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D1.6

A GIS based model approach to assess environmental risk and risk to human health risk on regional level

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1. Summary

The European agricultural policy requires the implementation of Integrated Pest Management (IPM) by 2014. This includes that use of synthetic pesticides must be carefully managed in order to minimise environmental risks.

The present deliverable is about the development of a novel web-based tool for environmental risk assessment considering regional environmental and field conditions based on the methodology of the risk indicator model SYNOPS. The aim was to develop an online application in order to make the indicator SYNOPS available as an easy-to-use online tool, which can be used by farmers, advisors and stakeholders for risk analysis and comparison of single pesticides application strategies under region specific environmental and field conditions. Within the EU project PURE, SYNOPS-WEB was applied for ex-ante and ex-post assessment of the newly designed IPM strategies for the different crops in WP2-7.

The user of this newly developed tool can select a certain field by using a map-service, choose a crop to be treated and enter the pesticide applications to be tested. With the field selection, SYNOPS-WEB will automatically extract the field and environmental parameters which are necessary to assess the aquatic and terrestrial risk from the soil geographical database of Eurasia, a database on the soil erodibility and a generalised land-use map, which lists the most important land-use types (annual crops, grass, permanent crops and rice). In addition, interpolated datasets for mean monthly temperature and precipitation are linked for meteorological input parameters. Furthermore, a database of about 500 active ingredients and a dataset of all registered pesticides in Germany are linked to the tool. Using these datasets, the user can easily choose an active ingredient or products to be applied and enter the application date, rate, area and the type of equipment used. SYNOPS-WEB then calculates and displays risk indices in the form of tables or charts per active ingredient or for the complete pesticide use strategies. These results can be downloaded as Excel-tables, XML-files or as report files.

2. Objectives

The European agricultural policy required the implementation of Integrated Pest Management (IPM) by 2014 in all agricultural systems of states members. As defined by IOBC (“International Organisation for Biological and Integrated Control”, <http://www.iobc-wprs.org/>) guidelines (Malavolta and Cross, 2009), IPM aims at improving the environmental efficiency of protection strategies by promoting the use of alternative methods (e.g. mechanical weed control) and non-synthetic active ingredients (e.g. microbiological products against moths), whereas the use of synthetic pesticides is permitted as last resort or under conditions. However the results of a survey among the European partners of the FP7-Project PURE (“Pesticide Use-and-risk Reduction in European farming systems with Integrated Pest Management”, <http://www.pure-ipm.eu/>) reveal low adoption of non-chemical tools such as granulosis virus, mating disruption and sanitation in fruit production as was already found during the ENDURE Network of Excellence (<http://www.endure-network.eu/>). Consequently, there is still a high potential to reduce pesticide use. This reduction requires the implementation of existing non-chemical tools as well as innovative methods to be integrated into a management strategy that would target all major animal pests, diseases and weeds. Initiatives such as the European research project PURE have been launched to help design such innovative farming systems.

The overall objective of PURE was to provide practical IPM solutions to reduce reliance on pesticides in selected major farming systems in Europe. Therefore, the mission of PURE was to provide IPM solutions and a practical toolbox for their implementation in key European farming systems. The strategy established in the framework of the PURE project was to combine existing methods with new tools and technologies into novel IPM solutions addressing the biological, agronomical and economic diversity in Europe. The process relies on a design-assessment-adjustment cycle aiming at ensuring continuous validation and improvement of the IPM solutions (Figure 1).

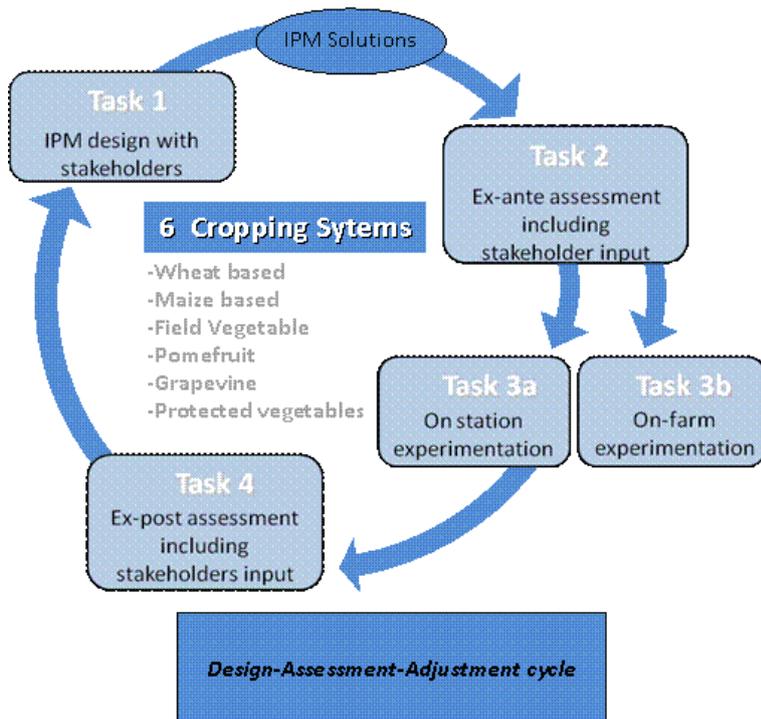


Figure 1: PURE strategy of design-assessment-adjustment cycle for validation and improvement of the integrated pest management (IPM) solutions.

During PURE, the environmental, economic and social sustainability of the IPM solutions were assessed in most work packages *ex-ante* (i.e. before testing) and *ex-post* (i.e. after on-station and on-farm experiments). *Ex-ante* and *ex-post* assessments were performed using the multi-criteria assessment tool DEXiPM complemented by an environmental risk assessment tool considering region specific environmental scenarios, SYNOPSIS-WEB, which was developed within WP 1 and is described in this deliverable. Results and comparisons of these assessment models are used to assess the different IPM tools and solutions in their efficacy (pest/disease/weed injury, yield/quality losses, and pesticide applications), cost benefit ratio, pesticide residue levels and their environmental risk.

In WPs 2-7, the *ex-post* assessments were performed using the multi-criteria assessment tool DEXiPM complemented by the risk assessment tool SYNOPSIS-WEB, which was based on Geographic Information Systems (GIS).

