Hodnotenie rizík prítomnosti „netradičných“ polutantov v riekach strednej Európy

AQUA 2014
“Liečivá a drogy vo vodách - normálny stav alebo hrozba do budúcnosti”
12. 6. 2014, Trenčín
85 mio known chemicals
14 mio commercially available
cia. 100.000 in daily use

> 10.000 compounds in environmental samples

45 priority pollutants (chemical status)

Where are we today?

- **Emerging pollutants** (e.g. pharmaceuticals, personal care products, biocides..., transformation products)
  - in daily use
  - widespread
  - not regulated, not systematically monitored
  - often polar, ionic, multi-functional („difficult“)
  - often poorly retained in WWTPs
  - occur in mixtures
  - may exhibit great biological activity
Many chemicals in the environment but only few determine the risk. Toxicity often predominated by unknown or unexpected chemicals. Example:

Predominating toxicant to green algae in Bilina sediments with very high contamination with PAHs from petrochemical industry identified with effect-directed analysis:

Bandow et al., ES&T 2009b
Many chemicals in the environment but only few determine the risk. Example: mixture toxicity of 15 anti-androgenic compounds in typical environmental concentrations (data from 2005):

5 chemicals explain 80% of the risk.
Prioritisation and management needs to focus on these chemicals

(Kortenkamp & Faust, 2010)
However: Rapidly changing Fungicides vinclozoline and procymidone are now forbidden and replaced by other fungicides of unknown anti-androgenic activity. Example: iprodione
Where are we today?

- No good ecological status in most European river basins (WFD)
- Chemicals play a significant role for degradation
- Priority pollutants often do not explain effects \( \Rightarrow \) emerging pollutants?
Danube River Basin District Management Plan 2009

Ecological status and ecological potential

Chemical status
Known vs Unknown
Well investigated vs emerging substances

Adapted from Jorge Rodriguez Romero – DG ENV - SOCOPSE Final Conference, Maastricht, 24 – 26 June 2009
Emerging pollutants in EU environmental policies

• Water Framework Directive (2000/60/EC)
  • River basin specific pollutants
• Drinking Water Directive (98/83/EC)
  – Water Safety Plans
• REAcH (EC Regulation 1907/2006)
• Biocidal Product Directive 98/8/EC (BPD)
  – replaced by EU regulation No 528/2012 from September 1, 2013
• Soil, sludge – « hot », coming soon
• Air – long-range transport, indoor air

- 12 additional PS (proposal incl. diclofenac);
- stricter EQS for four existing priority substances and slightly revised EQS for three others;
- the designation of two existing PS as PHS;
- the introduction of biota standards for several substances;
- provisions to improve the efficiency of monitoring and the clarity of reporting with regard to certain substances behaving as ubiquitous PBT substances.

- WATCH LIST - targeted EU-wide monitoring of substances of possible concern to support the prioritisation process in future reviews of the priority substances list.
Target monitoring: Current status of data collected at EU level

- **2000 to 2008 data**
  - 1151 substances
  - 19946 stations
  - 547161 individual samplings
  - 14,602,873 analyses

- **Water types**
  - 96% River Water
  - 2% Transitional Water
  - 1% Lake Water
  - 1% Coastal Water

- **Matrices covered**
  - 93% whole water
  - 6.3% sediment
  - 0.7% biota

**A closer look:**

- **Benzene**
  - Total measurements: 26,737
  - LOQ missing: 9.7%
  - LOQ not compliant: 2.6%
  - Useful data: 87.8%

- **Cadmium and its compounds**
  - Total measurements: 100,302
  - LOQ missing: 40.3%
  - LOQ not compliant: 58.7%
  - Useful data: 1% (1039)

- **Pentabrominated diphenyl ethers**
  - Total measurements: 536
  - LOQ missing: 1.5%
  - LOQ not compliant: 98.5%
  - Useful data: 0%

*Data Quality Study (ENV, 2010)*
NORMAN – Network of reference laboratories, research centres and related organisations for monitoring of emerging environmental substances

- Former EU-funded project, established as a permanent network (NORMAN Association) since 2009
- >55 members from EU leading organisations (from 19 European countries and Canada)

Mission:
- Exchange information on emerging substances
- Improve data quality
- Promote synergies among research teams

http://www.norman-network.net
Some achievements:

Working Groups: WG1) Prioritisation; WG2) Bioassays; WG3) Effect-Directed Analysis; WG4) Engineered nanoparticles; WG5) Wastewater; WG6) Indoor air

Databases: EMPODAT: Occurrence and (eco)toxicity data; NORMAN MassBank: Mass spectra => identification of unknowns

NORMAN Protocol for methods’ validation:
under negotiation at CEN

Interlaboratory studies: e.g. Perfluorinated comp. (2010); Passive sampling for emerging contaminants (2011); Organophosphorous flame retardants (2012); Non-target screening (2013)…

