Vertical variation in the depositional flux and biomass inventory of radiocesium through stemflow partitioning between tree canopy and trunk

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Understanding hydrological depositional flux through stemflow that transports radiocesium to the base of trees is crucial in estimating radiocesium sources and inventory in the forested ecosystems affected by the Fukushima Dai-ichi Nuclear Power Plant accident. Therefore, this study seeks to better understand the vertical variation in the depositional flux and biomass inventory of radiocesium through stemflow partitioning between tree canopy and trunk compartments. Working in a coniferous forest (*Cryptomeria japonica*, young Japanese cedar, with a mean height of 10.9m, mean DBH of 0.560m, and n=3) and a mixed deciduous broadleaved forest (*Quercus serrata*, Japanese oak, with a mean height of 14.3m, mean DBH of 0.789m, and n=2), we investigated precipitation partitioning via generation of stemflow and branchflow by collecting stemflow from upper portion of trunk (1m below the canopy layer) and lower portion at trunk base (1.37m from forest floor), and branchflow from the base of primary branches at the various canopy layers (*C. japonica*: younger foliage, mixed foliage, and dead foliage; *Q. serrata*: upper and middle canopy). We determined partitioning between canopy-trunk compartments via ^{137}Cs depositional flux by multiplying a volume-weighted mean of ^{137}Cs (Bq L^{-1}) with branchflow and stemflow depth of basal area (L m^{-2}) and a ^{137}Cs inventory by multiplying a volume-weighted mean of ^{137}Cs (Bq L^{-1}) with biomass density in each tree compartment (kg m^{-2}). Furthermore, we characterized seasonal changes of the ^{137}Cs depositional flux and ^{137}Cs inventory between canopy and trunk compartments to clarify the sources and dynamics distribution of leachable ^{137}Cs in both forest stands.

Results revealed that the magnitude of the total ^{137}Cs depositional flux for the oak stand was higher than that of the cedar stand by ten times, with 0.95 and 10.34 Bq m^{-2} $stand^{-1}$ day^{-1} for cedar stand and oak stand, respectively. Such a difference could be attributed to higher branchflow and stemflow generated by oak stands. However, the distribution of ^{137}Cs sources was the largest within the canopy compartment of the cedar stand, with 71% compared to 47% in the oak stand. The result implies that ^{137}Cs leached from the canopy of cedar stands corresponded to initially intercepted radiocesium that tightly bonded to the vegetative cover and then washed off during incident rainfall. Meanwhile, the total ^{137}Cs inventory of the oak stand is six times greater than the cedar stand, with 1.46×10^{-2} and 8.31×10^{-2} Bq m^{-2} $stand^{-1}$ day^{-1} for cedar and oak stands, respectively. Both forest stands have a similar contribution of leachable ^{137}Cs that interacted with tree biomass with 85% and 87% originating from the canopy of cedar and oak stands, respectively. This study concludes that the sources and dynamics of ^{137}Cs leached via stemflow from a forest stand can be distinguished by partitioning through canopy and trunk compartments and subsequently corresponding to hydrological flux and biomass density fraction.

Keywords: Forest hydrology, Cedar stand, Oak stand, Cs-137 depositional flux, Cs-137 biomass inventory