The present deliverable details the process of development, the tool structure, the description of the underlying data and the implemented methodologies of the current version of SYNOPSIS-WEB. It gives a short overview on how to use SYNOPSIS-WEB and lists some example results.

3. Deliverable procedure

3.1. Risk assessment with SYNOPS

Since published in 1997 (Gutsche and Roßberg, 1997) SYNOPS was developed within national (Gutsche and Roßberg 1999) and European projects (Gutsche 2004). The model evaluates the risk potential for terrestrial (soil and field margin biotopes) and aquatic (surface water) organisms. It combines the use of data on pesticides (chemical, physical and ecotoxicological properties) with the environmental conditions of the application. The exposure of organisms is calculated by sub-models for the different exposure pathways. The combination of GIS data on land use, climate and soil data in the current version of SYNOPS makes it possible to assess the environmental risk of plant protection strategies on landscape level (Strassemeyer & Gutsche, 2010). Since 1996, SYNOPS is in addition used on national level to track the trend of pesticide risks in Germany on the basis of data on sales or aggregated pesticide use data (Gutsche and Strassemeyer 2007). The model is integrated in the national action plan for pesticide risk reduction. The existing versions of SYNOPS are tools for experts since they require knowledge in pre- and post-processing of input and output data.

The aim of this deliverable within WP1 was to develop a SYNOPS version which can be used by non-experts, based on the methodology and algorithms of the existing tool SYNOPS methodology. In order to accomplish this, we decided to develop a new web-based version of SYNOPS called SYNOPS-WEB. In the next sections an overview of the methodology of SYNOPS is given.

3.2. Assessment of the acute and chronic risk

In general, the risk indices are calculated as exposure toxicity ratios (ETR) for reference organisms in three compartments: soil, surface water and field margin biotope. These organisms are earthworms for soil, bees for field margin biotope and daphnia, algae, lemna, fish and chironomus for surface water.

SYNOPS estimates for each pesticide application the load of the active ingredient (a.i.) into the soil, field margin biotope and surface water. Based on the estimated load of a.i.'s a time dependent curve of the predicted environmental concentration (*PEC*) is derived considering a temperature dependent degradation according to a first order kinetics.

Loads and *PEC*'s of active ingredients into the soil are caused directly by pesticide application considering the interception of the crop. The drift into field margin biotopes is estimated by taking into account the distance from the field to the biotope, as well as the size and structure of the particular biotope. The loads and *PEC*'s in the surface water depend on the minimal distance from the field edge to the edge of the surface water, on the surface water type and dimension, on the slope and on the soil parameters like texture and organic carbon content. The assessed exposure pathways into the surface water are spray drift, run-off & erosion, and drainage (Figure 2).

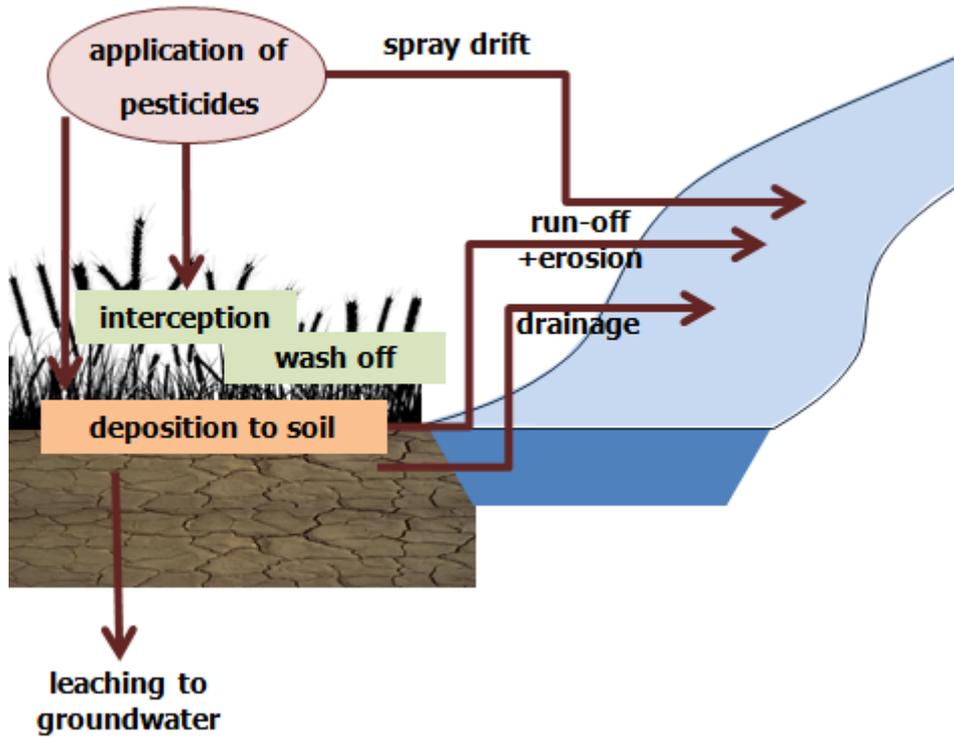


Figure 2: Exposure pathways considered in SYNOPS

From the time dependent concentration curves the short-term (*sPEC*) and long-term environmental concentration (*IPEC*) are derived. The maximum concentration (*CT*) over a vegetation period (*sPEC*) is used to calculate the acute risk potential for one active ingredient (Equation 1). To estimate the chronic risk potential, an integral over a time interval of $\Delta t = 7$ days is calculated on a daily basis (Equation 2). The maximum of these integrals is then considered for the chronic risk potential for an active ingredient.

$$sPEC = \max_{t=1}^{t=365+\delta_{ij}} CT(t) \quad \text{Equation 1}$$

where δ_{ij} is the Kronecker delta ($i = j$ for bissextile years)

$$IPEC = \frac{1}{Dt} \max_{t=1}^{365} \int_{t-Dt}^t CT(t) dt \quad IPEC = \frac{1}{\Delta t} \max_{t=1}^{t=365+\delta_{ij}} \sum_{t-\Delta t}^t CT(t) \Delta t \quad \text{Equation 2}$$

where δ_{ij} is the Kronecker delta ($i = j$ for bissextile years)

As a measure of innocuity, the lethal concentration (*LC50*) and the no effect concentration (*NOEC*) are considered to estimate the acute and chronic risk potential (Equations 3 and 4).

$$ETR_{acute(species)} = \frac{sPEC}{LC50_{species}} \quad \text{Equation 3}$$

$$ETR_{chronic(species)} = \frac{IPEC}{NOEC_{species}} \quad \text{Equation 4}$$

All necessary physico-chemical and eco-toxicological parameters of the active ingredients ($n > 500$) are summarised in a database, which is continuously updated at JKI. A comparison of different a.i. databases used in other models like I-PHY (van der Werf and Zimmer, 1998; Bockstaller, 2004) or in the EU-Projects Footprint (Footprint, 2007) has been documented in ENDURE (2010).

