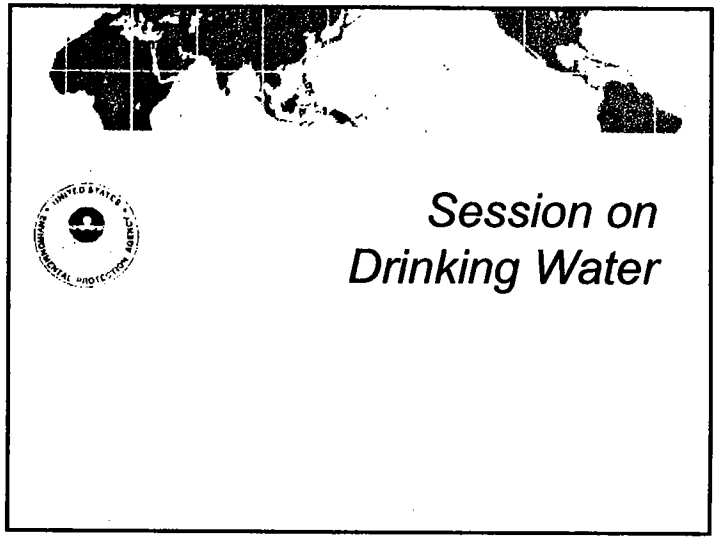
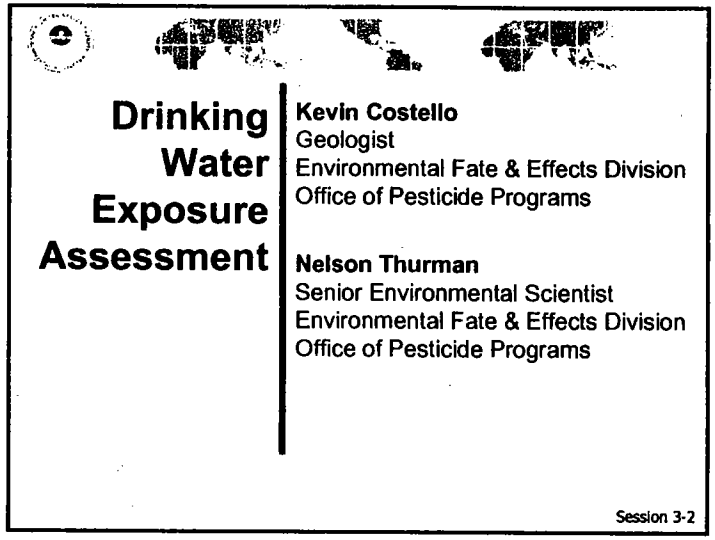
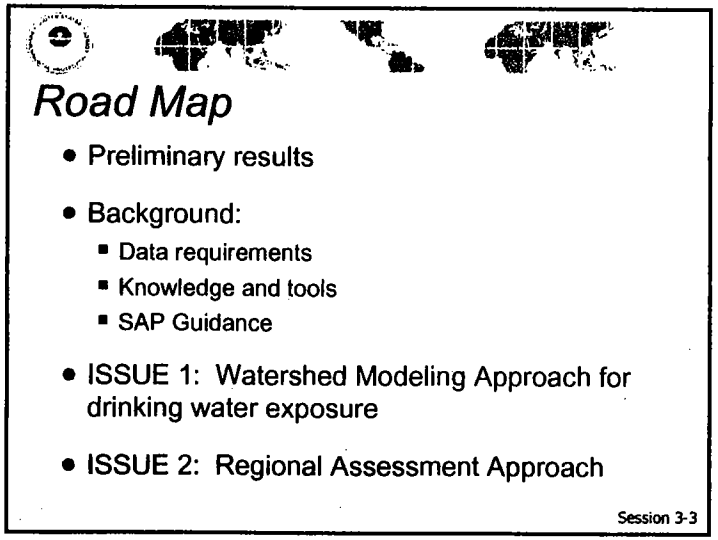
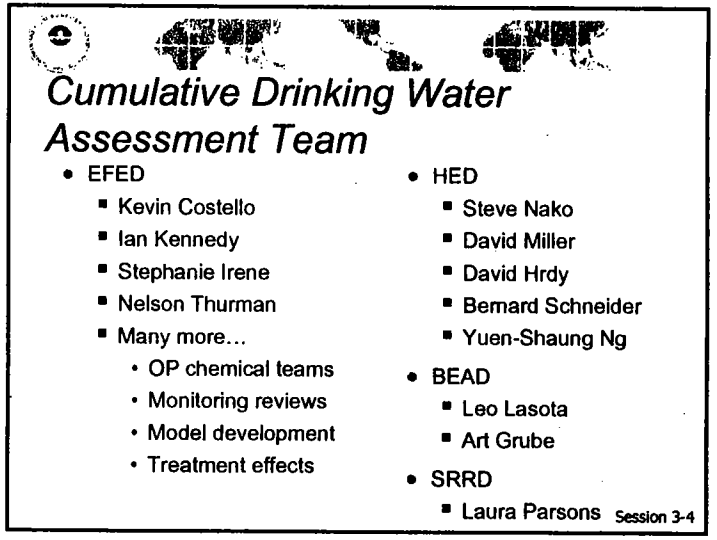

