Winter air quality in an urban area with high coal consumption in domestic devices

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1 INTRODUCTION

Air pollution is the 4th leading risk factor for mortality worldwide (HEI, 2020). Particulate matter (PM), classified as carcinogenic for humans (Group 1) (Loomis et al. 2013), is the leading environmental contributor to the global burden of disease contributing (European Environment Agency, 2019). Despite the improvements on outdoor air quality in Europe, PM levels can be heightened under episodic events provoked, for example, by seasonal emission sources under stagnant weather conditions. In this study, a winter monitoring campaign was carried out at the city center of León (Spain) in order to evaluate the PM_{10} concentrations, chemical composition and toxicity.
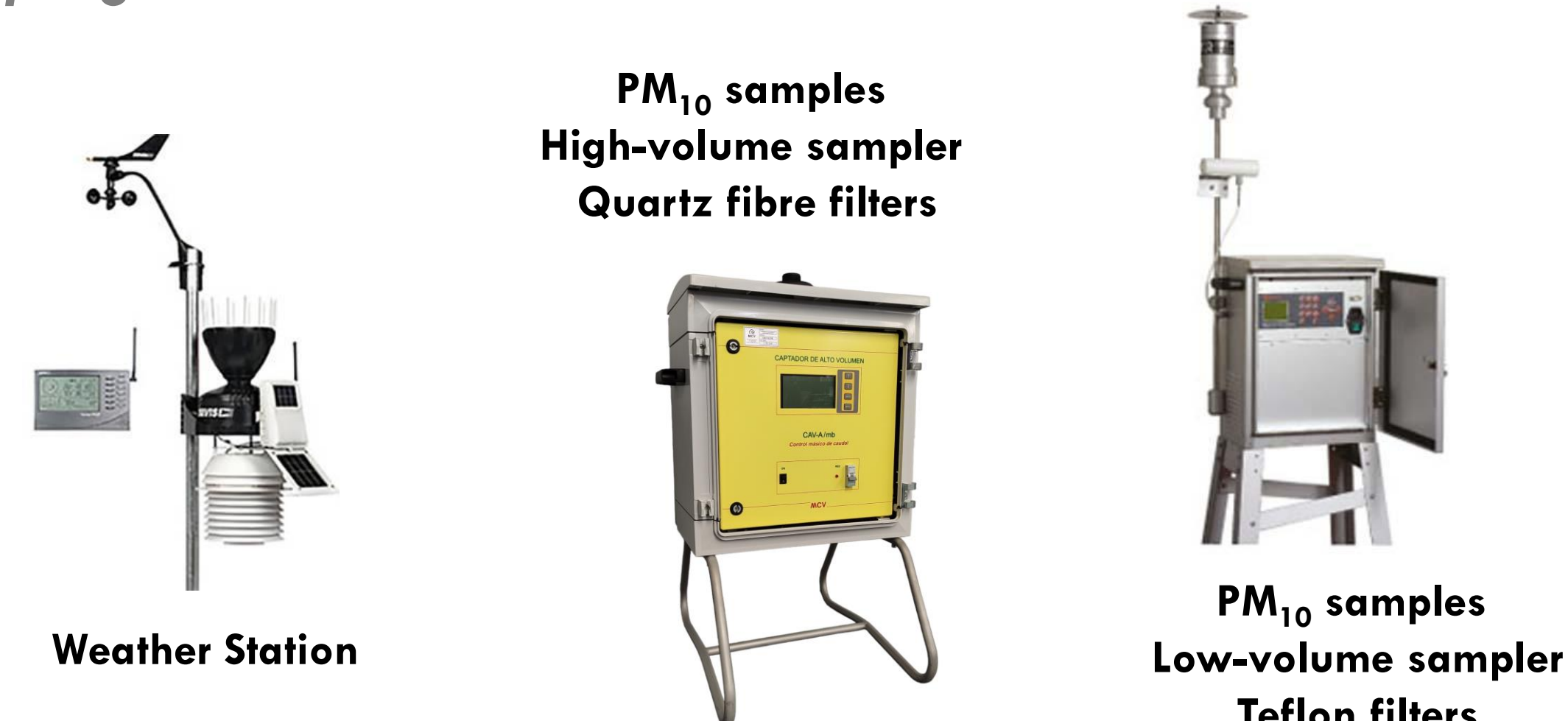
2 METHODS