The algorithms described above assess the risk caused by applying one single active ingredient on one specific field. When evaluating complete production systems, it is of interest to aggregate a.i. specific risk potentials to one value representing the complete application calendar with far more than one active ingredient. The acute risks indicator is describing the possible immediate harmful effects on the reference organisms. Therefore the acute risk is calculated in SYNOPSIS simply as the maximum risk event of all applied active ingredients, which then represents the risk of the complete application calendar.

The chronic risk assesses the possible harmful effects that are caused by mutable and prolonged exposure of the reference organisms. The procedure of aggregating the chronic risk for a complete application pattern is divided into two steps. In the first step the *ETR*-values (time-weighted-mean/*NOEC*) are calculated for each applied active ingredient on every day. These single *ETR*-curves are then summarised by adding the *ETR* values on daily basis according to the following function:

$$ETR_{chronic(species)} = \max_{d=1}^{365} \sum_{i=1}^i \frac{IPEC_{(d, active_i)}}{NOEC_{(species, active_i)}} \quad \text{Equation 5}$$

$$\text{where } IPEC(d, active_i) = \frac{1}{Dt} \int_{d-Dt}^d CT(t, active_i) dt \quad \text{Equation 6}$$

The risk indices for the surface water are calculated separately for the different reference organisms. The overall aquatic risk is defined as the maximum calculated risk potentials of the five aquatic reference organisms (fish; algae; lemna; daphnia and chironomus).

$$ETR_{chronic(aquatic)} = \max(ETR_{chronic(algae)}, ETR_{chronic(fish)}, ETR_{chronic(daphnia)}, ETR_{chronic(lemna)}, ETR_{chronic(chiron)}) \quad \text{Equation 7}$$

$$ETR_{acute(aquatic)} = \max(ETR_{acute(algae)}, ETR_{acute(fish)}, ETR_{acute(daphnia)}, ETR_{acute(lemma)}, ETR_{acute(chiron)})$$

Equation 8

In a similar way the terrestrial risk is calculated as follows:

$$ETR_{chronic(terrestrial)} = \max(ETR_{chronic(earthworm)}, ETR_{chronic(bee)})$$

Equation 9

$$ETR_{acute(terrestrial)} = \max(ETR_{acute(earthworm)}, ETR_{acute(bee)})$$

Equation 10

In addition to the terrestrial and aquatic indicators, a simple indicator for groundwater based on the Dutch indicator GEO-Pearl was implemented in the developed tool SYNOPSIS-WEB according to the procedures described in Krunje et al. (2014).

3.3. Risk assessment at a regional level

The tool SYNOPSIS-GIS is used to assess the environmental risk potential of plant protection strategies at a regional level using GIS functionalities by linking it to geo-referenced databases for land use, soil conditions and climate data and to a dataset of regionalised surveys on pesticide applications. The GIS databases were established by integrating all environmental information on field level which is necessary to estimate the environmental exposure by drift, run-off and drainage.

In Germany, the underlying data models on national level for the integration of environmental and field related input data for SYNOPSIS are an extended geographical dataset on land use (ATKIS, Adv 2001), a digital soil map (BÜK1000, BGR 1995), a digital elevation model (BKG, 2005) and a set of 430 climate stations of the German weather service (DWD). Using GIS procedures the exact location of orchards, vineyards, and arable fields and their connectivity to surface waters and other landscape objects are extracted on national level. The outputs of these procedures are the minimal distance from the edge of the field to the edge of the surface water and the mean width of the field margins.

The slope for each field is calculated by linking the ATKIS dataset to a digital elevation model (DGM-d). According to a digital soil map (BÜK1000) the main soil types for the region were identified and linked to the fields. The relevant biophysical parameters like the organic carbon content, the hydrological soil class or the texture of the soil are linked to the main soil types. Data on precipitation and temperature were available from stations of the German Weather Service. For each field the closest climate station was determined.

The information on the cultivated crops is not included in the ATKIS dataset. ATKIS differentiates only between permanent crops like vineyards, orchards and hops and arable crops. So for arable crops and orchards information on the crop or fruit cultivated on field level is achieved by random distribution of the crops on community level, according to the national crop statistics.

