

Wastewater-Based Epidemiology: monitoring the use of psychoactive substances at music festivals

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SCIENCE BEHIND ADDICTIONS

1st NAAC Congress

Cyprus, 11-12 of September 2019

Wastewater-Based Epidemiology



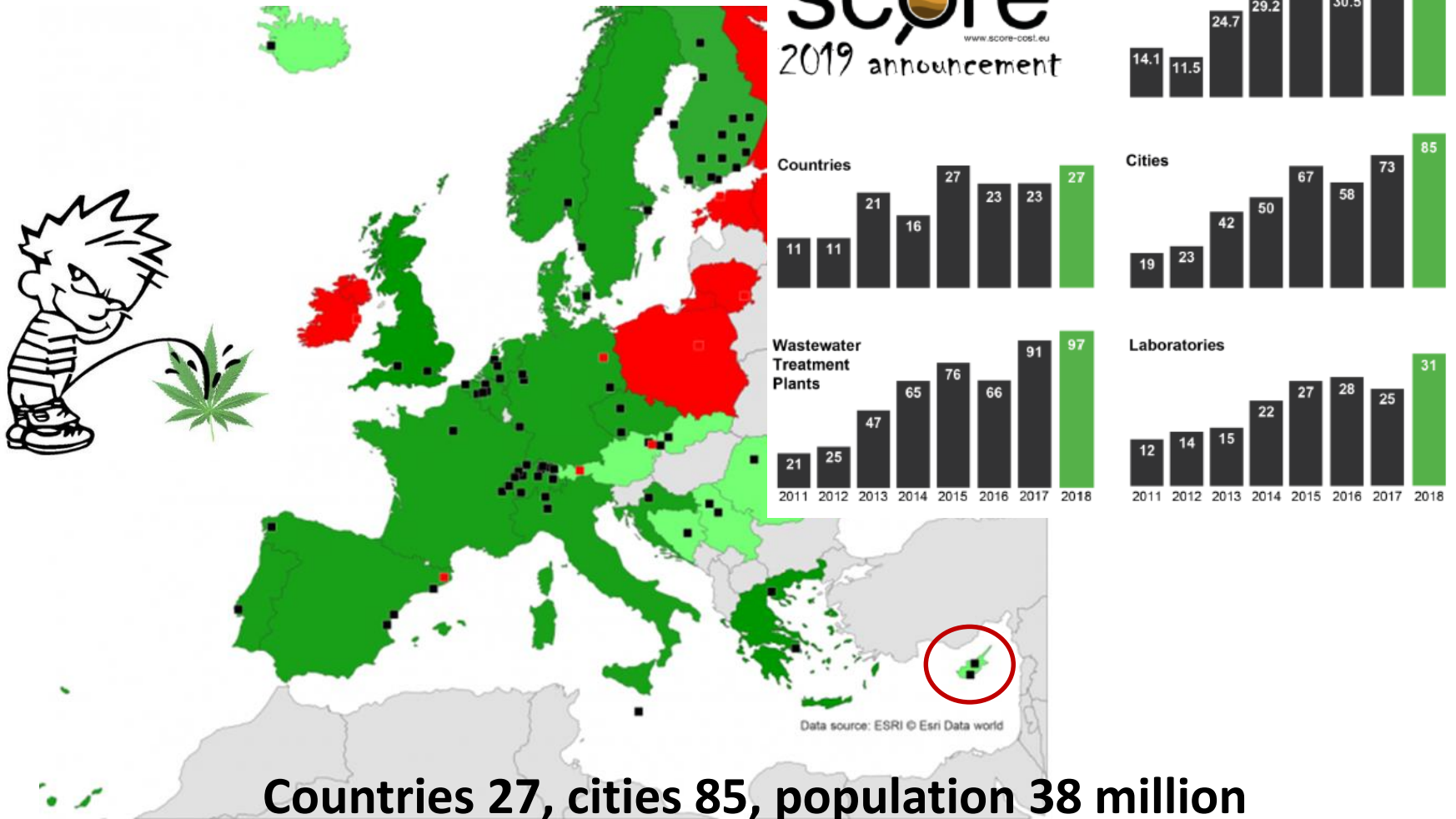
Concentrations found in influent wastewater