Sample Collection

Location and Collection Period
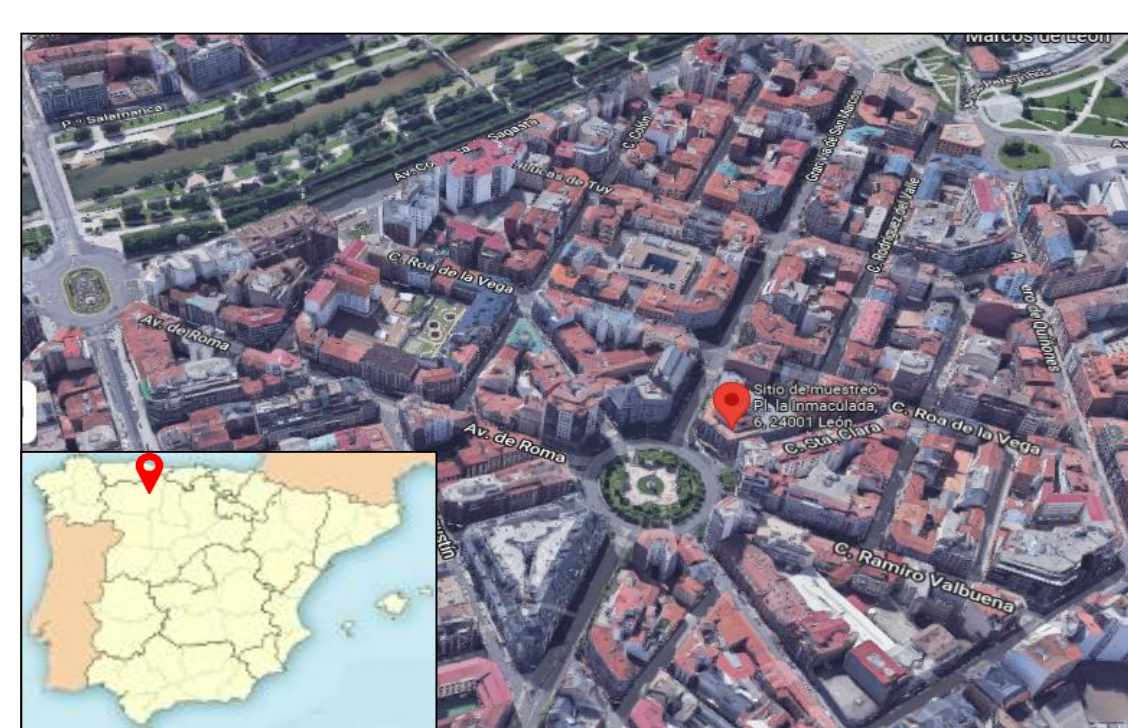
**Plaza la Inmaculada, León
(rooftop of an official building)
From 17th to 24th January 2022**

Sampling Instruments

Weather Station

PM_{10} samples
High-volume sampler
Quartz fibre filters

PM_{10} samples
Low-volume sampler
Teflon filters

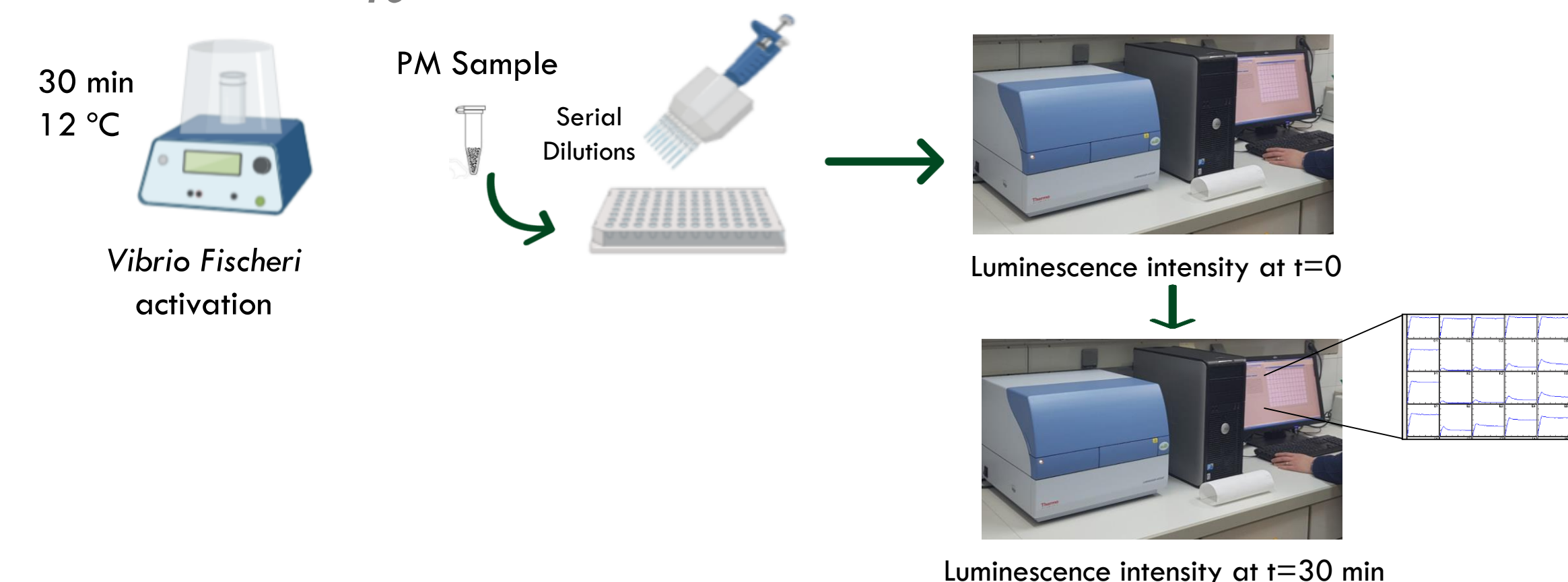PM_{10} sampling – 23h30 every day starting at 1100 and ending at 1030 UTC

