Meteorological characteristics associated to air pollution in Bucharest Greater Area, Romania

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Navigation

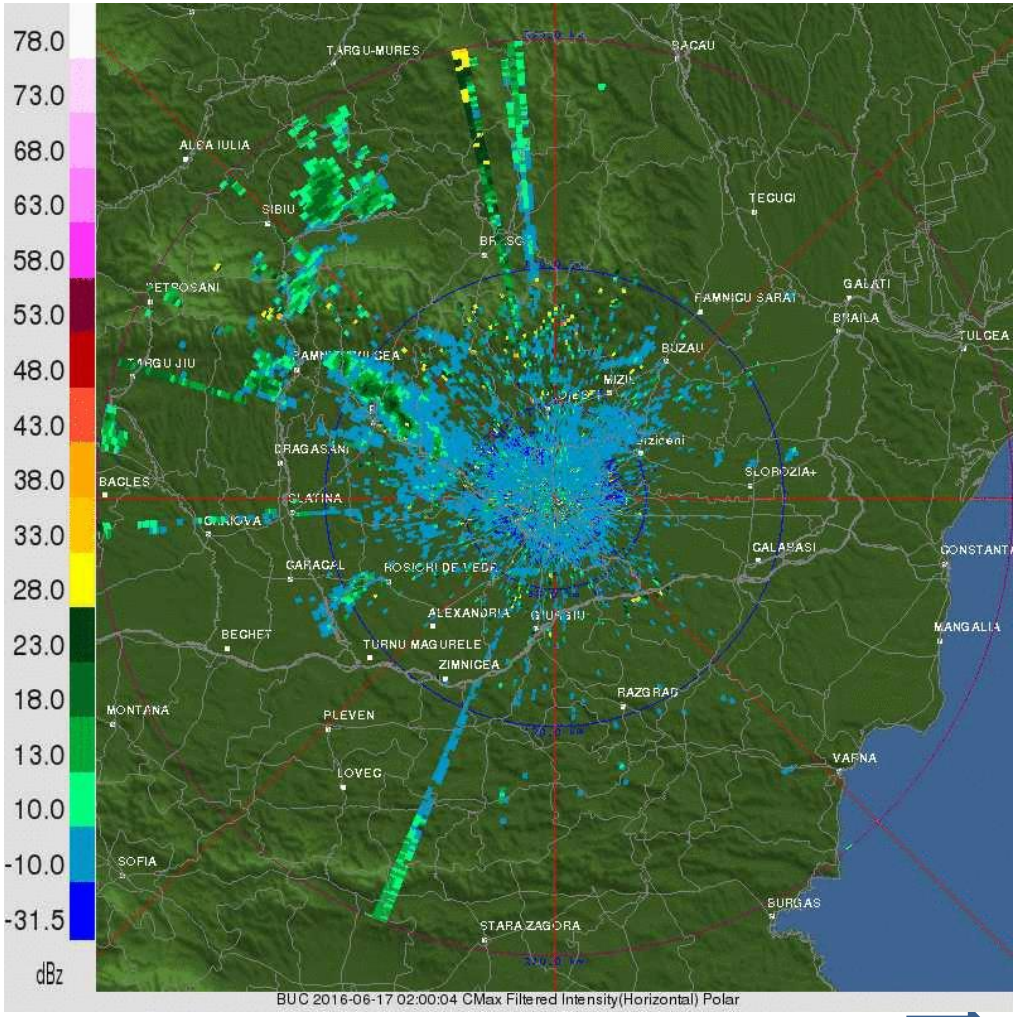
- The orange arrow (horizontal) takes you to the next slide
- The orange arrow (vertical) takes you to the section menu

Introduction

Observation: lowest PM_{10} and $PM_{2.5}$ in 2016 were correlated with intense precipitation events

Example: Bucharest and Prahova Region, 17-20.06.2016

Percentile	$PM_{2.5}$ ($\mu g\ m^{-3}$)	PM_{10} ($\mu g\ m^{-3}$)
Minimum	9.09	10.9
P25	12.54	22.17
P50 (Median)	15.81	27.44
P75	20.72	33.26
Maximum	47.78	75.95



(Chiritescu, Hriscan et al., Geophys. Res. Abs. 21, 2019)

Introduction

Bucharest Greater Area

(44° 26'N, 26° 06'E)

Located in open plain; surface of about 285 km^2; altitudes: 56 m a.s.l. (SE) to 92 m a.s.l. (W); relatively round shape.

Main Pollution Sources

- Industrial –> **electro-thermal power stations (CETs)**
- Traffic – mixed vehicle fleet (non-EURO ÷EURO6)
- Construction sites
- Residential heating sources
- Various points/areas where domestic waste is collected and stored
- Plenty of agricultural activities in the peri-urban area