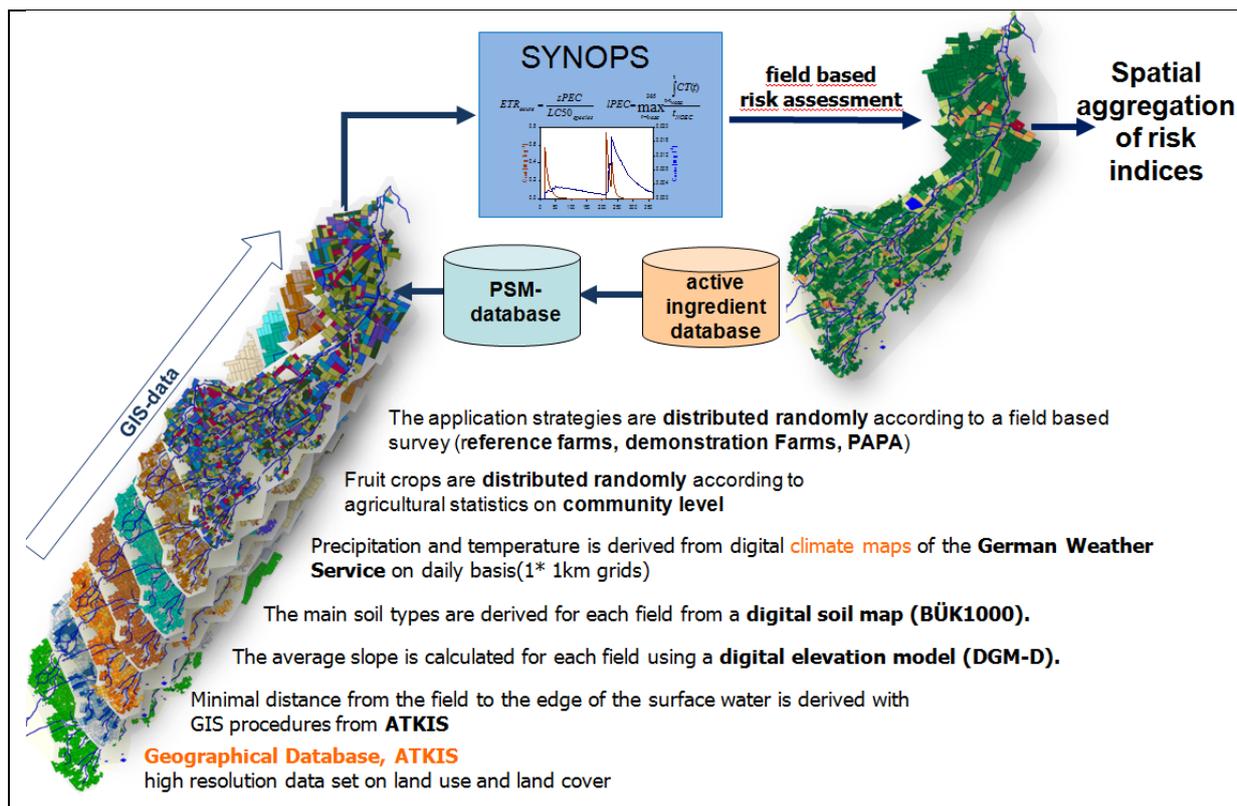


Figure 3: Overview on GIS- related input data and risk analysis with SYNOPSIS-GIS

The pesticide use data are available from field-based surveys, which were conducted at a regional level (Roßberg, 2004; Roßberg, 2013). The application strategies of these surveys are also distributed randomly to the fields according to the crop related to the field and according to the related region to the pesticide use survey.

This high level of data availability permits to accomplish a detailed regional risk analysis based on field level risk assessment for all agricultural regions in Germany. Figure 3 illustrates an overview of the GIS- related input data and the risk analysis with SYNOPSIS.

It was clear that this level of data availability would not be reached in all EU-Member states. Therefore we decided to integrate the input database of SYNOPSIS-WEP on grid (10*10 km² or 1*1 km²) and not on field level. The European soil map includes all necessary parameters for SYNOPSIS on 1*1 km² grid level and was implemented as a basis for the SYNOPSIS-Web database. Since no EU-wide information on surface water is available, it was decided to enter the parameters linked to surface water as scenarios.

3.4. Model Structure of SYNOPS-Web

Within the PURE work package WP1, the risk assessment tool SYNOPS-WEB was developed as an easy to use online-tool, which enables producers, advisors, policy makers and other stakeholders to evaluate and compare the potential environmental risk of pesticide application scenarios under realistic environmental site conditions.

The reasons for the decision to develop SYNOPS-WEB as an online tool rather than a stand-alone version, which has to be installed on a computer, were the following:

- **Easy availability**
no installation necessary, always accessible
- **Easy maintenance**
the tool SYNOPS-WEB and the underlying database are always available as actual version for all registered users, no updates necessary

SYNOPS-WEB was developed in Java using JSP, Hibernate for database integration, Java Sever Pages and Spring.

It consists of three separately modules: (1) a web based Graphical User Interface (GUI) with an embedded GIS application to support the user in entering site and application scenarios, in running the model and interpreting the calculated results; (2) a model application service including the Model Core Library (MCL) which contains the underlying models for environmental risk assessments interfaces; and (3), a database SQL-Database (ORACLE) to store entered site and application scenarios, including all necessary information on environmental conditions and pesticides

The web based GUI of SYNOPS-WEB and the model application service are linked to each other via a XML interface. This opens also the door for external tools to use SYNOPS results via this XML Interface. An example and description of the interface is given in Appendix I.

Within PURE such a linkage of an external tool has been accomplished with the tool Premise which was also developed within Pure WP1 and WP5.

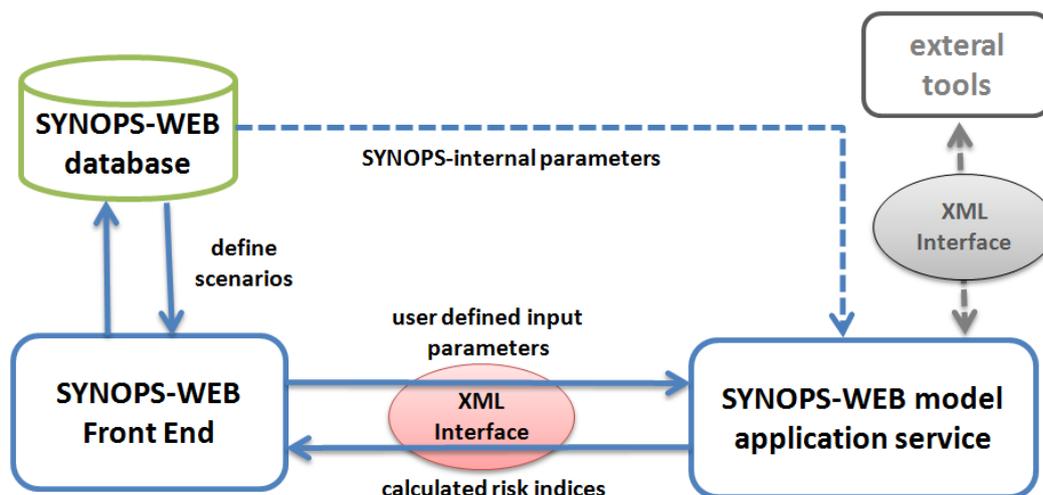


Figure 4: Structure of SYNOPS-Web

3.5. SYNOPS-Web database

The developed database SYNOPS-Web was established under Oracle 11c and is available through an external JKI-Sever. SYNOPS-WEB uses the Hibernate technology to communicate with the SYNOPS-WEB database. The user extracts the data from the database into the SYNOPS-WEB tool by simply clicking on the integrated GIS map.

