EUROPEAN TOPIC CENTRE ON WATER

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overview of emissions to water

existing data collections

AUTHORS: D.Preux, B.Fribourg-Blanc (IOW)

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EXECUTIVE SUMMARY

Emissions to water are one of the major environmental problems for water. The emissions can stem from point or from diffuse sources and raise various questions related to geographical scale, temporal aggregation and parameters. The main characteristic that make them difficult to assess is however that they follow various pathways from the emission source to the receiving environment.
The various initiatives to collect emissions to water data often support specific objectives and do not allow to show a complete picture. The EEA and more recently the WFD provided new approaches towards a better balanced knowledge.
The existing data collections can be classified in collections dedicated to some sectors and parameters (EPER and UWWTD), collections with a more complete coverage as regards the sources (Marine Conventions OSPAR and HELCOM, EUROSTAT/OECD JQ) and emerging data collections (WFD, E-PRTR). From these various data collections, including the emerging ones, it appears that some are overlapping, needing to collect twice the same data, whereas main gaps exist, especially as regards small and diffuse sources, and that major drawbacks will not allow in the future to gain an adequate knowledge.
Eionet-emission of the EEA proposes a methodology that seek to answer the various needs especially by providing a data organisation, the main elements being the identification of the sources, the pollutants, and geographical and temporal aggregations. Integration of this in the Water Information System for Europe, whose objective is to include all existing data flows on water, will lead to major improvement of the whole picture.
Progress on data quality as regards the various elements and especially the development of shared nomenclatures, are however needed to reach a good level of confidence.

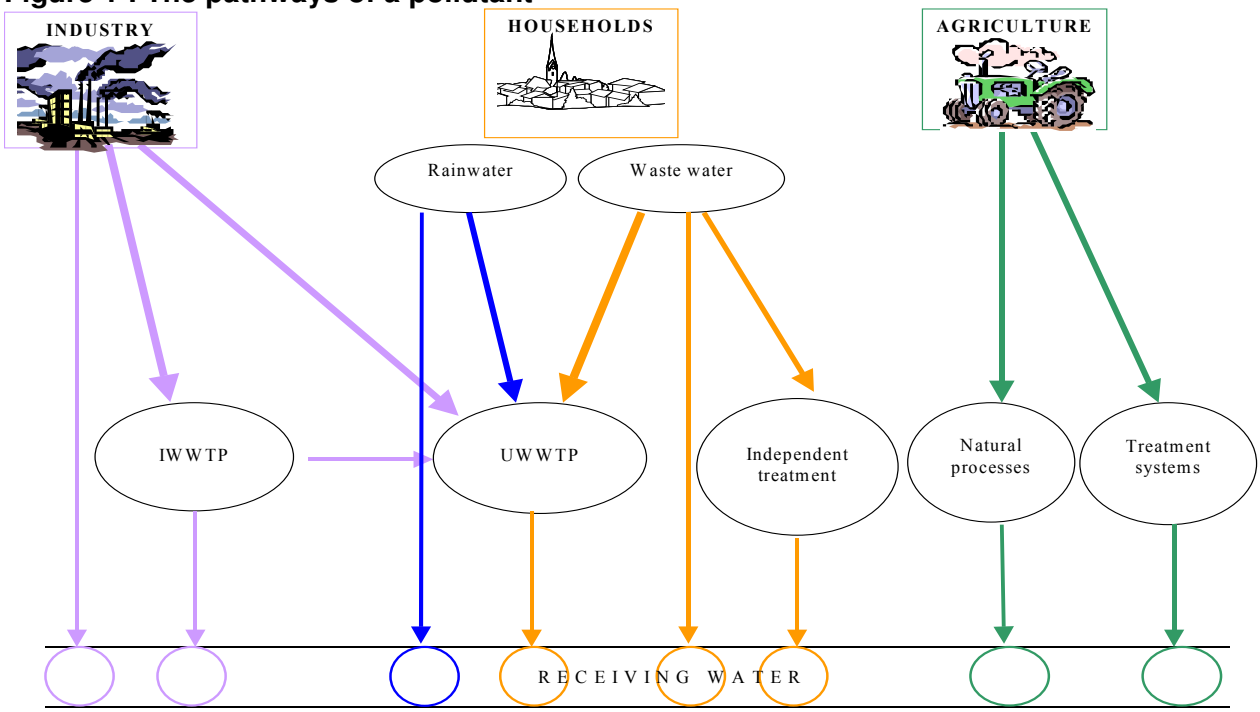
1 SETTING THE SCENE

1.1 What is an emission to water ?

Emission to water is a complex topic, much more complicated than emission to air for instance, due to some major elements.

