

*JRC C.5 – “Pulvirus” Common meeting  
June 24<sup>th</sup>, 2021*

**WP 3**

# Characterization of the particulate matter chemical composition and size distribution



Agenzia nazionale per le nuove tecnologie,  
l'energia e lo sviluppo economico sostenibile





## WP3 actions

WP 3

June 24<sup>th</sup>, 2021

- Action 3.1: collection of available data on the chemical composition of particulate matter and other parameters not required by D.Lgs. 155/2010 (e.g. BC, PNC, Ammonia);
- Action 3.2: collection of particulate samples useful for biological analyses (→WP5);
- Action 3.3: data analysis;
- Action 3.4: implementation of specific campaigns.



# CHEMICAL COMPOSITION: daily data

WP 3

June 24<sup>th</sup>, 2021

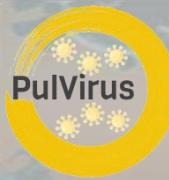
## Available data

PM10

- 3 urban background sites (Milano, Torino, Bologna) & 1 rural background site (Schivenoglia – MN) **[Prepair project]** → *EC/OC (Niosh-like); Elements (XRF); Ions; Levoglucosan*

PM2.5

- 3 urban background sites (Parma, Rimini, Bologna) & 1 rural background site (S. Pietro Capofiume – BO) → *EC/OC (EUSAAR2); Elements (ICP-MS); Ions; Levoglucosan*
- 1 rural background site (Schivenoglia – MN) → *Elements (XRF)*

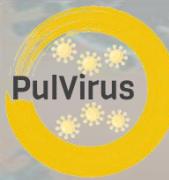


# AVAILABLE DATA: high time resolution

WP 3

June 24<sup>th</sup>, 2021

Company	OPC		
	brand/model	classes	sites
Provincia di Bolzano	---		
ARPA Emilia Romagna	FAI	8 from 0.28 µm	2
ENEA	GRIMM 107	31 from 0.25 µm	1
ARPA Lazio	---		
ARPA Lombardia	FAI	8 from 0.28 µm	2
	Envea	3 from 1 µm	
	GRIMM 108	31 from 0.25 µm	campaigns
ARPA Piemonte	TSI 3031	6 from 0.02 µm	1
ARPA Puglia	FAI	8 from 0.28 µm	1
ARPA Sardegna	---		
ARPA Toscana	GRIMM 108	31 from 0.25 µm	campaigns in 7 sites
APPA Trento	---		



# AVAILABLE DATA: high time resolution

WP 3

June 24<sup>th</sup>, 2021

Company	BC			NH <sub>3</sub>		
	brand/model	classes	sites	model	principle	sites
Provincia di Bolzano	MAGEE AE33	7 λ	1	---		
ARPA Emilia Romagna	MetONE	10 λ	1	API 201	Chemiluminescence	1
ARPA Lazio	---			API 201	Chemiluminescence	2
ARPA Lombardia	Thermo MAAP		1	API 201	Chemiluminescence	7
	MAGEE AE23	2 λ	1	TEI 17i	Chemiluminescence	4
	MAGEE AE33	7 λ	1	Ap2E	Cavity	1 + campaign
ARPA Piemonte	MAGEE AE33	7 λ	2	API 201	Chemiluminescence	3
ARPA Toscana	---			---		
APPA Trento	MAGEE AE33	7 λ	1	---		
ARPA Toscana	---			---		
APPA Trento	MAGEE AE33	7 λ	1	---		



# AVAILABLE DATA: high time resolution

WP 3

June 24<sup>th</sup>, 2021

Company	BC			NH <sub>3</sub>				
	brand/model	classes	sites	model	principle	Sites		
ARPA Puglia	---			TEI 17i	Chemiluminescence	1		
ARPA Sardegna	MAGEE AE23	2 λ	1	---				
Company	EC/OC							
	model			principle	sites			
ENEA	Sunset laboratory Inc/Model 4 OCEC (Carbon Aerosol) Field Analyzer			Thermo-Optical Semi-Continuous	1			
Company	Other instruments (campaigns)							
ENEA	ACSM, SMPS from 10 to 250 nm							



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# BIBLIOGRAPHIC ANALYSIS

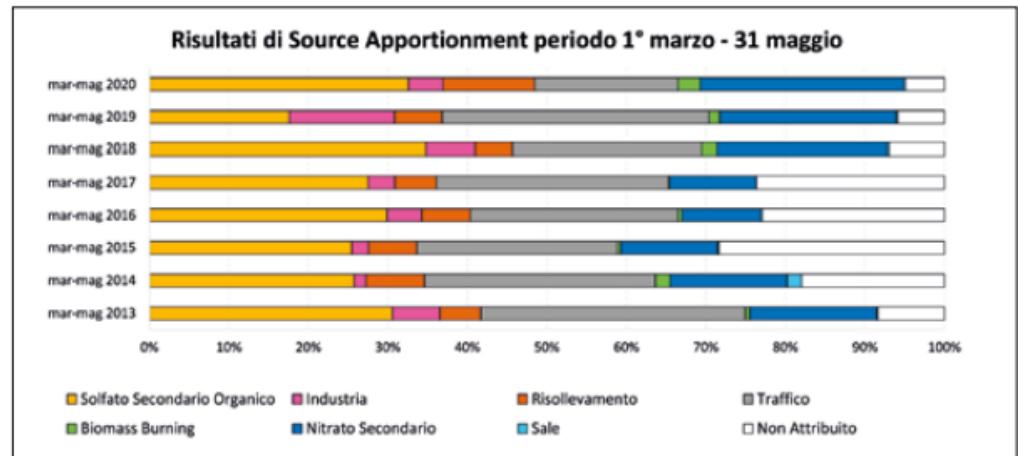
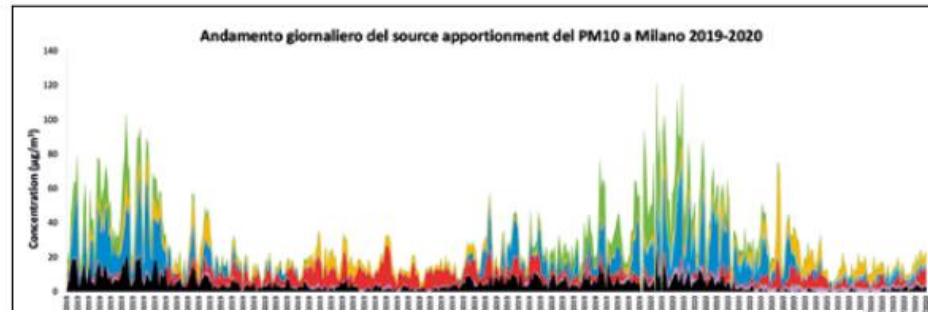
International papers

