Dynamic modelling of pesticide fluxes to surface waters using SWAT

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Problem statement

how important are direct losses
should we add them to SWAT?
Case study

• location

- small basin: 34 km², 16 km long, $t = 1$ day
- well documented
- studied in detail for pesticide application: 1998-2002
Case study

<table>
<thead>
<tr>
<th>teelt</th>
<th>% opp.</th>
<th>pesticide</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGBT</td>
<td>10.34</td>
<td>→ chloridazon</td>
</tr>
<tr>
<td>CORN</td>
<td>15.09</td>
<td>→ atrazine</td>
</tr>
<tr>
<td>WATR</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>WWHT</td>
<td>21.53</td>
<td>→ isoproturon</td>
</tr>
</tbody>
</table>
→ highly dynamic system with hourly variations
→ due to runoff but also to direct losses
Modelling pesticide fluxes

Sensitivity analysis:

**hydrology**
- CN2
- rchrg_dp
- surlag
- GWQMN
- ESCO
- GW_DELAY
- sol_z
- ALPHA_BF
- GW_REVAP
- SMFMX
- SOL_AWC
- canmx

**pesticide supply**
- CN2
- rchrg_dp
- surlag
- GWQMN
- ESCO
- GW_DELAY
- apfp_pest
- hlfs_pest
- Koc_pest
- hlff_pest
- wofp_pest
- pwsol_pest
Modelling pesticide fluxes

hydrology

1/11/98  1/11/99  1/11/00  1/11/01
Modelling pesticide fluxes

→ acceptable agreement
→ direct losses are lacking
Adjustments to SWAT

**Insertion in the apply.f –file:**

if (k == irtpest) then
    drift(jj) = drift(jj) + xx * (1-ap_ef(kk))* hru_km(j) * 100. * 1.e6
end if

xx = xx * ap Ef(kk)

*with:* xx : amount of pesticide applied to HRU
ap Ef : application efficiency
hru Km : area of HRU

**Insertion in the virtual.f-file:**

varoute(11,ihout) = wsolp(sb) +drift(sb)
Modelling results: subbasin 25
Modelling results: subbasin 25

![Graph showing atrazine supply, rainfall, and losses over time from 1/03/98 to 1/10/98.]

- Atrazine supply (kg/day) ranges from 0.0 to 2.0.
- Rainfall (mm) ranges from 0 to 30.
- Dates from 1/03/98 to 1/10/98 are shown on the x-axis.

Legend:
- Blue: diffuse
- Red: direct losses
- Light blue: rainfall
Modelling results: subbasin 25
Modelling results: mouth of the river

Diagram showing the concentration of atrazine over time at the mouth of the river, with dates from January 3, 1998, to January 10, 1998. The x-axis represents the date, and the y-axis represents the concentration of atrazine (µg/l). The graph includes lines for diffuse, direct losses, rainfall, and measured values.
Conclusions

- direct losses can contribute for 50 to 70% of pesticide load
- sensitivity analysis → sensitive parameters
- calibration of pesticide supply with SWAT2000 gives reliable predictions
- in dry periods: → extension of SWAT code ↓ better results
- what happens in routing towards the mouth?
questions ?