Actions du réseau Norman : partager les connaissances et harmoniser les pratiques pour une meilleure exploitation de l'analyse non-ciblée dans le domaine environnemental

V. Dulio (1), J. Hollender (2), J. Slobodnik (3)

[1] INERIS, Verneuil en Halatte – FR
[2] Eawag, Dübendorf - CH
[3] Environmental Institute, Kos – SK

Valeria.dulio@ineris.fr

Colloque Améliorer le diagnostic des polluants organiques environnementaux : Mise en œuvre d'approches d'analyses non-ciblées *, 6 Février, Paris*

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

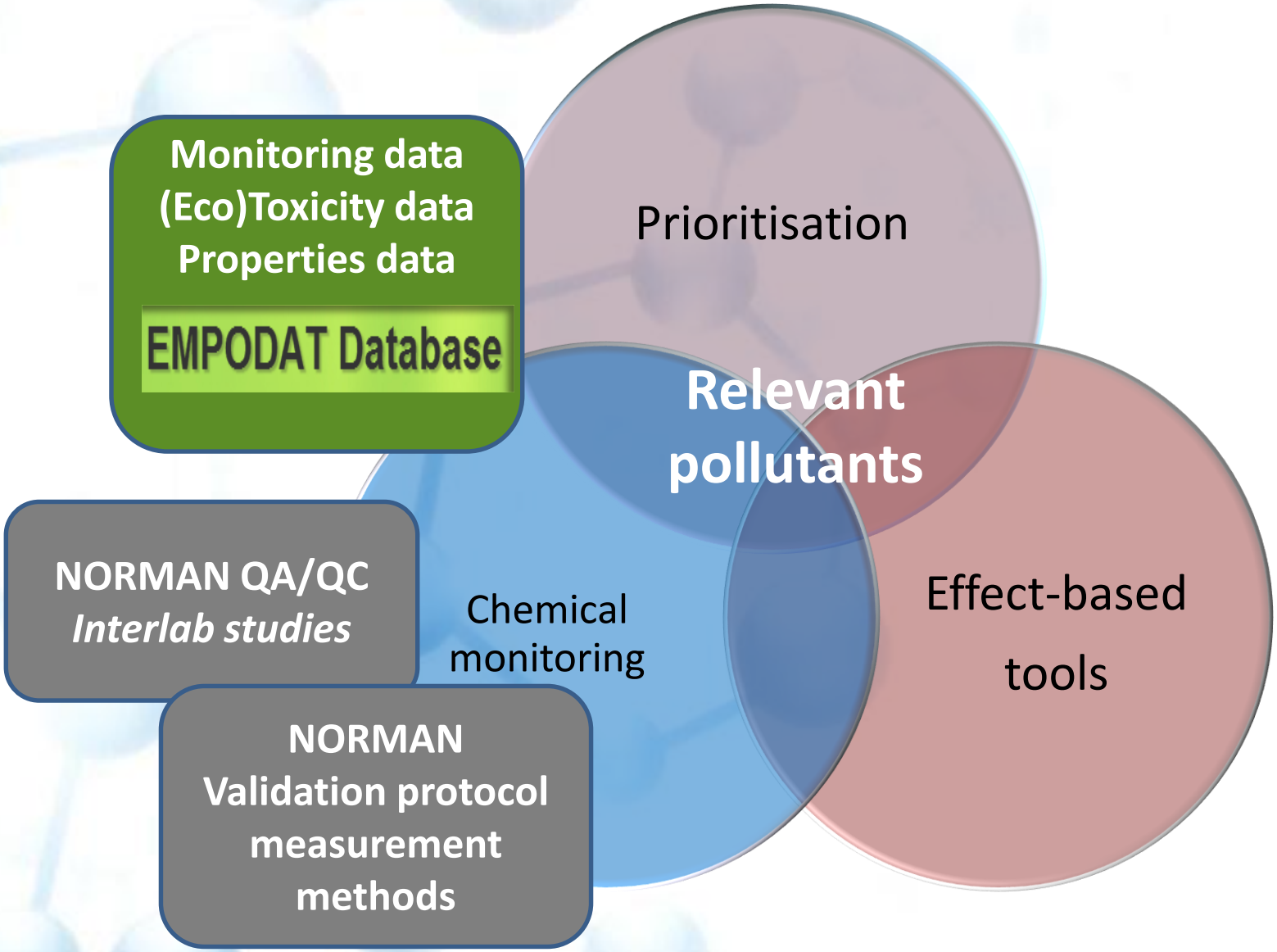
- **Crée en 2005 comme projet UE**, financé par le 6ème PCRD (2005-2008), pérennisé en 2009 sous forme d'association loi 1901 **(Association NORMAN)** sous la **coordination de l'INERIS**
- Compte aujourd'hui **> 70 membres** dans 21 pays en Europe et au-delà

Mission:

- **Echange information** sur les substances émergentes
- Améliorer la **qualité et comparabilité des données**
- Promouvoir **synergies** entre les équipes de recherche et rendre plus efficace le **transfer *des résultats de la recherche* vers les politiques**

http://www.norman-network.net

Stratégie de NORMAN pour identification substances d'intérêt émergent



Liste de substances émergentes de NORMAN

Delete / hide	Former emerging substance	Keep on NORMAN List	NEW: Add to NORMAN List
38 compounds : WFD PS (diuron, dichlorvos, dicofol, heptachlor, PCBs, BDE -47, BDE-153, BDE-154, HBCDD, PAHs, PFOS, etc.) Microcystines Well known Industrial Chem. (aniline, styrene, toluene, xylenes, etc.)	• **72 compounds :** • Phathalates • Organotins • Nitro musks • Organo-lead • 8 well known PFASs • 23 herbicides / insecticides, banned in EU and /or not frequently detected / quantif • 10 surfactants (NPEOs, LAS)	• **527 compounds** •8 Plasticisers •73 PPP • 20 PPP / biocides or biocides •209 Pharmas • 60 Pers care prod. •16 Flame retard. • 44 Ind. Chemicals • 8 PFASs, ….etc. •**61 DBP (only** drinking water)	• **253 compounds :** • 67 flame ret. (used as alternatives to banned products) • 10 PPP most frequently detected, highest conc. or chronic EQS exceeded in recent studies • 118 PPP/biocides & biocides in use or under review • 50 PFASs in use • 8 Pharmas, etc.

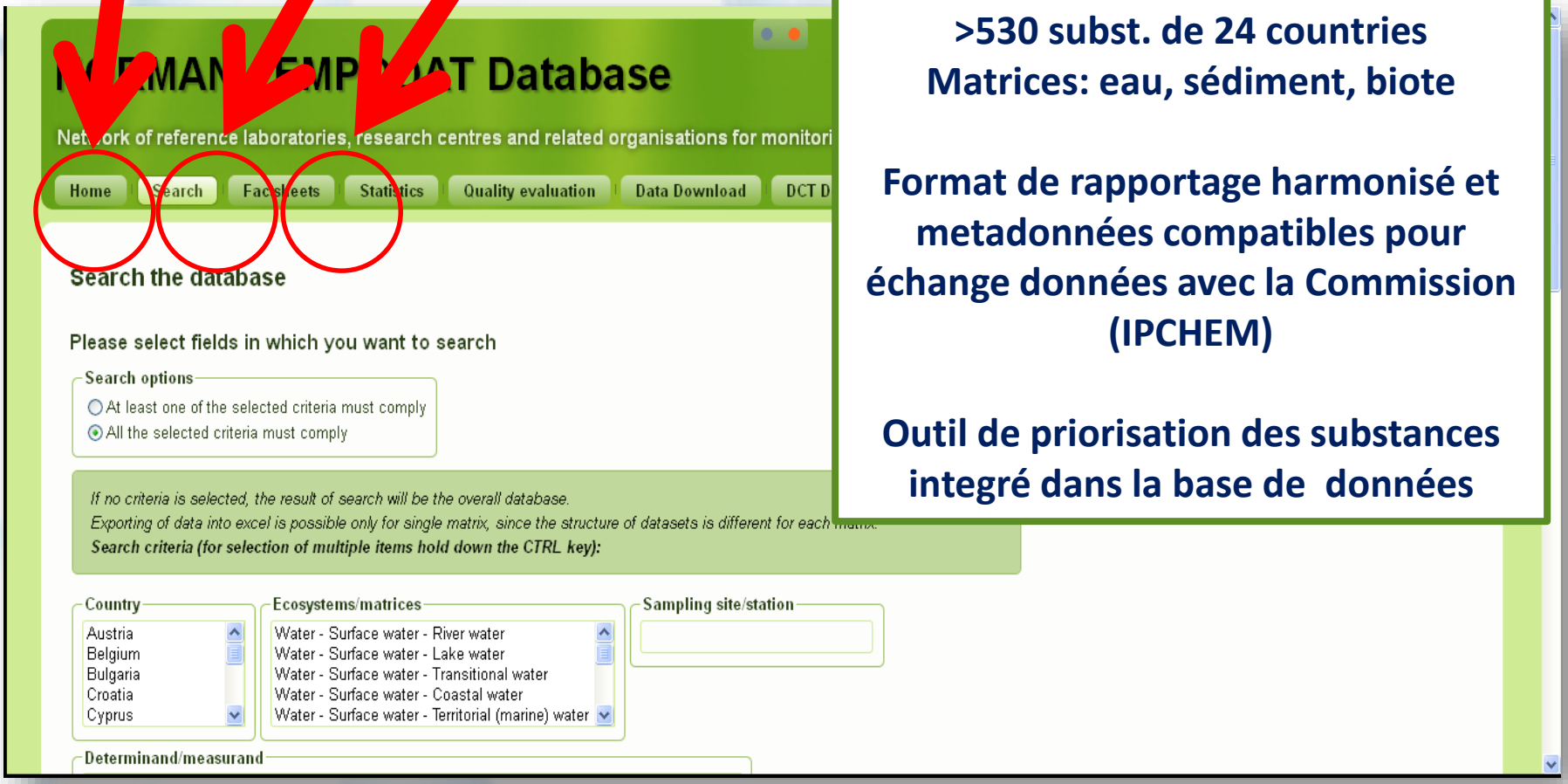
NORMAN list: ca. 800 substances (périodiquement mise à jour)

NORMAN EMPODAT Database
Chemical Module

Search

Factsheets

Statistics



>9.7 million données
>530 subst. de 24 countries
Matrices: eau, sédiment, biote

Format de rapportage harmonisé et metadonnées compatibles pour échange données avec la Commission (IPCHEM)

Outil de priorisation des substances integré dans la base de données

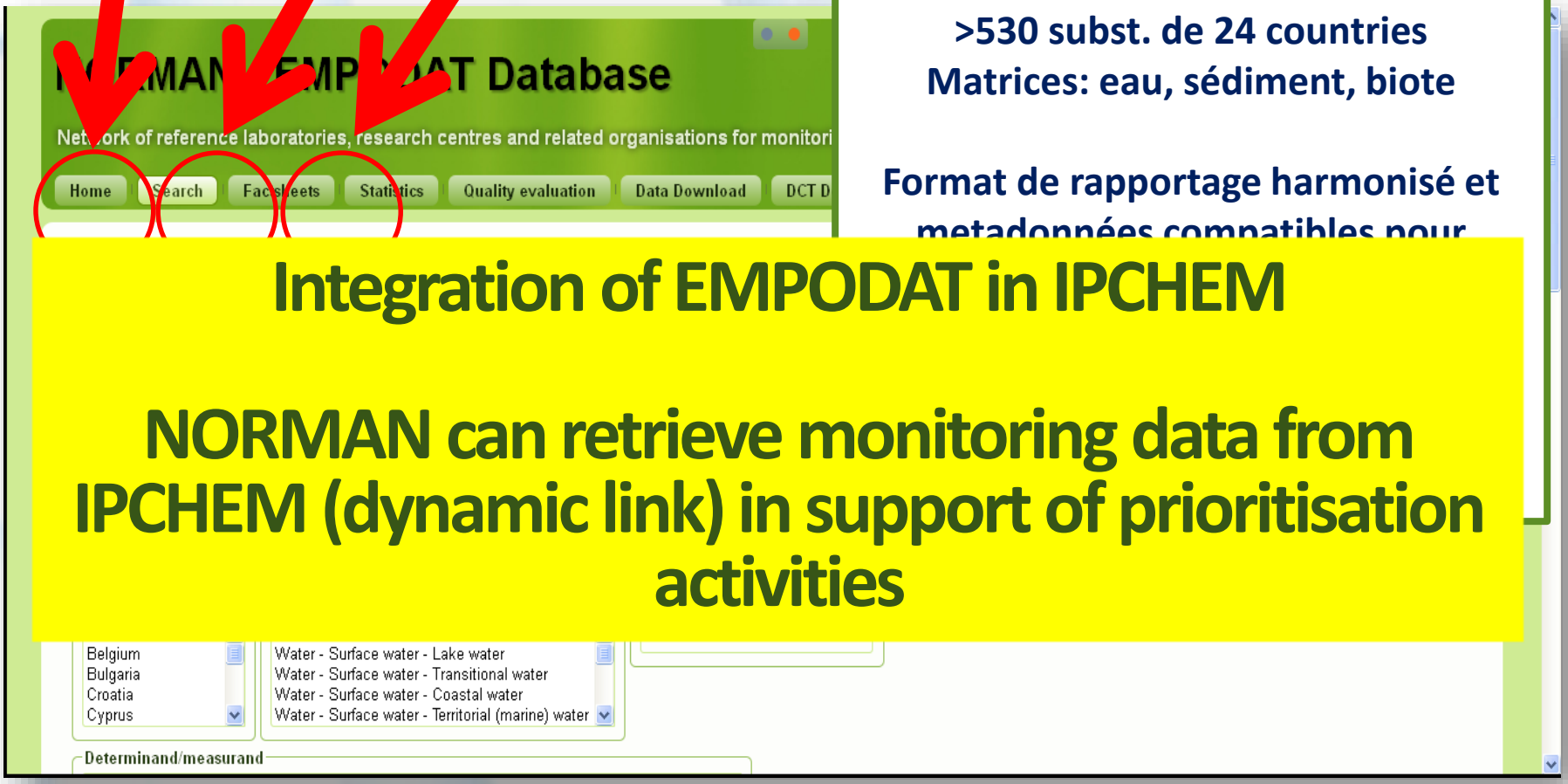
http://www.norman-network.net/empodat/

NORMAN EMPODAT Database
Chemical Module

Search

Factsheets

Statistics



>9.7 million données
>530 subst. de 24 countries
Matrices: eau, sédiment, biote

Format de rapportage harmonisé et

Integration of EMPODAT in IPCHEM

NORMAN can retrieve monitoring data from IPCHEM (dynamic link) in support of prioritisation activities

http://www.norman-network.net/empodat/

PNECs - how to trust them?
NORMAN ECOTOX database

- Compilation de données experimentales à partir des BD existantes
  ➔ ~ 1500 substances