Italian papers

e.g. Mistaro et al. 2021 →

(BEA, Il bollettino degli esperti  
ambientali)

Source apportionment per year, Milano (UB) - PM10





# PRELIMINARY RESULTS: CHEMICAL COMPOSITION 1)

WP 3

June 24<sup>th</sup>, 2021

Comparison between data published by the Prepair project\* (5 sites) on PM10 composition and the Emilia-Romagna data on PM2.5 (4 sites)

Period: March-May 2020 vs previous years (total lockdown)

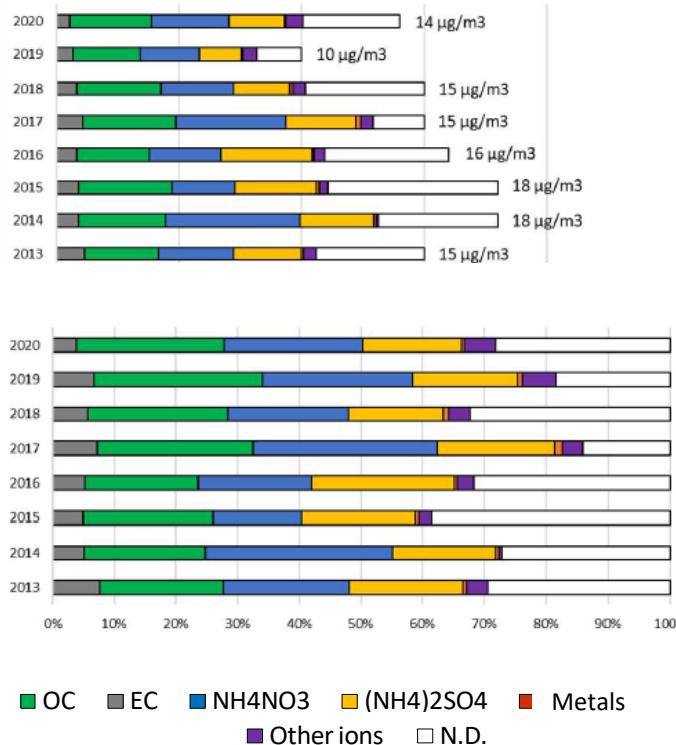
\*<https://www.lifeprepair.eu/index.php/2021/02/24/covid-19-e-qualita-dellaria-disponibile-il-terzo-rapporto-prepair-sulla-composizione-chimica-del-particolato/>



# MASS CLOSURE PER YEAR: 2 URBAN SITES, 2013-2020

WP 3

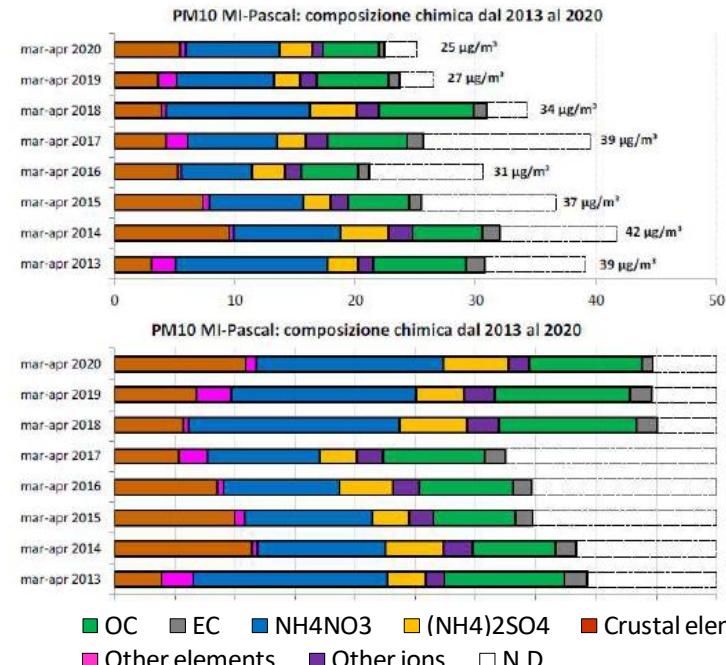
## Bologna, PM2.5 - 10/3-18/5



With the contribution  
of the LIFE Programme  
of the European Union



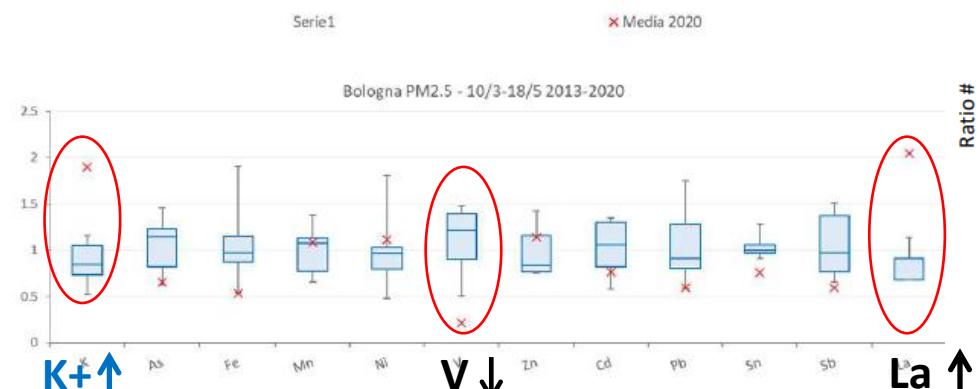
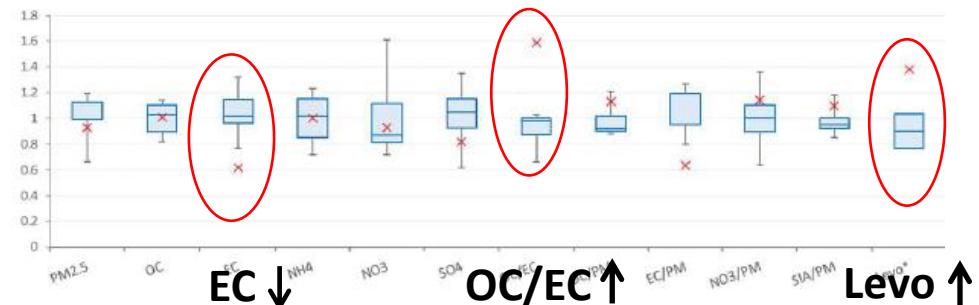
## Milano Pascal, PM10 - March&April