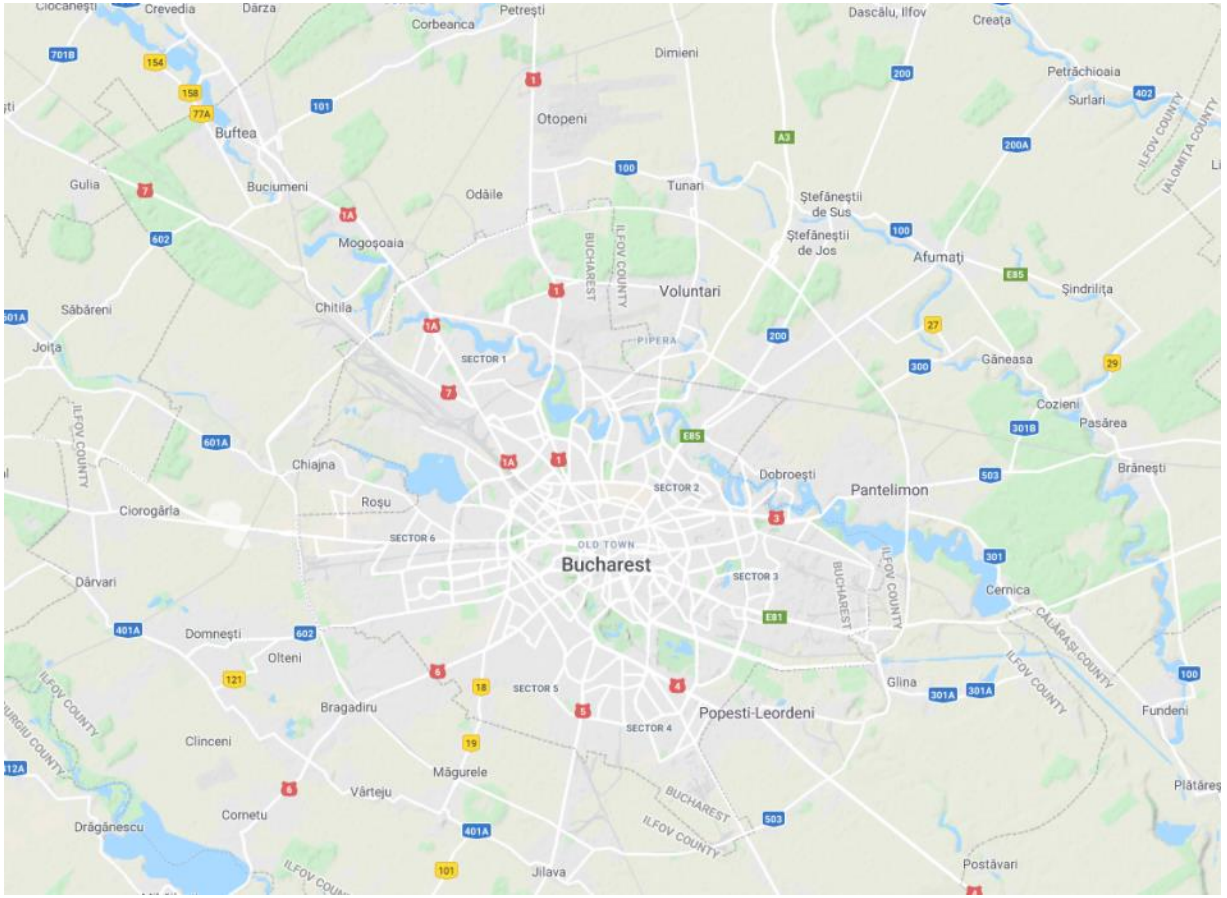


Fig. 1 Map created using www.google.com/maps

Low ventilation coefficient

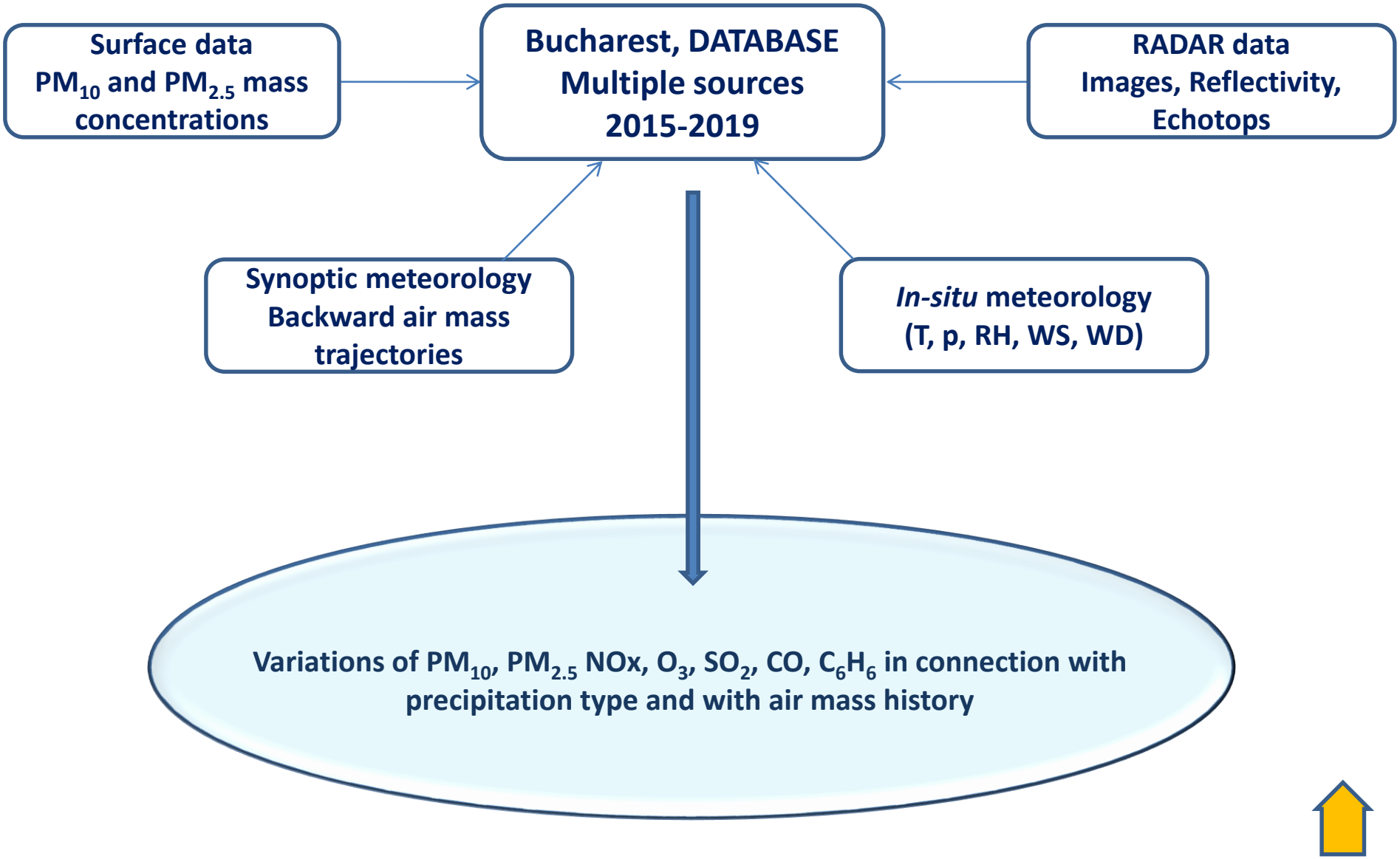
(Manolache et al., 2019)

