Agricultural contribution to the formation of atmospheric particulates: Results of Supersite Project and actions included in the air quality plan PAIR 2020 of the Emilia-Romagna Region

Vanes Poluzzi Chief of Regional Central for Urban Areas - ARPA Emilia Romagna

Index:

1. Results from some studies conducted in Emilia-Romagna region circa the environmental impact on atmospheric particulate from the agricultural activities ;

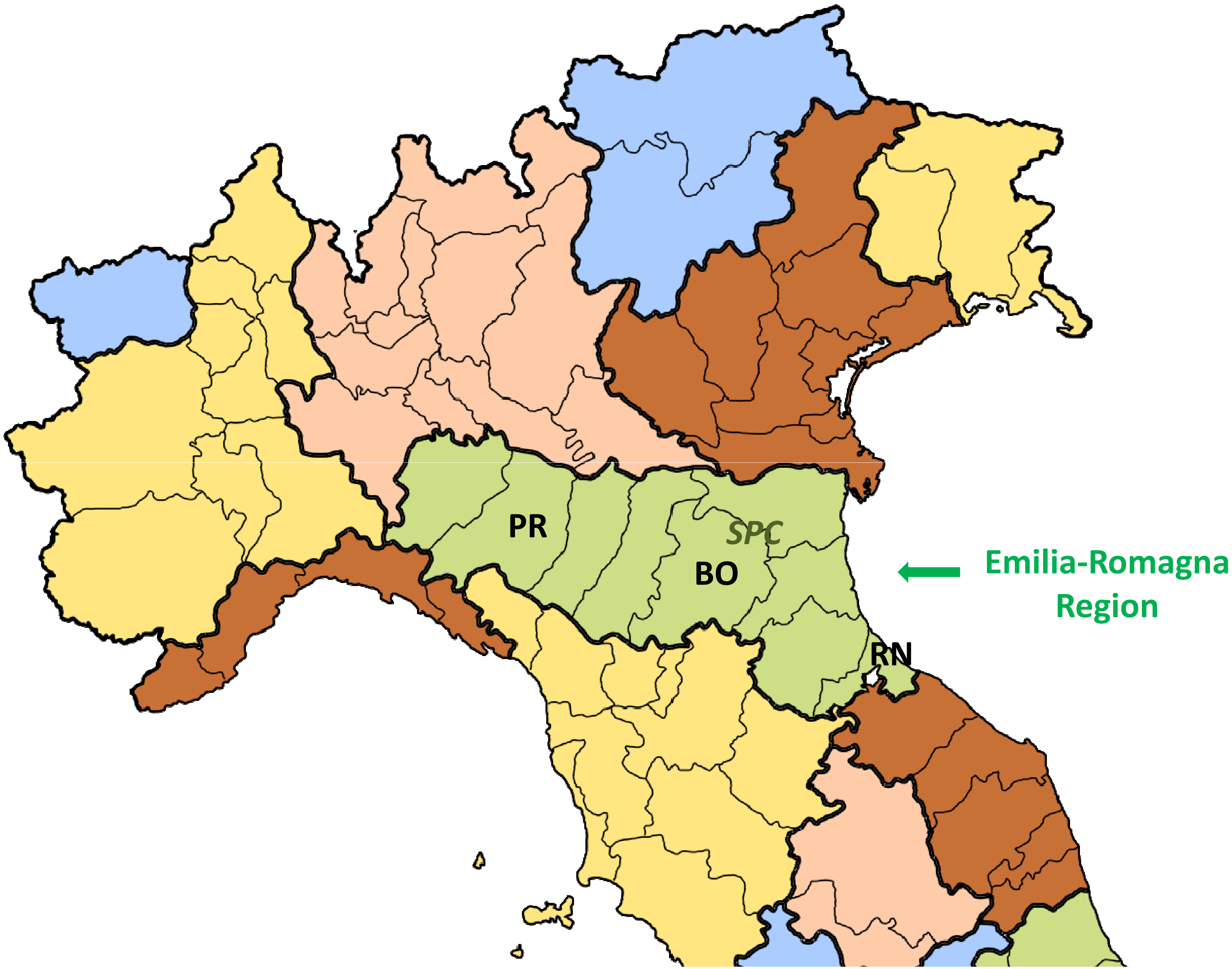
1. Results obtained from the simulations with mathematical models - connected to the potential reductions of the pollution of atmospheric particulate - of the actions on the Agriculture sector, contained in the plan for Air Quality of the Emilia-Romagna Region.

Territorial framework

- **Emilia-Romagna is one of the Po basin Regions, its agriculture is characterized of a great variety of products and with a lot of abundance of some of these ones.**

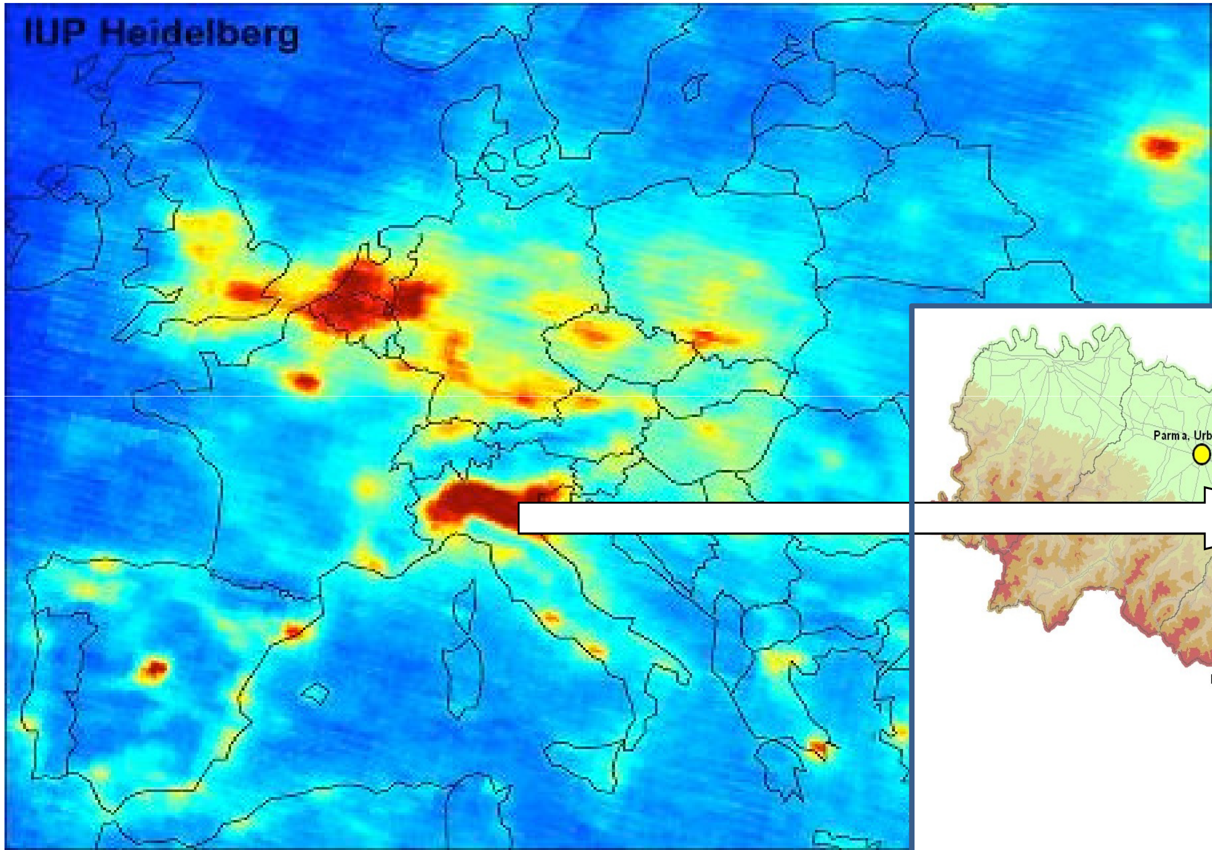
- **Its favorauble climatic and geographical position, together with the use of best modern techniques and the organization of the selling and distribution of its products, put the Emilia-Romagna at the first places in Italy for the production of wheat, sugar beet , barley, rice, fruits and wine.**

- **Widely applied is the breeding and pigs cattles ant the fish in sea that give anchoves, sardines, mackerel, eels, mullets and sea bass.**

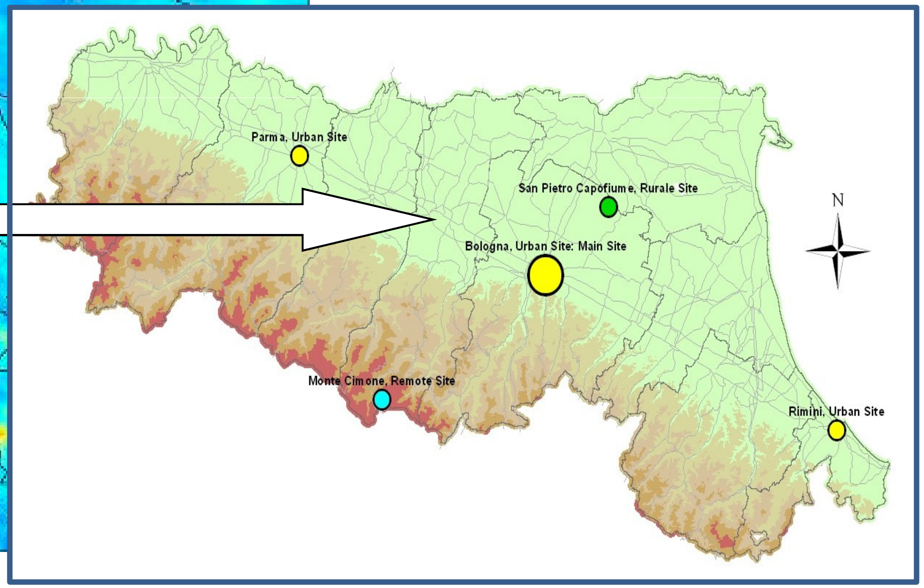

PR
SPC
BO
RN
Emilia-Romagna
Region

PO VALLEY

Ground level **NO_2 concentration** as measured by the SCIAMACHY instrument on ESA's Envisat. Credits: University of Heidelberg



Emilia-Romagna Region



Critical parameters: PM_{10} - $PM_{2.5}$ - O_3 - NO_x

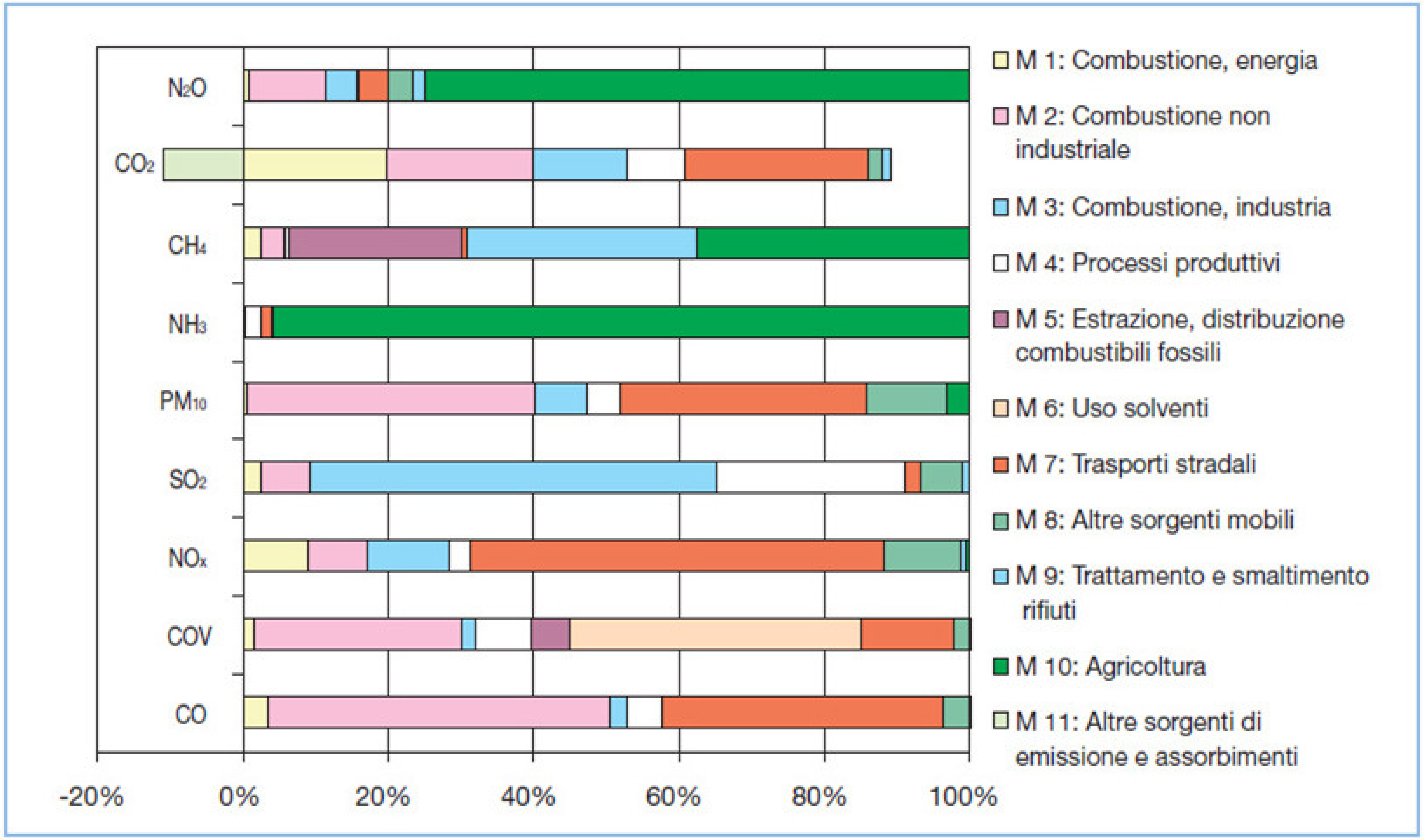
EMILIA-ROMAGNA REGION ATMOSPHERIC EMISSIONS INVENTORY

INEMAR - Arpa Emilia-Romagna (2013), INEMAR, Inventario Emissioni in Atmosfera: emissioni in Regione Emilia-Romagna nell´anno 2010 -Arpa Emilia-Romagna

www.arpa.emr.it
InemarWiki - http://inemar.terraria.com/xwiki/bin/view/InemarWiki/

Distribuzione percentuale delle emissioni in atmosfera dei principali inquinanti per macrosettore (anno 2010)

Fonte: Regione Emilia-Romagna, Arpa Emilia-Romagna



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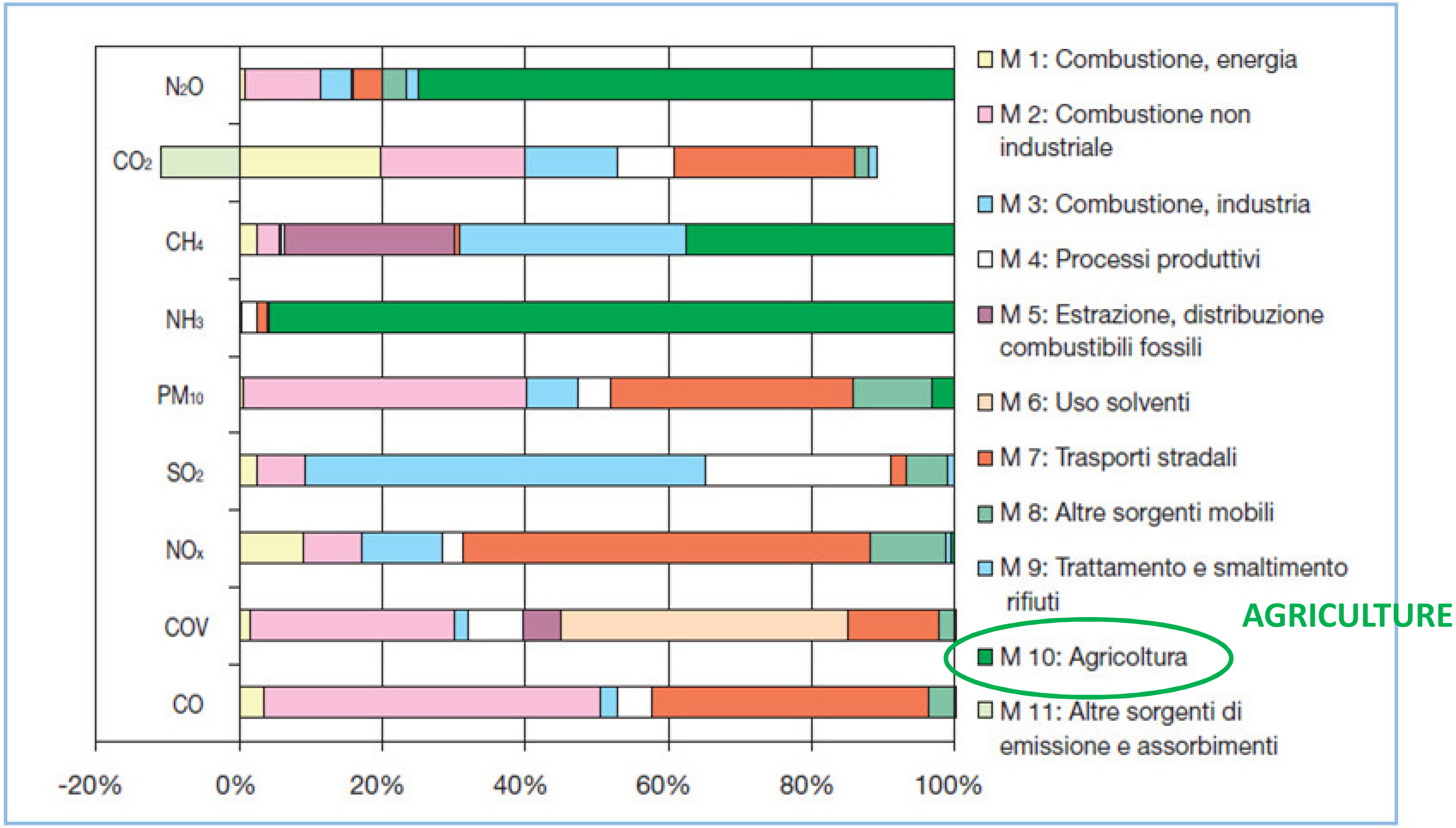

Tabella 3-1 Emissioni regionali per macrosettore (ton/anno, per CO2 kton/anno)

	CO	NMVOC	NOx	SO2	PM10	NH3	CH4	CO2	N2O
M 1: Combustione - Energia	6003	1534	9482	430	86	0	4135	9956	79
M 2: Combustione - non industriale	83256	28309	8729	1194	5395	154	5,479	10093	956
M 3: Combustione - industria	4501	1770	12207	9773	993	0	358	6468	391
M 4: Processi produttivi	8333	7645	3077	4540	617	1106	868	3920	30
M 5: Estraz. Distribuz. combustibili fossili	0	5187	0	0	0	0	40319	0	
M 6: Uso solventi	0	39883	15	2	4	1	0	0	
M 7: Trasporti stradali	68266	12498	60675	371	4593	832	1138	12697	356
M 8: Altre sorgenti mobili	6231	2055	11300	1005	1524	2	48	934	306
M 9: Trattamento e smaltimento rifiuti	255	62	622	183	6	128	53351	550	156
M 10: Agricoltura	0	59	637	0	418	49299	63680	0	6785
M 11: Altre sorgenti di emissione ed assorbimenti	0	0	0	0	0	0	0	-5455	0
Totale	**176846**	**99002**	**106745**	**17499**	**13637**	**51522**	**169377**	**39163**	**9059**

