NH_3 in URBAN EUROPE
Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban & Industrial AreaS

RI-URBANS WP1 GROUP

TFMM Annual meeting, 6th-7th May, 2024

European Commission

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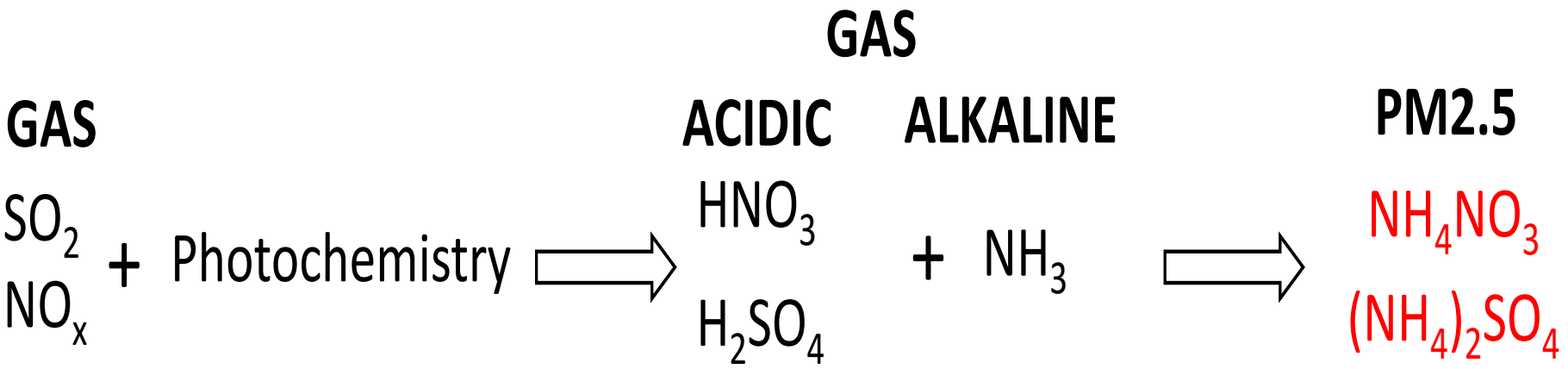
NH_3 and air quality

- Direct impact on vegetation
- Acidification and eutrophication
- Generation of secondary inorganic (ammonium sulphate and nitrate) & organic (BrC) PM2.5



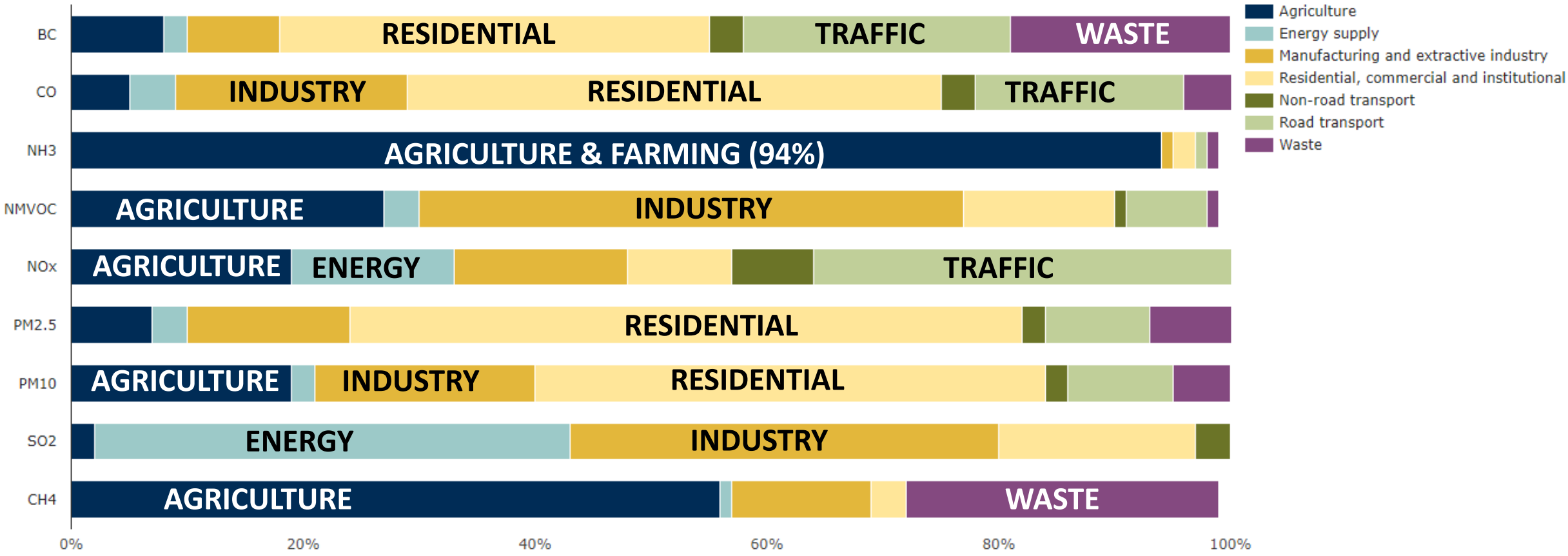
NH_3 emission inventories EU-27, 2020

European Environment Agency

https://www.eea.europa.eu/publications/air-quality-in-europe-2022/sources-and-emissions-of-air

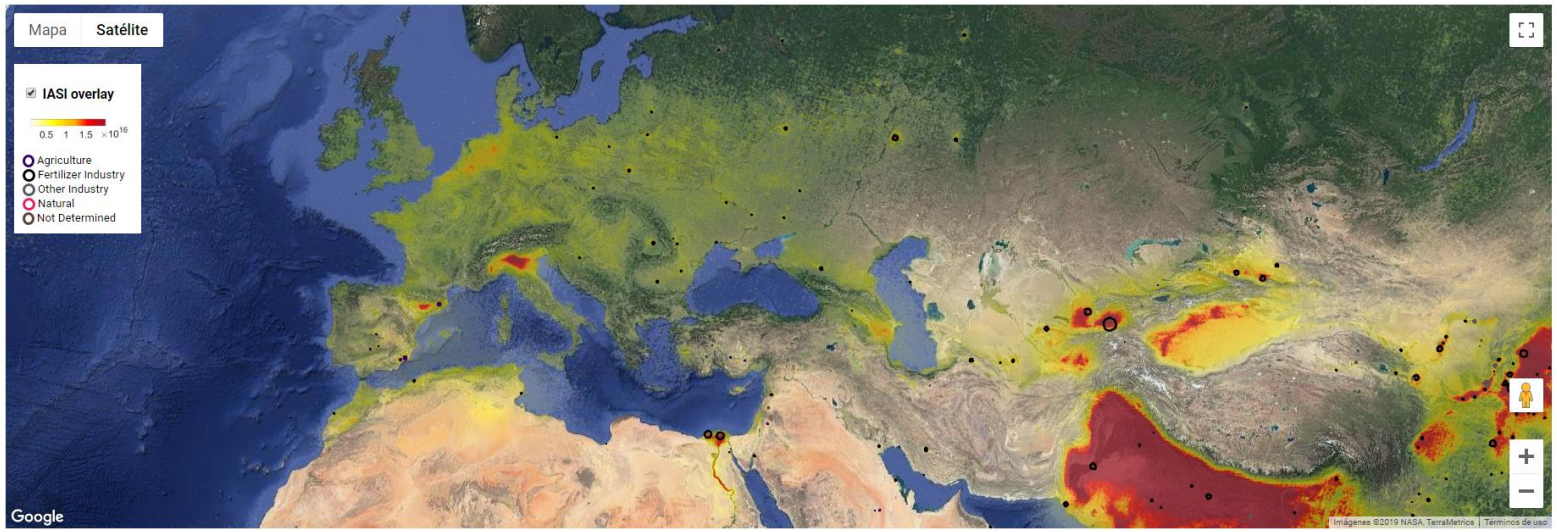
Air quality in Europe 2022
1 Dec 2022

Chart — Contributions to EU-27 emissions of BC, CO, NH_3, NMVOCs, NOx, primary PM_{10}, primary $PM_{2.5}$, SO_2 and CH_4 from the main source sectors in 2020