Session on
Drinking Water

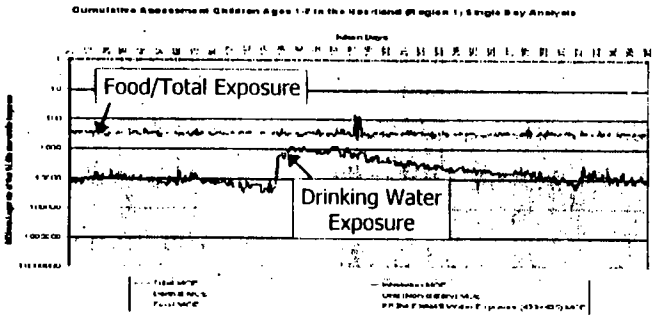

Drinking
Water
Exposure
Assessment
Kevin Costello
Geologist
Environmental Fate & Effects Division
Office of Pesticide Programs
Nelson Thurman
Senior Environmental Scientist
Environmental Fate & Effects Division
Office of Pesticide Programs
Session 3-2


Road Map
• Preliminary results
• Background:
▪ Data requirements
▪ Knowledge and tools
▪ SAP Guidance
• ISSUE 1: Watershed Modeling Approach for drinking water exposure
• ISSUE 2: Regional Assessment Approach
Session 3-3


Cumulative Drinking Water Assessment Team
• EFED
▪ Kevin Costello
▪ Ian Kennedy
▪ Stephanie Irene
▪ Nelson Thurman
▪ Many more...
• OP chemical teams
• Monitoring reviews
• Model development
• Treatment effects
• HED
▪ Steve Nako
▪ David Miller
▪ David Hrdy
▪ Bernard Schneider
▪ Yuen-Shaung Ng
• BEAD
▪ Leo Lasota
▪ Art Grube
• SRRD
▪ Laura Parsons
Session 3-4

Preliminary Results

- Drinking water is not a major contributor to total cumulative risk



Calendar-Based Approach

- Daily concentrations are the "building blocks" for estimation of exposure for any time period
  - Daily exposures can be combined to build a longer time of exposure whether it's a week, month or longer
- DEEM™/Calendex™ uses a calendar-based approach looks at each individual day of the year
- Appropriate "temporal matching" of exposures through food, drinking water, residential pathways
  - Critical for OP's due to expected seasonal pulses and seasonal use-patterns for water, residential exposure

Session 3-6

The Water Assessment Must…

- Provide distribution of daily concentrations for probabilistic exposure assessment
- Account for variations in time (daily, seasonally, yearly)
- Account for variations in place for drinking water
- Reflect co-occurrence of multiple chemicals as they occur together in place and time