The structure overview of the database is shown in Appendix I. The following data is included in the database:

1. user table

Includes username password and user specific information like name, institution and email-address

2. spatial data to select and define site scenarios covering the EU27 member states

All data for relevant soil parameters are based on the soil geographical database of Eurasia at a scale of 1:1000000 (Panagos et al., 2012).

The climate data consists of 12 maps containing the monthly mean precipitation (mm/month) and average temperature for the period 1960-1990 (Hijmans et al., 2005).

An overview of the extracted data from these to database is given in Figure 5.

3. data linked to products and active ingredients to define pesticide application scenarios

The German online product database (BVL 2015) is updated on monthly basis. This includes the registered application rates and all product specific mitigation measures for runoff and drift. The EPPO Code for 250 crops and 500 pest organism are included in the database.

The physico-chemical and toxicological properties are derived from the pesticide property database (PPDB). This is a comprehensive relational database of pesticide physicochemical and ecotoxicological data. It has been developed by the Agriculture & Environment Research Unit (AERU) at the University of Hertfordshire, from the database that originally accompanied the EMA (Environmental Management for Agriculture) software.

4. site and pesticide application scenarios which were defined by the user

All scenario data which was entered by the user is stored in this section of the database. This data can be edited by the user only.

5. additional parameters and information needed by SYNOPS-WEB model application service

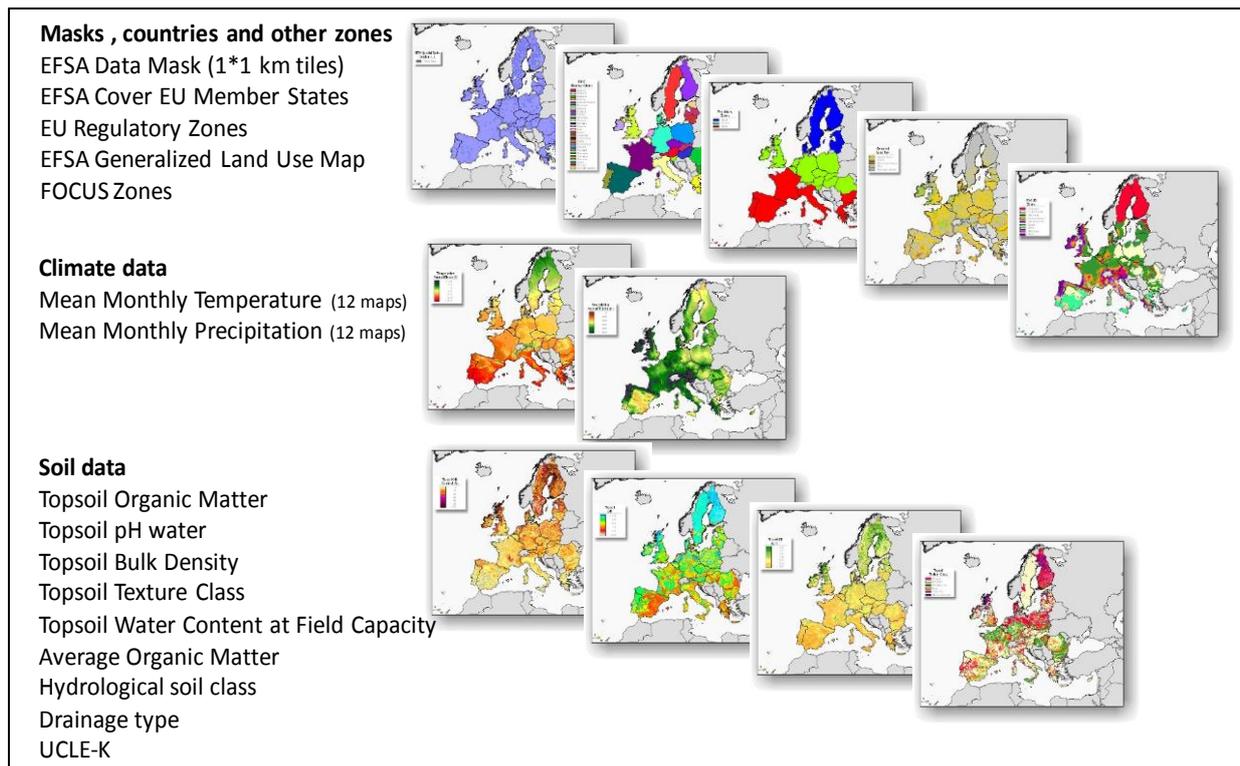


Figure 5: List of SYNOPSIS-WEB input data for soil parameters and climate.

3.6. Environmental Risk assessment with SYNOPSIS-WEB

The GUI of SYNOPSIS-WEB is available via internet under the following web site:

<http://sf.jki.bund.de/synopsis-web/>

SYNOPSIS-WEB is freely available for any registered user. An e-mail-address is given for registration on the home page. Once the user is logged in he/she can start entering his/her application scenarios.

In order to assess the environmental risk of a certain plant protection strategy under specific environmental and field conditions, the user has to follow a stepped approach:

Step 1: Define site scenario

The input data for the environmental scenarios are derived from EU-wide GIS maps for soil, climate and elevation. The environmental and soil data is selected by simply clicking in the map on the tile (1*1 km² or 10*10 km²) where your site is located. For the surface water (SW) parameters and the connectivity to surface water fixed scenarios are entered manually in the tool (distance to SW, width and depth of SW, SW type and filter strips for runoff). Also the selection of drift reducing elements (e.g. hedges) is possible.

Within PURE WP2-7 the site scenarios have been defined according to the typical realistic worst-case-condition within this the different regions.

Step 2: Define application scenario

The user enters first a tractor ride with the exact application date and the equipment properties. Linked to the tractor ride the date, type of equipment, drift reduction, percentage of area sprayed and buffer zones can be entered.

Then, the applied pesticides are then added to the tractor ride either as active ingredients or as products. The user has to enter the application rate of the product or active ingredient. All registered active ingredients are included in the database (products are only included for Germany). The input for the applied of plant protection products are entered by the partners of the different WPs conducting the on-station and on-farm experiments.

Step 3: Combine site- and application scenario

The entered site scenarios can be combined with any of the application scenarios. The selected input-data can be exported as excel files. A sample of the exported parameters is given in Appendix I.

