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Spider web biomonitoring as a tool to quantify sources of potentially toxic elements in urban dust

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Pollution has been stated as one of the major challenges to modern humankind [1]. In the face of growing urbanization, air quality and especially urban particulate matter (PM) are key aspects [2]. Since classical air quality monitoring does often include none or only few potentially toxic elements (PTE), biomonitoring – the sampling and analysis of biological materials – might be a useful complement or even inexpensive standalone technique.

Spider web biomonitoring has been shown to be an excellent method to identify PTE like Cr, Cu, Fe, Pb, Sn or Zn in urban PM [3]. In this work we show that spider webs can also be used to both identify and quantify sources of PTE in dust. Repeated sampling of webs has been performed at 22 locations in the city of Jena (Central Germany). Contents of 28 PTE in the samples were determined with ICP-MS and ICP-OES after aqua regia digestion.

Results of a principal component analysis, followed by a quantification [4], reveal three main sources of PTE in dust from the study area: resuspended geogenic particles, brake wear and abrasion of steel tram/train tracks. The first two ones make up for more than 85% of most of the element's loads in the samples, highlighting that with time natural dust gets enriched with toxic elements in the city, forming a massive traffic-related source of PM and PTE.

Contents of PTE in the samples might also be used to assign samples to pre-defined pollution classes. We show that a linear discriminant analysis allows the correct classification of new samples from the study area to three classes, based on the type of most nearby traffic (car, tram/train and pedestrian).

Quantification and classification might be helpful tools not only for researchers but also for decision-makers that need straightforward information rather than detailed information on element contents.

[1] Landrigan et al. (2018), *Lancet* 391, 462-512.

[2] Qiang et al. (2015), *Environ. Geochem. Hlth.* 37, 71-82.

[3] van Laaten et al. (2020), *Water Air Soil Pollut.* 231, 512.

[4] Thurston & Spengler (1985), *Atmos. Environ.* 19, 9-25.