Regione Emilia-Romagna

MARKER

arpa agenzia regionale prevenzione e ambiente dell'emilia-romagna

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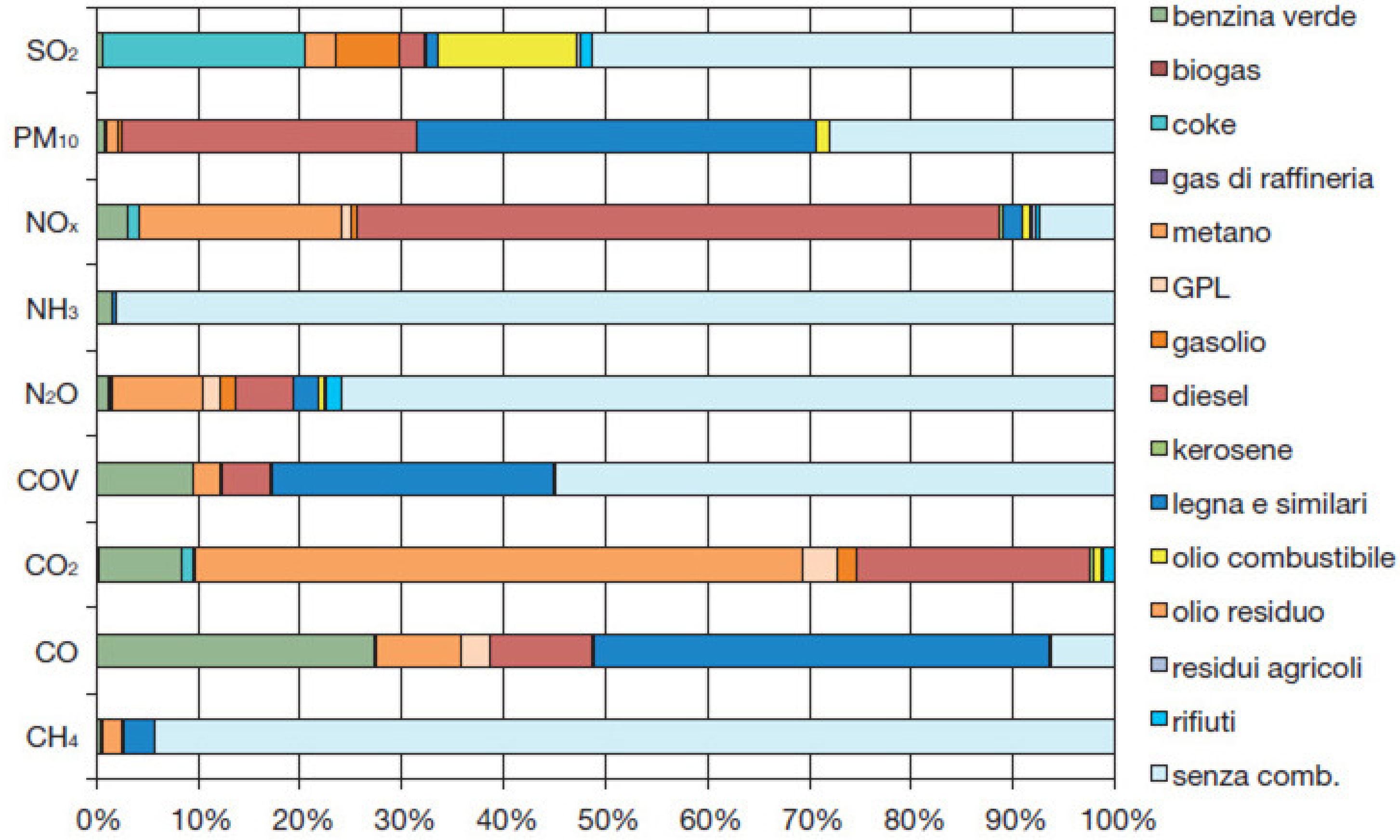
>95% AMMONIA FROM AGRICULTURE IN REGION

Distribuzione percentuale delle emissioni dei principali inquinanti per combustibile
(anno 2010) - Fonte: Regione Emilia-Romagna, Arpa Emilia-Romagna



>95% AMMONIA FROM AGRICULTURE

MEAN CONTRIBUTION IN EMILIA-ROMAGNA REGION

↓

% NH_3 FROM AGRICULTURE by DISTRICT

- BOLOGNA: 90%
- PARMA: 97%
- RIMINI: 90%

3.9.5 Emissioni totali macrosettore 10

Tabella 3-46: Emissioni totali provinciali, Macrosettore 10- Agricoltura (ton/anno)

	NMVOC	CH4	NOx	N2O	NH3	PM10
Piacenza	8	8639	65	666	4820	4
Parma	12	16549	29	993	7501	5
Reggio Emilia	15	16829	31	967	8210	10
Modena	12	11948	76	917	7352	9
Bologna	3	3320	127	727	4253	14
Ferrara	2	2016	140	625	4594	29
Ravenna	2	1548	148	868	6005	84
Forlì-Cesena	3	2097	19	911	5854	244
Rimini	1	734	3	111	711	19

Regione Emilia-Romagna | **arpa** agenzia regionale prevenzione e ambiente dell'emilia-romagna

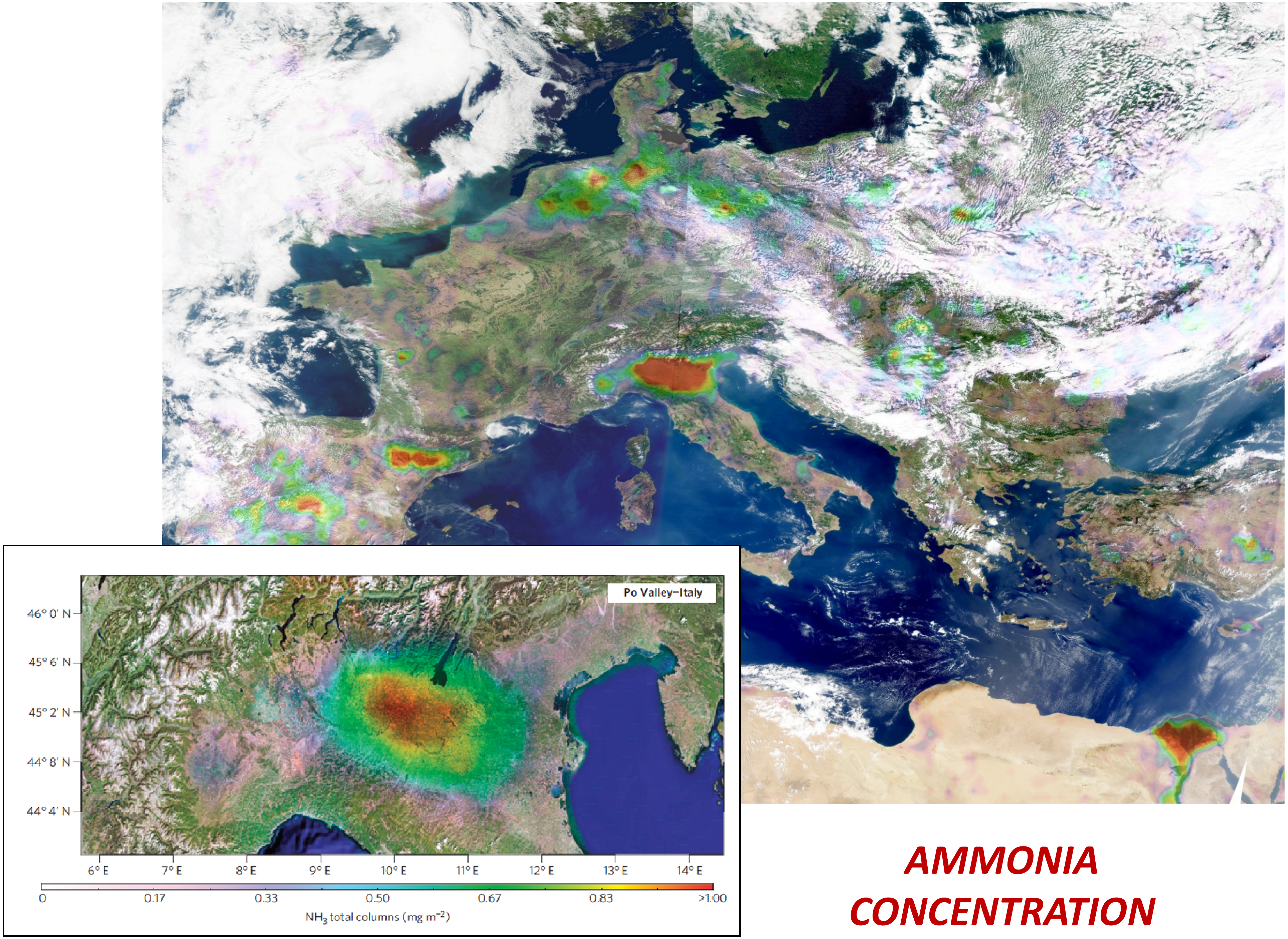
Tabella 3-13 **Emissioni industriali per macrosettore per provincia (ton/anno, CO2 kton/anno)**

Provincia	Macrosettore	CO	SO2	NMVOC	CH4	NOx	PTS	CO2	N2O	NH3	PM10
Piacenza	Combustione	524	3577	163	39	1677	100	795	50	0.0	70
Parma	Combustione	448	719	193	38	1544	151	901	50	0.0	105
Reggio Emilia	Combustione	475	1351	228	43	1852	266	914	57	0.0	207
Modena	Combustione	1099	1931	375	55	2647	420	1099	72	0.0	336
Bologna	Combustione	1184	1191	420	117	2144	251	1316	83	0.0	159
Ferrara	Combustione	275	316	131	22	1088	80	583	29	0.0	25
Ravenna	Combustione	225	327	94	18	612	65	405	24	0.0	45
Forli-Cesena	Combustione	153	211	97	11	372	41	267	15	0.0	21
Rimini	Combustione	118	150	68	16	270	38	190	11	0.0	25
Piacenza	Processi Produttivi	9	31	160	0.1	17	11	102	0.0	15	9
Parma	Processi Produttivi	23	78	2122	0.2	123	36	259	0.0	116	23
Reggio Emilia	Processi Produttivi	401	152	548	2	312	17	459	1.1	46	14
Modena	Processi Produttivi	49	274	684	0.4	93	54	871	0.1	127	43
Bologna	Processi produttivi	107	146	2116	0.5	239	75	511	0.1	277	57
Ferrara	Processi produttivi	377	299	786	0.1	923	124	698	0.0	421	97
Avenna	Processi produttivi	7321	3434	645	865	1315	515	552	29	51	252
Forli-Cesena	Processi produttivi	15	81	349	0.1	27	6	262	0.0	18	6
Rimini	Processi produttivi	32	45	235	0.1	28	145	205	0.0	37	117

Nella tabella seguente si riportano i dati delle emissioni provinciali relative al traffico.

Tabella 3-24 Emissioni provinciali totali (ton/anno, CO_2 kton/anno)

Provincia	CO	SO2	NMVOC	CH4	NOx	PTS	CO2	N2O	NH3	PM10
Piacenza	6700	32	1240	103	5332	485	1079	29	66	391
Parma	8909	46	1596	140	7792	693	1552	42	96	557
Reggio Emilia	7565	43	1339	129	6883	654	1463	41	97	527
Modena	9641	55	1762	167	8632	853	1899	55	129	687
Bologna	13819	80	2462	238	12888	1219	2752	78	191	976
Ferrara	5935	31	1073	96	4887	466	1053	30	72	375
Ravenna	5928	32	1116	101	5387	510	1103	31	69	413
Forlì-Cesena	6466	35	1256	106	5978	543	1167	32	67	441
Rimini	3303	18	653	57	2896	279	629	17	45	226



IASI Data analysis. *Clarisse et al. 2009 (DOI: 10.1038/NGEO551)*

AMMONIA CONCENTRATION

Preliminaries results of the project “Supersito” concerning the atmospheric aerosol composition in Emilia-Romagna region, Italy

V. Poluzzi[1], A. Trentini[1], F. Scotto[1], I. Ricciardelli[1], S. Ferrari[1], C. Maccone[1], D. Bacco[1], C. Zigola[1,3], G. Bonafè[1], P. Ugolini[1], G. Bertacci[2], M. C. Pietrogrande[3], M. Visentin[3], S. Gilardoni[4], M. Paglione[4], M. Rinaldi[4], M. C. Facchini[4]

[1]*Regional Agency for Prevention and Environment of Emilia-Romagna (Arpa), Bologna, Italy*
[2]*University of Bologna - Department of Physics and Astronomy, Bologna, Italy*
[3]*University of Ferrara - Department of Chemical and Pharmaceutical Sciences, Ferrara, Italy*
[4]*Institute of Atmospheric Science and Climate - National Research Council, Bologna, Italy*

Realization of a integrated study of atmospheric pollution in Emilia-Romagna region by chemical, physical and toxicological measures and health, epidemiological and environmental evaluation by interpretative models.

www.supersito-er.it

Promoters:
Assessorato alle Politiche per la Salute RER
Assessorato all' Ambiente e Sviluppo Sostenibile RER
Coordination
Regional Agency for Prevention and Environment of Emilia-Romagna

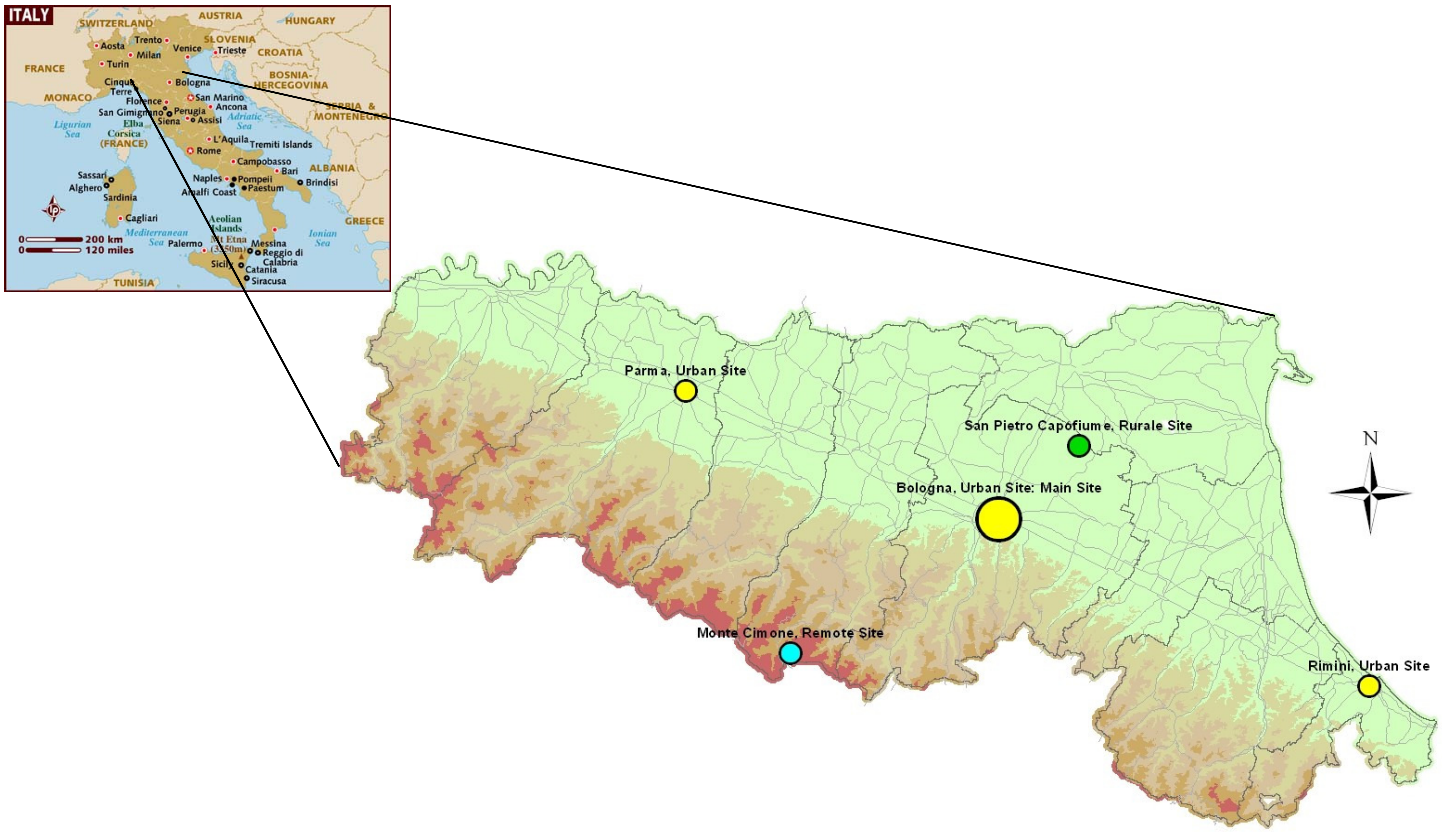
Institutes involved:
Institute of Atmospheric Sciences and Climate (CNR-ISAC)
University of Bologna
University of Ferrara
University of Eastern Finland
Finnish Meteorological Institute
Department of Epidemiology of the Regional Health Service (Lazio)
University of Insubria

GENERAL OBJECTIVE

The aim of Supersite Project is to realize in Emilia-Romagna region a detailed study about some chemicals, physical and toxicological parameters of the atmosphere and to get health, epidemiological and environmental evaluations by interpretative models.

In detail we work to improve knowledgde about environmental and health aspects of fine (PM2.5) and ultrafine particulate (UFP), in primary and secondary components, in atmosphere outdoor and indoor

SPATIAL DISTRIBUTION SAMPLING SITES



n. 3 in urban area: Bologna (main site), Parma (US1) and Rimini (US2)

n. 1 in rural area: S. P. Capofiume (RS3)

n. 1 in remote area, Monte Cimone (RS4).

PM 2.5 source apportionment in the urban area of Bologna

Project Supersito

Measurements period: july 2012 - february 2014

(165 daily sampler)

Sampling site: urban background in the city of Bologna, inside the area of National Research Council

Data collection

Daily samplings of $PM_{2.5}$ were carried out by using:

-three low volume instruments operating at a flow rate of 38 l min^{-1} (SWAM Single Channel, SWAM Dual Channel, FAI Instruments - Roma, I) set side-by-side with a low volume sampler operating at a flow rate of 38 l min^{-1} (Skypost, TCR TECORA, Milano, I).

-Samples were collected on 47 mm in diameter quartz filter: Whatman QM-A for elemental content, Pall for ions and EC/OC. The quartz membranes used for EC/OC analysis were pre-fired at 800°C for three hours before use.

Data collection

The quartz filters were digested by a microwave oven using a mix of Supra pure nitric acid-hydrogen peroxide 4:1 attack and analysed by ICP-MS (7700x Agilent Technologies, USA), for determining the elemental content (**Mg, K, Ca, V, Cr, Mn, Fe, Ni, Zn, As, Cd, Pb, Sn, Sb, Ba, La).**

For the analysis of the ions the filters were water extracted in an ultrasonic bath and analysed by means of ion chromatography (ICS-1000 and 1100, Dionex Co., USA); the instruments were equipped with Ionpac AS9HC column for anions (**Cl^- NO_3^- SO_4^{2-}, PO_4^{3-}**) and Ionpac CS12A column for cations (**Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+}**).