# COMPARISON BETWEEN CHEMICAL ANALYSIS 2 URBAN SITES, 2013-2019 vs 2020

Bologna, PM2.5 - 10/3-18/5



■ 75° - 25° percentile 2013-2019

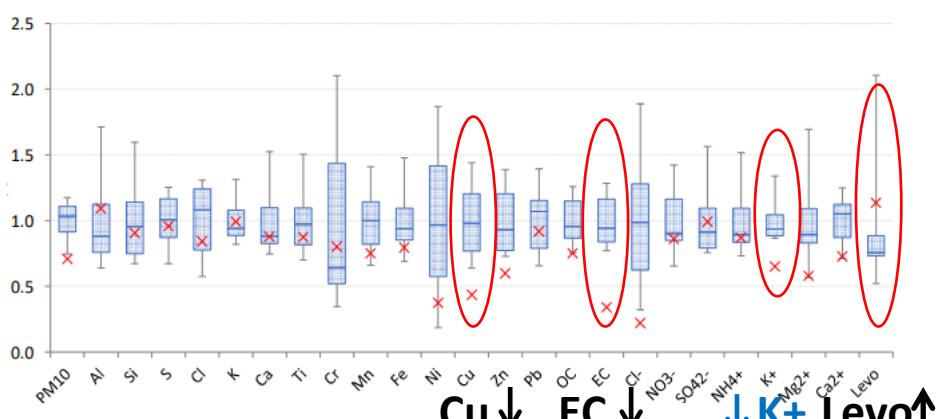
✕ Mar-Apr 2020



With the contribution  
of the LIFE Programme  
of the European Union  
LIFE15 IPS/IE-013



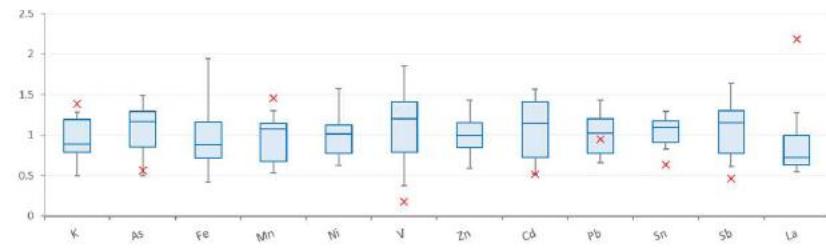
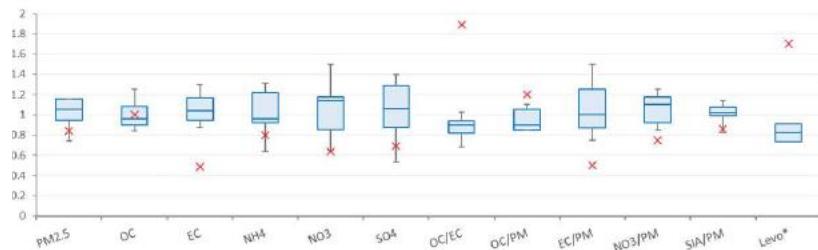
Milano Pascal, PM10 - March&April



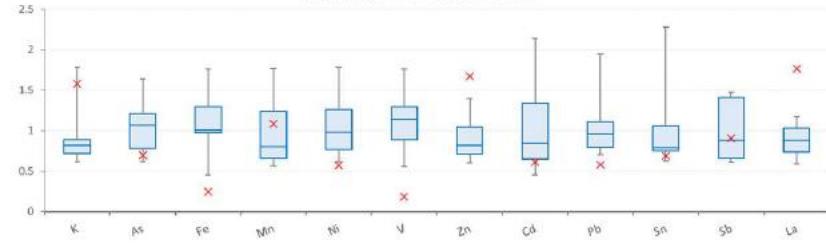
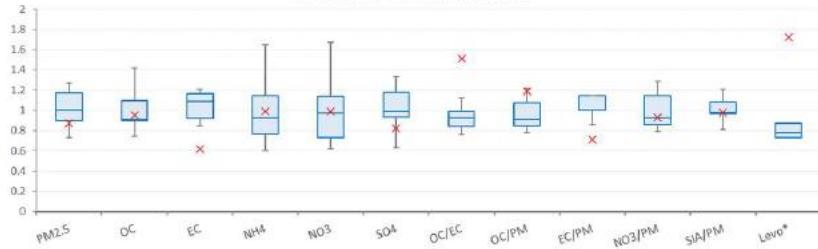
# COMPARISON BETWEEN CHEMICAL ANALYSIS 2013-2019 vs 2020, 10/3-18/5

WP 3

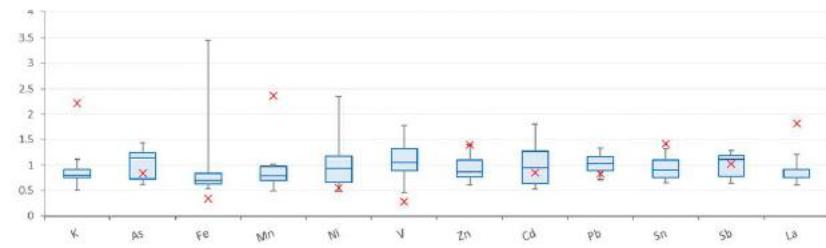
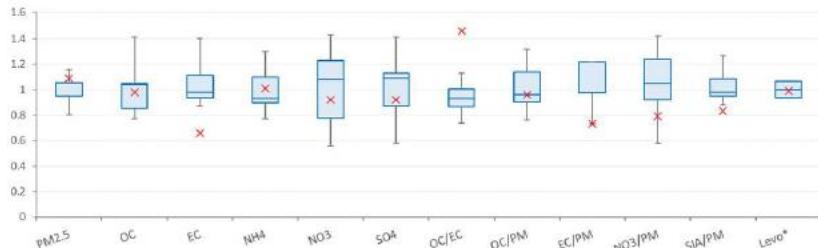
**Urban site - Parma**