- Flow data
- Metabolism
- etc



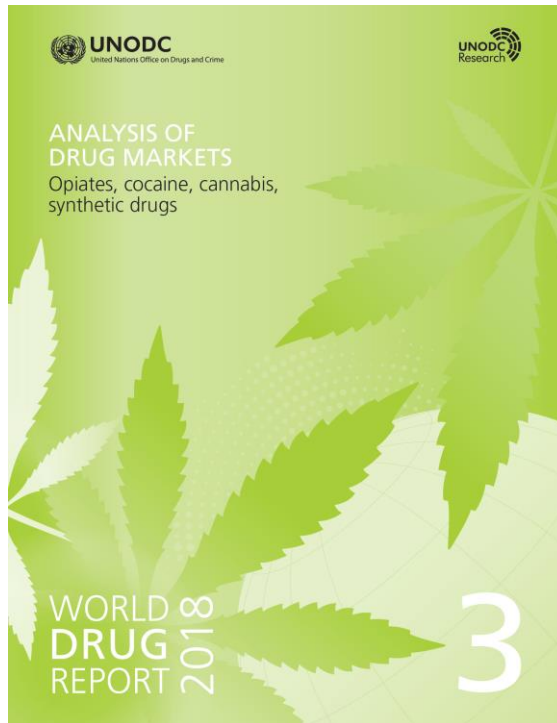
Information about **lifestyle habits**, **exposure to toxicants** and **public health** can be obtained from the chemical analysis of urban wastewater

WBE: Monitoring of illicit drugs use in Europe (2011-2018)



WBE: Monitoring of illicit drugs use in Europe (2011-2018)