PM_{10} Analysis

Chemical characterisation of PM

Organic and Elemental Carbon
Thermal-optical analysis

Elements
PIXE

Water-soluble inorganic ions
Ion chromatography

Toxicity of PM_{10} - Vibrio Fischeri bioluminescence inhibition assay

30 min
12 °C

Vibrio Fischeri activation

PM Sample
Serial Dilutions

Luminescence intensity at t=0
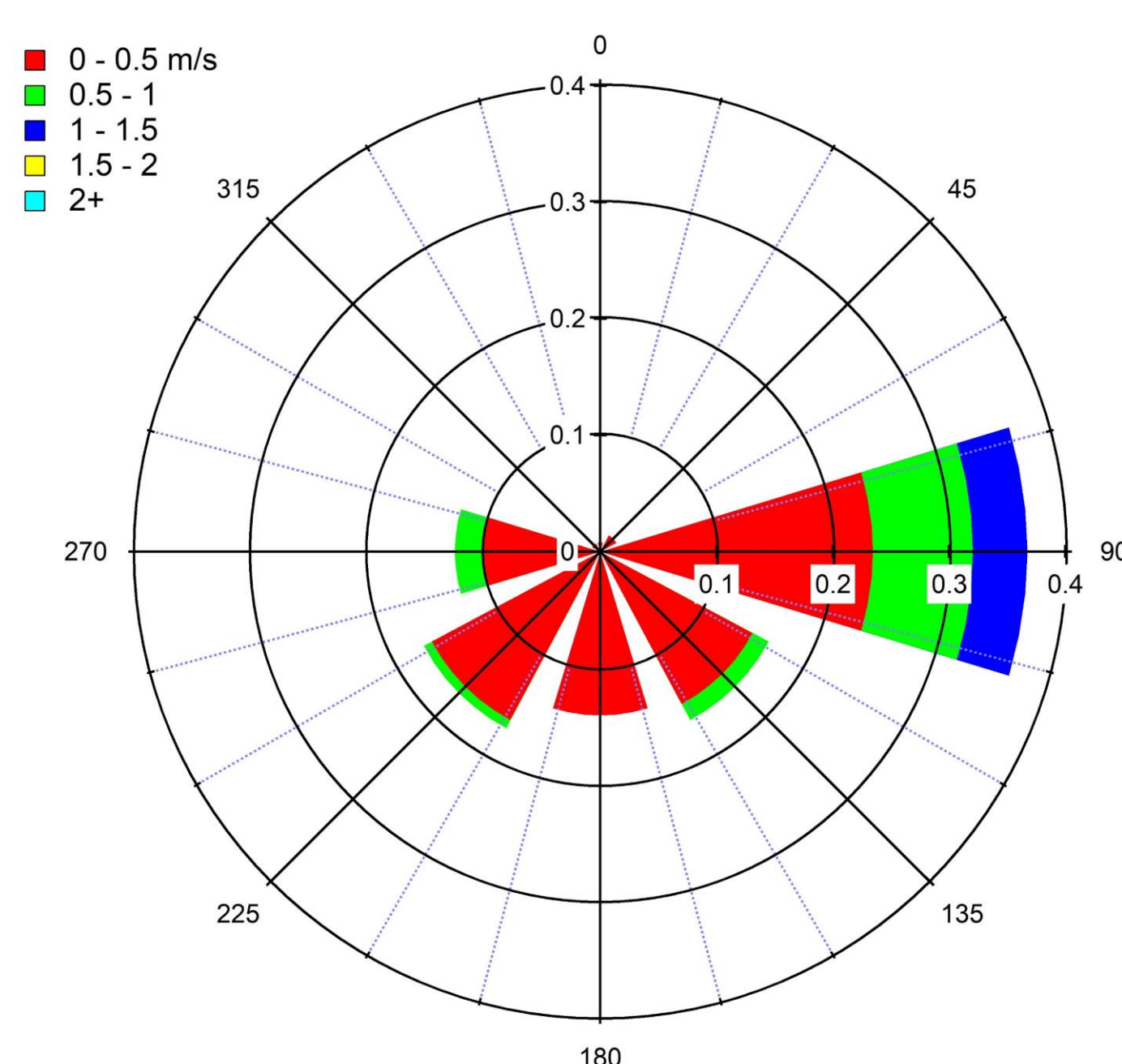
Luminescence intensity at t=30 min