Session 3-7

Starting Point

- 24+ individual OP assessments
  - Pesticide properties
  - Individual water assessments
  - Regulatory actions taken
- Monitoring
- Water assessment approach for individual chemicals (screening and refined)
- SAP guidance on water assessments

Session 3-8

Available Monitoring

- OPs are found in drinking water sources
  - Not usually frequently or at high levels
  - Surface water sources generally more vulnerable
  - Chlorpyrifos, diazinon, malathion most frequent
- Co-occurrence is likely
  - Multiple OPs detected together
  - Related to usage in watershed

Session 3-9

Available Monitoring

- Covers a number of sites, but not all high use areas
- Sampling not frequent enough for daily fluctuations
- Limited number of years
- Not all OPs are included in monitoring
- Few or no OP degradates of toxic concern are included
- Does not reflect most recent regulatory actions

Session 3-10

Guidance From SAP

- **December 1997 SAP:** "Estimating Drinking Water Exposure as a Component of the Dietary Risk Assessment"
  - Implement existing models, including PRZM-EXAMS, for use in individual chemical screening assessments
  - Devote resources to surface water impacts, define higher assessment tiers and develop techniques for estimating concentration distributions for probabilistic risk assessments
  - Use both modeling and monitoring data in assessment

Session 3-11

Guidance from SAP

- July 1998 SAP: "Proposed Methods for Basin-Scale Estimation of Pesticide Concentrations in Flowing Water and Reservoirs for Tolerance Reassessment"
  - Move forward on Index Reservoir and account for amount of cropping in the watershed
  - Geometry and hydrology based on actual vulnerable reservoir from Midwest US (Shipman City, Illinois reservoir)
  - Evaluate existing watershed models for use in refined assessments (currently in progress)

Session 3-12

Guidance from SAP

- **May 1999 SAP:** "Proposed Methods For Determining Watershed-Derived Percent Crop Areas and Considerations for Applying Crop Area Adjustment to Surface Water Screening Models"
  - Method for calculating percent crop areas (PCA) for major crops (Corn, Soybeans, Wheat, Cotton)
  - Due to concerns about scale differences (large hydrologic units compared to size of drinking watersheds, extrapolating state- or county-level data to watersheds), did not recommend using PCA for minor crops or percent treated without further monitoring
  - Recommended regional modeling

Session 3-13

Guidance from SAP

- **March 2000 SAP:** "Development and Use of Distributions of Pesticide Concentrations in Drinking Water for FQPA Exposure Assessments"
  - Two proposed regression modeling approaches from USGS (WARP, SPARROW) showed promise
- **June 2000 SAP:** "National Drinking Water Survey Design for Assessing Chronic Exposure"
  - Shift focus to monitoring programs to support model development and evaluation

Session 3-14

Guidance from SAP

- **December 2000 SAP:** "A Case Study of the Cumulative Risk of 24 Organophosphate Pesticides"
  - Used WARP regression model in the case study
  - SAP concluded that additional monitoring data was needed to complete model (model is only as good as the data going into it)
  - WARP addressed spatial, not temporal, variability
  - WARP was not ready for use in cumulative OP assessment, is still in development

Session 3-15

Guidance from SAP

- **September 2000 SAP:** "Literature review on effect of water treatment on pesticides"
  - Cannot assume that water treatment is a viable pesticide removal process in drinking water based on the limited data on water treatment effects
  - Drinking water assessments should be conducted on raw water rather than treated water unless data was available
  - Need to consider impacts of transformation products

Session 3-16

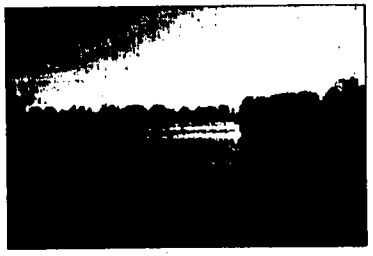
Water Treatment Effects

- Limited evidence parent OP residues are likely to be reduced by water treatment
- Limited evidence for transformation to products that are of toxic concern
- Not enough information to make quantitative adjustments

