Landscape level exposure assessment of pesticide concentration at drinking water abstraction points— a study on spatio-temporal controls using SWAT

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Introduction
Surface water (SW) is an important source for drinking water (DW) supply in many European countries (ca. 35 %). The effect of drinking water treatments on plant protection products is a data requirement in the EU regulatory framework (1107/2009); one specific aspect is the exposure assessment at DW abstraction points. However, no generic guidance is available. The only EU-known approach is the national approach of the Netherlands (DROPLET [1]), a simplistic but very solid first Tier approach taking into account edge-of-field PEC\textsubscript{soy}, cropping area, use intensity, and other impact factors. However, the calculation of the mixing factor (from edge-of-field to the drinking water abstraction point) so far mainly considers highly simplified worst-case assumptions. Our work explores the mixing factors at landscape level to get a better insight into more realistic scenarios using the Soil and Water Assessment Tool (SWAT). Particular focus was on the controlling factors of pesticide and water transport in connected surface water systems, for example application timing, weather forcing, dissipation and entry path (runoff, drainage) into the water system.

Theory & Methods

Impact Factors

![Diagram showing impact factors affecting surface water mixing in a stream network.]

Moreover, substance properties (e.g. dissipation, sorption), catchment characteristics (e.g. hydrology, climate, soil, crop area), abstraction type (e.g. bank infiltration, reservoir abstraction) and market share have a high impact. (adapted from [1])

Simulation Scenarios
A1: Tracer stream inflow (1 kg/ha agr. area) with simultaneous applications (1\textsuperscript{st} May), no degradation.
A2: Tracer stream inflow (1 kg/ha agr. area) with appl. window (1\textsuperscript{st} May ± 5 days), no degradation.
B1: Tracer simultaneous field application (1 kg/ha agr. area, 1\textsuperscript{st} May), no degradation.
B2: Tracer simultaneous field application (1 kg/ha agr. area, 1\textsuperscript{st} May), with degradation in soil.

Mixing Factor Calculation

\[ MF_t = \frac{c(\text{Tracer})_{\text{pot},t}}{c(\text{Tracer})_{\text{outlet},t}} \]

where \( MF_t \) is the mixing factor at time \( t \) between the potential tracer concentration \( c(\text{Tracer})_{\text{pot},t} \) [mg/m\(^3\)] and concentration \( c(\text{Tracer})_{\text{outlet},t} \) at the subbasin outlet.

Conclusions

- SWAT is a promising tool to explore key factors of vulnerable areas in potential drinking water catchments at high spatial resolution on EU, regional or local level.
- With more realistic processes and application patterns in the model, the mixing factor increases substantially for the entry pathway runoff and drainage.

Outlook

- Derivation of mixing factors for selected/representative crop-based drinking water catchments with the help of further SWAT tracer experiments.
- Exploration of drift entry path way and its effects on mixing factor.

References