NH_3 farming/agricultural hotspots

Atmospheric ammonia as seen by the IASI satellite instrument



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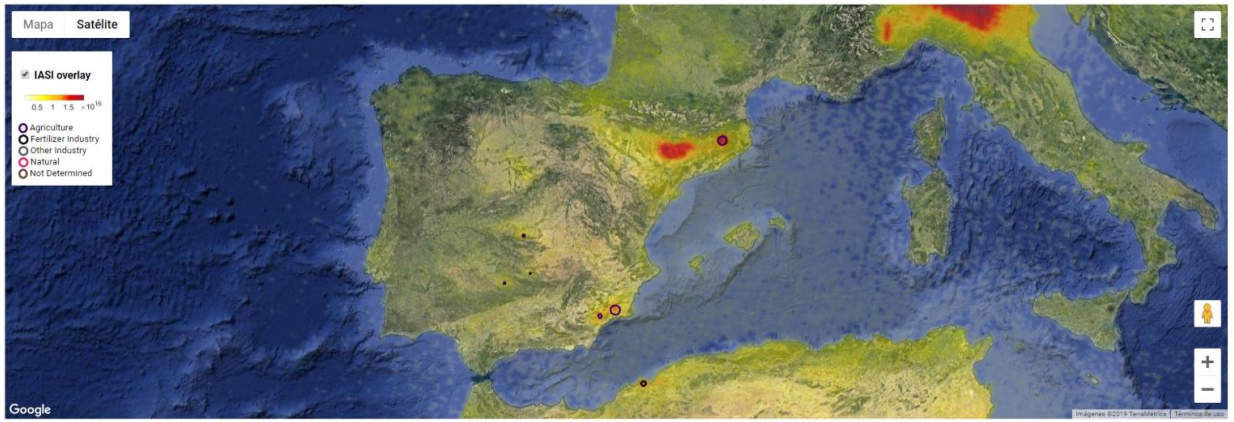
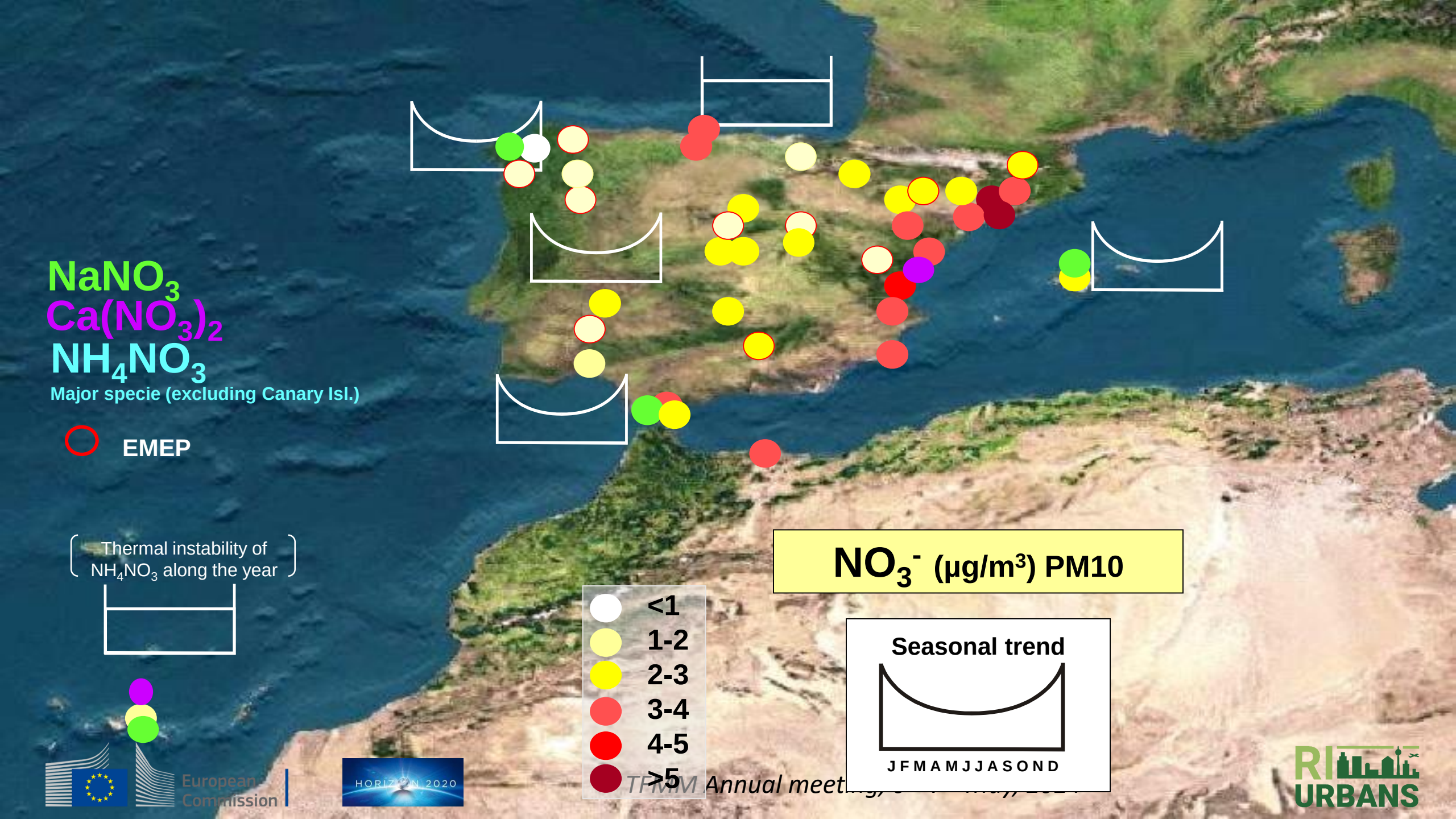


FAHs

- Inside regions identified by remote sensing
- RB sites > 1.5 µg/m^3 NH_3

http://www.ulb.ac.be/cpm/NH3-IASI.html


$NaNO_3$
$Ca(NO_3)_2$
NH_4NO_3
Major specie (excluding Canary Isl.)
EMEP
Thermal instability of NH_4NO_3 along the year
NO_3^- (µg/m³) PM10
<1
1-2
2-3
3-4
4-5
>5
Seasonal trend
J F M A M J J A S O N D
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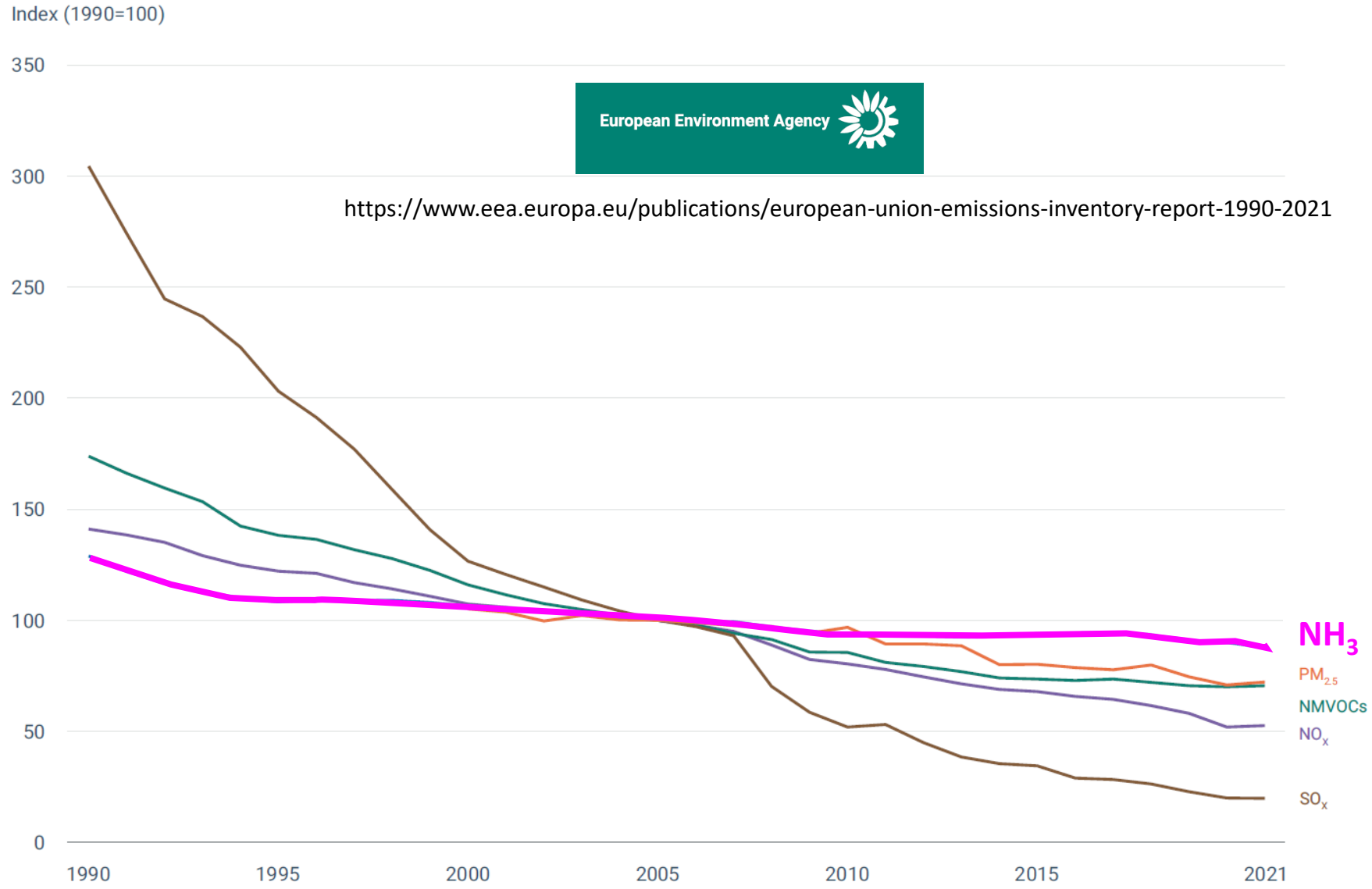
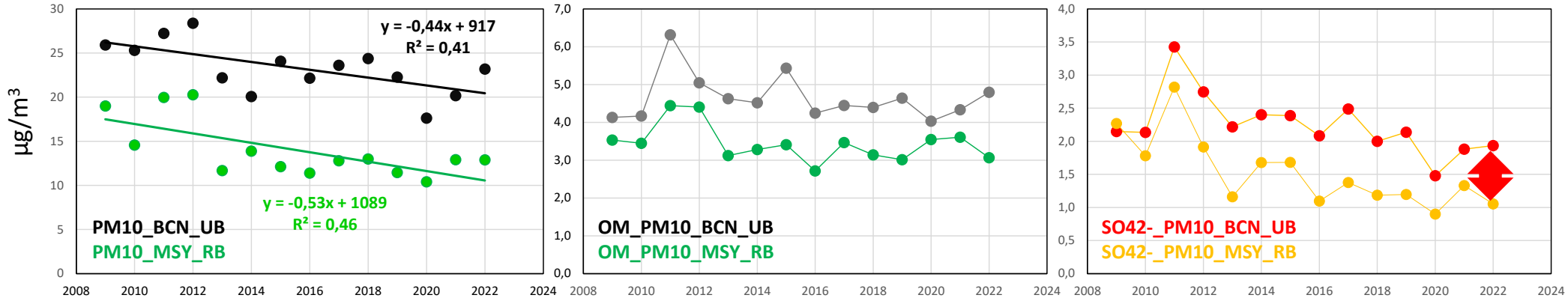
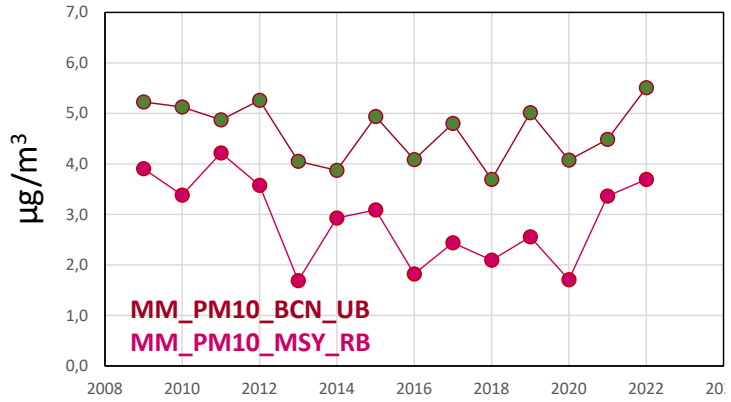
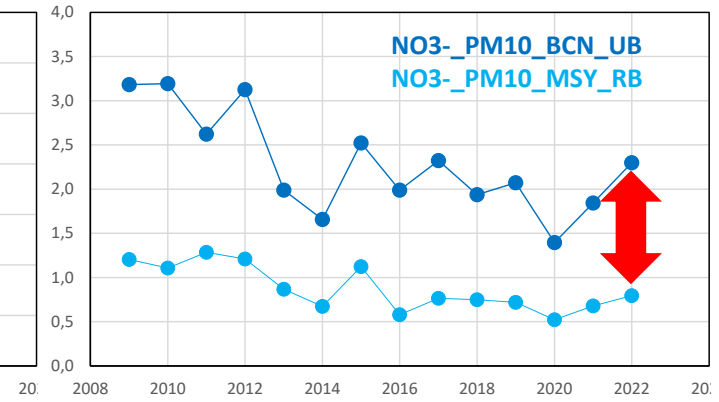
NH_3 emission inventories EU-27, 1990-2021