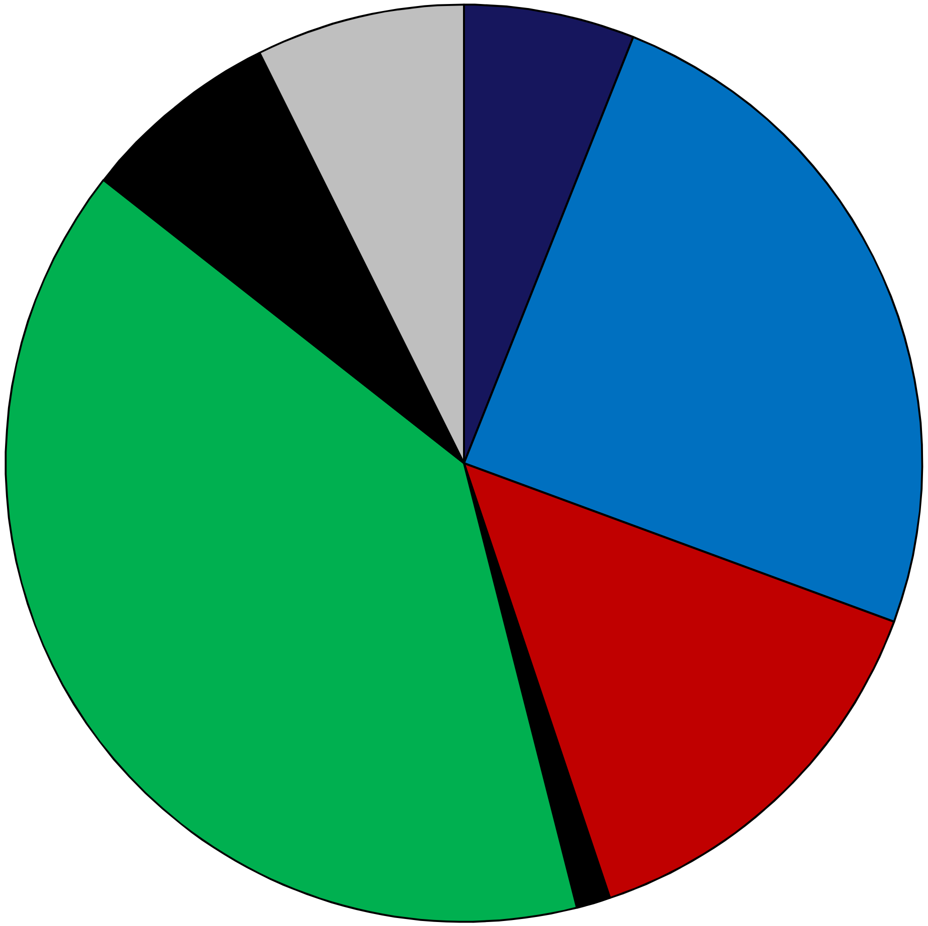
Data collection

The quartz filters for EC/OC analysis were punched and each punch (1.5 cm^2) analysed by means of a thermal-optical analyser (OCEC Carbon Aerosol Analyser, Sunset Laboratory, OR-USA).

The instrument operates in two phases: during the first step the sample is heated up to 650°C in helium atmosphere (evolution of organic compounds); then, during the second step, after a cooling-off period, it is heated again up to 850°C in oxidant atmosphere (evolution of elemental carbon). Both the evolved organic and elemental compounds are converted from CO_2 to CH_4 and determined by a flame ionization detector. Pyrolitic conversion is taken into account through laser monitoring.

Mass Closure

	Average
	μg m⁻³
$PM_{2.5}$	20.2
Crustal	1.2
NH_4NO_3	4.9
$(NH_4)_2SO_4$	2.9
NH_4Cl	0.2
Organic Matter	8.0
Elemental Carbon	1.4
Unknown	1.5



Ricciardelli et al., PM2014

PMF

Daily concentration data of **ions, elements, EC/OC and $PM_{2.5}$ mass have been analyzed by Positive Matrix Factorization (PMF)**, in order to identify major pollution sources affecting the area and to retrieve their contribution. Positive Matrix Factorization - EPA PMF v5.0 - was used to analyze the complete dataset

Some chemical species were eliminated because of a inadequate number of data over the detection limit: Br^-, PO_4^{3-}, Al, Ba.

PMF

Missing data of chemical species (N < 10) were replaced with the geometrical average.

Data lower the limits were replaced with ½ LOD.

The uncertainities of the data < LOD and missing data have been processed according to: Polissar et al 1998

$$\sigma_{ij}^{k} = u_{ij}^{k} + d_{ij}^{k}/3 \quad \text{For determined values}$$

$$\sigma_{ij}^{k} = d_{ij}^{k}/2 + d_{ij}^{k}/3 \quad \text{For below limits of detection values}$$

$$\sigma_{ij}^{k} = 4\tilde{v}_{ij}^{k} \quad \text{For missing values}$$

where v_{ij}^{k}, u_{ij}^{k}, and d_{ij}^{k} are the measured concentration, the analytical uncertainty and the analytical detection limit, respectively, for sample i, element j and sampling site k; $\bar{d}_{ij}^{k}$ is arithmetic mean of the

PMF

Missing data of PM2.5 have been replaced with the estimate data from a linear regression with the ones coming from near monitoring stations (r>0.9) and the uncertainity (normally fixed to 2 µgm-3 on the base of experimental tests) has been multiplied by 3.

For the uncertainities of chemical species it has been used the metodology followed by Zabalza et al. 2006 and Polissar et al. 1998

$$\sigma_{(x_{ij}<DL_j)} = x_{ij} + \frac{2}{3}(DL_j)$$

$$\sigma_{\{DL_j<x_{ij}<3(DL_j)\}} = 0.2x_{ij} + \frac{2}{3}(DL_j)$$

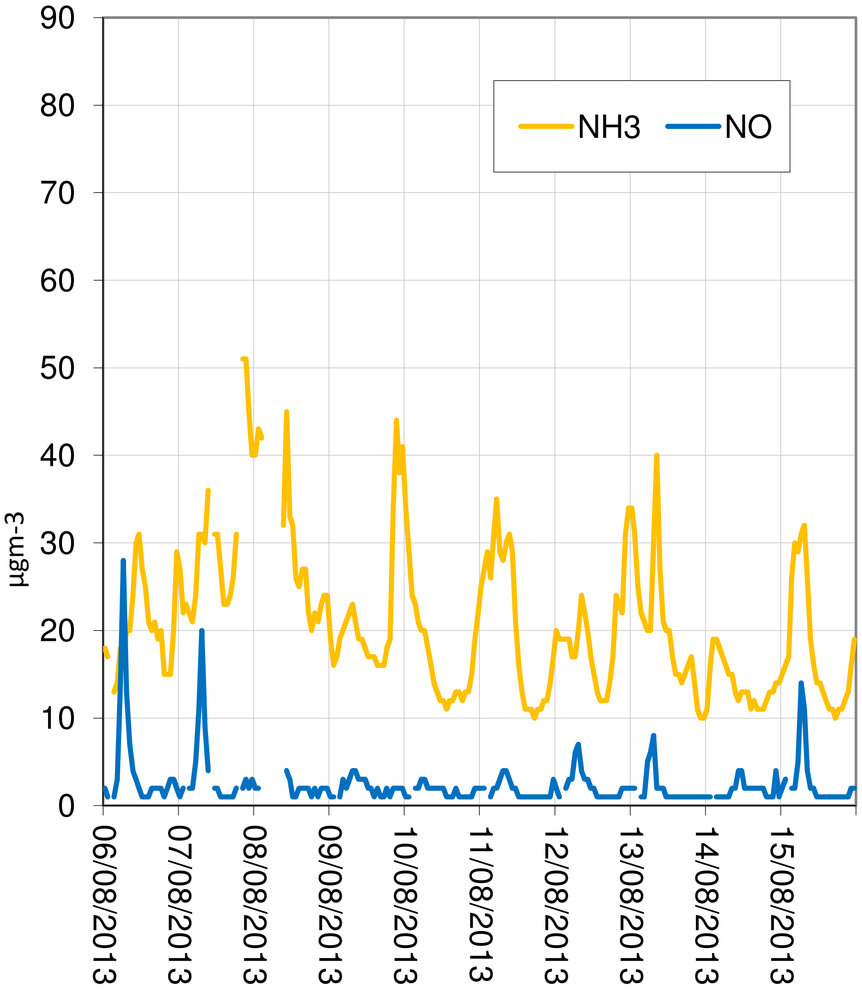
$$\sigma_{\{x_{ij}>3(DL_j)\}} = 0.1x_{ij} + \frac{2}{3}(DL_j)$$

Jon Zabalza, David Ogulei, Philip K. Hopke, Jong Hoon Lee, Injo Hwang, Xavier Querol, Andrés Alastuey and Jesús Santamaría.
Concentration and sources of PM_{10} and its constituents in Alsasua, Spain
Water, Air, and Soil Pollution (2006) 174: 385–404

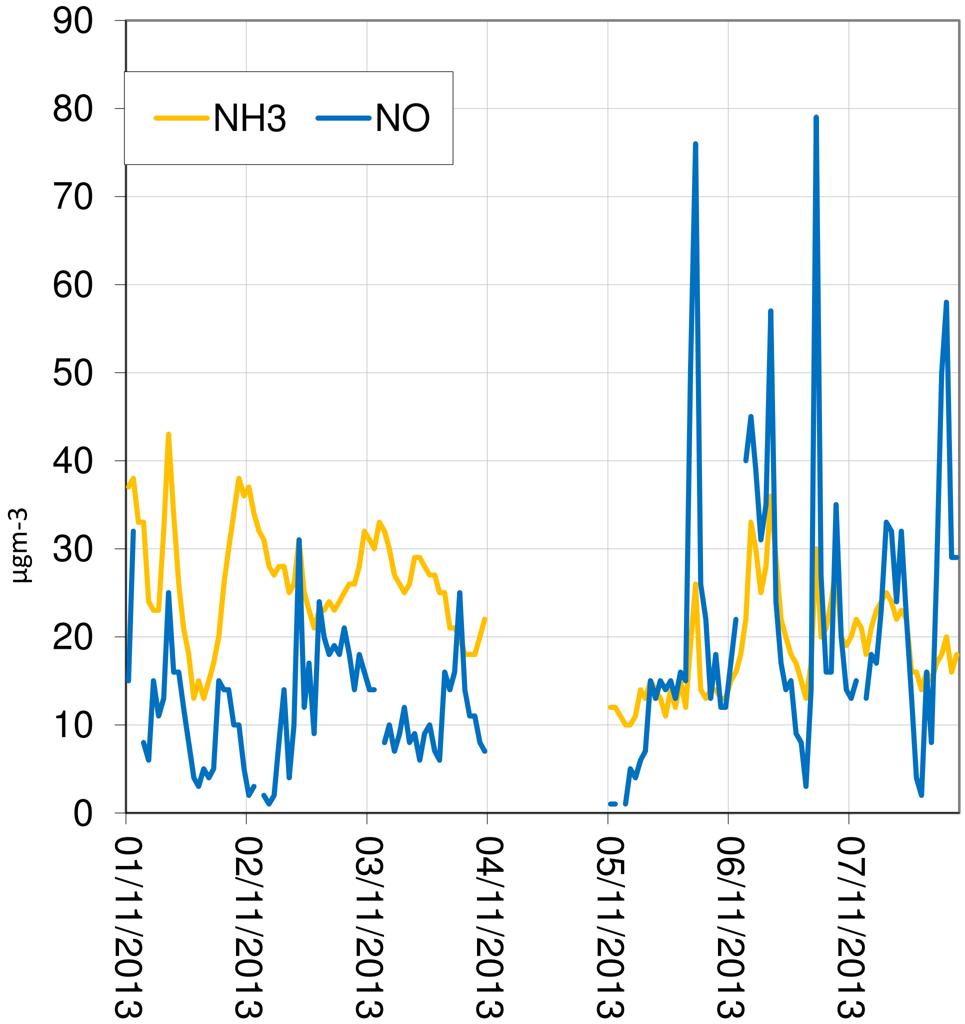
Polissar, A.V., Hopke, P.K., Paatero, P., Malm, W.C., & Sisler, J.F. (1998). Atmospheric aerosol over Alaska: 2. Elemental composition and sources. Journal of Geophysical Research, 103(D15), 19045–19057.

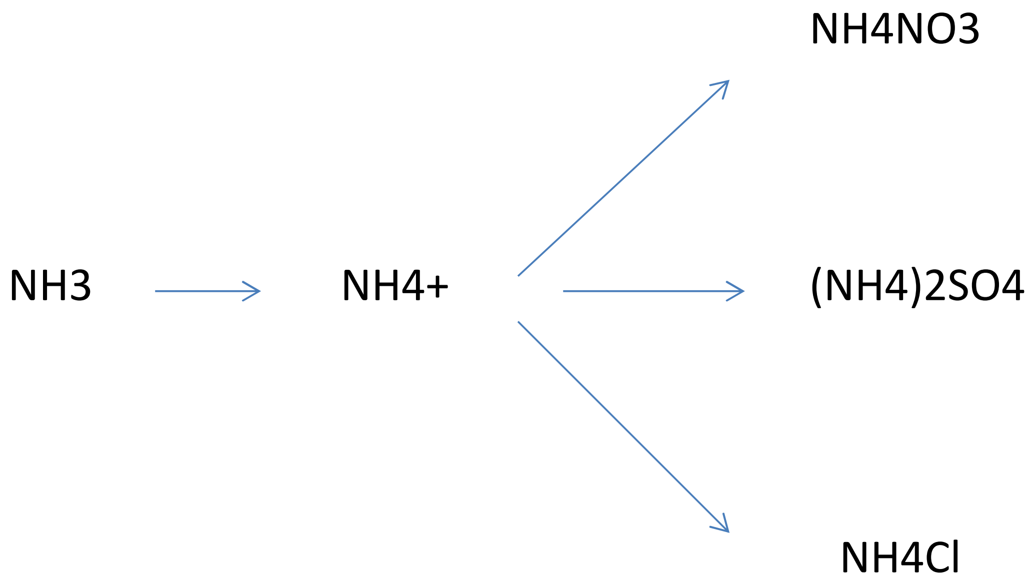
AMMONIA CONCENTRATION DO NOT SHOW A SEASONAL TREND

