

DO YOU KNOW NORMAN?

“Are you involved in research on the occurrence and environmental effects of emerging substances? Or are you concerned with the assessment and management of the risks associated with them? If so, you are a potential stakeholder in the NORMAN network.”
[\(http://www.norman-network.net/\)](http://www.norman-network.net/)



The major focus of much of the activities of environmental authorities to date has been to identify, measure and remediate traditional pollutants in the environment. However as analytical techniques have developed in terms of selectivity and sensitivity the range and complexity of compounds detected in environmental analysis has increased dramatically and attention is now being focussed on emerging environmental contaminants. These are not necessarily new chemicals but may be substances that have long been present in the environment but whose presence and significance are only now being elucidated through developments in modern analytical techniques and data analysis software. Emerging contaminants include perfluorinated compounds, nanomaterials, pharmaceuticals, illicit drugs, antibacterials, hormones, flame retardants, artificial sweeteners, benzotriazoles and bio toxins. Moreover, many of these contaminants can be transformed in the environment from processes such as metabolism, microbial degradation, photolysis, and hydrolysis, and they can also react with disinfectants in drinking water or wastewater treatment to form disinfection by-products.

This poses a major problem for researchers and regulators tasked with ascertaining the toxicity and risks associated with these compounds and this was the prime reason for the establishment of the NORMAN network.

The recent progress of the scientific community in analytical techniques and innovative monitoring tools, together with efficient systems for data archiving and data treatment, will dramatically improve our knowledge of emerging substances. In this context, NORMAN fosters the exchange of information, validation and harmonization of protocols in view of future implementation of these new tools into policy.

NORMAN Overview

The NORMAN network was established in 2005 with financial support from the European Commission and in 2009 it became a permanent self-sustaining network of reference laboratories, research centres and related organisations for the monitoring and biomonitoring of emerging environmental substances.

The stated mission of the NORMAN network is to:

- Enhance the exchange of information and collection of data on emerging environmental substances.
- Encourage the validation and harmonisation of common measurement methods and monitoring tools so that the demands of risk assessors can be better met.
- Ensure that knowledge of emerging pollutants is maintained and developed by stimulating coordinated, interdisciplinary projects on problem-oriented research and knowledge transfer to address identified needs.

To achieve this the network organises a range of activities, including expert group meetings, workshops, databases and methods validation exercises, all of which are included in its Annual Joint Programmes of Activities.