score



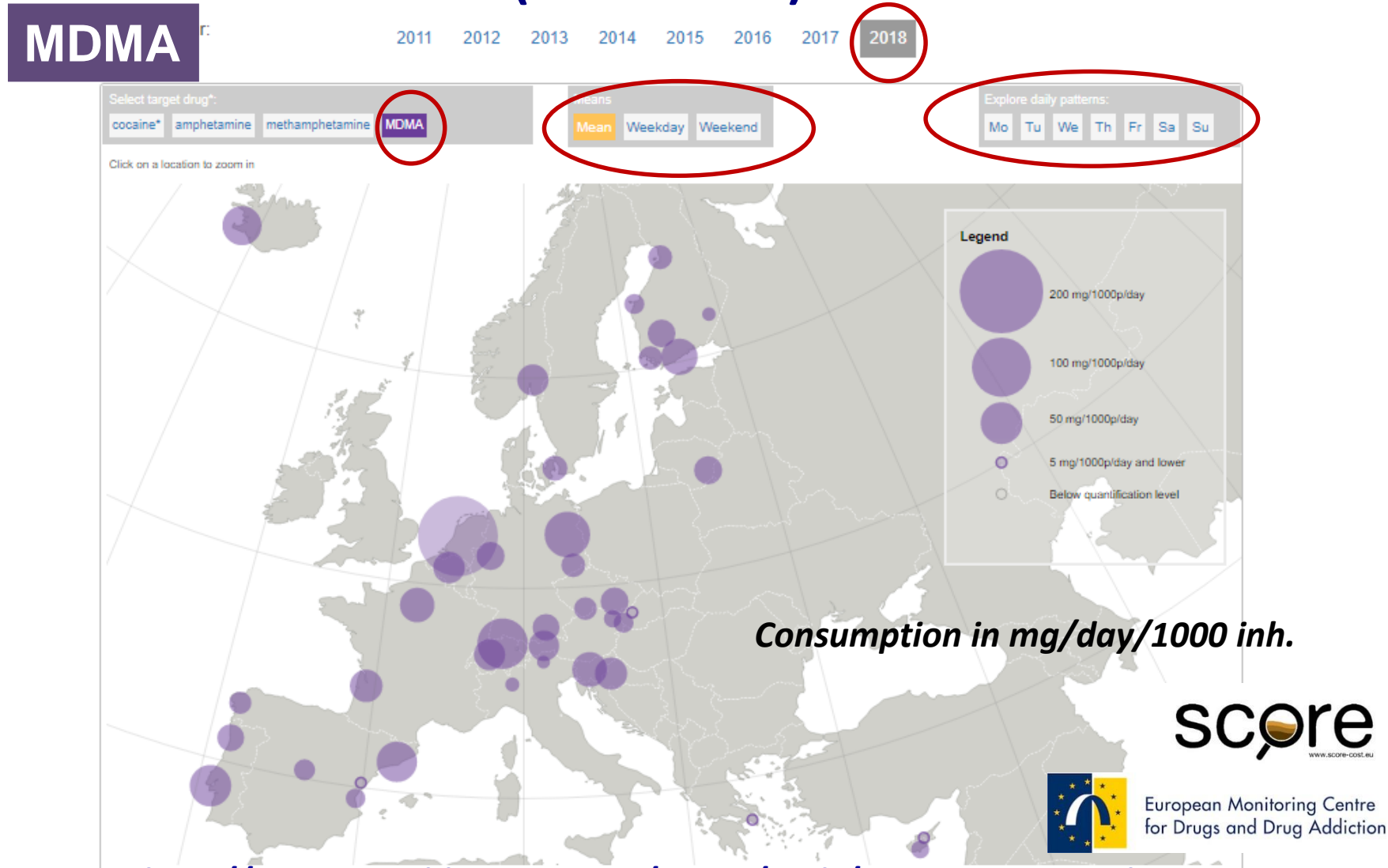
UNODC report since 2016

www.score-network.eu



EMCDDA report since 2014

WBE: Monitoring of illicit drugs use in Europe (2011-2018)



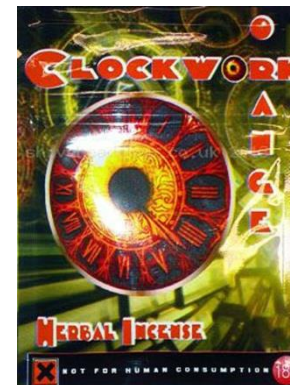
New Psychoactive Substances

NPS are substances which **mimic the effects of drugs** such as cocaine and ecstasy. The main difference is that they're **often not controlled** under any Drugs Act.

Challenges / limitations of monitoring NPS

- Number of consumers are small
- Users do often not exactly know what they consume
- The lack of data on their metabolism

