Atmospheric radioactivity monitoring in Slovakia

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^{14}C content in the atmosphere was investigated in two localities, in Bratislava (since 1967, Povinec et al., 2008) and Žlkovce (since 1987, Povinec et al., 2009). The samples taken in Bratislava station (city with 0.5 million inhabitants) correspond to highly industrialized region. The second station, Žlkovce, is situated approximately 60 km NE from Bratislava in a flat agricultural area, close to the Bohunice Nuclear Power Plant. A high variability in ^{14}C concentration in the atmospheric CO_2 was observed at these stations until 1993. In this period the annual mean values of delta ^{14}C in heavily polluted atmosphere of Bratislava were about 5 % lower, and at Žlkovce about 2 % lower, compared to delta ^{14}C in European background air. Since 1994 the annual mean of delta ^{14}C has been at both sites close to each other. This behaviour could be explained by the decrease of the fossil fuel CO_2 emissions in Slovakia after 1990, and their stabilization after 1994.

Radiocarbon in the atmosphere of Slovakia

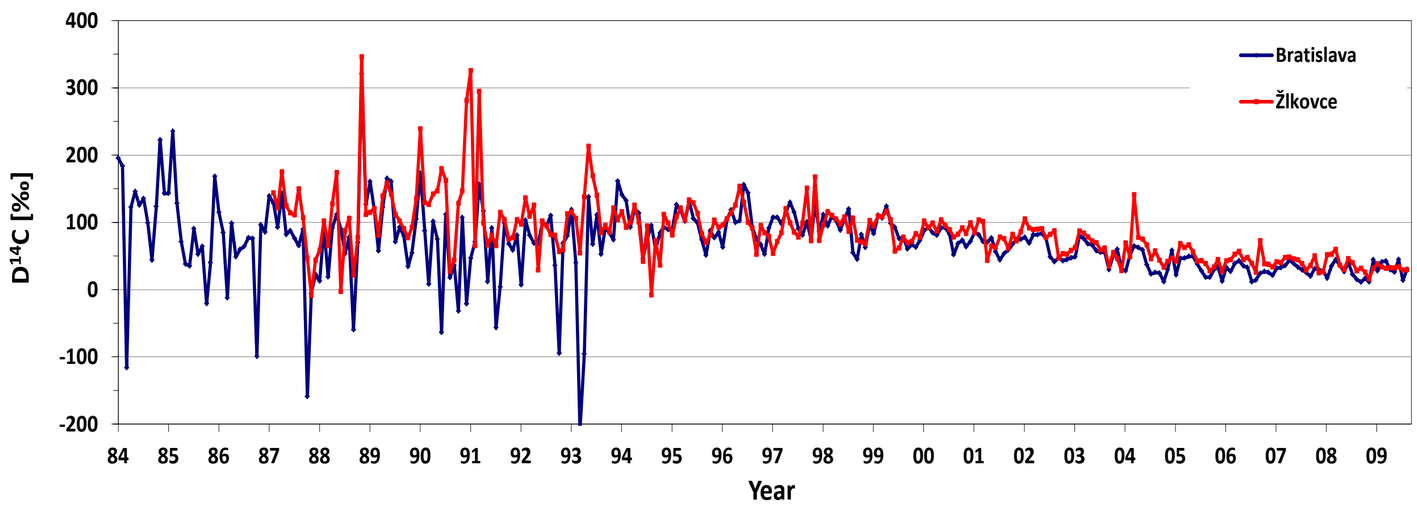

Fig. 1. Variations of Δ^{14}C in the atmosphere of Bratislava and Žlkovce.