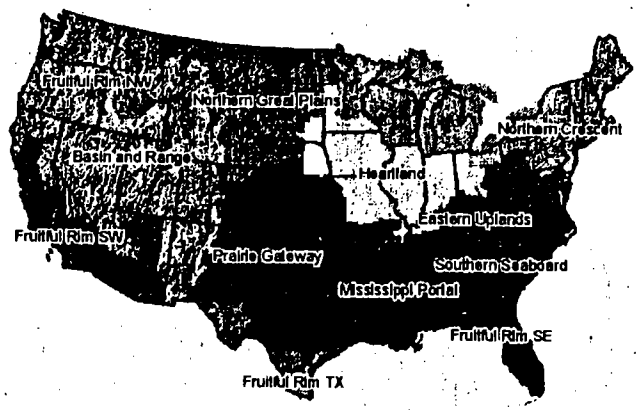
Session 3-17

Watershed Modeling Approach

- Adapted PRZM/EXAMS to estimate pesticide levels in a small drinking water reservoir
- Daily distributions over multiple years (weather variability) for 12 regional assessments
- Multiple chemicals used on crops in multiple fields in the watershed
- Typical use patterns (rates, area treated)
- Region-specific inputs



Regional Framework



Source: USDA ERS

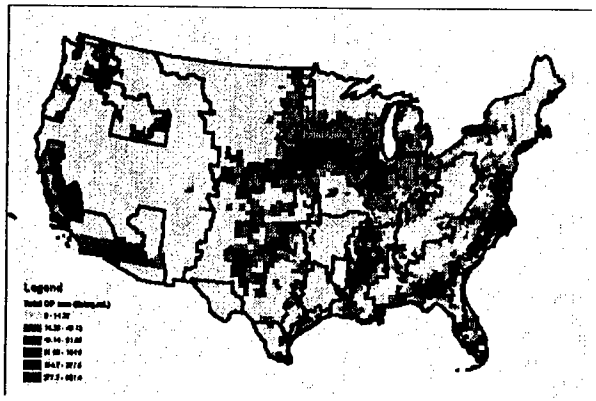
Factors in Building the 12 Regional Cumulative Assessments

- OP usage
  - What crops?
  - What OPs and how much?
- Sources of drinking water
- Vulnerability of drinking water sources
  - Runoff for surface water
  - Leaching, depth for ground water

Session 3-20

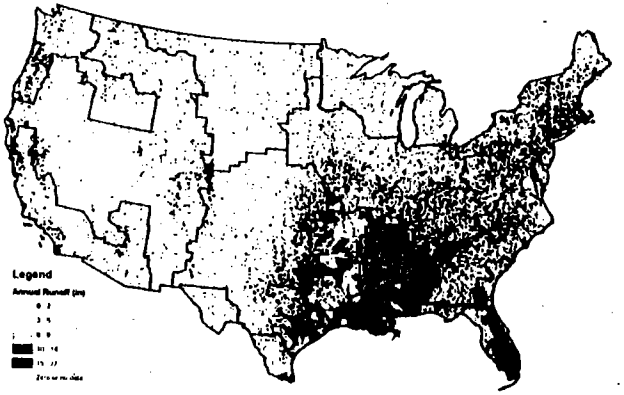
Building the Cumulative Assessment

- Identify high OP usage areas within each region



Building the Cumulative Assessment

- How vulnerable are surface water sources of drinking water in OP use areas?



