# How much the radiocesium fallout remain in forest surface soils?

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Radioactive contamination in the forested area was caused by the $^{137}$Cs discharged from Fukushima Dai-ichi Nuclear Power Plant (FDNPP) accident. To predict longterm redistribution of fallout $^{137}$Cs, we investigated global fallout $^{137}$Cs ($^{137}$Cs-GFO) from nuclear weapon tests in the atmosphere in the 1950s and 60s. We examined concentrations and amounts of $^{137}$Cs-GFO of three layers of soil samples (0–5, 5–15 and 15–30 cm in depth) at 316 sites all over Japan, which were collected just before the accident. We determined $^{137}$Cs-GFO by NaI well-type scintillation counter with its accuracy verified by measurements using a germanium detector. An average of $^{137}$Cs-GFO inventories of forest soils in Japan was estimated to be 1.7 ±1.4 kBq m$^{-2}$ as of Oct. 2008 with highly nation-wide spatial variation. Otherwise district meteorological observatory estimated accumulated $^{137}$Cs-GFO deposits to be 2.4 ±0.8 kBq m$^{-2}$. Since the number of measurement by district meteorological observatory was limited (n = 7), we have to compare these data with regards to spatial variation of the initial deposit possibly caused by climate condition. Climate factors used were precipitation normal value, vertical variation of tropopause height, and special rainfall events within atmospheric nuclear test peak period. The precipitation is positively correlated with $^{137}$Cs-GFO deposit. The vertical variation of tropopause height affects the $^{137}$Cs concentration of atmosphere in the troposphere. Influence of atmospheric nuclear test on the $^{137}$Cs concentration of atmosphere peaked from Dec. 1962 to June 1963. Special rainfall events of this period might have a great impact on the $^{137}$Cs-GFO deposit. Winter precipitation of the precipitation normal value (October to February) had been explained well the large amount of the $^{137}$Cs-GFO distribution trend with greater accumulation in the north-western part along the Sea of Japan side. We made, you create a general mixed model using winter precipitation as a fixed effect and survey points as random effects (model 1). The tropopause altitude daily observations in 2014 were extrapolated to 0.5 degrees mesh, which turned differential data of the one-day intervals and two day intervals, and the increase in tropopause height was extracted. We added monthly frequency of the increase events as an explanatory variable to model 1 (model 2). The model 2 improved estimation accuracy in Akita pref. and Kitakyushu region underestimated in model 1 and in Okinawa pref. and Tokai region overestimated in model 1. To consider the impact of special rainfall events, the AMeDAS point monthly precipitation (1950-1964) was extrapolated into a 0.1-degree mesh data set using the spline interpolation. Precipitation from Dec. 1962 to Feb. 1963 (a heavy snowfall event) was added an explanatory variable to model 1 (model 3). The model 3 remedied the $^{137}$Cs-GFO underestimation in some prefectures (Akita, Saga, Fukui and Nagasaki). Within the frame of the above three models, the $^{137}$Cs accumulation in forest soils were compared to the cumulative amount of deposit measured in the district meteorological observatory. All of the three models indicated that there was no significant difference in the amount of the $^{137}$Cs between the forest soils and the district meteorological observatories. We concluded that most of the $^{137}$Cs-GFO had remained in forest soils during the 60 years.

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