The point source emissions, that are the wastewaters containing polluting substances drained in sewer networks and treatment plants and that gain directly a river, the ocean or even a groundwater, are relatively easy to work out. Linking these emissions to the emitting source is however highly complicated by the multiple possible pathways. Thus it will never be easy to distinguish in the effluent coming out from a wastewater treatment plant the part that should be attributed to emission from a specific industry connected to the sewer network, as also illustrated in the following figure.

Figure 1 : The pathways of a pollutant



Source: IOW for French Ministry of Environment (2004)

Diffuse emissions raise difficult questions. On the one hand because behind this generic term, emissions of a very different type are grouped together.

On the one hand the real diffuse emissions that stem from emissions to soils (nutrient surpluses in agriculture, atmospheric redeposition etc .) for which the transfer to water through rainwater runoff for surface waters or through leaching for groundwater has to be estimated. Interactions between surface and groundwater as well as other environmental variables add a complexity level in the correct estimation of the quantities as well as the real receiving water.

On the other hand, many very small point sources too small and too numerous to be individually monitored are often considered to be part of the diffuse pollution, whereas they are more dispersed than real diffuse ones.

Although this is actually the case in much of the existing emission inventories, where they are absent, considering that diffuse emissions are in some areas and for some parameters the predominant ones, it is not reasonable to ignore them completely.

1.2 Underpinning questions

1.2.1 Geographical scale

Although complex, it is possible to make an inventory of each point source emission individually, but this is completely impossible for very small point sources and diffuse sources. Aggregation of emissions at a certain geographical scale are thus needed to include all emissions, but the choice of the smallest aggregation unit is to be discussed.

The statistical offices often have in favour the administrative levels, with at least the national level, as most often the data are handled by organisations that have competencies at this level. For the environment however, it must be recognised that this is not the best choice, as for example surface water and the related natural cycles are bounded by watersheds and aquifers do not care of country borders.

WFD requires Member States to designate Water Bodies and to make analysis at the Water Body scale. Taking into account the wide number of such Water Bodies, the feasability of such detailed analysis is questionable as well as the use of the datasets for other than local uses.

The methodology developed by the EEA thus proposes to focus on the river basin scale or the sub-basin for wide river basins in a pragmatic way to allow for an easy to manage and read and represent at the European scale system and limit the unavoidable mistakes in attribution of emissions to one river basin or the other at the border of the respective catchments.

1.2.2 The timescale

Here also the goal is a reasonable compromise between what is desirable and what is feasible. Emissions are not always steady all over the year . And the impact on aquatic environment of peaks can be higher than the same quantity emitted at a steady state along time.

But if the information on peak emissions (with indication of the corresponding period, in order to be able to add emissions only when they happen at the same period) are necessary and useful at the local level, they can not be easily managed at an higher geographical scale, and thus the annual aggregation seems an acceptable compromise.

1.2.3 The parameters

The pollution is generally measured in terms of the quantity of a measured parameter (generally physico-chemical parameters) released during a certain period. It can however be expressed either directly in terms of the quantity of a parameter or reported to an arbitrary unit that can represent one or more parameters (e.g. population equivalent made of BOD5, N, P, SS).
These parameters can be physical (e.g. temperature, volume, oxygen…) or chemical (e.g. pH, substance). Chemical parameters include functionalities or groups defined by the measurement method (e.g. total phosphorus, BOD5) and individual substances defined as chemical species clearly identified (e.g. nitrate, mercury).
Many pollution parameters and individual substances exist (about 100 000 chemical species are identified) but it is almost impossible to monitor all of them. It is thus recommended to use the existing lists of parameters stemming from the existing legislation (EPER, WFD), and to be aware that they may evolve.