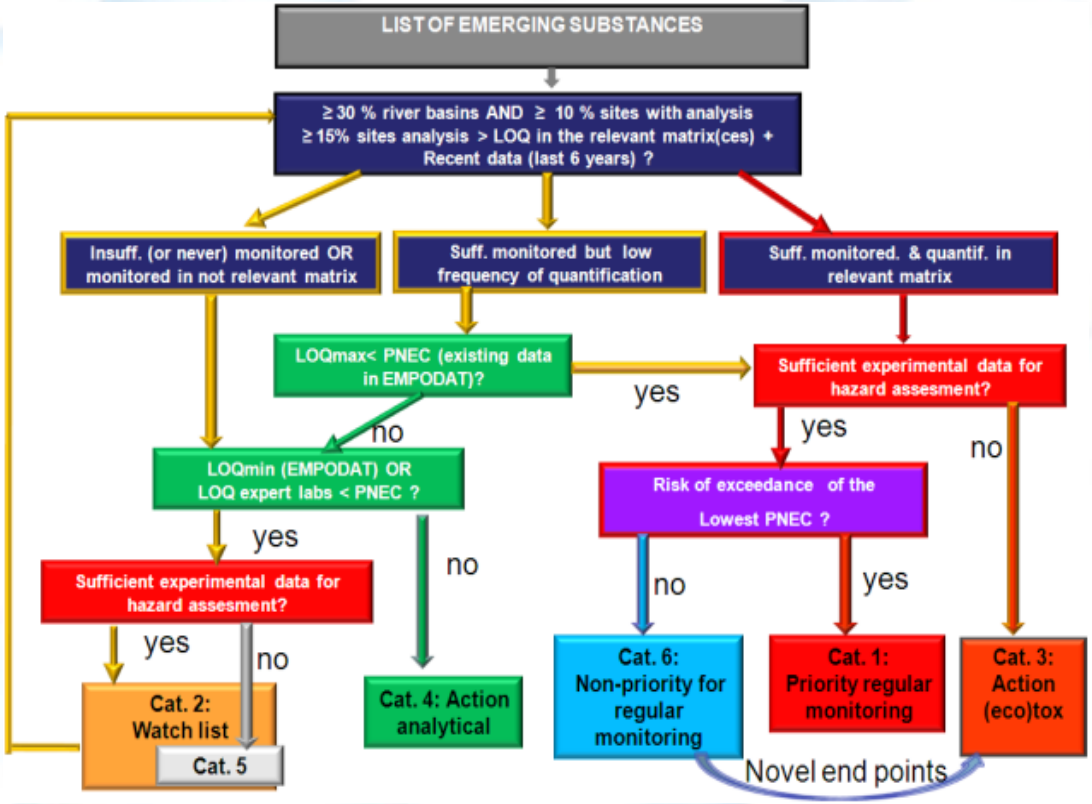
- QSAR predictions pour substances sans données experimentales
  ➔ ~ 13000 substances

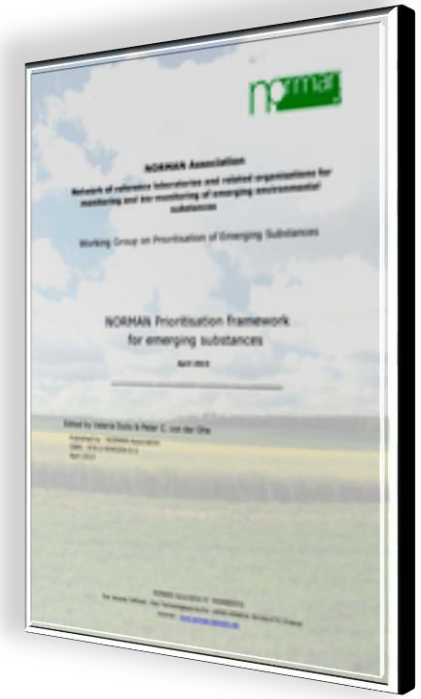
- Compilation normes de qualité (NQE) existantes
  ➔ ~ 300 substances

➔ **Compile all ecotox data**

WG-1 : Priorisation des substances émergentes

NORMAN Prioritisation scheme for emerging substances
(V. Dulio & P.C. von der Ohe, 2013, ISBN : 978-2-9545254-0-2)





- **Priorisation par catégorie d'action (selon les manques de connaissance identifiées)**
- **Priorisation au sein de chaque catégorie d'action**

L'analyse chimique ciblée est-elle suffisante?

- La complexité de notre environnement est un facteur crucial: besoin de prendre en compte un **univers de substances de plus en plus élargi**
- Les développements récents au niveau des **techniques HRMS** et des capacités **d'échange et traitement de données** nous ouvrent des nouvelles perspectives

Delete / hide	Former emerging substance	Keep on NORMAN List	NEW: Add to NORMAN List
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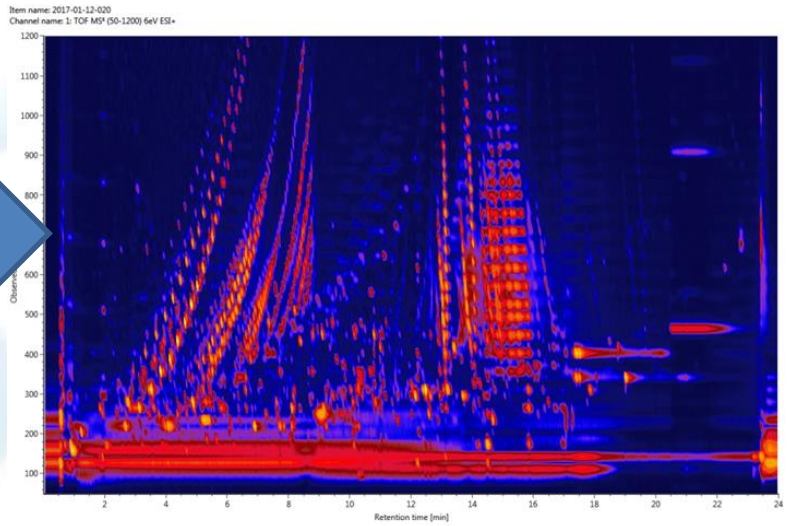
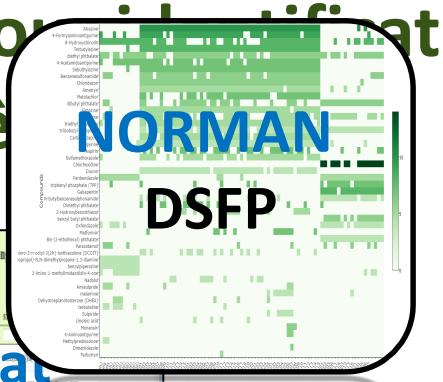
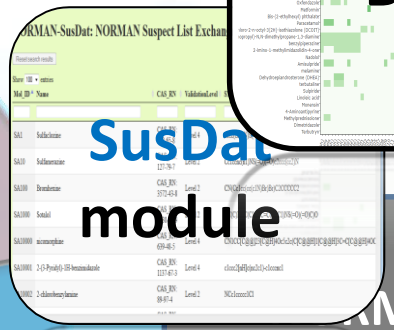


NORMAN list: 860+ subst. **« Universe of substances »**

Stratégie de NORMAN pour l'identification des substances d'intérêt





Monitoring data
(Eco)Toxicity data
Properties data

EMPODAT Database

Prioritisation

screening

Relevant pollutants

target screening

NORMAN QA/QC
Interlab studies non-target screening

NORMAN QA/QC
Interlab studies

NORMAN
Validation protocol measurement methods

Effect-based tools

Identification of unknowns

MassBank norman

WG Non-target screening

Cross-Working Group Activity Non-target Screening (NTS)

Non-target screening techniques for environmental monitoring

eawag aquatic research

Co-ordinator: Eawag (Switzerland)

In collaboration with EI, NIVA, NILU, UFZ

ENVIRONMENTAL INSTITUTE

NIVA Norsk institutt for vannforskning

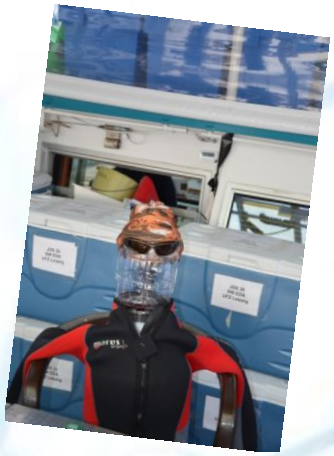
NILU

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

NORMAN Collaborative Trial

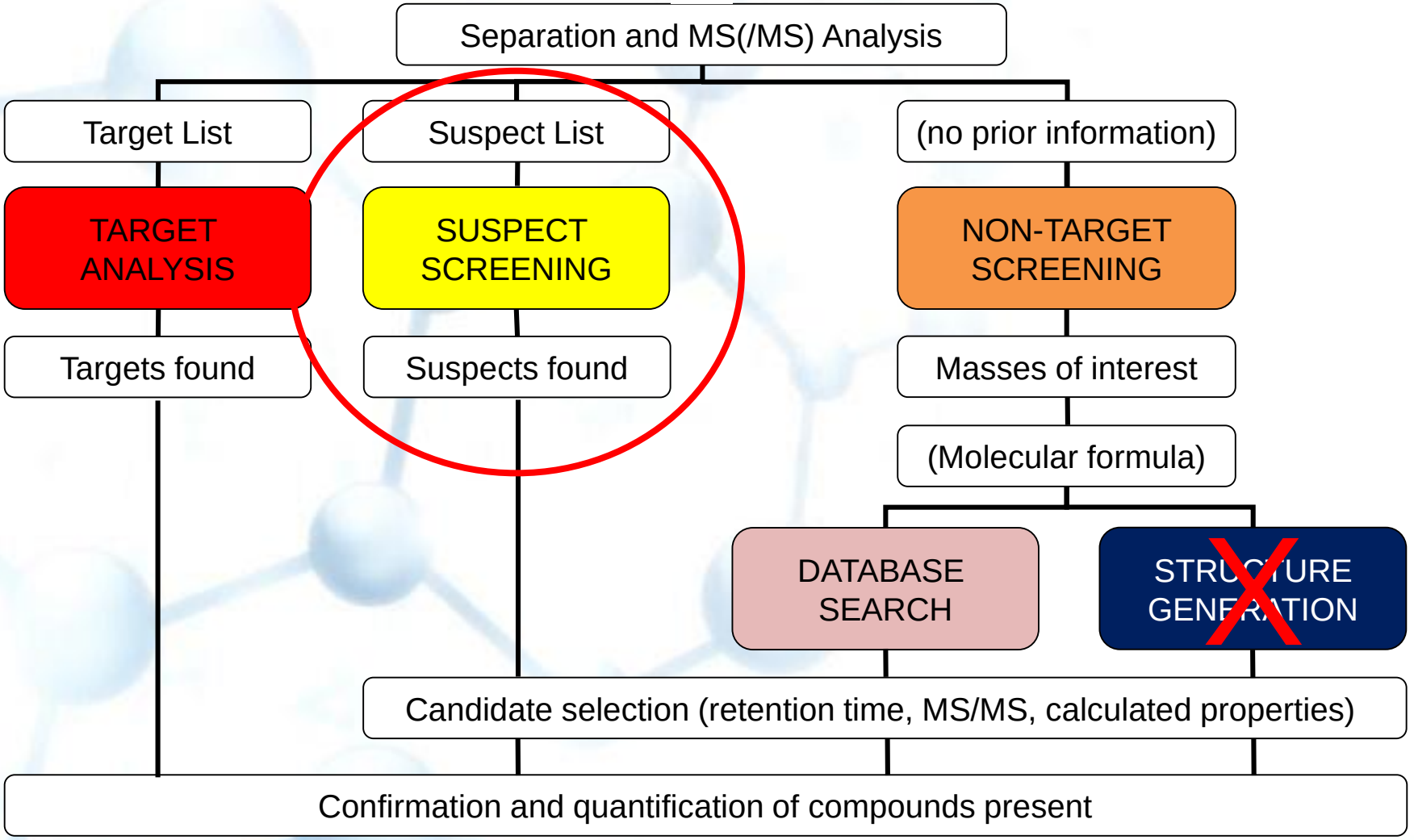
Non-target screening of organic substances in river water samples (2013 / 2014)