**Urban site - Rimini**



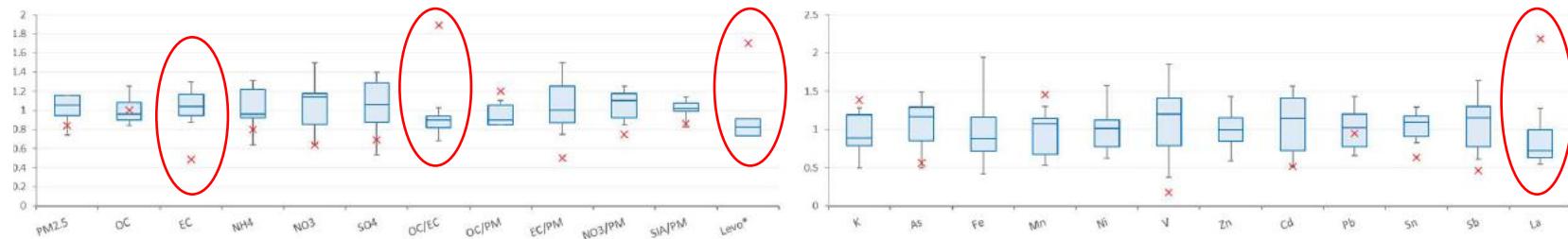
**Rural site - SPC (BO)**



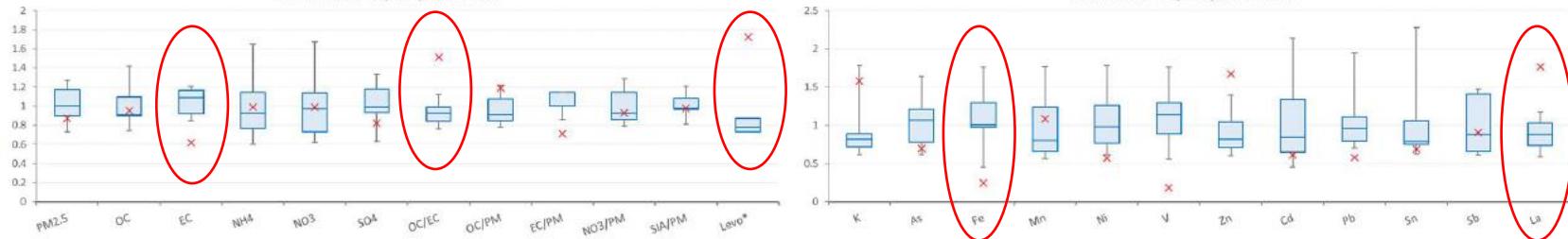
# COMPARISON BETWEEN CHEMICAL ANALYSIS 2013-2019 vs 2020, 10/3-18/5

WP 3

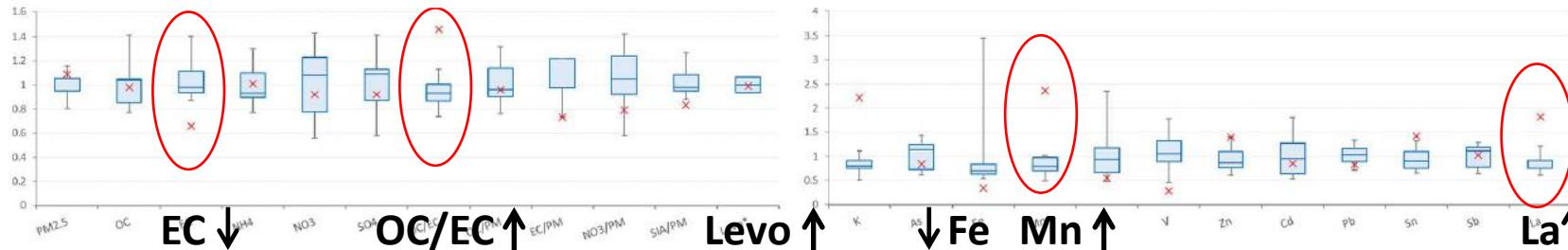
**Urban site - Parma**



**Urban site - Rimini**



**Rural site - SPC (BO)**





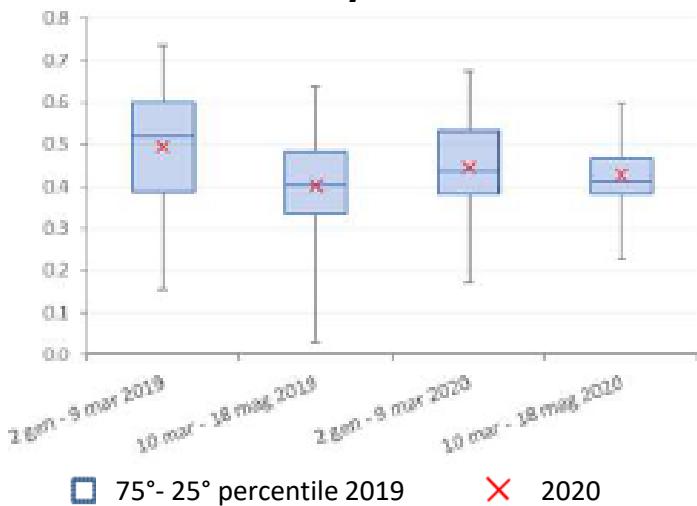
# COMPARISON before and after LOCKDOWN URBAN SITE BOLOGNA, 2019 vs 2020

WP 3

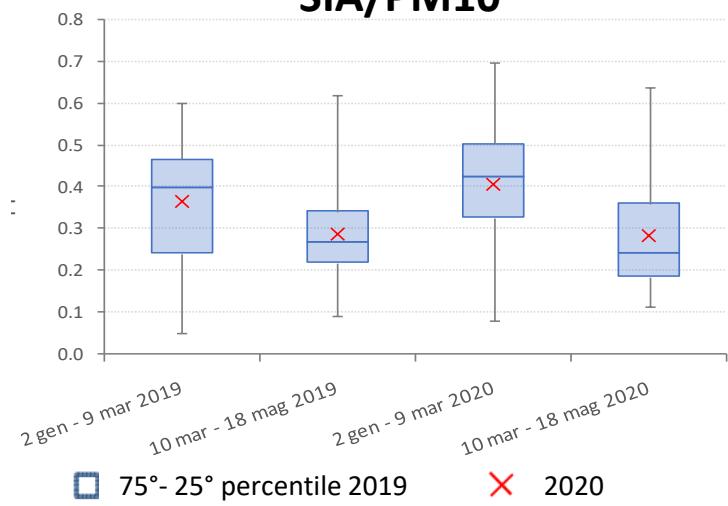
June 24<sup>th</sup>, 2021



## SIA/PM2.5



## SIA/PM10



Same analyses performed for all the different parameters in the available sites(EC/PMx, OC/PMx, OC/EC, levo/PMx, etc.)