1.3 What is it for ?

The numerous initiatives aiming at registering emissions to water are often included in broader actions or programmes that are built to limit pollutions.
They are often targeted approaches, dedicated to some categories of polluters, some substances or some receiving environment classified as more sensitive or impacted, and not overall approaches targeted to the environmental knowledge.

This is the case for the inventories stemming from the Integrated Pollution Prevention and Control (IPPC) Directive that mainly address emissions from industry, and the emission data from the reporting to the Urban Waste Water Treatment Directive (UWWTD) mainly address the emissions from the domestic sector and food industry and a very limited number of parameters, Marine Conventions only cover load to the marine environment, etc.

Since 1995 EEA has included its tasks on emissions in a much wider perspective, using the DPSIR approach.

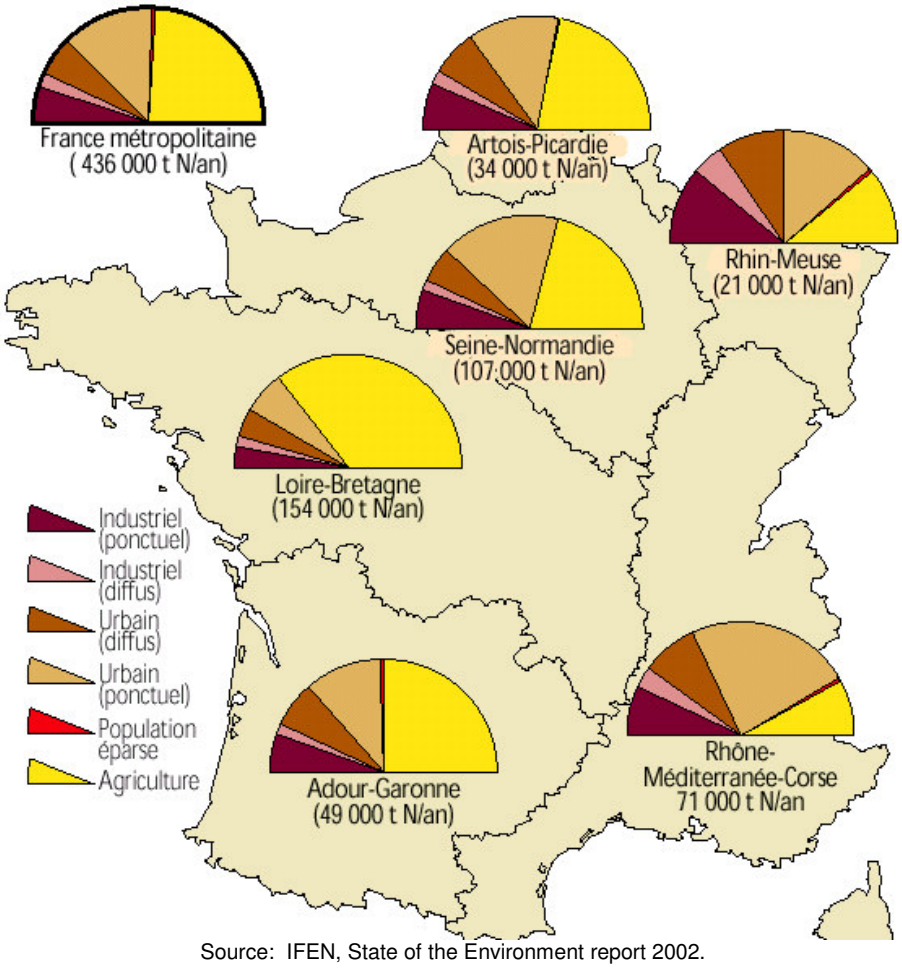
Emissions are Pressures that originate from Driving forces (agriculture, industry, populations etc.). They lead to a State of the environment, the deterioration of which (Impact) should lead to measures (Responses), and their effect should be checked.

From this point of view, the EEA approach was in advance of the Water Framework Directive (WFD). Through the WFD, the pressures and impacts analyses have the same goal of identifying the main causes for pollution, in order to decide on the most appropriate measures taking into account their cost and economical consequences. Information on pressure comes especially from Art.5 reports under the WFD which are taken into account for the future work. All future data collection should fit into one common data stream in a shared information system (WISE) that meets the needs of EU-level users required to provide EU-level assessments.