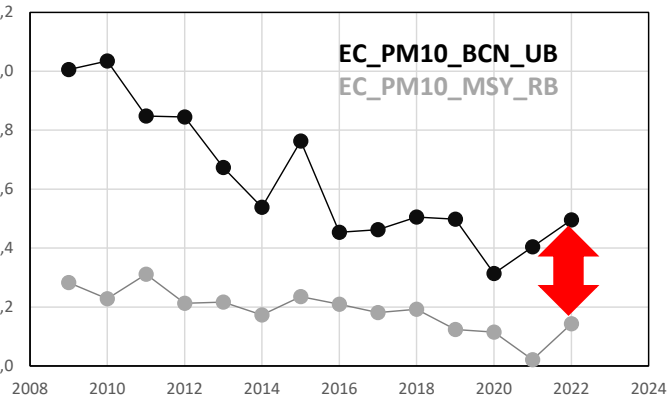


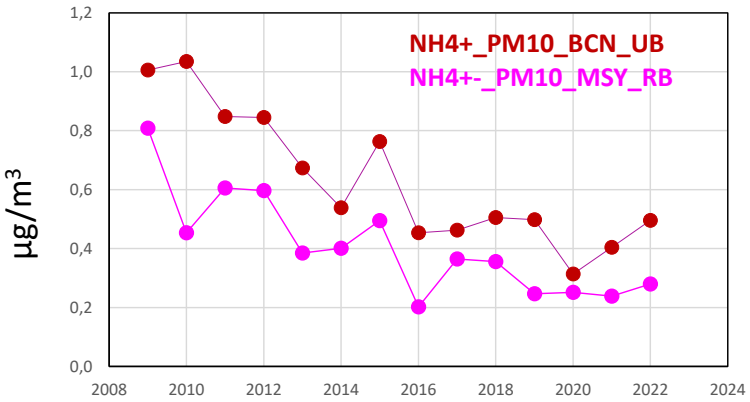
Barcelona (UB) & Montseny (RB) PM10 speciation 2009-2022 trends











