SITE- AND USE-SPECIFIC RISK ASSESSMENT FOR PESTICIDE INPUTS VIA DRAINAGE AND RUNOFF INTO GERMAN SURFACE WATERS

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Introduction

The contamination of surface water bodies with agricultural pesticides can pose a significant threat to aquatic ecosystems. The aim of this work was to develop a site- and use-specific risk assessment approach for pesticide inputs into surface waters via drainage and runoff. This approach constitutes the basis for a web-based decision support tool for farmers and advisors (on www.ISIP.de).

Materials and Methods

Drainflow calculations were performed with MACRO 4.3b. A scenario-based approach was used with 8 drainage-relevant soil classes and 19 soil/climate scenarios. Simulations were performed for 109 different active ingredients and 229 uses registered in Germany. For the runoff simulations (185 a.i. and 446 uses) the model PRZM 3.21 was employed. Again, a scenario-based approach was chosen, comprising 5 soil classes with different runoff susceptibility, 8 climate scenarios with different probability of high-intensity rainstorms, and 20 different weather years per climate. The maximum daily pesticide loss over the simulation period (and the corresponding date and drainflow/runoff volume), together with regional variables, served as the basis for the calculation of maximum initial PEC_{sw} (Predicted Environmental Concentrations in surface water). The PEC_{sw} obtained refer to the outlet of a small catchment with about 10 (1-100) km^2 area. The higher of both concentrations ($PEC_{sw,Runoff}$ and $PEC_{sw,Drainage}$) is compared with the acute aquatic "maximum tolerable concentration" for the respective pesticide.

Results and Discussion

In most cases, $PEC_{sw,Runoff}$ were on average higher than $PEC_{sw,Drainage}$ for the same use (cf. Fig. 2). There were large differences in PEC_{sw} not only between different uses and input paths, but also between different regions in Germany (Fig. 1). The need for a regionally differentiated exposure and risk assessment is therefore evident.

Conclusions and Outlook

As the developed risk assessment approach includes the influence of regional factors on the predicted concentrations, it allows to create risk maps for Germany as well as to carry out a Germany-wide probabilistic risk assessment for a given use. Thus, it can provide a viable basis for improving the regulatory practice in Germany.

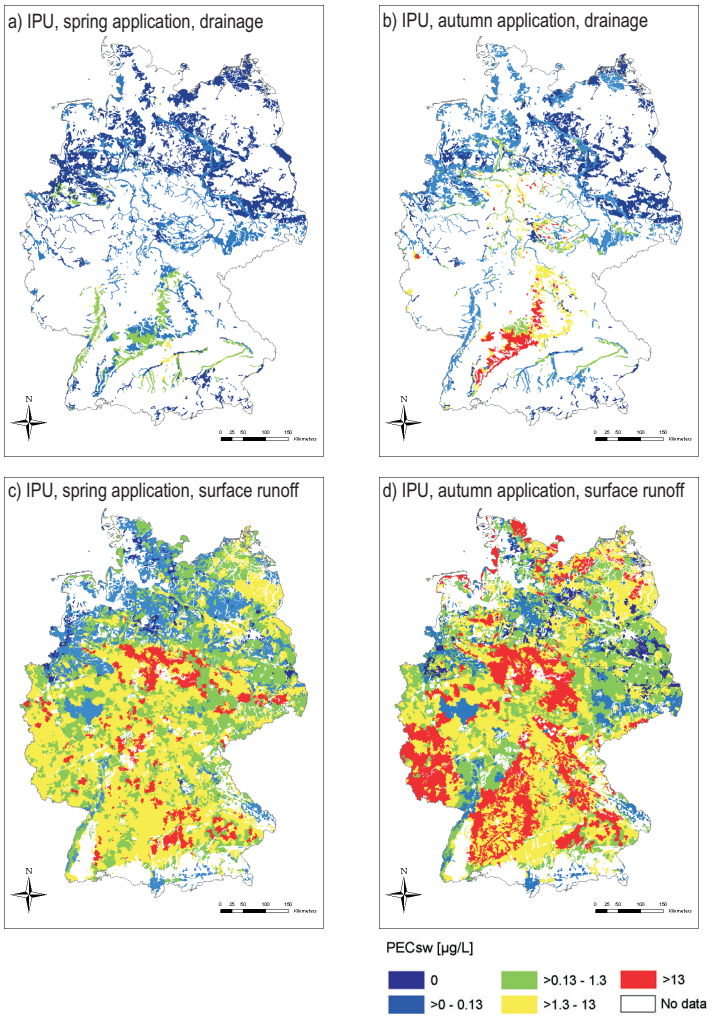

Fig. 1: PEC_{sw} (maximum initial concentrations in the receiving surface water body) for isoproturon in winter cereals: a) due to drainage inputs after spring application, b) due to drainage inputs after autumn application, c) due to surface runoff inputs after spring application, d) due to runoff inputs after autumn application. The runoff PEC are based on the 90th percentile year with respect to maximum daily runoff loss.

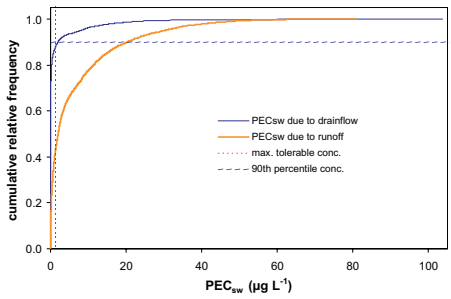

Fig. 2: Cumulative frequency distribution of PEC_{sw} over all soil/municipality combinations due to drainage and surface runoff inputs for isoproturon in winter cereals, autumn application. The vertical dashed line indicates the maximum tolerable aquatic IPU concentration (1.3 µg L^{-1}), and the horizontal dashed line the 90th percentile of the distributions.

References:
Reichenberger, S. (2005): Field-scale risk assessment for diffuse-source pesticide inputs into German surface waters. PhD thesis, Univ. Giessen. ISBN 3-931789-41-1

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