10 Thematic international workshops
Position papers
NORMAN Bulletin

http://www.norman-network.net
NORMAN activities to identify the relevant emerging pollutants

Prioritisation

Target screening

Relevant pollutants

Effect-Directed Analysis

Non-target screening

Usage data/Use index

Databases:
- Monitoring
- Toxicity Properties data

NORMAN Validation protocol
- Measurement methods

NORMAN Massbank – identification of unknowns

NORMAN Monitoring Toxicity Properties data
Effect-directed analysis (→ field-based approaches)

Predicted effects based on target monitoring are often different from measured effects

WG on Effect-Directed Analysis (EDA)
⇒ EDA-EMERGE project (ITN Marie Curie)

- Effect monitoring at site level
- No *a priori* knowledge on or selection of compounds required
- Applicable to any matrix (water, sediments, biota, ...)

![Diagram showing the process of environmental contamination, fractionation, chemical analysis, biological analysis, and toxicant confirmation.](image-url)
A harmonised format for data collection: EMPODAT DCTs

Network of reference laboratories, research centres and related organisations for monitoring of emerging environmental substances

Data collection templates (DCTs)

Uploading Bulk Data

To submit a bulk data a set of specific templates has been prepared. For each ecosystem/matrix two templates are available – for individual and for aggregate data. Each template contains several worksheets:

- Instructions – with basic explanation of each item in worksheets;
- Data source – where information about the data provider, laboratory and references should be inserted;
- Analysis – to enter information on sampling station, measured values and other relevant metadata;
- Analytical method – to enter information about analytical methods used for each determinant.

According to the ecosystem/matrix and type of data (individual/aggregate) an appropriate template should be filled in and sent to the following e-mail address: norman@el.sk with copy to slobodnik@el.sk for further processing and upload to the web-database.

It is particularly important to fill in all obligatory fields in order to facilitate proper work of the Search function in the database.

Please download the templates relevant for your data:

<table>
<thead>
<tr>
<th>Ecosystem/matrix</th>
<th>Individual data</th>
<th>Aggregate data</th>
<th>Bioassays Monitoring data</th>
<th>Bioassays Ecotoxicity studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Zip Date: 2012-01-15 File size: 1.16 MB</td>
<td>Zip Date: 2009-05-03 File size: 2.59 MB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biota</td>
<td>Rar Date: 2013-04-01 File size: 1 MB</td>
<td>Rar Date: 2013-04-01 File size: 1.38 MB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediments</td>
<td>Rar Date: 2013-04-01 File size: 825.54 kB</td>
<td>Rar Date: 2013-04-01 File size: 800.21 kB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sewage Sludge</td>
<td>Rar Date: 2013-04-01 File size: 938.29 kB</td>
<td>Rar Date: 2013-04-01 File size: 869.45 kB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil</td>
<td>Rar Date: 2013-04-01 File size: 828.48 kB</td>
<td>Rar Date: 2013-04-01 File size: 846.61 kB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPM</td>
<td>Rar Date: 2013-04-01 File size: 905.36 kB</td>
<td>Rar Date: 2013-04-01 File size: 1003.12 kB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Score according to the metadata provided by the supplier

• Limit of quantification ?
• Limit of detection ?
• Validation of the method ?
• Analytical method ?
• Sample preparation method ?
• Was the field blank checked ?
• Participation in Interlab studies ?
• .....
Categorisation - what are the actions needed?

Emerging substances

Prioritisation within each category
Why emerging? What are the priorities?

1. Sufficient exposure/hazard info - risk: Candidate PS/RBSP
   - Sufficient exposure/hazard info – no risk: Reduce monitoring efforts

2. Lack of exposure info: Screening campaigns

3. Lack of ecotox info: Hazard assessment (PNEC)

4. LOQ > PNEC/EQS: Improvement of analytical methods

5. Lack of exposure AND ecotox info: Screening AND hazard assessment

6. Sufficient exposure/hazard info – no risk: Reduce monitoring efforts
LIST OF EMERGING SUBSTANCES (NORMAN list)

- ≥ 4 countries AND ≥ 100 sites with analysis
- ≥ 20 sites analysis > LOQ in the relevant matrix(ces) + Recent data (>last 6 years) ?

- Insuff. (or never) monitored OR monitored in „wrong“ matrix
- Suff. monitored but low frequency of quantification
- Suff. monitored. & quantif. in relevant matrix

LOQmax< PNEC (existing data in EMPODAT) ?

- yes
- no

LOQmin (EMPODAT) OR LOQ expert labs < PNEC ?

- yes
- no

Risk of exceedance of the Lowest PNEC ?

- yes
- no

Sufficient experimental data for hazard assessment?

