Framework for Using Surface Water Monitoring Data Quantitatively in Pesticide Drinking Water Exposure Assessments

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Measure of Exposure: Goal

To derive reasonable upper bound pesticide concentrations

**Monitoring Data**
- Direct **measure**
- **Actual** pesticide use for specific site
- Often limited in time
- Often available for many sites with varying vulnerabilities
- Tends to underestimate frequency of occurrence and peak exposure

**Modeling Data**
- Direct **estimate**
- **Maximum** or **typical** pesticide use
- Simulations over long time
- Based on a few standard vulnerable sites
- Daily concentrations and inputs can be adjusted to be more or less conservative
History

• Surface water monitoring data are difficult to interpret for quantitative use in pesticide exposure assessment

• FIFRA SAP raised concerns that peak concentrations may not be captured in currently available monitoring data and infilling techniques

• USGS recently released a new model: SEAWAVE-QEX

• Soliciting internal and external feedback
Project Summary and Goals

• Develop a framework and overall process for using surface water monitoring data quantitatively in pesticide drinking water exposure assessments

• Evaluate (and integrate as appropriate) potential tools to account for temporal and spatial limitations in currently available surface water monitoring data to increase the utility of monitoring data

• Address concerns raised by stakeholders such as:
  • Reliance on aquatic exposure models
  • Exclusive use of upper bound exposure scenarios/conditions
  • Monitoring data can underestimate real exposure
Proposed Drinking Water Assessment Framework
Scoping

• Regulatory action (i.e., new chemical, new use, registration review) and cross divisional dialogue
• Registered uses, amount used, geographic distribution, USDA and other pesticide use surveys
• Environmental fate and transport of pesticide and transformation products
• Previous work completed
• Identification of toxicity endpoints, parent and degradate toxicity; estimated DWLOC
• Scale of assessment and level of effort required to complete; identify starting point in tiered process
Tier 1

• High-end pesticide concentration based on pesticide specific physical chemical properties or environmental fate and transport properties
  • No current Tier 1 model
  • e.g., solubility

• Results
  • Concentration < DWLoC
    • no additional work necessary
  • Concentration > DWLoC
    • go to Tier 2
Tier 2

• Modeling (PWC, PFAM)
  • Pesticide specific physical chemical properties and environmental fate and transport input values based on standard input parameter guidance
  • All use sites considered at maximum application rates, minimum retreatment intervals
  • Standard high-exposure sites representing geographically-specific conditions (e.g., soil, weather); index reservoir
  • Entire watershed is treated
    • Refine with percent cropped areas for community drinking water intake watersheds (national or regional scale)
  • Protective but within realm of possibility
    • High exposure often result from high use, large areas treated due to pest pressures

• Monitoring
  • All available data summarized highlighting range of concentrations, sample frequency
Tier 2 Results

- Single exposure site represents entire crop and/or country or region
- Highest modeling or measured pesticide concentration on a national or regional scale provided as point estimate or distribution to HED
Tier 2 Next Steps

• All concentrations < DWLoC
  • no additional work necessary

• Some concentrations < DWLoC and some concentrations > DWLoC
  • only sites and regions with concentrations > DWLOC go to Tier 3*

• All concentrations > DWLoC
  • go to Tier 3*

* if data allow
Tier 3

• Modeling (PWC, PFAM)
  • Pesticide specific physical chemical properties and environmental fate and transport input values, including a sensitivity analysis
    • Focus on major routes of dissipation and impacts not captured in standard modeling
  • Typical use information considered
  • Sites representing geographically-specific conditions (e.g., soil, weather); index reservoir
    • Confirming scenarios, uses are relevant
    • On-going method development
  • Percent cropped areas for community drinking water intake watersheds on regional scale

• Monitoring
  • All available data summarized highlighting range of concentrations, sample frequency on a regional basis; application of “standard” sampling bias factors
    • Confirming sites are in relevant use areas
What is a Sampling Bias Factor (SBF)?

- protective multiplier of the measured concentration or summary statistic from monitoring data to account for uncertainty associated with sampling frequency

- SBF can be applied to summary statistics from less than daily monitoring data to ensure that at least X% percent of the time, the SBF-adjusted monitoring concentration (i.e., measured concentration x SBF) is equal to or higher than the true unknown parameter.
  - Currently SBF is developed such that at least 95% percent of time, the SBF-adjusted monitoring concentration is equal to or higher than the true concentration
Tier 3 Results, Next Steps

- Multiple exposure sites representing crop and/or regions
- Highest modeling or SBF adjusted measured pesticide concentration provided as point estimate or distribution to HED on regional basis

- All concentrations < DWLoC
  - no additional work necessary

- Some concentrations < DWLoC and some concentrations > DWLoC
  - Only sites, sub-regions, or regions with concentrations > DWLOC go to Tier 4*

- All concentrations > DWLoC
  - go to Tier 4*

* if data allow
Tier 4

• Modeling (Spatial Aquatic Model)
  • Geographically-specific conditions (e.g., soil, weather) coupled with actual waterbodies
    • Currently not available, on-going method development

• Monitoring
  • SEAWAVE-QEX analysis on all sites (nationwide to capture known variability)
    • Map showing analysis sites relative to potential use sites and community water system intake locations/watersheds
  • Chemical specific sampling bias factors when data meet sample criteria
    • Map showing analysis sites relative to potential use sites and community water system intake locations/watersheds
SEAWAVE-QEX Model

- Time series model developed by USGS
  - Relates measured pesticide concentrations with daily streamflow (or other covariate) using a seasonal wave model to produce multiple, equally-probable simulations of daily concentration data
  - Developed to estimate “extreme” concentrations using stream flow (i.e., developed for flowing systems)

- Minimum requirements of the model
  - ≥ 12 samples/year with 3 years of data
  - ≤ 75% censoring rate

Tier 4 Results, Next Steps

- Site-specific pesticide concentrations
- SEAWAVE-QEX chemographs and SBF adjusted point estimates to HED

- All concentrations < DWLoC
  - no additional work necessary

- Some concentrations < DWLoC and some concentrations > DWLoC
  - assessment stops with combination of estimated pesticide concentrations from modeling and monitoring

- All concentrations > DWLoC
  - assessment stops with combination of estimated pesticide concentrations from modeling and monitoring
Future Directions

• FIFRA SAP in 2019 (TBD)
• White Paper
  • Evaluation of SEAWAVE-QEX
  • Development and evaluation of short-term (1-, 4-, and 21-day) and long-term (365-day) SBFs for use in drinking water assessments for pesticides with cancer and non-cancer toxicity
  • Development and evaluation of watershed regression equations
• Drinking Water Assessment Framework
• Case Studies
  • Cancer and non-cancer