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Biogeochemical recycling of K and Cs isotopes in deciduous forest stands on the long term after deposition

T1.14 Forest radioactive contamination: long-term dynamics and impact on ecosystem and society

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Abstract

Due to atmospheric releases from the Chernobyl and Fukushima accidents, Cs-137 long half-life (30y) and its incorporation into the biogeochemical cycle of elements lead to its persistence within forest ecosystems, affecting forest ecosystem services even more since their decontamination is hardly possible. Predicting its behavior and transfer dynamics over time is of key importance to help recovering benefit from forest products. Such assessment studies require the transfer processes to be documented with numerous data to encompass the variability of environmental factors (e.g. species, age, climate, deposit). To date, the root-uptake which is known to be the major process of Cs-137 intake in trees after the transition phase (>10y) couldn't be robustly assessed due to the remaining contribution of initial foliar uptake. More, data remain scarce for deciduous trees as most post-Chernobyl and post-Fukushima field studies mainly focused on evergreen species.

Relying on stands monitoring data collected during the post-accident long-term phase (>30y) in 4 various deciduous forest stands (France, Ukraine), we compared their Cs-137 concentrations and inventories distributions in trees as well as those of stable chemical analogues (Cs-133, K). To differentiate annual root-uptake from internal translocations fluxes in trees, we assessed their biogeochemical cycling fluxes (mass balance approach).

On the long-term, the Cs-137 initial foliar uptake contribution was no more visible at our sites due to biomass dilution and Tag (aggregated transfer factor) values were one order of magnitude lower than reference ones (IAEA, 2009) likely indicating a long-term decrease of Cs-137 bioavailability in soil. The concentrations of Cs-133 and Cs-137 normalized by the exchangeable inventories in soil were linearly correlated ($r > 0.7$, $p < 0.05$) and differences between isotopes were explained by the soil depth root density. The Cs isotopes were more sequestered than K in roots. Compared to evergreen coniferous forests, uptake rates (y^{-1}) were up to twice higher for K but up to 10 times lower for Cs isotopes, consequently exhibiting a stronger Cs/K discrimination. In a *Q. serrata* stand sampled in 2014-2018 (Japan, early-medium stage) where dynamics were slower than for coniferous, use of Cs-133 and K to assess the magnitude of Cs-137 root uptake rate is underway.