Pesticide Use Data in Water Quality Modeling

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Role of Pesticide Use Data

\[
\int_0^t [U(\tau) \cdot LAPU(t - \tau)] d\tau = L(t)
\]

U = Pesticide use rate (kg/day)
L = Pesticide loading (kg/day)
LAPU = Loading as percent of use (dimensionless)
# Temporal and spatial scales

<table>
<thead>
<tr>
<th>PUR</th>
<th>Water quality models</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporal</strong></td>
<td></td>
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<tr>
<td>Agricultural: Daily</td>
<td>Landscape processes: Daily</td>
</tr>
<tr>
<td>(application time reported)</td>
<td>In-stream processes: Sub-daily</td>
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<tr>
<td>Urban: Monthly</td>
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<tr>
<td><strong>Spatial</strong></td>
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<tr>
<td>Agriculture: Section (2.56 km²)</td>
<td>Watershed models: 1,000 km²</td>
</tr>
<tr>
<td>Urban: County (1,000 ~10,000 km²)</td>
<td>Field-scale models: ha ~ km²</td>
</tr>
<tr>
<td></td>
<td>Fine-resolution models: m²</td>
</tr>
</tbody>
</table>
I. Watershed modeling

Lower San Joaquin River Watershed, 15,000 km²
Orestimba Creek watershed, 500 km²
Chlorpyrifos: monthly uses in the lower San Joaquin River watershed, and monthly dissolved loads for the San Joaquin River at Vernalis (Luo et al., 2008)
Chlorpyrifos: Observed and predicted dissolved concentrations at the watershed outlet of Orestimba Creek (Luo & Zhang, 2009)
II. Field-scale modeling

Surface flows (water, sediment, & pesticide)

Subsurface flows (water & pesticide)

Edge-of-field flows

(From Waichler et al. 2004)
Natural vs. “computational” fields

PUR Sections and DWR landuse map
Geo-referencing

• Spatial information in PUR
  – site_code, site_loc_id
  – acre_planted and acre_treated

• Mapping with landuse data
  – DWR landuse survey database
  – Local survey (e.g., Westside Coalition)
  – Remote sensing data (e.g., Google Earth)

• Example: 7.4 million fields are defined for the Central Valley (Williams, 2011)
PUR records for 50M06S08E26

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*Site_code*: 15001 (BEANS, DRIED-TYPE), 3001 (ALMOND), 3009 (WALNUT), 23001(ALFALFA).
Dissolved concentrations of diazinon (top) and chlorpyrifos (bottom) in soil, section M06S08E26 (Luo & Zhang, 2009)
Pesticide loads from fields

The load as percent of use (LAPU) values for (a) diazinon and (b) chlorpyrifos over the Orestimba Creek watershed, 1992-2006 average (Luo & Zhang, 2009)
LAPU for chlorpyrifos over Central Valley, 2003-07 (Luo & Zhang, 2010)
Summary

- Types of PUR-related WQ modeling studies
  - Watershed modeling,
  - Field-scale modeling,
  - Drift estimation, urban PUR downscaling, and more...

- Modeling capability of pesticide WQ models depends on the availability, accuracy, and resolution of application data;

- Future development of WQ models should incorporate spatial analysis on chemical applications;

- Modeling of WQ protection also provides information/suggestions for PUR development.
References: PUR in WQ modeling

Thank you

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