# PRELIMINARY RESULTS: CHEMICAL COMPOSITION 2)

WP 3

*June 24<sup>th</sup>, 2021*

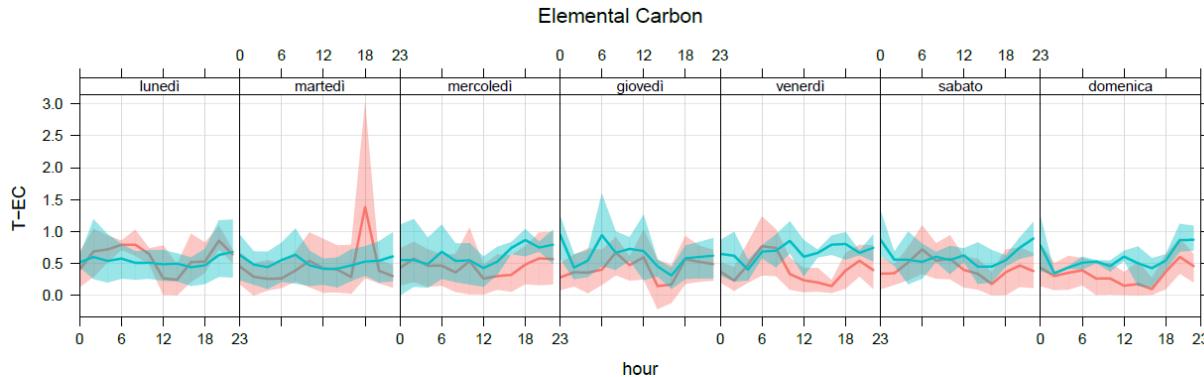


# COMPARISON WEEKLY and DIURNAL PATTERN (ENEA) EC - URBAN SITE BOLOGNA, 2020

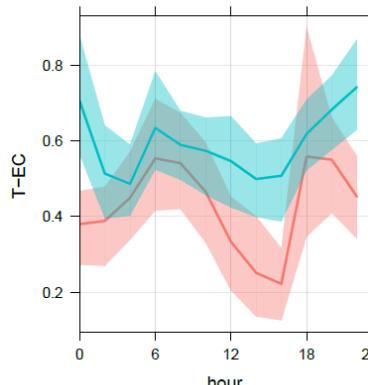
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June 24<sup>th</sup>, 2021

DPCM  
(Prime Minister Decrees)  
11 June 2020

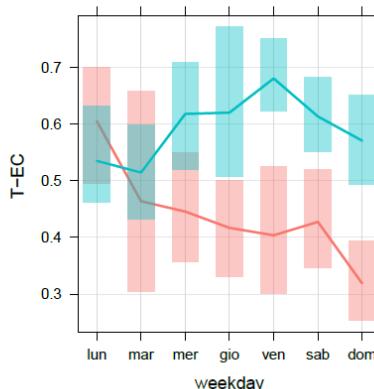
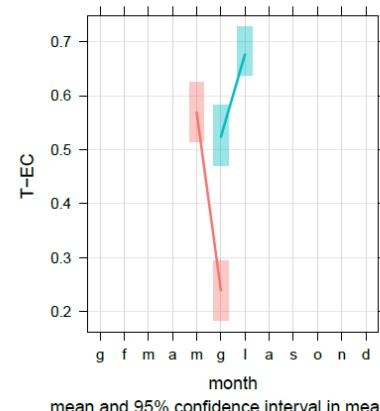


13 May – 10 June



before DPCM      after DPCM

11 June – 13 July





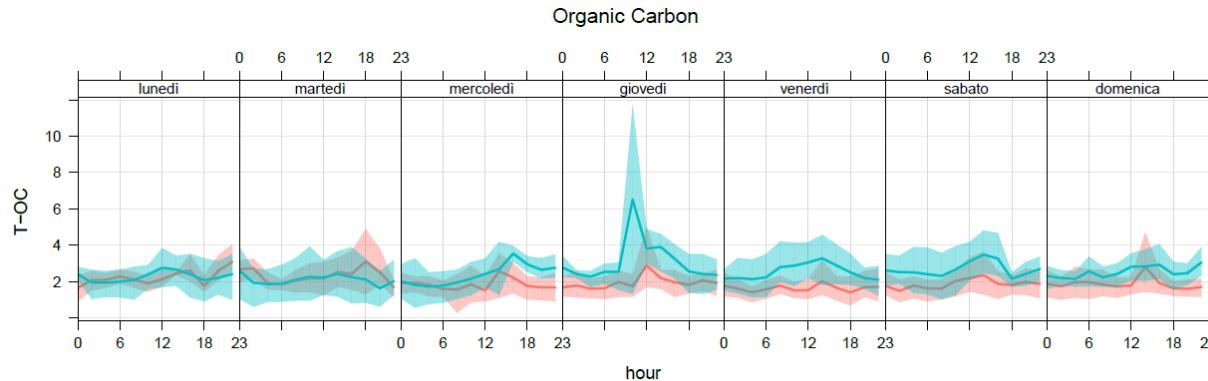
# COMPARISON WEEKLY and DIURNAL PATTERN (ENEA) OC - URBAN SITE BOLOGNA, 2020

WP 3

June 24<sup>th</sup>, 2021

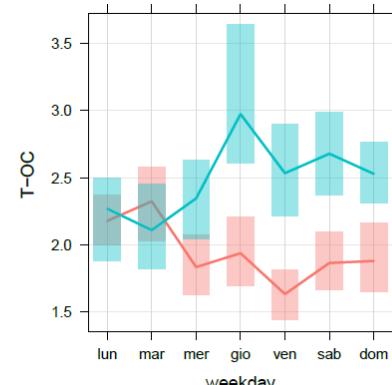
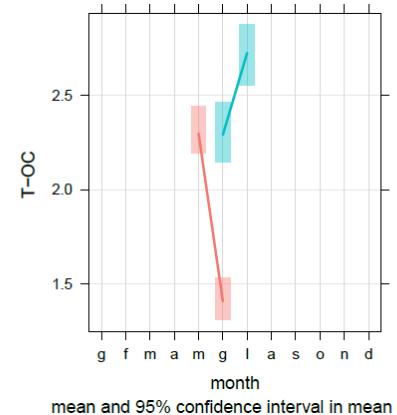
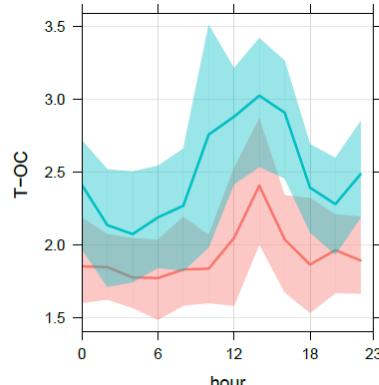
DPCM