Step 4: Calculate environmental risk

For all selected site and application-scenario-combinations the environmental risk indicators are calculated according to the underlying models for environmental risk assessments in the Model Core Library (MCL). The MCL of SYNOPSIS-WEB calculates the potential risk of chemical plant protection products for terrestrial and aquatic organisms and for the groundwater as described above.

3.7. Results of the environmental risk

In order to summarise and visualise the calculated risk indices, four risk classes were defined and given a specific colour (Table 1). The level of negligible risk for the chronic risk is considered to be $ETR=1$, which is equivalent to the no effect concentration (NOEC). For the acute risk an $ETR < 0.1$ is considered to be low risk. This is equivalent to the tenth of the concentration lethal to 50% of test organisms (LC50).

Table 1: Classes for the acute and chronic risk indices calculated with SYNOPSIS

risk classes of SYNOPSIS results	acute risk	chronic risk
very low risk	$ETR < 0.01$	$ETR < 0.1$
low risk	$0.01 < ETR < 0.1$	$0.1 < ETR < 1$
medium risk	$0.1 < ETR < 1$	$1 < ETR < 10$
high risk	$ETR > 1$	$ETR > 10$

The results can be viewed directly within the graphical user interface of SYNOPSIS-WEB as aggregated risk scores or as risk index for each reference organism separately. They can be viewed in form of tables or graphs or they can be exported as excel files. In Figure 6, an example of screenshot demonstrates how risk indices can be viewed within SYNOPSIS-Web. Table 2 gives an example of the exported aggregated risk scores for an apple orchard in Hungary.

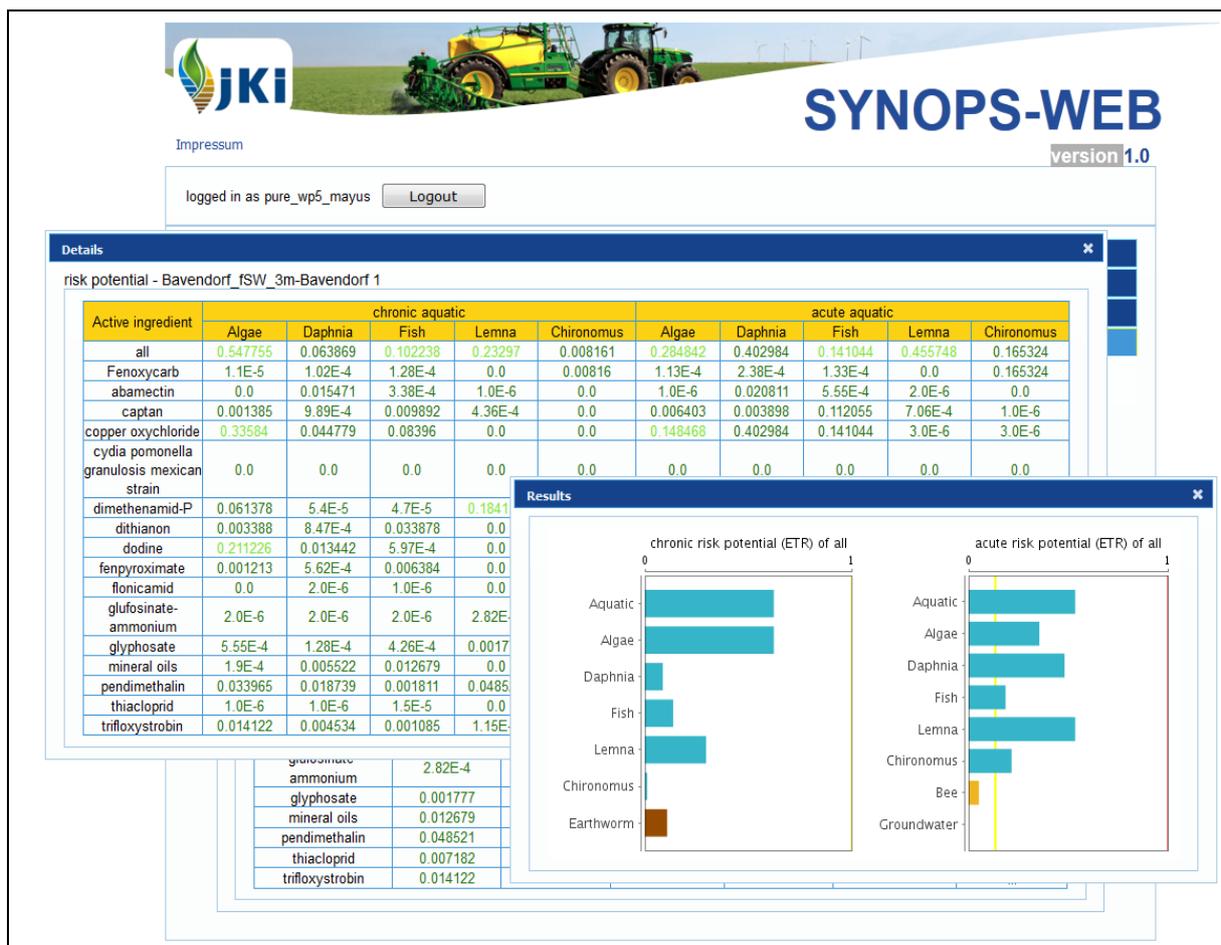


Figure 6: Sample screen shot of calculated risk indices.

Table 2: Comparison between acute and chronic risk in the baseline and the innovative cropping systems tested in Hungary orchards in 2013 against apple scab.

	Aquatic	Algae	Daphnia	Fish	Lemna	Chironomus	Terrestrial	Earthworm	Bee	Groundwater
Acute risk										
Baseline	3.554	3.554	0.553	0.307	0.004	0.050	0.007	0.004	0.007	0.171
Innovative	0.111	0.111	0.017	0.013	0.001	0.006	0.007	0.007	0.000	0.292
Chronic risk										
Baseline	1.841	1.841	0.128	0.229	0.003	0.005	0.090	0.090	0.070	0.034
Innovative	0.059	0.059	0.004	0.015	0.001	0.000	0.159	0.159	0.002	0.058

3.8. Conclusion

The final version SYNOPSIS-Web was officially launched in autumn 2013. Since then it has been successfully used within PURE for *ex-ante* assessments of the developed IPM strategies for wheat (WP2), maize (WP3), field vegetables (WP4), pomefruit (WP5) and grapevine (WP6). Within these WPs, SYNOPSIS-WEB contributed together with DEXIPM to improve and optimise the developed IPM strategies on the basis of environmental risks.