Example of ammonia SUMMER concentration

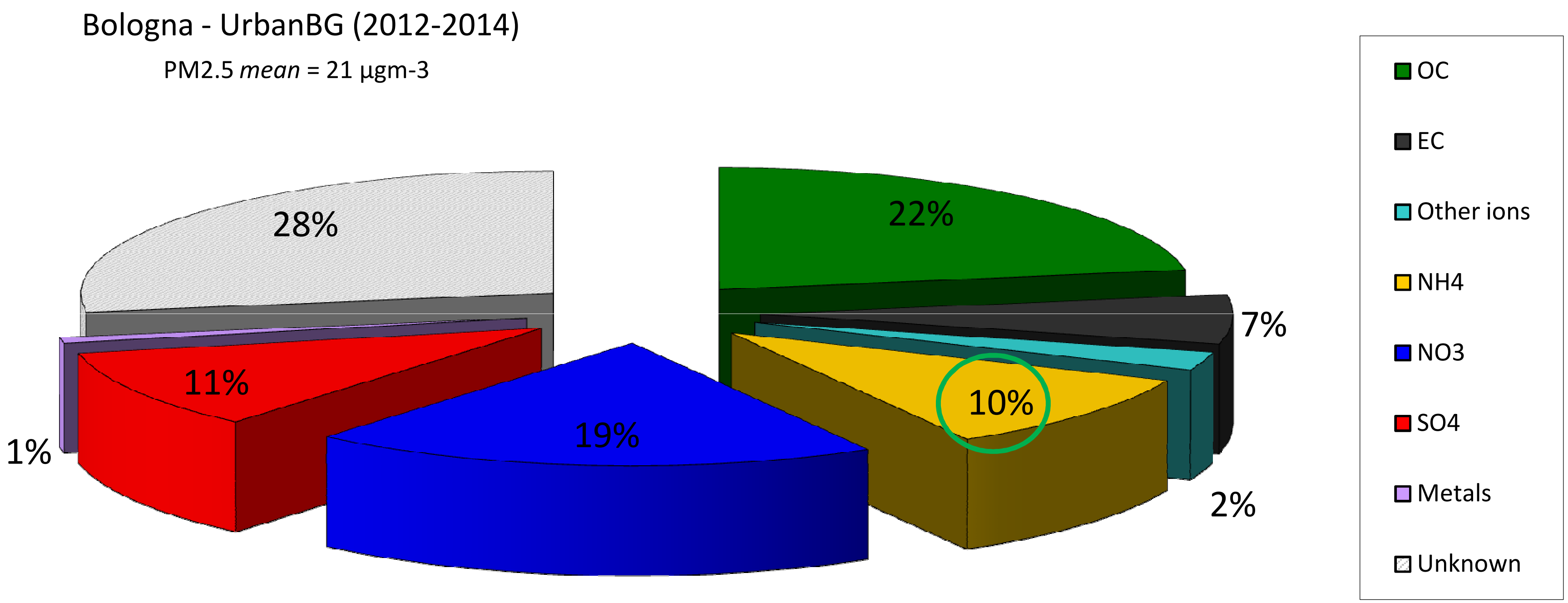


Example of ammonia WINTER concentration

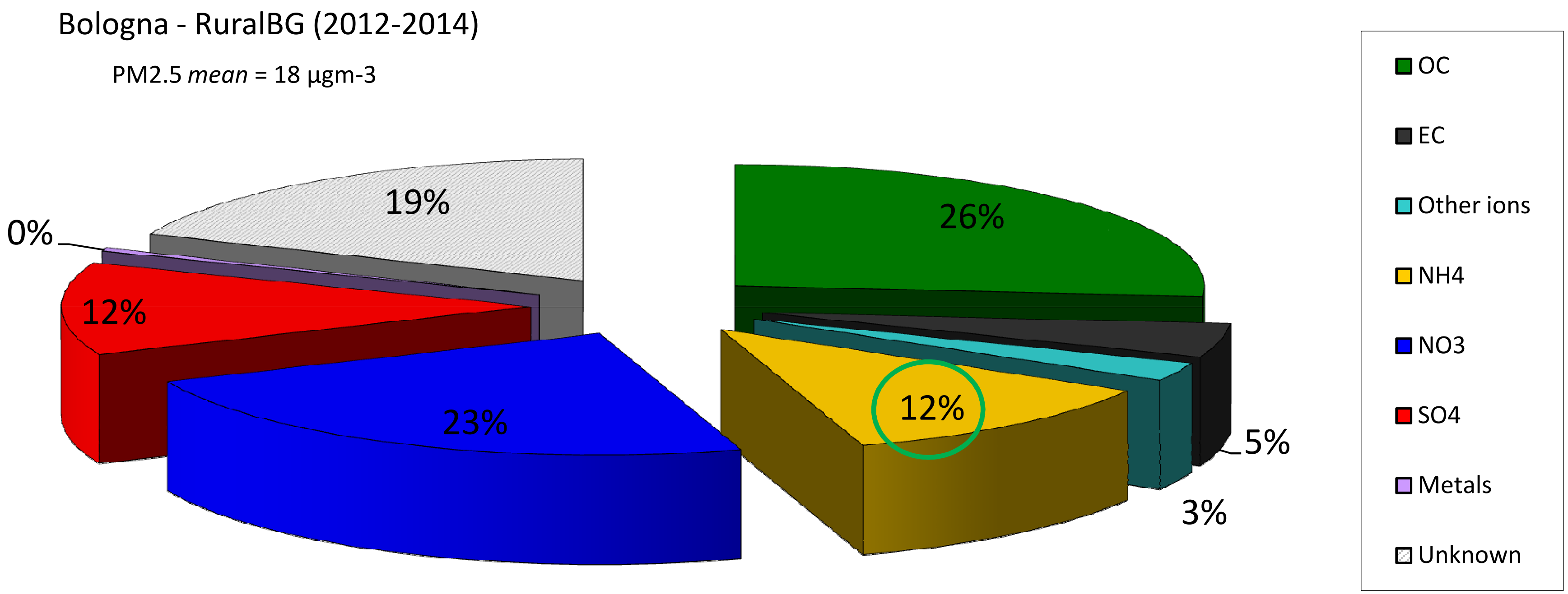


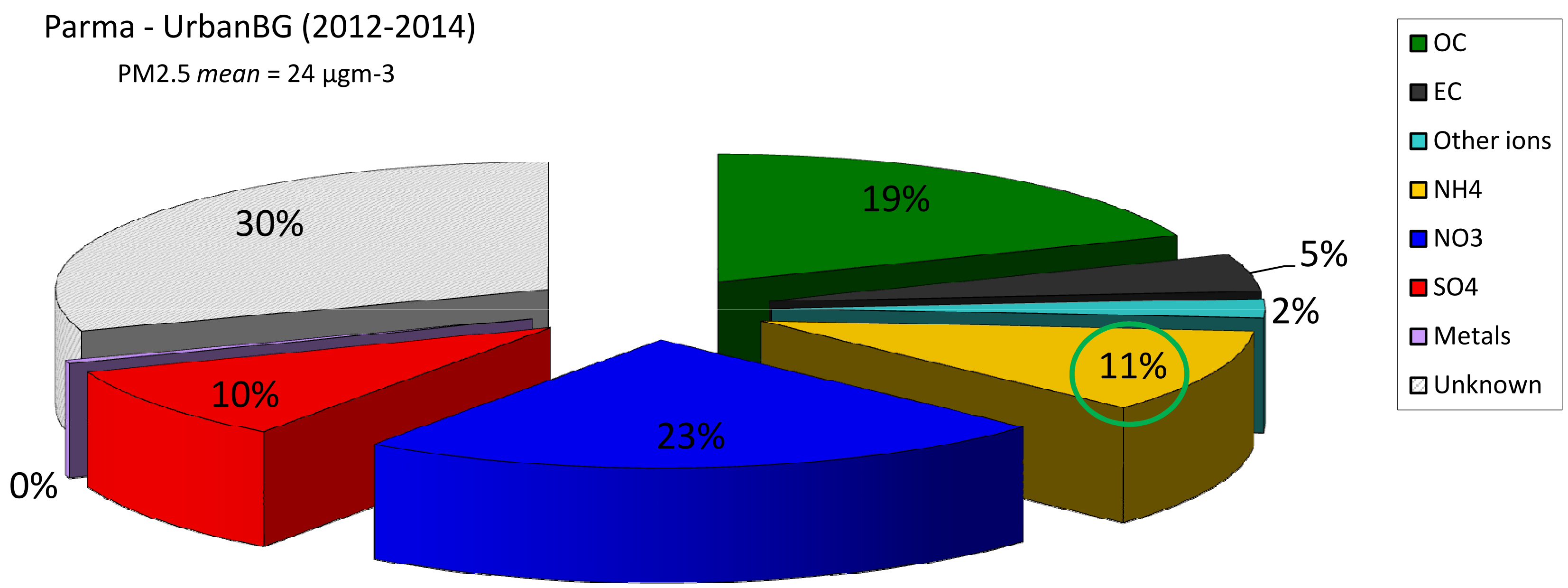


NH3
NH4+
NH4NO3
(NH4)2SO4
NH4Cl

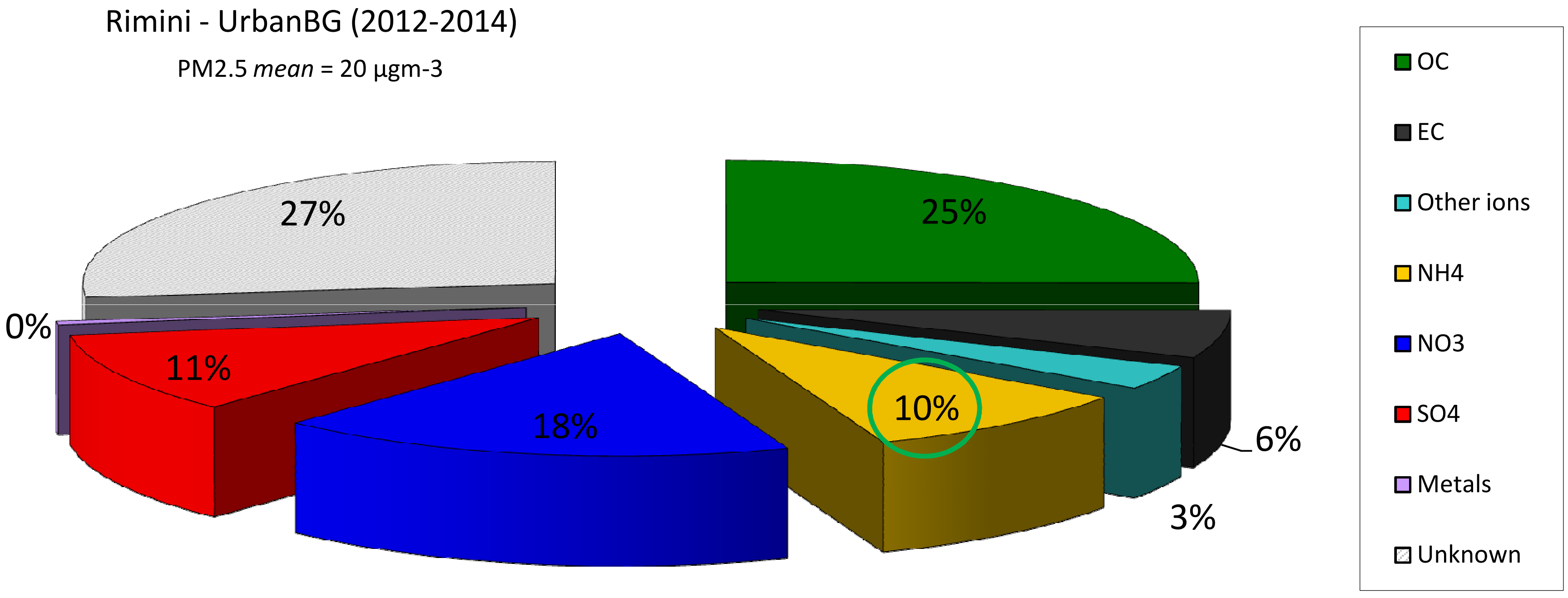


Bologna - UrbanBG (2012-2014)
PM2.5 *mean* = 21 µgm-3
28%
22%
7%
10%
2%
19%
11%
1%
OC
EC
Other ions
NH4
NO3
SO4
Metals
Unknown


Bologna - RuralBG (2012-2014)
PM2.5 *mean* = 18 µgm-3
19%
0%
12%
23%
26%
12%
5%
3%
OC
EC
Other ions
NH4
NO3
SO4
Metals
Unknown



Parma - UrbanBG (2012-2014)
PM2.5 mean = 24 µgm-3
30%
19%
5%
2%
11%
23%
10%
0%
OC
EC
Other ions
NH4
NO3
SO4
Metals
Unknown



Rimini - UrbanBG (2012-2014)
PM2.5 *mean* = 20 µgm-3
27%
25%
0%
11%
18%
10%
6%
3%
OC
EC
Other ions
NH4
NO3
SO4
Metals
Unknown

ABOUT 10% OF PM2.5 IS AMMONIUM

AMMONIUM DERIVE FROM AMMONIA

IN REGION 95% OF AMMONIA DERIVE FROM AGRICULTURE

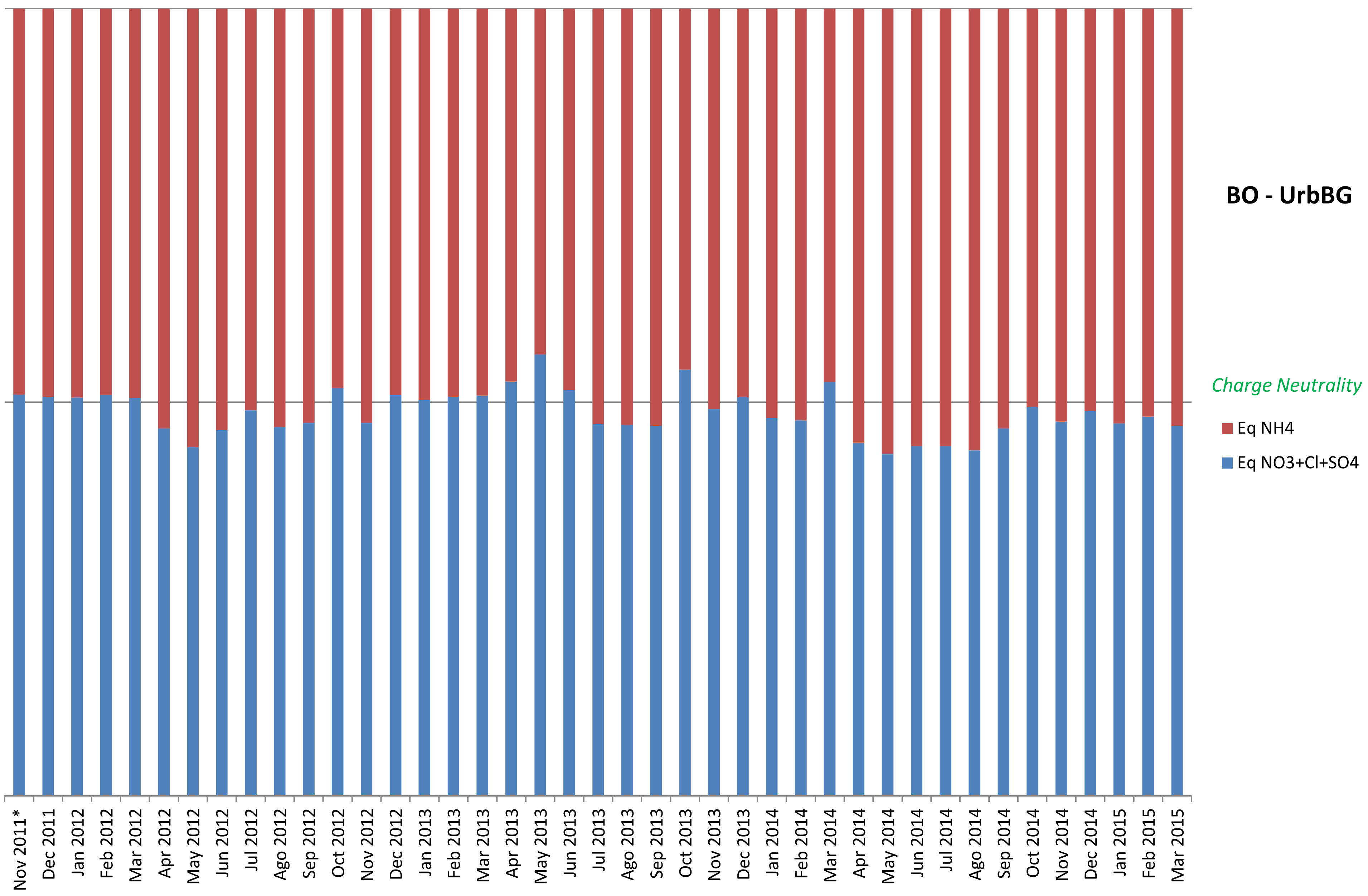
ABOUT **10%** OF PM2.5 COULD DERIVE FROM AGRICULTURE

*MAYBE **MORE** BECAUSE:*

1 - AMMONIUM NEUTRALIZE NITRIC ACIDITY SO NEW NO_x CAN BECAME NO_3^- ON PARTICLES

2 - AMMONIA IS NOT THE ONLY POLLUTANT FROM AGRICULTURE

1 - AMMONIUM NEUTRALIZE NITRIC ACIDITY SO NEW NOx CAN BECAME NO_3^- ON PARTICLES


BO - UrbBG
Charge Neutrality
Eq NH4
Eq NO3+Cl+SO4
Nov 2011*
Dec 2011
Jan 2012
Feb 2012
Mar 2012
Apr 2012
May 2012
Jun 2012
Jul 2012
Ago 2012
Sep 2012
Oct 2012
Nov 2012
Dec 2012
Jan 2013
Feb 2013
Mar 2013
Apr 2013
May 2013
Jun 2013
Jul 2013
Ago 2013
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Oct 2013
Nov 2013
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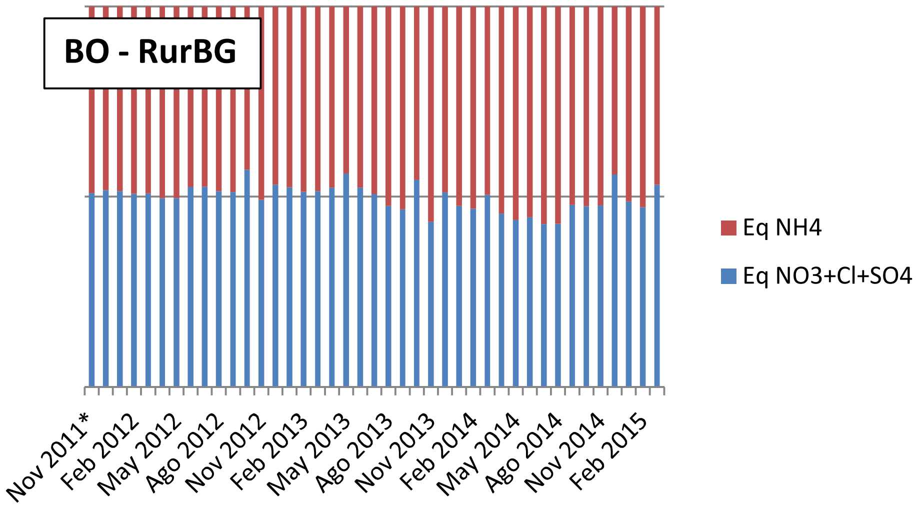
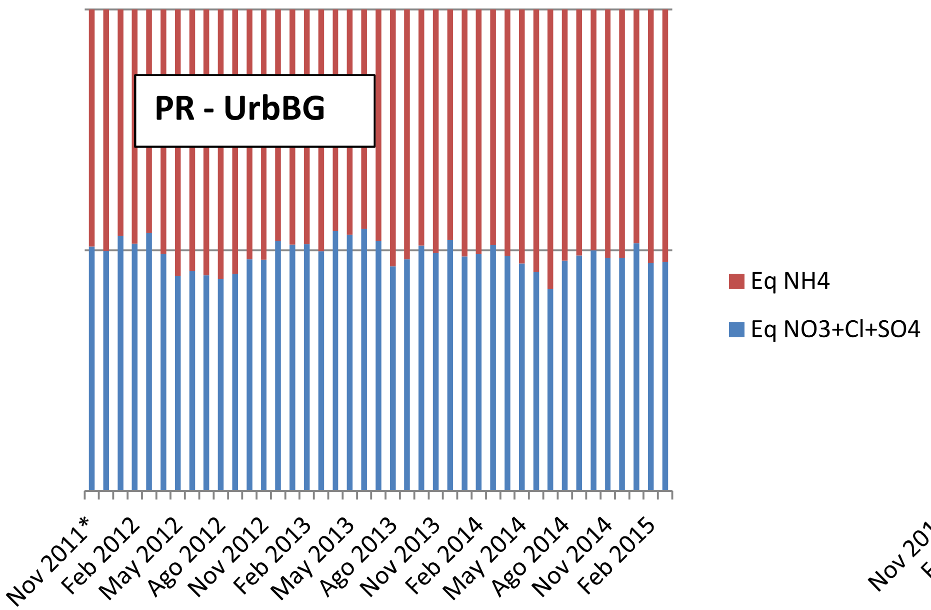
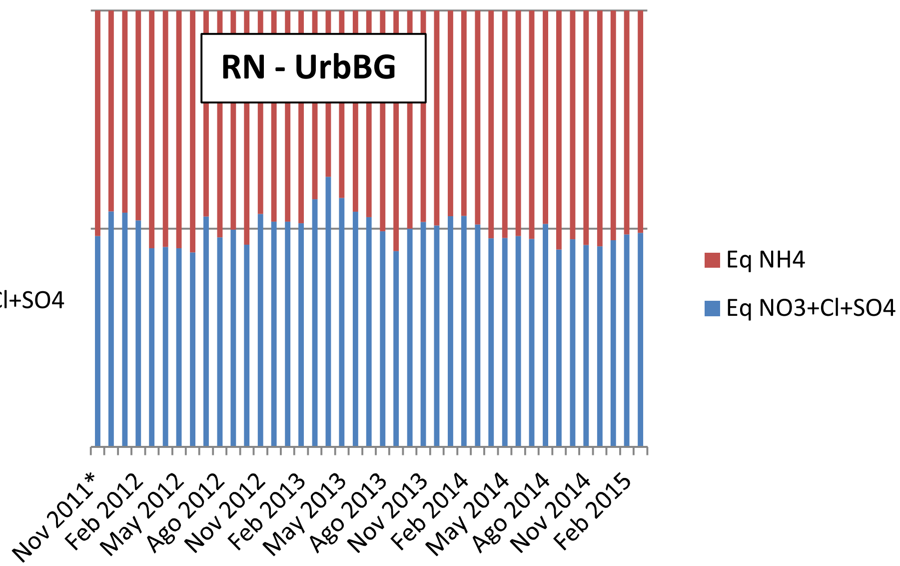
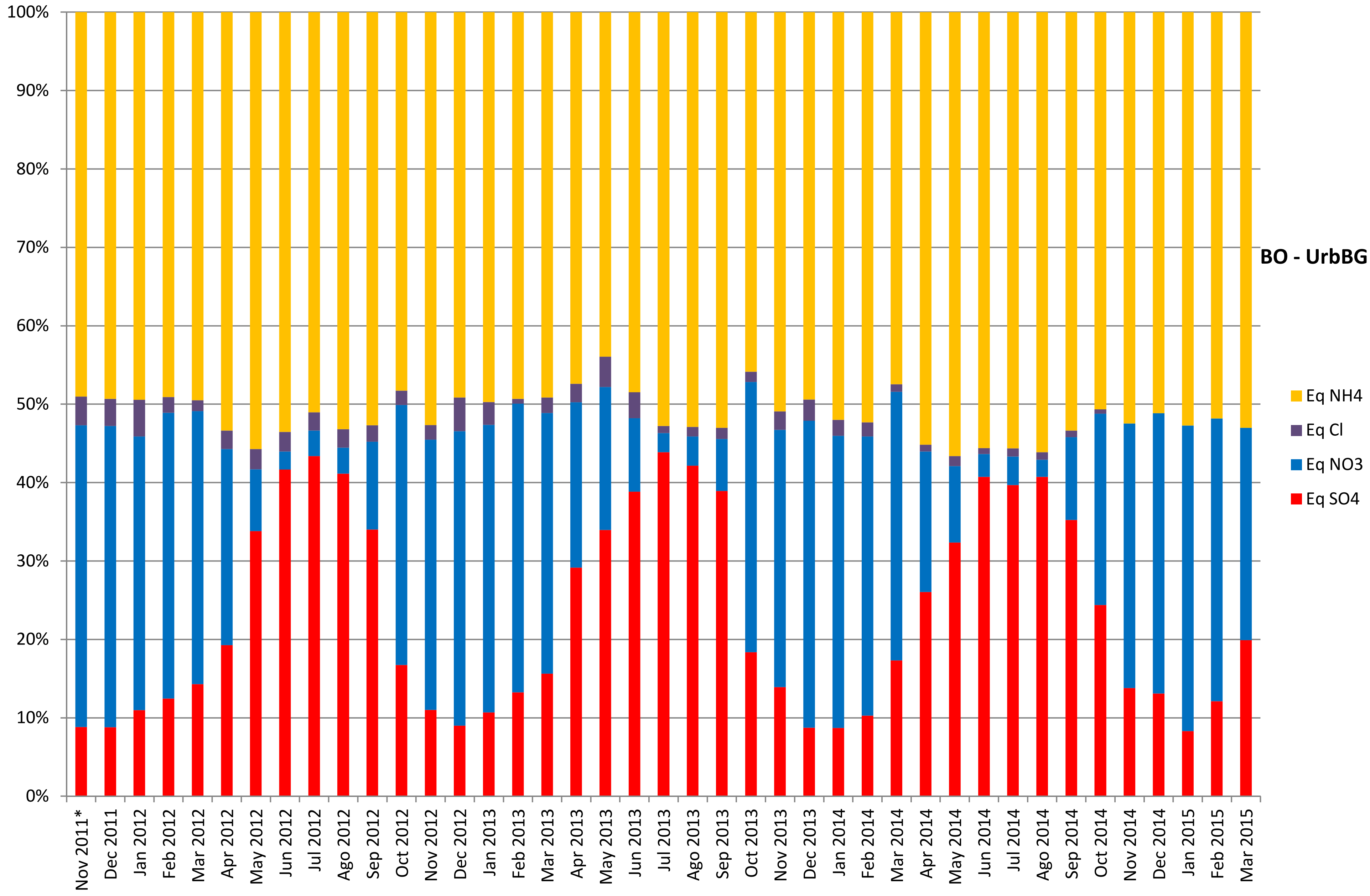
Dec 2014
Jan 2015
Feb 2015
Mar 2015