Lesson learnt: “screen smart” is more effective than “screen big”

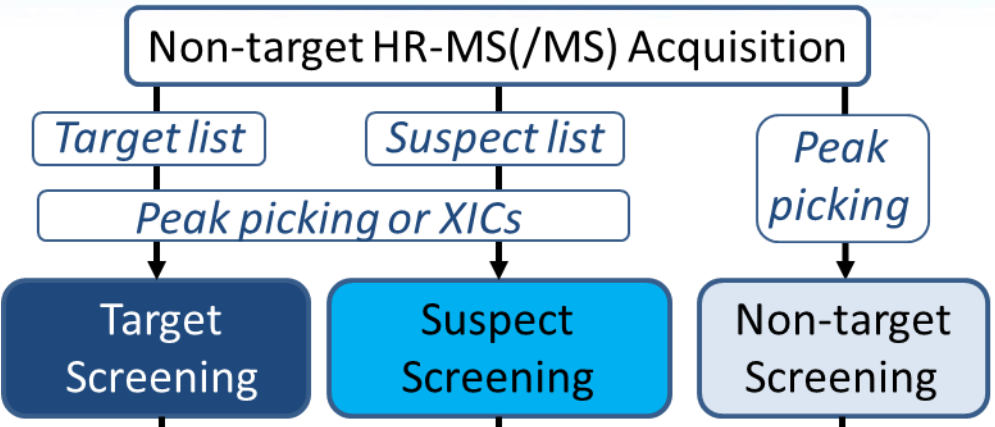


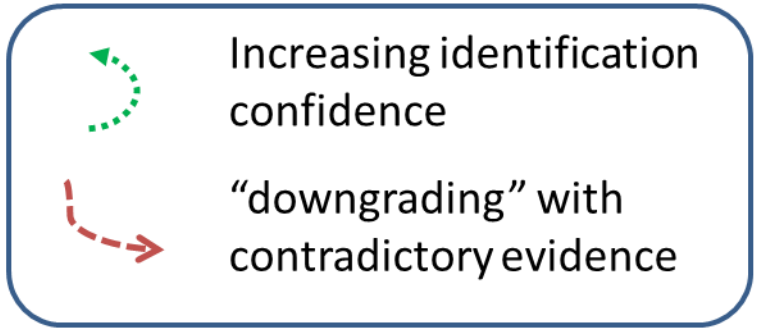
Emma L. Schymanski, Heinz P. Singer, Jaroslav Slobodnik, Ildiko M. Ipolyi, Peter Oswald, Martin Krauss, Tobias Schulze, et al., *Non-target screening with high-resolution mass spectrometry: critical review using a collaborative trial on water analysis,* ***Anal. Bioanal. Chem., DOI 10.1007/s00216-015-8681-7, 2015***.

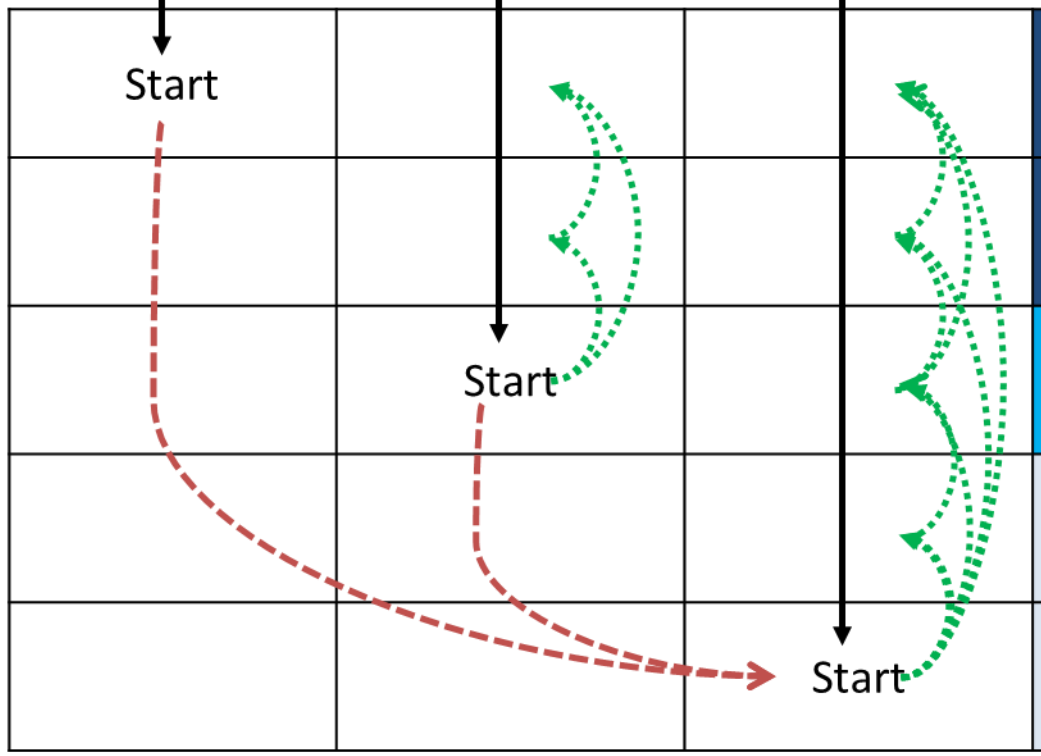
Status quo of identification approaches for LC/GC-MS



Identification Strategies



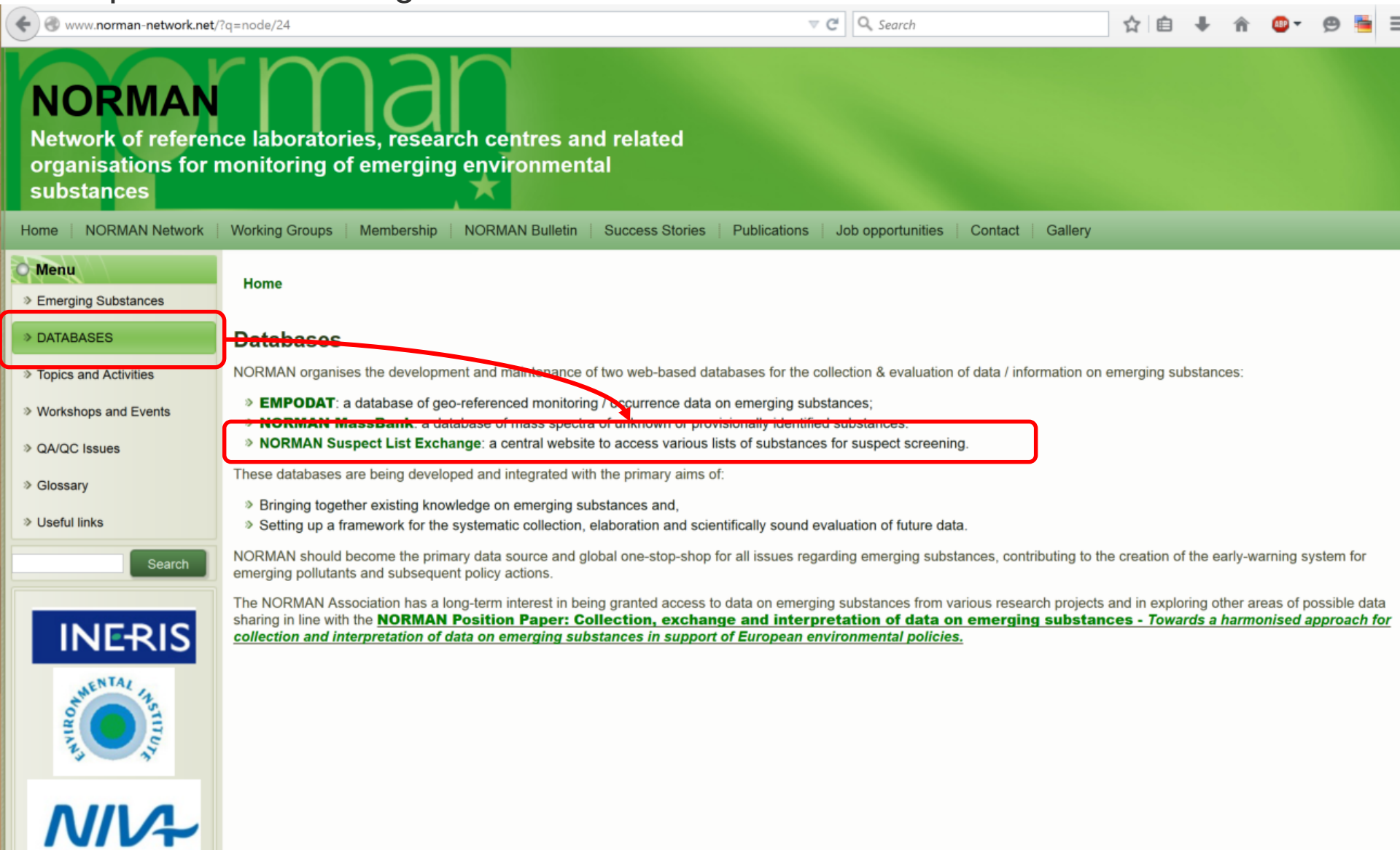




Level 1	***Confirmed Structure*** by reference standard
Level 2	***Probable Structure*** by library/diagnostic evidence
Level 3	***Tentative Candidate(s)*** suspect, substructure, class
Level 4	***Unequivocal Molecular Formula*** insufficient structural evidence
Level 5	***Mass of Interest*** multiple detection, trends, …

NORMAN Databases

Suspect List Exchange – initiated in 2015



NORMAN Suspect List Exchange (SusDat)

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

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- Topics and Activities
- Workshops and Events
- QA/QC Issues
- Glossary
- Useful links

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Password *
Request new password
Log in

Home

http://www.norman-network.com/?q=node/236

NORMAN Suspect List Exchange

Full Lists | InChIKeys | References

Name and Description	Link to full list	Link to InChIKey list	References
Eawag Compounds in MassBank	Eawag_C…6.csv	Eawag_Co…ChIKeys.txt	www.massbank.eu Stravs *et al.* 2012. DOI: 10.1002/jms.3131
UFZ Compounds in MassBank	UFZ_Compounds_in_MassBank_27012016.csv	UFZ_Compounds_in_MassBank_27012016_InChIKeys.txt	www.massbank.eu
Eawag Surfactant Suspect List (formulas only)	Surfactant_Suspects_Schymanski_etal_2014.xlsx Surfactant_Suspects_Schymanski_etal_2014.csv		Schymanski *et al.* 2014. DOI: 10.1021/es4044374
NORMAN Collaborative Trial Targets and Suspects	Targ_Sus_NT-wID_LC_final_31102016.xlsx Targ_Sus_NT-wID_LC_final_31102016.csv Targ_Sus_NT-wID_GC_final_31102016.xlsx Targ_Sus_NT-wID_GC_final_31102016.csv	Targ_Sus_NT-wID_GC_final_InChIKeys_31102016.txt Targ_Sus_NT-wID_LC_final_InChIKeys_31102016.txt	Schymanski *et al.* 2015. DOI: 10.1007/s00216-015-8681-7
Uni. Jaume I	Bade_etal_544Compounds_wInChIs_31102016.xlsx Bade_etal_544Compounds_wInChIs_31102016.csv	Bade_etal_2015_544Compounds_InChIKeys.txt	Bade *et al* 2015, Sci. Tot. Environ. 538: 934-941. DOI: 10.1016/j.scitotenv.2015.08.078
KWR Suspect List	NormanTargetSuspects_template-KWR.xlsx NormanTargetSuspects-KWR_withStructures.xlsx NormanTargetSuspects-KWR_withStructures.csv	NormanTargetSuspects-KWR_InChIKeys.txt	Sjerps *et al.* 2016 Water Research 93: 254-264. DOI: 10.1016/j.watres.2016.02.034
PFAS Suspect List (fluorinated substances)	PFAS csv database 11.26.15.csv (MassHunter format) PFAS excel database 11.26.15.xlsx (contains several sheets)	PFAS_database_26112015_InChiKeys.txt	Kindly supplied by Xenia Trier, David Lunderberg and colleagues. Reference information contained in files.
HSWT/LfU STOFF-IDENT database of water-relevant substances (complete data set)	STOFF-IDENT_content_ed_17052016.xlsx STOFF-IDENT_Content_28102016.xlsx STOFF-IDENT_Content_28102016.csv	STOFF-IDENT_28102016_InChIKeys.txt	The database enables the search for exact masses from target or unknown lists and the automatic use of a Retention Time Index. See: http://bb-x-stoffident.hswt.de - free access after registration
Uni. Tübingen Env. Analytical Chemistry Compounds in MassBank	EAC_UTueb_Compounds_in_MassBank_31102016.csv	EAC_UTueb_Compounds_in_MassBank_InChIKeys_31102016.txt	www.massbank.eu
Uni. Athens Compounds in MassBank	AthensUni_Compounds_in_MassBank_31102016.csv	AthensUni_Compounds_in_MassBank_31102016_InChIKeys.txt	www.massbank.eu
Uni. Athens Surfactant and Suspect List	GagoFerrero_etal_2015_SuspectsNontargets.xlsx GagoFerrero_etal_2015_SuspectsNontargets.csv	UniAthens_SuspectAndSurfactants_InChIKeys.txt	Gago-Ferrero*et al.* 2015. DOI: 10.1021/acs.est.5b03454
Antibiotic List (ITN MSCA ANSWER)	Antibiotics_ITN_MSCA_ANSWER_160616.csv	Antibiotic_ITN_MSCA_ANSWER_InChIKeys_160616.txt	A list of antibiotics compiled by Nikiforos Alygizakis (EI/Uni Athens).
NormaNEWS	Coming soon…		