Objective

This study examines how the concentrations of particulate matter with an aerodynamic diameter below 10 µm (PM_{10}) and below 2.5 µm ($PM_{2.5}$) and main gaseous pollutants (NOx, O_3, SO_2, CO, C_6H_6) might be linked with precipitation characteristics using an observational data set for three years (2015-2019) in Bucharest metropolitan area:

- Estimation of the scavenging coefficient Λ of particulate matter
- Link of Λ with rainfall category during the annual convective periods.
- Possible link between reduced air pollution and meteorological phenomena and the air mass history.

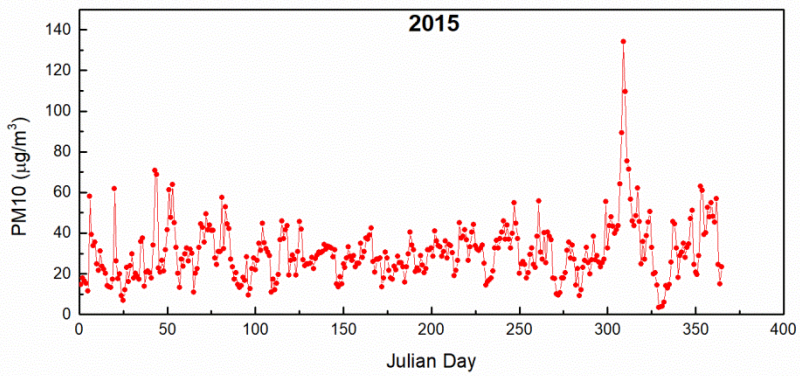
Data and methods

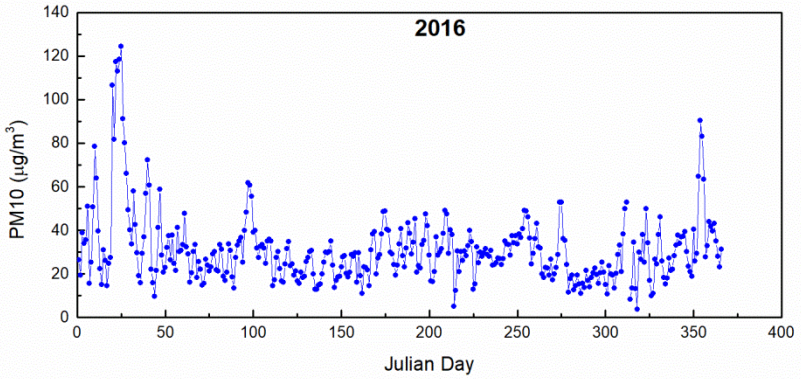


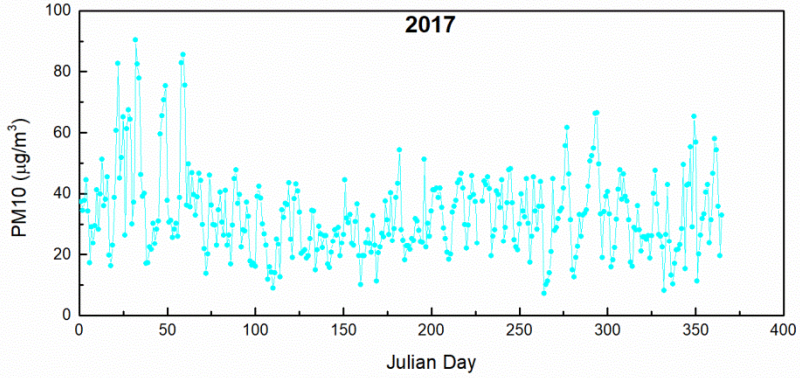
Results

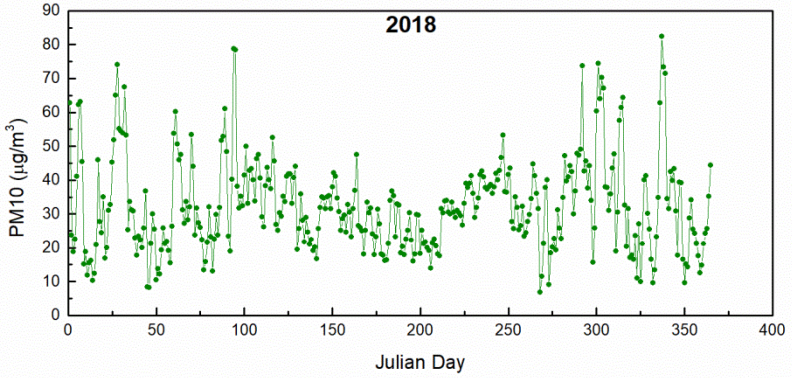
Daily mean PM_{10} and $PM_{2.5}$ mass concentrations over Bucharest; 2015-2019