3 RESULTS

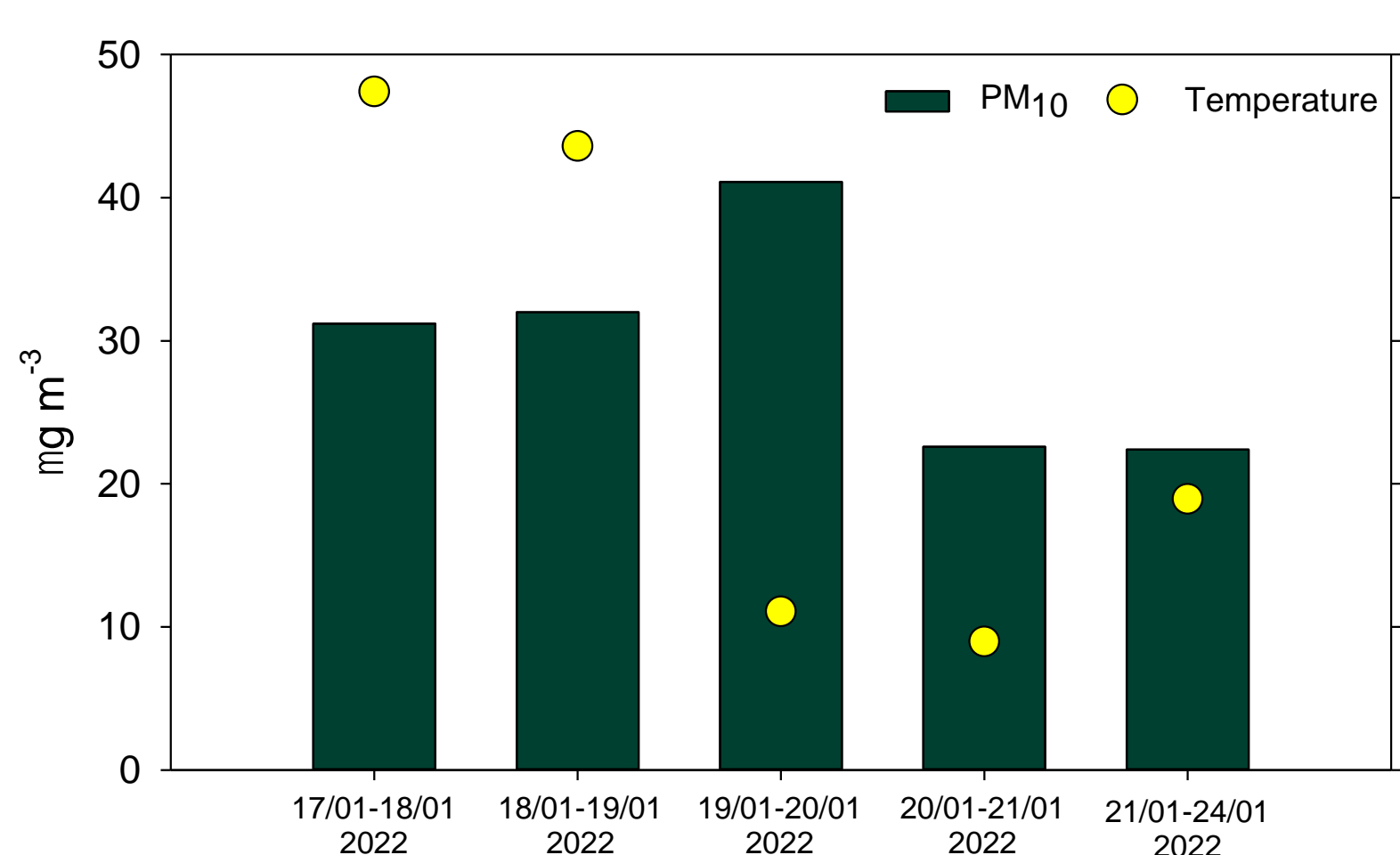Figure 1. Wind rose for the studied period.

