O.54 - The GIS-based tool SYNOPS is used to analyse the regional environmental risk in fruit growing regions

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Abstract

The development of new and innovative strategies of pesticide use in orchards may contribute strongly to an overall reduction of the environmental risk. To quantify the impact of new strategies on the environmental risk and to analyse the risk-behaviour of farmers it is mandatory to assess the risk potential in the context of the landscape. For this purpose it is planned to apply the GIS-based risk assessment tool SYNOPS in four selected pomefruit regions in Europe, which differ in respect to the intensity and innovation of pesticide use. The availability of input data for this approach still has to be assured for the selected case study regions. As an example to demonstrate the method and the approach to assess the impact of innovative strategies on landscape level SYNOPS has been applied to fruit growing regions in Germany in combination with field based surveys for pesticide use. The risk potential of the strategies commonly used in each of the fruit growing regions is aggregated in spatial dimension and visualized in risk maps. The impact of future strategies will be assessed by replacing common strategies under certain assumptions and recalculating the risk potentials for the regions. In combination with repetitively conducted surveys, the temporal development of the regional risk potentials was analysed.

Introduction

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As an example to demonstrate the method and the approach to assess the impact of innovative strategies on landscape level, SYNOPS has been applied to fruit growing regions in Germany in combination with field-based surveys for pesticide use. The risk potential of the strategies commonly used in each of the fruit growing regions is aggregated in spatial dimension and visualised in risk maps. The impact of future strategies will be assessed by replacing common strategies under certain assumptions and recalculating the risk potentials for the regions.

Methodology

The risk assessment model SYNOPS [1] calculates predicted environmental concentrations for soil, surface water and non target plants on a daily basis following a temperature dependent degradation of the active ingredients. It considers the interception on the crop and the input pathways spray drift for the terrestrial indicators and spray drift, surface run-off and drainage for the aquatic indicators. From the daily environmental concentrations the short-term (*sPEC*) and long-term exposure (*lPEC*) are derived. The acute and chronic risk potentials are calculated as the ratio of exposure to toxicity (*ETR*) for three reference species (Daphnia, fish and algae) in aquatic systems and two species (earthworm and bee) for terrestrial systems.

The regional risk assessment relies on a GIS database, which includes all necessary environmental parameters at field level to estimate the environmental exposure by drift, run-off and drainage. The database was established by merging information via GIS procedures from an extended geographical dataset (ATKIS) [2], a digital soil map (BÜK1000), a digital elevation model (DGM-d) and a set of 430 climate stations (DWD).

The pesticide use data is available from field based surveys in 12 fruit growing regions for 5 different fruits and three years (NEPTUN) [3]. This high level of data availability enables us to calculate acute and chronic risk potentials at field level for all major fruit growing regions in Germany. For this study three fruit growing regions in Baden-Württemberg were selected.

Results and Discussion

Three fruit growing regions and the corresponding statistics for 2003 are summarised in Table 1.

The risk potentials were calculated for all fields within these regions. Table two shows the summarised acute risk potential for the three regions. Detailed statistical analysis has been conducted on smaller regional scales, at community level or grid level (10*10km). These results are expressed in risk maps for the fruit growing regions and are the basis of identifying regions with high risk potential.

The impact of product specific buffer zones on the environmental risk potentials is shown on a regional scale. An evaluation of the active ingredients, which trigger high risk potentials, has been conducted. In combination with repetitively conducted surveys the temporal development of the regional risk potentials was analysed.

Table1: Area and statistics of fruits cultivated in three fruit growing region of Baden-Württemberg.

	area	farmers	fields	apple	pear	sweet cherry	sour cherry	plums	other
	[ha]	n	n	% of area					
Rheinebene	5743	3937	6615	0.32	0.05	0.31	0.02	0.28	0.03
Lake Constance	7092	1675	4135	0.89	0.04	0.03	0.01	0.03	0.00
Neckartal	1583	1048	1848	0.78	0.09	0.05	0.03	0.03	0.02

Table2: Statistical evaluation of calculated acute risk potentials for the aquatic reference specie in three fruit growing regions. Shown are the 50th and 90th percentiles and percentage of area with ETR values >1

	acute risk for Daphnia			acute risk for algae			acute risk for fish		
	P50	P90	%area>1	P50	P90	%area>1	P50	P90	%area>1
Rheinebene	0.0064	0.0709	2.97	0.0064	0.2659	2.10	0.0081	0.1382	2.20
Lake Constance	0.0092	0.0564	1.11	0.0182	0.2557	0.14	0.0108	0.0480	0.40
Neckartal	0.0009	0.0483	1.33	0.0007	0.3041	1.96	0.0010	0.1004	0.83