Based on such inventories, it is then possible to make useful evaluations such as the source apportionment, temporal trends or pressure indicators, provided for this last that adequate weighting factors can be found, etc…

The following figure 2 illustrate one possible use of emissions to water data apportioned by the responsible emission source.

Figure 2 : Source apportionment of Nitrogen emissions to water by Water Agency in France in 1997



Source: IFEN, State of the Environment report 2002.

Finally, one should keep in mind that polluting emissions are only one of the causes of the state of the environment. Water mitigation (for cooling, Drinking water production, …) or hydro morphologic modifications (dams, …) are other types of pressure that often better explain the biological quality of water than emissions. On the other hand, polluting emissions are the major cause of the physico chemical state of surface and ground waters.

2 THE EXISTING DATA COLLECTIONS

A wide variety of tools and systems exist that address at least partly emissions to water. Limiting the scope to those that are widely spread in the sense that they are concerning a high number of countries, the following picture can be proposed.

2.1 Data collection dedicated to some sectors

2.1.1 The European Pollutant Emission Register (EPER)

EPER was established by Commission decision 2000/479/EC of 17 July 2000 on the implementation of a European Pollutant Emission Register (EPER) according to Article 15 of Council Directive 96/61/EC concerning Integrated Pollution Prevention and Control (IPPC).

It is a system of reporting large emissions to air and water for 50 substances from a list of 56 industrial sectors, and intensive animal husbandry sites. It includes a European database, hosted by the EEA, and the associated public website that allows for the consultation of the data reported (http://eper.eea.eu.int/eper/).

Only the facilities located in the European Union that carry at least one IPPC Annex I activity, and that emit at least one of the 26 EPER Annex A1 pollutants, directly or indirectly to water (organic pollution, nutrients, heavy metals, micro pollutants) above the threshold mentioned in this Annex should report their emission.

At present, reporting is due every third year, and the first reporting cycle was completed in 2003, thus including only the facilities of the EU15 countries, providing data on emissions in 2001 (optionally 2000 or 2002). The next reporting cycle is due in June 2006 for the year 2004 and will include facilities of EU25

2.1.2 The Urban Waste Water Treatment Directive (UWWTD)

Directive 91/271/EEC sets minimum standards for the collection, treatment and disposal of wastewater originating from urban areas and some industrial sectors, depending upon the size of the discharge, and the type and sensitivity of the receiving waters.

It covers urban wastewater and industries connected to Urban Waste Water Treatment Plants (UWWTP), as well as industrial sectors listed in Annex III of the Directive (food industry) discharging directly in the receiving waters.

Only the wastewater treatment systems with a treatment capacity above the thresholds of the Directive (2 000 population equivalent in 2005 for urban areas, 4 000 population equivalent for food industry with direct discharge) and located in the European Union should report collected load and percentage reduction for 5 parameters (COD, BOD_5, total nitrogen, total phosphorus and suspended solid).

At present, reporting is due every second year, since 1994 and the next reporting cycle is due in 2006.

2.2 Data collection with a more complete coverage

2.2.1 OSPAR Convention

Initiatives to protect the north-east Atlantic were first established in 1969 and the OSPAR Convention signed in 1998 is the most recent tool in this process. Although with no real legal burden, once signed the Convention should be respected.

It aims to prevent and eliminate pollution and to protect the maritime area (geographically well defined in the Convention) against the adverse effects of human activities, it thus addresses all human activities.

The Convention includes Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, The Netherlands, Norway, Portugal, Spain, Sweden, UK, Luxembourg and Switzerland.

A priority list of 66 substances is established with a 50% emission reduction target.

Inventories were made in 1985 and 1999 to assess if the target was reached.

2.2.2 Helcom Convention

The Convention was first established in 1992 and ratified in 2000.

It aims to control and minimise land-based pollution of the marine environment of the Baltic Sea Area and thus addresses all human activities.

Contracting parties to the convention are European Economic Commission, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden.

A priority list of 48 substances is established and the Convention has a wide variety of activities, each addressing a specific list of substances.