NORMAN Suspect List Exchange (SusDat)

Pharmaceutical List with Consumption Data	SwissPharma_TableS2.csv	SwissPharma_TableS2_InChIKeys.txt	Singer *et al.* 2016. DOI: **10.1021/acs.est.5b03332**
Swiss Insecticides, Fungicides and TPs	SwissPesticides_TableS1.csv	SwissPesticides_TableS1_InChIKeys.txt	Moschet *et al.* 2013. DOI: **10.1021/ac4021598**
NormaNEWS for retrospective screening of new emerging contaminants	NormaNEWS_V4_26042017.csv	NormaNEWS_V4_InChIKeys.txt	**NormaNEWS** list provided by Nikiforos Alygizakis, Saer Samanipour and Kevin Thomas
Combined Inventory of Ingredients Employed in Cosmetic Products (2000) and Revised Inventory (2006)	Merged_CosmeticProducts_04052017.csv	Merged_CosmeticProducts_04052017_InChIKeys.txt	The scientific committee on cosmetic products and non-food products Intended for consumers - **SCCNFP/0389/00 Final** and Commission **Decision 2006/257/EC** amending the Decision 96/335/EC. Provided by Peter von der Ohe, UBA, curated by Reza Aalizadeh, University of Athens
PFAS Highly fluorinated substances list: KEMI	PFAS_Market_Keml_EPA_1Feb2017.xlsx	Curation in progress: coming soon	Appendix 2 from Swedish Chemicals Agency **KEMI Report 7/15**. Provided by Stellan Fischer, KEMI
NORMAN Priority List 2015	NORMAN_PriorityList_2016.csv Further curation in progress...	NORMAN_PriorityList_2016_InChIKeys.txt	Priority substances from NORMAN WG-1 (Prioritisation), provided by Valeria Dulio
French Monitoring List	French_List_08052017.csv Further curation in progress	FrenchList_UniqueInChIKeys_08052017.txt	Provided by Valeria Dulio, curated by Reza Aalizadeh, University of Athens
KEMI Market List	KEMI_MarketList_12052017_MSready.xlsx	KEMI_MarketList_12052017_MSready_InChIKeys.txt	Provided by Stellan Fischer, KEMI including Hazard and Exposure scores, documented here. Curated by Reza Aalizadeh, University of Athens.
TSCA Surfactants	Coming soon...		Provided by Lee Ferguson, sourced from James Little

3,333 Cosmetic products

~2,600 PFAS

24,883 Marketed substances list (Expo, Hazard Scores)

NORMAN Suspect List Exchange Data table (“SusDat”)

SCREEN SMART – OR BIG – OR BOTH?

All suspect lists available in one table:

- http://www.norman-network.com/datatable/
- Quick search options on every field, e.g. name, mass, …

NORMAN-SusDat: NORMAN Suspect List Exchange Merged Data Table

Reset search results

Show 100 entries

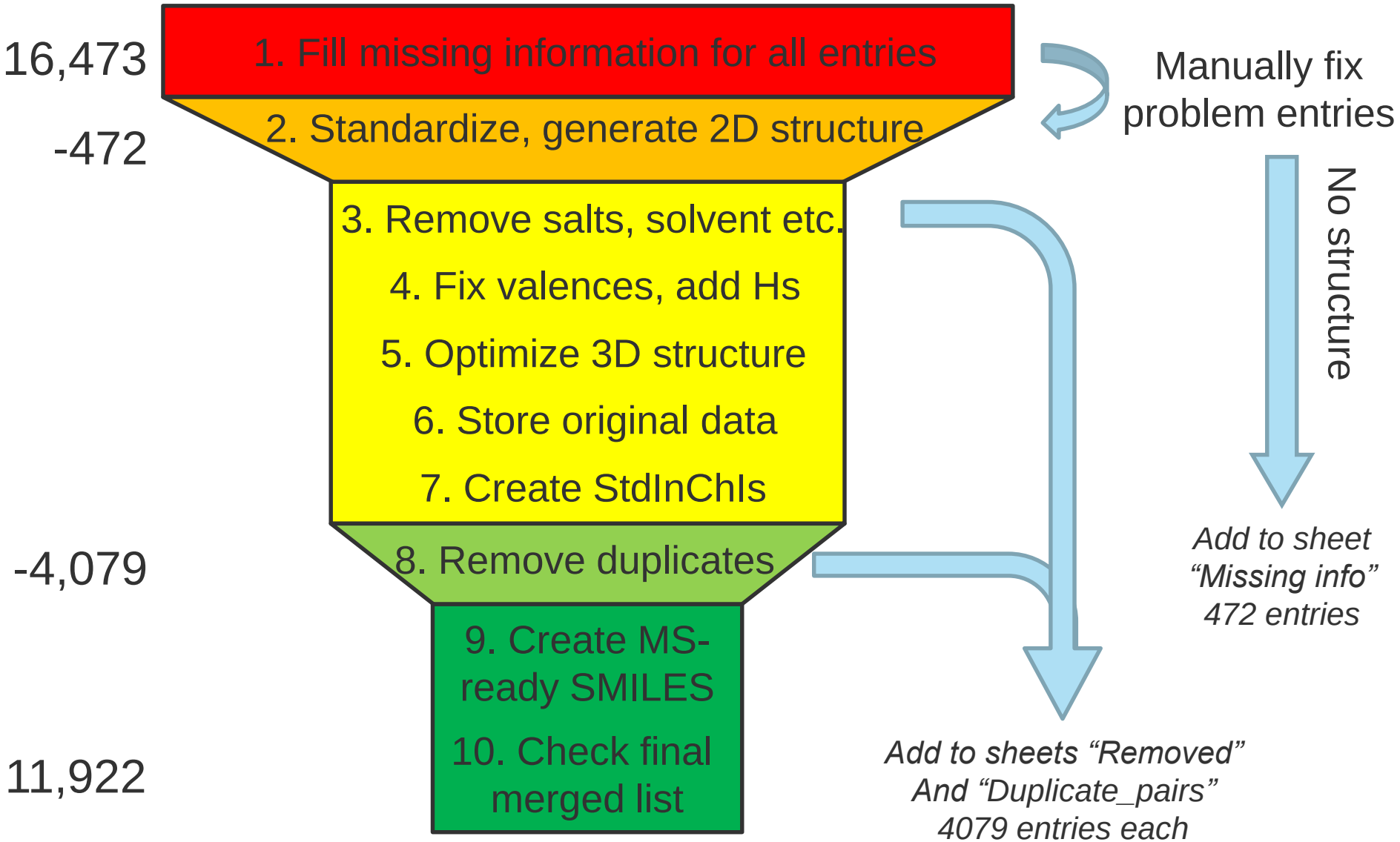
Mol_ID	Name	CAS_RN	ValidationLevel	SMILES
SA1	Sulfaclozine	CAS_RN: 102-65-8	Level 4	c1cc(ccc1N)S(=O)(=O)Nc2cncc(n2)Cl
SA10	Sulfamerazine	CAS_RN: 127-79-7	Level 2	Cc1ccnc(n1)NS(=O)(=O)c2ccc(cc2)N
SA100	Bromhexine	CAS_RN: 3572-43-8	Level 2	CN(Cc1cc(cc(c1N)Br)Br)C2CCCCC2
SA1000	Sota			
SA10000	nicc			C@@H]3C
SA10001	2-(3			
SA10002	2-chlorobenzylamine	CAS_RN: 89-97-4	Level 2	NCc1ccccc1Cl

MERGING SEVERAL LISTS IS NOT TRIVIAL!
WORK IN PROGRESS!!!

Curation and Merging Workflow

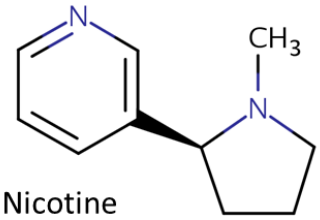
Schymanski *et al*. in prep.
Fourches et al 2010, 2016

12(+) lists => one



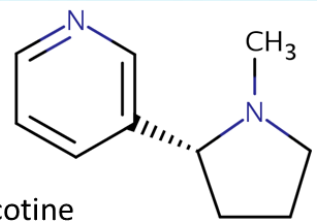
The Chemical Identity Challenge => CompTox Side

LEGEND: Name, SMILES
DTXSID | InChIKey 1st Block
CAS | **Monoiso. Mass** | logP | **Sources**
Data on: **Toxicity | Exposure | Bioassays**



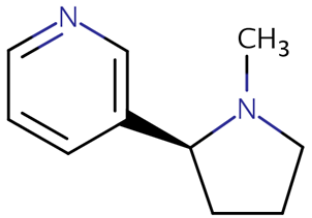
Nicotine

CN1CCC[C@H]1C1=CN=CC=C1
DTXSID1020930| SNICXCGAKADSCV
54-11-5 | **162.1157**| 0.929| **72**
Tox: **yes**| Expo: **yes**| Bioassay: **yes**



D-Nicotine

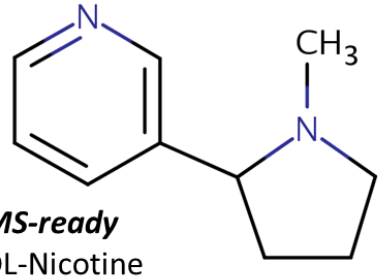
CN1CCC[C@@H]1C1=CN=CC=C1
DTXSID004635| SNICXCGAKADSCV
25162-00-9 | **162.1157**| 0.929| **20**
Tox: **no**| Expo: **yes**| Bioassay: **yes**



HCl

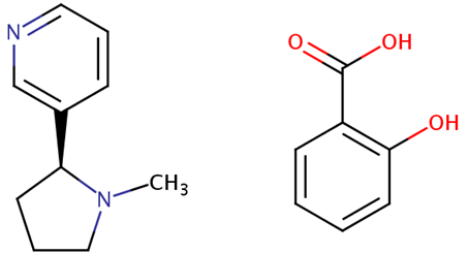
Nicotine hydrochloride

Cl.CN1CCC[C@H]1C1=CN=CC=C1
DTXSID602093| HDJBTCAJIMNXEW
2820-51-1 | **198.0924** | 0.929| **9**
Tox: **no**| Expo: **yes**| Bioassay: **yes**



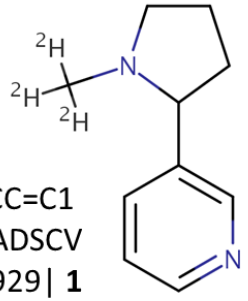
MS-ready
DL-Nicotine

CN1CCCC1C1=CN=CC=C1
DTXSID3048154 | SNICXCGAKADSCV
22083-74-5 | **162.1157**| 0.953| 9
Tox: **yes**| Expo: **no**| Bioassay: **yes**



Benzoic acid, 2-hydroxy-, compd. with
3-[(2S)-1-methyl-2-pyrrolidinyl]pyridine (1:1)

OC(=O)C1=C(O)C=CC=C1.CN1CCC[C@H]1C1=CN=CC=C1
DTXSID5075319| AIBWPBUAKCMKNS
29790-52-1| **300.1474**| 0.929| **6**
Tox: **no**| Expo: **yes**| Bioassay: **no**