New substances replace
banned substances



*~700 NPS reported
to EWS in last 10y*

Analytical challenge

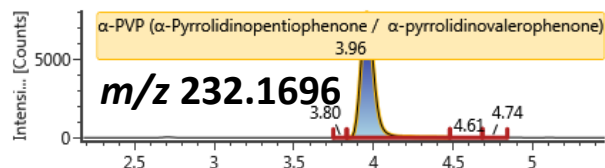
Strategy!

Screening based on IM-QTOF-MS

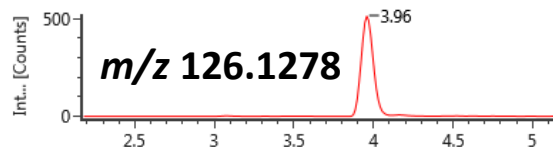
- No prior need for reference standards
- Screening of ∞ NPS, also retrospectively

Identification / confirmation – α -PVP

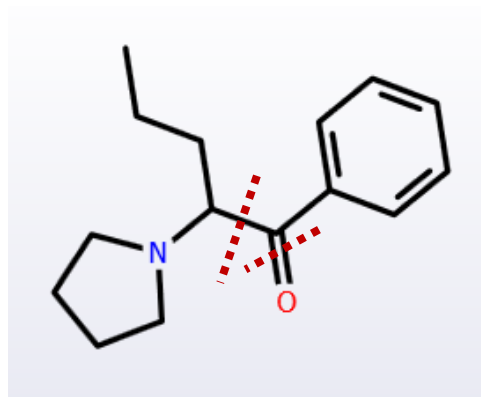
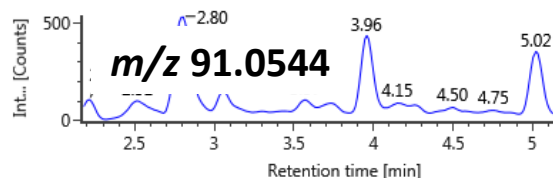
RT aligned *polarity*



Item name: TICTAC-030 hydro.
Channel name: α -PVP (α -Pyrrolidinopentiophenone / α -pyrrolidinovaler...