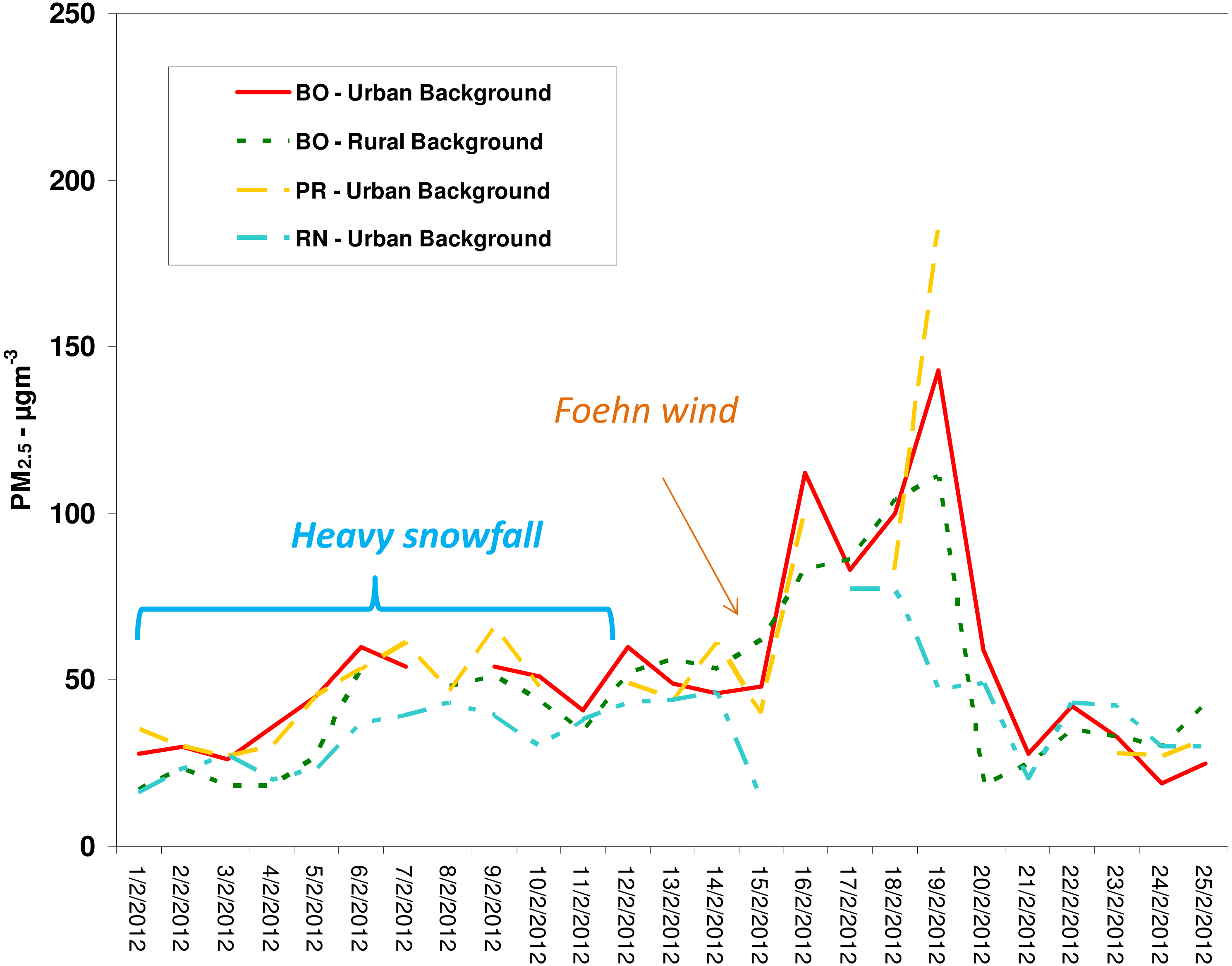
Charge neutrality verified in every site



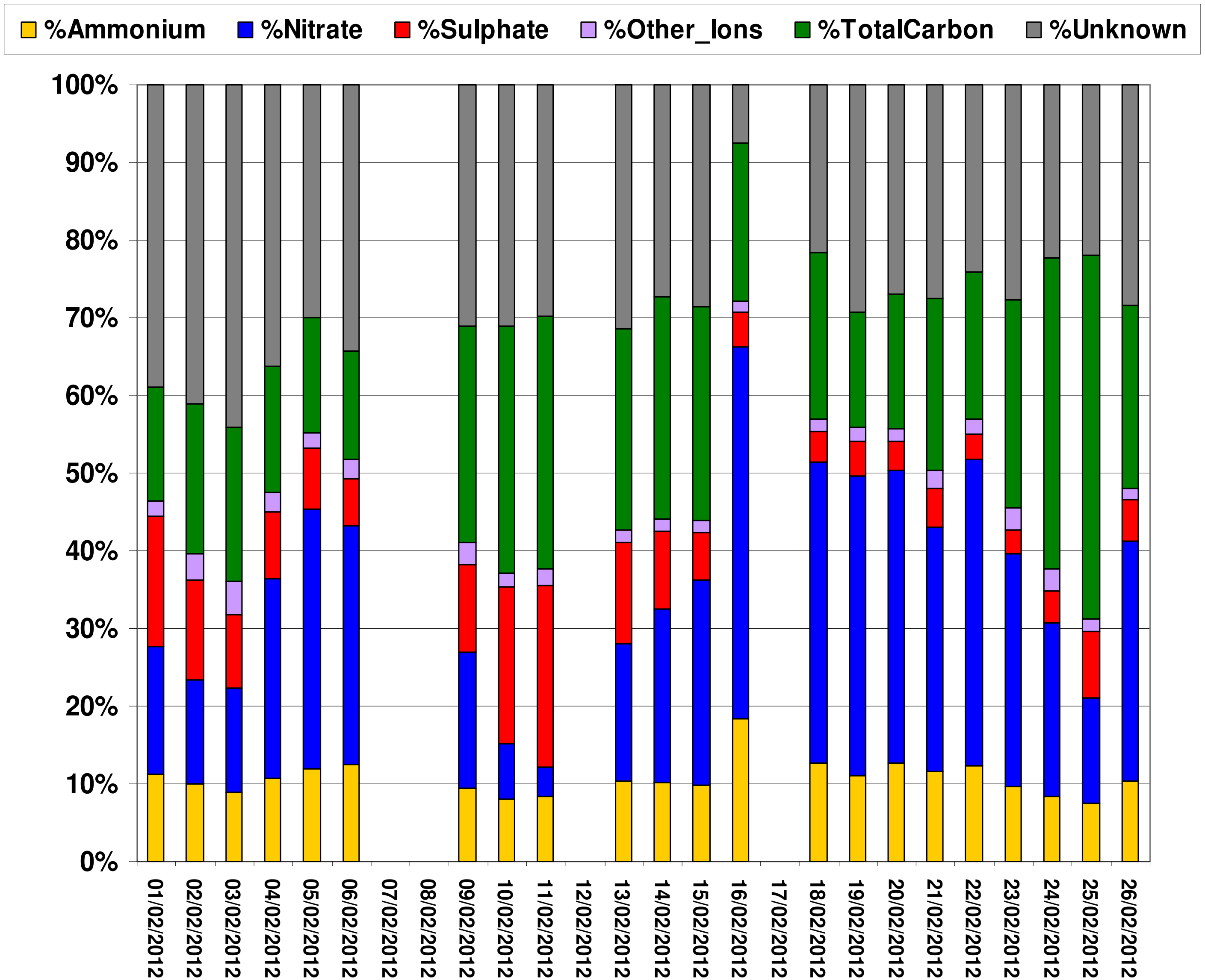


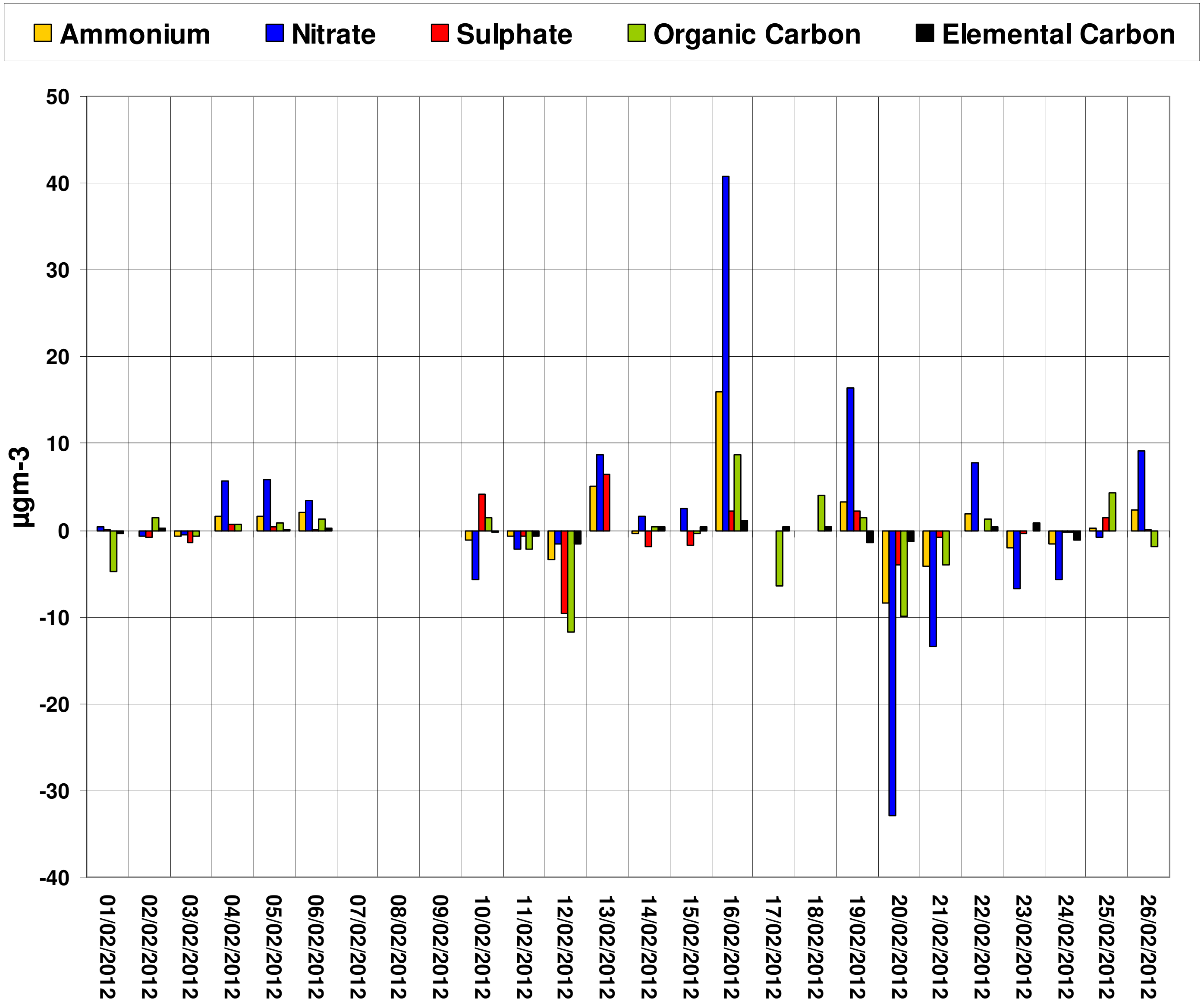

BO - UrbBG
Eq NH4
Eq Cl
Eq NO3
Eq SO4
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Nov 2011*
Dec 2011
Jan 2012
Feb 2012
Mar 2012
Apr 2012
May 2012
Jun 2012
Jul 2012
Ago 2012
Sep 2012
Oct 2012
Nov 2012
Dec 2012
Jan 2013
Feb 2013
Mar 2013
Apr 2013
May 2013
Jun 2013
Jul 2013
Ago 2013
Sep 2013
Oct 2013
Nov 2013
Dec 2013
Jan 2014
Feb 2014
Mar 2014
Apr 2014
May 2014
Jun 2014
Jul 2014
Ago 2014
Sep 2014
Oct 2014
Nov 2014
Dec 2014
Jan 2015
Feb 2015
Mar 2015

PM POLLUTION EPISODE – Feb 2012



Manuring of field in northern regions available from 15th Feb


%Ammonium
%Nitrate
%Sulphate
%Other_Ions
%TotalCarbon
%Unknown
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
01/02/2012
02/02/2012
03/02/2012
04/02/2012
05/02/2012
06/02/2012
07/02/2012
08/02/2012
09/02/2012
10/02/2012
11/02/2012
12/02/2012
13/02/2012
14/02/2012
15/02/2012
16/02/2012
17/02/2012
18/02/2012
19/02/2012
20/02/2012
21/02/2012
22/02/2012
23/02/2012
24/02/2012
25/02/2012
26/02/2012



Ammonium
Nitrate
Sulphate
Organic Carbon
Elemental Carbon
µgm-3
50
40
30
20
10
0
-10
-20
-30
-40
01/02/2012
02/02/2012
03/02/2012
04/02/2012
05/02/2012
06/02/2012
07/02/2012
08/02/2012
09/02/2012
10/02/2012
11/02/2012
12/02/2012
13/02/2012
14/02/2012
15/02/2012
16/02/2012
17/02/2012
18/02/2012
19/02/2012
20/02/2012
21/02/2012
22/02/2012
23/02/2012
24/02/2012
25/02/2012
26/02/2012

EAC 2013 – Poluzzi et al.

"Several studies [1-3] identified in snowmelt a possible origin of nitrate precursors, like NO or NO_2, and possible reaction pathways for production of nitrate into the snow (in liquid layer or in interstitial air) are proposed [4]. Therefore, the snowmelt may have increased the nitrate availability in air.

Ammonia is the principal precursor of ammonium and its concentration in Po Valley is usually among the highest in Europe.

Ammonia main source is agriculture, in particular animal husbandry and manuring of fields [5]. The regional laws prohibit the use of nitrogen fertilizer from livestock, normally, until the end of January. In February, this kind of manuring is permitted only if water, snow or ice don't cover the soil, so in the northern and western Po Valley, where no snow was present, the agricultural activities could have begun in the studied days. Even if other hypothesis can be considered, i.e. transboundary transport, the manuring seems to have played a key role in such a high ammonia availability."

[1]: Bock J., Jacobi H.W., *J. Phys. Chem. A*, 114, 1790-1796, 2010;

[2]: Helmig D., Seok B., Williams M.W., Hueber J., Sanford R., *Biogeochemistry*, 95, 115-130, 2009;

[3]: Stanier C., Singh A., Adamski W., Baek J., Caughey M., Carmicheal G., Edgerton E., Kenski D., Koerber M., Oleson J., Rohlf T., Lee S.R., Riemer N., Shaw S., Sousan S., Spak S.N., *Atmos. Chem. Phys.,* 12 11037-11056, 2012;

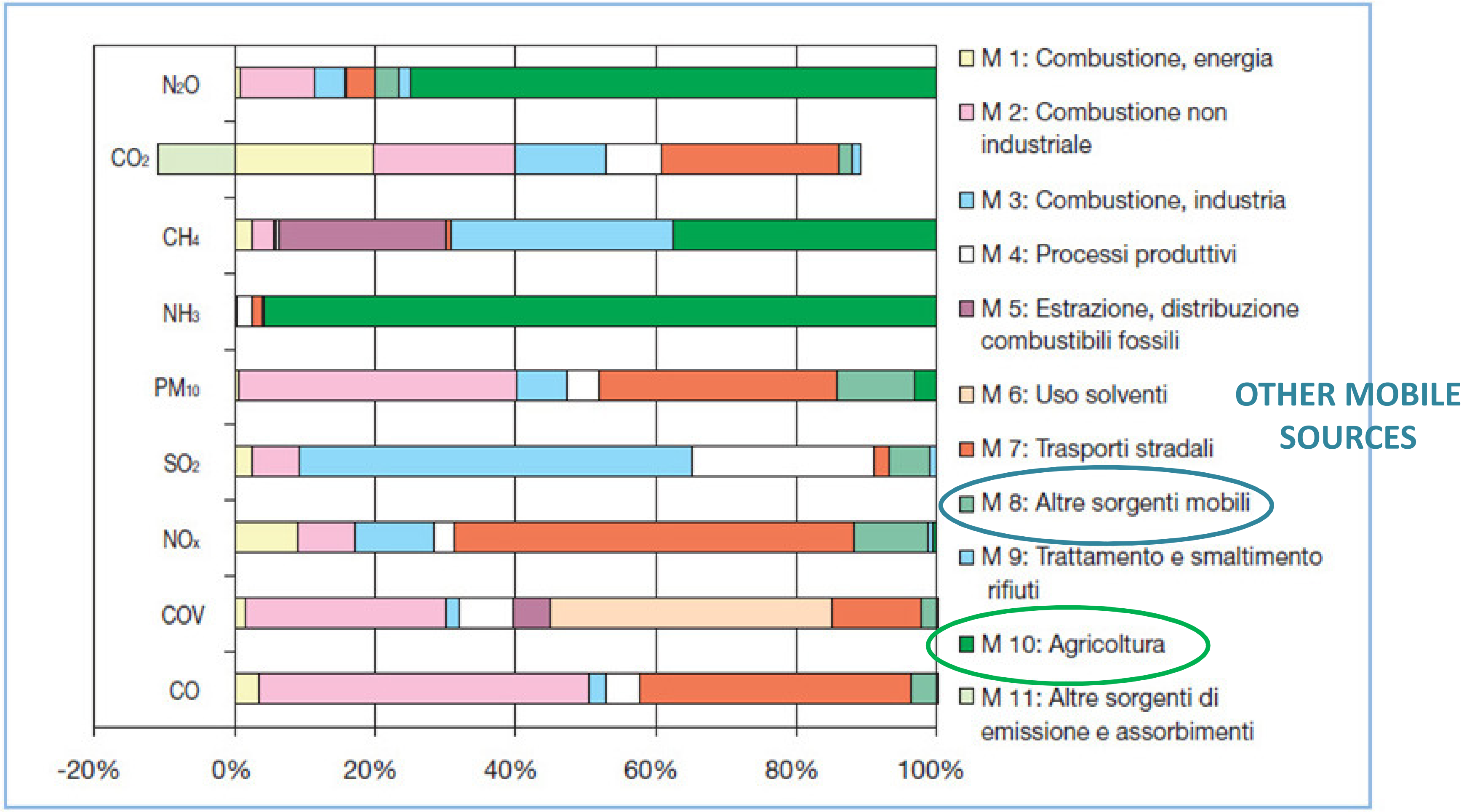
[4]: Jacobi H.W., Hilker B., J. Photochem. Photobiol. Chem., 185 (2-3), 371-382, 2007;

[5]: Tugnoli S., Rumberti V., Atmospheric Emissions Inventory in Emilia-Romagna region, Agency for Prevention and Environment (ARPA-ER), 2010.