Figure 2. Average daily PM_{10} concentrations and temperature during the studied period
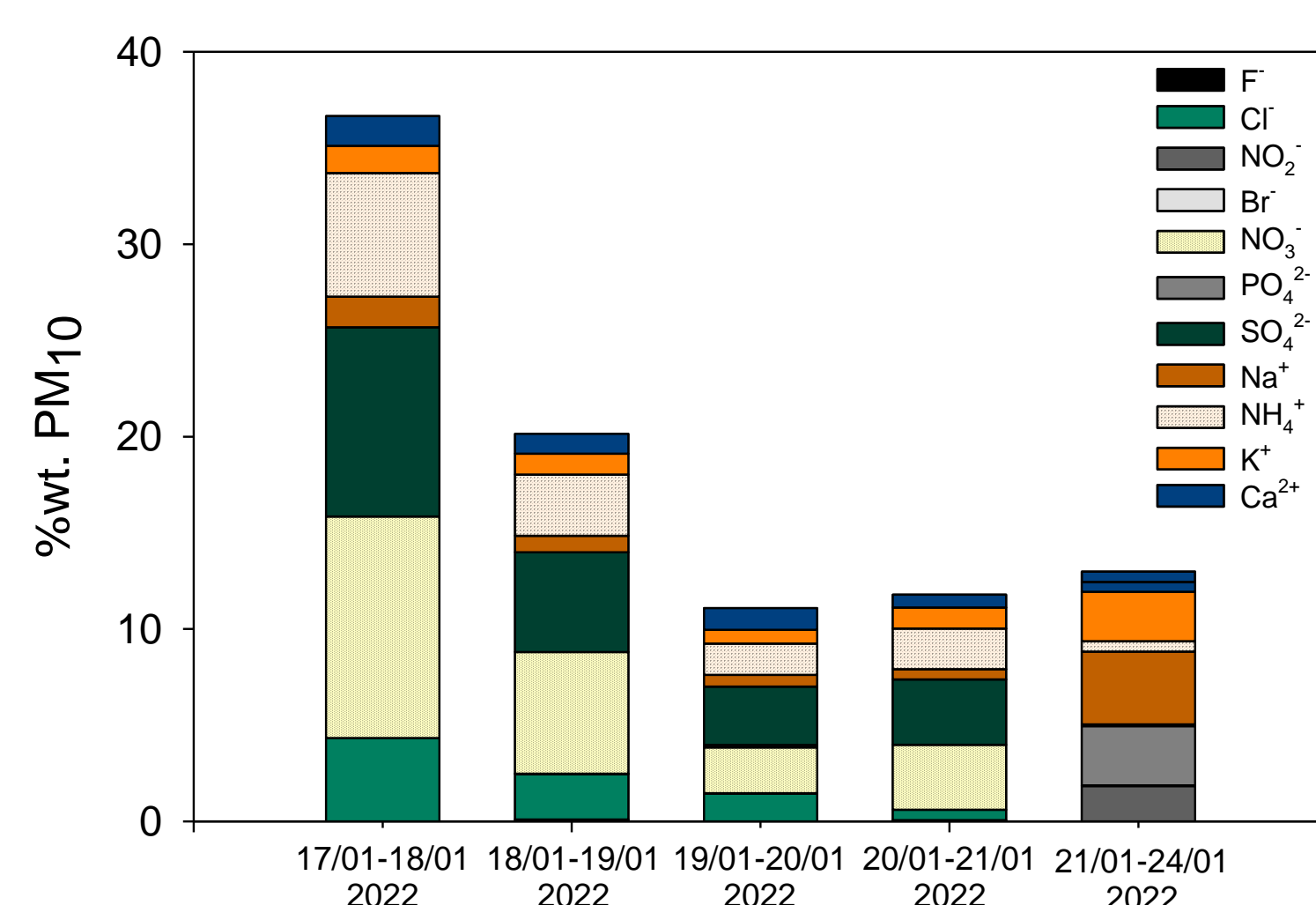

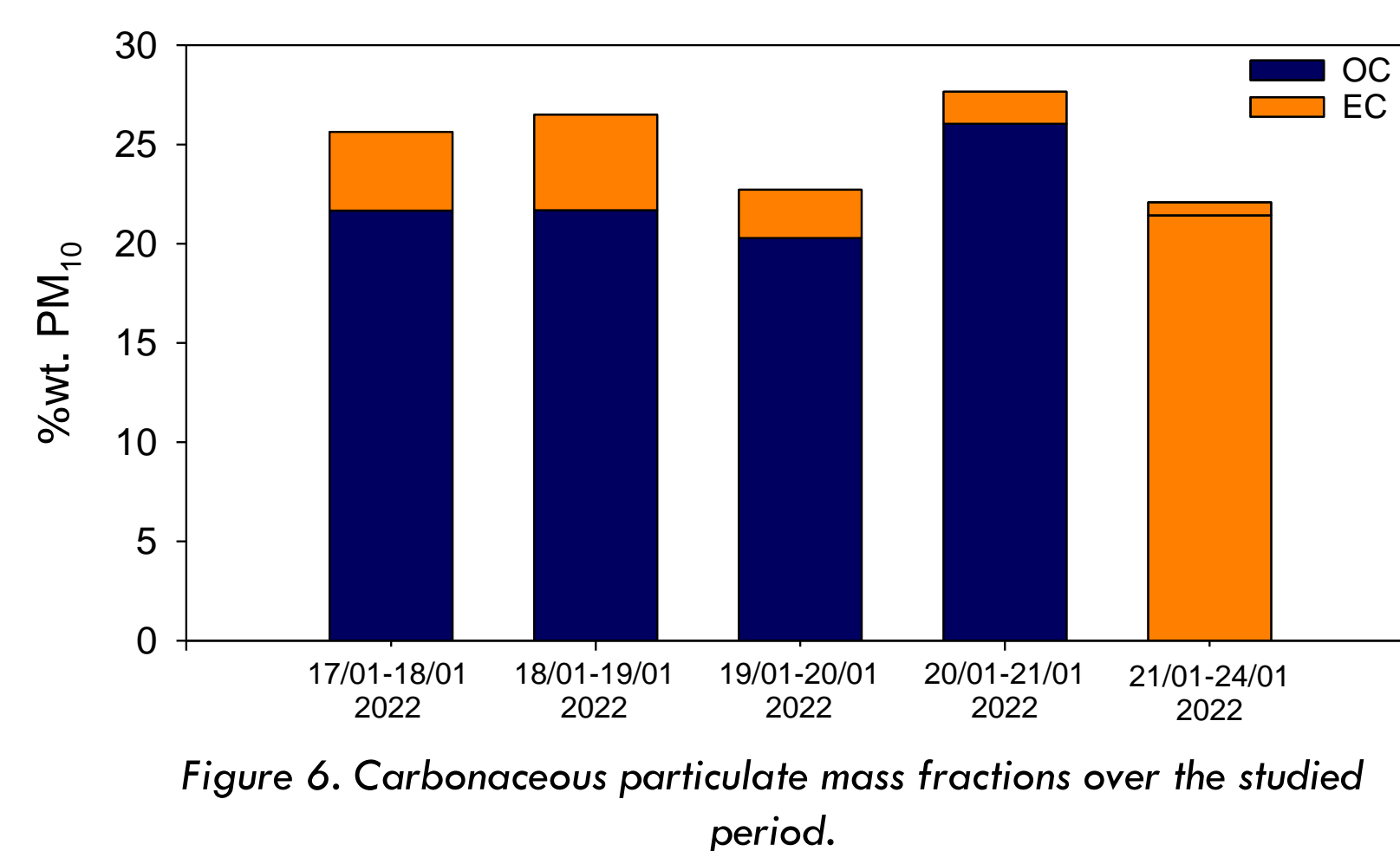Figure 3. Water soluble ions mass fractions over the studied period