11 June 2020



13 May – 10 June

before DPCM      after DPCM



11 June – 13 July



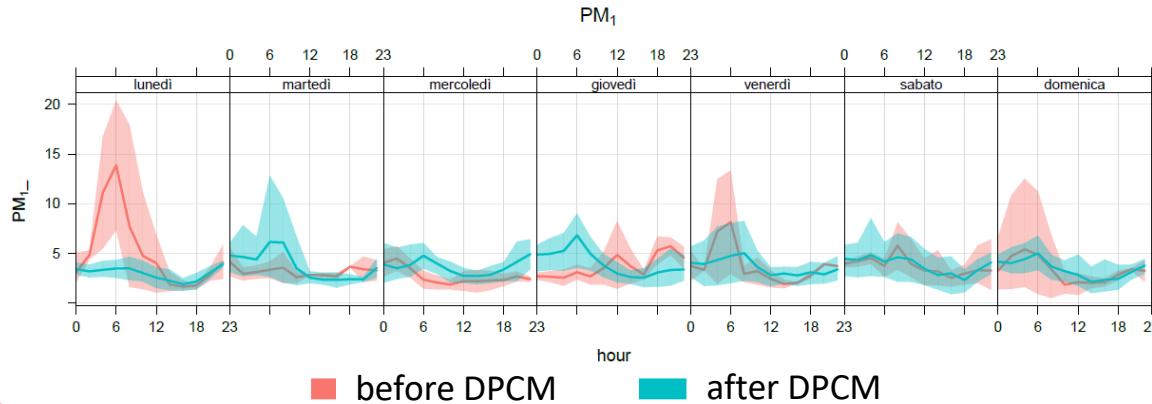
# COMPARISON WEEKLY and DIURNAL PATTERN (ENEA) PM1e - URBAN SITE BOLOGNA, 2020

WP 3

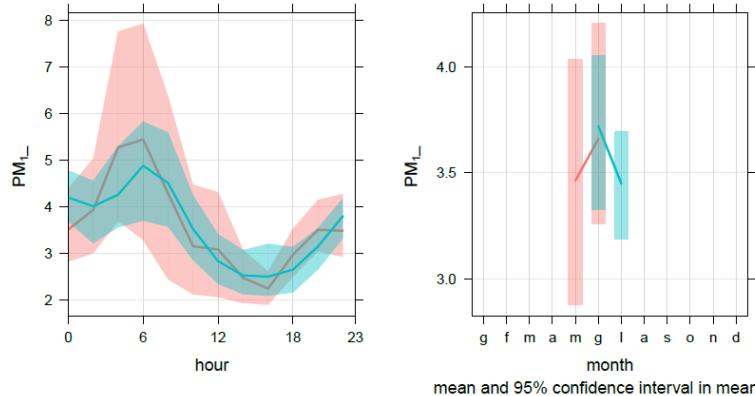
June 24<sup>th</sup>, 2021

DPCM

11 June 2020



25 May – 10 June



11 June – 13 July



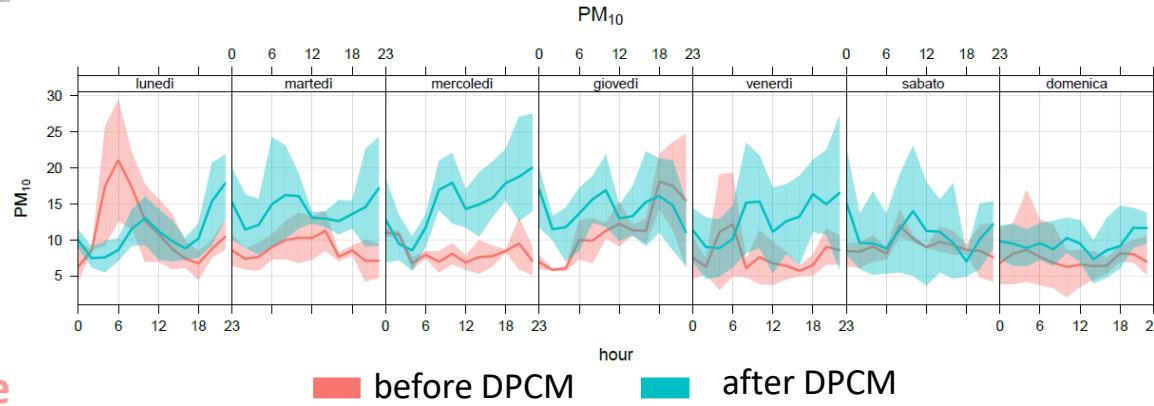
# COMPARISON WEEKLY and DIURNAL PATTERN (ENEA) PM10e - URBAN SITE BOLOGNA, 2020

WP 3

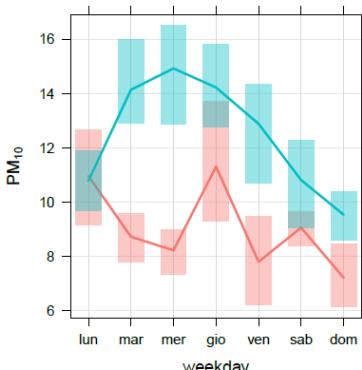
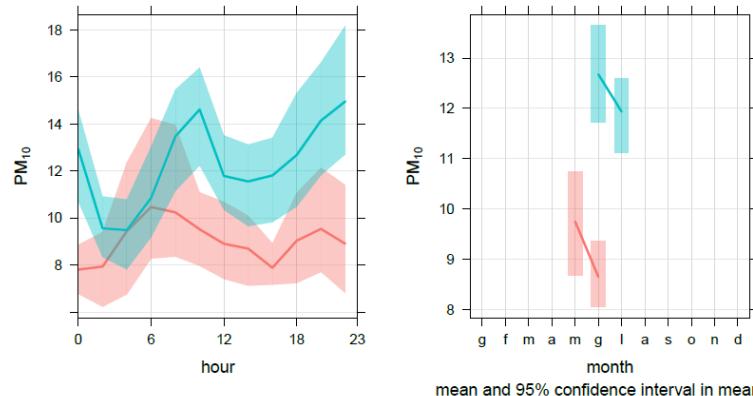
June 24<sup>th</sup>, 2021