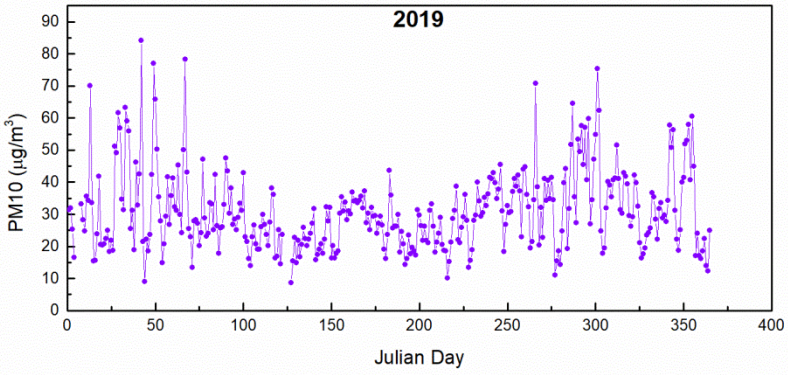
Urban area











PM2.5/PM10:

2016: 0.77 (R^2=0.73),

2017: 0.63 (R^2=0.55),

2018: 0.79 (R^2=0.79)

2019: 0.88 (R^2=0.94)

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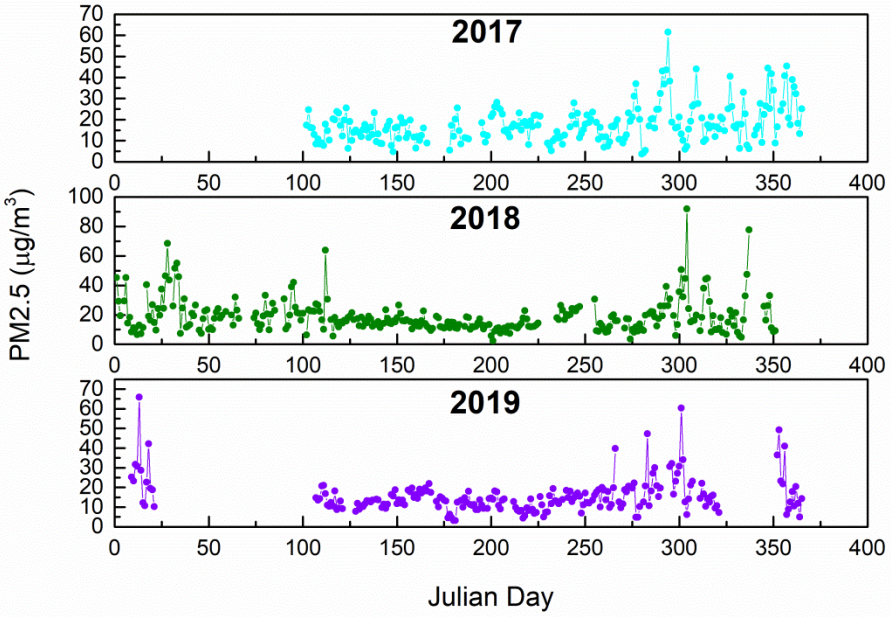
Daily mean PM_{10} and $PM_{2.5}$ mass concentrations over Bucharest; 2015-2019

Suburban area



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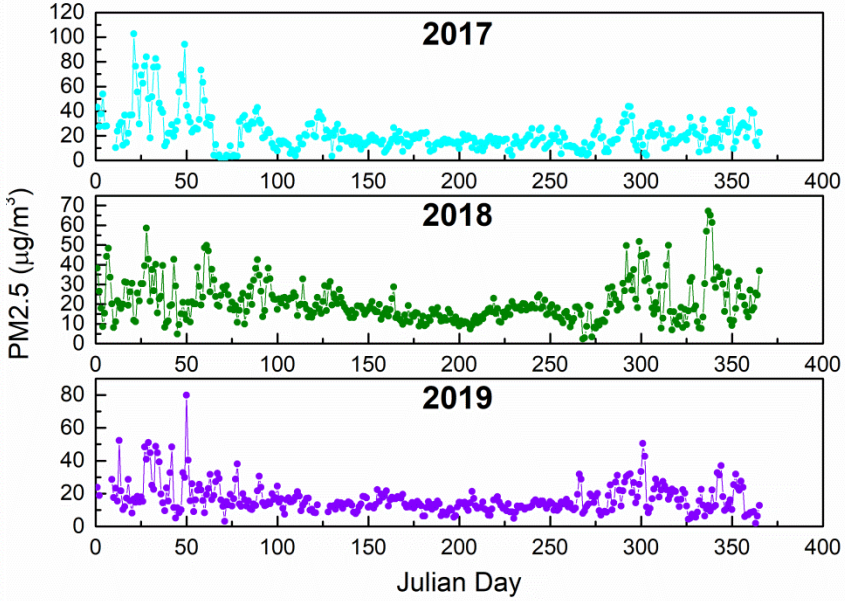

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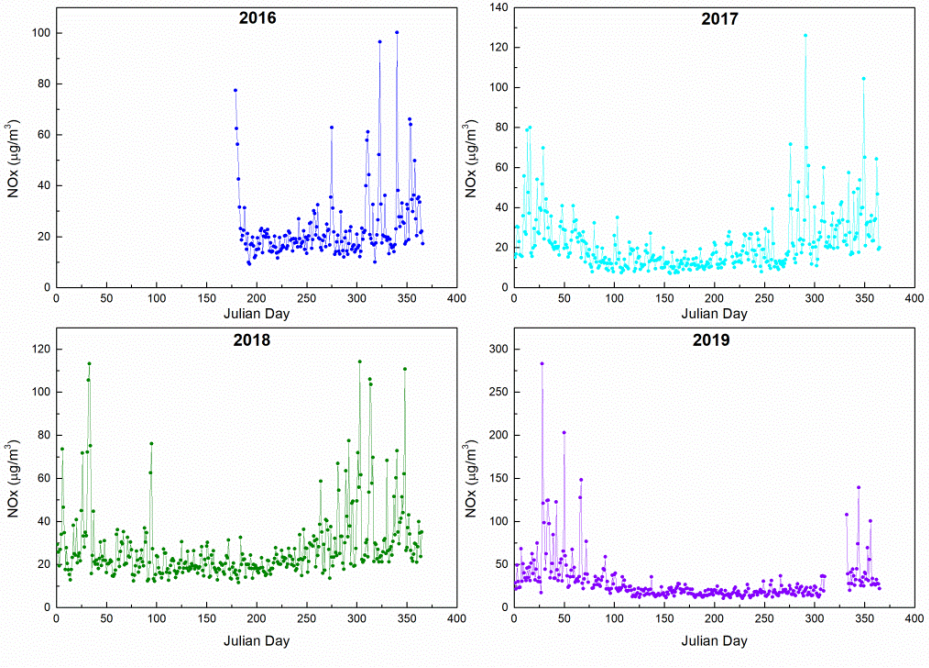
Daily mean NOx mass concentrations over Bucharest; 2015-2019



