Investigation on distribution of radioactive substances in Fukushima (11) Spatial variation in the transport and deposition of radiocesium through the tree canopy via branchflow and stemflow

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Abstract

This study seeks to better understand the spatial variation in the transport and deposition of radiocesium through the tree canopy via branchflow and stemflow in the aftermath of the Fukushima Dai-ichi Nuclear Power Plant accident.

Keywords: Leachable radiocesium, stable isotopes, branchflow, stemflow, cedar stand, oak stand, bark water storage capacity

1. Introduction

Stemflow, a fraction in the hydrological partition and a pathway of radiocesium deposition in the forest ecosystem. Less attention but involve with complex processes when intercepted radiocesium at canopy leached along the preferential pathway until reached to trunk basal area. This interaction could alter stable isotopic composition.

2. Objectives~Methodology

Working in both a coniferous forest (*Cryptomeria japonica*, young Japanese cedar stands, mean height is 10.9 m, mean DBH is 0.560 m) and a mixed deciduous broadleaved forest (*Quercus serrata*, Japanese oak stands, mean height is 14.3 m, mean DBH is 0.789 m), we investigated the fate of radiocesium transported by branchflow from upper and lower portions of canopy and deposited by stemflow at trunk basal area. In addition, we used stable isotopes to clarify the signature of evaporation loss via branchflow and stemflow on its routing through the canopy.

3. Results and Discussion

The results showed leachable radiocesium (¹³⁷Cs concentration) was greater for branchflow that received washoff from the dead foliage than the branchflow receiving radiocesium inputs from mixed and younger foliage. For the tree trunk, radiocesium leached more in stemflow from the lower part as compared to the upper part, possibly due to the increased residence time of stemflow on the lower reaches of the trunk. We also found that the isotopic composition of branchflow and stemflow in oak stands was generally enriched in δ^{18} O and δ D compared to cedar stands, however, the differences in enrichment between branchflow and stemflow remains unclear.

4. Conclusion

High spatial variability of leachable ¹³⁷Cs via branchflow and stemflow was detected within and among cedar and oak stands. Further work should examine the effect of bark water capacity and its relationship with the ¹³⁷Cs vertical distribution and isotopic composition of each tree stands.