

# Long-term trends of PM<sub>10</sub>-bound arsenic, cadmium, nickel, and lead across the Veneto region (NE Italy)

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Since the mid-90s, the European Community has adopted increasingly stringent air quality standards. Consequently, air quality has generally improved across Europe. However, current EU standards are still breached in some European hotspots.

The Veneto region (NE Italy) lies in the eastern part of the Po Valley, a major European hotspot for air pollution, where EU standards for particulate matter, nitrogen oxides and ozone are still breached at some sites.

This study aims to analyse the PM<sub>10</sub>-bound arsenic, cadmium, nickel, and lead concentrations over a 10 years-long period (2010-2020) in the Veneto Region by using data collected by the local environmental protection agency (ARPAV) in 20 sampling stations mostly distributed across the plain areas of the region and categorized as rural (RUR), urban (URB), and suburban (SUB) background, industrial (IND) and traffic (TRA) hotspots (Figure 1). The comprehensive dataset discussed in this study was statistically investigated to detect the seasonal trends, their relationship with other air pollutants and meteorological parameters and their spatial variations at a regional scale. This study completes previous air quality studies over the Veneto region for gaseous pollutants and bulk PM<sub>10</sub> (Masiol et al. 2017).

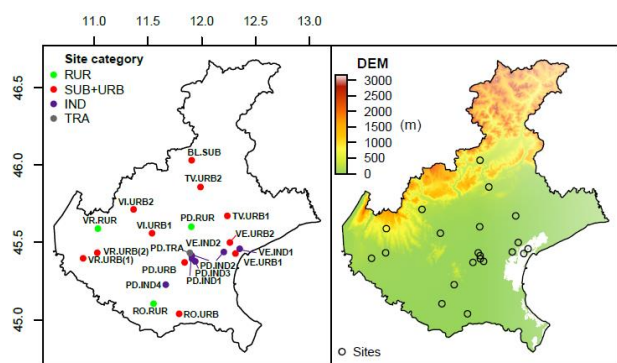


Figure 1. Maps of the sampling sites used in this study: site categories (left); location of sites and orography (right). DEM = digital elevation map.

Samplings were carried out according to CEN EN 12341:1998 standard on quartz fibre filters and were continuous for 24 h, starting at midnight. The gravimetric

determination of PM<sub>10</sub> mass was measured following the CEN EN 12341:2014 standard. The elemental analysis was performed using an ICP-MS (Agilent 7700) after acid digestion (EN 14902:2005).

The trends were analysed using different approaches on the monthly-averaged data. The shape of trends and their seasonal variations were assessed through the seasonal-trend decomposition time series procedure based on "Loess" (STL). The linear trends were computed by the Mann-Kendall trend test ( $p < 0.05$ ) and the Theil-Sen nonparametric estimator of slope (MK-TS). Since this latter analysis assumes monotonic linear trends and does not consider the shape of trends, the presence of possible breakpoints was investigated using the piecewise regression.

Generally, monthly patterns of all analysed elements show higher concentrations during winter, following PM<sub>10</sub> concentrations. Some exceptions were detected and discussed. Results of trend analysis indicate statistically significant negative (decreasing) or null linear trends in almost all stations. A few positive (increasing) but not statistically significant trends were also detected.

Some sites showed rapid decreases occurred in short periods and linked to peculiar events or local causes. Among others, several sites across the Venice area showed significant drops of arsenic concentrations after the REACH (Registration Evaluation Authorisation of Chemicals) implementation (Formenton et al., 2021).

Data used in this study are provided by ARPAV (Agenzia Regionale per la Prevenzione e Protezione Ambientale del Veneto, <https://www.arpa.veneto.it/>).

## References

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