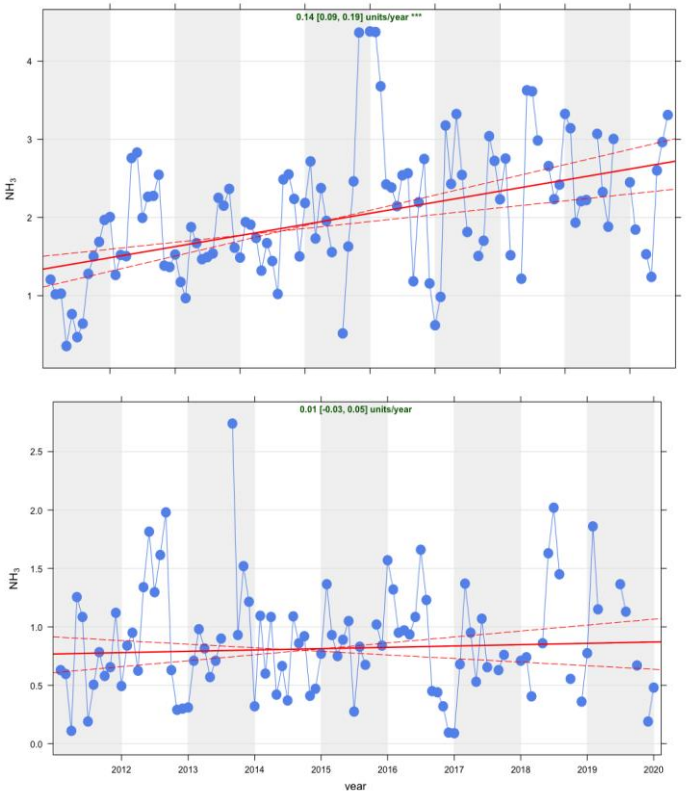
% reduced in PM10 from BCN to MSY

OM	SO_4^{2-}	NH_4^+	MM	PM10	NO_3^-	EC
-26	-33	-36	-38	-40	-62	-82

Urban and rural NH_3 in Barcelona

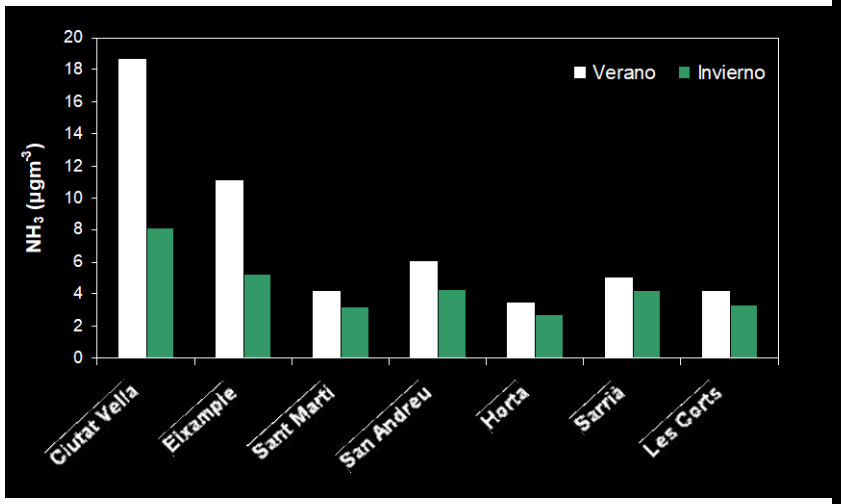
Reche C. et al., 2022. Chemosphere

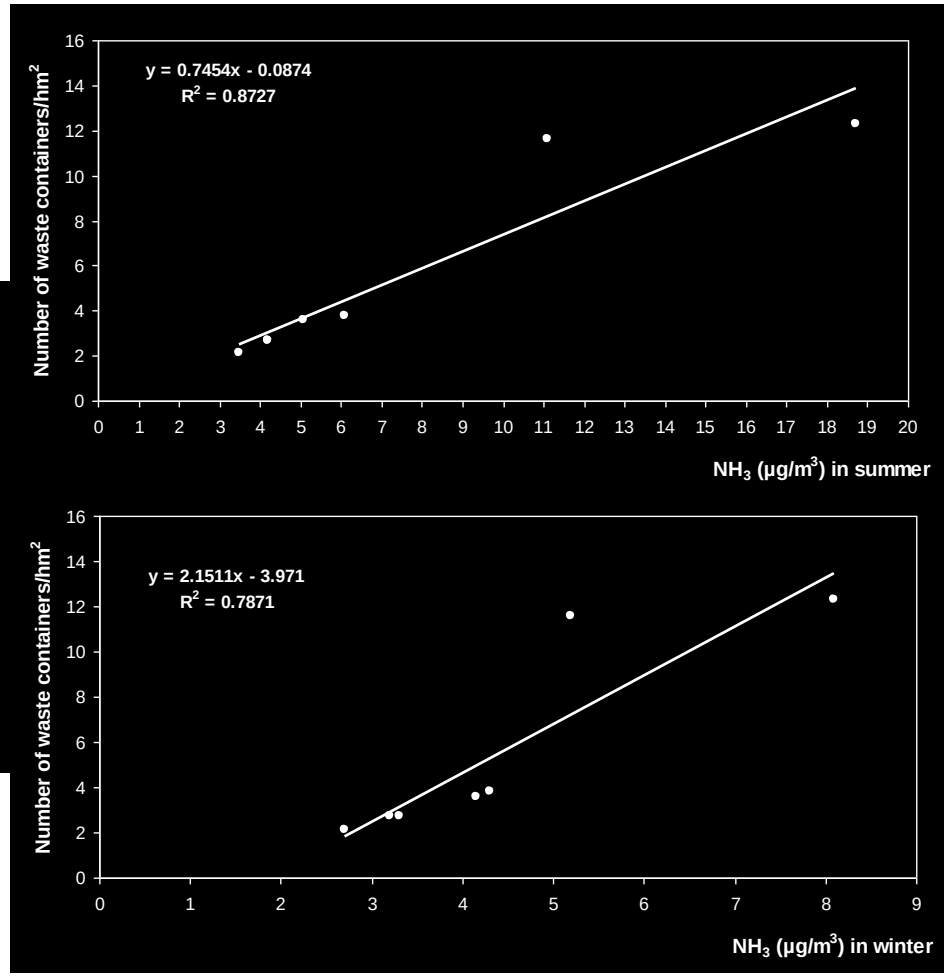
Urban NH_3 Barcelona 2011-2021



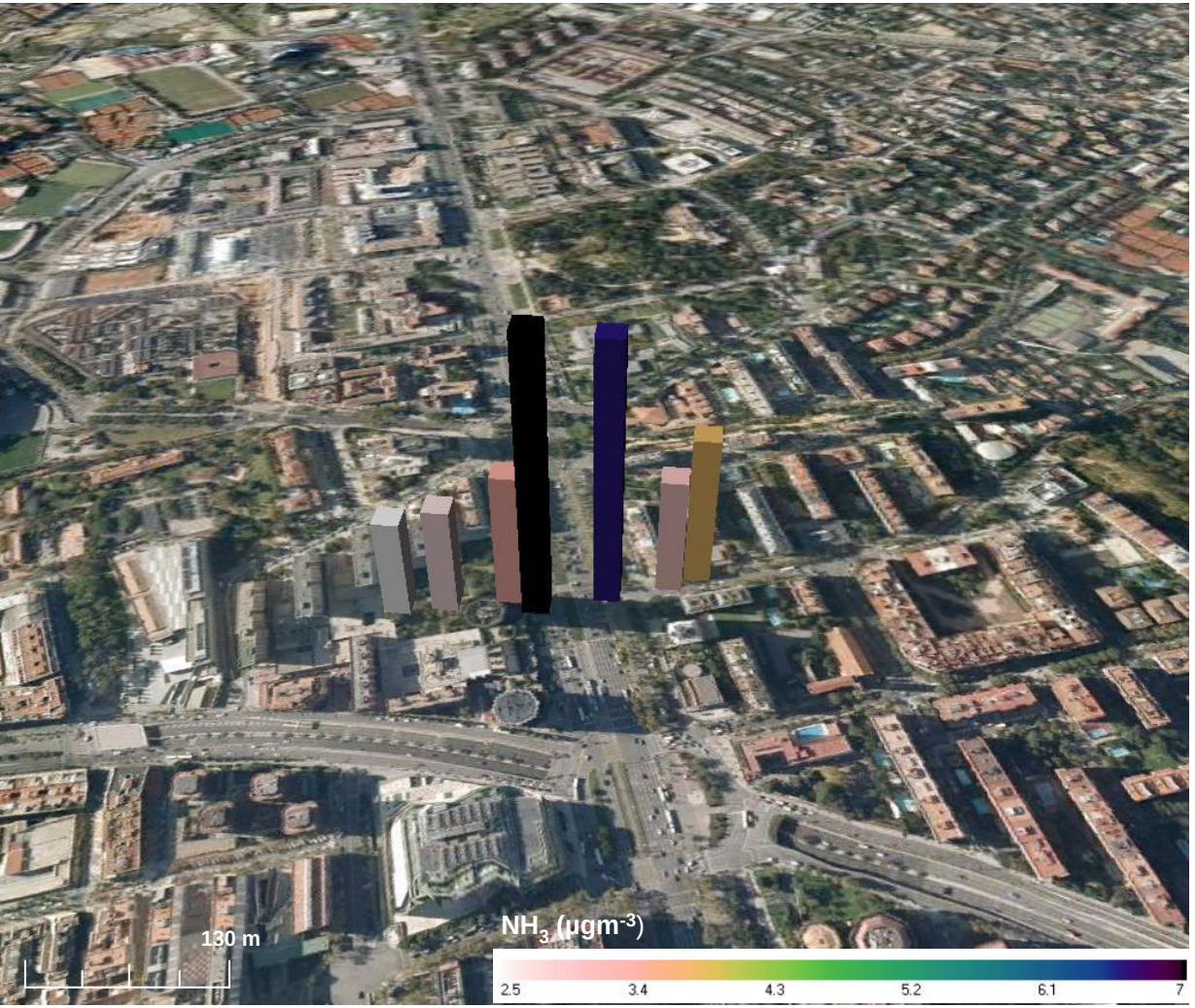
Rural NH_3 2011-2021

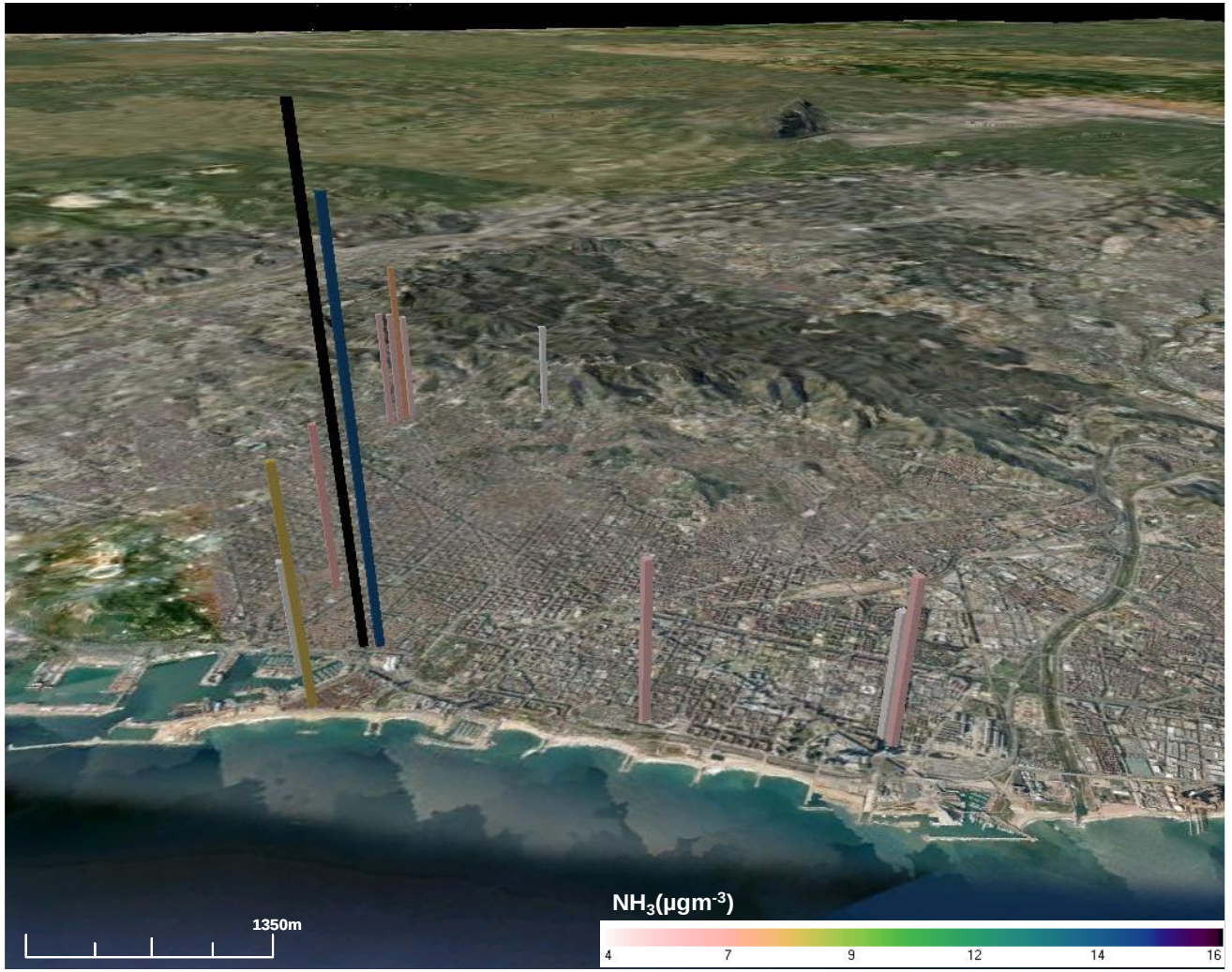
Reche et al., 2012
Atmospheric Environment





Urban and rural NH_3 in Barcelona





Reche et al., 2012 Atmospheric Environment

NH_3 in urban Europe

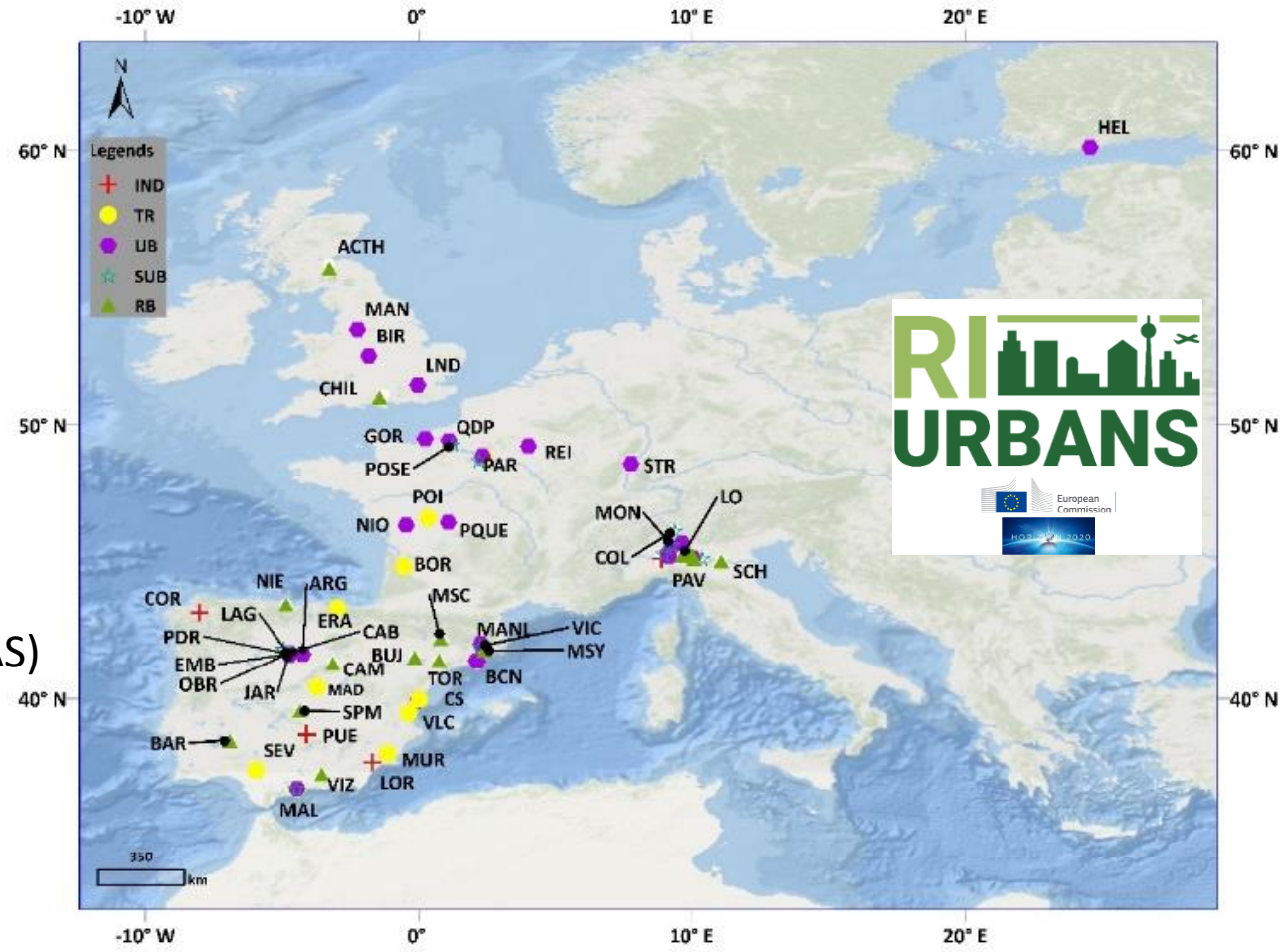
- 69 datasets of NH_3 concentrations from Spain (36), France (15), Italy (12), UK (5), Finland (1).
- UB (25), SUB (12), TR (12) and 5 (IND) sites and 15 RB, divided in agricultural/farming hotspots and non-shotspots

OFFLINE

- Passive sampling CEN method EN 17346 from 2020
- Denuders EMEP: NH3+NH4, ilterpack

