
Bio-monitoring of CO₂ emission: carbon isotopic composition of pine growing near the combined heat and power plant in Łaziska Górne (Poland)

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Abstract

Human alterations of the carbon cycles has influenced the dynamics, biodiversity, and functioning of many ecosystems and ecological processes. According to NASA, water vapor and clouds are the major contributors to Earth's greenhouse effect, but a new atmosphere-ocean climate modeling study shows that the planet's temperature ultimately depends on the atmospheric level of carbon dioxide.

The main aim of this studies was the analysis of the human activities influencing carbon stable isotopes and radiocarbon in Scots pine growing in the vicinity of the combined heat and power station in Łaziska Górne. The analysed samples covered the time span from 1975-2012 AD, the time period of the development of industrialization and the modernization in the industrial sector in Poland, similarly as in Eastern Europe. Since the 1990's, the emission of gaseous pollutants was reduced in a majority of Polish and developing country factories whereas the level of energy production was similar to that prior to the 1990s.

The carbon isotope discrimination has been proposed as a method for evaluating a decrease in the total amount of atmospheric ¹³C and ¹⁴C that has been caused by fossil-fuel burning (Suess effect) and the ratio between CO₂ assimilation and stomatal conductance (water use efficiency).

The stable carbon isotope compositions of the samples were determined using an IsoPrime elemental analyser/Continuous flow isotope ratio mass spectrometer (GV Instruments, Manchester, UK) at the Mass Spectrometry Laboratory of the Silesian University of Technology, whereas radiocarbon were determined using Accelerator mass *spectrometry* at the DirectAMS, Seattle, USA.

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 CO₂ 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.

Keywords : tree rings ; Water Use Efficiency ; stable carbon isotopes ; radiocarbon ; combined heat and power plant ; bio- monitoring