10 +/- 9 | 36 |
| Mouth | 10 +/- 9 | 33 |

# Surfaces and Biomarkers of Exposure

Association between biomarkers & food handled outside



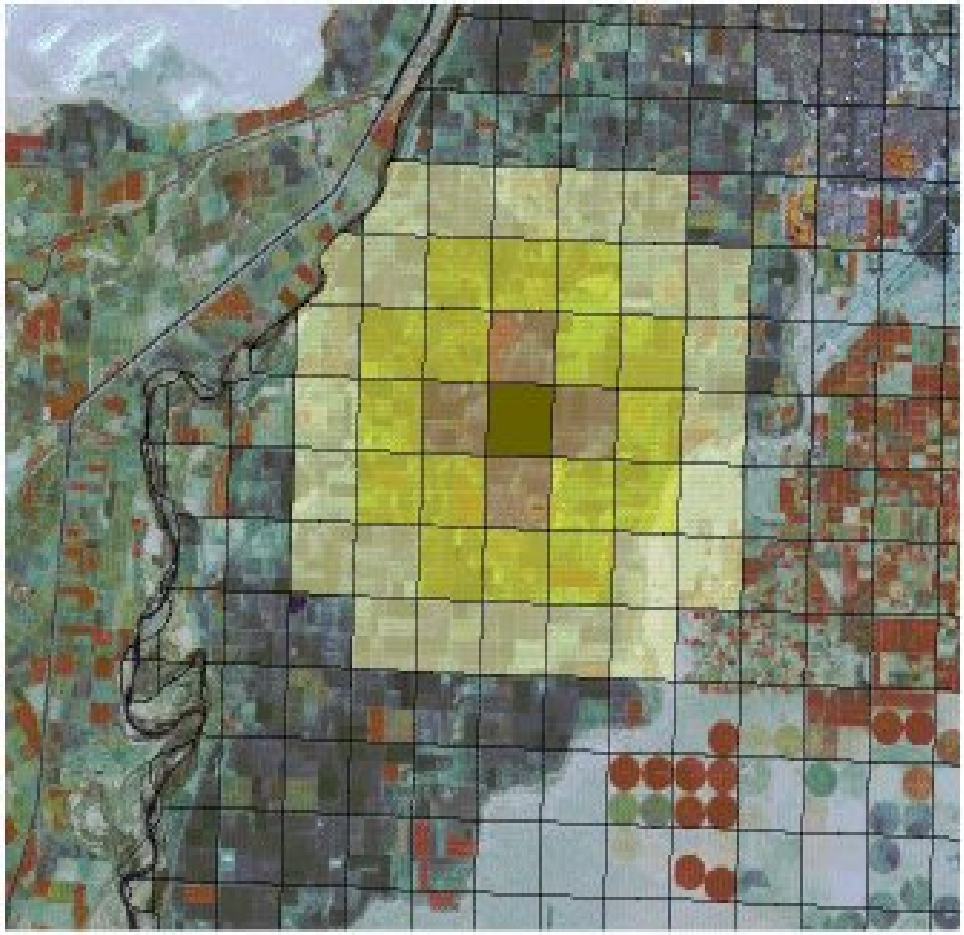

Impact of contact duration on Biomarker concentrations



# Comparison of metabolite levels (μg/l)

| DMP | 50%ile | 75%ile | 90%ile | 95%ile |
|---|---|---|---|---|
| NHANES (6-11yrs) n=471 | 1.0 | 4.4 | 10.0 | 21.0 |
| Arizona screen (<6 yrs) n=189 | 10.0 | 28.5 | 62.0 | 111.0 |
| AZ Video subset (<6 yrs) n=36 | 30.0 | 54.0 | 118.0 | 176.1 |
| **DMTP** | | | | |
| NHANES | 4.1 | 20.0 | 40.0 | 62.0 |
| AZ subset | bdl | 25.1 | 111.4 | 167.2 |
| **DMDTP** | | | | |
| NHANES | bdl | 4.3 | 16.0 | 32.0 |
| AZ subset | bdl | bdl | 79.5 | 153.9 |