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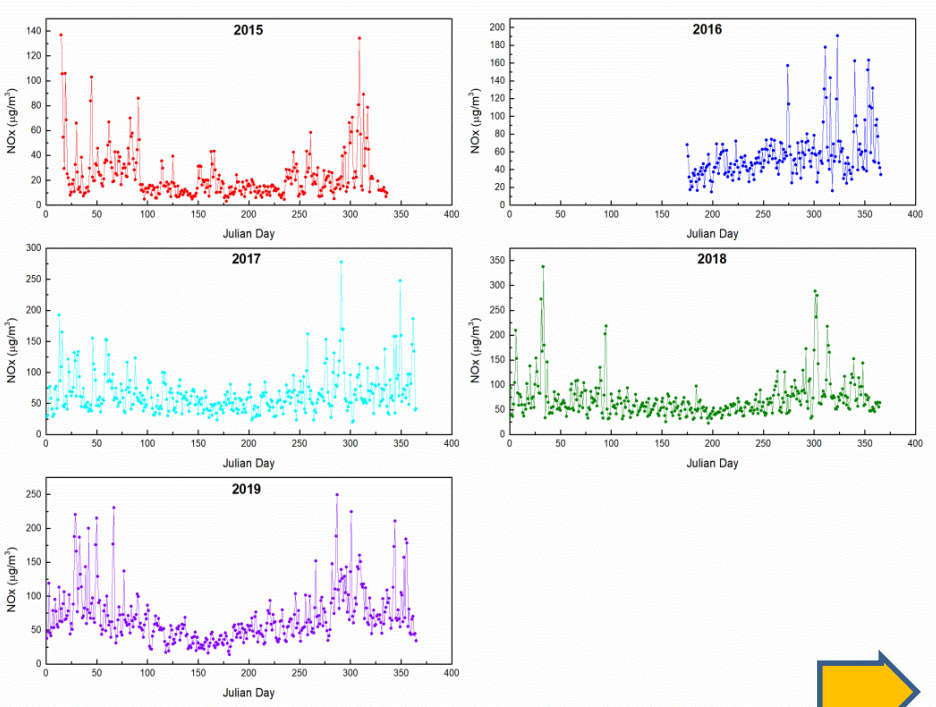
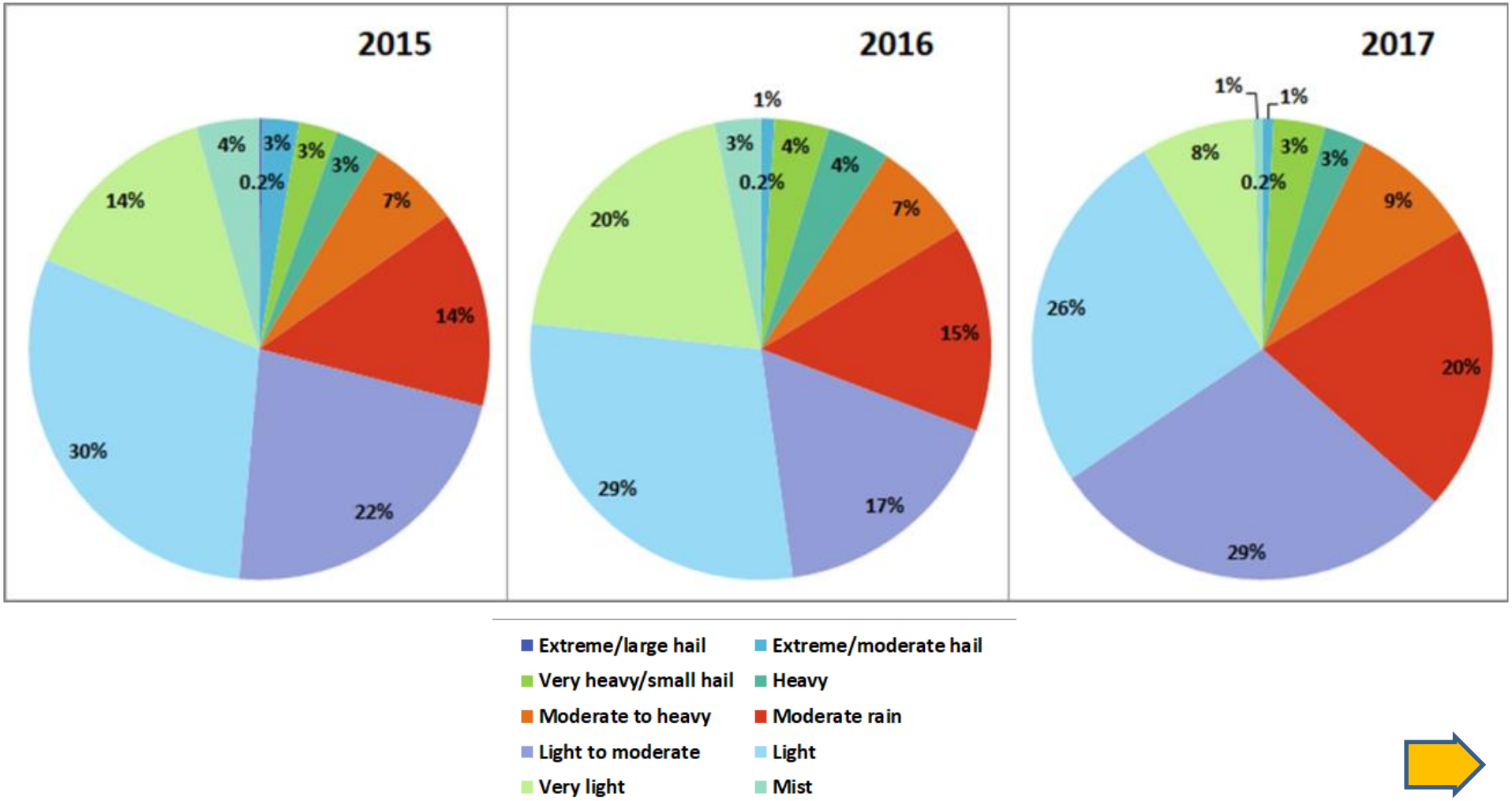