4. Annex I

4.1. XML-Interface

Example of a XML-input for SYNOPSIS-Web of the parameters describing a site (site), the pesticide applications (scenario) and a climate dataset (weather). Explanations are written in grey.

```

<input>
<site>
<climateScenarioId>2</climateScenarioId>      (Focus scenario, optional, only required if no
values for emergence,                          maturation, harvest, fallow are available)
<textureId>3</textureId>                       (see table below)
<drainageScenario>D4</drainageScenario>       (FOCUS Drainage scenarien, D4 für Poseidon)
<organicCarbonTopSoil>2.8</organicCarbonTopSoil> (in [%])
<organicCarbonSubSoil>1.6</organicCarbonSubSoil> (in [%])
<density>1.5</density>                        (in [kg/dm3])
<hsc>C</hsc>                                   (Hydrologic soil class A,B,C oder D)
<fieldCapacity>0,378</fieldCapacity>         Water content at field capacity of top soil [m3/m3]
<pH>6.5</pH>
<kFactor>1</kFactor>                           (für USLE)
<waterBodyWidth>1.0</waterBodyWidth>         (in [m])
<waterBodyDepth>0.3</waterBodyDepth>         (in [m])
<floatingWaters>>false</floatingWaters>        (Boolean)
<widthMargin>2.0</widthMargin>               (in [m])
<hedge>>false</hedge>                           (Boolean)
<slope>1.5</slope>                             (in [%])
<minDist>1.0</minDist>                        (in [m])
<runoffDist>0.0</runoffDist>                 (in [m])
</site>

```

Table for soil texture:

- 1: Coarse (18% < clay and > 65% sand)
- 2: Medium (18% < clay < 35% and >= 15% sand, or 18% < clay and 15% < sand < 65%)
- 3: Medium fine (< 35% clay and < 15% sand)
- 4: Fine (35% < clay < 60%)
- 5: Very fine (clay > 60 %)
- 9: No mineral texture (Peat soils)

Table for application type

GS	Vehicle ground boom and other downward spraying, Downward
GSUP	Outdoor upward spraying, Upward
ST	Seed treatment
GB	Granular broadcast, Downward, mechanical
GI	Granular incorporated, Downward, mechanical
LVM	Low volume misting
MANUAL	Handheld spraying, Downward
MANUP	Handheld upward spraying, Upward

<scenario>

<cropId>251</cropId> *crop (251=apple)*
 <takeDatesFromScenario>true</takeDatesFromScenario> *(optional, if true, then*
 <doYEmergence>130</doYEmergence> *doYEmergence, doYMaturation, doYHarvest +*
doYFallow are mandatory. <doYMaturation>248</doYMaturation> If false these values are taken
from the Focus scenario (climateScenarioId))
 <doYHarvest>298</doYHarvest>
 <doYFallow>305</doYFallow>
 <applications>

<application>

<aiId>3</aiId> *(Active ingredient number)*
 <ppp>Active_Name0</ppp> *(Name or number of the plant protection product)*
 <applicationRate>1000.0</applicationRate> *(Rate [g/ha])*
 <drivingSpeed>8.0</drivingSpeed> *([km/h], not considered)*
 <applicationDate>2009-01-01</applicationDate> *(date)*
 <sprayRestriction>0.0</sprayRestriction> *(drift reduction by sprayer [%])*
 <distanceRestriction>0.0</distanceRestriction> *(distance regulations to surface water [m])*
 <applicationType>GSUP</applicationType> *(see table above)*
 <applicationArea>100.0</applicationArea> *([%])*

</application>

<application>

<aiId>3</aiId>
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 <distanceRestriction>0.0</distanceRestriction>
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 <applicationArea>100.0</applicationArea>

</application>

<application>

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 <applicationDate>2009-03-03</applicationDate>
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 <distanceRestriction>0.0</distanceRestriction>
 <applicationType> GSUP </applicationType>
 <applicationArea>100.0</applicationArea>

</application>

<application>

<aiId>4</aiId>
 <ppp>Active_Name3</ppp>
 <applicationRate>100.0</applicationRate>
 <drivingSpeed>0.0</drivingSpeed>
 <applicationDate>2009-04-04</applicationDate>
 <sprayRestriction>0.0</sprayRestriction>
 <distanceRestriction>0.0</distanceRestriction>

```
<applicationType> GSUP </applicationType>  
<applicationArea>100.0</applicationArea>  
</application>  
</applications>  
</scenario>
```

```
<weather>  
<data month="1">
```

*Expected are 12 values (<data month=...>) or 365/366
daily values(<data doy=...>) for the weather*

```
<temperature>7.5</temperature>  
<precipitation>105.0</precipitation>  
</data>  
<data month ="2">  
<temperature>8.2</temperature>  
<precipitation>96.0</precipitation>  
</data>  
<data month ="3">  
<temperature>10.3</temperature>  
<precipitation>88.0</precipitation>  
</data>  
...  
</weather>  
</inputData>
```