DL-Nicotine-d3

[2H]C([2H])([2H])N1CCCC1C1=CN=CC=C1
DTXSID80442666| SNICXCGAKADSCV
69980-24-1| **165.1345**| 0.929| **1**
Tox: **no**| Expo: **no**| Bioassay: **no**

Schymanski & Williams, 2017, ES&T DOI: 10.1021/acs.est.7b01908

SusDat

Predicted RTI, Uncertainty RTI (positive and negative)

MS_Ready_StdInChKey

M, M+, M-

MS_Ready_StdInChIKey	Source	PubChem_CID	ChemSpiderID	Monoiso_Mass	MplusHplus	MminusHminus	Pred_RTI_Positive_ESI	Uncertainty_RTI_
QKLPUVXBJHRFQZ-UHFFFAOYSA-N	UOA	66890	60252	284.013473949	285.021298981	283.005648917	265.021194579995	Covered by Model
QPPBRPIAZZHUNT-UHFFFAOYSA-N	UOA	5325	5134	264.068096338	265.07592137	263.060271306	247.335116536999	Covered by Model
OJGDCBLYJGHCIH-UHFFFAOYSA-N	UOA	2442	2348	373.999323944	375.007148976	372.991498912	503.023018697262	Covered by Model
ZBMZVLHSJCTVON-UHFFFAOYSA-N	Eawag	5253	5063	272.119463206	273.127288238	271.111638174	133.583096137009	Covered by Model
HNDXBGYRMHRUFN-UHFFFAOYSA-N	STOFF-Ident	5362460	4515048	495.179420925	496.187245957	494.171595893	454.942204377928	Covered by Model
BOUOQESVDURNSB-UHFFFAOYSA-N	STOFF-Ident	247635	216780	195.079647303	196.087472335	194.071822271	295.037937513342	Covered by Model
KDDNKZCVYQDGKE-UHFFFAOYSA-N	STOFF-Ident	66648	60015	141.034526968	142.042352	140.026701936	142.830578150953	Covered by Model
LSHROXHEILXKHM-								Experimental proof

Pour chaque substance: information exhaustive pour identification en spéctrométrie de masse (exact mass, RTI, adducts, fragments, etc.)

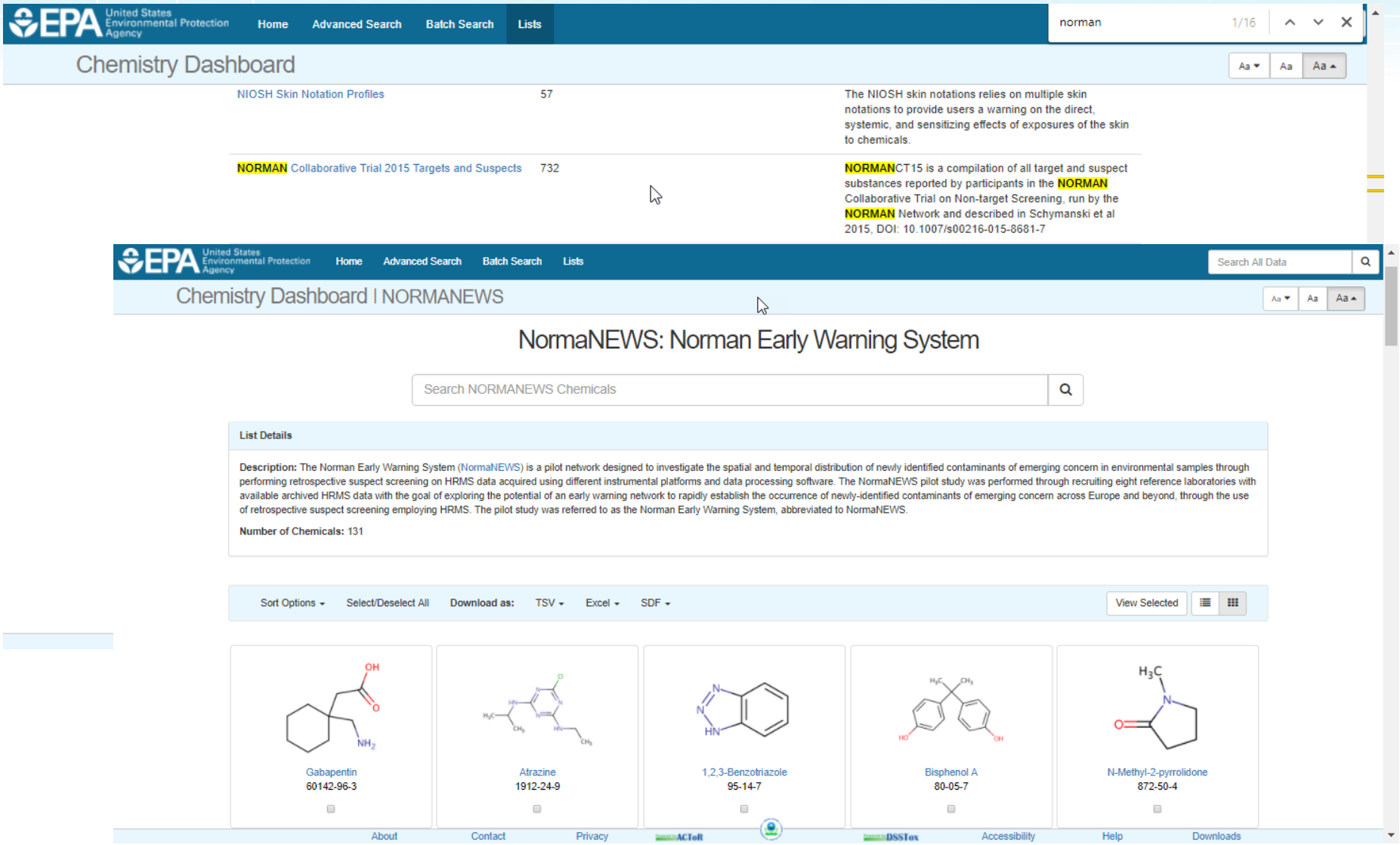
Master Table I

- ID
- Individual substance
- Acronym
- CAS No.
- MS Ready SMILES
- MS Ready INCHIKEY
- PubChem_CID
- ChemSpider ID
- NORMAN Prioritisation label
- Status on NORMAN list
- Use category I - 1
- Use category I - 2
- Use category II - 1
- Use category II - 2
- Log Kow final
- Experimental / predicted
- Reference Log Kow
- Solubility Final
- Experimental / predicted

- Koc Final
- Experimental / predicted
- Reference Koc
- PNECfw(µg/L)
- Experimental / predicted
- Species
- AF
- Endpoint
- Reference PNECfw key study (Source)
- Halflife in water [d]
- 25°C Experimental / predicted
- Reference t1⁄2 water
- PNECsed [µg/kg dw]
- Experimental / predicted
- Reference PNEC sed
- Halflife in sediment [d]
- 25°C Experimental / predicted

+ données propriétés physico-chimiques, usage, (eco)toxicité, etc.
Lien avec la base de données US EPA CompTox Chemistry Dashboard

NORMAN Lists in CompTox Chemistry Dashboard



https://comptox.epa.gov/dashboard/chemical_lists

Schymanski, Aalizadeh, Williams *et al*, in prep.

SusDat

http://www.norman-network.com/datatable/

SA10079	tetracosanol	506-51-4	Level 2	CCCCCCCCCCCCCCCCCCCCCCCCO
SA1008	Erythromycin	CAS_RN: 114-07-8	Level 2	CC[C@@H]1[C@@]([C@@H]([C@H](C(=O)[C@@H](C[C@@]([C@@H]([C@H]([C@(C(=O)O1)C)O[C@H]2C[C@@]([C@H]([C@@H](O2)C)O)(C)OC)C)O[C@H]3[C@@H](O3)C)N(C)C)O)(C)O)C)C)O)(C)O
SA10080	N-Nitrosodiisopropylamin	CAS_RN: 601-77-4	Level 2	CC(C)N(N=O)C(C)C
SA10081	3-chlorophenyl isocyanate	CAS_RN: 2909-38-8	Level 2	Clc1cccc(c1)N=C=O
SA10082	N-(4-bromobenzyl)-N-pentanoyl-L-valine	CAS_RN: 867022-57-9	Level 4	CCCCC(=O)N(Cc1ccc(Br)cc1)[C@@H](C(C)C)C(O)=O
SA10083	remifentanil	CAS_RN: 132875-61-7	Level 2	CCC(=O)N(c1ccccc1)C1(CCN(CCC(=O)OC)CC1)C(=O)OC
SA10084	3-Hydroxyibuprofen	CAS_RN: 53949-54-5	Level 4	CC(CO)Cc1ccc(cc1)C(C)C(O)=O
SA10085	Thiometon	CAS_RN: 640-15-3	Level 2	CCSCCSP(=S)(OC)OC
SA10086	3-methyl-5-phenylpentanol	CAS_RN: 55066-48-3	Level 2	CC(CCO)CCc1ccccc1
SA10087	7-ethoxyacridine-3,9-diamine	CAS_RN: 37222-28-9	Level 4	CCOc1ccc2nc3cc(N)ccc3c(N)c2c1
SA10088	5-(2,4-dioxo-1,2,3,4-tetrahydropyrimidine)-3- fluoro-2-hydroxymethyltetrahydrofuran	CAS_RN: 207128-22-1	Level 5	OCC1OC(CC1F)n1ccc(=O)[nH]c1=O

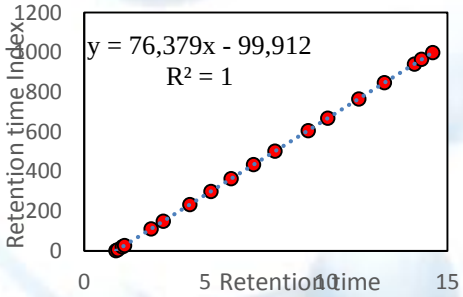
Showing 1 to 100 of 14,633 entries Previous 1 2 3 4 5 … 147 Next

14,633 molecules aujourd'hui → **40,000 bientôt**

Retention Time Index (RTI) for RPLC-HRMS

ACO based QSRR models for RTI system using SMILES information

$$RTI = \frac{(RTx - RTmin)}{(RTmax - RTmin)} * 1000$$



RTI = 76.379(RT) - 99.912

Predicted by QSRR model developed based on LC conditions with a C18 column (**Acclaim C18**)
A: H_2O/MeOH 90:10 with 5 mM ammonium formate & 0.01% formic acid .
B: MeOH with 5 mM ammonium formate & 0.01% formic acid
Gradient: 99/1

	Training			Test		
	R2	RMSE	F	R2	RMSE	F
MLR	0.835	92.575	1515.130	0.870	83.184	426.416
SVM	**0.861**	84.869	1838.745	**0.880**	80.029	467.038

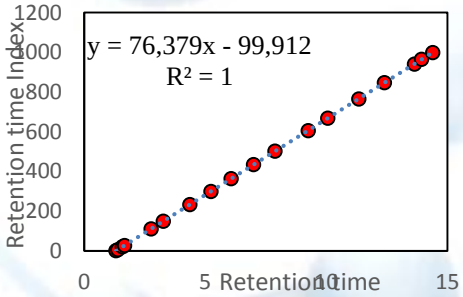
Calibrants	RT (Acclaim C18)	RTI
Guanylurea	1.31	1
Amitrole	1.39	6.111536
Histamine	1.58	20.62643
Chlormequat	1.67	27.50191
Methamidophos	2.76	110.7716
Vancomycin	3.26	148.9687
Cefoperazone	4.36	233.0023
Trichlorfon	5.23	299.4652
Butocarboxim	6.07	363.6364
Dichlorvos	7	434.683
Tylosin	7.88	501.9099
TCMTB	9.25	606.5699
rifaximin	10.06	668.4492
Spinosad A	11.34	766.2338
Emamectin B1a	12.4	847.2116
AvermectinB1a	13.64	941.9404
Nigericin	13.94	964.8587
Ivermectin B1a	14.4	1000

Retention Time Index (RTI) for RPLC-HRMS

ACO based QSRR models for RTI system using SMILES information

$$RTI = \frac{(RTx - RTmin)}{(RTmax - RTmin)} * 1000$$

RTI = 76.379(RT) - 99.912



Calibrants	RT (Acclaim C18)	RTI
Guanylurea	1.31	1
Amitrole	1.39	6.111536
Histamine	1.58	20.62643
Chlormequat	1.67	27.50191
Methamidophos	2.76	110.7716
Vancomycin	3.26	148.9687

