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Original

Development of an Evaluation Tool for Air Dose Rate in Forests Using a Monte Carlo Radiation Transport Code (PHITS)

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Summary

We developed a tool for creating three-dimensional models of trees, forest litter, soil and land topography in order to undertake PHITS Monte Carlo simulations of air dose rates in forests. Using this tool we modelled a forest in the Ogi district of Kawauchi-mura, Fukushima Prefecture. We considered how the partitioning of radiocesium among the forest canopy, litter layer and soil affected air dose rates by performing multiple simulations with different radiocesium source distributions. Moving radiocesium from the canopy to the litter layer did not affect air dose rates at 1 m above the ground in the simulations employing a source distribution applicable for October 2015. This is because there was almost no radiocesium in the canopy at that time. However air dose rates tended to be high near the canopy, and above the canopy up to 200 m altitude, when the simulations modelled a source distribution applicable for the August to September 2011 period. This is due to the larger amount of radiocesium in the canopy at that time. Transferring the radiocesium from the canopy to the litter layer in this case was associated with a three times increase in the air dose rate at 1 m, as the average distance between the radiocesium in the forest and 1 m height was shortened. In both cases (2011 or 2015 data) radiocesium transfer from the litter layer to the underlying soil was associated with a one third to 50% reduction in air dose rates at 1 m, due to the self-shielding effect of soil. In reality air dose rates at 1 m have been observed to decrease in line with the rate of physical decay of the radiocesium. This may be explained by the shielding effect of the litter layer and soil cancelling the concentration effect of radiocesium transfer from the canopy to the ground surface.

Key Words: Forest, Air dose rate, Monte Carlo Simulation, Radiation transport, Radiocesium