Micro-pollutants in Water and Aquatic Environments in France: State of Play

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The « Big Picture »: Chemical status of surface water bodies under the WFD

- 41 priority substances / priority hazardous substances routinely measured in surveillance monitoring networks (more than 2 000 sites)
- **Metals**, **pesticides** and **PAHs** are the parameters for which EQSs are the most frequently exceeded
- Chemical status is unknown for a large proportion of sites partly due to poor analytical performance

**Source:** *Synthèses Eaufrance (2015). L’état des eaux de surface et des eaux souterraines*
The « Big Picture »: How do we compare to other Member States?

Source: Synthèses Eaufrance (2015). L’état des eaux de surface et des eaux souterraines

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The « Big Picture »:
Most frequently detected pesticides in French rivers

- 92% of sites with at least one pesticide detected
- In water the 15 most quantified PPPs are (mostly) herbicides; in sediments pesticides that are the most detected are insecticides
- 3 out of the top 15 pesticides (or degradation products) found in water were already banned by 2007 (8 out of 15 in sediments)

Pesticides (and other micro-pollutants) occur in the aquatic environment as mixtures.

Percentage of monitoring sites
Freshwaters (running waters)

What about contaminants of emerging concern?
Nationwide survey for the detection of non-regulated chemical substances

- 115 river sites, 18 lacustrine sites with contrasting pressures (both in type - industrial, agricultural, urban - and intensity)
  - 350 discrete (spot) water samples collected on 3 sampling occasions (spring, summer, fall)
  - 130 surficial sediment samples collected on one occasion (fall)
  - water samples filtered on a 0.7 µm pore-size membrane
  - 100 chemical substances systematically analysed in water samples, 134 in sediments

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Focus on emerging compounds that are most frequently encountered in freshwaters


Widespread contamination with know or suspected endocrine disrupting chemicals (EDCs)
Are some emerging compounds more problematic than others?

- Few sites “at risk”
- At risk for a large number of sites

- Not at risk
- Could be problematic if environmental concentrations increase

Fréquence de Quantification

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Some evidence of negative impacts on wildlife

Plasma vitellogenin (VTG) concentration in wild gudgeon

Source: Aït-Aïssa, Brion et al., 2014. Etude prospective 2012: apport des outils biologiques pour le diagnostic de la contamination des milieux aquatiques / Rapport INERIS

Incidence of intersexuality in wild gudgeon

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Water pollution: getting better?

Despite some uncertainties in the data…

- downward trends are detected for legacy/old contaminants
- trends observed in the OSPAR region can be attributed to a decline in atmospheric emissions (metals), a decline in emissions to water through the implementation of BAAT at industrial facilities and the improvement in municipal WWT, and the ban and restriction of the use of some chemicals (e.g. Lindane and PCBs)

**Inputs of hazardous substances via riverine loads and direct discharges into the North-Atlantic during the period 1990 to 2008 (Source OSPAR)**
Look at the problem from another perspective

- We are currently monitoring only a limited number of chemical substances through media-oriented regulations (WFD, MSFD, regional sea conventions)
- With the improvement of chemical analytical methods we are now capable of detecting a vast array of pollutants at very low concentrations (in the ng/L concentration range)


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Criticisms of current approaches to water-quality evaluation

► Evaluations based on “regulatory lists” with a limited number of chemicals (vs the capacity of the industry to develop substitutes for banned chemicals)
  □ pace of assessment of toxic substances on the Priority Substances List will have to speed up (see the Watch-List mechanism)

► Characterisation of exposure is hindered by the lack of good quality data. Representativeness of discrete (spot) sampling is questionable

► Chemical risk assessment is based on individual chemicals but chemicals typically occur in the (aquatic) environment as complex mixtures (parent molecules and degradation products)
  □ need to account for the combination effects of chemical mixtures (especially for EDCs)

► The case for Effect-Based Monitoring Tools (EBMT)?
A National plan to take action against the contamination of aquatic environments with micro-pollutants

- the French Ministry in charge of Ecology will launch by the end of 2015 a second action plan on micro-pollutants to preserve the quality of water and aquatic ecosystems and to protect and conserve biodiversity
  - incorporated within the framework of PNSE3, complementary to the ECOPHYTO plan for the reduction of the use of pesticides
  - overarching other “sectoral” plans (PCBs and Pharmaceutical residues in water)
  - more oriented towards preventive strategies rather than end-of-pipe solutions

- 1st objective: “reduce now the emissions of (well-)known micro-pollutants” by
  - limiting the release of pollutants into the aquatic environment
  - educating stakeholders as well as the general public

- 2nd objective: ”strengthen knowledge and improve understanding to respond to the challenge of micro-pollutants in aquatic ecosystems” by
  - increasing knowledge on sources of emissions and predict the occurrence of micro-pollutants in receiving waters
  - better evaluate their impacts on the quality of water resources and their effects on biodiversity

- 3rd objective: ”Identify and prioritise pollutants for which action is needed“
Thank you for your attention

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In the context of the implementation of the WFD, **biomarkers** and **bioassays** (*in vitro* and *in vivo*) could be used

- as screening tools, as part of the pressures and impacts assessment to help water managers to prioritise water bodies for further investigations
- to establish early warning systems
- to take into account the effects from mixtures of pollutants or chemicals that are not analysed in the first instance (e.g. to support investigative monitoring where causes of a decline of a species are unknown)
- to provide additional support in water and sediment quality assessment
Some recent data on WWTP
What’s the efficiency of different tertiary treatment processes in WWTP?

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<th>O₃ alone</th>
<th>Advanced oxidation process (AOP)</th>
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<td>Metals</td>
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Some recent data on WWTP
Differences in investment and operating costs between treatments

Some recent data on STP
What’s left after tertiary treatment of municipal sewage effluents?

32 water samples (filtered) / 6 STP

- **pyrène**
- **florène**
- **fluoranthrène**
- **phénanthrène**
- **4-NP**
- **cadmium**
- **4-NP1EC**
- **caféine**

- **anthracène**
- **acenaphtène**
- **nordiazépam**
- **aténolol**, **métoprolol**, **diuron**
- **bisoprolol**, **NP1EO**, **atrazine**
- **propanolol**, **acébutolol**, **aspirine**
- **acide fénofibrique**, **NP2EO**
- **clarithromycine**, **dicolfénac**
- **théophylline**
- **BPA**
- **sotalol**

- **chrysène**
- **triphenylène**
- **diazépam**
- **alprazolam**
- **fluméquine**, **ofloxacine**
- **simazine**, **azithromycine**
- **spiramycine**, **kétoprofène**
- **sulfaméthoxazole**
- **carbamazépine**
- **sulfapyridine**
- **naproxène**

- **acenaphthylène**
- **benzo(b+j+k)fluoranthrène**
- **acenaphthylène**
- **benzo(a)anthracène**
- **timolol**, **fluoxétine**
- **triméthoprine**, **sildénafil**
- **amtriptyline**, **nadolol**
- **bromazépam**, **4-t-OP**
- **salbutamol**, **ritonavir**, **β-E2**
- **métronidazole**, **gemfibrozil**
- **roxithromycine**, **oxprénolol**
- **érythromycine**, **4-t-BP**
- **acide phénofibrique**, **E1**
- **tétracycline**, **isopturon**
- **ibuprofène**
- **paracétamol**
- **norfloxacine**

Source: Capdeville *et al.* Plateform presentation, ECHIBIOTEB final restitution workshop, Villeurbanne, 3 February 2015

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