Item name: TICTAC-030 hydro.
Channel name: α -PVP (α -Pyrrolidinopentiophenone / α -pyrrolidinovaler...



Exact mass: 232.1696

Mass error: 0 ppm



Reference standard

Quantitative analysis based on QqQ (≈ 30 NPS)

WBE: monitoring the use of psychoactive substances at music festivals

Pooled urine and/or wastewater

Festivals across Europe



Different music styles



WBE: monitoring the use of psychoactive substances at music festivals

Pooled urine and/or wastewater



Hydrolysis

Dilution

Oasis HLB
generic cartridge

Oasis MCX
Specific cationic
exchange cartridge



“Keep your friends
close, but your
mass spectrometer
closer.”



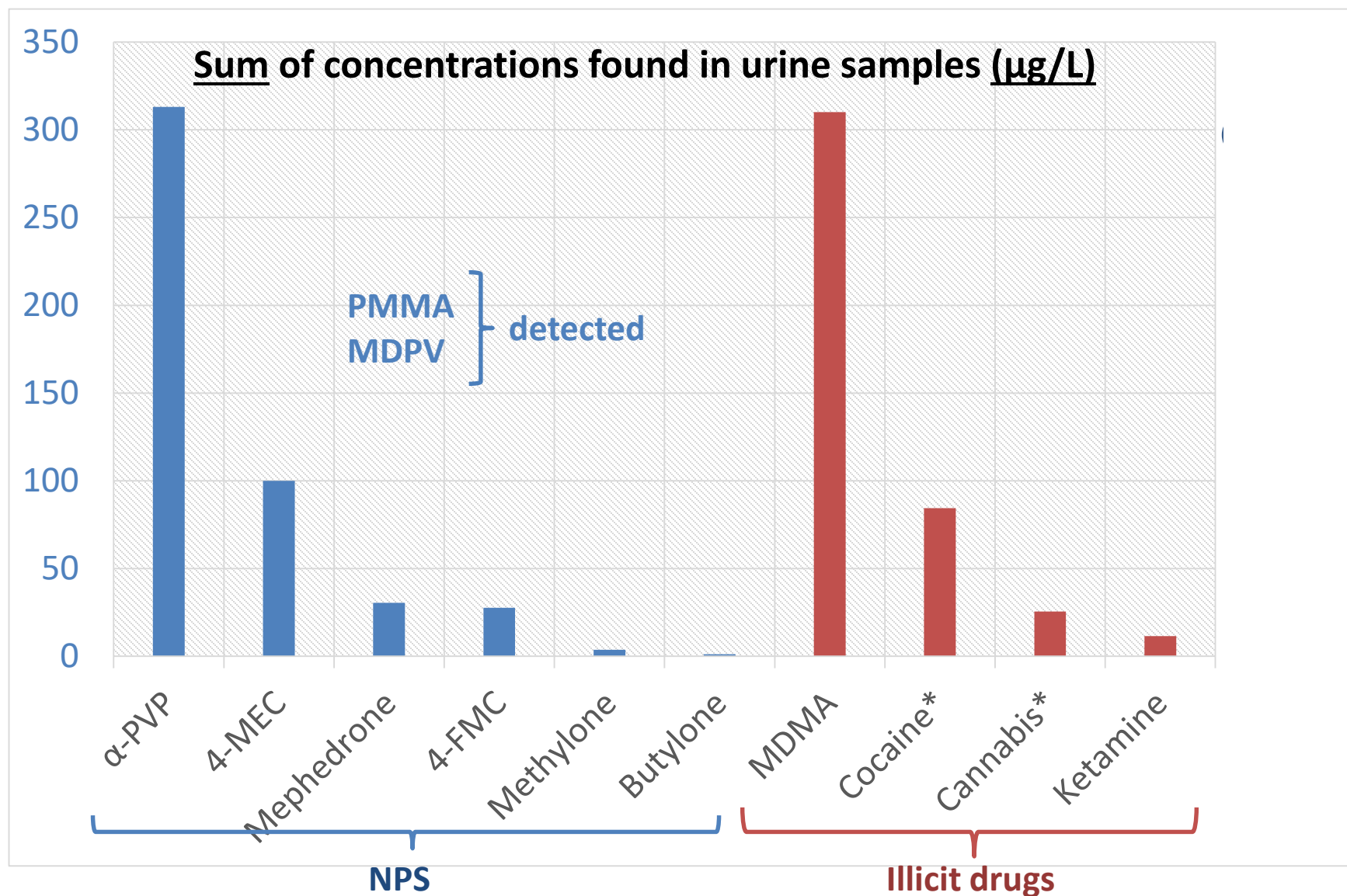
LC-MS

Results



Bijlsma *et al.* **“Monitoring the use of psychoactive substances at six music festivals across Europe”**
International Journal of Drug Policy, Submitted

England (*pooled urine*)



Portugal (*wastewater*)

Survey (n=887)

NPS last 48h	
Synthetic cannabinoids (3)	Piperazine (1)
Plants (1)	Synthetic cathinones (0)