Urban area

Results

Precipitations by type during convective seasons 2015-2019

RADAR Z-R relationship: $Z = a R^b$ RADAR reflectivity Z (dBZ), Rain Rate (mm h^{-1}), Stull (2000) classification



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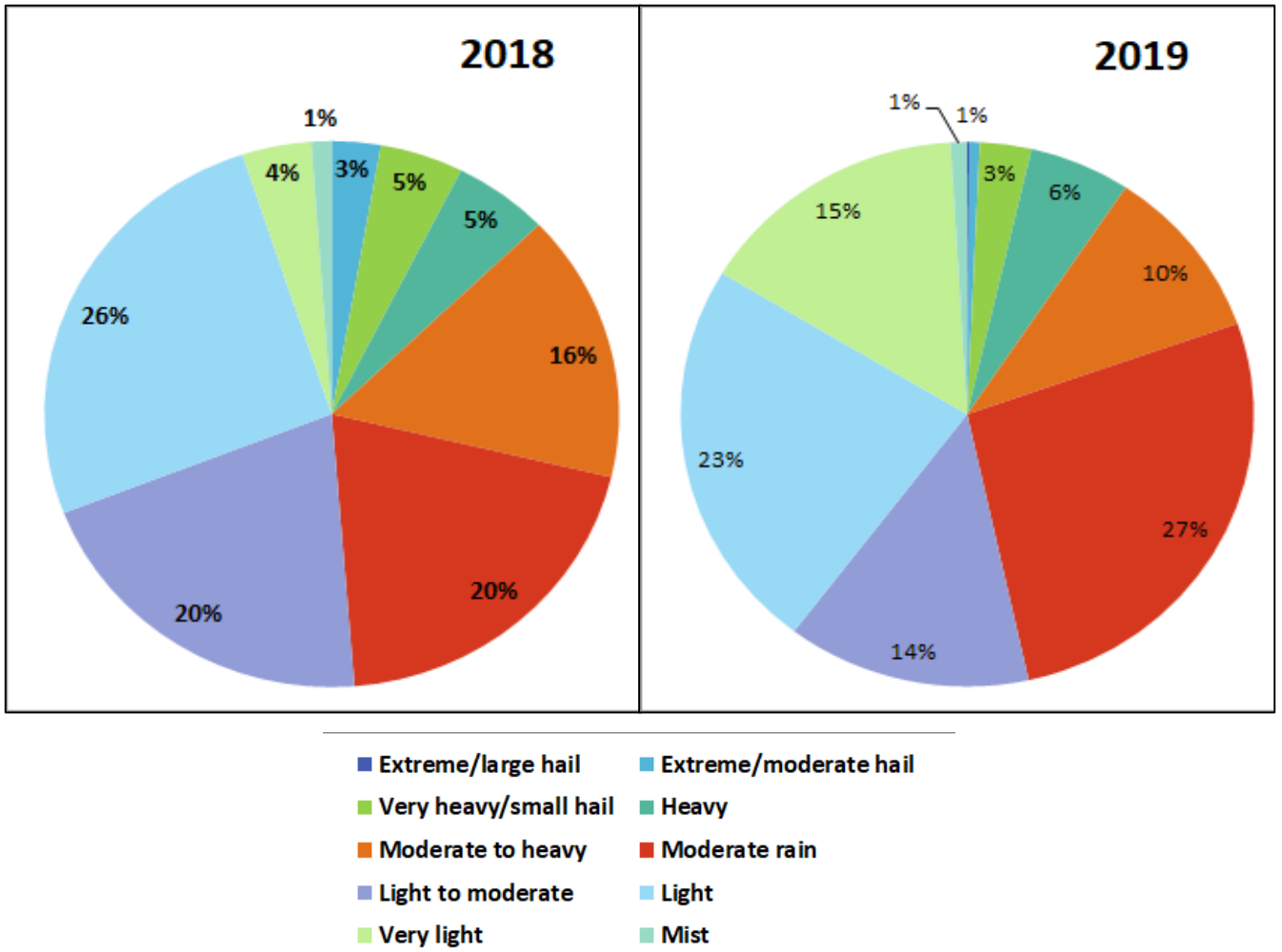


Results

Scavenging Coefficient: determination and comparisons

Scavenging coefficient Λ:

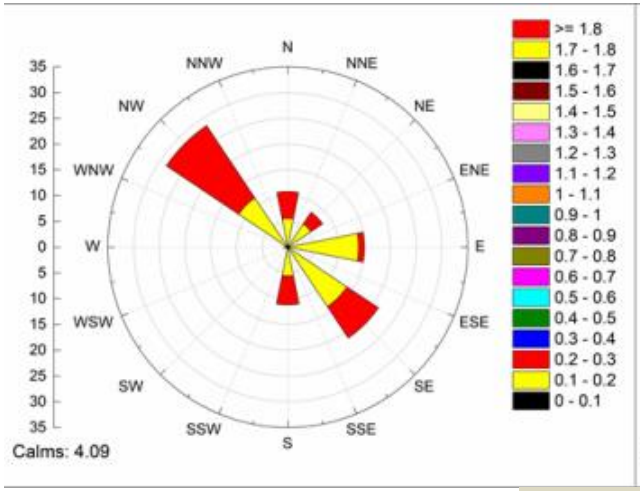
$$\frac{dC}{dt} = -\Lambda C$$

C= particulate matter concentration (µg m^{-3}); t=time (h^{-1})