4.3. Example of exported application scenarios

Table 3: Application Scenarios

Date	Appl. area [%]	Application method	Driving speed [km/h]	Drift reduction [%]	Product	PPP code	PPP Appl. Rate [g/ha]	Active ingredient	CAS-number	AI Appl. Rate [g/ha]	% of registered rate	Price [€/kg]	Price [€/ha]	Pest organism	Content [g/kg]
Scenario HR_apple_innovative															
Crop apple [MEDSA]															
Tractor rides	21	TFI	28	n AI	9										
2013-03-21	100	GSUP	8	90	SYLLIT	005427-00	2000	Dodin	2439-10-3	800	100	16,0 €	32,0 €		400
2013-03-28	100	GSUP	8	90	Merpan 80 WDG	004519-00	1000	Captan	133-06-2	800	100	11,9 €	11,9 €		800
2013-03-28	100	GSUP	8	90	Merpan 80 WDG	004519-00	1000	Captan	133-06-2	800	100	11,9 €	11,9 €		800
2013-04-05	100	GSUP	8	90	Delan WG	004424-00	600	Dithianon	3347-22-6	420	100	37,0 €	22,2 €		700
2013-04-05	100	GSUP	8	90	Scala	004225-00	750	Pyrimethanil	53112-28-0	300	100	42,3 €	31,7 €		400
2013-04-11	100	GSUP	8	90	Merpan 80 WDG	004519-00	1000	Captan	133-06-2	800	100	11,9 €	11,9 €		800
2013-04-11	100	GSUP	8	90	SYLLIT	005427-00	2000	Dodin	2439-10-3	800	100	16,0 €	32,0 €		400
2013-04-15	100	GSUP	8	90	Delan WG	004424-00	600	Dithianon	3347-22-6	420	100	37,0 €	22,2 €		700
2013-04-23	100	GSUP	8	90	Scala	004225-00	750	Pyrimethanil	53112-28-0	300	100	42,3 €	31,7 €		400
2013-05-03	100	GSUP	8	90	Merpan 80 WDG	004519-00	1200	Captan	133-06-2	960	100	11,9 €	14,3 €		800
2013-05-11	100	GSUP	8	90	Merpan 80 WDG	004519-00	1200	Captan	133-06-2	960	100	11,9 €	14,3 €		800
2013-05-11	100	GSUP	8	90	SCORE	004353-00	240	Difenoconazol	119446-68-3	60	100	78,6 €	18,9 €		250
2013-05-20	100	GSUP	8	90	Merpan 80 WDG	004519-00	1200	Captan	133-06-2	960	100	11,9 €	14,3 €		800
2013-05-20	100	GSUP	8	90	Discus	004331-00	200	Kresoxim-methyl	143390-89-0	100	100	0,0 €	0,0 €		500
2013-05-26	100	GSUP	8	90	Delan WG	004424-00	600	Dithianon	3347-22-6	420	100	37,0 €	22,2 €		700
2013-05-30	100	GSUP	8	90	SCORE	004353-00	240	Difenoconazol	119446-68-3	60	100	78,6 €	18,9 €		250
2013-05-30	100	GSUP	8	90	Delan WG	004424-00	600	Dithianon	3347-22-6	420	100	37,0 €	22,2 €		700
2013-06-10	100	GSUP	8	90	Merpan 80 WDG	004519-00	1200	Captan	133-06-2	960	100	11,9 €	14,3 €		800
2013-06-10	100	GSUP	8	90	Topas	033590-00	250	Penconazol	66246-88-6	25	100	56,3 €	14,1 €		100
2013-06-24	100	GSUP	8	90	Merpan 80 WDG	004519-00	1200	Captan	133-06-2	960	100	11,9 €	14,3 €		800
2013-06-24	100	GSUP	8	90	PPP c. trifloxystrobin		80	trifloxystrobin	141517-21-7	80	100	75,2 €	6,0 €		1000
2013-07-01	100	GSUP	8	90	Merpan 80 WDG	004519-00	1200	Captan	133-06-2	960	100	11,9 €	14,3 €		800
2013-07-16	100	GSUP	8	90	SCORE	004353-00	240	Difenoconazol	119446-68-3	60	100	78,6 €	18,9 €		250
2013-07-26	100	GSUP	8	90	Merpan 80 WDG	004519-00	1200	Captan	133-06-2	960	100	11,9 €	14,3 €		800
2013-08-13	100	GSUP	8	90	Merpan 80 WDG	004519-00	1200	Captan	133-06-2	960	100	11,9 €	14,3 €		800
2013-08-26	100	GSUP	8	90	Merpan 80 WDG	004519-00	1200	Captan	133-06-2	960	100	11,9 €	14,3 €		800
2013-10-21	100	GSUP	8	90	PPP c. copper oxychloride		1000	copper oxychloride	1332-40-7	1000	100	8,4 €	8,4 €		1000

4.4. Example of exported site scenarios

Table 4: Site Scenarios

	HU_Debrecen	NL_randwijk	I_Sorbara	FR_ref-SouthEast
Scenario for crop development (FOCUS)	2	3	8	3
Average slope [%]	4,5	1	1,5	1,5
Width of field margin [m]	2	2	4	2
Buffer zone) [m]	3	3	6	3
Runoff filter strip	1	1	1	1
Width of surface water [m]	1	1	1	1
Depth of surface water [m]	0,3	0,3	0,3	0,3
Flowing surface waters	true	false	false	true
hedge between site and waterbody	false	false	false	true
hydrologic soil class	A	C	B	B
Organic carbon content of top soil [%]	1,2	4,1	1,2	2,3
Organic carbon of soil profile [%]	0,6	2,2	0,6	1,2
Dry bulk density of top soil [t/m ³]	1,41	1,13	1,389	1,3
Water content at field capacity [m ³ /m ³]	0,24	0,45	0,24	0,38
Texture class	1	4	1	2
Drainage scenario	NONE	NONE	NONE	NONE
pH of top soil	5,8	6,2	6,9	8
USLE K-factor	0,029	0,031	0,048	0,048
Prec. January [l/m ²]	40	67	32,63	49
Prec. February [l/m ²]	38	49	28,48	59
Prec. March [l/m ²]	34	57	44,22	54
Prec. April [l/m ²]	44	48	57,72	49
Prec. May [l/m ²]	62	59	67,11	51
Prec. June [l/m ²]	84	70	63,47	42
Prec. July [l/m ²]	70	74	47,51	22
Prec. August [l/m ²]	64	73	71,63	42
Prec. September [l/m ²]	45	69	62,56	75
Prec. October [l/m ²]	41	68	66,89	92
Prec. November [l/m ²]	51	70	61,46	69
Prec. December [l/m ²]	54	73	54,11	60
Tmp. January [°C]	-2,5	1,9	3,015	5,3
Temp. February [°C]	0,2	2,4	4,95	6,6
Temp. March [°C]	5	5,2	9,03	9,6
Temp. April [°C]	10,8	8,2	12,465	12,5
Temp. May [°C]	15,7	12,5	17,51	16,3
Temp. June [°C]	16,1	14,4	21,18	19
Temp. July [°C]	18,9	15,5	24,02	20
Temp. August [°C]	19,9	16,8	23,61	21,9
Temp. September [°C]	16,1	14,4	19,755	19,1
Temp. October [°C]	10,5	10,6	14,41	14,5
Temp. November [°C]	5	5,9	7,78	9,5
Temp. December [°C]	0,2	3,2	3,835	5,9

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