

## **Bio-monitoring of the most industrialized area in Poland: Trees' response to climate and anthropogenic environmental changes**

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Silesia is one of the regions with the highest levels of air pollution in Europe, highly industrialized over the years and highly populated.

In this study, trees (*Pinus Sylvestris* L.) growing in the heavily urbanized area in close proximity to point-source pollution emitters, such as a heat and power plant, nitrogen plant, and steelworks in Silesia (Poland), were analyzed as bio-indicators of contemporary environmental changes.

Trees are a very good archive of ecosystem changes, because they are sensitive to climate changes and anthropogenic pollution. The pollution impacts human, plants and animal life and different ecosystem processes. The changes in the ecosystem can disturb the metabolism and physiological processes of trees, and consequently, they also have an effect on the wood structure, tree ring width and the isotopic composition of wood and its components.

The analysed samples covered the time period of the development of industrialization and the modernization in the industrial sector in Poland. In Poland, the systematic long-term monitoring of air pollutants is generally restricted to rural point-source regions in urban areas. Even for those areas, air pollution emissions were not continually monitored and data is only available for the last decades. Tree ring series that present long-term data can be used to analyse the ecosystem changes, caused by human activities. The conifers investigated in this study have grown for many years under the stress of environmental contamination.

We analysed the spatiotemporal distribution of growth reductions, the depth of reduction with respect to the distance from the emitter, the relationship between tree growth and radiocarbon and stable isotope composition and climate during the industry development period and during pro-ecological strategy application. Pines chronologies indicate that trees have a similar sensitivity to most climatic elements of the previous and given year, but there is also observed a different rhythm between the studied populations of incremental growth of pines. The carbon isotope discrimination has been proposed as a method for evaluating a decrease in the total amount of atmospheric  $^{13}\text{C}$  and  $^{14}\text{C}$  that has been caused by fossil-fuel burning (Suess effect) and the ratio between  $\text{CO}_2$  assimilation and stomatal conductance (water use efficiency). In the period of time from 1975 and 2012,  $\Delta^{14}\text{C}$  indicates the presence of local Suess effect. In the period of time prior to 2000, a decrease in conductivity of stomata was associated with a minor changes in photosynthesis net and that elevated  $\text{CO}_2$  increased intrinsic water use efficiency (approx. by 40%). The usage of carbon isotopes data provides historical records of anthropogenic impact on the environment and allows to identify the behaviour adaptation to the contamination.

This project was funded by the National Science Centre allocated on the basis of the decision number DEC-2011/03/D/ST10/05251. This publication is supported under the grant rector in research and development. Silesian University of Technology, grant number 14/990/RGJ17/0077.

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