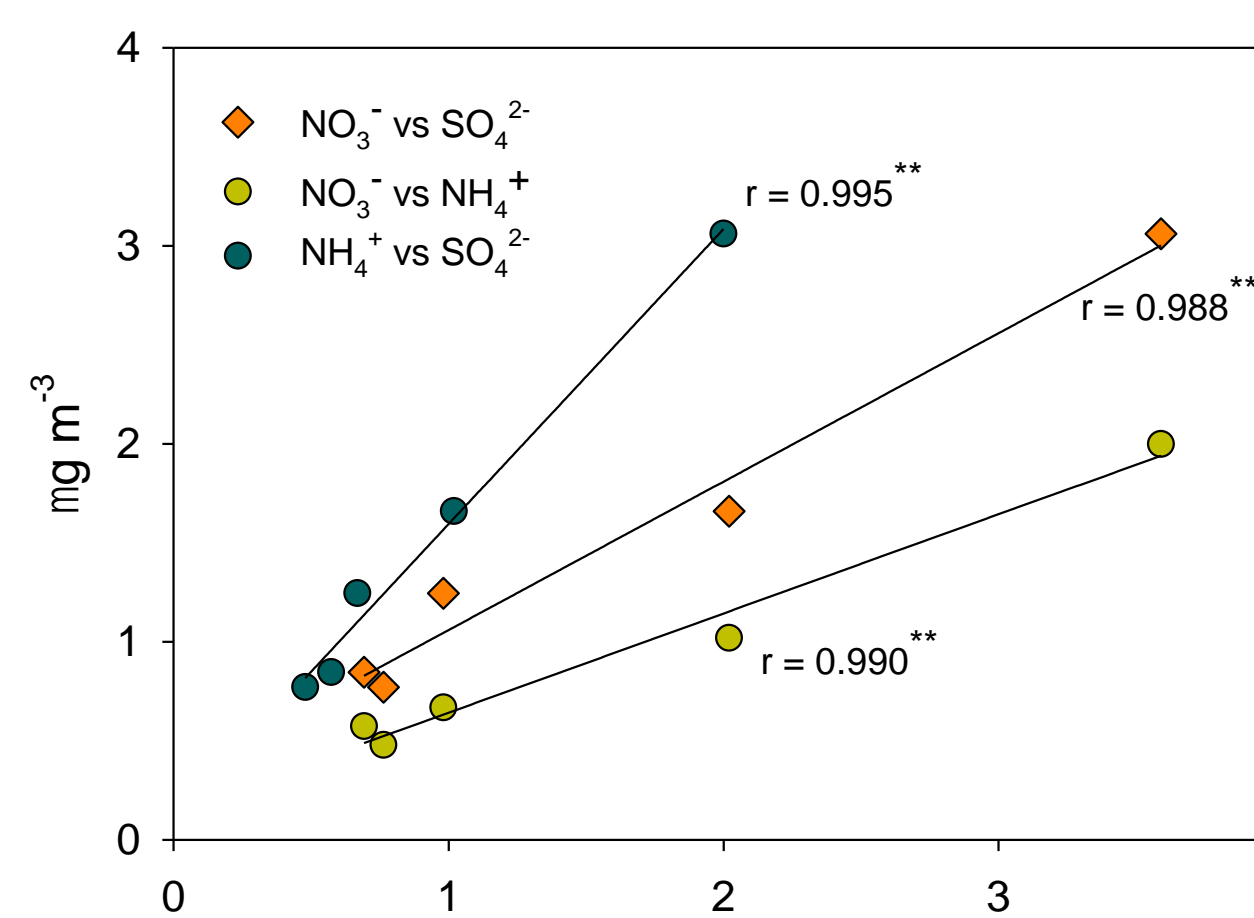Figure 6. Carbonaceous particulate mass fractions over the studied period.

