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Radiocesium distributions and fluxes in the forest ecosystems of Chernobyl and Fukushima

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Institute of Environmental Radioactivity (IER) of Fukushima University and Ukrainian Institute of Agricultural Radiology (UIAR) of NUBiP of Ukraine have started the long-term monitoring programs for characterization of the radiocesium distributions and fluxes in the typical forest ecosystems of the Fukushima and Chernobyl zones, respectively. Realization of the programs will enable identification of the key processes governing the radionuclides cycling in the forest ecosystems at the intermediate (Fukushima) and late (Chernobyl) stages of the two accidents and will provide the empirical data needed for modelling the radionuclide long-term behavior in the Fukushima and Chernobyl forests.

At the present stage in the Chernobyl zone root uptake of radionuclides plays the main role in the forest biomass contamination with 137Cs. In the typical Scots pine forests its inventories in the aboveground biomass and litter may reach several percents of the total radionuclide activity in the ecosystem. The radionuclides biogenic fluxes (root uptake and return to soil with litterfall and throughfall) in the Chernobyl forests are comparable or exceed their geochemical migration fluxes in the root-inhabited soil layer, which leads to stabilization of the radionuclide distributions in the soil profile and to the gradual decrease of the apparent vertical migration rates. For example, the main part (about 80%) of the radiocesium activity in soil is still localized in the 0-5 cm topsoil layer; the radiocesium uptake flux may reach 0.n % year-1 of its total activity in the ecosystem, while the geochemical migration flux from the root-inhabited layer is estimated as 0.1 % year-1.

In the studied typical forest ecosystem at the territory contaminated as a result of the Fukushima accident (Sugi forest) about 20% of the total radiocesium activity in the soil profile is localized in the forest litter, and similarly to the Chernobyl forest, major part of the activity, about 70% of the total in soil profile, is located in the 0-5 cm topsoil layer. The radiocesium fraction in litter was formed mainly by the radionuclide return fluxes in the period after the initial foliar contamination in March of 2011. In the present period, after the gradual removing of the initially intercepted radionuclides from the foliage, root uptake becomes an important contributor to the aboveground biomass contamination with radiocesium, which can be inferred from the first estimates of the root uptake flux. Also, our preliminary results show the comparable large return fluxes (at the level of n % year-1) in the Fukushima Sugi forest. Planned studies will enable more precise assessment of the radiocesium fluxes and therefore will bring a light to its further fate in the studied forest ecosystem.