- yes
- no

Cat. 2: Watch list

Cat. 4: Action analytical

Cat. 5

Cat. 6: Non-priority for regular monitoring

Cat. 1: Priority regular monitoring

Cat. 3: Action (eco)tox

Novel end points
NORMAN Prioritisation criteria*

- **Exposure relevance:**
  - N° of countries/sites with analyses > LOQ, frequency of quantification
  - Use pattern

- **(Eco)toxicological relevance / Hazardous properties:**
  - PBT, vPvB criteria
  - CMR properties
  - Endocrine disruption potential
  - Novel end points (behavioural effects)

- **Risk indicators:**
  - Frequency of exceedence of the PNEC (spatial exposure)
  - Extent of exceedance of the PNEC (intensity of impact)

Risk indicators

- To address the intensity of impact:
  - *Extent of Exceedance* = $\frac{\text{MEC95}}{\text{Lowest PNEC}}$

Where,

- **MEC95** is 95th percentile of the max conc. at each site
- **Lowest PNEC**

Score for „Exceedance of environmental treshold“

- $10 > \frac{\text{MEC95}}{\text{Lowest PNEC}} > 1$.... = 0.1
- $100 > \frac{\text{MEC95}}{\text{Lowest PNEC}} > 10$... = 0.2
- $1000 > \frac{\text{MEC95}}{\text{Lowest PNEC}} > 100$.. = 0.5
- $\frac{\text{MEC95}}{\text{Lowest PNEC}} > 1000$......... = 1
Risk indicators

- To address the spatial exposure aspects:
  - Frequency of Exceedance = \( \frac{n}{N} \)

Where,

- \( n \) is the number of sites with \( \text{MECsite} > \text{Lowest PNEC} \)
- \( N \) is the total number of sites where the substance was measured

Score: value between 0 and 1
- Cat. 1, 3, 6: calculated using RECENT DATA
- Cat. 2, 4, 5: calculated using ALL DATA (all YEARS)
Collected data NORMAN http://www.norman-network.com/empodat/

<table>
<thead>
<tr>
<th>Property</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kow (partit. coeff. octanol/ water)</td>
<td>692 / 707 subst.</td>
</tr>
<tr>
<td>Koc (adsorption coeff.)</td>
<td>691/ 707 subst.</td>
</tr>
<tr>
<td>S (hydrosolubility)</td>
<td>693 / 707 subst.</td>
</tr>
<tr>
<td>Fugacity models</td>
<td>559 / 707 subst.</td>
</tr>
<tr>
<td>PNEC (P-PNEC)\textsubscript{water/ sed/ biota} (experim. data + calculated values *)</td>
<td>707 / 707 subst.</td>
</tr>
<tr>
<td>Monitoring data (EMPODAT database)</td>
<td>&gt;3 500 000 data for 392 substances</td>
</tr>
<tr>
<td>LOQ (analytical performance)</td>
<td>Available in the NORMAN DB + litterature search and expert labs for &gt; 400 substances</td>
</tr>
<tr>
<td>Classification</td>
<td>PBT, vPvB, CMR, ED 693 /707</td>
</tr>
</tbody>
</table>

* *kNN read-across methodology, Schüürmann et al. 2011, EST DOI:10.1021/es200361r*
### NORMAN Framework: Prioritisation of substance by action needed

<table>
<thead>
<tr>
<th>Cat. 1</th>
<th>Cat. 2</th>
<th>Cat. 3</th>
<th>Cat. 4</th>
<th>Cat. 5</th>
<th>Cat. 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total water</td>
<td>24</td>
<td>119</td>
<td>19</td>
<td>39</td>
<td>219</td>
</tr>
</tbody>
</table>

#### Number of substances by action categories

- **Mitigation measures**
- **Monitoring campaigns**
- **Improve ecotox**
- **Improve analytics**
- **Improve exp & ecotox**
- **Non priority**

262 substances: not yet allocated to an action category
## Prioritisation - list of candidate substances proposed for Category 1 in water

