



Radionuclide behaviour in forest soils of Russian Federation and Ukraine

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Behaviour of radionuclides in soil determines to a great extent the radionuclide root uptake and their further migration in food chains. The radionuclide fate in the soil is determined by a wide spectrum of simultaneously running, often competitive elementary processes, such as adsorption–desorption, diffusion–mass transport, retention–migration, etc. The intensity of each elementary process depends, in turn, on a combination of several factors such as nature of the radionuclide, physicochemical features of the fallout, soil properties, environmental regimes, etc. Radionuclide deposition in soils is known to be a basic criterion of the radioecological situation in the contaminated territory. Our long-term investigations performed in contaminated forests (30-km zone of Chernobyl NPP; Tula, Kaluga and Bryansk regions of the Russian Federation) had shown that radionuclide migration in the forest landscapes was determined primarily by the forest litter presence. The key factors of radionuclide redistribution within the soil litter are (i) permanent addition of the low-contaminated organic matter (“clean” litterfall), and (ii) high rate of transformation. The dynamics and intensity of decontamination processes depends on the forest litter sub-horizon. Leaf (A0l) layer exhibits the highest rate of decontamination: ^{137}Cs content in this layer decreased twofold by the second year after the accident and reached its equilibrium value (about 1% of the total deposition) by the 4–5th year after the fallout. The corresponding quasi-equilibrium radionuclide content in A0f layer (10–20%) is reached by the 8–9th year after the accident. The corresponding equilibrium in A0h layer is not reached yet. Thus, the effective half-life of radionuclides in soils should be calculated for each sub-horizon separately, taking into account the above-discussed features of the radionuclide dynamics. The rate of annual radionuclide replacement from the forest litter to mineral layers depends on the following factors: (i) soil properties and regimes. In hydromorphic areas, the rate is much higher than in the automorphic areas. This is due to the above-discussed specific features of hydromorphic and automorphic soils, on the one hand, and different pedogenetic processes running under the coniferous and mixed stand, on the other hand; (ii) distance from the accidental unit. The rate of ^{137}Cs migration from forest litter to the mineral soil layers in the territory of the Russian Federation is higher than in the exclusion zone by a factor of 1.5; (iii) weather conditions. Annual rate of ^{137}Cs migration from the forest litter to the mineral horizons varies by 0.5–11%. The variation is well agreed with the dynamics of rainfall during the vegetative season: the migration rate increases drastically in the wet years.