ONLINE

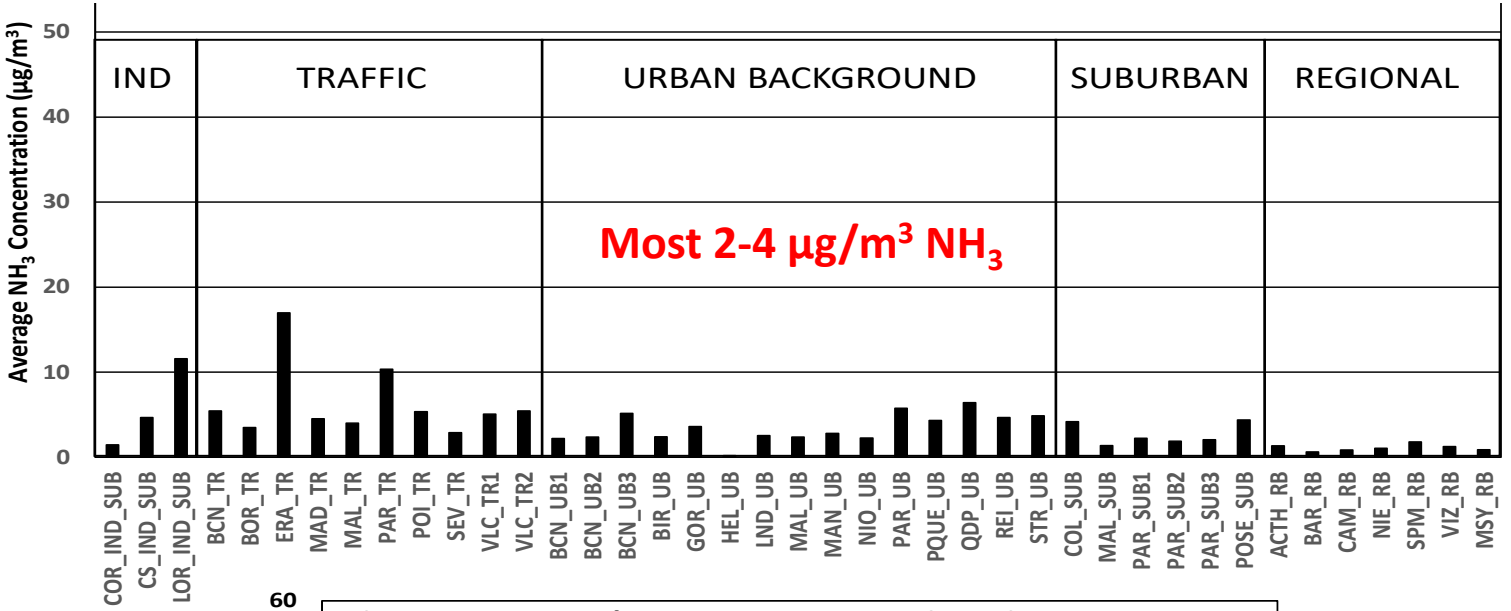
- Differential Optical Absorption Spectroscopy (DOAS).
- Cavity Ring-Down Systems (CRDS)
- Optical-Feedback Cavity-Enhanced Abs. Spectr. (OF-CEAS)
- Quantum Cascade Laser Absorption Spectrometers (QCLAS)
- Open-Path Fourier Transform Infrared Systems (FTIR)
- Photoacoustic methods



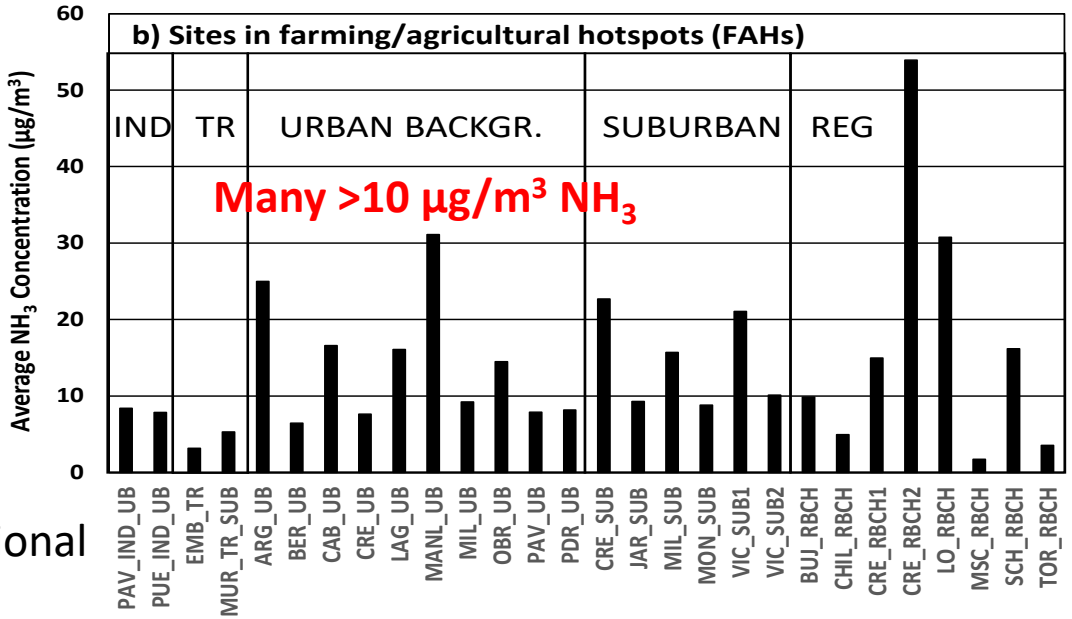
Liu et al., 2024, Environment International

NH_3 in urban Europe

Out of farming hotspots



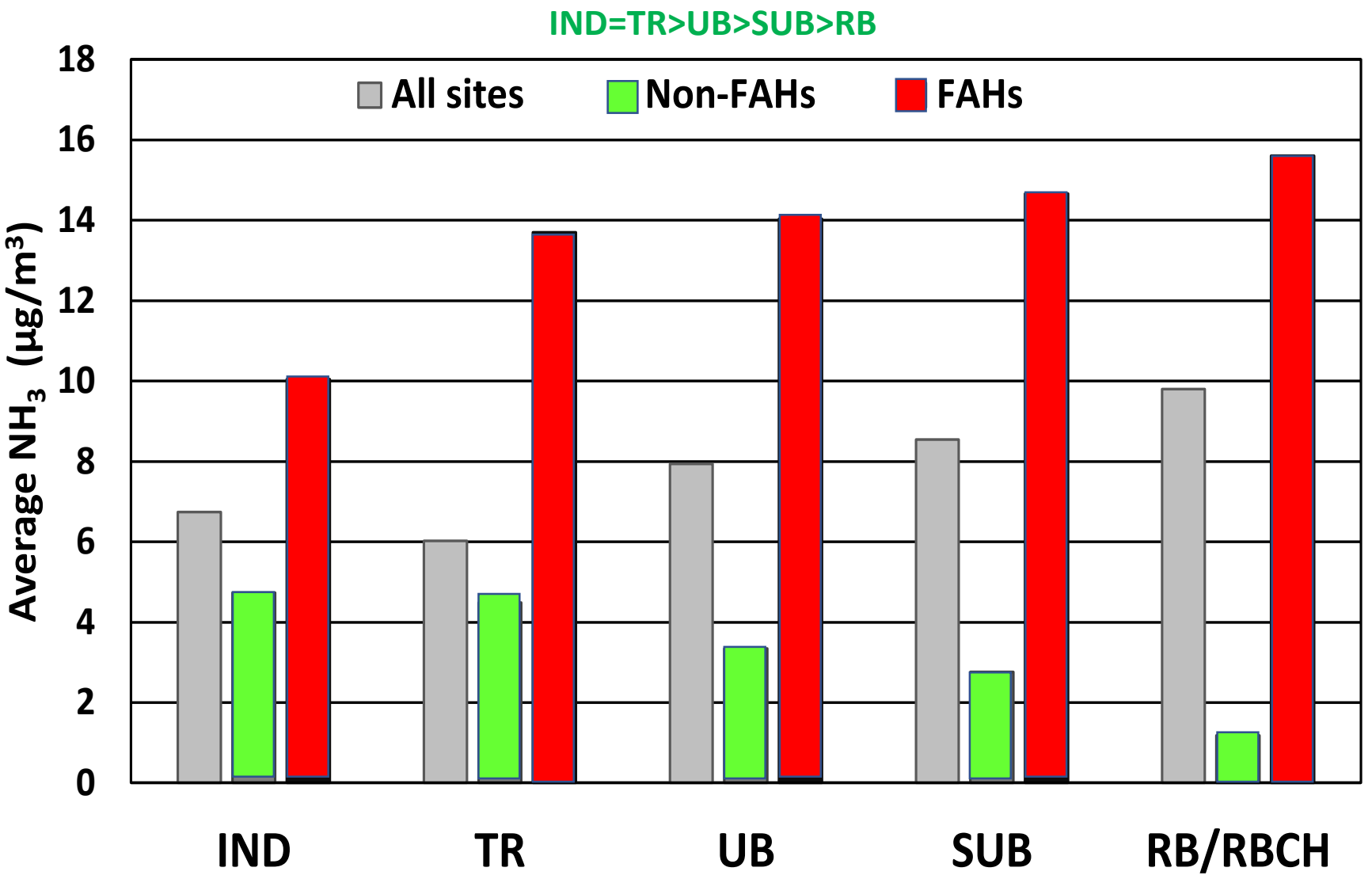
In farming hotspots



Annual
3 sites 30-54 µg/m³ NH_3

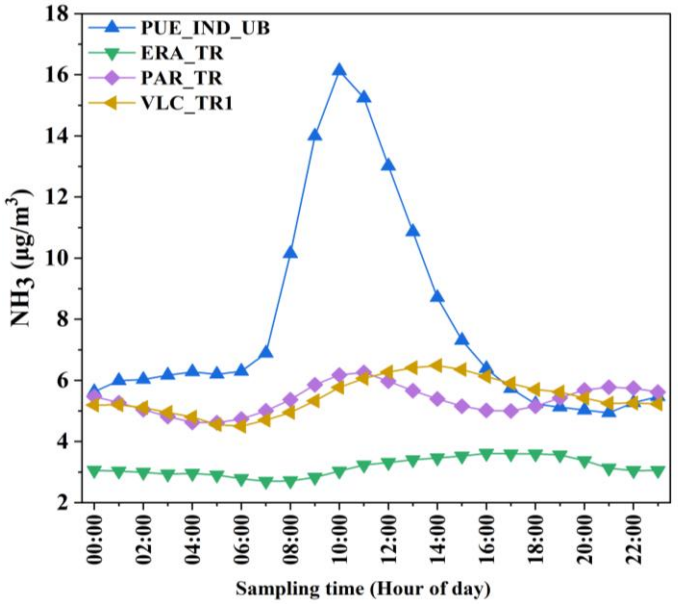
Liu et al., 2024, Environment International