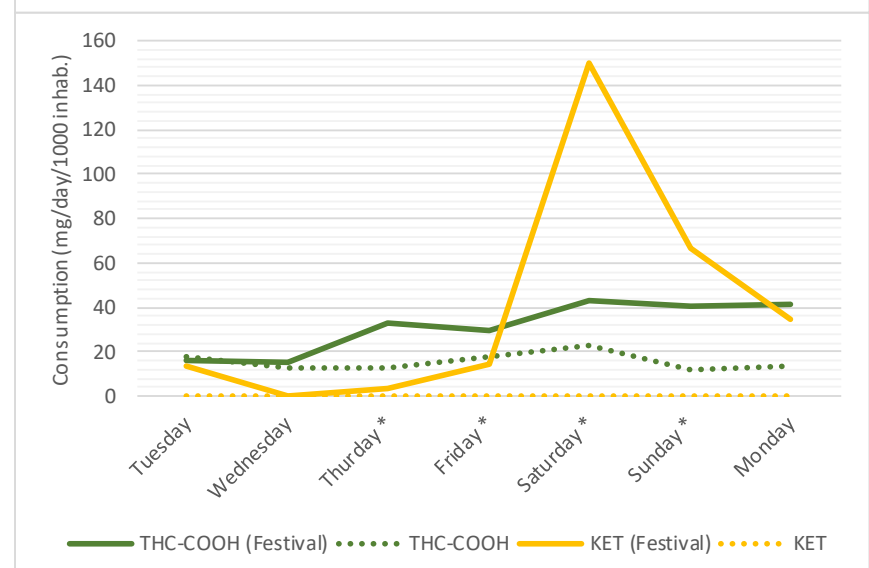
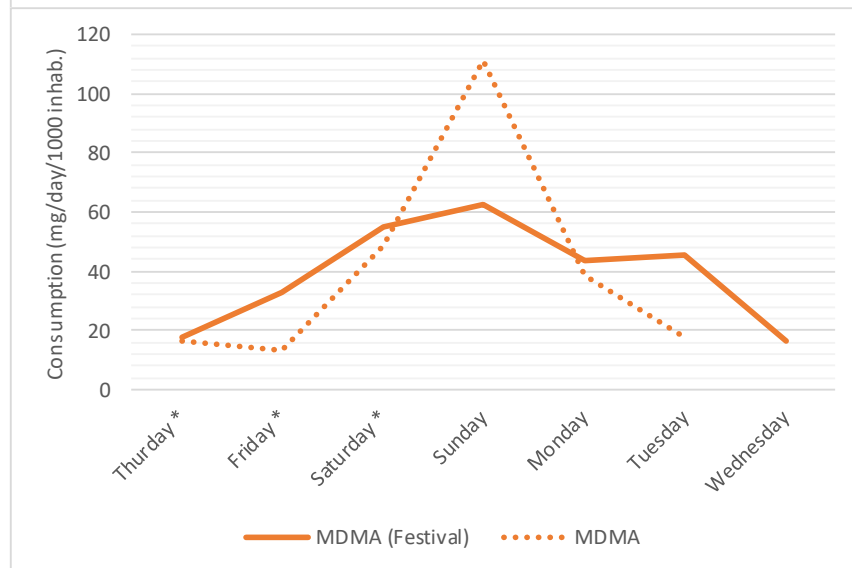
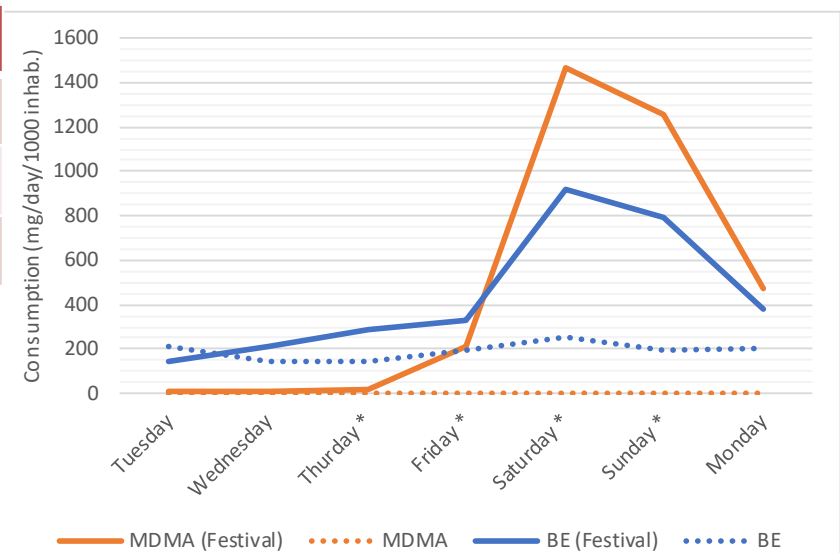
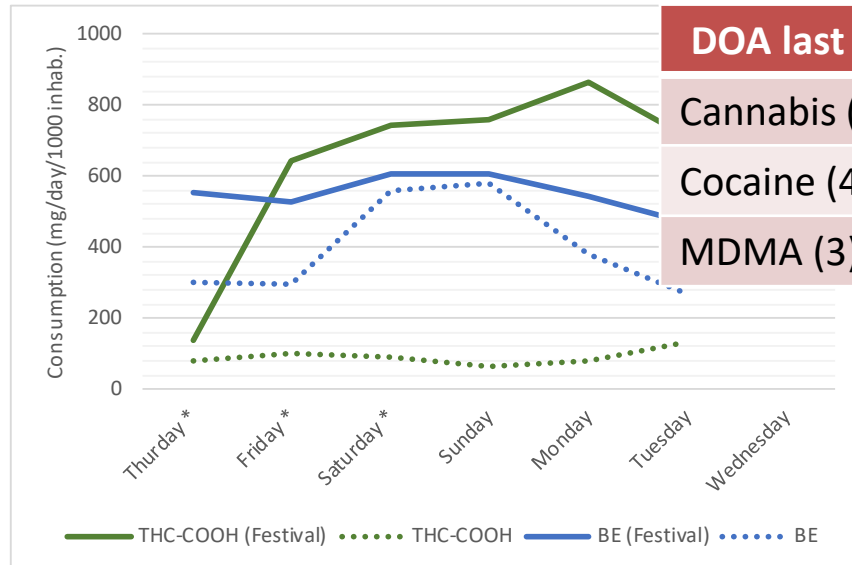
NPS loads found in wastewater taken during festival week (g/day)