Every 5 years, inventories of loads are made and the last included an emissions inventory and was done in 2004

2.2.3 Eurostat/OECD Joint questionnaire

Eurostat's mission is to provide the European Union with a high-quality statistical information service. For water environment this information is obtained in close cooperation with OECD through the dissemination of a joint questionnaire to national authorities.

Environmental information is requested on point and non-point sources. The nationally aggregated point sources are divided into 8 sectoral activities using ISIC and NACE classifications. The population connected to the different sewage treatment types, the capacity of waste water treatment plants and the waste water generated by source and sector in terms of the main determinands are required.

Eurostat covers the EU-15 countries, the 3 associated European Free Trade Association (EFTA) countries and the 10 Accession Countries (AC10) from Eastern Europe and the questionnaire collects information at a nationally aggregated level.

15 parameters are requested that are Volume, Suspended Solids, BOD, COD, Population Equivalent, total Phosphorus, total Nitrogen, heavy metals and Arsenic.

The questionnaire is circulated by OECD since 1981 and by Eurostat every second year since 1988.

2.3 New or future systems

2.3.1 Water Framework Directive (WFD)

Adopted in 2000, the Water Framework Directive asks for a review of the impact of human activity of which emission are an important part and requires that MSs collect and maintain information on these. The principal aim is to identify where and to what extent human activities raise problems for environmental objectives. For the application of this very large

Directive, the European Commission has established a Common Implementation Strategy. Various guidelines were produced with in view the streamlining of the approaches as regards the data collection and accessibility with other possible data gatherers and users like Eurostat or the EEA, including wider scope for the data collection than only the one needed for the WFD. In 2003 first steps were made towards the building of a *Water Information System for Europe (WISE)* and the associated Electronic Reporting Tool, that will in the longer term include all international water related reporting.
First specifications for the data collections were made that include the following aspects.

The sectors addressed for emissions are, for point sources:
- waste water,
- industry,
- mining,
- contaminated land,
- agriculture point,
- waste management,
- aquaculture.

for diffuse sources:
- urban drainage (including runoff),
- agriculture diffuse,
- forestry,
- other diffuse

And for the activities using specific substances, it is the manufacture, use and emissions from all industrial/agricultural sectors.
In summary the main driving forces are Urban, Industry and Agriculture for which it is required to collect and maintain information on the pressures they exert on water.

The geographical coverage is the 25 Members of the European Union (EU) and the countries that have specific agreement with the EU on this Directive.

The parameters are most of the polluting substances including organic pollution, nutrients, heavy metals, a list of 33 priority substances, and many others.

Under the WFD, specific report focussed among others on human activities and impacts and called Article 5 report, was due for every River Basin District (RBD) of the MSs in December 2004. An update is to be produced in 2013 and every six years thereafter.

2.3.2 Pollutant Release and Transfer Register (PRTR)

First studies of the OECD on PRTR were published in 1996 and many documents were developed since.

Under the UNECE protocol on PRTR to the Aarhus convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (UNECE, 2003) each party to the protocol should develop a publicly accessible (including in electronic form) national PRTR that address point and diffuse sources.

The register should include reports with the following main aspects: the report should be facility specific for each point source and include also diffuse sources, be pollutant specific or waste specific, include releases to air, water and land, and information on transfers. The report should be coherent, based on mandatory periodic reporting and include standardised and timely data, with a limited number of thresholds. It should also give rise to the development of one or more electronic databases, maintained by the competent authority.

The protocol lists 86 substances to report, of which 70 to water, the activities to report and the format for the reporting of release and transfer data.

The list of activities includes Urban Waste Water Treatment Plants of more than 100.000 population equivalent and Industrial Waste Water Treatment Plants treating more than 10.000 m3/day, intensive aquaculture sites, and diffuse sources being defined as the many smaller or scattered sources whose combined impact is significant and for which it is impractical to collect individual reports.

The data to report should be the calendar year emissions and off-site transfers.

At present 36 countries, and the European Community have signed the protocol.

During 2004 the Commission has proposed to transform the EPER in a PRTR, for a first application for all EU countries in 2007.

The shift from EPER to the European PRTR (E-PRTR) will increase the number of activities reported (+8), but also the pollutants (+36) and the periodicity of reporting (each year).