<table>
<thead>
<tr>
<th>Substance</th>
<th>CAS No#</th>
<th>Ranking (recent data)</th>
<th>Ranking (recent + old data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Di-n-butylphthalate (DBP)</td>
<td>84-74-2</td>
<td>4,62</td>
<td>4,99</td>
</tr>
<tr>
<td>Perfluorooctane sulfonate (PFOS) - anion</td>
<td>45298-90-6</td>
<td>3,88</td>
<td>3,97</td>
</tr>
<tr>
<td>Diclofenac</td>
<td>15307-86-5</td>
<td>3,96</td>
<td>3,83</td>
</tr>
<tr>
<td>Terbuthylazine</td>
<td>5915-41-3</td>
<td>3,53</td>
<td>3,46</td>
</tr>
<tr>
<td>Diazinon</td>
<td>333-41-5</td>
<td>3,07</td>
<td>3,34</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>15687-27-1</td>
<td>3,18</td>
<td>2,90</td>
</tr>
<tr>
<td>Terbutryn</td>
<td>886-50-0</td>
<td>2,4</td>
<td>2,40</td>
</tr>
<tr>
<td>Chlorotoluron</td>
<td>15545-48-9</td>
<td>0,56</td>
<td>1,07</td>
</tr>
<tr>
<td>Triclosan</td>
<td>3380-34-5</td>
<td>1,5</td>
<td></td>
</tr>
<tr>
<td>Dichlorvos</td>
<td>62-73-7</td>
<td>0,78</td>
<td>2,57</td>
</tr>
<tr>
<td>Carbendazim</td>
<td>10605-21-7</td>
<td>1,91</td>
<td>2,50</td>
</tr>
<tr>
<td>MCPA</td>
<td>94-74-6</td>
<td>1,03</td>
<td>1,34</td>
</tr>
<tr>
<td>Chloridazon</td>
<td>1698-60-8</td>
<td>0,52</td>
<td>0,60</td>
</tr>
<tr>
<td>Metamitron</td>
<td>41394-05-2</td>
<td>0,55</td>
<td>0,57</td>
</tr>
</tbody>
</table>
Triclosan—the forgotten priority substance?

Peter Carsten von der Ohe, Mechthild Schmitt-Jansen, Jaroslav Slobodnik, Werner Brack

A new risk assessment approach for the prioritization of 500 classical and emerging organic microcontaminants as potential river basin specific pollutants under the European Water Framework Directive

Peter Carsten von der Ohe, Valeria Dulio, Jaroslav Slobodnik, Eric De Deckere, Ralph Kühne, Ralf-Uwe Ebert, Antoni Ginebreda, Ward De Cooman, Gerrit Schüürmann, Werner Brack

A harmonized European framework for method validation to support research on emerging pollutants

David Schwesig, Ulrich Borchers, Laure Chancerelle, Valeria Dulio, Ulla Eriksson, Marinella Farré, Anders Goksoyr, Marja Lamoree, Pim Leonards, Peter Lepom, Dean Leverett, Anne O’Neill, Rod Robinson, Katarina Silharova, Jaroslav Slobodnik, Peter Tolgyessy, Renaud Tutundjian, Jan-Willem Wegener, David Westwood
3-step approach for identifying relevant contaminants for water monitoring programmes in France

- **Screening study** (1 every 6 years)
- **Regular monitoring of selected substances**
- **Consolidating datasets (longer time series)**
- **River Basin Specific Pollutants & Input to EU for PS review**

**Wide-scope screening study**

*Investigation of occurrence levels (snapshot)*

**Watch list (6 years)**

**Monitoring of RBSPs** (update every 6 years)
A combination of monitoring tools for

- Sampling + chemical analysis of water and sediment samples at all river, lake and coastal sites
- Passive sampling (POCIS) in 20 rivers and at all 40 coastal sites
- Bioassays (in vitro & in vivo) and biomarkers (gudgeon) at 20 river sites

- Improving knowledge of the occurrence of a substance in the water / sediment compartments
- Combining biological & chemical data for selected sites (test this approach for future surveillance)

Total budget 2.9 M€
Non-target screening

- Samples of water/sediment/biota/soil/air screened with GC-MS and/or LC-accurate mass-MS
- Data stored in NORMAN MassBank
- Provisional identification of substances present in samples
- Derivation of provisional PNECs using QSAR
- Prioritisation based on occurrence and toxicity
- Top listed non-target substances → target monitoring

NORMAN MassBank database
http://massbank.normandata.eu/Massbank
NORMAN MassBank – “let’s share the knowns and focus on the unknowns”

- **VISION** => bringing together community of environmental chemists and set up of a common and open access mass spectral database for identification purposes.

- Upgrade of the former NORMAN EMPOMASS database => hosted and maintained by UFZ, Leipzig
- NORMAN joined MassBank consortium (existing global platform *) in 2012
- Members of the NORMAN network committed to provide mass spectra to fill up the database
- Training workshop on the use of NORMAN MassBank 27 November 2012, Amsterdam

*MassBank Horai et al., 2010; www.massbank.jp
Identification of river basin specific pollutants and derivation of environmental quality standards: A case study in the Slovak Republic

Jaroslav Slobodník, Lea Mráfková, Mario Carere, Fulvio Ferrara, Bruno Pennelli, Gerrit Schüermann, Peter Carsten von der Ohe