	NPS	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Synthetic cathinones	Mephedrone	0.23	1.57	1.35	0.86	0.51	0.26	0.17
	Methcathinone	-	0.16	0.14	0.11	0.13	-	-
	3,4-DMMC	-	-	-	0.25	-	-	-
	Buphedrone	-	-	0.52	0.29	0.20	-	0.19
	4-chloro- α -PPP	d	d	d	d	d	-	-
	2-Phenethylamine	d	d	d	d	d	d	d

Note: Festival days in red

Wastewater

(n=887)

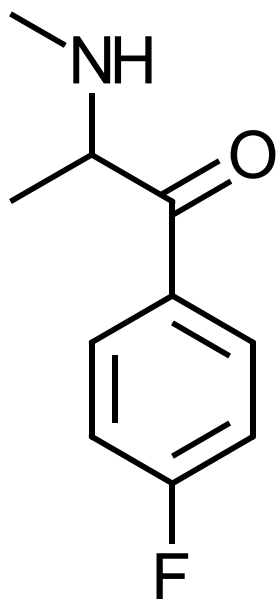
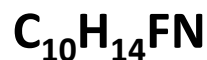
**Portugal (pop/rock)****Spain (electronic)**

Retrospective analysis: 4-FA replaced by 4-FMA

the Netherlands

(electronic, hardcore house)

4-Fluoromethamphetamine



Tim Boersma
@TimBoersmaBFCC

Follow

Na regen komt zonneschijn. Fantastische sfeer op @DecibelOutdoor #db17

Translate from Dutch

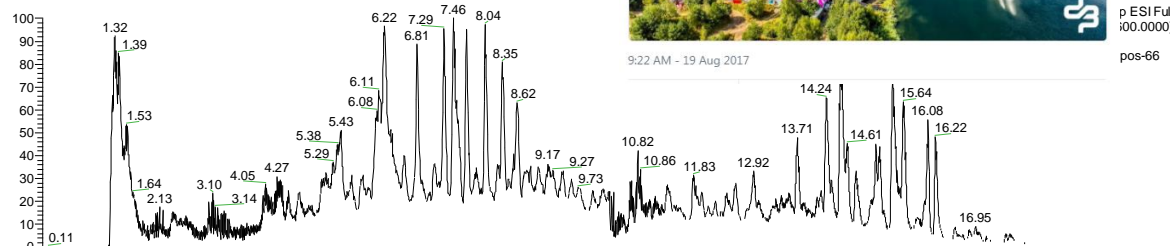


9:22 AM - 19 Aug 2017

p ESI Full
100.0000]

