Geophysical Research Abstracts,
Vol. 11, EGU2009-9836, 2009
EGU General Assembly 2009


# A GIS-based approach to prevent contamination of groundwater at regional scale

M. Balderacchi (1), C. Vischetti (2), A. Di Guardo (3), and M. Trevisan (1)

(1) Istituto di Chimica Agraria ed Ambientale, Università Cattolica del Sacro Cuore, Via Emilia Parmense 84, 29100 PIACENZA (Matteo.balderacchi@unicatt.it/ +390523599217), (2) SAPROV, Università Politecnica delle Marche, Va Brecce Bianche, 60121 Ancona, (3) Informatica Ambientale srl, Via Teodosio 13, 20131 Milano

Sustainable development is a fundamental objective of the European Union. Since 1991, the use of numerical models has been used to assess the environmental fate of pesticides (directive 91/414 EC). Since then, new approaches to assess pesticide contamination have been developed. This is an ongoing process, with approaches getting increasingly close to reality. Actually, there is a new challenge to integrate the most advanced and cost-effective monitoring strategies with simulation models so that reliable indicators of unsaturated flow and transport can be suitably mapped and coupled with other indicators related to productivity and sustainability. The most relevant role of GIS in the analysis of pesticide fate in soil is its application to process together input data and the results of distribution model based simulations of pesticide transport. FitoMarche is a GIS-based software tool that estimates pesticide movement in the unsaturated zone using MACRO 5 and it is able to simulate complex and real crop rotations at the regional scale. Crop rotation involves the sequential production of different plant species on the same land, every crop is characterized by different agricultural practices that involve the use of different pesticides at different doses. FitoMarche extracts MACRO input data from a series of geographic data sets (shapefiles) and an internal database, writes input files for MACRO, executes the simulation and extracts solute and water fluxes from MACRO output files.
The study has been performed in the Marche region, located in central Italy along the Adriatic coast. Soil, climate, land use shapefiles were provided from public authorities, crop rotation schemes were estimated from ISTAT (the national statistics institute) 5th agricultural census database using a municipality detail and agricultural practices following the local customs. Two herbicides have been tested: “A” is employed on maize crop, and “B” on maize, sunflower and sugarbeet.
In the first part the study focused of a definition of an indicator of groundwater contamination. The probably to exceed the groundwater quality endpoint has been chosen and it has been developed according a probabilistic approach and following a lognormal distribution of the data. After that the effect of crop rotation on pesticide leaching has been evaluated by a stepwise procedure.
The tier 1 was the worst case in which the whole region is considered cropped with maize, therefore the pesticide application is every year on the crop with the highest application rate, whereas the tier 2 was a first refinement of the previous tier, the pesticide application was still every year but only in to the areas with the presence of authorised crop fore the assessed pesticide and with a crop LUA (land under agriculture) ratio higher than 10%. In the passage from tier 1 to tier 2 a contemporaneous reduction of simulated surface and pesticide leaching occurred because a relationship exists between agriculture and pesticide use. The step 3 considered a pesticide timing based on typical crop rotations. Te application followed label doses and was every time an authorised crop was found in the rotation. The passage to step 3 allowed a further percolation reduction.
Step 3 blind simulations have been plotted as maps and matched with the results of the regional environment agency monitoring plan. A good correspondence between prediction and observation has got. Nevertheless herbicide “A” was detected in a larger area than assumed to be cropped with maize. However, in the past this compound was authorized for application to crops other than maize and was also used extensively in non-agricultural applications. Herbicide “B” was also detected in two wells located in areas not considered vulnerable. In the first well, water was sampled three times and the compound was detected once, in the other water was sampled once and the compound was detected. In this case point contamination, could be the origin of that. These pesticides were also researched in areas in which there is not application. This suggest that GIS approach can allow the design

of new agrochemical monitoring plans that focus resources in areas with the highest probability of detection, reducing the cost to the community, and increasing the scientific value of the data collected. In the future, when well validated geographic data sets are available, it will also be possible to distinguish between point and diffuse contamination.