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SPATIAL VARIABILITY OF ^{137}Cs ACTIVITIES IN THE SOIL OF BELGRADE REGION (SERBIA)

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Abstract

In this study, the specific activities of ^{137}Cs in surface soils from the territory of Belgrade in the period 2006-2010 were determined by gamma-ray spectrometry. Mean specific activity of ^{137}Cs was 23 Bq/kg and the corresponding absorbed dose was 1.5 nSv/h.The specific activities of ^{137}Cs in soil were geographically mapped. The significant spatial variability of ^{137}Cs specific activities of was observed.

Introduction

As the consequence of the nuclear tests carried out since 1945, large amounts of various radioactive materials were emitted into the atmosphere and subsequently distributed all over the world. Radionuclide ^{137}Cs was introduced into the atmosphere through nuclear weapon tests notably in the northern hemisphere in 1945 and then produced as the result of the accidents especially in Chernobyl in 1986 and routine processes of nuclear reactors. Among radionuclides in the soil deposited after Chernobyl accident, ^{137}Cs poses considerable environmental and radiological problems because of its relatively long half-life (30.17 y), its abundance in the fallout, high mobility and similarity to potassium as the major plant nutrient [1].

The aim of this work was to investigate the spatial variability of the specific activity of ^{137}Cs in soil samples collected across the territory of Belgrade, the capital of Serbia, using gamma-ray spectrometry. The absorbed gamma dose rate in air due to this radionuclide is also assessed.

Materials and Methods

The samples of undisturbed surface soil (n=250) were taken from 70 regions in Belgrade, during 2006-2010. Samples were dried at 105 °C to constant weight, homogenized and passed through a 2 mm mesh sieve. The specific activities of ^{137}Cs were measured by HPGe gamma-ray spectrometer (ORTEC-AMETEK, 34% relative efficiency and 1.65 keV FWHM for ^{60}Co at 1.33 MeV, 8129 channels) for 60 ks. The activity of ^{137}Cs was determined using its 661.66 keV gamma-ray line. The software package Gamma Vision 32 was used to process the spectra obtained [2]. From these results external effective dose rates were calculated according to the internationally accepted activity to dose rate conversion equations [3-6]. The specific activities of ^{137}Cs were geographically mapped using ArcGIS from ESRI [7].

Results and Discussion

Descriptive statistics for the specific activities of ^{137}Cs in soil samples collected from the territory of Belgrade and the corresponding external effective dose rates are presented in Table 1.

Table 1. Descriptive statistics for the specific activity of ^{137}Cs in soil samples collected from the territory of Belgrade during 2006-2010 and the corresponding external effective dose rates.

Parametar	^{137}Cs (Bq/kg)	D_{Cs} (nSv/h)
Mean	23	1.5
St. deviation	20	1.2
Median	15	1.0
Range	84	56
Mode	11	0.6
Minimum	3	0.2
Maximum	87	5.8

The mean of ^{137}Cs specific activity obtained in this study is comparable to those reported for Republic of Srpska (26 Bq/kg), Italy (40 Bq/kg) and FYR Macedonia (71 Bq/kg) [8-10].

The significant variability of the specific activities of ^{137}Cs in analyzed samples of soil was observed (Fig. 1).

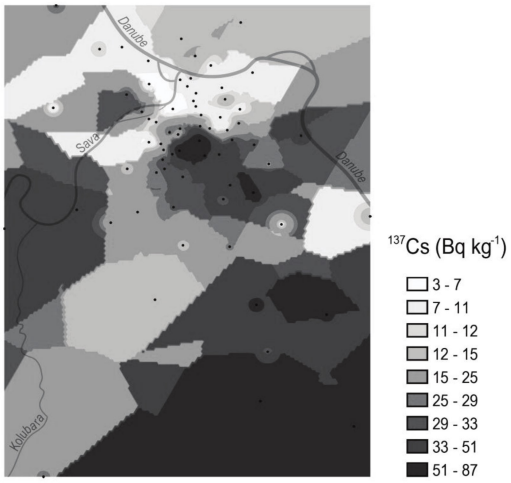

Figure 1. Spatial distribution of the ^{137}Cs specific activity in Belgrade soil.

Conclusion

The presence of ^{137}Cs has been detected in all soil samples, with high variability of its specific activity, ranging from 3 Bq/kg to 87 Bq/kg. The observed range reflects

the inhomogeneity of the deposition process following the Chernobyl accident. The results of the present study will be valuable database for future estimations of the impact of radioactive pollution.

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