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Intensive monitoring of pesticides in river systems: lessons learned

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Abstract:

Different factors influence the flux of pesticides towards a river system e.g. the application date and rate, the time before a rainfall event, management practices, ...

To gain more insight in the fate and transport of pesticides, 2 intensive monitoring campaigns were set up during spring 2004 and 2005. One campaign focused on a small, hilly basin situated in the central part of Belgium: the Nil catchment, which has an area of 32 km². The second campaign was set up in the Demer catchment, which has an area of 2130 km². For this purpose, automatic samplers were placed for

three months at different places in both river basins, taking 8 hour composite samples of water and suspended solids. Undisturbed sediment samples were taken by means of a macro-core and immediately frozen with CO_2-ice. The samples were sliced and analysed for pesticides in pore water and on the sediment. The method for all pesticide analysis consisted of an on-line solid phase extraction (SPE) followed by desorption with mobile phase and detection by liquid chromatography mass spectrometry (LC-MS). The pesticides were detected in multiple reaction-monitoring mode (MRM) using positive ion electro spray.

The results of the study revealed the dynamics of the different compartments of a river system. The water compartment showed hourly variations in pesticide peak concentrations, regularly exceeding the standards. The amount of pesticides transported by suspended solids increased after a rainfall event. The concentration of pesticides in pore water on a monthly basis followed the trends of the water compartment remarkably well, but in a significantly lower concentration. The highest pesticide concentrations and consequently the highest effects on local fauna and flora, could be found in the upstream rivers with a high agricultural pressure.

As a conclusion, the monitoring campaigns revealed that:

-the occurrence of pesticide peaks coincided with the application period of the pesticide for the various crops in the area; relevant sampling periods for atrazine are from half april till half june, for isoproturon from half march till half april, etc ...;

-pesticide dynamics showed hourly variations; such short time events can only be explained by surface runoff after rainfall or direct spills; monitoring should preferably be continuous within the application window of the pesticide; passive sampling may be a suitable alternative, but needs further investigation; grab sampling at regular time-intervals over a one-year-period is not suitable for pesticide monitoring;

-monitoring of herbicides should preferably be performed in the smaller upstream rivers, draining rural catchments where extreme concentrations are most likely to occur, and impacts on local ecosystems are expected to be severe; backtracking of peak events can reveal direct losses due to poor agricultural practices