Watersheds Represent Regions

- Geographic areas with high apparent potential for cumulative exposure chosen to represent each region
  - Coincide with surface water sources with high runoff potential
  - Account for impact of multiple OP pesticides
  - Not necessarily highest exposure for any single pesticide
- Expect combined OP exposure to be among the highest in each region

Session 3-23

Tailored Assessment to Selected Area(s)

- Location-specific environmental data (soil/site, weather, crops)
- Major crop-OP combinations within that area
  - Crops that actually occur together
  - OPs that are actually used on those crops
  - Account for approximately 95% of OP use in area

Session 3-24

Key Components in the Cumulative Water Assessment

- Regional framework
- Watershed-based modeling
  - Multiple fields with multiple chemical uses
  - Adjustments for area treated
- Probabilistic for weather over multiple years
- "Typical" usage patterns
  - application rates and timing

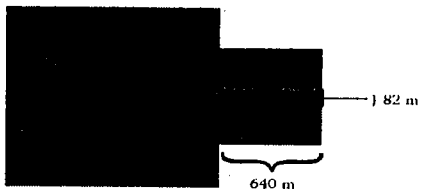
Session 3-25

Paired Model System

- PRZM: Pesticide Root Zone Model
  - Field scale simulation of chemical movement
  - Hydrology: Runoff, erosion, infiltration, evapotranspiration
  - Chemical transport: runoff, erosion, adsorption, transformation, volatilization, infiltration, plant uptake, foliar washoff & decay
- EXAMS: Exposure Analysis Modeling System
  - Chemical Fate in the Water Body: ionic and sorptive equilibria, advective and dispersive transport, chemical transformation, volatilization

Session 3-26

Scenarios: Fixed Inputs



- Geometry & hydrology of reservoir and watershed
  - 178 ha watershed, 5.3 ha reservoir, 2.7 m deep

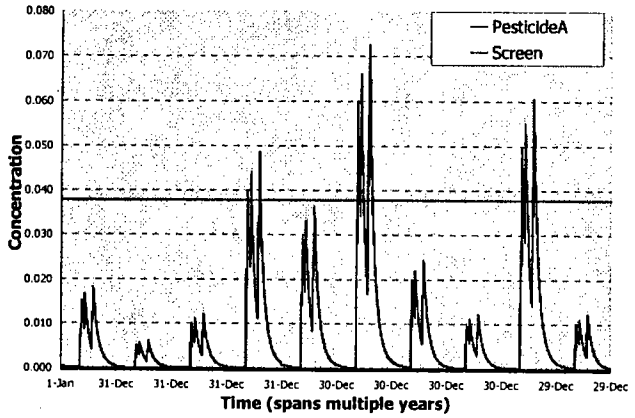
Session 3-27

Scenarios: Variable Inputs

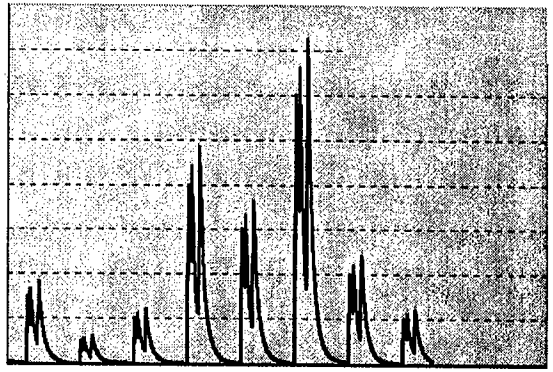
- Weather from nearest available station
- Site: soil, runoff, slope
- Management practices
  - Planting harvest represent local practice and conditions
  - Use the reasonably prevalent management practices
  - Pesticide use and timing

Session 3-28

Daily Distributions/ Multiple Years, Single Chemical



Co-Occurrence: Timing of Use



Watershed Assessment: Multiple Fields

- PRZM is a field-scale model
  - In individual screens, PRZM simulated a watershed
- For cumulative, PRZM simulated multiple fields in the watershed
  - No spatial distinction w/in the watershed
  - All runoff flows into the reservoir