3 DISCUSSION

3.1 The main elements of a complete system

The needs are so different from one obligation or institution to the other that it is still hard to say how should be the ideal system, but one can however already list what should be included in a system that would answer to the knowledge needs for use and comparisons at an international level. It is the idea that underpins the methodology for Eionet-Emission for the EEA, that will feed the WISE process.

Eionet-water-emissions or Eionet-emissions is part of the Eionet-water, the "European Environment Agency's Monitoring and Information Network for Inland Water Resources and Transitional, Coastal and Marine Waters" (for more details see ETC/WTR, 2004a).

Emissions are most often reported as the quantity of a pollutant discharged over a time period, with the emitter geographically located, and its activity sector identified (agriculture, urban, industry), or the concentration of this substance in the wastewater with a volume of wastewater discharged and the emitter identified.
One of the most difficult point in the emissions to water is that the pollutants are not simply discharged in the receiving environment but follow various pathways from their emission by an emission source to the receiving water. This poses various problems of which the respective responsibilities of the polluter, the holder of the wastewater treatment plant and others, the various leaks and purification processes along the pathway, but also the allocation of the emission to the real emitter.

This leads to the necessity to clearly identify the main components that are :
- the source (preferably as economic agent) that emits,
- the substance (CAS code or other shared code)
- the geographical localisation,
- and the temporal aggregation.

This should in turn help the correct assessment of the apportionment of emission between the various economic agents, of the respective efforts of these agents to reduce their emissions, of the temporal and geographical trends in emissions of pollutants, for the application of the polluter-pays principle.

Under Eionet-emissions the European Topic Centre on Water of the EEA will analyse the Article 5 reports to see if they can, together with other existing data collections, and as both EEA and DGENV expect, form the main source of information for emissions.

3.2 Limits of the existing data collections

It is of everyone's interest to limit the collection and reporting burden on emissions to water. It is thus necessary to look in more details if the gathering of all collecting systems in one single system would with the same or less effort be a good solution for the sake of the emissions knowledge needs.

From the various reporting systems presented in chapter 2, it is clear that the whole picture lacks consistency with big gaps and double counting. Like a jigsaw with some missing pieces and others overlapping.

3.2.1 overlaps

Not pretending to make an exhaustive analysis, overlaps can be illustrated on some examples.

EPER register gives a relatively good picture of industrial point emissions, limited to the biggest ones. One should however know that among EPER activities, the battery farming of poultry and pigs that are agriculture activities are included.

On the other hand, emissions to water of this register are taken at the same level and with the same thresholds whether the facilities discharge directly to water environment or to a collective wastewater collecting and treatment system. No identification of these wastewater collecting and treatment system is made that would allow an estimation, through the reporting to the UWWTD, of the level of pollution abatement in the system before discharge in the water environment. And furthermore, the UWWTD involves only some of the 26 parameters of EPER.

3.2.2 The main gaps

Diffuse emissions, or emissions that can be put in the same category, are absent from almost every existing reporting system, whatever the sectors considered.

The pollution from scattered households, from small and medium enterprises, from transports (especially maintenance of roads and embankment), and real diffuse emissions stemming from transfers from agriculture land and from atmospheric redeposition are almost absent from every statistics.

3.3 Data quality

High quality results and robust conclusions can only be drawn if the data are of good quality. Each of the main elements of an emission inventory should be scanned.

Above the quality problems that may come from the monitoring itself, especially for complex substances and low concentrations, much of the problems that occur when building an emission inventory come from a lack of shared references : point and diffuse emissions have not the same definition everywhere, and differences in identification of sources, substances, geographical localisation and the way the monitoring is used for temporal aggregation all lead to comparability problems.

3.3.1 The source

The correct identification of the source is very important, but a major problem stem from the fact that the same economic activity can use various technical processes to produce the same product and various economic activities can use the same process. For example various technical processes can be used to produce beer, and on the other hand, heating systems are used by various economic activities. Eurostat had proposed the NOSE classification to solve this problem, but it is mainly air emissions oriented and adaptations are needed.