pos-66

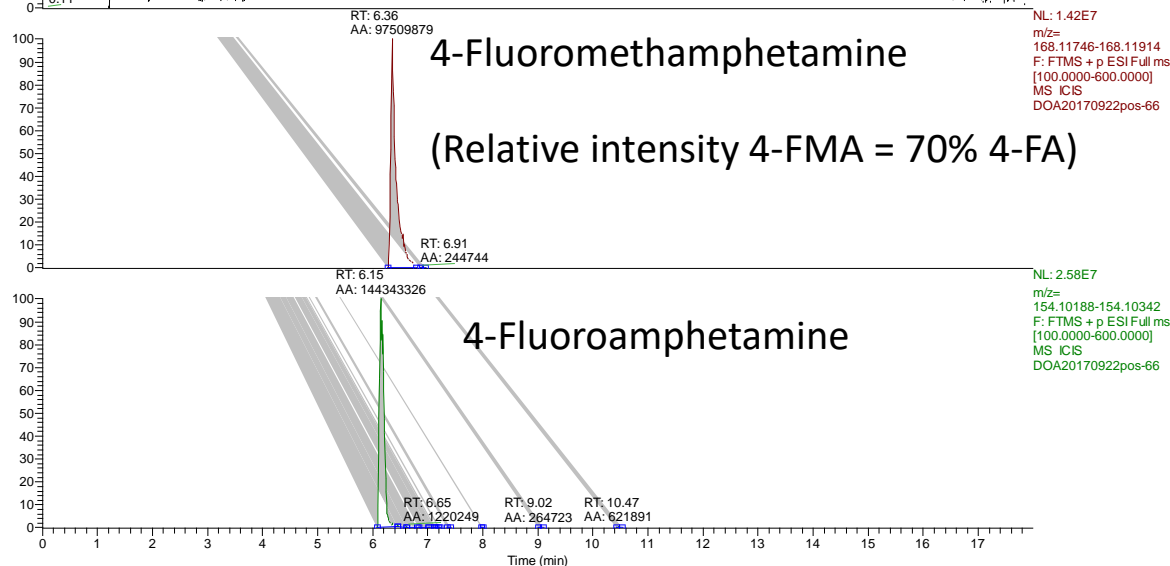
RT: 0.00 - 18.00



4-Fluoromethamphetamine

(Relative intensity 4-FMA = 70% 4-FA)

NL: 1.42E7
m/z= 168.11746-168.11914
F: FTMS + p ESI Full ms
[100.0000-600.0000]
MS ICIS
DOA20170922pos-66

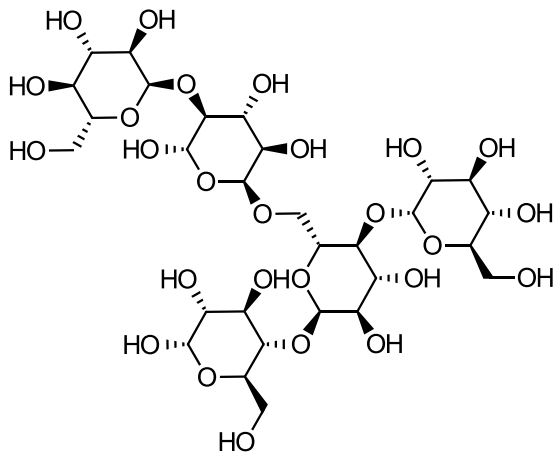


4-Fluoroamphetamine

NL: 2.58E7
m/z= 154.10188-154.10342
F: FTMS + p ESI Full ms
[100.0000-600.0000]
MS ICIS
DOA20170922pos-66

Emerging psychoactive substances: DFF

Polymeric carbohydrate



DFF: Dutch French Fries

Overview: NPS identified

Cathinones	Phenylethylamines	Other
3,4-DMMC	2-phenethylamine	α-methyltryptamine
4-chloro-α-PPP	25-E-NBoMe	
4-MEC*	25-iP-NBoMe	Ketamine
6-APDB	4-FA	2-fluoroketamine
α-PVP	4-FMA	Methoxetamine
Buphedrone	Butylone	
Flephedrone*	Ethylone*	5F-AB-FUPPYCA
Methcathinone	MDPV*	
Metamfepramone	Methylone	DFF
Mephedrone	2-CB	
Methedrone	2-CE	

In **bold** = confirmed with reference standard

* Only detected in 2015 samples of the UK
i.e. before the Psychoactive Substances Act was established in 2016

Conclusions

Challenges / limitations

- Their rapid transience on the drug scene
- The lack of data on their metabolism
- Low concentration levels

- **LC-MS** is powerful tool to investigate NPS in pooled urine and wastewater
 - Many potential users
 - Large number of compounds (without standards)
 - **Retrospectively** e.g. new NPS and/or metabolites
- Analyzing wastewater/pooled urine allows detecting potential **new emerging drugs**
- NPS does **not** seem direct **substitutes** of conventional drugs in festivals

Conclusions

- **Data triangulation** is very important and interesting e.g. Portuguese festivals

Disadvantages WBE

- No information on single users (for example: age, gender)
- No information on the behaviour of single users and on their demographics

Advantages WBE

- Anonymous (no consent)
- Near real-time data
- Monitoring trend of drug use
- 1 sample represents large population
- Relatively cheap

Complementary!

Gjerde *et al.* “Drug use by music festival attendees: A novel triangulation approach using self-reported data and test results of oral fluid and pooled urine samples” Substance Use and Misuse, in press

Acknowledgements

All the people who provided samples!



ing. Erik Emke



Watercycle Research Institute

MSc. Alberto Celma



Αρχή Αντιμετώπισης Εξαρτήσεων Κύπρου
Cyprus National Addictions Authority

Thank you for your attention!

Ευχαριστώ!



Questions

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