Impact of different land use along the Kasumigaura lake on suspended sediment delivery and particulate ^{137}Cs discharge

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Large quantities of ^{137}Cs released from the Fukushima Daiichi nuclear power plant are being continuously transported from surrounding rivers into Kasumigaura lake (Ibaraki prefecture), which may pose a potential radiation threat to millions of residents' health and the local industrial development. Given over 95% of ^{137}Cs in the river tightly combined with suspended sediment (SS), learning the dynamic variation in particulate 137Cs input/discharge and the behind mechanisms controlling their migration is essential for this region. Land use is usually viewed as a critical factor affecting sediment yield and ^{137}Cs inventory. Particularly in rain season, its difference in soil erodibility would be significantly amplified, altering fluvial sediment supply and particulate ^{137}Cs discharge. However, due to the lack of long-term river monitoring in Kasumigaura lake region, the dynamic variation in fluvial SS and particulate ^{137}Cs are still unknown, which also hamper our ability to learn the impact of land use differences on the ^{137}Cs dynamic transport.

To fill this knowledge gap, we conducted a six-year monitoring campaign in two sub-catchments (i.e., Koise river basin and Sakura river basin) where the former has a higher forest proportion, and the latter one has a higher agricultural land proportion. The river monitoring dataset shows the turbidity is significantly correlated with water discharge in Koise, whereas this relationship is not evident in Sakura. Through the hysteresis analysis, we discover that hysteresis type 3 appeared more frequently in Koise, suggesting the existence of delayed SS supply. The ^{137}Cs monitoring dataset demonstrates both sites present a significant exponential decrease trend in particulate ^{137}Cs concentration, but the activities in Koise are slightly higher. Furthermore, the estimated ^{137}Cs fluxes were also found higher in Koise. Considering the forest is usually farther from rivers and has a higher ^{137}Cs entrainment coefficient, these scenarios are thought as the result of the difference in sediment supply due to their different land use composing proportions. Additionally, combining synchronous rainfall records, we find both water discharge and sediment load in two catchments responded extremely well to rainfall, confirming the significant role of precipitation in fluvial sediment supply. Furthermore, we also utilize meteorological radar data, quantified land use, and ^{137}Cs inventory to reconstrue the spatial distribution of ^{137}Cs loss, which provides a potential tool to predict the ^{137}Cs loss with watershed characteristics.

Keywords: land use, suspended sediment dynamic, particulate 137Cs discharge, Fukushima nuclear accident