Following the requirements of the European Water Framework Directive (WFD), a process of selecting relevant dangerous substances and developing related Pollution Reduction Programme (PRP) has started in the Slovak Republic in 2001. Based on the results of a three years investigative screening campaign, 59 chemical substances were identified as relevant dangerous substances in 2004 and included in the national PRP. This study describes two independent prioritization approaches that have been applied to revise the list of relevant dangerous substances in 2010. The first approach was using a classification system based on the occurrence monitoring data of these substances combined with self-monitoring data by industries on their emissions into wastewaters and data on production/usage of chemicals and agricultural pesticides. As an outcome, 41 of the 59 relevant substances were proposed to be retained in the updated PRP. The second approach was based on the evaluation of the Frequency of exceedance and the Extent of exceedance of environmental thresholds, referred to as predicted no effect concentrations (PNEC), for all organic compounds monitored in the river systems of the Slovak Republic from 2001 to 2010, with exclusion of WFD priority substances (PS). The results showed that 18 of 87 monitored compounds deserve closer attention in future revisions of the list, out of which 11 pollutants were
Non-target screening

Priority based on GC-MS screening:

<table>
<thead>
<tr>
<th>No.</th>
<th>CAS</th>
<th>Name</th>
<th>Max. conc.</th>
<th>MEC&lt;sub&gt;aa&lt;/sub&gt;</th>
<th>AA-EQS&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Source EQS</th>
<th>Lowest PNEC</th>
<th>Ref&lt;sup&gt;c&lt;/sup&gt;</th>
<th>TL&lt;sup&gt;d&lt;/sup&gt;</th>
<th>Freq. PNEC&lt;sup&gt;e&lt;/sup&gt;</th>
<th>Exceed. PNEC&lt;sup&gt;e&lt;/sup&gt;</th>
<th>Priority&lt;sup&gt;e&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>629-62-9</td>
<td>Pentadecane</td>
<td>1.7</td>
<td>1.5</td>
<td>2</td>
<td>SK</td>
<td>0.0015</td>
<td>B</td>
<td>A</td>
<td>0.20</td>
<td>1000</td>
<td>1.20</td>
</tr>
<tr>
<td>2</td>
<td>544-76-3</td>
<td>Hexadecane</td>
<td>3.6</td>
<td>2.4</td>
<td></td>
<td></td>
<td>0.0015</td>
<td>P</td>
<td>F</td>
<td>0.17</td>
<td>1600</td>
<td>1.17</td>
</tr>
<tr>
<td>3</td>
<td>95-16-9</td>
<td>Benzthiazole</td>
<td>30,958</td>
<td>4459</td>
<td></td>
<td></td>
<td>0.021</td>
<td>B</td>
<td>F</td>
<td>0.12</td>
<td>2230</td>
<td>1.12</td>
</tr>
<tr>
<td>4</td>
<td>57-10-3</td>
<td>Hexadecanoic acid</td>
<td>15</td>
<td>3.7</td>
<td></td>
<td></td>
<td>0.023</td>
<td>B</td>
<td>F</td>
<td>0.53</td>
<td>176</td>
<td>1.03</td>
</tr>
<tr>
<td>5</td>
<td>629-50-5</td>
<td>Tridecane</td>
<td>8.0</td>
<td>10</td>
<td></td>
<td></td>
<td>0.74</td>
<td>B</td>
<td>F</td>
<td>0.50</td>
<td>187</td>
<td>1.00</td>
</tr>
<tr>
<td>6</td>
<td>84-74-2</td>
<td>Di-&lt;i&gt;n&lt;/i&gt;-butylphthalate (DBP)</td>
<td>60</td>
<td>22</td>
<td></td>
<td></td>
<td>0.96</td>
<td>E</td>
<td>F</td>
<td>0.77</td>
<td>30</td>
<td>0.97</td>
</tr>
<tr>
<td>7</td>
<td>117-81-7</td>
<td>DEHP</td>
<td>272</td>
<td>46</td>
<td></td>
<td></td>
<td>0.0095</td>
<td>B</td>
<td>P</td>
<td>0.25</td>
<td>232</td>
<td>0.83</td>
</tr>
<tr>
<td>8</td>
<td>629-59-4</td>
<td>Tetradecane</td>
<td>4.3</td>
<td>2.2</td>
<td></td>
<td></td>
<td>0.009</td>
<td>P</td>
<td>D</td>
<td>0.21</td>
<td>622</td>
<td>0.83</td>
</tr>
<tr>
<td>9</td>
<td>112-40-3</td>
<td>Dodecane</td>
<td>6.8</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.04</td>
<td>P</td>
<td>A</td>
<td>0.12</td>
<td>188</td>
<td>0.62</td>
</tr>
<tr>
<td>10</td>
<td>1002-84-2</td>
<td>Pentadecanoic acid</td>
<td>9.0</td>
<td>5.0</td>
<td></td>
<td></td>
<td>0.05</td>
<td>P</td>
<td>A</td>