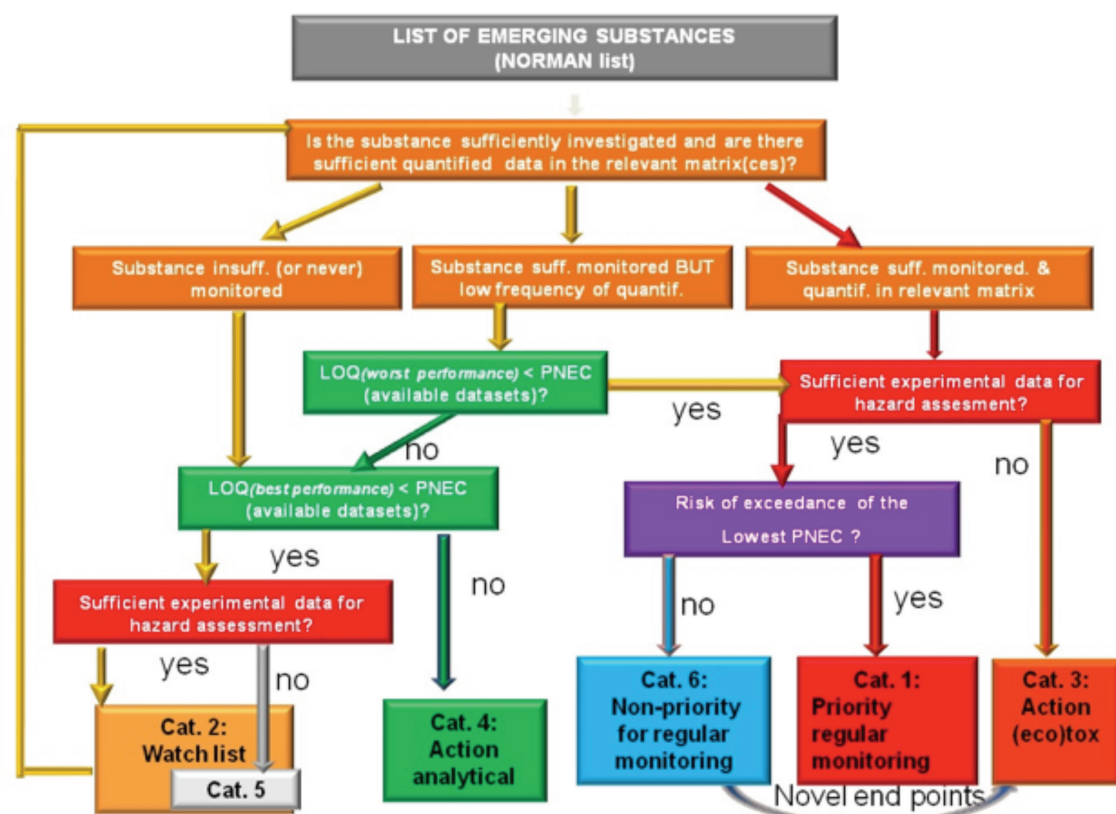


Figure 1: The NORMAN decision tree for categorising emerging substances. Reproduced with permission from NORMAN.

The range of activities undertaken and the output from NORMAN is extensive and cannot be fully covered in an overview article where we are looking at the key features of the network and readers are advised to visit the excellent network website where details of all the activities and outputs can be found. (<http://www.norman-network.net>)

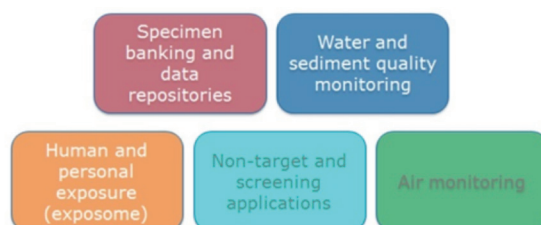


Figure 2: Present and future passive sampler applications and cross-working group activities within the NORMAN association. Reproduced with permission from NORMAN.

NORMAN Working Groups

The NORMAN network runs six, topic-based working groups dealing with issues related to emerging substances and two horizontal working groups. The current working groups are:

Working Group 1: – Prioritisation of Emerging Substances

This group focuses on the identification of the substances that pose the greatest threat to ecosystems and human health. A rational strategy for prioritisation is needed to close existing knowledge gaps as many chemicals of emerging concern cannot currently be satisfactorily evaluated or may even be overlooked by conventional prioritisation methods. The NORMAN method combines the ranking process with a prior allocation of the substances into action categories, which allows substances to be managed based on the level of available information, thereby avoiding the exclusion or discrimination of substances for which there are limited data. Figure 1 shows the flow chart for the NORMAN prioritisation process.

Working Group 2: - Bioassays and biomarkers in water quality monitoring

This group studies the value of bioassays and biomarkers in water monitoring programmes and develops strategies for the interpretation of results based on sharing data and experience via NORMAN databases and workshops. The group aims to define and harmonize the interpretation of results gained within monitoring studies using bioassays with a view to determine what they can or cannot tell about our water quality and how decision-makers can use the results.