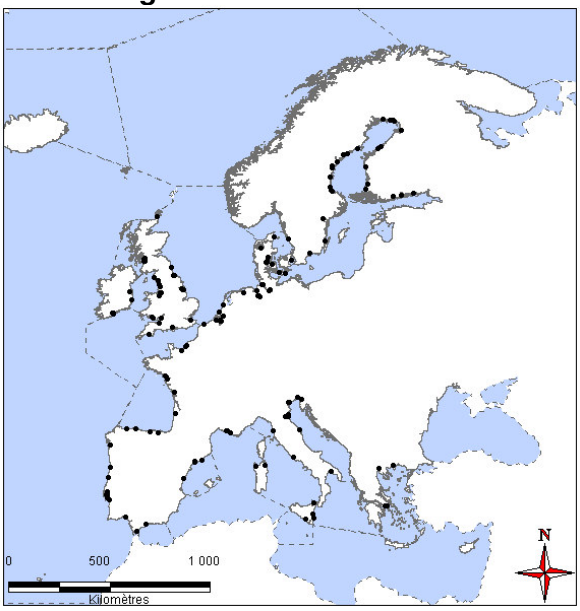
3.3.2 The substance

For the substances, the main quality problems are on the use of shared identification codes. Chemical Abstract Service (CAS) code or other European codes are seldom used, and some parameters like BOD5 are not defined in these lists. For example HCH data can be reported but if an identification code is not used, it is hard to know if this is related only to lindane (gamma-HCH) or to all the isomers.

3.3.3 Geographic localisation

For water it is of high importance to be able to correctly allocate the emission to the right receiving environment, as a bad quality may lead to wrong conclusions, the emissions being attributed to another river basin. This asks for the localisation of the point of discharge, that may be far from the point of emission, and a clear link between discharge and emission.
For example EPER data are reported to the point of emission, it is then impossible for facilities close to the coast to know if the emissions are directed to inland or marine water. And whatever the localisation, a facility can be located on a river basin and the point of discharge on another.
This is illustrated in the following figure for EPER facilities emitting Nitrogen and located at less than 10 km of the coast. The available data do not allow to know if the emissions to water are discharged in a river, and then which river?, or at sea.

Figure 3 : EPER facilities emitting N at less than 10 km from the coast



Sources: JRC CCM Version 1.0, IOW treatment

3.3.4 Temporal aggregation

When addressing emissions, one of the most interesting aspects is to know the quantities that are discharged. As the continuous monitoring is very rare, the real quantities are often estimated from an average concentration calculated using the data from the monitoring, and the flow measured continuously.
Main statistical problems can occur:

- the flow station and the water quality station may not be located at the same place, needing some additional hypothesis,
- the emission of a substance can have temporal behaviour that should be filtered to allow significant temporal trend: diffuse emission of nitrates (from soils) vary along the year and follow a model curve,
- peak concentrations are difficult to catch and related to frequency of measures, and if a simple average of all measures is done, there is a risk of over or under estimation of the real load,
- peak flows, especially from floods, that can represent the major part of the emission of some substances are often badly known as monitoring stations are out of order during them.

4 CONCLUSION

Today, the correct knowledge of emission to water is still far from being complete. The WISE approach, by gathering together and taking into account every existing system will greatly help the improvement of this. Information on pressure comes especially from Art.5 reports under the WFD which are taken into account in the future work.

The strategy initiated by the WFD is very interesting from the conceptual side, as it aims at identifying all significant emissions for a reasonable number of key parameters. For the moment however, the approach presents some major drawbacks :

- The frequency on which it is based : every six years, seems too wide to allow an easy trend analysis,
- The Water Body scale is far too small (as there are thousands of such objects) to be efficiently put in place and used,
- The reporting system is still not defined and for the first deadline (2004), for the Article 5 reports, the data and information reported are textual reports, preventing from using them for wide statistical and indicators analysis.

All future data collection should fit into one common data stream in a shared information system (WISE) that meets the needs of EU-level users required to provide EU-level assessments. Each international organisation involved in this will help the necessary adjustments to integrate all the needs.

On the other hand, the reasoning initiated by the PRTR seems promising, if only the thoughts regarding diffuse emissions are put in practice in a way that make them a real usable information source. For this last, there is a need to question the level of thresholds, on the one hand too high for the moment (for example for urban pollution, only agglomerations of more than 100 000 inhabitants are addressed) and on the other hand not enough homogenous, but also the information related to localisation that allow to link emissions to the receiving environment.