DPCM

11 June 2020

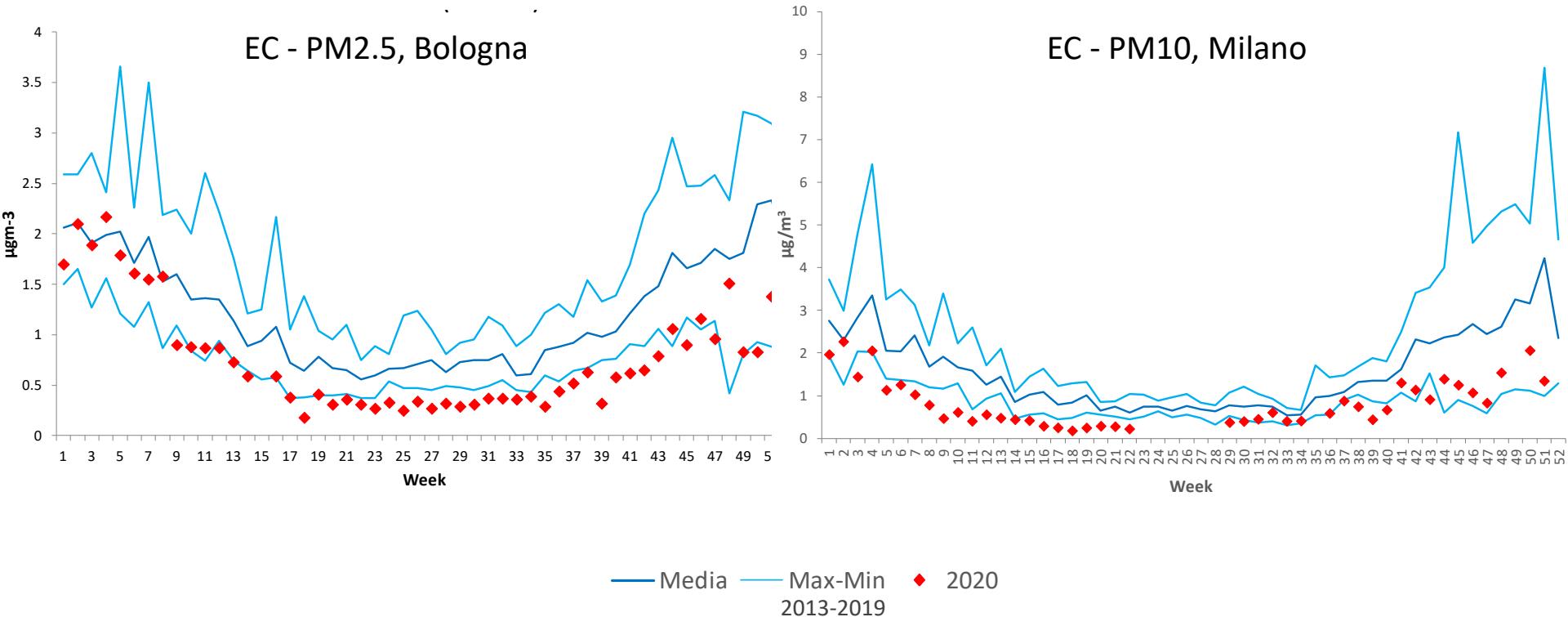


25 May – 10 June



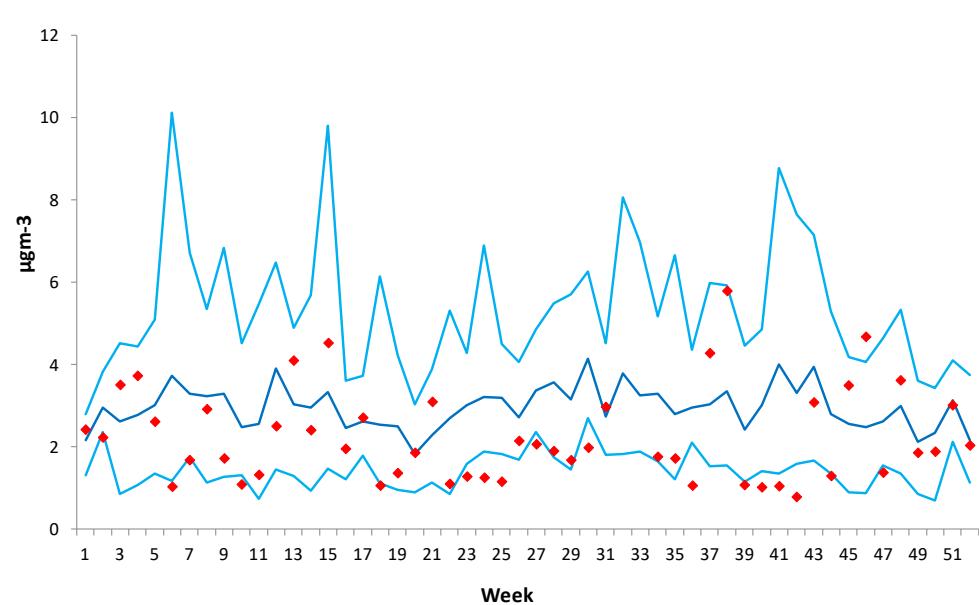
11 June – 13 July

Similar results for PMcoarse (PM2.5-10)