2 - AMMONIA IS NOT THE ONLY POLLUTANT FROM AGRICULTURE

Distribuzione percentuale delle emissioni in atmosfera dei principali inquinanti per macrosettore (anno 2010)

Fonte: Regione Emilia-Romagna, Arpa Emilia-Romagna



Nella tabella seguente si riportano i dati delle emissioni provinciali relative al traffico.

Tabella 3-24 Emissioni provinciali totali (ton/anno, CO2 kton/anno)

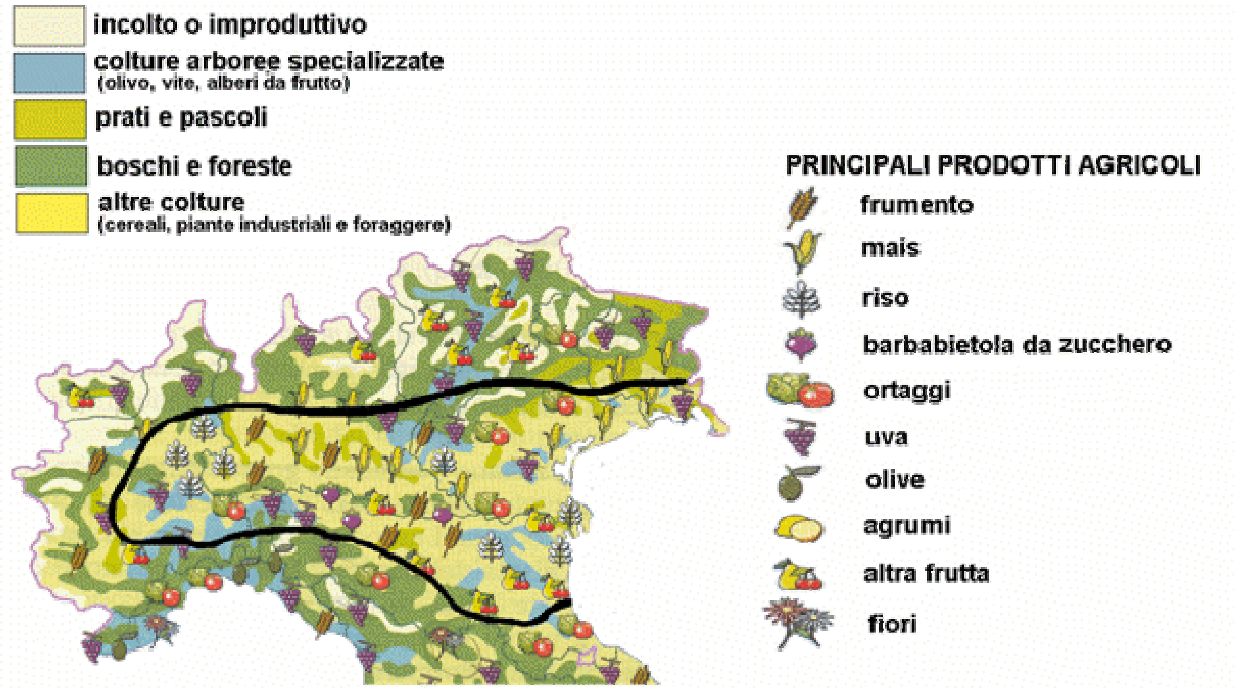
Provincia	CO	SO2	NMVOC	CH4	NOx	PTS	CO2	N2O	NH3	PM10
Piacenza	6700	32	1240	103	5332	485	1079	29	66	391
Parma	8909	46	1596	140	7792	693	1552	42	96	557
Reggio Emilia	7565	43	1339	129	6883	654	1463	41	97	527
Modena	9641	55	1762	167	8632	853	1899	55	129	687
Bologna	13819	80	2462	238	12888	1219	2752	78	191	976
Ferrara	5935	31	1073	96	4887	466	1053	30	72	375
Ravenna	5928	32	1116	101	5387	510	1103	31	69	413
Forli-Cesena	6466	35	1256	106	5978	543	1167	32	67	441
Rimini	3303	18	653	57	2896	279	629	17	45	226

tractors

Tabella 3-28 Emissioni provinciali – Altri trasporti mobili: Agricoltura (ton/anno, CO2 kton/anno)

	CO	NOx	PM10	NMVOC	NH3	SO2	N2O	CH4	CO2
PIACENZA	607	1354	204	215	0.3	19	41	6	107
PARMA	519	1159	174	184	0.3	16	35	5	92
REGGIO EMILIA	470	1002	151	163	0.2	14	30	4	79
MODENA	687	1234	186	221	0.3	17	37	6	98
BOLOGNA	824	1290	194	252	0.3	18	39	6	103
FERRARA	1009	1663	250	314	0.4	23	50	8	132
RAVENNA	869	1263	190	258	0.3	18	38	6	101
FORLI-CESENA	679	844	127	191	0.2	12	26	5	67
RIMINI	139	294	44	48	0.1	4	9	1	23

harvesters



incolto o improduttivo
colture arboree specializzate
(olivo, vite, alberi da frutto)
prati e pascoli
boschi e foreste
altre colture
(cereali, piante industriali e foraggere)
PRINCIPALI PRODOTTI AGRICOLI
frumento
mais
riso
barbabietola da zucchero
ortaggi
uva
olive
agrumi
altra frutta
fiori

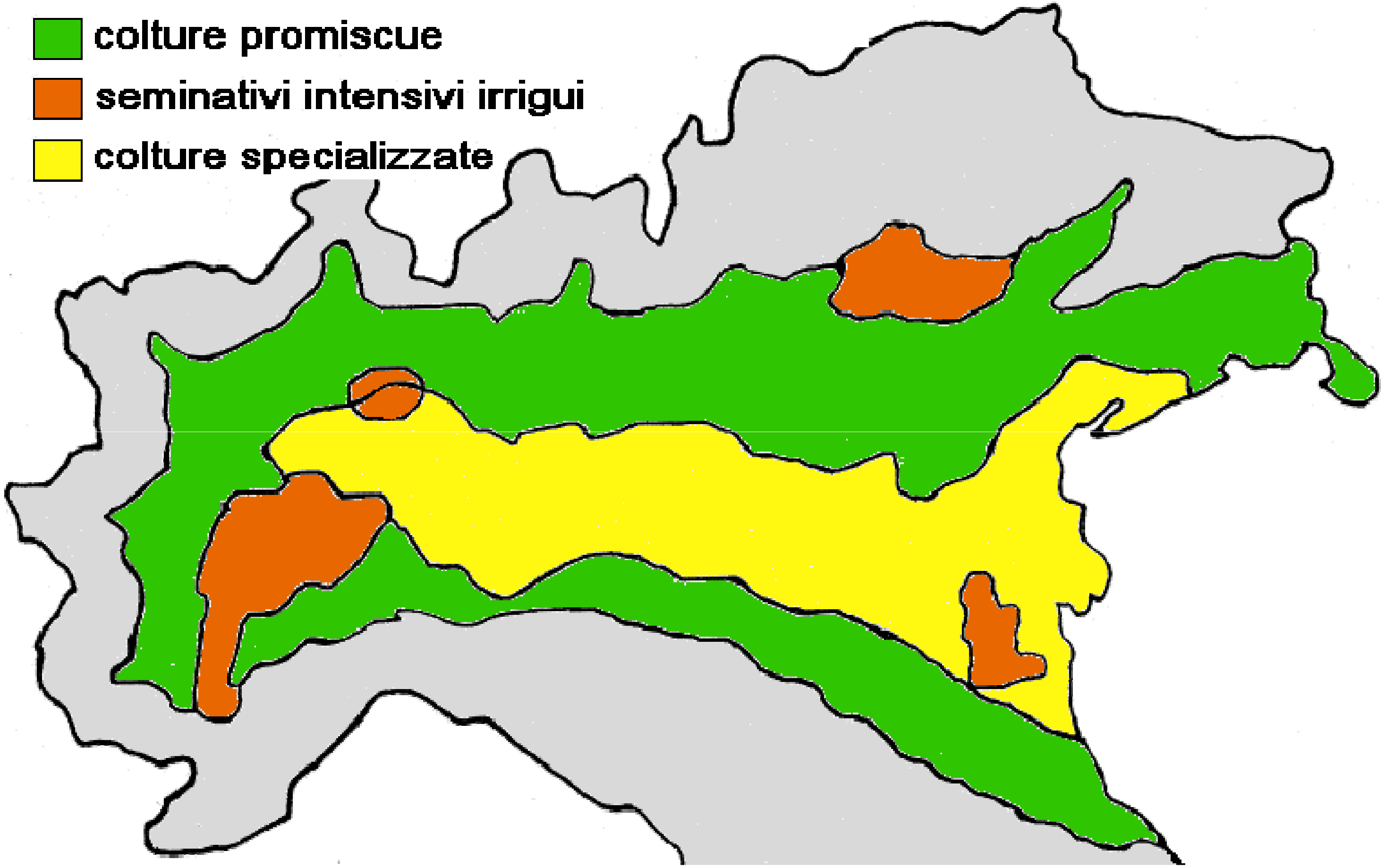

colture promiscue
seminativi intensivi irrigui
colture specializzate

Tabella 3-29 Emissioni totali provinciali Macrosettore 8- Altre sorgenti mobili (ton/anno, CO2 kton/anno)

	CH4	CO	CO2	NMVOC	N2O	NH3	NOx	PM10	PTS	SO2
PIACENZA	6	607	107	215	41	0.3	1 354	204	214	19
PARMA	5	519	92	184	35	0.3	1 159	174	184	16
REGGIO EMILIA	4	470	79	163	30	0.2	1 002	151	159	14
MODENA	6	687	98	221	37	0.3	1 234	186	195	17
BOLOGNA	6	1 251	185	389	39	0.3	1 573	198	208	54
FERRARA	8	1 009	132	314	50	0.4	1 663	250	263	23
RAVENNA	6	869	150	331	38	0.3	2 178	190	312	845
FORLI-CESENA	5	679	67	191	26	0.2	844	127	134	12
RIMINI	1	139	23	48	9	0.1	294	44	47	4

Tabella 3-28 Emissioni provinciali – Altri trasporti mobili: Agricoltura (ton/anno, CO2 kton/anno)

	CO	NOx	PM10	NMVOC	NH3	SO2	N2O	CH4	CO2
PIACENZA	607	1354	204	215	0.3	19	41	6	107
PARMA	519	1159	174	184	0.3	16	35	5	92
REGGIO EMILIA	470	1002	151	163	0.2	14	30	4	79
MODENA	687	1234	186	221	0.3	17	37	6	98
BOLOGNA	824	1290	194	252	0.3	18	39	6	103
FERRARA	1009	1663	250	314	0.4	23	50	8	132
RAVENNA	869	1263	190	258	0.3	18	38	6	101
FORLI-CESENA	679	844	127	191	0.2	12	26	5	67
RIMINI	139	294	44	48	0.1	4	9	1	23
TOTAL CONTRIBUTION:	*5803*	*10103*	*1520*	*1846*	*2.4*	*141*	*305*	*47*	*802*

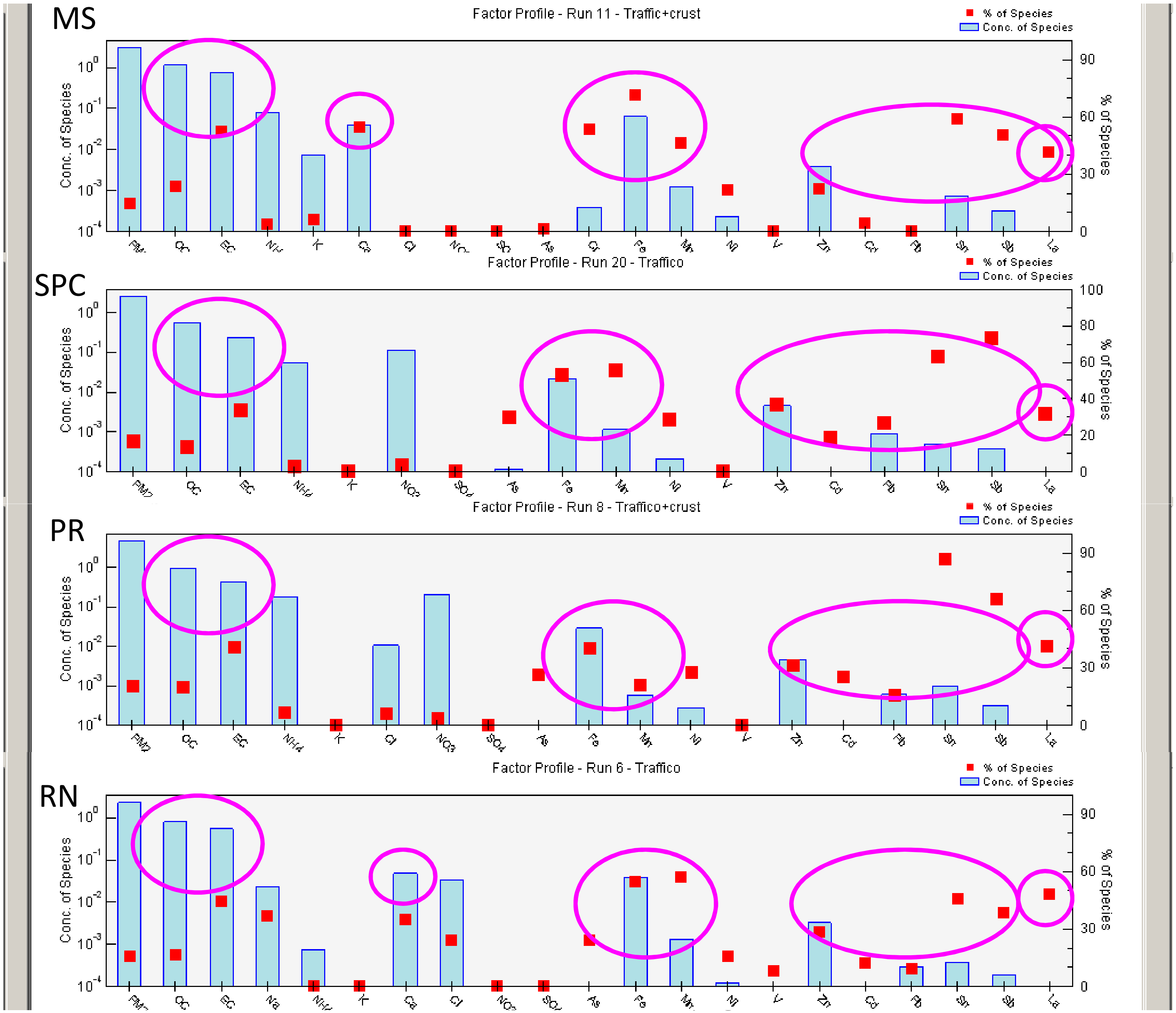
Tabella 3-25 **Emissioni da traffico aeroportuale (ton/anno, CO2 kton/anno)**

	CO	NOx	PM10	NMVOC	NH3	SO2	CO2
BOLOGNA	427	283	4	137	0	36	82

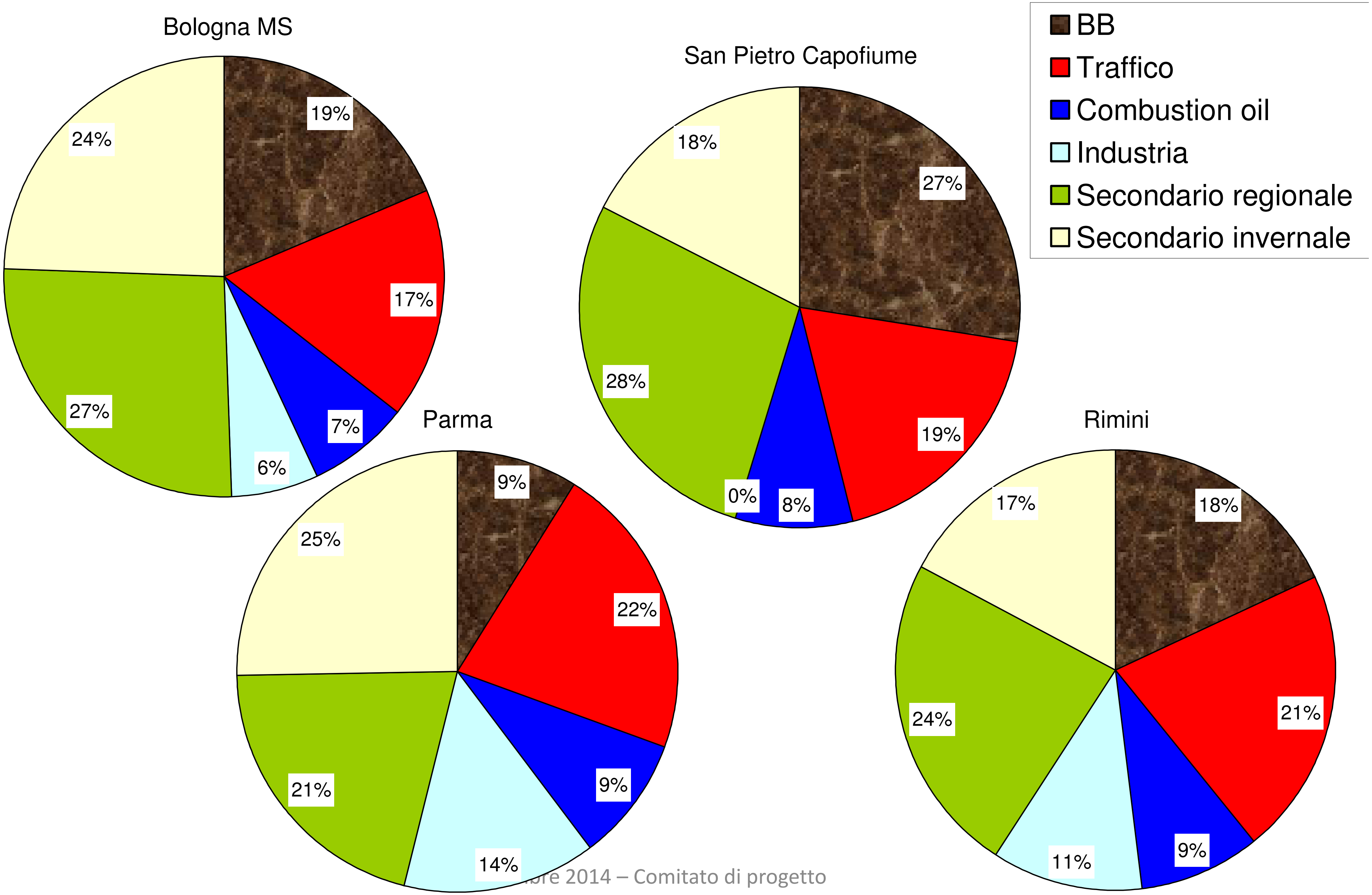
Tabella 3-26 **Emissioni da traffico portuale (ton(anno, CO2 kton/anno)**