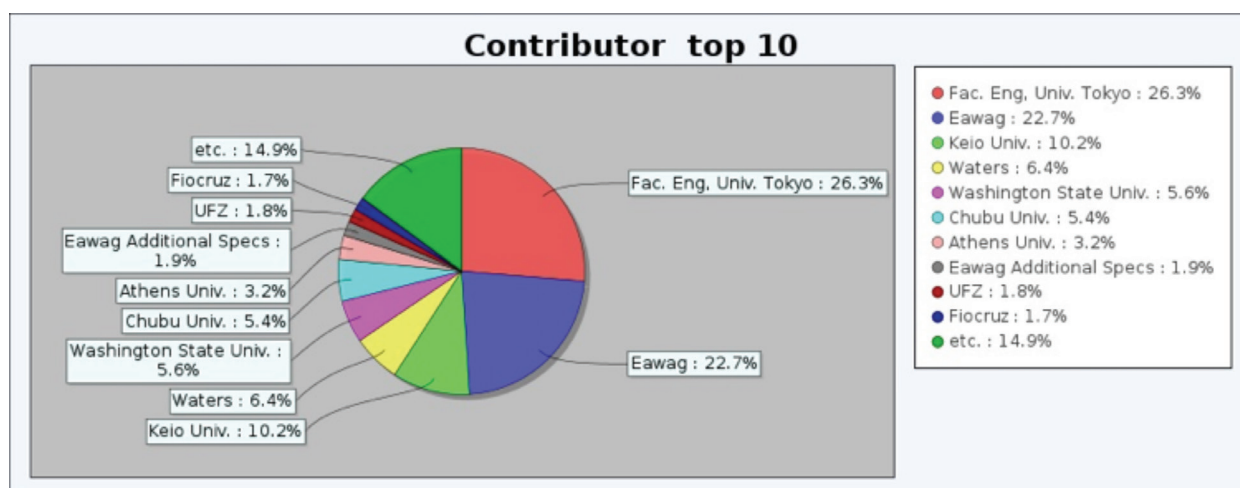


Figure 3: the top 10 laboratories who have contributed to the NORMAN MassBank mass spectral database. Reproduced with permission from the NORMAN Network.

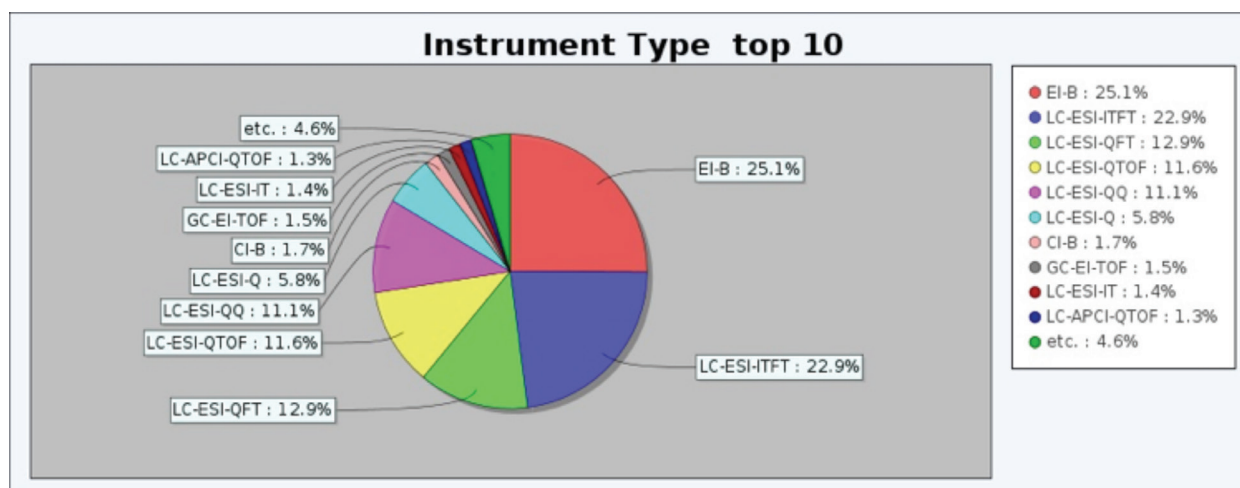


Figure 4: the top 10 instrument combinations which have employed to contribute to the NORMAN MassBank mass spectral database. Reproduced with permission from the NORMAN Network.

Working Group 3: - Effect-directed analysis (EDA) for hazardous pollutants identification

Many of the large numbers of synthetic chemicals we use in everyday life eventually end up in the environment where they do not occur one by one but as complex mixtures. The activities of the EDA working group focus on the development and testing of effect-based tools to unravel these complex mixtures and to understand the cause and effect relationships between contamination and the impact of exposure on microorganisms, plants, animals and humans.

Working Group 4: -Nano and micro scale particulate contaminants

The increasing volumes of engineered nanomaterials and natural particulate contaminants will lead to a proliferation of these materials in the environment with poorly understood effects on ecosystems. Therefore, this working group focuses on increasing our understanding of particle behaviour in the environment and the resulting consequences on ecosystems.

Working Group 5: - Wastewater Reuse and Contaminants of Emerging Concern

Treated wastewater is now widely reused and is increasingly employed as a reliable alternative water source for irrigation and replenishment. Although wastewater reuse is accompanied by a number of benefits, there are a number of questions around emerging contaminants and their potential uptake by plants and crops and the effects that these contaminants may have on the environment. This group studies many aspects of waste water reuse including its role in antibiotic resistance, the identification of technologies to remove such contaminants from wastewater, and the identification of solutions to overcome these problems and promote safe reuse practices.