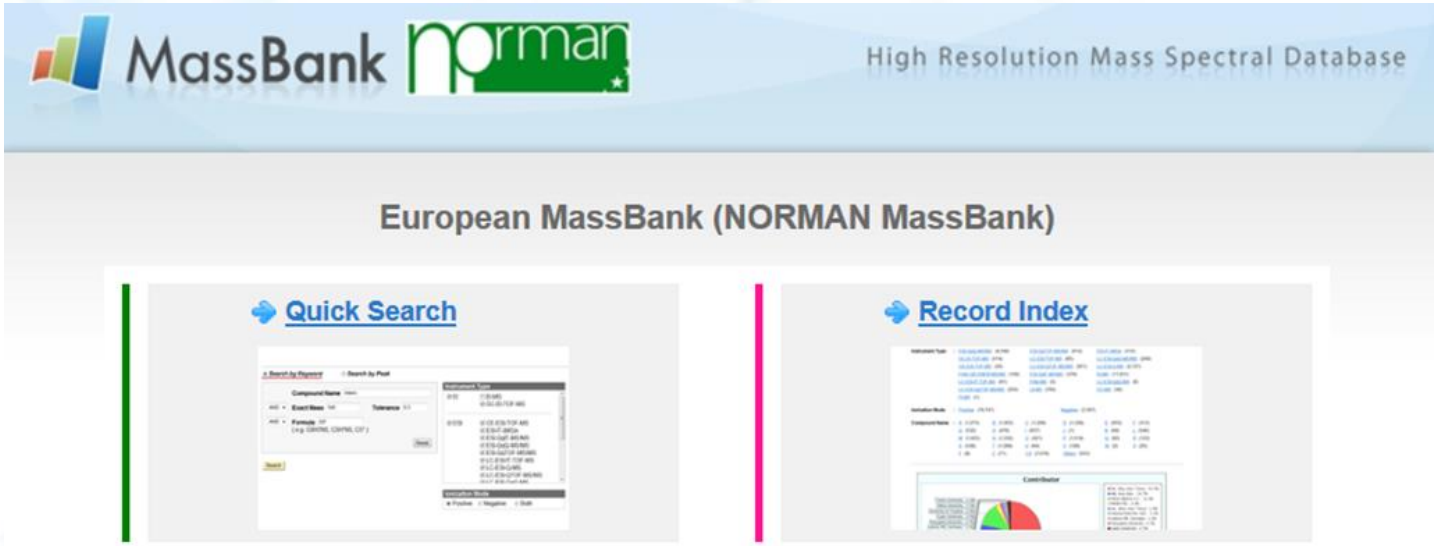
Modèle harmonisé pour la détermination du **Retention Time Index (RTI)**:

- Pour aider l'identification des substances (suspects) et réduire les faux positifs
- Pour normaliser les RT par rapport aux différentes méthodes analytiques

NORMAN MassBank

http://massbank.eu/MassBank

Base de données en ligne et open access pour tous types de spectres de mass spectra (e.g. EI-MS, QToF-MSMS, FTMS)

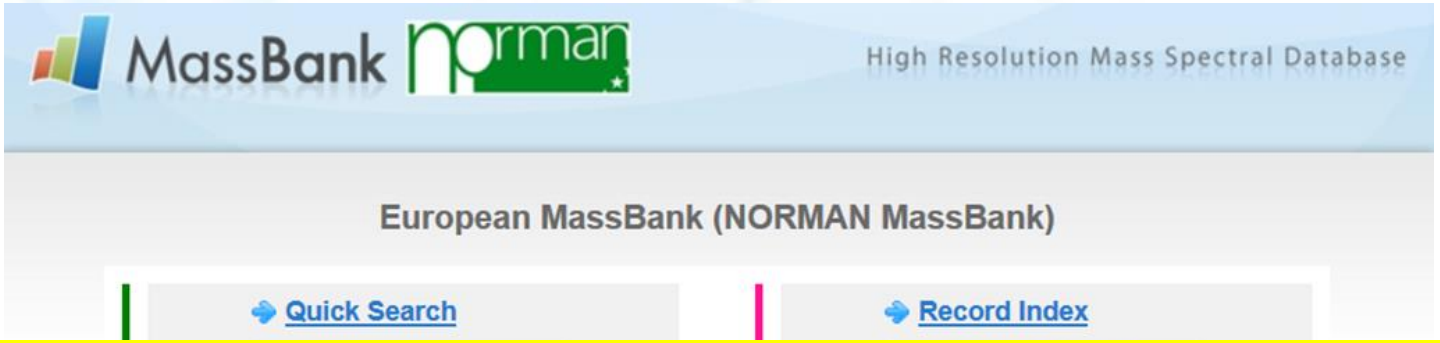


- **14,186 MS/MS spectres; ~1,200 substances des membres de NORMAN**
- Stockage de spectres de masse de **différents instruments**
- NORMAN MassBank héberge beaucoup de spectres non disponibles dans d'autres bibliothèques

NORMAN MassBank

http://massbank.eu/MassBank

Base de données en ligne et open access pour tous types de spectres de mass spectra (e.g. EI-MS, QToF-MSMS, FTMS)

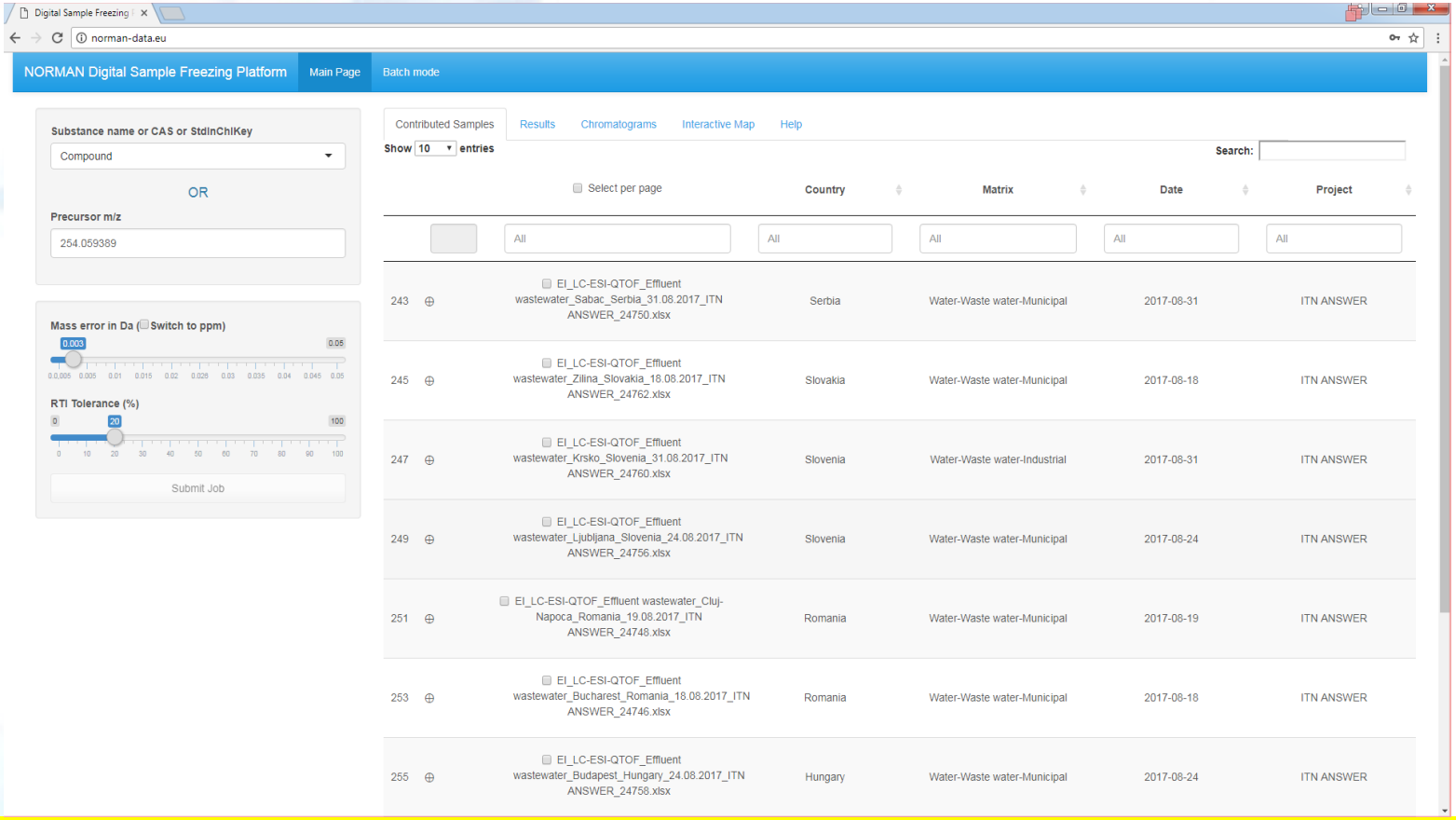


Partager les spectres de masse dans MassBank :

Une collaboration gagnant – gagnant !

- **14,186 MS/MS spectres; ~1,200 substances des membres de NORMAN**
- Stockage de spectres de masse de **différents instruments**
- NORMAN MassBank héberge beaucoup de spectres non disponibles dans d'autres bibliothèques

Digital Sample Freezing Platform: DSFP



NORMAN – **Digital Sample Freezing Platform (DSFP) – Une échantillothèque digitale** de spectres de masse d'échantillons géo-référenciés

Nontarget screening DCT (NTS DCT)