Figure 4. Pearson correlation coefficients. Significant correlation coefficients at the p-level < 0.05 and 0.01, are marked with * and **, respectively.
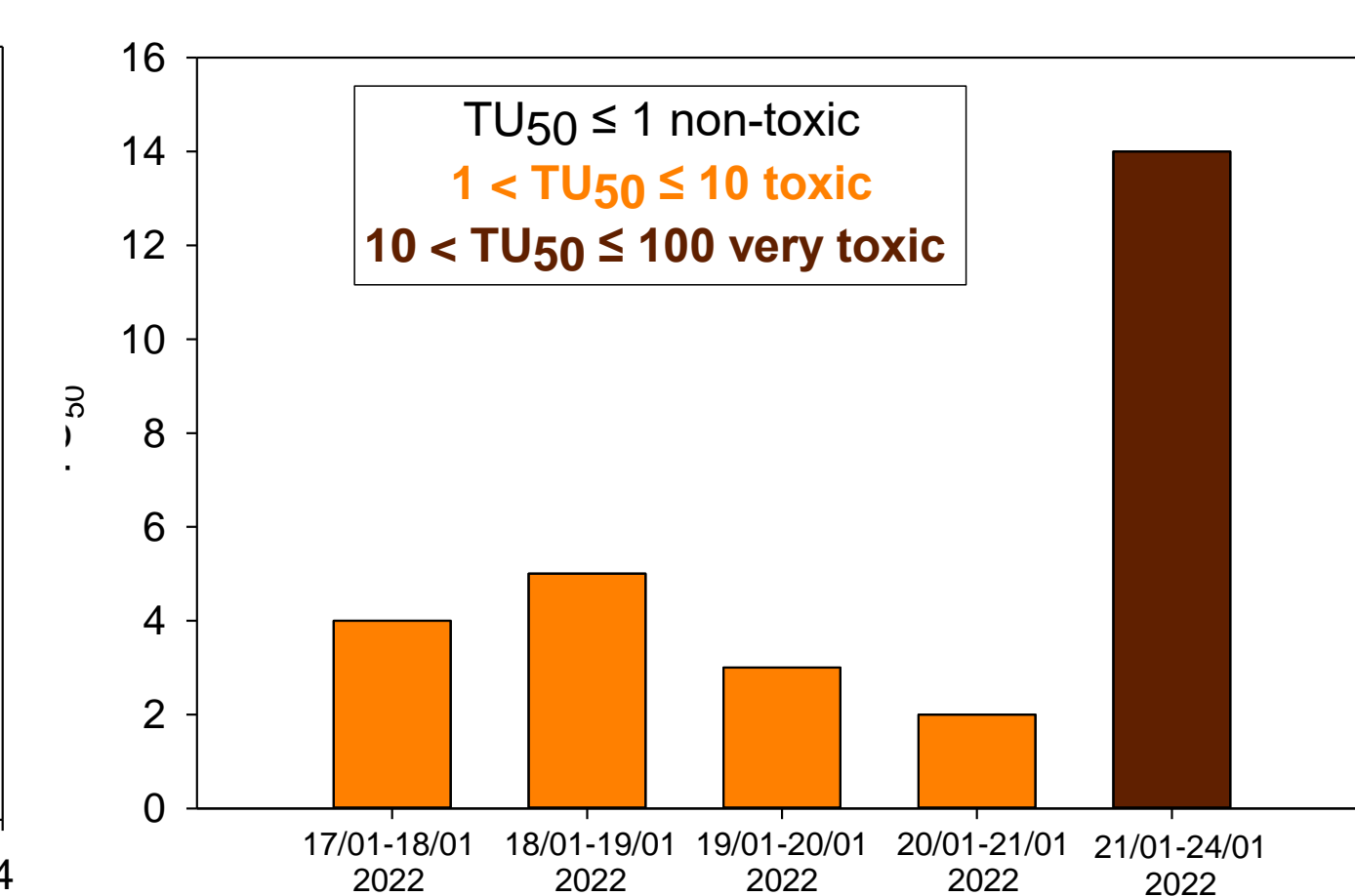