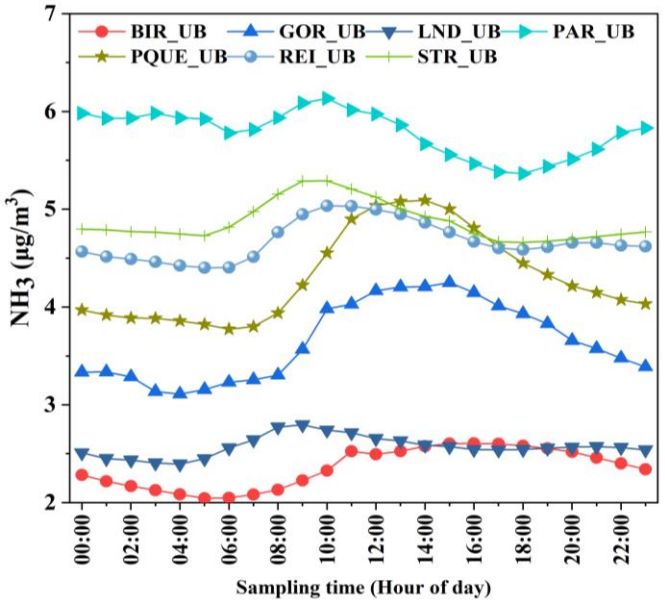
NH_3 in urban Europe

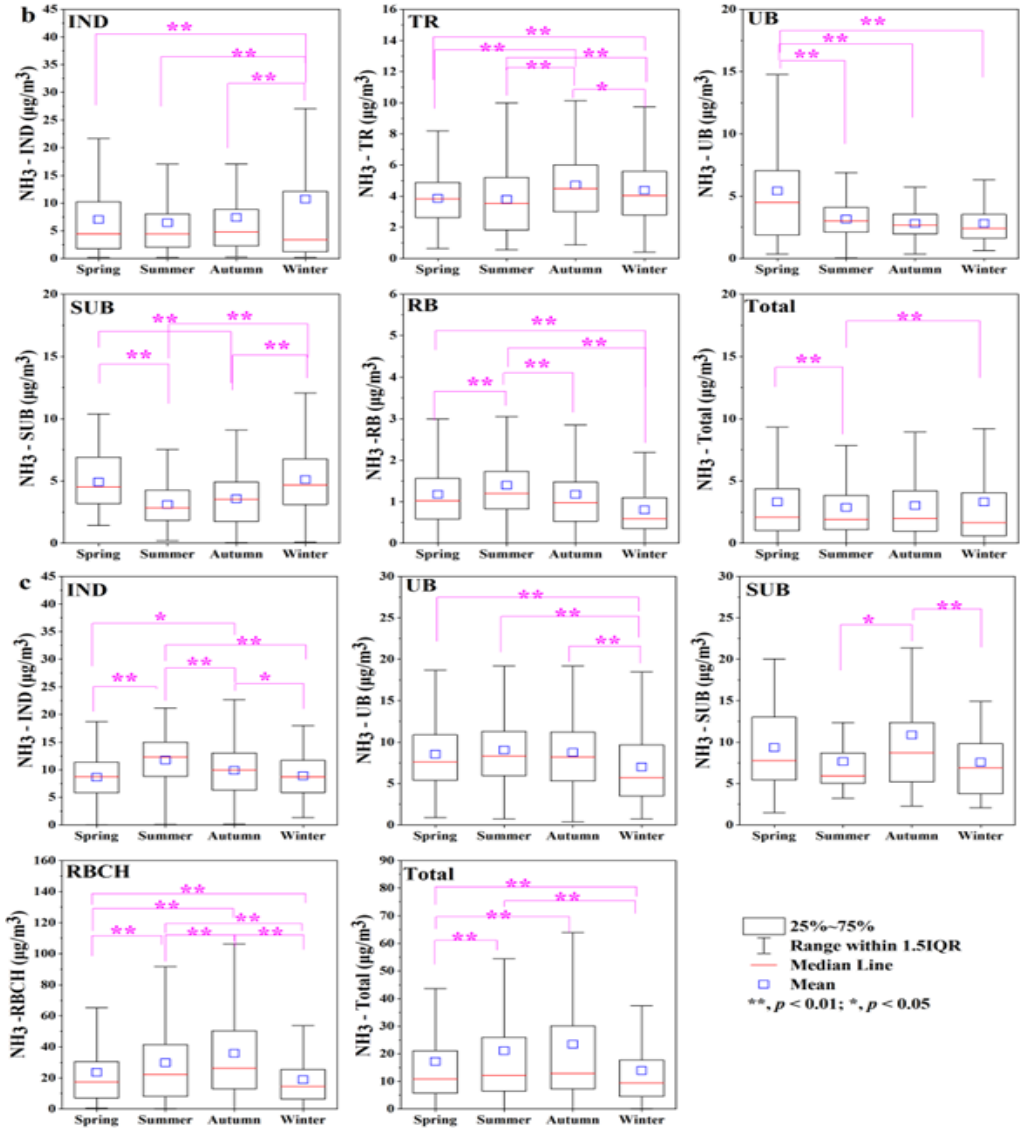


Liu et al., 2024, *Environment International*

NH_3 in urban Europe





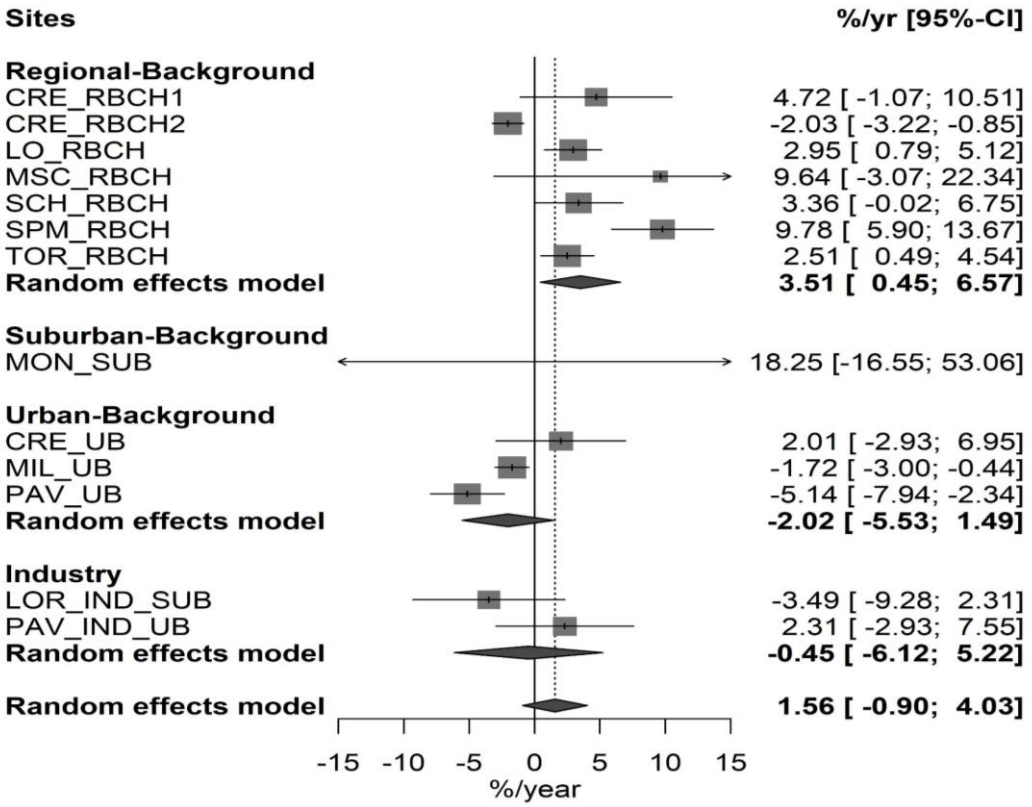


Liu et al., 2024, *Environment International*

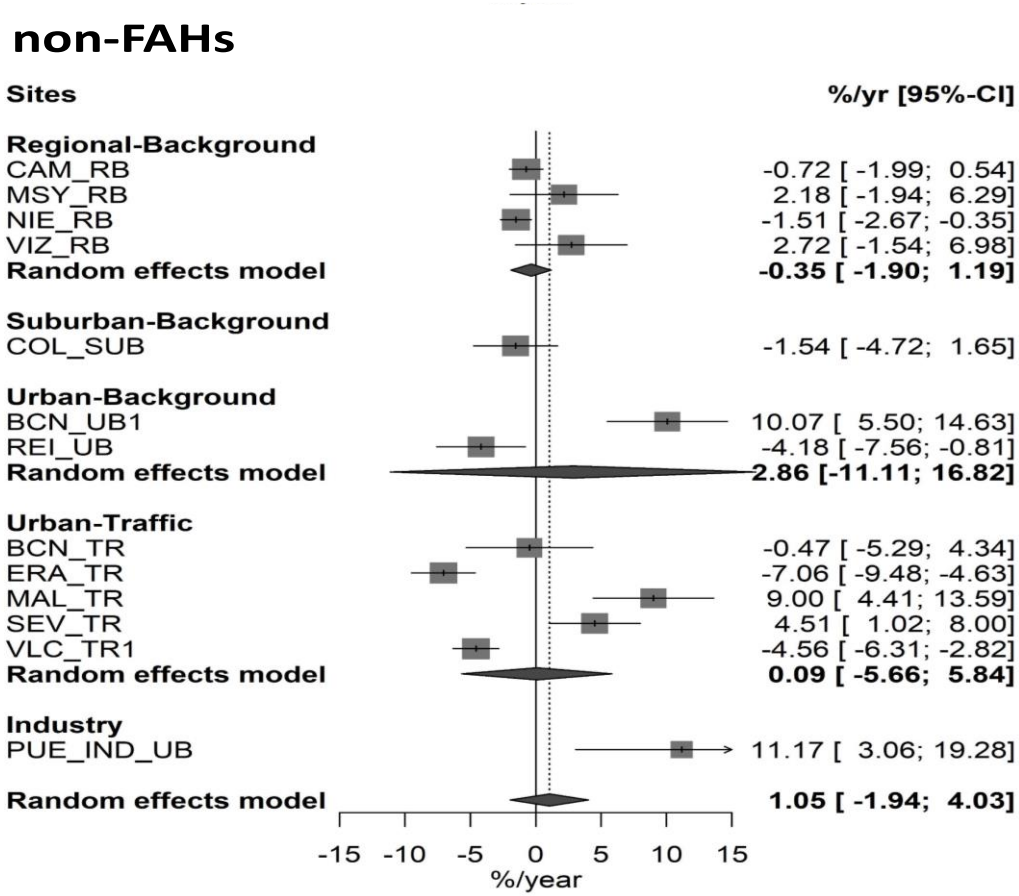
14th EMEP Annual meeting, 6th-7th May, 2024

