British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

An assessment of micro-organic pollutants in groundwater across England and Wales

Katya Manamsa, Emily Crane, Marianne Stuart, John Talbot and Alwyn Hart

Aim

To examine long term observations from a national database in order to establish if there are relationships between land use and the micro organics that dominate the results. Using UK Environment Agency water quality dataset with observations from 2004 to 2012 we looked for relationships between compounds and land use on national scale.

Method

The dataset contains results from 2650 sites in water quality network for England and Wales. Substantial data cleaning and QA were undertaken which removed less than results, rationalized results by CAS number and eliminated compounds that were detected fewer than 10 times to rule out spurious results.

For land use assessment CORINE land use dataset was used for Europe (EEA, 2006) to assign a land use type to each sampling site. Methodology developed by Lapworth (2012) was used to combine the numerous land use types within CORINE to the 4 listed below).

Four Categories for land use:

- Natural Forest (NF)
- Urban and Industrial (UI)
- Arable (A)
- Pasture/grazing (P)

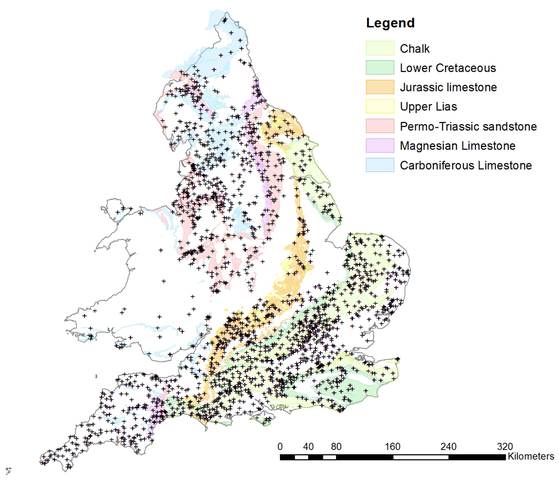
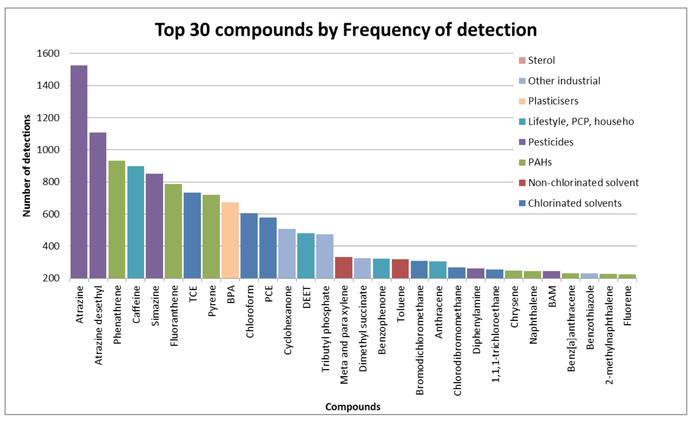


Figure 1 Distribution of sites within network and different aquifers they sample.

Then a land use type was assigned based on the dominant land use type within the 500 m of the site. Only where a land use type was over 60% within the 500 m radius of the site that land use type was assigned. Mixed use was not considered here due to multiple sources for the same compounds, out of 2605 sites 25.11% classed as mixed.

Results

- Pesticides dominate – 3 out of top 5
- A number of PAHs
- Caffeine 4th most detected
- Frequency depends on the use and persistence in the environment (atrazine banned in EU since 2004)



- Dominated by chlorinated solvents 6 out of top 8 and 11 in the top 30
- Absence of PAHs

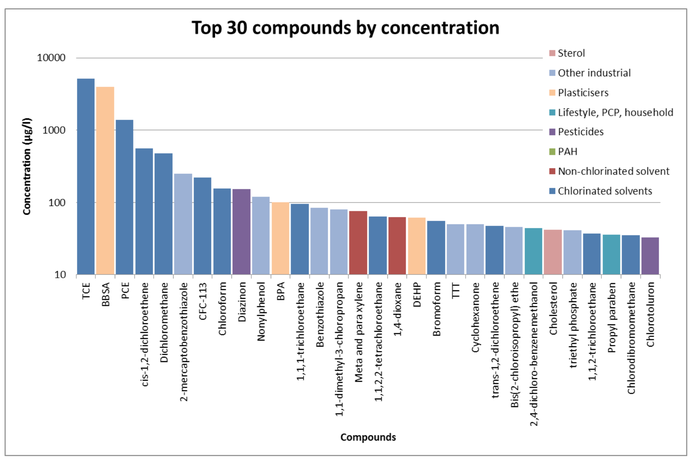


Figure 2 Assessment of overall top 30 compounds in the database based on maximum concentration and frequency of detection.