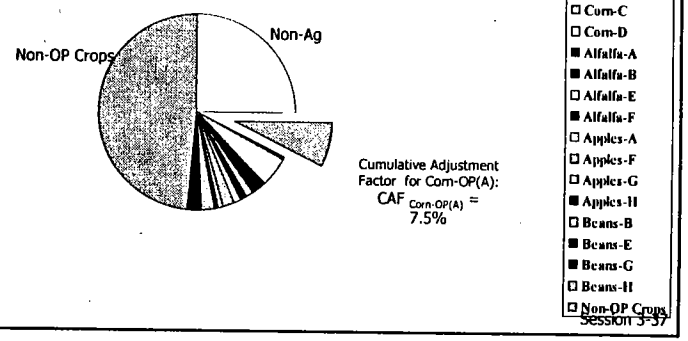
Session 3-31

Watershed Assessment

- To estimate cumulative OP impacts, the assessment considered...
  - Not all land in the watershed is planted to OP crops
  - Not all OP crops are treated with OP's
  - Those OP crops which are treated with OP's are treated at specific rates, at specific times, and with specific frequencies

Session 3-32

Illustration of CAF Adjustments



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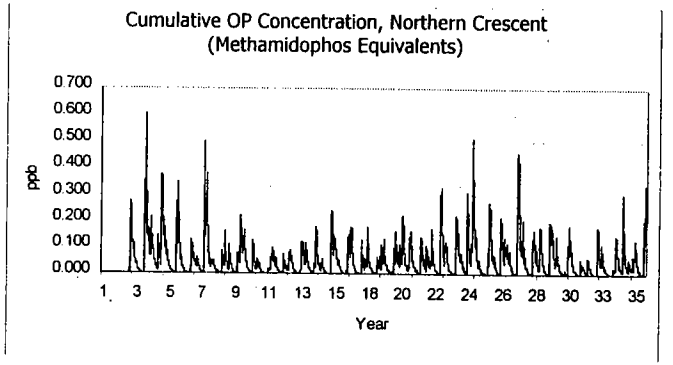
Cumulative Distribution Over Time



Session 3-38

CAF Issues: PCA

- SAP concern regarding different scales for data sources
  - County, state level use information
  - Large HUCs in relation to drinking watersheds
  - Problems with crops covering small area
- Calculated Cumulative OP PCA
  - Started with total agricultural PCA (same as in SAP), adjusted for total OP uses

Session 3-39

CAF Issues: Acre Treatments

- Adjusting for amount of crop treated with any single OP
- Acres treated factor based on survey data compiled at the state level
  - Data available at state-level: Assumes uniformity across all watersheds in the state
  - Assumes uniformity in time (no yearly variability)

Session 3-40

CAF Issues: Illustration in Red River Valley

- Counties on either side of the Red River
  - ND: Walsh, Grand Forks, Pembina
  - MN: Polk, Norman, Clay
- Terbufos use on sugar beets
  - ND: 1.97 lb/a; 69% acres treated
  - MN: 1.75 lb/a; 51% acres treated
- Azinphos Methyl use on potatoes
  - ND: 0.48 lb/a; 19% acres treated
  - MN: 0.39 lb/a; 10% acres treated

Session 3-41

Reflecting "Typical" Use

- Based on survey data, not forecasting
- OP use in most recent year
  - Application rate (average, not maximum)
  - Number of applications (average)
  - Method of application (aerial/ground)
- Primary Source: National Agriculture Statistic Service (NASS) Usage Reports

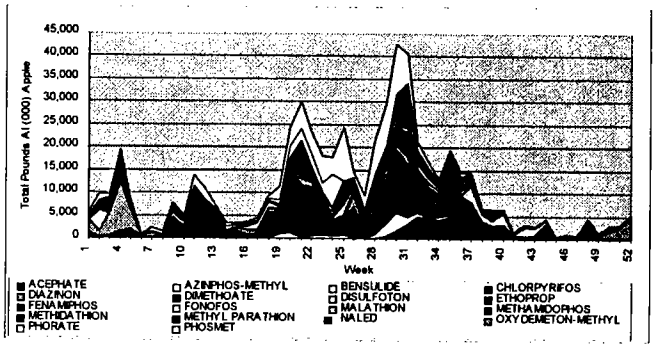
Session 3-42

Temporal Variability in Pesticide Use

- Pesticides may be applied throughout the year
- Various factors contribute to this temporal variability, including:
  - Applications to different crops/planting dates
  - Timing in pest infestations
  - Different pests treated

