Variation of soil water content in litter and soil layer impacts radiocesium air dose in the forests of Yamakiya District, Fukushima Prefecture

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The Fukushima Daiichi Nuclear Power Plant (NPP) accident in March of 2011 released over 1800 kbq/m2 of radiocesium over the forests of Fukushima Prefecture. Of the total deposition of radiocesium from the accident, forests in Fukushima accumulated nearly three quarters. As such, in addition to understanding the rates of stabilization in these forests, inquiries into the natural processes that may mitigate contamination to humans through air dose exposure has been of great importance in the years following the accident.
As atmospherically deposited radiocesium accumulates in the litterfall and upper soil layers of the forest, these compartments greatly contribute to the air dose rates near the forest floor. The litter layer and forest soil have high water retention capacities due to the presence of pore spaces, and the radiation dose derived from radioactive cesium on the forest floor may vary greatly depending on their moisture content. As these compartments retain moisture after rainfall events, and given water’ s properties as an absorber of gamma radiation, this pore water can have a shielding effect which may change over time as the water in soil pores drains, evaporates, and refills. Therefore, it was our goal to determine how the variation of water content in litter and soil layers impacts radiocesium air dose rates, and at which time-scale pore-water is most effective in shielding gamma radiation and reducing air dose rates within the forest. In this study, we measured the change over time of the moisture content of the litter layer and soil surface, and the change over time of the air dose rate at 40 cm and 1 m for three forest stands in the Yamakiya district in Fukushima Prefecture. Results indicate that there is a weak negative correlation between the antecedent precipitation index and air dose rate, and it appears that there are a seasonal trend and event-based periodicity to this relationship, especially within the broadleaf site. Long-term drainage processes associated with small pores seems to be the driving factor behind decreases in air dose associated with antecedent precipitation index, and the strength of the relationship between API and air dose increases when short and long-term drainage are combined.

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