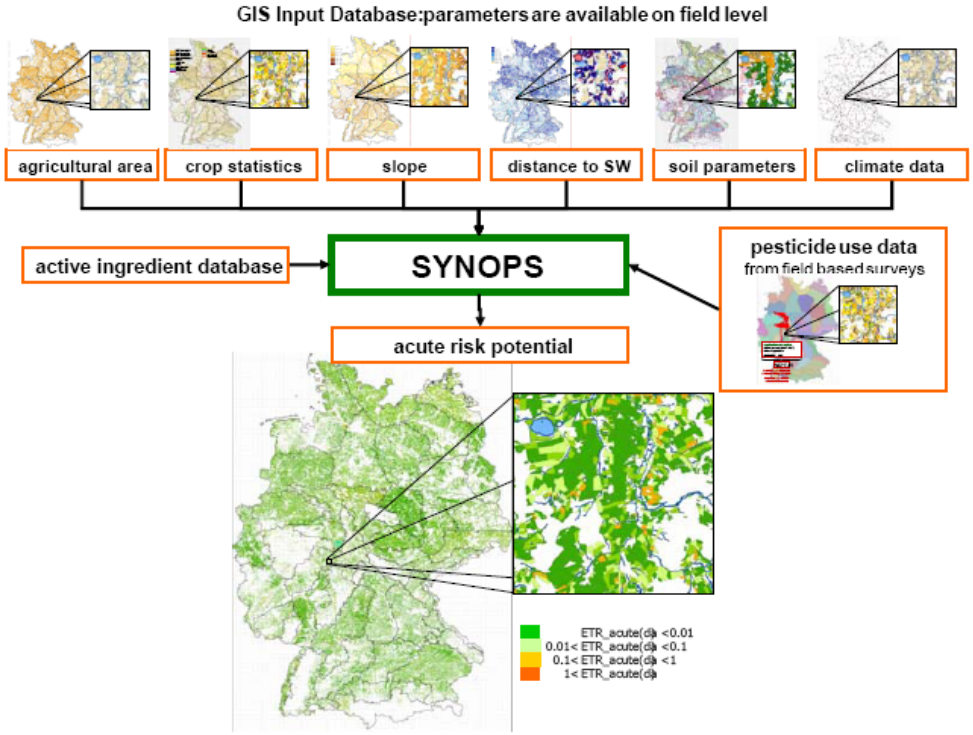

Figure 1: Gis-based risk assessment with SYNOPS. Input data are available on filed basis and risk potentials are calculated for single fields

Conclusions

The application of a GIS-based risk assessment tool enables us to assess the environmental risk of pesticide use in orchards in the context of different landscapes. The results imply that not only differences in pesticide use are responsible for the difference in the environmental risk. Also different landscape structures are important factors influencing the impact of pesticide use on the environment. The lower level of pesticide use in the region Rheinebene due to a lower proportion of apple and a higher proportion

of stone fruit production does not result in lower risk potentials. One reason for this is the significantly higher proportion of standing surface waters in this region.

Using this system the environmental risk within the different landscapes can be recalculated assuming certain changes in the behaviour of farmers. An analysis of the impact of novel and non-chemical crop protection strategies for orchards on the environmental risk in the context of different landscapes will be conducted. An important task of the future work in RA3.3 will be the application of SYNOPS to other European pomefruit regions.

References

Gutsche V. & Strassemeyer J (2007) SYNOPS - ein Modell zur Bewertung des Umwelt-Risikopotentials von chemischen Pflanzenschutzmitteln, Institut für Folgenabschätzung im Pflanzenschutz, Biologische Bundesanstalt für Land- und Forstwirtschaft

AdV. (2002): ATKIS-Objektartenkatalog - Erläuterungen zu allen Teilkatalogen, Version 3.1. Arbeitsgemeinschaft der Vermessungsverwaltungen,

Roßberg, D., H. Eckert, and U. Gernand, (2005): Farm assessment regarding the environmental sustainability. Part: quantitative assessment of the intensity of applications of plant protection products. Nachrichtenblatt des Deutschen Pflanzenschutzdienstes, 57(6), p. 121-125