

Application of PELMO v.3.22 to FOOTPRINT Italian scenarios for pesticide risk assessment

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Abstract

The FOOTPRINT project aims at developing computer tools to evaluate -and reduce- the risk of pesticides impacting on water resources in the EU. In FOOTPRINT project, a large number of agro-environmental scenarios, a combination of nuts, climate, soils and land cover, was created. ICPS, a FOOTPRINT Italian partner, through the FOOT-tools, starting from the Lombardy Region detailed dataset, created a revised and detailed version of the FOOTPRINT scenarios for the Lombardy Plain. In particular, a very detailed soil map was created, identifying 68 FOOTPRINT Soil Types. As modelling results from MACRO is an activity still running in FOOTPRINT, an integration of FOOTPRINT datasets with PELMO model (v3.22) was developed to obtain a leaching map. PELMO needs four main inputs: appropriate climatic dataset, soil layer parameterisation, characterisation of pesticides, and selection of a crop. The Piacenza climatic FOCUS dataset has been identified as the most suitable one for FOOTPRINT scenarios/PELMO evaluation in Lombardy. Different groups of FOOTPRINT soils with dissimilar hydraulic characteristics were selected. Two pesticides, mostly used in Lombardy, with different environmental characteristics were used with ad hoc application rate and dates. Maize was identified as suitable to perform the evaluation. The results of the application were compared with the groundwater monitoring data, from regional surveys, provided by the Regional EPA, to allow a first qualitative assessment. Moreover, a comparison was performed with a qualitative leaching index, developed by ICPS as a tool for addressing pesticide risks at regional level.

Introduction

The combined use of FOOTPRINT science & software and PELMO model (Klein, 1994; FOCUS, 2002) has been used in this work to assess the groundwater pesticide risk in the Southern plain areas of the Lombardy Region (LR), where maize is intensively cultivated.

Predicted model concentrations have been compared with data from monitoring campaigns performed by ARPA Lombardy (Regional Environmental Protection Agency of the LR) obtaining a quality evaluation of model results vs monitoring ones.

Materials and Methods

PELMO (v3.22) model has been used as it is one of the FOCUS reference model.

Maize is the major crop in LR (ISTAT 2000, SIARL 06/08); therefore it was considered as the reference crop. For simplicity, all the evaluated polygons were considered completely cultivated with maize.

Terbuthylazine and Bentazone, the 2 pesticides mostly used and applied in LR, were selected considering ad hoc application rates and dates

Piacenza climatic FOCUS dataset has been identified as the most suitable one for FOOTPRINT scenarios/PELMO evaluation;

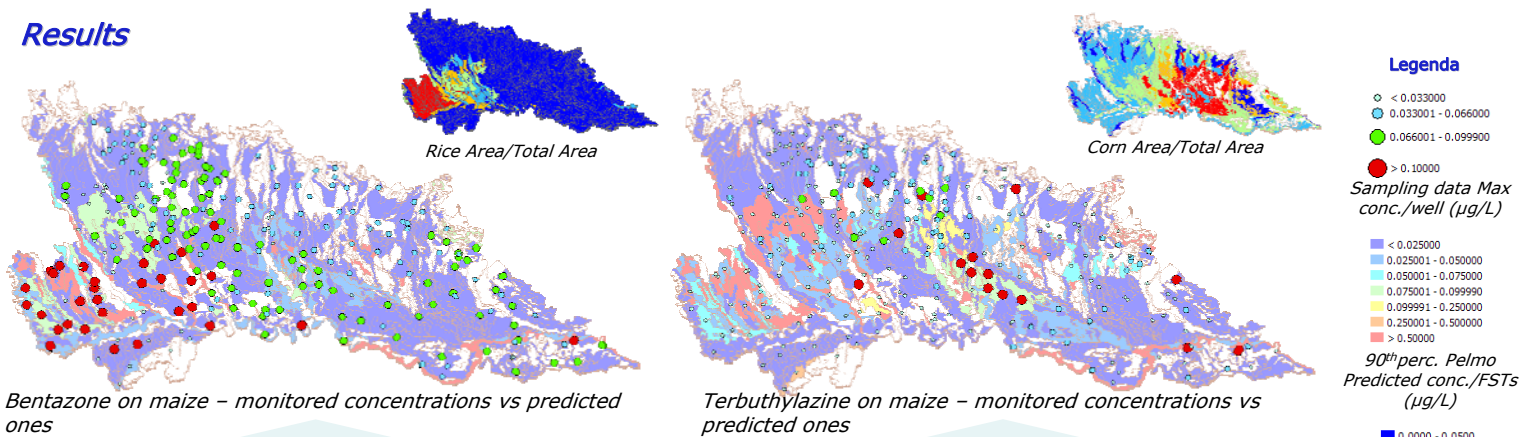
Different groups of FOOTPRINT soils with dissimilar hydraulic characteristics were selected from the 68 FSTypes identified in LR (Thickness, B.D., F.C., OC, pH, Biodegradation factor).

PELMO parameterizations:

	Application Rate (kg/ha)	Solubility (ml/L)	Vapour Pressure (Pa)	DT ₅₀ in soil (d)	Koc (ml/g)	Application
Bentazone	1.479	570	1.7 x10 ⁻⁴	9	25.2	15 May
Terbuthylazine	0.84	6.6	9 x10 ⁻⁵	40	219	22 April

Maize	Emergence	Maturity	Harvest
	1 May	11 September	29 September

Results



Bentazone: most of the high monitored concentrations are located in areas where the model predicted high leaching. These areas are located in the western part of the LR plain in the Pavia province, where maize is not cultivated and rice is the major crop. Bentazone was largely used on rice in the recent past. It can be stated that a good correspondence exists between model results and measured concentrations.

Terbuthylazine: PELMO model seems to underestimate the leached concentrations in ground water. This discrepancy may derive from the assumption that all the considered soil polygons are cultivated with the same crop. In reality, the maize area is located mainly in the central part of the LR plain where the model results suggest high leaching, data confirmed by monitored high concentrations.

Conclusions

The association of PELMO predictions and FOOTPRINT soil types together with the landuse map areas describes quite well the leaching behaviour of pesticides. The results from this approach are in agreement with results from ASTERisk, a tool to guide enforcement and monitoring of pesticides use.

According to the ASTERisk leaching index (a qualitative index based on GUS index and EU-FOOTPRINT SUGAR index), terbuthylazine and bentazone are described as medium leachers in the whole LR at sub-provincial level, which corresponds to PELMO evaluation / FOOTPRINT results.

References

FOCUS (2002). FOCUS version 3.22 (FOCUS_PELMO v.3.3.2): <http://focus.jrc.ec.europa.eu/gw/index.html>

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Klein M. (1994). Evaluation and Comparison of Pesticide Leaching models for Registration Purposes, Results of Simulations performed with the Pesticide Leaching Model. J.E.S.H., A29(6):1197-1209

6th Framework Programme - EU-Project FOOTPRINT 2006-2009 <http://www.eu-footprint.org>

ASTERisk
A Tool to Assess the Pesticide Risk