<td>0.36</td>
<td>38</td>
<td>0.56</td>
</tr>
<tr>
<td>11</td>
<td>544-63-8</td>
<td>Tetradecanoic acid</td>
<td>6.8</td>
<td>5.0</td>
<td></td>
<td></td>
<td>0.092</td>
<td>B</td>
<td>D</td>
<td>0.36</td>
<td>28</td>
<td>0.56</td>
</tr>
<tr>
<td>12</td>
<td>4130-42-1</td>
<td>Phenol, 2,6-bis[1,1-dimethylthyl]-4-ethyl</td>
<td>4.3</td>
<td>2.2</td>
<td></td>
<td></td>
<td>0.27</td>
<td>E</td>
<td>A</td>
<td>0.22</td>
<td>10</td>
<td>0.42</td>
</tr>
<tr>
<td>13</td>
<td>85-68-7</td>
<td>Benzyldihydroxyphenylphthalate (BBP)</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.08</td>
<td>P</td>
<td>F</td>
<td>0.20</td>
<td>31</td>
<td>0.40</td>
</tr>
<tr>
<td>14</td>
<td>143-07-7</td>
<td>Dodecaneic acid</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.9</td>
<td>P</td>
<td>F</td>
<td>0.26</td>
<td>4</td>
<td>0.36</td>
</tr>
<tr>
<td>15</td>
<td>84-69-5</td>
<td>Diisobutyl phthalate</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.013</td>
<td>B</td>
<td>F</td>
<td>0.15</td>
<td>58</td>
<td>0.35</td>
</tr>
<tr>
<td>16</td>
<td>57-19-4</td>
<td>Octadecanoic acid</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.36</td>
<td>E</td>
<td>D</td>
<td>0.12</td>
<td>56</td>
<td>0.32</td>
</tr>
<tr>
<td>17</td>
<td>92-52-4</td>
<td>Biphenyl</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.032</td>
<td>B</td>
<td>F</td>
<td>0.12</td>
<td>56</td>
<td>0.32</td>
</tr>
<tr>
<td>18</td>
<td>2091-29-4</td>
<td>9-hexadecenoic acid</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.14</td>
<td>E</td>
<td>D</td>
<td>0.15</td>
<td>1.86</td>
<td>0.25</td>
</tr>
<tr>
<td>19</td>
<td>120-72-9</td>
<td>9-indole</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.31</td>
<td>P</td>
<td>D</td>
<td>0.05</td>
<td>12</td>
<td>0.25</td>
</tr>
<tr>
<td>20</td>
<td>128-37-0</td>
<td>Melatonin</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.08</td>
<td>E</td>
<td>D</td>
<td>0.08</td>
<td>9</td>
<td>0.18</td>
</tr>
<tr>
<td>21</td>
<td>615-22-5</td>
<td>Cholesterol</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.26</td>
<td>P</td>
<td>A</td>
<td>0.07</td>
<td>3</td>
<td>0.17</td>
</tr>
<tr>
<td>22</td>
<td>1620-98-9</td>
<td>9,10-dehydrodihydroxy-14-ethylphe in</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>1.2</td>
<td>D</td>
<td>F</td>
<td>0.04</td>
<td>6</td>
<td>0.14</td>
</tr>
<tr>
<td>23</td>
<td>334-27-9</td>
<td>Undecane</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>2.4</td>
<td>E</td>
<td>F</td>
<td>0.02</td>
<td>2</td>
<td>0.12</td>
</tr>
<tr>
<td>24</td>
<td>208-01-0</td>
<td>Undecane</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.0024</td>
<td>F</td>
<td>P</td>
<td>0.11</td>
<td>1</td>
<td>0.11</td>
</tr>
<tr>
<td>25</td>
<td>982-21-4</td>
<td>Undecane</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.083</td>
<td>P</td>
<td>D</td>
<td>0.10</td>
<td>10</td>
<td>0.10</td>
</tr>
<tr>
<td>26</td>
<td>1097-30-5</td>
<td>Undecane</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.0005</td>
<td>P</td>
<td>D</td>
<td>0.10</td>
<td>10</td>
<td>0.10</td>
</tr>
<tr>
<td>27</td>
<td>1838-21-4</td>
<td>Undecane</td>
<td>9.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td>0.024</td>
<td>P</td>
<td>D</td>
<td>0.07</td>
<td>1</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Based on 169 surface-water and waste-water samples!
Joint Danube Survey 3
ICPDR, the biggest river expedition in the world
11 August – 26 September 2013, 11 countries
http://danubesurvey.org/news
Passive sampling in the JDS3

- “Active” passive sampler system on board of the expedition ship + collection of sediment/SPM at highly relevant sites
- Temporally- and spatially- integrative sampling approach - defined stretches
- Passive samplers for hydrophobic and for polar compounds