Working Group 6: -Emerging substances in the indoor environment

Consumer products used indoors contain a variety of both well-known chemicals and emerging substances which can be transferred into indoor air and dust and is therefore becoming

an important pathway of chemical exposure for humans and the outdoor environment. This working group aims to improve the indoor environment by studying all aspects of emerging chemicals and chemical groups and improve harmonisation of sampling, measurement and modelling techniques. The data will be used to identify important pathways of chemical exposure for humans indoors together with pathways to the outdoor environment to improve links between policy and science in the field of the indoor environment.

Cross Working Group Activities

In addition, there are two cross-working group activities on technologies which could be applied across the topic-based groups. The first one works on the application of Passive Sampling for Emerging Contaminants (Figure 2) which are proving to be reliable, robust and cost-effective monitoring tools for the time-integrated measurement of bioavailable contaminants in water and sediment. The second group on Non-Target Screening works on the application of screening techniques to detect the presence of harmful substances, including degradation by-products and metabolites, which are not screened for by conventional target based approaches. Thanks to the application of high resolution chromatographic and mass spectrometric techniques thousands of compounds and their transformations can now be detected and structurally identified routinely in a single environmental sample. Non-target screening is expected to become an efficient tool to identify new emerging substances, prioritise them and identify the effect-causing compounds.

NORMAN Databases

The network has developed, maintains and is integrating web-based databases as a framework for the systematic collection, elaboration and scientifically sound evaluation of information on emerging substances. This long-term activity aims to facilitate bringing together existing knowledge on emerging substances and to accelerate the transfer of high quality validated data to policy makers and legislators.

EMPODAT: a database of geo-referenced monitoring / occurrence data on emerging substances

EMPODAT is designed to allow to the latest information on emerging pollutants with an overview of benchmark values on the occurrence of emerging substances across Europe and to identify gaps in data relating to time, geographical areas and/or environmental matrices. It comprises a Chemistry module for monitoring and occurrence data on emerging substances which are already known to be present in the environment but which are not yet included in routine monitoring programmes. Data can be submitted by participants using downloadable templates from the website. EMPODAT is currently being integrated in the European Information Platform for Chemical Monitoring (IPCHEM), which will improve even further its added value for efficient exchange of information on emerging substances in Europe.

NORMAN MassBank: a database of mass spectra of unknown or provisionally identified substances. This is mass spectrometric database used for the identification of "unknown" substances and represents a source of potential candidate substances which should be considered for inclusion in the current list of emerging substances. The spectral data has been submitted by 38 contributing laboratories from around the world and the top 10 contributors who account for circa 85% of the data are shown in Figure 3. The data has been acquired from 35 different combinations of chromatography, ionisation type and mass spectrometer with the top 10 shown in Figure 4. At the time of writing the database contained over 47,000 mass spectra attributed to over 15,000 compounds. The database has an excellent keyword search facility with filters for compound name, accurate mass, formula and instrument type allowing visitors to rapidly find spectral information. There is also a peak search facility where peak data can be entered, again with instrument type filters. This database is a highly valuable reference for researchers and industry stakeholders using mass spectrometry in every day analysis.

NORMAN Suspect List Exchange (SusDat database): As part of a series of workshops in September 2014, NORMAN members expressed the need to exchange various lists of substances to improve their suspect screening efforts and this website was established in 2015 as a central access point for NORMAN members (and others) to find suspect lists relevant for their environmental monitoring.

NORMAN List of Emerging Substances

NORMAN has identified a list of the currently most frequently discussed emerging substances and pollutants and the latest update published on the site from February 2016 contains 967 compounds. The Prioritisation Working group is now aiming to expand the NORMAN List of emerging substances to a much larger list of compounds in line with the evolution of technology towards "big data" management. The NORMAN SusDat database contains more than 40,000 compounds which will become the new reference list of compounds for the Prioritisation of Emerging Substances Working Group and the NORMAN List of emerging substances will then be defined as the highest-ranked compounds from SusDat which deserve priority actions.

Conclusion

Having been introduced to the NORMAN network and then exploring the excellent website I can only conclude by fully agreeing with the following statement taken from the site "NORMAN should become the primary data source and a global one-stop-shop for all issues regarding emerging substances, contributing to the creation of the early-warning system for emerging pollutants and subsequent policy actions"

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