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Detecting changes in industrial pollution through the analyses of heavy metals concentrations in tree-ring wood from Romanian conifer forests

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The impact of air pollution on forests, especially in urban areas, has been an increasingly discussed topic in recent years. A number of pollutants, including heavy metals, are released into the atmosphere from various sources, such as mining activities, non-ferrous metal processing plants, fossil fuel combustion, and can have adverse effects on tree growth but also on vigor of other species including humans.

We compared the concentrations of several elements in tree-ring wood from two conifer species (Silver fir-*Abies alba*, and Norway spruce-*Picea abies*) growing in polluted and unpolluted areas. Two regions (Bicaz and Tarnița) subjected to historical changes in pollution and located in northern Romania were selected. Two methods of chemical analyses were used: inductively coupled plasma mass spectrometry (ICP-MS) and X-ray fluorescence spectrometry (XRF).

Silver fir trees from the intensively polluted area in Tarnița region are negatively impacted by industrial pollution according to their Mn concentrations in wood which are, on average, three times higher than in the unpolluted areas (ca. 30 vs. 10 $mg \cdot kg^{-1}$). This finding is consistent with both ICP-MS and XRF analyses, but this difference was found in Norway spruce only in XRF data which detected 7 times higher Mn concentrations in trees from polluted areas than in those from unpolluted areas (ca. 700 vs. 100 $mg \cdot kg^{-1}$).

In the Tarnița region, Norway spruce was able to accumulate a higher quantity of heavy metals compared to Silver fir, but the most pronounced differences between polluted and unpolluted were found in Silver fir.

The two analysis methods complemented each other with ICP-MS being a qualitative method with a low detection limit of some elements, and XRF being a more quantitative method with high detection limit and satisfactory accuracy.