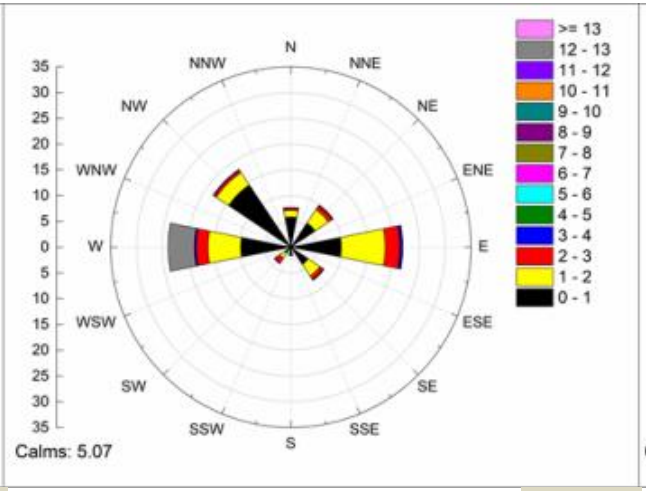
Λ (h^{-1})	Reference	Observations
3.36 x 10^{-5}	Webster and Thomson (2014)	in-cloud
8.4 x 10^{-5}	Webster and Thomson (2014	below cloud
2.3 x 10^{-6} – 8.4 x 10^{-5}	Zikova and Zdimal (2016)	10-800 nm
1.1 x 10^{-5} – 7.6 x 10^{-4}	Chate and Pranesha (2004)	13-750 nm
5.9 x 10^{-6} –1.4 x 10^{-5}	Maria and Russell (2005)	10-20000 nm
6.2 x 10^{-5} – 3.0 x 10^{-4}	Depuydt et al. (2013)	250-32000 nm
3.29 x 10^{-3} – 4.71 x 10^{-3}	Hriscan et al. (2019)	long, intense (7-8 consecutive days)
	Examples from this study, focus on long (>24 h^{-1}) precipitations	
8.50 x 10^{-4}	intense / heavy (30 h, July 2017)	
3.19 x 10^{-3}	light / moderate (26 h, May 2017)	

Results

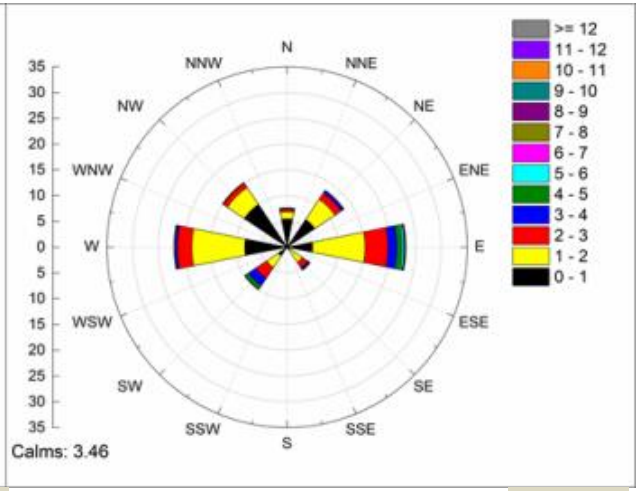
Connections to meteorological phenomena occurrence and air mass history