- Target analysis for priority substances + relevant river basin specific compounds
- Non-target screening analysis (GC-TOF-MS; LC-HR-MS(MS))
- Toxicity profiling – set of bioassays harmonised with EDA EMERGE project
TARGET SCREENING (QUANT)

29 PESTICIDES

14 OTHER MEDICAL DRUGS

7 PCPP

78 ILlicit AND OTHER DRUGS

40 NEUROLOGY DRUGS

Rainy day 20.08.2014
26.08.2014.
12.09.2014.
TARGET SCREENING (QUANT)

After weekend, 19.08. monday - JDS 9 Vienna, 26.08. monday – JDS 22 Budapest, 03.09. thursday – JDS 33 Novi Sad
NON-TARGET SCREENING (QUAL)
### Suspect screening - JDS 58

**phase I - MS only**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquired Time</td>
<td>104.950</td>
<td>184.951</td>
<td>0.190</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Name</td>
<td>250.000</td>
<td>395.001</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Version</td>
<td>3.760</td>
<td>5.760</td>
<td>4.340</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cpd 214: Spectinomycin**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cpd 39: Ambenoxan**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cpd 227: Nifedipine**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Desmethyltramadol**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cpd 129: Esculin**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cpd 64: Dinaline**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cpd 38: Embelin**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Desmethyltramadol**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cpd 68: N-phosphatindanone**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hexenal**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sulfamethoxazole**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Urapidil**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hydroxyacetophenone**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**1-(3-Pyridinyl)-1,4-aspirin (Acetylsalicylic acid)**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**9-Riburonosyladenine**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fenchlorazole**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**2-Aminobenzimidazole**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Metoprolol**

<table>
<thead>
<tr>
<th>Component</th>
<th>RT (min)</th>
<th>Mass (m/z)</th>
<th>Abund.</th>
<th>Name</th>
<th>Formula</th>
<th>Td Match</th>
<th>MS Match</th>
<th>DR Formula</th>
<th>DR Match (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Suspect screening - JDS 58 phase II -All Ions

### Compounds Table

<table>
<thead>
<tr>
<th>Label</th>
<th>Tgt Name</th>
<th>Tgt Score</th>
<th>Tgt Error (ppm)</th>
<th>MFP Formula</th>
<th>Tgt Formula</th>
<th>Obs. RT</th>
<th>Ref Mass</th>
<th>Obs. Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-C4</td>
<td>ANG-1</td>
<td>49.9</td>
<td>7.03</td>
<td>C1</td>
<td>33.15</td>
<td>10.45</td>
<td>17.20</td>
<td>17.68</td>
</tr>
<tr>
<td></td>
<td>ANG-2</td>
<td>50.8</td>
<td>1.23</td>
<td>C1</td>
<td>33.15</td>
<td>9.43</td>
<td>16.89</td>
<td>17.38</td>
</tr>
<tr>
<td></td>
<td>ANG-3</td>
<td>50.7</td>
<td>0.85</td>
<td>C1</td>
<td>33.15</td>
<td>9.22</td>
<td>16.89</td>
<td>17.31</td>
</tr>
<tr>
<td></td>
<td>ANG-4</td>
<td>50.8</td>
<td>2.36</td>
<td>C1</td>
<td>33.15</td>
<td>10.45</td>
<td>17.24</td>
<td>17.68</td>
</tr>
<tr>
<td></td>
<td>ANG-5</td>
<td>50.8</td>
<td>1.45</td>
<td>C1</td>
<td>33.15</td>
<td>9.43</td>
<td>16.89</td>
<td>17.34</td>
</tr>
<tr>
<td></td>
<td>ANG-6</td>
<td>50.9</td>
<td>2.02</td>
<td>C1</td>
<td>33.15</td>
<td>10.45</td>
<td>17.22</td>
<td>17.68</td>
</tr>
</tbody>
</table>

### Data File

- **Data File**: `ALLMS_JDS_58_.d`
- **Sample Name**: `ALLMS_JDS_58`
- **Sample Type**: `Sample Position P1-C4`
- **Instrument Name**: `QTOF1`
- **User**: `DA`
- **Key Method**: `DA Method`
- **DNH Calculation Status**: `HEL FM/In`
- **Acquisition Time**: `2013-07-16 13:57:19`
- **Comment**: `Data File ALLMS_JDS_58_.d Sample Name ALLMS_JDS_58`

### Molecule Formulas

- **Molecule 1**: `C41 H67 N O15`
- **Molecule 2**: `C8 H15 N5 O`
- **Molecule 3**: `C4 H6 N4 O12`
- **Molecule 4**: `C9 H8 I N O3`
- **Molecule 5**: `C14 H9 Cl O3`
- **Molecule 6**: `C11 H13 N3 O`
- **Molecule 7**: `C10 H6 Cl4 O4`
- **Molecule 8**: `C10 H15 N O`
- **Molecule 9**: `C12 H17 N O3`
Unknown screening - JDS 58