Session 3-43

Co-occurrence Based on Use (CA)



Session 3-44

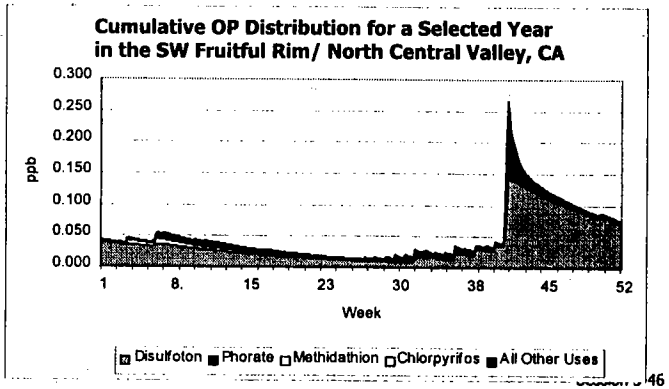
FIFRA SAP Meeting on the Preliminary Cumulative Risk Assessment: February 5 to 8, 2002

Accounting for Temporal Variability

- CA: CDPR Pesticide Use Reports
  - 5 dates each representing 20% of applied
- Other regions: USDA chemical usage, planting/harvest reports, crop profiles to identify use window
  - Single application with no distribution information: applied at the beginning of use window
  - Single application with distribution information: applied at midpoint of active window
  - Multiple applications: distributed evenly across window

Session 3-45

Preliminary Cumulative Distributions



46

Comparison to Monitoring Data

- Most estimated concentrations and monitoring were comparable
- A few known detections of one or more OP occurred at higher levels than estimated
  - Some attributed to uses being canceled
  - Some detects not necessarily in area of highest cumulative impacts
- A few pesticides with known detections significantly less than estimated

Session 3-47

Questions for the SAP on Drinking Water

Session 3-48

FIFRA SAP Meeting on the Preliminary Cumulative Risk Assessment: February 5 to 8, 2002

Question 1

After evaluation of available monitoring data and consideration of the available tools for estimating pesticide exposure in drinking water, the agency adapted available tools to provide watershed-level estimates of residues in drinking water sources. These tools have been presented to the SAP in the past in relation to individual chemical assessments and have been improved as a result of panel feedback. Because of differences between individual and cumulative assessments, this assessment reflects novel uses for some of these tools. The approach used in the Preliminary OP Cumulative Risk Assessment:

Session 3-49

Question 1 (continued)

- Used PRZM/EXAMS with the Index Reservoir, along with local site characteristics to estimate concentrations in the drinking water reservoir
- Simulated multiple OP uses on multiple fields within that watershed
- Adjusted for area within the watershed that potentially contribu ted OP loads to the reservoir using a cumulative adjustment factor
- Provided a qualitative, rather than quantitative, assessment of treatment effects on residues

Are there significant flaws in this approach and its assumptions that would be likely to lead to consistent significant underestimation of daily levels of residues in surface water across the calendar year (for instance, an order of magnitude)? If such flaws exist, what can be done to correct them? What additional information and/or tools might be available that will meet the goals/needs of the cumulative OP assessment?

Question 2

It is not feasible to conduct drinking water assessments for every watershed in which OP pesticides are used. Therefore, regional w ater exposure assessments were used to represent exposures from typic al OP usage conditions at one of the more vulnerable surface watersheds in the region. Each regional assessment focuses on areas where combined OP exposure is likely to be among the highest within the region as a result of total OP usage and vulnerability of the drinking water sources. In this manner, OPP is confident that if the reg ional cumulative risk assessment finds that exposure in water is not a significant contributor to the overall OP exposure in that area, it will not be a significant contributor in other areas in the region.

Does the SAP see anything that would call this assumption into question? If the regional approach, with its assumptions is inadequate, what can be done to improve the approach?

Session 3-51

Session 3-52