Full scan Positive

Full scan Negative

Data Independent Positive

Data Independent Negative

Data-Dependent 5 precursors Positive

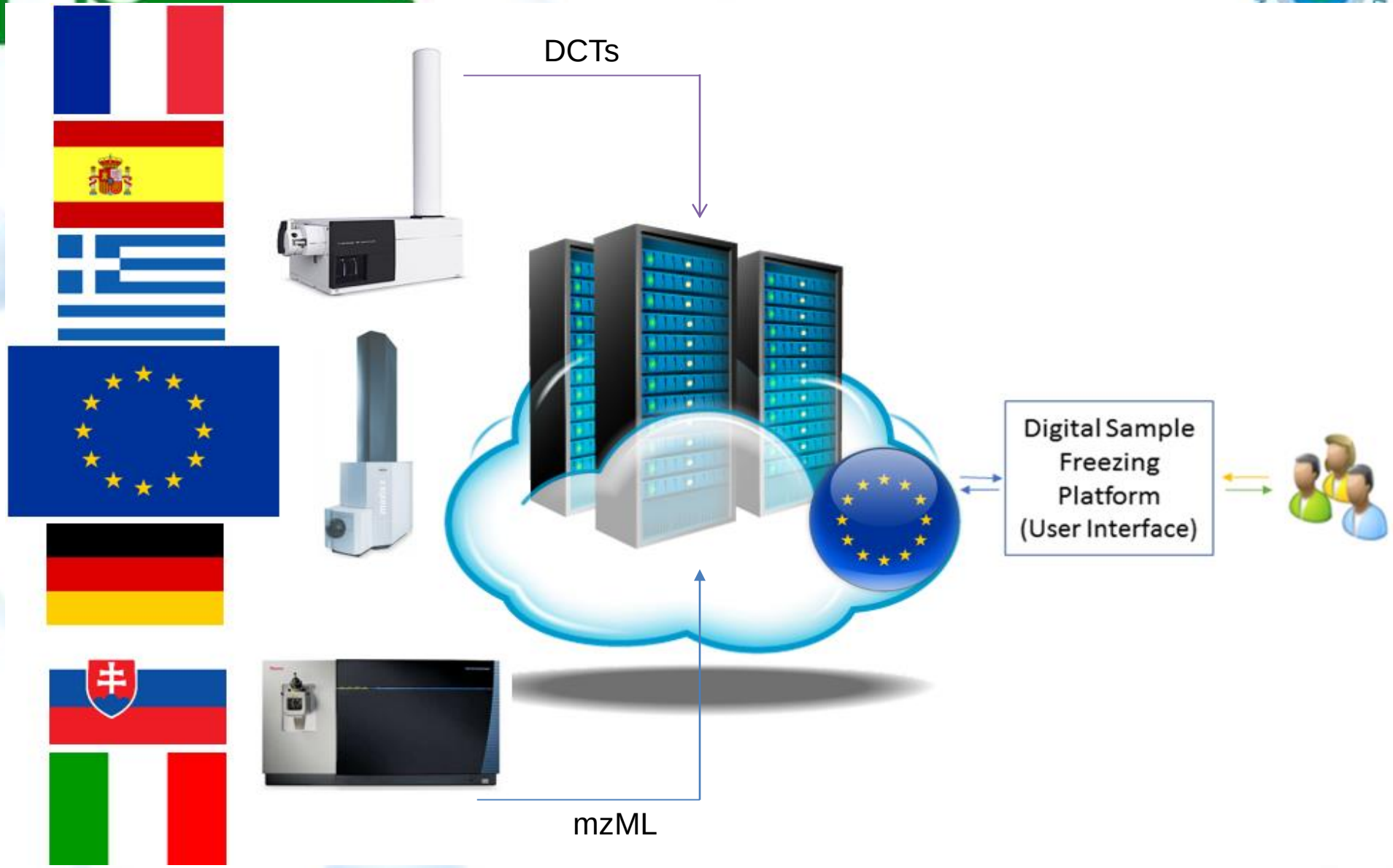
Data-Dependent 5 precursors Negative

NTS DCT

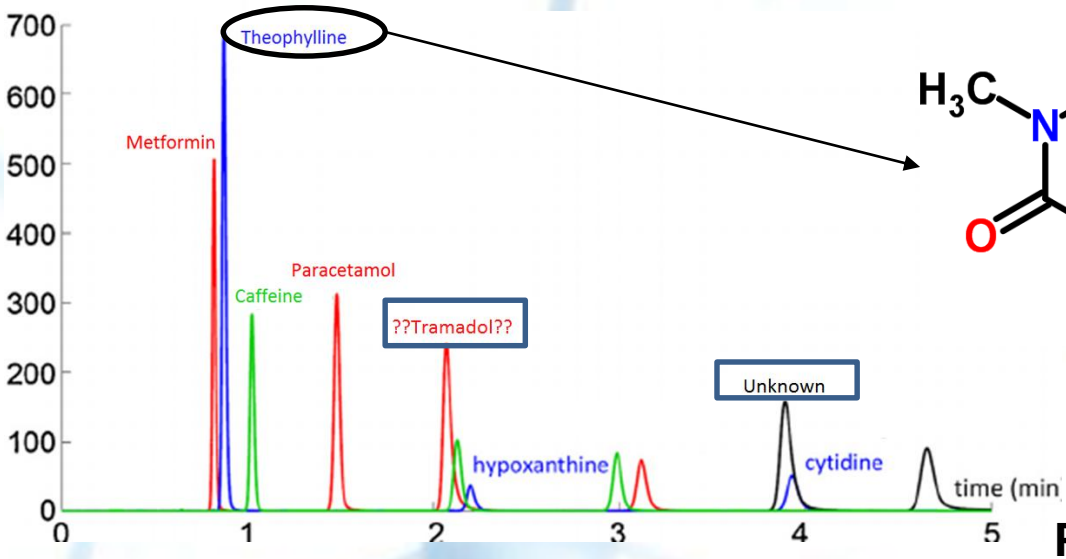
Size: Few GB-hundreds MB

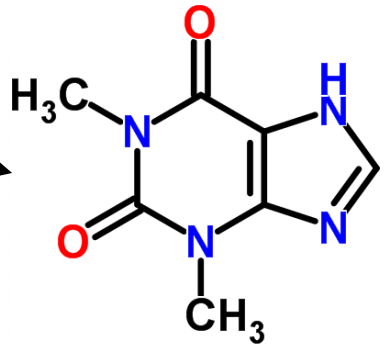
Size: Few MB

Archiving of LC-HRMS data across EU



Suspect screening?





Exact mass: 181.072002

MS/MS fragments:

- 124.0505
- 142.06110
- 109.0271
- 96.0556
- 69.04472

Digital Sample Freezing Platform (DSFP) - evaluation of NTS mass chromatograms

Contributed Samples | Results | Chromatograms | Interactive Map | Help

Select Chromatogram

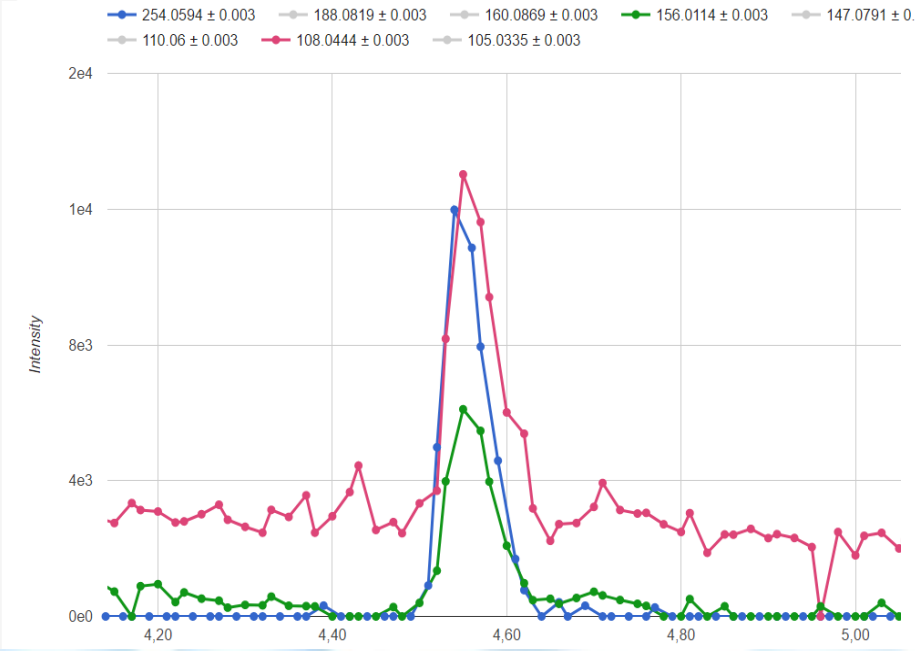
UoA_LC-ESI-QTOF_Seawater UA07_Black Sea_Ukraine_19.05.2016_EMBLAS II_17856.xlsx

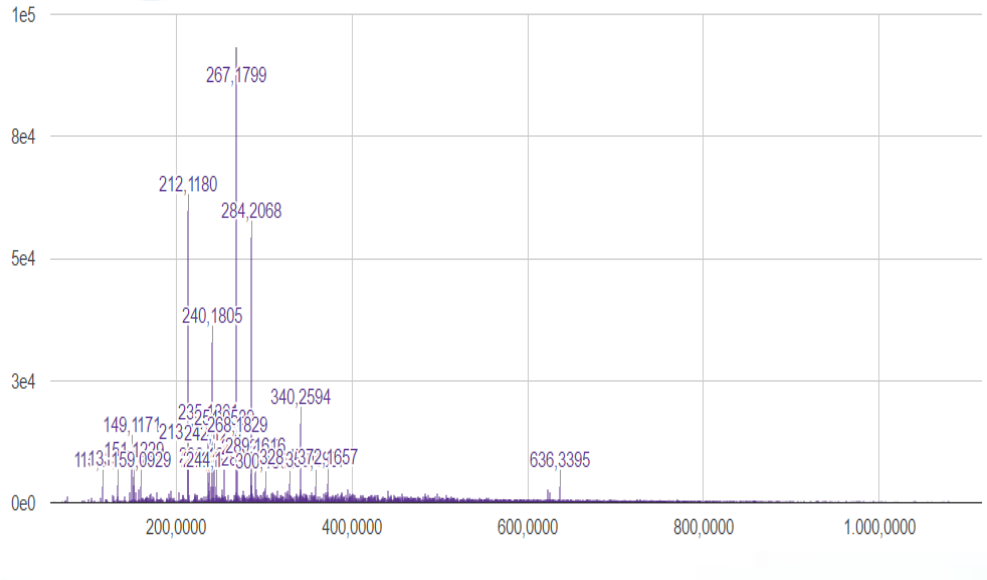
Data-Independent | Data-Dependent

	show	mz	accuracy_mDa	chromatogram
1	☑			
2	☐			
3	☐			
4	☐			
5	☐			
6	☐			
7	☐			
8	☐			

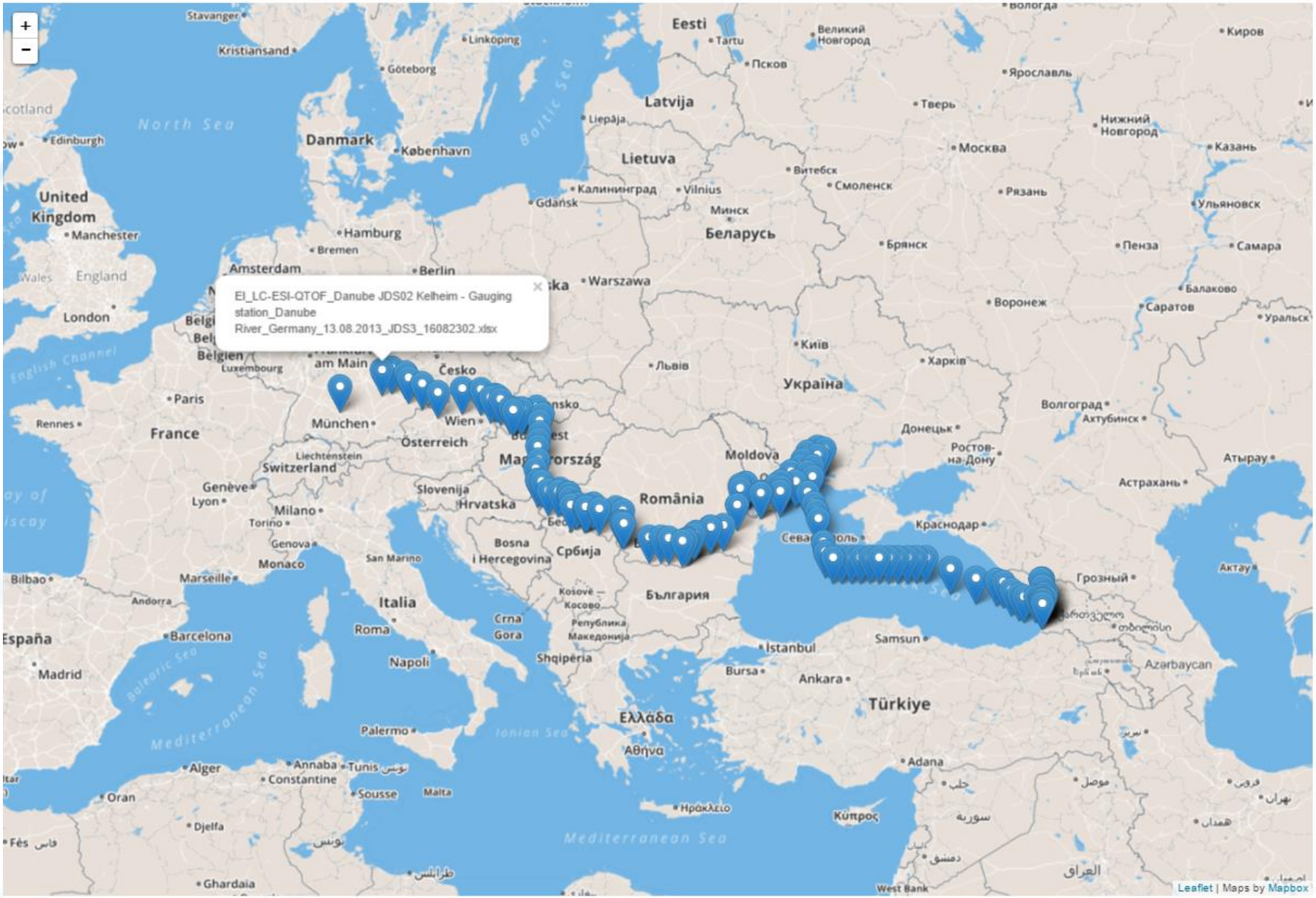
>14,000 substances in the NORMAN Suspect Exchange List (SusDat); >30,000 in the pipeline

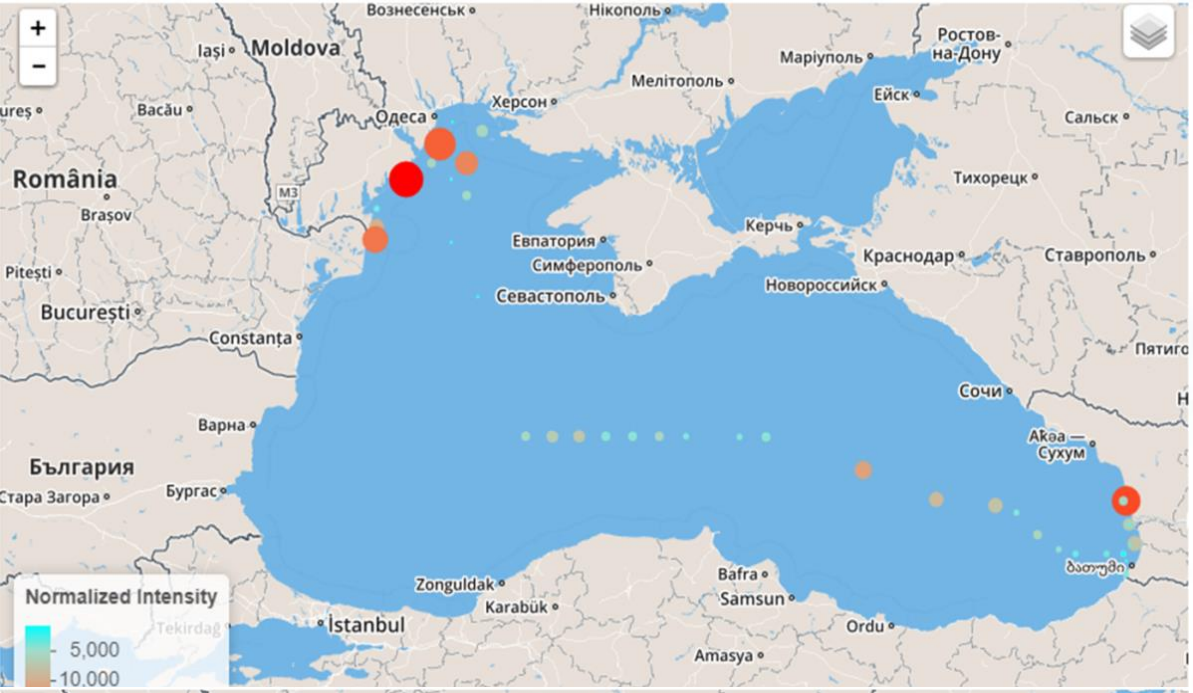
Submit (Press the button everytime changes are done to the table above)