Land use and percentage detection

- Dominated by solvents.
- Chlorinated solvents are found most frequently in UI, but also in P and A. Chloroform stands out as the compound detected in at least 15% of samples in all of the environments and interestingly with the highest percentage detection of 40% within NF use. This could imply that its origin is within the water treatment process and supports the hypothesis that chloroform is introduced via leakage into aquifers and together with plasticisers these compounds are widely detected in the environment. A has lower % detection of phthalates compared to P overall, however this trend is reversed for TCE.
- Over 10% detection also include chloroform in other 3 environments, xylene in UI, P, NF; 1,1,1 trichloroethane and cis1,2dichloro in UI
- NF lower phthalates compared to P overall, however this trend is reversed for TCE.
- Caffeine and DEET only found within NF
- CFC are likely to be overestimated

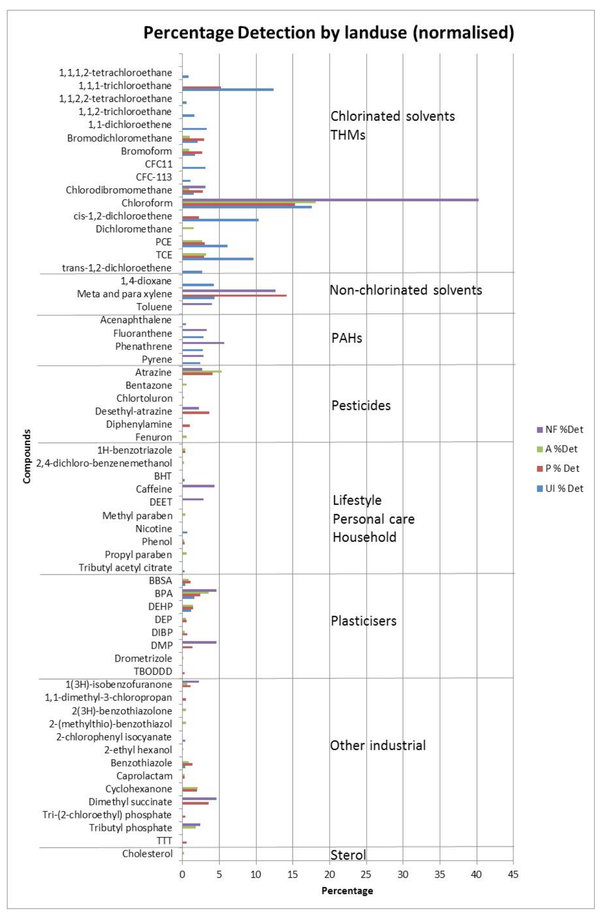


Figure 4 Percentage detection of the top 30 most frequently detected compounds (normalised).

Land use and maximum concentration

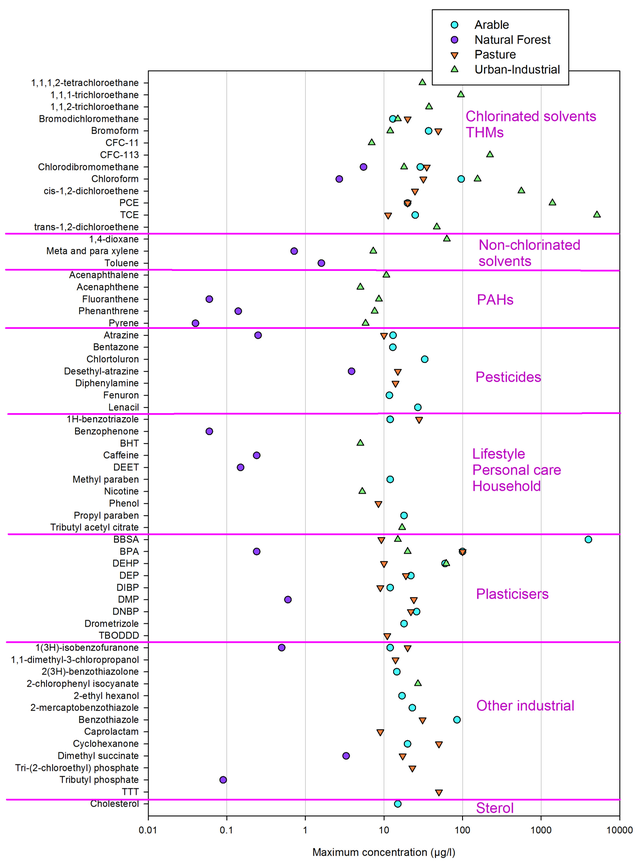


Figure 3 Maximum concentration of the top 30 compounds for different land use types grouped by types of compounds.

Plasticisers and Chlorinated solvents present in all 4 categories. Pesticides present in Arable (A) and Pasture (P)

TCE highest record overall (Urban Industrial) followed by BBSA (Arable) with Natural Forest having lowest concentration for pyrene.

Chloroform concentrations illustrate the pattern with the highest concentrations found in UI (155 µg/l) followed by A (96 µg/l), P (31.7 µg/l) and NF (2.7 µg/l). BPA follows a similar pattern with NF having the lowest concentration of 0.24 µg/l, 2 magnitudes lower than UI at 20 µg/l and 5 times lower than A and P both at 100 µg/l.

National Forest (NF)

- only 18 compounds
- has lower concentrations overall
- lowest maximum concentrations (5.5 µg/l for chlorodibromomethane)
- most concentrations under 1 µg/l

Urban Industrial (UI)

- 13 compounds not found in top 30 for other land use types
- accounts for the highest overall concentration (5000 µg/l)

Conclusions

- High concentrations of chlorinated solvents dominate the national picture
- Nationally frequency of detects dominated by pesticides and PAHs
- When looking at land use solvents dominate
- NF has lower concentrations & fewer compounds
- UI has highest concentrations and compounds not found in other land use types
- Chloroform dominating all of the land use types
- DEET & Caffeine – frequency of detection on national scale (<5%)
- Inclusion of information linked to laboratory methods and numbers of monitoring network sites changes for long term trend analysis in national scale long term monitoring datasets is highly beneficial to establishing developments of long term trends.

For further information

Katya Manamsa katy1@bgs.ac.uk www.bgs.ac.uk