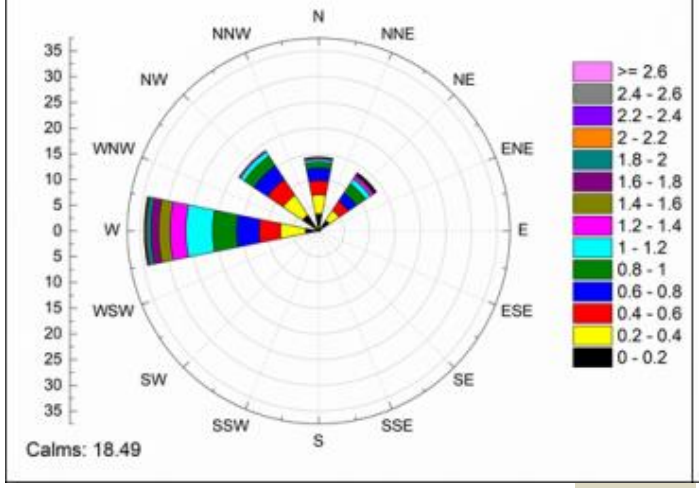
2015



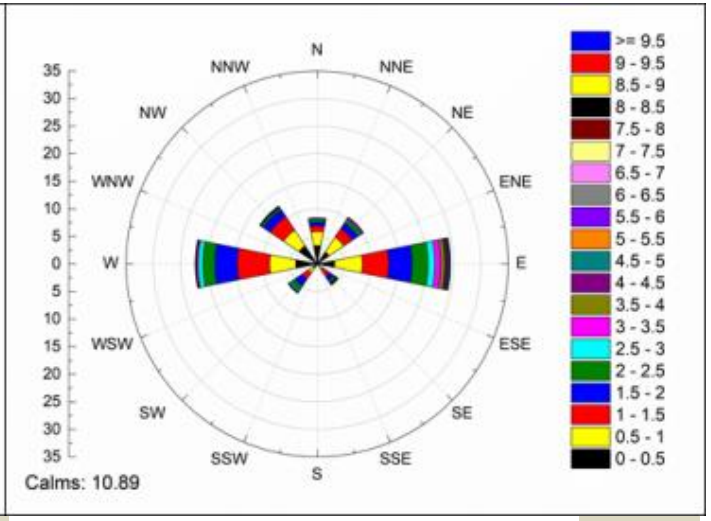
2016



2017



2018



2019

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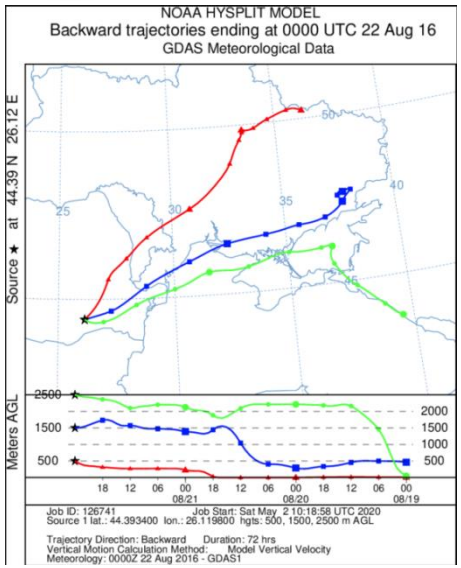

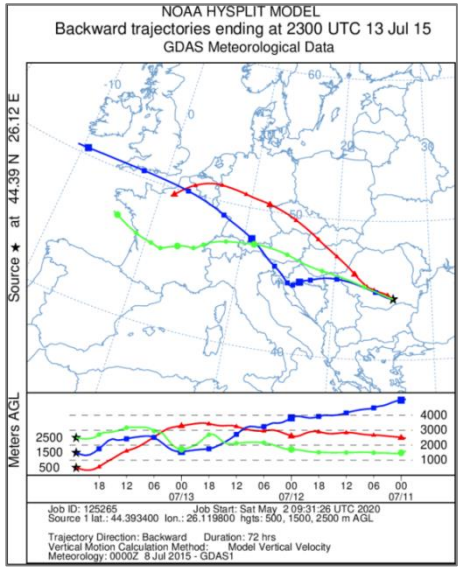

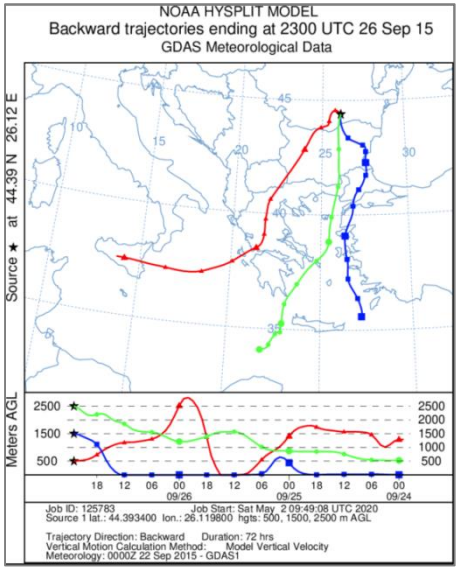

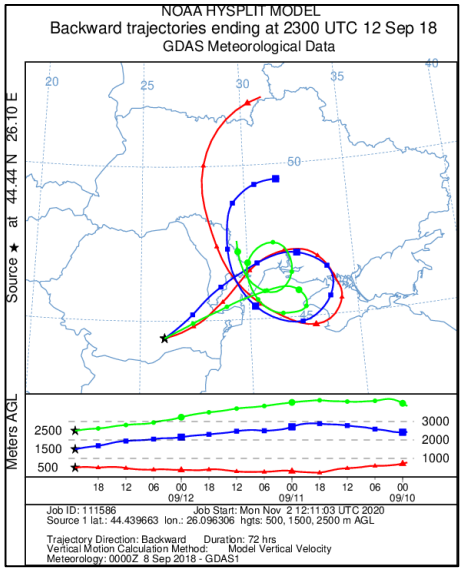

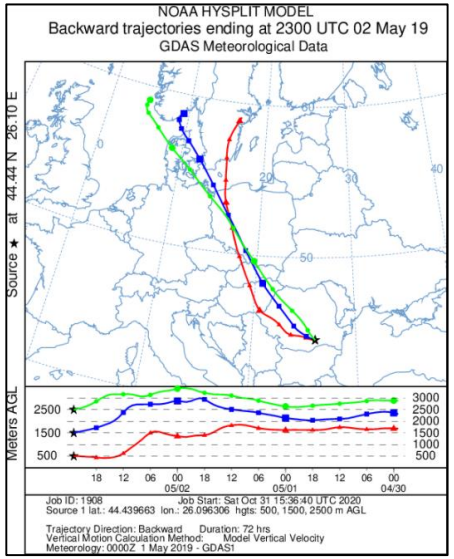

Examples of typical air mass back trajectories

Conclusions

- We observed PM_{10} levels exceeded frequently the daily limit value of 50 µg m^{-3} imposed by the EU legislation; even peaks of about 2.5 times higher were observed. Both PM_{10} and $PM_{2.5}$ presented higher values during the wintertime and generally higher values in 2015, 2016, 2017 and 2019 than in 2017. A large fraction of fine particles is present in PM.

- The annual mean mass concentrations of gaseous pollutants showed variations as follows: NOx values are two times higher in the urban versus suburban area, while O_3 C_6H_6 , and SO_2 values have the same level during 2015-2019.

- Type of precipitation has a strong influence on the atmospheric aerosol concentrations: intense and heavy precipitation determined an increased value of scavenging coefficient with up to one order of magnitude higher than in case of a moderate precipitation.

- Assessment of mean scavenging coefficient for Bucharest Greater area has been performed for the first time.

- Present results show a good capability of the convective precipitating systems to clear the atmosphere from aerosol over Bucharest Greater Area.

Acknowledgements

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Thank you!