NH_3 in urban Europe

a) FAHs

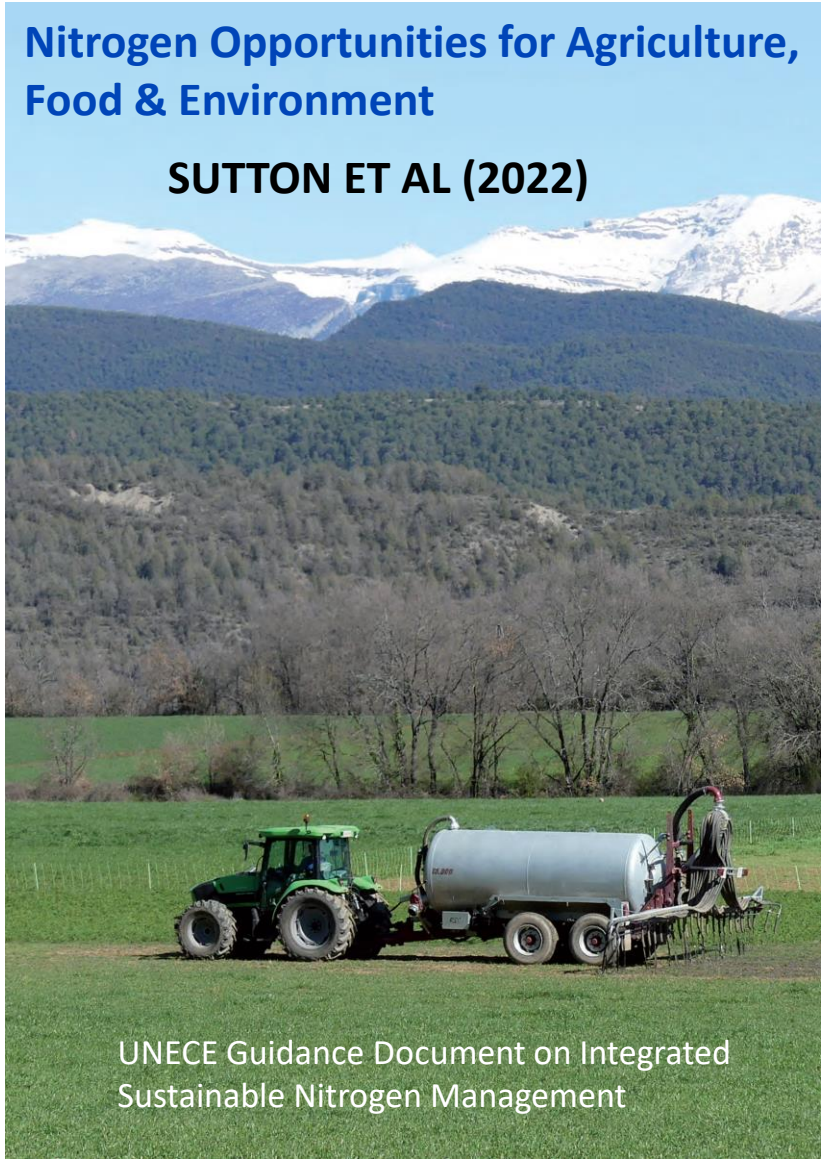


b) non-FAHs



b) non-FAHs

Final considerations



1. To abate PM, decreasing NH_3 (urban and agricultural/farming) emissions are needed
2. Highly recommended measuring NH3 IN URBAN AREAS (not required by the new AQ directive)
3. In farming hotspots NH_3 in cities x4
4. Abating urban emissions:
   - Organic city waste management
   - NH_3 slip from SCR in diesel vehicles
   - Sewage management
5. Abating farming/agricultural emissions:
   - Animals diet: Low N
   - Farm design
   - Handling and storage of residues
   - Managing residues
   - Application of residues as fertilizers

Thanks for your attention!!!!

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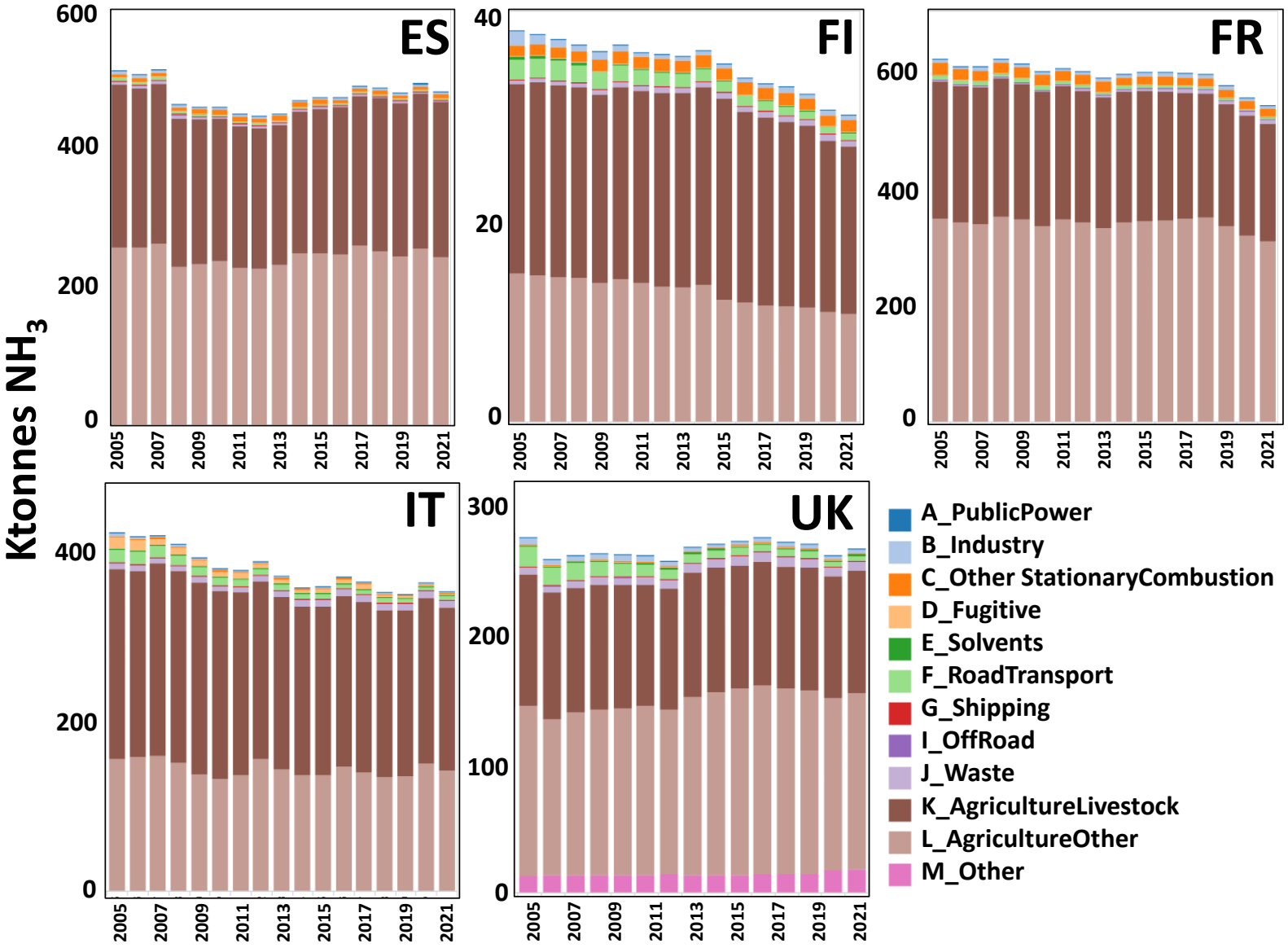
NH_3 emission inventories EU-27, 2005-2021



https://www.ceip.at/data-viewer-2/officially-reported-emissions-data

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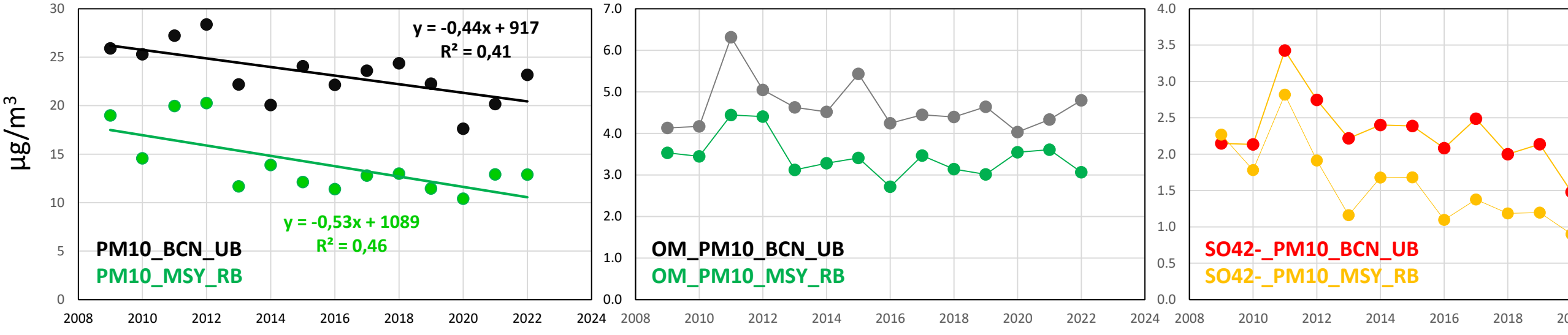