Radionuclide content of atmospheric aerosols

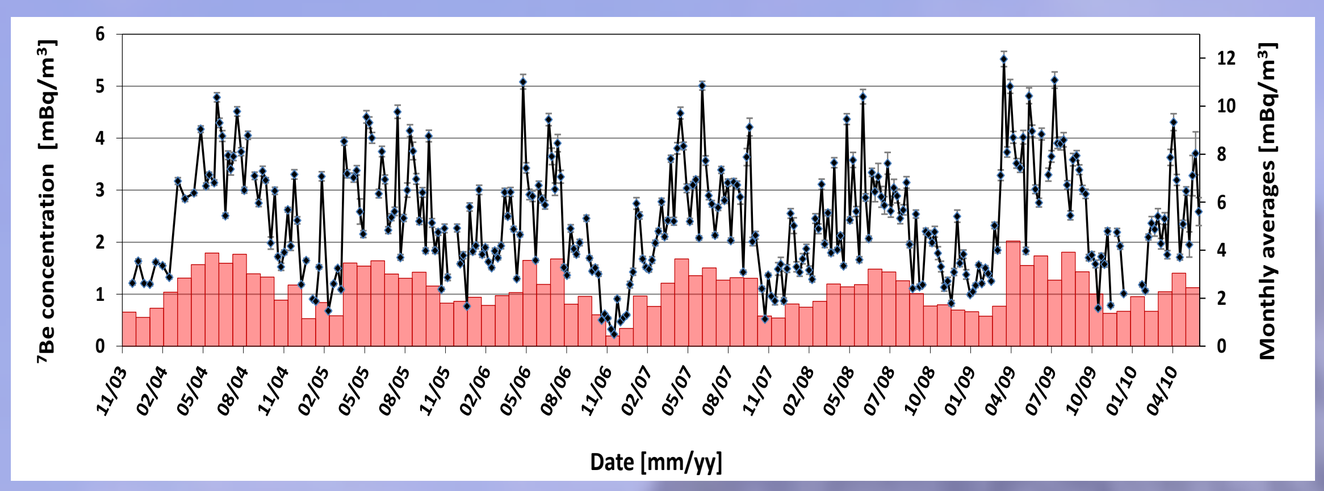

Fig. 2. Variations of ^{7}Be concentration in the atmosphere of Bratislava.

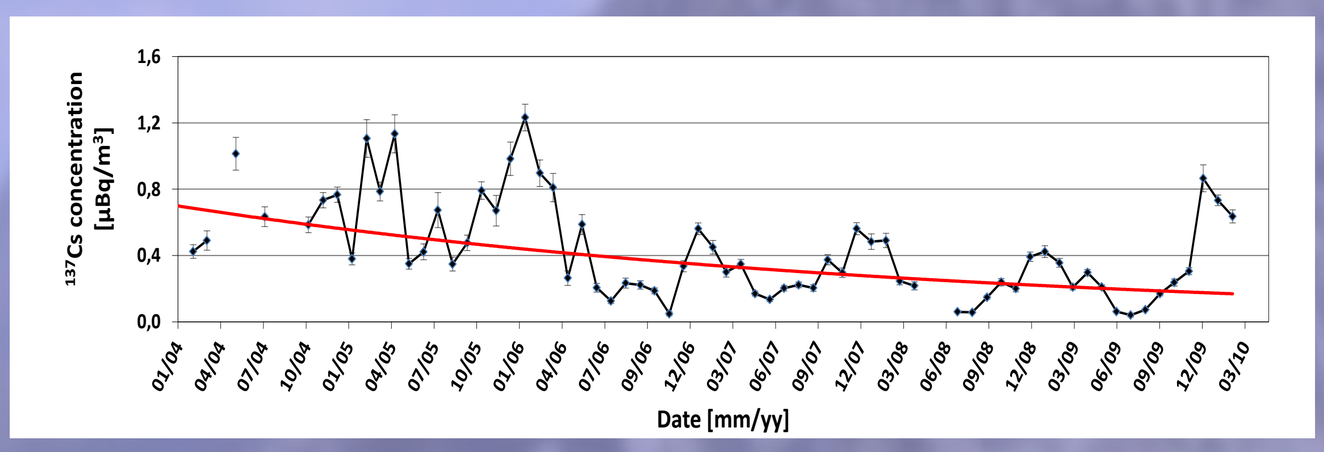

Fig. 3. Variations of ^{137}Cs concentration in the atmosphere of Bratislava.

Aerosols containing ^{7}Be, ^{40}K, ^{137}Cs and ^{210}Pb in the ground level atmosphere of Bratislava were collected on nitro-cellulose filters, with the average flow rate of about 80 m^3/hour (Sýkora et al. 2007). After a one week period, exposed filters were gamma-spectrometrically analyzed using HPGe detectors situated in low background shields (Sýkora et al. 2008).