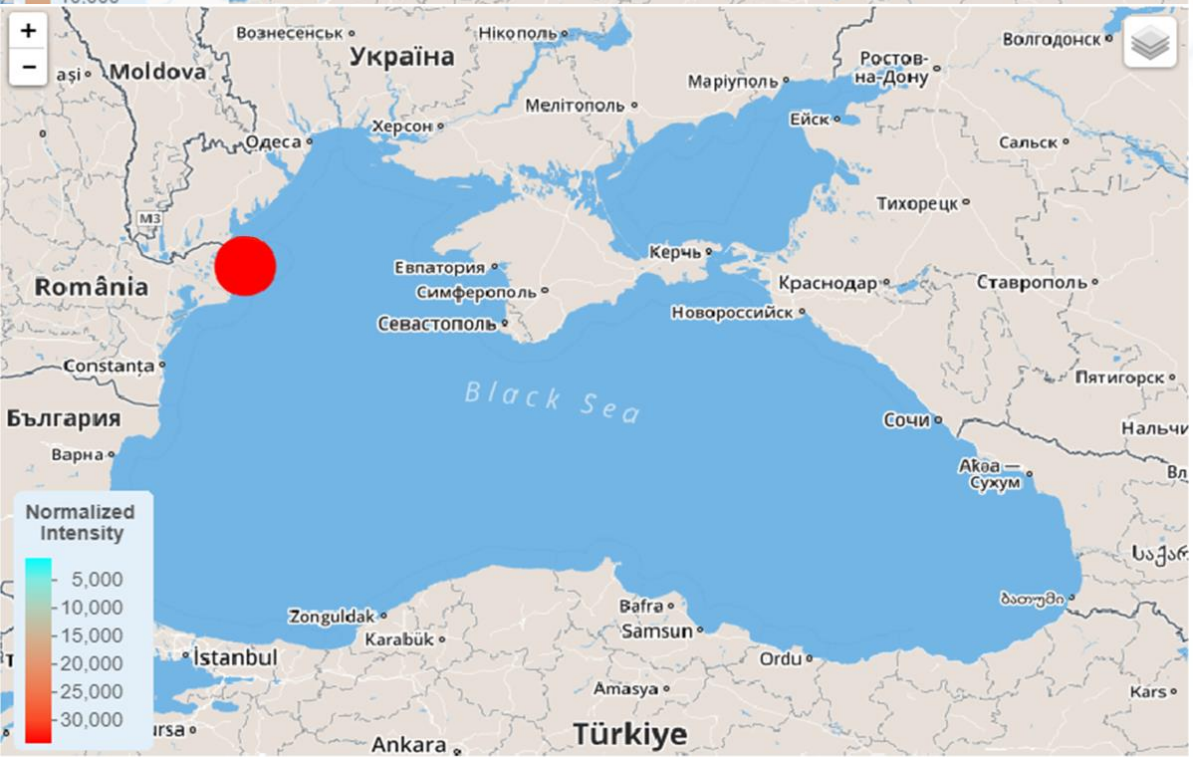




Selection of river water samples from JDS3 (68) and EMBLAS seawater samples (55)





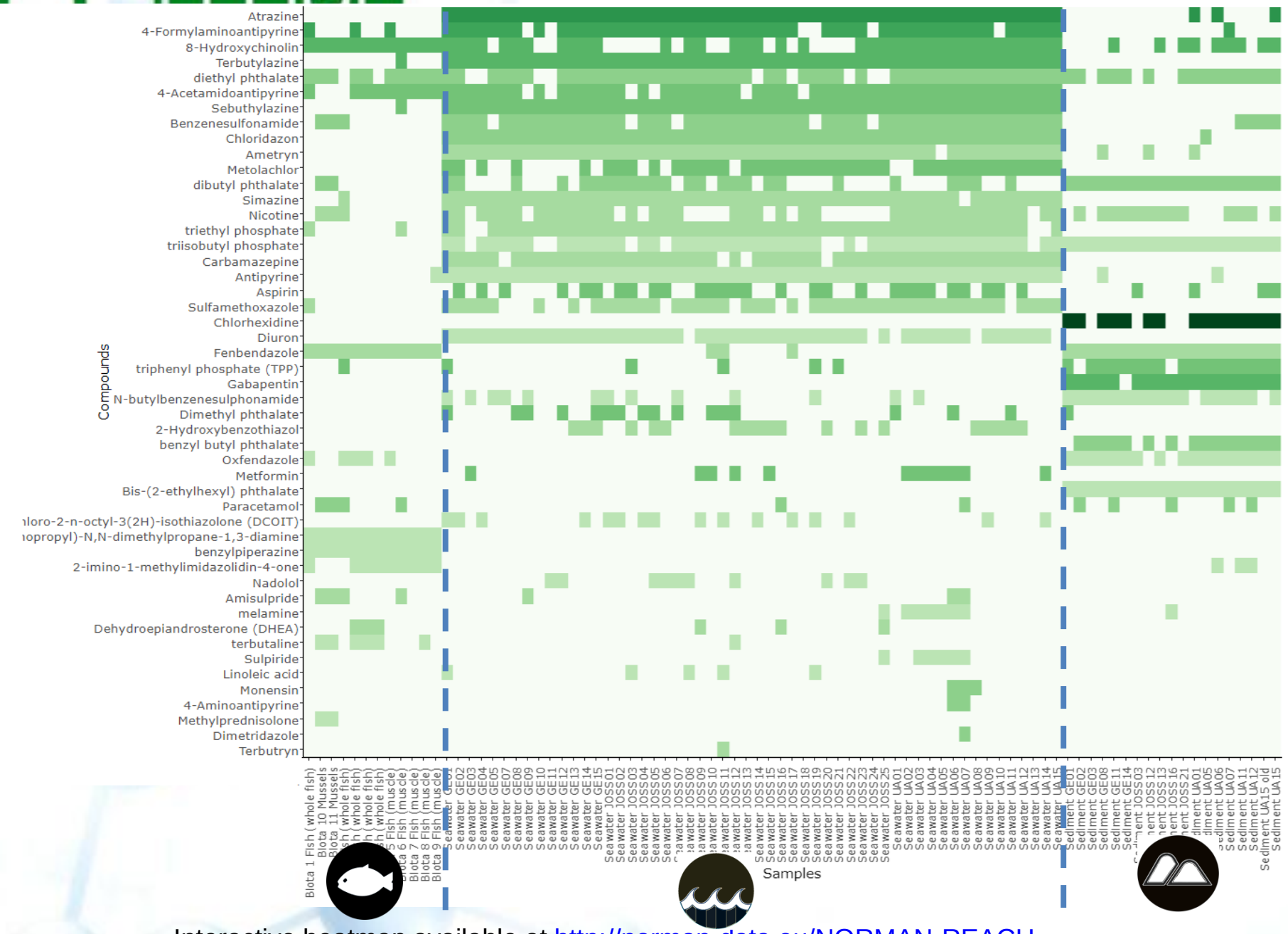


DEET detected in many seawater samples from the Black Sea

Example of point and widespread detection

Monensine detected only at 1 sampling station

Screening of REACH compounds in samples from the Black Sea



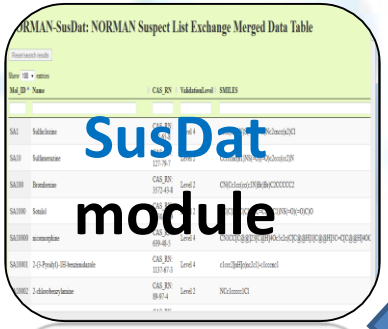
Interactive heatmap available at http://norman-data.eu/NORMAN-REACH

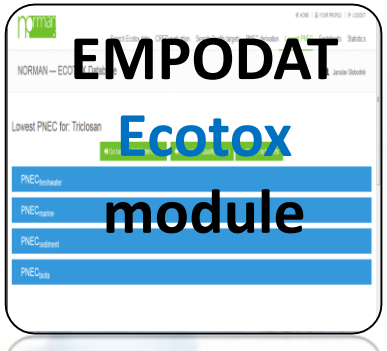
Screening of REACH compounds in samples from the Black Sea

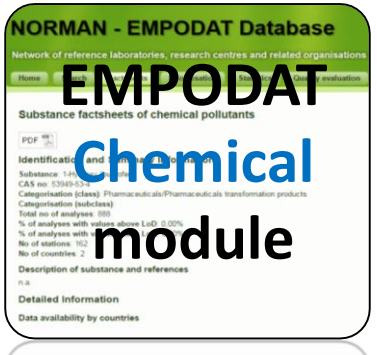
- **« Frequency of Appearance »** (FoA): indicateur pour prioriser les **substances plus fréquemment détectées**
- Premiers tests sur une **liste de « suspects »**, mais l'indicateur peut être aussi appliqué pour **priorisation de pics (substances pas encore identifiées)**

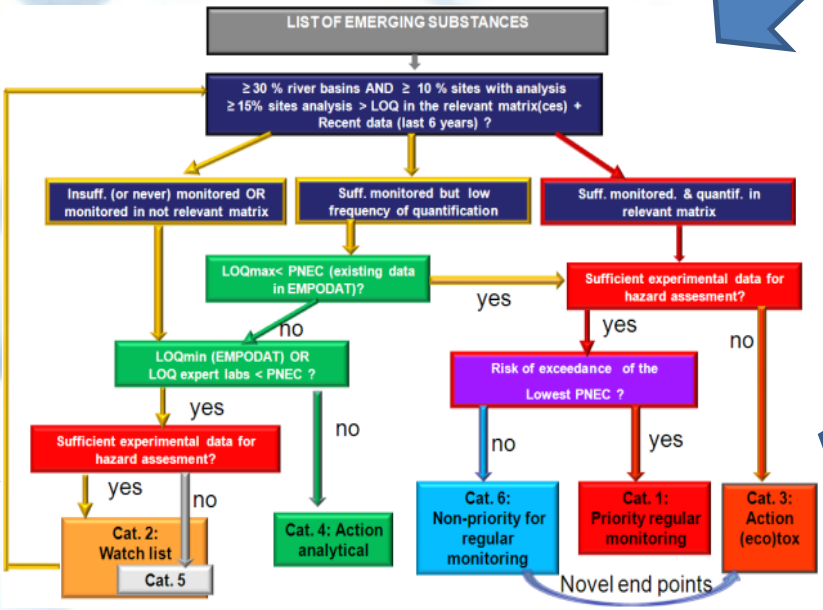
Interactive heatmap available at http://norman-data.eu/NORMAN-REACH

NORMAN Prioritisation system









Where are we now?

- Data:
  - **EMPODAT** – target monitoring data **500+** substances
  - **SusDat** – **14,663** → **40,000+** curated substances
  - **NORMAN MassBank** – ca. **10,000 MS (1,000 subst.)**
  - **DSFP** – **14,663** → **40,000+** substances
    - Full scan LC-HRMS chromatograms for **65 river water samples from JDS3** **and** **55 samples from Black Sea**

Analyse non-ciblée: un changement de paradigme dans le diagnostique chimique

- Information à plus large spectre pour un diagnostique chimique élargi et capitalisable à longue terme
  - **Anticipation** des contaminants émergents pas encore identifiés à partir des signatures environnementales (pics récurrents)
  - **Priorisation des substances:** Il est possible de rechercher des substances (initialement non recherchées) de manière rétrospective: des nouvelles perspectives s'ouvrent pour la priorisation des substances
  - Comparaison **empreintes chimiques vs empreintes toxicologiques** (effets observés / outils biologiques)

Conclusions

- L'effet réseau a été déterminant pour l'avancé de cette technique au niveau international
  - Le réseau n'est pas un « luxe », mais une **nécessité**
  - **Harmonisation des pratiques** pour améliorer l'inter-comparabilité des données
  - **Partage systématique de données** (MassBank, SusDat, DSFP) pour augmenter le potentiel d'exploitation de cette approche

Conclusions

- L'effet réseau a été déterminant pour l'avancé de cette technique au niveau international
  -
  -
  - t,

Collaboration au niveau international => indispensable pour avancer de manière plus efficace

cette approche

Acknowledgements

NIVA

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

eawag aquatic research

normaNEWS

ENVIRONMENTAL INSTITUTE

National and Kapodistrian UNIVERSITY OF ATHENS

KEMI Kemikalieinspektionen

Bayerisches Landesamt für Umwelt

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

norman

MetFrag2.2

SEVENTH FRAMEWORK PROGRAMME

solutions

EU Grant 603437

?TOFF IDENT

RMassBank

MassBank.eu

MERCI POUR VOTRE ATTENTION

QUESTIONS?

Environmental Science & Technology

Feature

Cite This: *Environ. Sci. Technol.* 2017, 51, 11505-11512

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Nontarget Screening with High Resolution Mass Spectrometry in the Environment: Ready to Go?

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