Application of complementary methods in chemical and ecotoxicological monitoring of sediments under WFD in Wallonia (Belgium).

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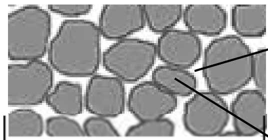
Introduction

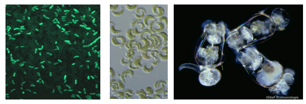
Sediment remains an important matrix for the monitoring of certain substances with significant potential for accumulation to assess long-term impacts of anthropogenic activity and trends. The EQS Directive (2008/105 EC amended by 2013/39/EU) provides that Member States should take measures with the aim of ensuring that existing levels of contamination in sediment will not significantly increase. Chemical analysis of priority pollutants is often not sufficient to explain ecotoxicological effects of these complex environmental samples. Risk assessment based on concentrations, e.g. of priority pollutants in sediments or water, obviously does not reflect the risk of the actual mixture of contaminants, but only the risk of those pre-selected toxicants. Bioassays are therefore useful tools for the evaluation of sediment in which both known and unknown contaminants are present.

Materials and methods

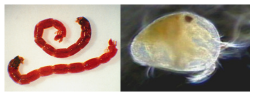
From 2010 to 2012, 31 monitoring stations included in the surveillance monitoring programme of the WFD in Wallonia (Belgium) were sampled for sediment. Bioassays were carried out to determine the potential impact of contaminated sediment. According to their level of toxicity for the different tests, the sediments of the surveillance monitoring stations were classified from non-toxic to extremely toxic. Priority substances selected as pertinent for a monitoring in sediments and other pertinent chemicals were analyzed in each sample (63 µm fraction). The link between physico-chemical and ecotoxicological parameters was assessed by multivariate statistical analysis

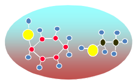
Bioassays and chemical analysis





Vibrio fischeri, *Pseudokirchneriella subcapitata* and *Brachionus calyciflorus bioassays* for pore waters.



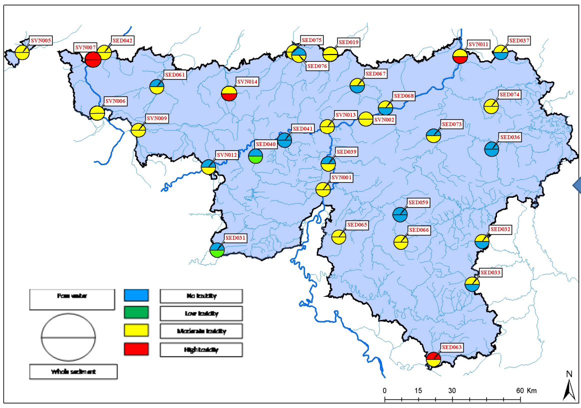


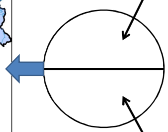
Priority pollutants according to EQS Directive (2008/105/EC amended by 2013/39/EU) – trend analysis on 63µm fraction.

Chironomus riparius, *Heterocypris incongruens* (*Ostracodtoxkit®*) for whole samples.