$TU_{50} \leq 1$ non-toxic
$1 < TU_{50} \leq 10$ toxic
$10 < TU_{50} \leq 100$ very toxic

Figure 5. Toxicity Units (TU_{50}) calculated from EC_{50} values obtained with Vibrio Fischeri bioassay.
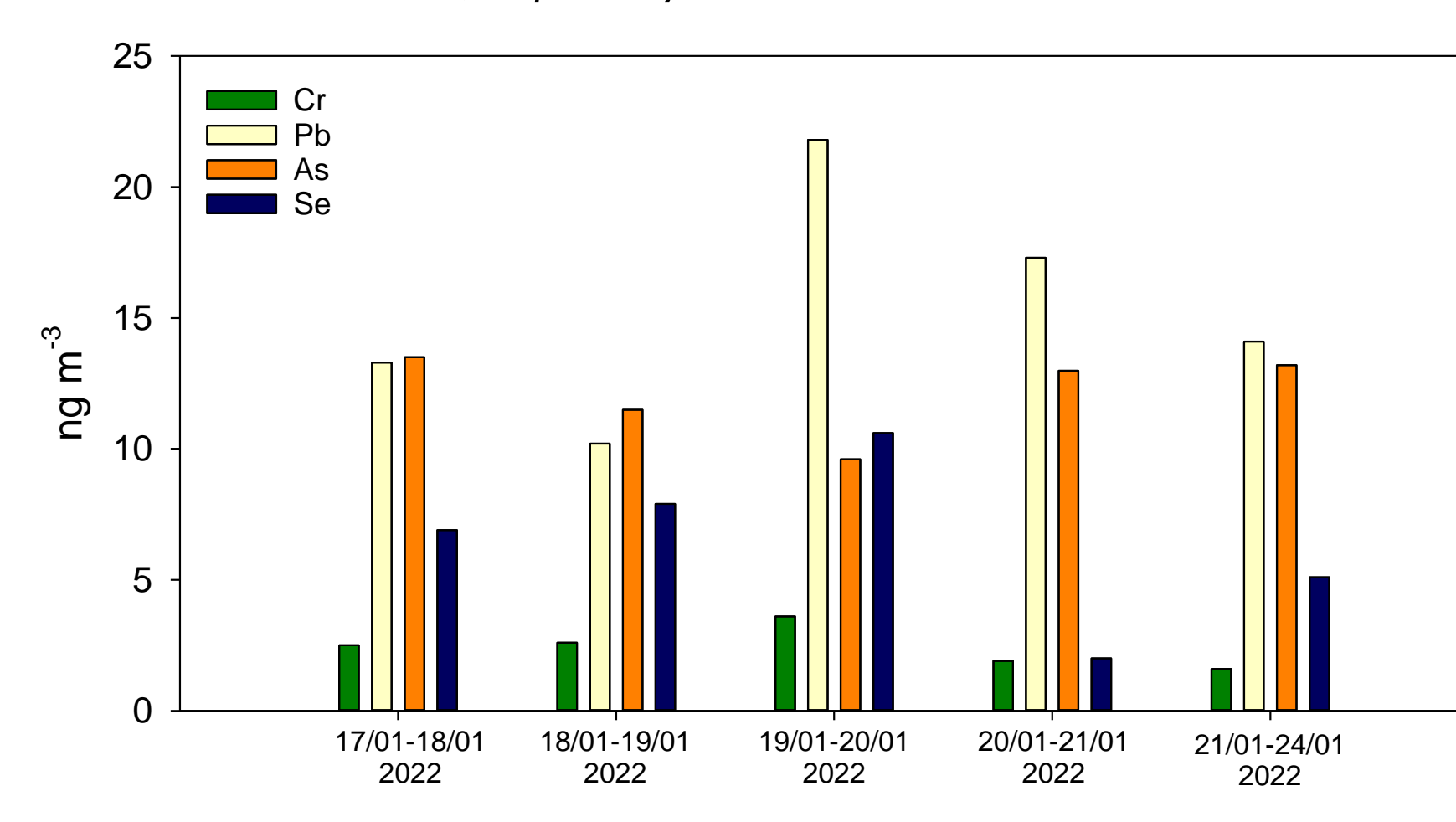

Figure 7. Average concentration of toxic metals and coal burning tracers during the studied period

4 CONCLUSIONS

- The daily average PM_{10} concentrations were always below the EU daily limit value, ranging between 20.0 and 39.2 µg m^{-3}.
- The dominant water-soluble species were sulphate, nitrate and ammonium which globally represented 64% - 76% of the total ionic content. These secondary inorganic ions were significantly correlated.
- During the sampling campaign, the average daily concentration of As, a coal burning tracer, did surpass the year standard of 6 ng m^{-3} imposed by the European Air Quality Directive (2008/50/EU).
- All the samples inhibited the bioluminescence of the bacteria, indicating that all the samples were toxic. No correlations between toxicity and PM-bound components were detected.

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