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Radiocarbon concentration in the atmosphere and in tree rings in the south-west Slovakia

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Content

The 14C tree-ring record is well averaging method for estimation of the atmospheric 14C concentrations in CO2, documenting its suitability for long-term monitoring of 14C levels around Nuclear Power Plants (NPP). The increment borer for tree-ring sampling allows develop a long-term 14C record from the same tree. As the tree-ring samples are collected from living trees there is much bigger choice of trees around a NPP, so microclimatic conditions can be better taken into account (e.g., a wind rose). The Accelerator Mass Spectrometry (AMS) technology with miniaturization of samples below mg mass allows to analyze single tree rings with high precision so local 14C contributions from NPPs can be evaluated. Tree-ring samples offer a good possibility to reconstruct 14C concentrations in a given locality, usually back in time for several decades. The time resolution is limited by 1 year growing cycle of the tree, when some information on short-term variations in carbon isotopic composition could be lost (e.g., Suess minima or sudden 14C releases from NPP during winter). Atmospheric radiocarbon has been monitored in the Bratislava since 1967 and around the Jaslovske Bohunice NPP (Žlkovce station) since 1969. The aim of this paper has been to compare atmospheric radiocarbon data in Bratislava and in Žlkovce with tree ring data collected in Bratislava, Žlkovce and Vysoká pri Morave (a clean air station). In 2012, tree ring samples were collected from Tilia cordata using an increment borer at Žlkovce monitoring station situated close to the Jaslovské Bohunice NPP. Tree ring samples were also collected in 2014 at the Vysoká pri Morave clean air station. The aim of this study has been to investigate changes in radiocarbon concentration in the atmosphere and biosphere over the time period from 1970 to 2015. Each tree ring was identified and graphite targets were produced for 14C analysis by accelerator mass spectrometry (AMS). A gradual decrease from the bomb peak was observed in the measured radiocarbon concentrations, which was described by an exponential function. Influence of carbon dioxide released by fossil fuel combustion (Suess effect) can also be seen in all the stations, and potential local and regional carbon dioxide emission sources will be discussed. Radiocarbon concentration in tree-ring samples from Vysoká pri Morave shows an expected exponential decrease with time decay constant of (14.5 $\pm$ 1.2) years. Measured Δ14C values are systematically lower than the clean air reference levels as a consequence of dilution by fossil CO2 depleted in radiocarbon (local Suess effect). The 14C concentrations obtained from the tree-ring samples have been in a reasonable agreement with the averaged annual 14C concentrations in atmospheric CO2.

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