	NOx	PTS	NMVOC	SO2	CO2
RAVENNA	914	112	72	827	49

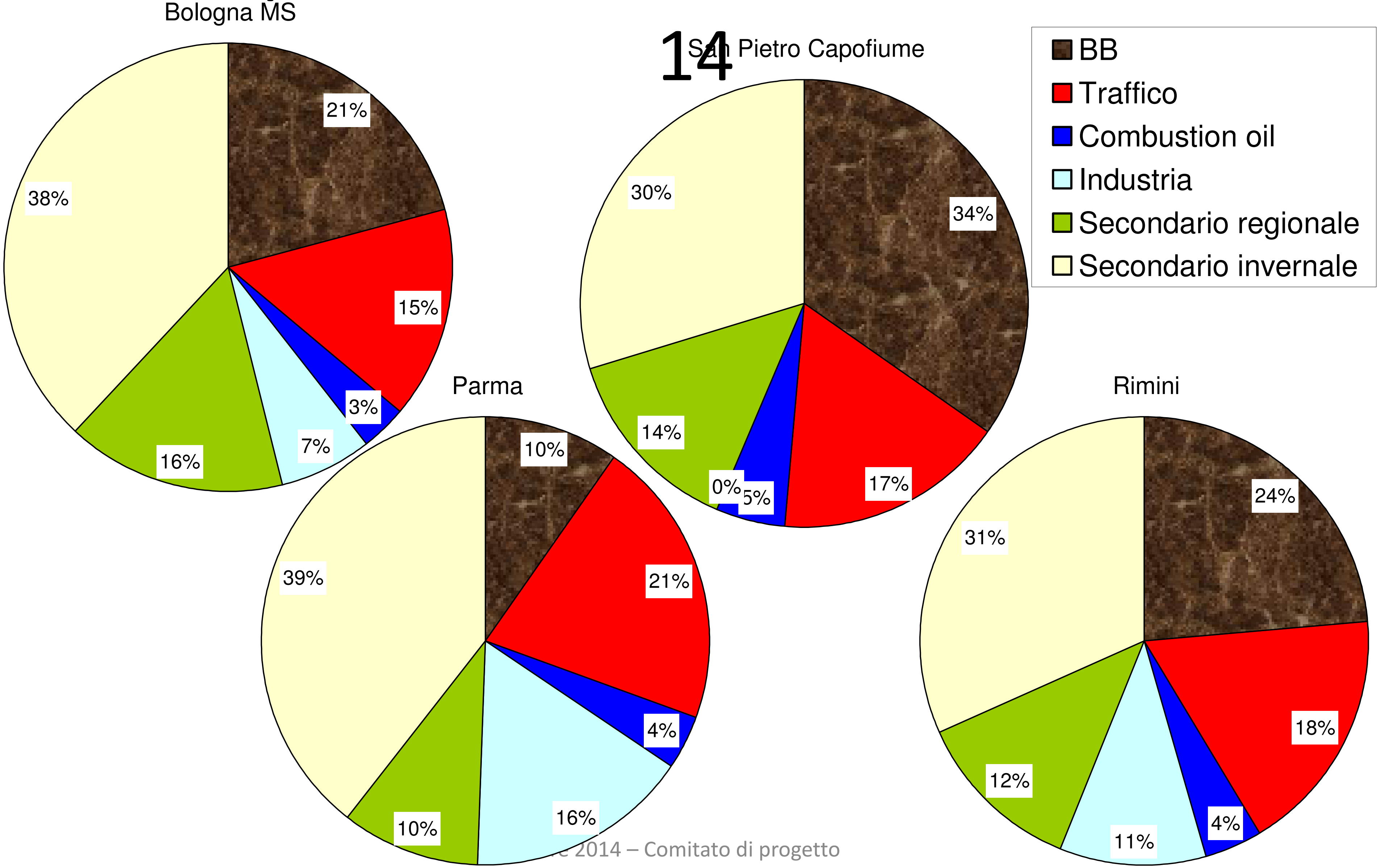
TRAFFICO CON RISOLLEVAMENTO (componente primaria)



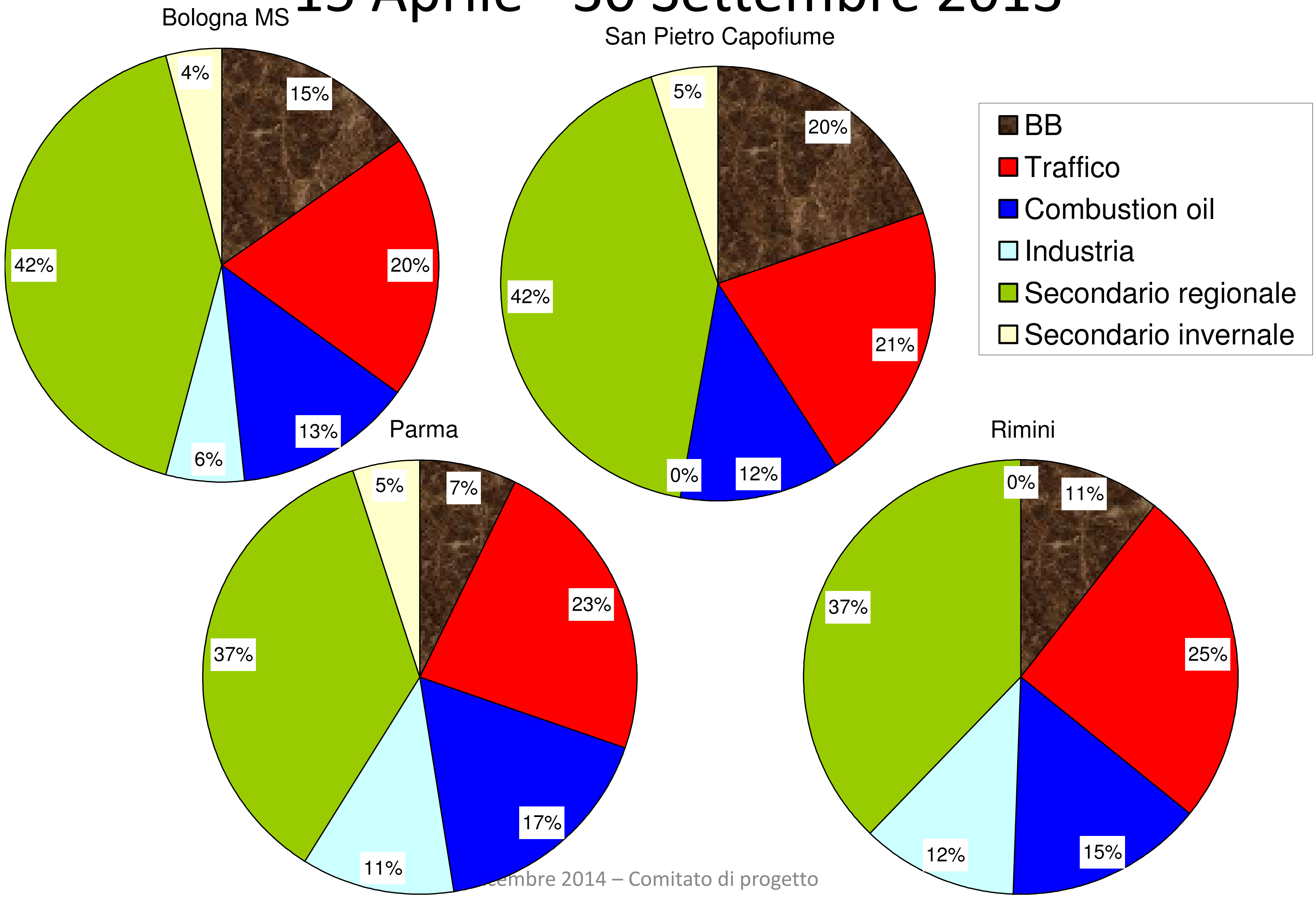
Aprile 2013 – Febbraio 2014

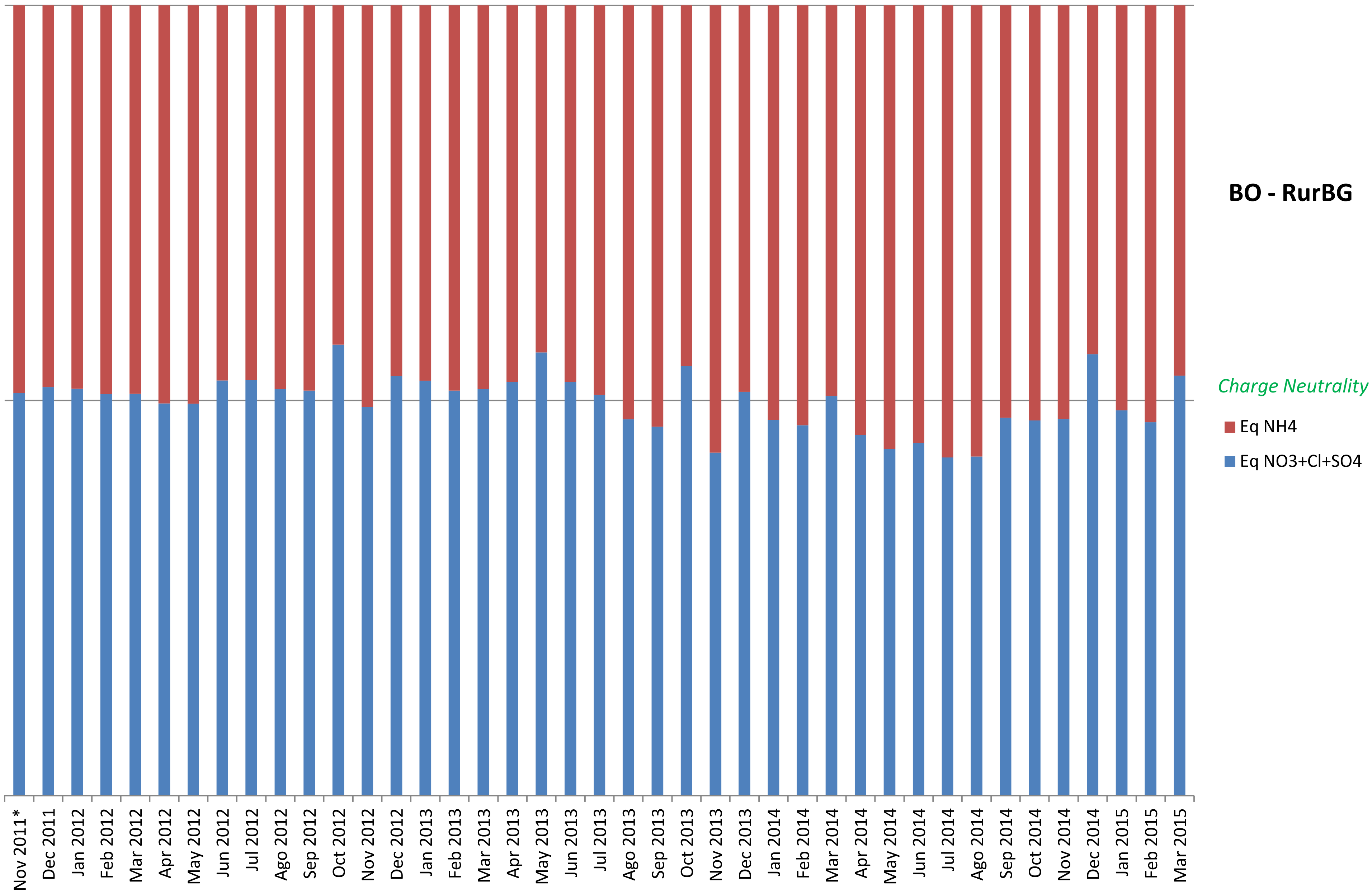


Stagione fredda
1-15 Aprile 2013 - 1 Ottobre 13-Febbraio 14



Stagione calda
15 Aprile - 30 Settembre 2013




BO - RurBG
Charge Neutrality
Eq NH4
Eq NO3+Cl+SO4
Nov 2011*
Dec 2011
Jan 2012
Feb 2012
Mar 2012
Apr 2012
May 2012
Jun 2012
Jul 2012
Ago 2012
Sep 2012
Oct 2012
Nov 2012
Dec 2012
Jan 2013
Feb 2013
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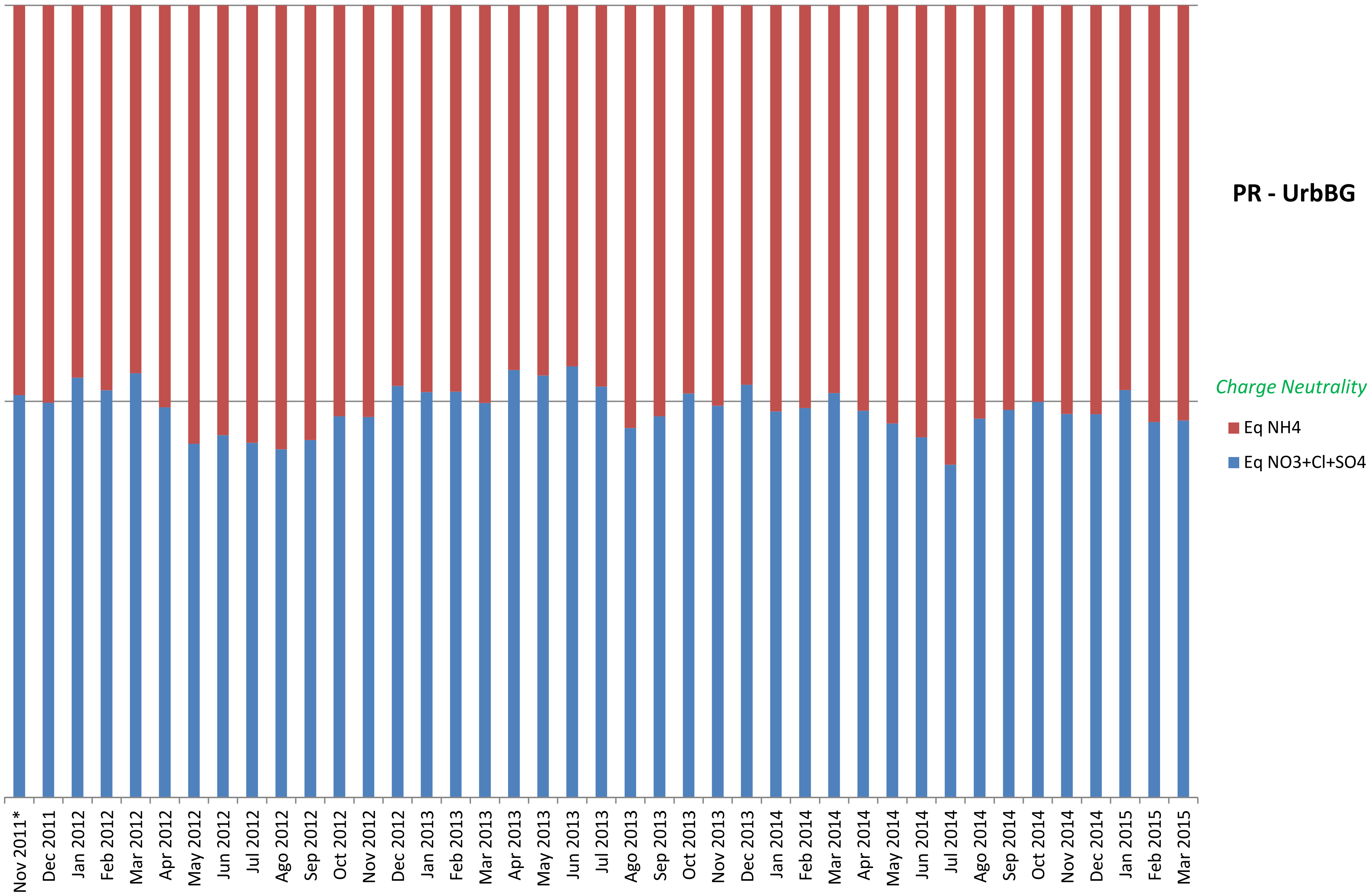
Dec 2014
Jan 2015
Feb 2015
Mar 2015



PR - UrbBG
Charge Neutrality
Eq NH4
Eq NO3+Cl+SO4
Nov 2011*
Dec 2011
Jan 2012
Feb 2012
Mar 2012
Apr 2012
May 2012
Jun 2012
Jul 2012
Ago 2012
Sep 2012
Oct 2012
Nov 2012
Dec 2012
Jan 2013
Feb 2013
Mar 2013
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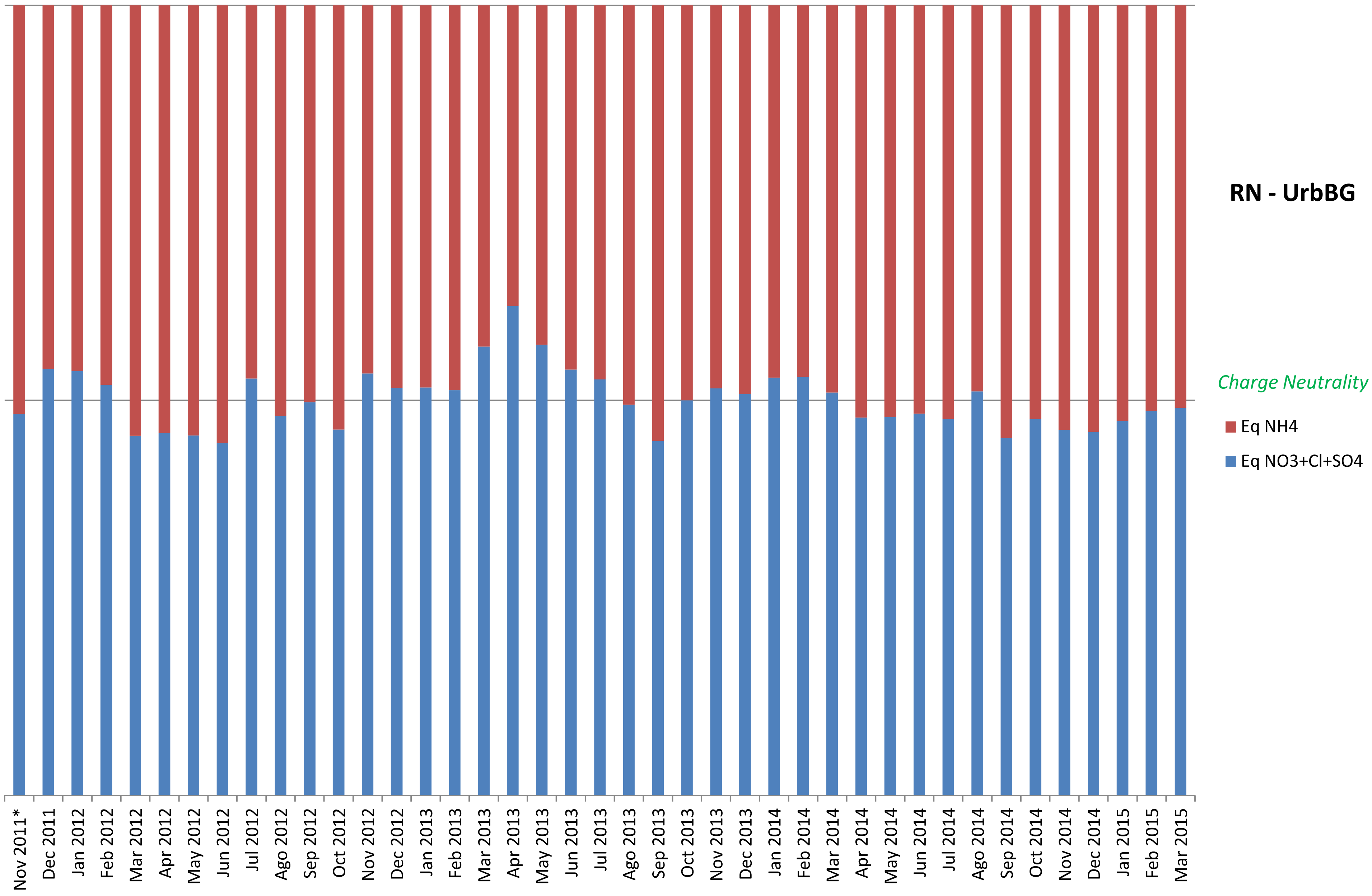
Nov 2014
Dec 2014
Jan 2015
Feb 2015
Mar 2015