Results and discussions

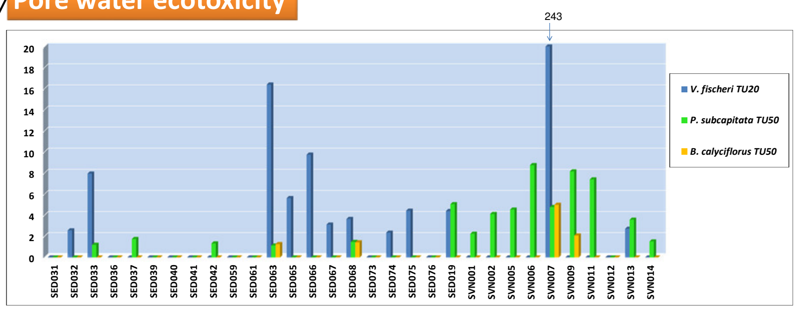
Sediment ecotoxicity distribution



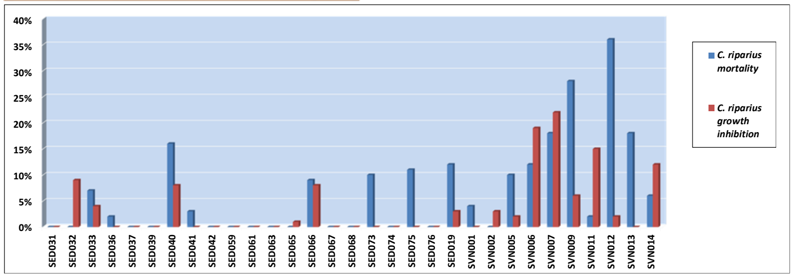


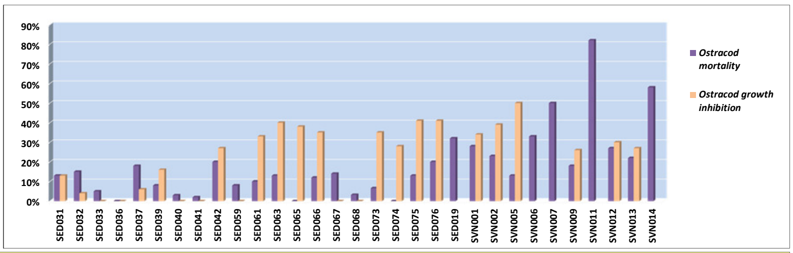
Based on <u>pore water</u> toxicity, 10/31 sites were not toxic, 19/31 sites showed moderate toxicity and 2/31 displayed high toxicity.
Based on <u>whole sediment</u> toxicity, 8/31 sites were not toxic, 2/31 sites showed low toxicity, 18/31 sites displayed moderate toxicity and 3/31 sites high toxicity. Considering <u>both compartments</u>, 3/31 sites were not toxic 12/31 displayed moderate toxicity and 1/31 was highly toxic.

Pore water ecotoxicity



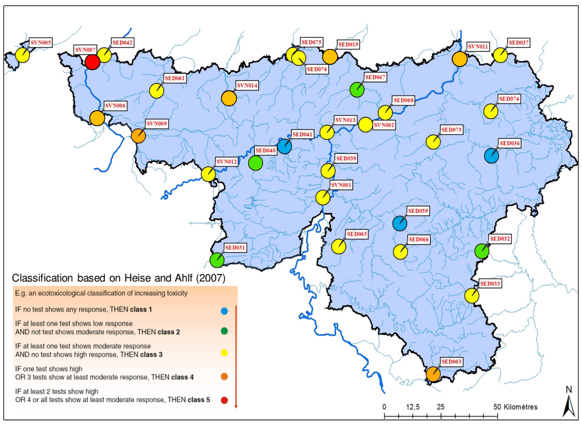
Whole sediment ecotoxicity





As far as pore water is concerned, the most sensitive bioassays are algae (*Pseudokirchneriella subcapitata*) and bacteria (*Vibrio fischeri*). For whole sediment Ostracodtoxkit® test is more sensitive than *Chironomus riparius* bioassay. It is worth noticing that Ostracod mortality is only significant above 30% (and when it is the case the growth inhibition is not assessed). Inland waterways (SVN) seem to be more contaminated.

Sediment ecotoxicity classification



The ecotoxicological classification based on Heise and Ahlf (2007) shows that 3/31 sites were "not toxic", 4/31 sites showed "low toxicity", 17/31 sites displayed "moderate toxicity", 6/31 sites were "highly toxic" and only one site belonged to class 5 ("extremely toxic").

Relationship between priority pollutants and ecotoxicity

	Vibrio fischeri	*Pseudokirchneriella subcapitata*	*Brachionus calyciflorus*
Significant positive relation between chemical parameters and ecotoxicity (p<0,05)	Benzene, Aliphatic Hydrocarbons C10-C40	Mercury, arsenic, lead, Aliphatic Hydrocarbons C10-C40, PAHs (Acenaphtylene, Acenaphtene, Fluorene) Nonylphenols, HCB, PBDE	-

	Chironomus riparius	*Heterocypris incongruens*
Significant positive relation between chemical parameters and ecotoxicity (p<0,05)	Mercury, Aliphatic Hydrocarbons C10-C40, PAHs (16 compounds) Nonylphenols, HCB	organic carbon, Mercury, PAHs (Acenaphtylene, Acenaphtene, Fluorene) Nonylphenols, HCB, PBDE.

Statistical analysis showed significant (p<0.05) positive relations between some chemical parameters (hydro-carbons, metals), and the different bioassays (except for *Brachionus calyciflorus*).

Conclusion

The results of this monitoring show that sediment collected in inland waterways display the higher toxicity. The sediments originating from the Scheldt hydrographic district are also more toxic. These results underline the interest of using a bioassay battery to characterize sediments, each species having a different sensitivity to pollutants in the sediment. They give additional information (for instance for bioavailability) and are a useful tool for assessing risk posed by contaminated sediments.