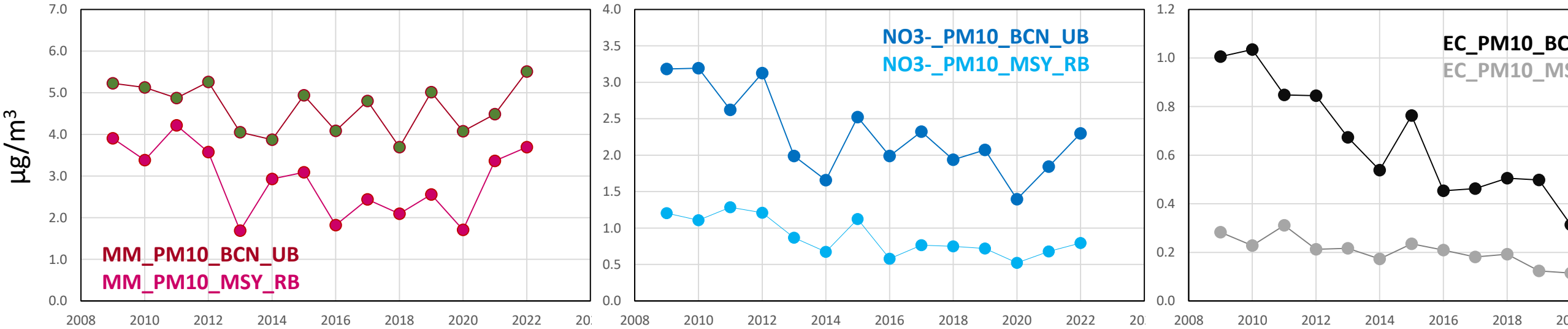

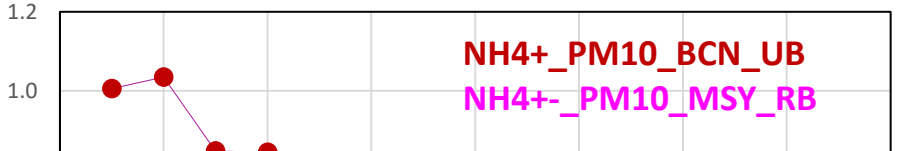

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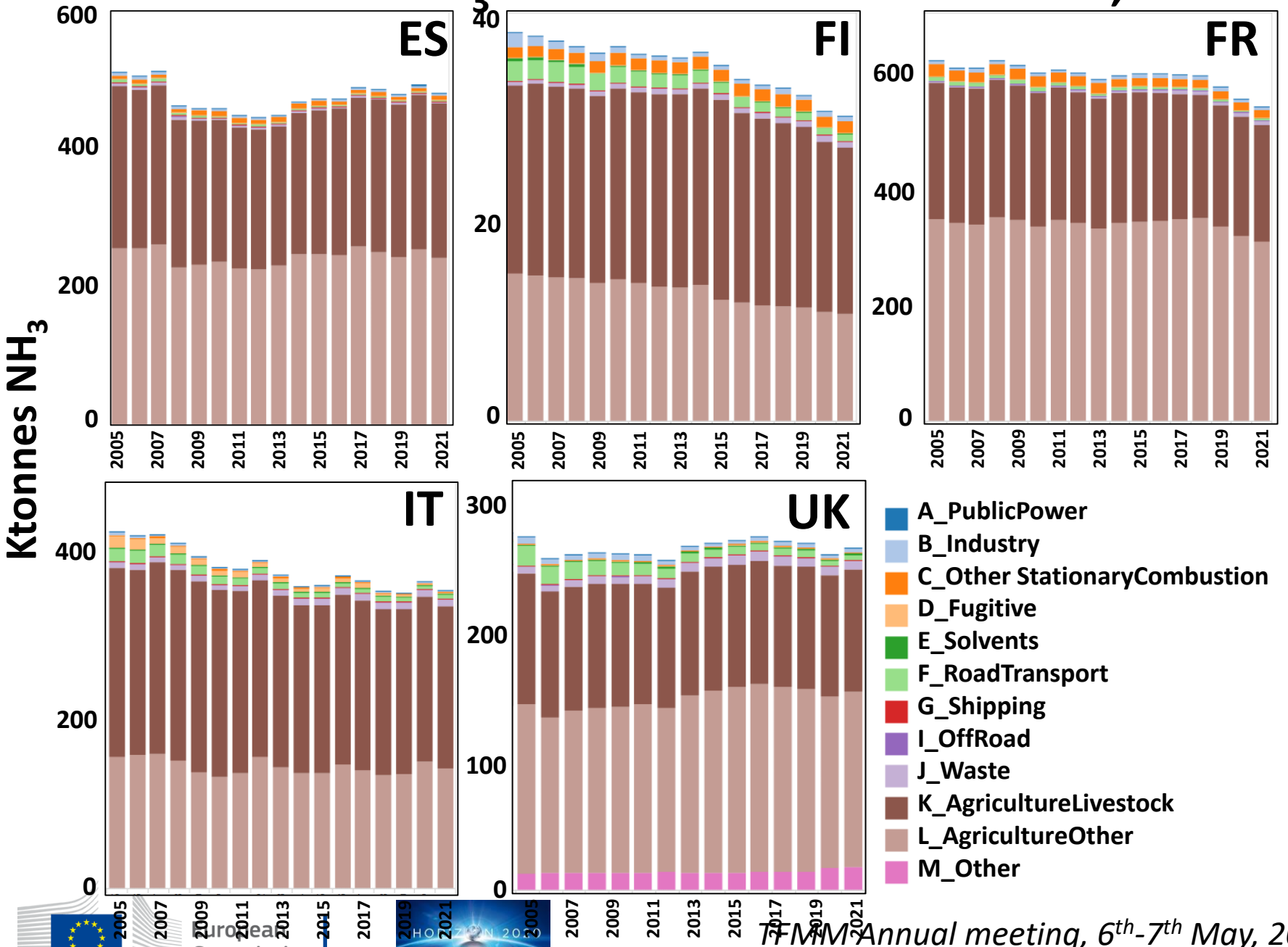

NH_3 in urban Europe

Site	City	Start	End	Res	Method	Site		Start	End	Res.	Method
LOR_IND_UB	Lorca (ES)	2018/04	2023/07	H	Chem	PAR_UB	Paris (FR)	2020/03	2021/12	H	CRDS
PAV_IND_UB	Sannazzaro (IT)	2013/10	2022/06	H	Chem	PAV_UB	Pavia (IT)	2012/01	2022/06	H	Chem
PUE_IND_UB	Puertolano (ES)	2007/01	2023/07	H	Chem	PDR_UB	Valladolid (ES)	2021/09	2022/12	H	Chem
COR_IND_SUB	Coruña (A) (ES)	2020/05	2022/12	D	Dos	PQUE_UB	Rouen P.Q. (FR)	2016/09	2019/03	H	CRDS
CS_IND_SUB	Castellón (ES)	2022/01	2023/07	D	Chem	QDP_UB	Rouen Q.P. (FR)	2020/03	2020/07	H	CRDS
BCN_TR	Barcelona (ES)	2013/11	2018/06	D	Dos	REI_UB	Reims (FR)	2016/01	2023/01	H	CRDS
BOR_TR	Bordeaux (FR)	2022/02	2022/12	2W	Dos	STR_UB	Strasbourg (FR)	2019/01	2022/12	H	CRDS
EMB_TR	Valladolid (ES)	2023/01	2023/04	H	Chem	COL_SUB	Colico (IT)	2013/12	2022/06	H	Chem
ERA_TR	Erandio (ES)	20140/1	2022/03	H	Chem	CRE_SUB	Cremona (IT)	2013/07	2018/08	H	Chem
MAD_TR	Madrid (ES)	2012/06	2012/07	2W	Dos	JAR_SUB	Valladolid (ES)	2020/06	2021/09	H	Chem
MAL_TR	Málaga (ES)	2014/01	2021/12	3W	GC-MS	MAL_SUB	Málaga (ES)	2011/05	2013/12	2W	GC-MS
MUR_TR_SUB	Murcia (ES)	2023/04	2023/07	D	Chem	MIL_SUB	Milano (IT)	2021/07	2021/11	H	Chem
PAR_TR	Paris (FR)	2020/11	2021/12	H	CRDS	MON_SUB	Monza (IT)	2013/02	2019/07	H	Chem
POI_TR	Poitiers (FR)	2022/02	2022/12	2W	Dos	PAR_SUB1	Paris (FR)	2017/05	2021/06	5Min	AMANDA
SEV_TR	Sevilla (ES)	2011/05	2022/12	2W	GC-MS	PAR_SUB2	Paris (FR)	2012/03	2013/05	H	AMANDA
VLC_TR1	Valencia (ES)	2015/04	2023/03	H	Chem	PAR_SUB3	Paris (FR)	2018/01	2018/04	1W	Dos
VLC_TR2	Valencia (ES)	2021/07	2021/12	H	Chem	POSE_SUB	Poses (FR)	2023/06	2023/08	H	CRDS
AGR_UB	Valladolid (ES)	2019/10	2020/04	H	Chem	VIC_SUB1	Vic (ES)	2018/06	2018/07	10Min	Chem
BCN_UB1	Barcelona (ES)	2011/02	2022/02	1W	Dos	VIC_SUB2	Vic (ES)	2015/07	2015/07	1Min	Chem
BCN_UB2	Barcelona (ES)	2011/06	2011/07	1M	AMANDA	ACTH_RB	Auchencorth M.	2018/01	2021/01	H	MARGA
BCN_UB3	Barcelona (ES)	2011/06	2011/06	1M	AMANDA	BAR_RB	Barcarrota (ES)	2012/09	2013/12	1W	Dos
BER_UB	Bergamo (IT)	2021/02	2022/06	H	Chem	BUJ_RBCH	Bujaraloz (ES)	2020/07	2023/05	2W	Dos
BIR_UB	Birmingham (UK)	2019/01	2021/01	H	HFOC	CAM_RB	Campisábalos (ES)	2004/08	2022/12	1W	Dos
CAB_UB	Valladolid (ES)	2018/12	2019/02	H	Chem	CHIL_RBC	Chilbolton (UK)	2018/01	2021/01	H	MARGA
CRE_UB	Cemona (IT)	2011/02	2022/06	H	Chem	CRE_RBCH	Cremona (IT)	2011/10	2021/12	D	Chem
GOR_UB	Gonfreville (FR)	2020/07	2023/08	H	CRDS	CRE_RBCH	Cremona (IT)	2007/01	2021/12	H	Chem
HEL_UB	Helsinki (FI)	2009/11	2010/05	H	MARGA	LO_RBCH	Bertonico (IT)	2009/03	2021/12	D	Chem
LAG_UB	Valladolid (ES)	2019/05	2019/10	H	Chem	MSC_RBC	Montsec (ES)	2011/02	2021/05	Mon	Dos
LND_UB	London (UK)	2019/01	2020/11	H	HFOC	MSY_RB	Montseny (ES)	2011/02	2022/01	Mon	Dos
MAL_UB	Málaga (ES)	2011/05	2011/12	2W	GC-MS	NIE_RB	Niembro (ES)	2004/08	2022/12	1W	Dos
MAN_UB	Manchester (UK)	2018/01	2020/12	H	HFOC	SCH_RBCH	Schivenoglia (IT)	2013/02	2022/06	H	Chem
MANL_UB	Manlleu (ES)	2021/01	2023/01	2W	Chem	SPM_RBC	S. P. Montes (ES)	2012/06	2022/12	1W	Dos
MIL_UB	Milano (IT)	2007/06	2021/12	H	Chem	TOR_RBCH	Els Torms (ES)	2012/08	2022/12	1W	Dos
NIO_UB	Niort Venise (FR)	2022/01	2022/12	2W	Dos	VIZ_RB	Víznar (ES)	2012/08	2022/12	1W	Dos
OBR_UB	Valladolid (ES)	2019/02	2019/05	H	Chem						

Liu et al., 2024, Environment International

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