RN - UrbBG
Charge Neutrality
Eq NH4
Eq NO3+Cl+SO4
Nov 2011*
Dec 2011
Jan 2012
Feb 2012
Mar 2012
Apr 2012
May 2012
Jun 2012
Jul 2012
Ago 2012
Sep 2012
Oct 2012
Nov 2012
Dec 2012
Jan 2013
Feb 2013
Mar 2013
Apr 2013
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Jul 2013
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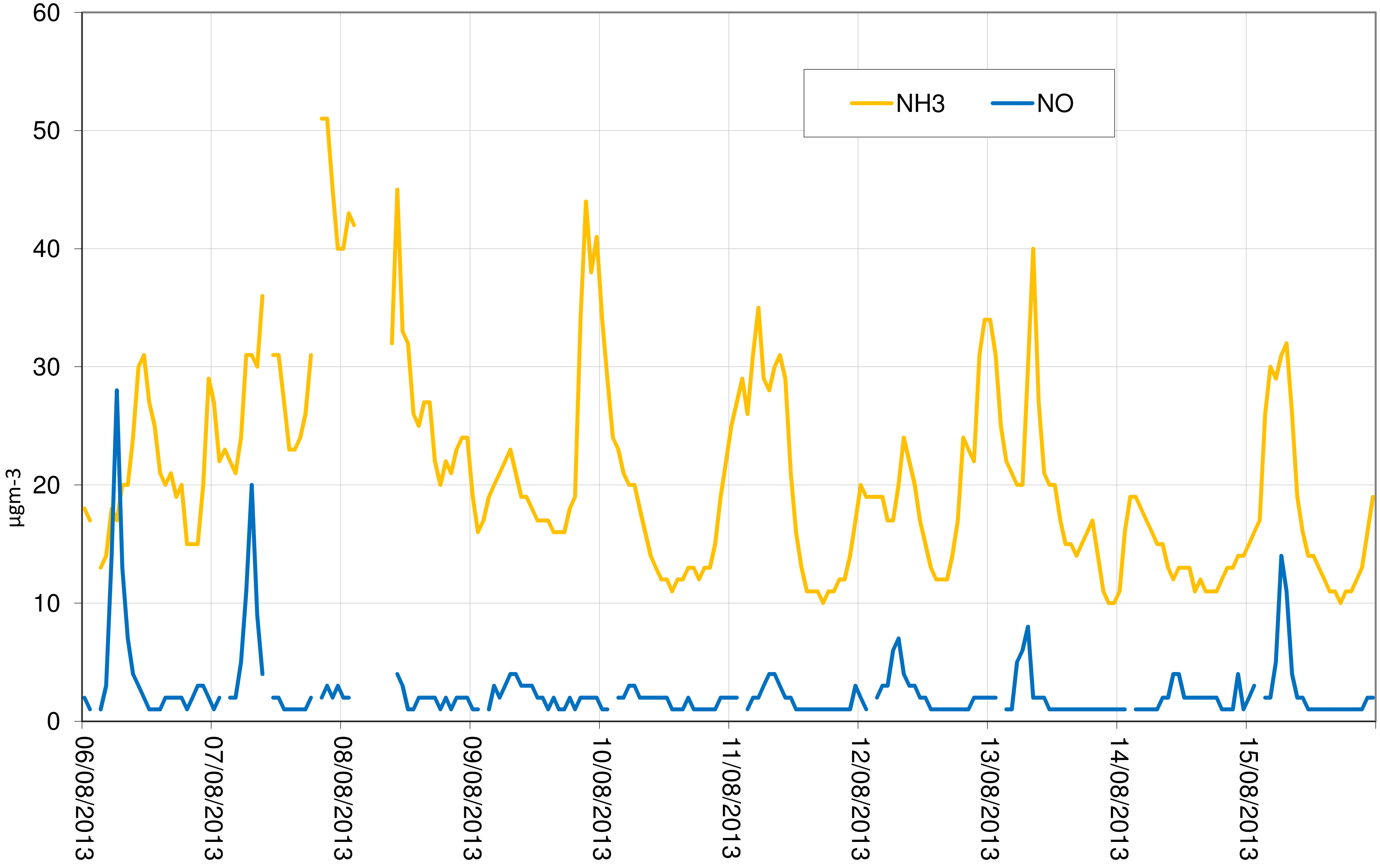
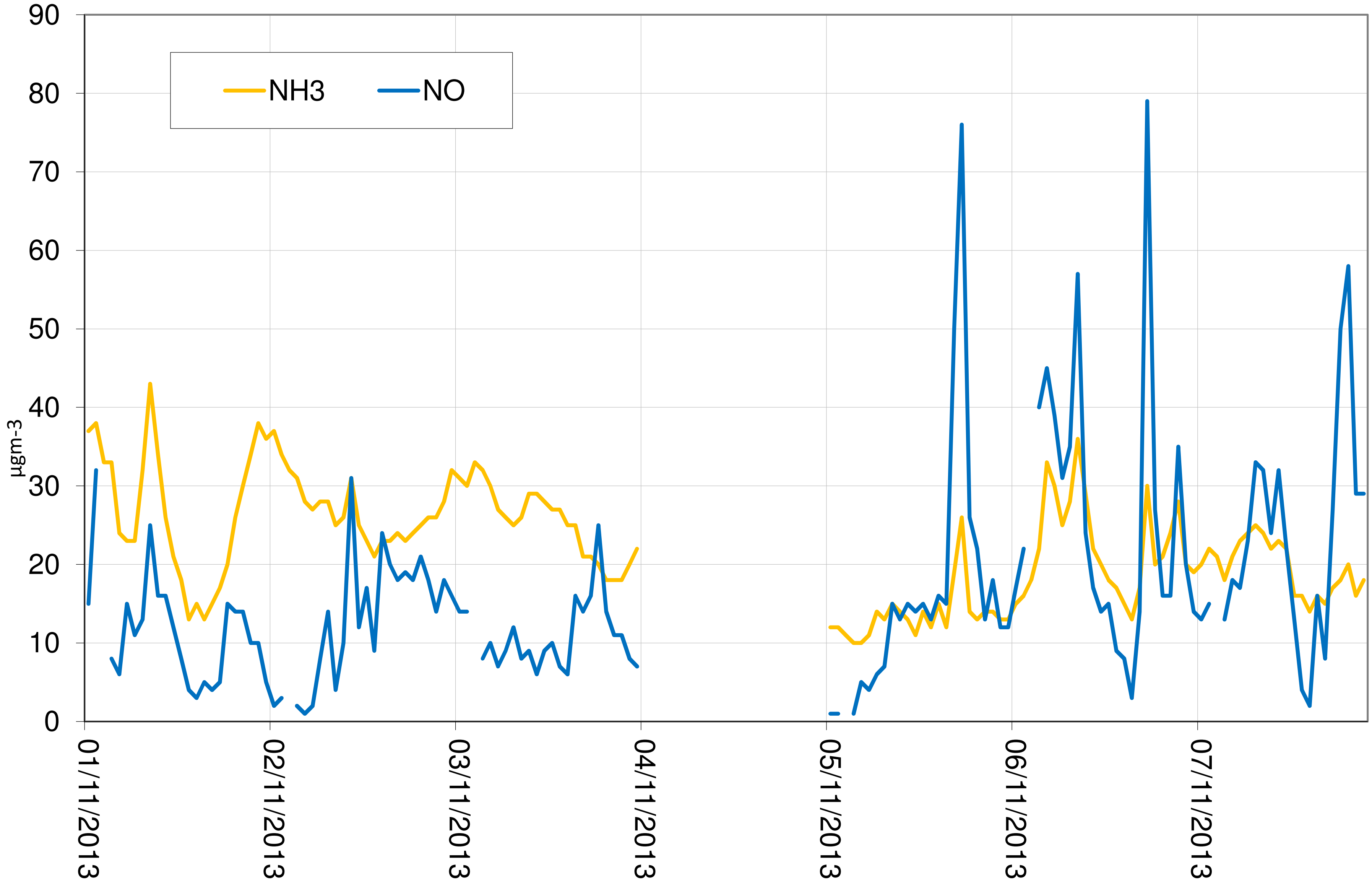
Nov 2014
Dec 2014
Jan 2015
Feb 2015
Mar 2015



60
50
40
30
20
10
0
µgm-3
NH3
NO
06/08/2013
07/08/2013
08/08/2013
09/08/2013
10/08/2013
11/08/2013
12/08/2013
13/08/2013
14/08/2013
15/08/2013



NH3
NO
µgm-3
0
10
20
30
40
50
60
70
80
90
01/11/2013
02/11/2013
03/11/2013
04/11/2013
05/11/2013
06/11/2013
07/11/2013

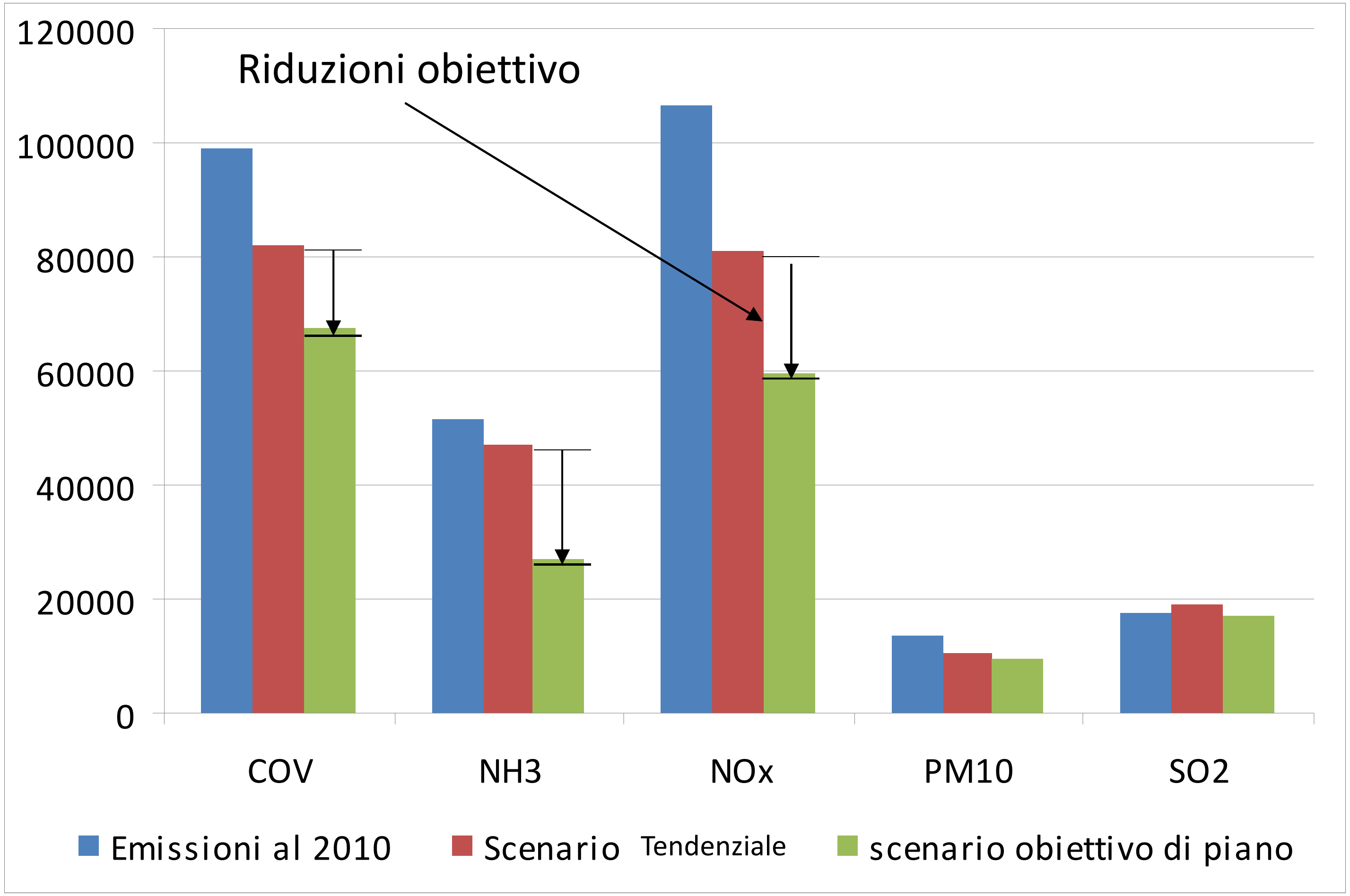
Identificazione dello scenario obiettivo di piano

Azioni di risanamento e loro valutazione per il Piano della qualità dell'aria dell'Emilia-Romagna PAIR 2020

www.operatool.eu

Lo strumento RIAT+ implementato in Emilia-Romagna fornisce un ampio spettro di informazioni e dati a supporto dell'analisi dell'inquinamento, delle cause di superamento e delle possibili misure per ridurre le emissioni inquinanti:

- L'analisi costi-benefici è stata utilizzata per identificare lo scenario obiettivo di piano;
- Il database delle azioni è stato utilizzato per identificare e valutare le misure più efficaci;
- Il modello sorgente-recettore è stato utilizzato per una valutazione rapida degli effetti sulla qualità dell'aria delle misure selezionate;
- i dati di emissione relativi agli scenari selezionati vengono utilizzati per preparare i dati di ingresso per il modello NINFA

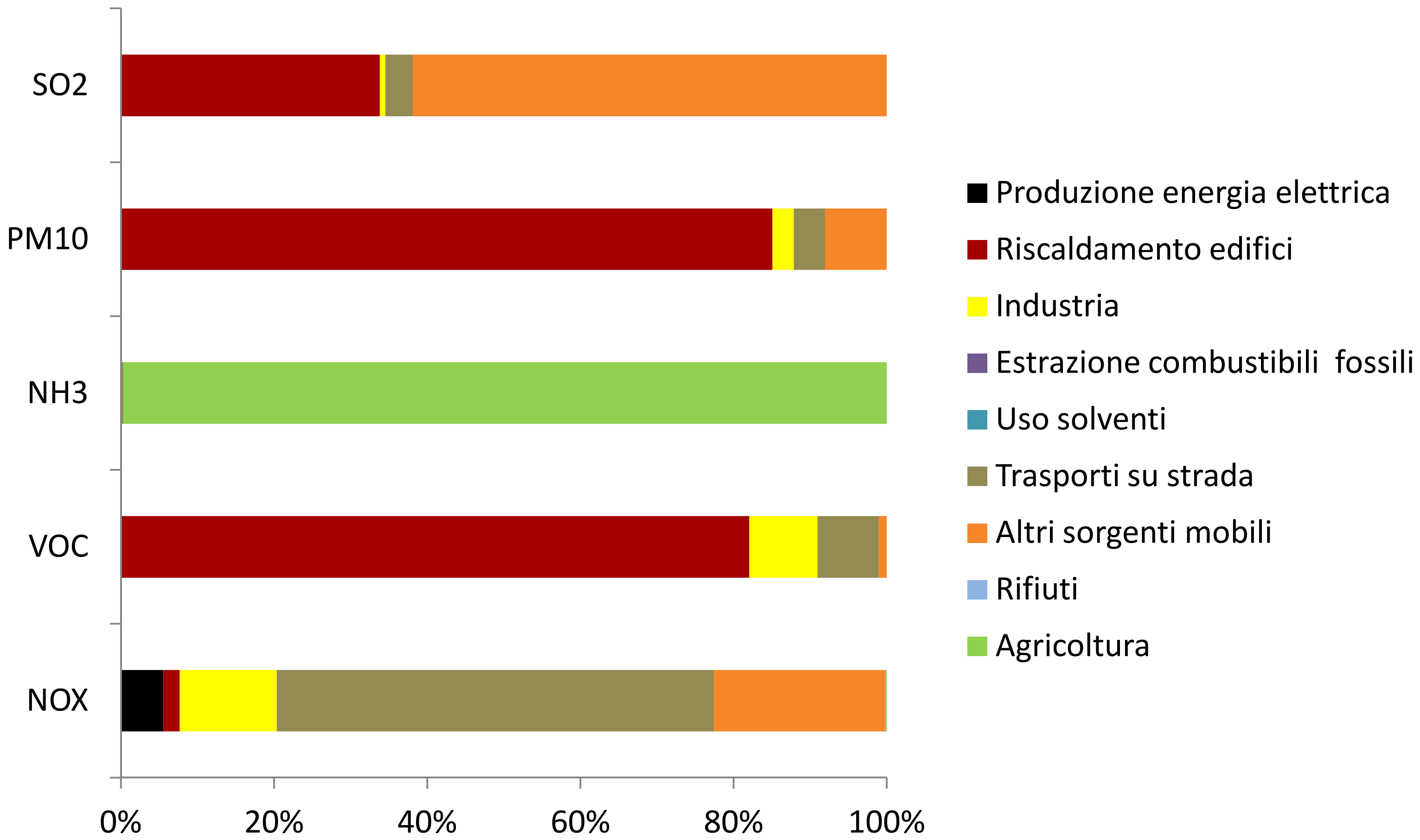


120000
100000
80000
60000
40000
20000
0
Riduzioni obiettivo
COV
NH3
NOx
PM10
SO2
Emissioni al 2010
Scenario Tendenziale
scenario obiettivo di piano

Identificazione delle azioni che possono consentire il raggiungimento degli obiettivi del piano:
l'analisi del database delle azioni OPERA/GAINS-I

- 2200 azioni tecniche (GAINS-I) e non tecniche/di efficienza energetica (Life-OPERA)
- ad ogni azione sono associati i dati di:
  - RE (efficienza di abbattimento) per ogni inquinante
  - AR (tasso di applicazione)
  - Massimo tasso di applicazione
  - Costo unitario

Misure dello scenario obiettivo di piano suddivise per macrosettore (RIAT+)



AGRICOLTURA

Le azioni su questo settore permettono di raggiungere il 100 % dell'obiettivo per NH3

- applicazione combinata all'allevamento di bovini, suini, pollame ed altri animali di:
  - alimentazione a basso contenuto di azoto,
  - copertura delle vasche di stoccaggio dei liquami
  - adozione di tecniche di spandimento a basso rilascio di ammoniaca
  - miglioramento dei ricoveri per animali
  - Utilizzo di fertilizzanti a basso contenuto di urea

ALTRE SORGENTI MOBILI

Le azioni in questo settore permettono di raggiungere il 20 % dell'obiettivo per NOx

- Nello scenario tendenziale CLE 2020 non sono ipotizzate riduzioni delle emissioni in questo settore, il margine di azione quindi è elevato.
- Si stima un potenziale di riduzione dalle 5.000 alle 7.000 ton di NOx e dalle 1.000 alle 1.200 ton di PM10
  - (*) non sono stati considerati i trattori a benzina dato che il loro contributo è totalmente trascurabile

Conclusions:

The important contribute at the emissions and at the concentrations of PM coming from agricultural activities is now well known and the Supersito project, together to the inventary emissions analysis show how relevants are these contributions in the Emilia-Romagna region.

However, the introduction of best action and techiques requested by PAIR 2020 , if they are well conducted, should give good results to decrease this impact.