

Radiocarbon in the gaseous and particulate constituents of the atmosphere in Bratislava, Slovakia

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Radiocarbon is a cosmogenic radionuclide produced primarily in the atmosphere and in the form of carbon gases it participates in the global carbon cycle together with the stable carbon isotopes. This makes it an excellent tracer of both natural and anthropogenic effects on the carbon in the atmosphere and connected carbon reservoirs. Radiocarbon levels in the atmosphere are influenced by natural processes such as transport of carbon between reservoirs and changes in solar activity, but human activities have a significant impact on radiocarbon activity in the environment as well. Nuclear weapon testing in the past and current releases from nuclear power plants increase the radiocarbon activity, however, emissions of ¹⁴C-free fossil CO₂ decrease its specific activity. Radiocarbon is also present in the atmosphere in the form of carbonaceous particulate matter. Its sources are biogenic emissions from the biosphere and combustion of biomass and fossil fuels. Based on the different radiocarbon signal of biomass and fossil fuels, analysis of radiocarbon content of aerosols enables source apportionment of these particles.

Three of the carbon-containing fractions of the atmosphere have been sampled and analyzed at the Comenius University in Bratislava - atmospheric carbon dioxide, hydrocarbons, and aerosols. Several decades long record of atmospheric ¹⁴CO₂ activity has recently been supplemented by measurement of radiocarbon content of total suspended particles and CO/C_nH_m gaseous fractions. Comparison of radiocarbon levels in atmospheric CO₂ with clean air reference values will be presented, which shows both anthropogenic effects - input of excess radiocarbon and dilution of radiocarbon by fossil carbon dioxide. The amplitude of these effects slowly decreased over the decades. For a period of 10 years, in addition to sampling at the university campus, a sampling station in the middle of the city center was also used and the comparison of these two sites shows significant local differences in radiocarbon levels. The results of radiocarbon analysis of carbonaceous aerosols collected on quartz filters reveals that even in an industrialized and densely populated city, the non-fossil aerosols represent the majority of carbonaceous particulate matter during most of the year.