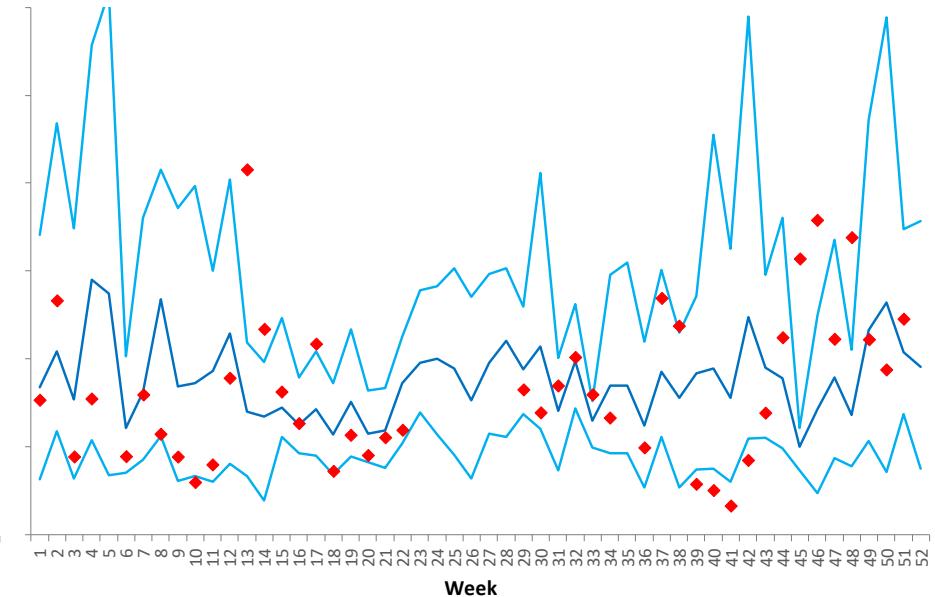




$(\text{NH}_4)_2\text{SO}_4$  - PM2.5, Bologna



$(\text{NH}_4)_2\text{SO}_4$  - PM10, Milano



— Media   — Max-Min   ♦ 2020  
2013-2019



# BOLOGNA - URBAN SITE (Wilcoxon-Mann Test)

WP 3

June 24<sup>th</sup>, 2021

( $\mu\text{g}/\text{m}^3$ )	2020	2013-2019	Diff.	%	
$\text{PM}_{2.5}^*$	18	21	-3	-14%	↓
$\text{EC}^*$	0.79	1.13	-0.34	-30%	↓
$\text{OC}$	4.43	4.2	0.23	5%	=
$\text{NO}_3^-*$	4.98	4.13	0.85	21%	↑
$\text{SO}_4^{--}*$	1.61	2.12	-0.51	-24%	↓
$\text{EC/PM}^*$	0.05	0.07	-0.02	-29%	↓
$\text{OC/PM}^*$	0.27	0.24	0.03	13%	↑
$\text{NO}_3^-/\text{PM}^*$	0.18	0.14	0.04	29%	↑
$\text{SO}_4^{--}/\text{PM}^*$	0.1	0.12	-0.02	-17%	↓
$\text{OC/EC}^*$	6.62	4.1	2.52	61%	↑
$\text{LEVO}$	0.23	0.21	0.02	10%	=
$\text{NH}_4^+$	2.73	2.21	0.52	24%	=
$K^+$	0.17	0.13	0.04	31%	=

\*p-value<0.05



# CHEMICAL COMPOSITION RURAL SITE SCHIVENOGLIA

WP 3

June 24<sup>th</sup>, 2021

Elements concentration in PM10 and PM2.5 in the year 2020  
(January-December) in a rural background site (Schivenoglia – MN)

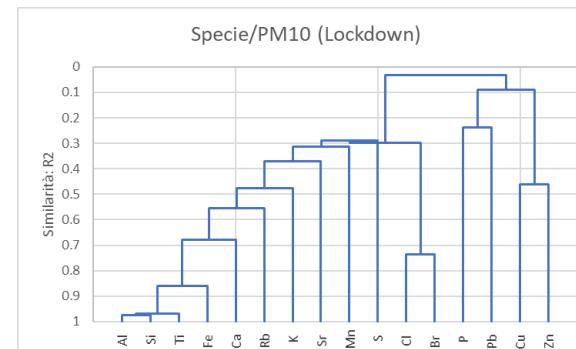
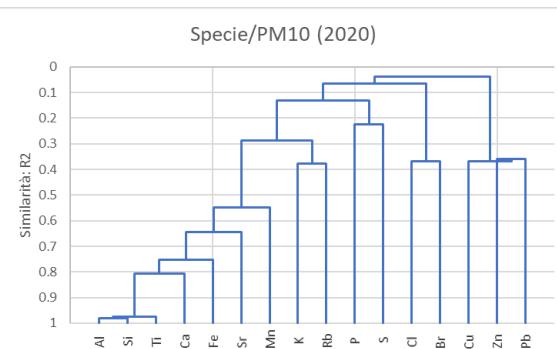
% dati > LdQ, PM10

Al	Si	P	S	Cl	K	Ca	Ti	V	Cr	Mn	Fe	Ni	Cu	Zn	Br	Rb	Pb	Sr
98	100	99	100	95	100	100	99	64	34	95	100	12	92	100	100	90	100	88

% dati > LdQ, PM2.5

Al	Si	P	S	Cl	K	Ca	Ti	V	Cr	Mn	Fe	Ni	Cu	Zn	Br	Rb	Pb	Sr
85	100	66	100	100	100	90	69	43	1	97	99	48	98	100	100	34	100	35

Cluster  
and  
PCA analysis





## PRELIMINARY RESULTS - PARTIAL SUMMARY

WP 3

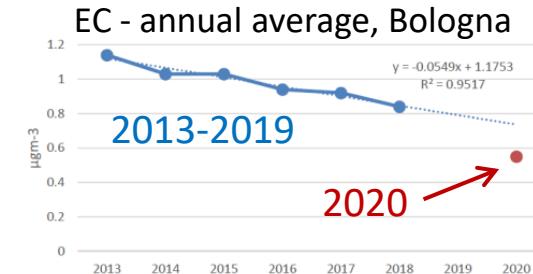
June 24<sup>th</sup>, 2021

### COMPARISON 2020 vs PREVIOUS YEARS

- EC → reduction of both PM10 and PM2.5 (each site)
- OC/EC → increase of both PM10 and PM2.5 (each site)
- Levoglucosan → increase of both PM10 and PM2.5 (no SPC)
- Rural site (SCH, 2020): XRF → no noticeable variations in both PM10 and PM2.5
- SIA → no noticeable variations both PM10 and PM2.5 (each site)
- SO<sub>4</sub> → reduction on PM2.5 (Bologna, Parma, Rimini, SPC)

### COMPARISON before&after 11 June 2020

- EC&OC → increase after 11 June (reduction of national restrictive measures)
- PM10&PM10-2.5 → increase after 11 June ("")
- PM1 → no noticeable variations ("")





## TO DO

WP 3

June 24<sup>th</sup>, 2021

In progress • Trend analysis of the species concentration and analysis of the meteorological components

- Weekly and daily analysis (BC and PNC)
- Source apportionment

In order

- To understand different effects of the anti-Covid measures on PM composition (e.g. Traffic vs Biomass Burning on EC) and the differences among cities
- To verify variation on SIA component concentration
- *To differentiate the effect on traffic due to smart working and entertainment activities limitations (restaurants, theaters, gyms, ...)*