The concentrations of ^{210}Pb and ^{7}Be ranged from 0.22 to 2.37 mBq·m^{-3} with the mean value of 0.73±0.03 mBq·m^{-3}, and from 0.23 to 5.1 mBq·m^{-3} with the mean value of 2.49±0.06 mBq·m^{-3}, respectively. Measured concentrations of ^{7}Be are shown in Fig. 2. Seasonal variations in concentration of both radionuclides were observed. Concentrations of ^{7}Be show typical trends for inland country of the Northern Hemisphere with maxima in spring and early summer and with minima in winter. Concentrations of ^{210}Pb (a radon decay product) are different and show minima in summer and maxima in winter.

In order to measure low concentrations of ^{137}Cs and ^{40}K in atmospheric aerosols, monthly samples were accumulated from weekly sampled filters. Fig. 3 shows a decreasing trend of ^{137}Cs concentration, introduced to the atmosphere by global fallout and the Chernobyl accident. Higher concentrations in winter months refer to resuspension of soil particles to the atmosphere. The aerosol component of the ground level atmosphere in Bratislava showed typical values of activity concentrations also for ^{137}Cs and ^{40}K, as expected for the Central Europe.

Radon in the atmosphere of Bratislava

^{222}Rn activity concentration has been continuously monitored in the surface air since 1991 by a large volume scintillation chamber (Holý et al. 1999). Average daily radon activity concentrations for individual months of years 1991-2009 show significant daily and seasonal patterns (Fig. 4). Daily maximum occurs in the morning, minimum in the afternoon. Minimal monthly average concentration are usually found in spring, maximal in late autumn or winter (Holý et al. 2007). This is ascribed to different levels of atmospheric stability during the year. Highest amplitudes of daily radon waves are typically found in the middle of year, lowest ones at the beginning and at the end of year. These amplitude variations are directly linked to the variations of intensity of solar radiation. In the period from 1991-2009 the average annual activity varied from 4.1 to 7.2 Bq·m^{-3}, with arithmetic mean 5.2 Bq·m^{-3}.

Daily radon activity concentration composite for 12 months of the year for the entire 19-year period (1991-2009) is depicted in Fig. 5. This figure represents a complex view of radon behaviour in the Bratislava atmosphere and reflects the relationship between radon and meteorological parameters. Highest amplitude of daily variations was found in August (2.7 Bq·m^{-3}), the lowest in December (0.7 Bq·m^{-3}). Seasonal minimum of average radon concentration occurs in April (3.7 Bq·m^{-3}), maximum in October (6.6 Bq·m^{-3}).

The results of radon investigation in Bratislava have contributed to better understanding of the processes in the surface layer of the atmosphere under variable meteorological conditions and to more precise estimation of the public radiation dose due to inhalation of ^{222}Rn and its decay products.

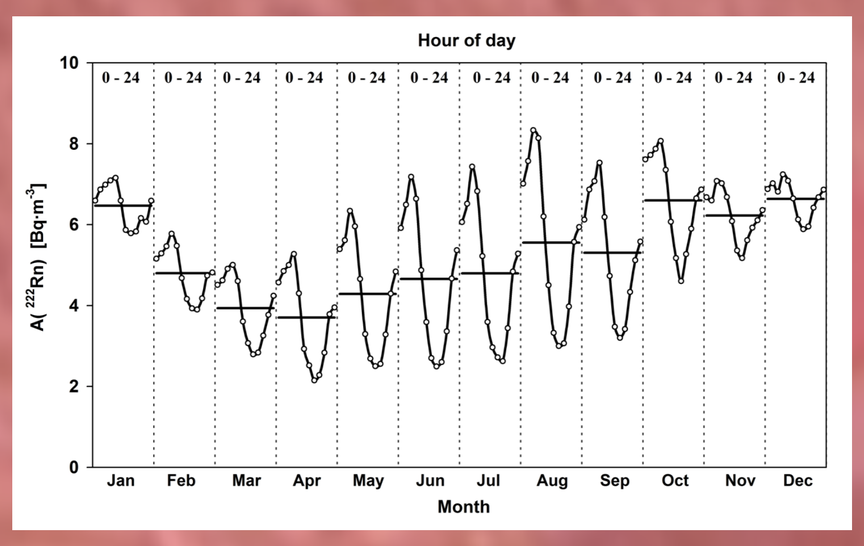

Fig. 5. Daily radon activity concentration for 12 months of composite year 1991-2009 in the atmosphere of Bratislava.

Fig. 4. Average daily radon activity concentration in the Bratislava atmosphere for individual months of years 1991-2009.

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