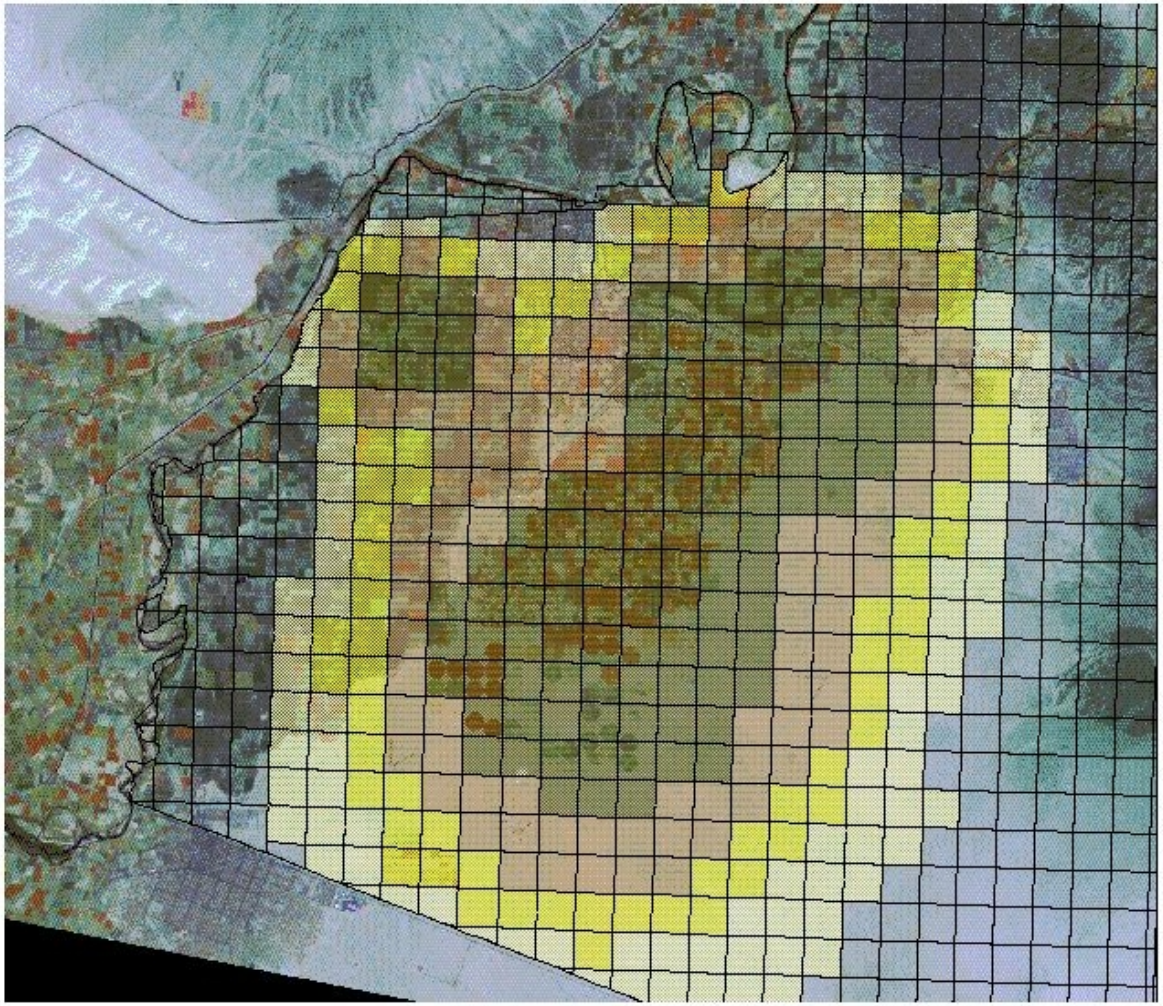
# Extrapolated TCPY Levels for an Arbitrary Spraying Location