Digital Data Banking
Aims:

• To provide screening of urban and industrial waste water streams for identification of major polluters and discharged substances

→ Prioritisation of most relevant “Bosna RBSPs” and establishment of emission limit values for major polluters
Priority rank of the 11 polluters based on non-target analysis

<table>
<thead>
<tr>
<th>SITE</th>
<th>CAS</th>
<th>Compound Name</th>
<th>Conc</th>
<th>Lowest PNEC</th>
<th>Exce.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-1</td>
<td>107304-12-1</td>
<td>Stigmanstan-6,22-dien, 3,5-dedihydro-</td>
<td>0.0016</td>
<td>0.00036</td>
<td>4</td>
</tr>
<tr>
<td>I-1</td>
<td>57-88-5</td>
<td>cholesterol</td>
<td>0.0014</td>
<td>0.00053</td>
<td>3</td>
</tr>
<tr>
<td>I-2</td>
<td>207-08-9</td>
<td>benzo[k]fluoranthene</td>
<td>0.0021</td>
<td>0.00017</td>
<td>12</td>
</tr>
<tr>
<td>I-2</td>
<td>205-99-2</td>
<td>Benzo(b)fluoranten</td>
<td>0.0018</td>
<td>0.00017</td>
<td>11</td>
</tr>
<tr>
<td>I-2</td>
<td>57-88-5</td>
<td>cholesterol</td>
<td>0.0045</td>
<td>0.00053</td>
<td>8</td>
</tr>
<tr>
<td>I-3</td>
<td>59-48-3</td>
<td>2H-Indol-2-one, 1,3-dihydro-</td>
<td>50</td>
<td>0.50</td>
<td>100</td>
</tr>
<tr>
<td>I-3</td>
<td>620-92-8</td>
<td>Phenol, 4,4’-methylenebis-</td>
<td>33</td>
<td>1.69</td>
<td>20</td>
</tr>
<tr>
<td>I-3</td>
<td>106-44-5</td>
<td>p-Cresol</td>
<td>28</td>
<td>1.4</td>
<td>20</td>
</tr>
<tr>
<td>I-3</td>
<td>57-11-4</td>
<td>octadecanoic acid</td>
<td>0.03</td>
<td>0.0013</td>
<td>20</td>
</tr>
<tr>
<td>I-3</td>
<td>141-02-6</td>
<td>2-Butenedioic acid (E)-, bis(2-ethylhexyl) ester</td>
<td>0.14</td>
<td>0.0094</td>
<td>14</td>
</tr>
<tr>
<td>I-3</td>
<td>3735-92-0</td>
<td>Carbamodithioic acid, dimethyl-, methyl ester</td>
<td>0.26</td>
<td>0.049</td>
<td>5</td>
</tr>
<tr>
<td>I-3</td>
<td>80-05-7</td>
<td>Bisphenol A</td>
<td>0.27</td>
<td>0.2</td>
<td>1</td>
</tr>
<tr>
<td>I-3</td>
<td>78-51-3</td>
<td>tri(butoxyethyl)phosphate</td>
<td>8.9</td>
<td>6.8</td>
<td>1</td>
</tr>
</tbody>
</table>
Závery

• Tradičné regulované polutanty sú minulosťou a výskyt „netradičných polutantov“ je všeobecne potrdený prioritný problém vo všetkých oblastiach legislatívy životného prostredia.

• Nie je možné vyvinúť potrebné poznatky a metódy iba na národnej úrovni.

• Je nutná dohoda na:
  • Metodológií prioritizácie a následných aktivít
  • Harmonizácia DCTs
  • Kontinuálne vylepšovanie analytickej expertízy a kvality údajov
  • Zavedenie skríningu a EDA na identifikáciu zlúčenín zodpovedných za toxické efekty
  • Vývin nových monitorovacích techník (napr. pasívnych vzorkovačov)
  • Formulácia spoločných názorov a potrieb na výskum ohľadne priorít pre budúcu legislatívu EÚ
  • MEDZINÁRODNÁ SPOLUPRÁCA
• www.norman-network.com
• http://www.solutions-project.eu/
• http://www.ufz.de/eda-emerge/
WORKSHOP
Methodologies for prioritising hazardous chemicals in European waters: the state of play and the need for improvement

Organised jointly by
The NORMAN network and SOLUTIONS

Hosted by
INERIS, France

24–25 June 2014
Cité Universitaire - Paris, France
WORKSHOP
Non-Target Screening
Towards the harmonisation of methods for non-target screening of environmental samples

Organised jointly by
The NORMAN network and SOLUTIONS

Hosted by
EAWAG,
Switzerland
16 September 2014
Zurich