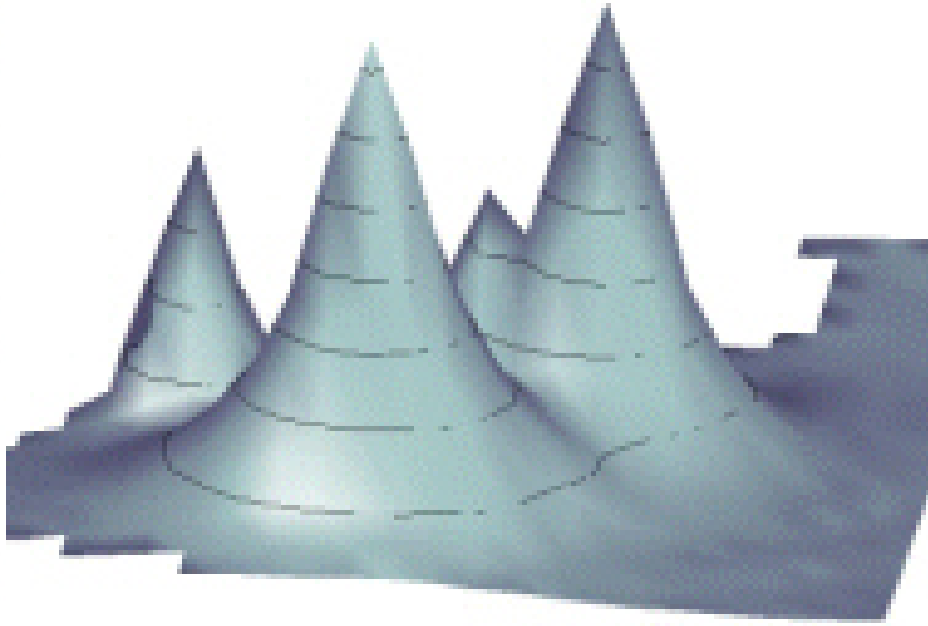


Predicted detectable levels of TCPY for simulated application.

Demonstration Only--Simulations are undergoing calibration so map may overstate distance of impact.

# Predicted TCPY surface based on modeled chlorpyrifos application in the study area.





Predicted TCPY for May 1998 Sprayings

# Conclusions

- Children of Arizona living in heavily farmed areas experience elevated levels of pesticide exposure.
- Less than 2% of OP exposure comes from air and water *combined*.
- Ingestion appears to be the primary exposure route
  - Direct Consumption
    - Food: Solid = 18.8% Liquid = 10.9%
  - Incidental Consumption
    - House Dust = 68.8%

# Conclusions

- A child's behavior plays a major role in exposure via dermal transfer.
- NOELs do not exist for Aggregate exposures by pesticide class—We may think we are safe when we are not.
- Exposed children experience deficits in speed of attention, sequencing, mental flexibility, visual search and motor function (Trails B measures)
- Az Dept Ag data of pesticide application can be modeled to predict exposure and verified by field collection of biomarkers

# Thanks to Many Collaborators

- Special thanks to the study participants for their patience and efforts.
- Thanks to the staff at the participating institutions UA, Battelle Memorial Institute, WAHEC, EPA Las Vegas, ADHS, Research Triangle Institute, Pacific Toxicology, EPA Cincinnati and their Water Lab Contractors.
- Thanks to EPA and ADHS for funding these complex surveys.
- Although the research described in this presentation has been funded wholly or in part by the United States Environmental Protection Agency through Cooperative Agreement CR821560, CR824719, R825169, and R8274430 to the University of Arizona, it has not been subjected to Agency review and therefore does not necessarily reflect the views of the Agency, and no official endorsement should be inferred.