Distribution of radioactive Cs in Iitate soil, Fukushima: Multivariate analysis and numerical modeling approaches

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The transport of radioactive Cs in soil has been extensively studied. Many complex numerical models have been introduced to elucidate the migration mechanism of Cs in soil. The models usually required a lot of parameters which are not always available or hard to get, thus their applicability is still limited especially in a large field due to lack of input data. Moreover, the uncertainties and heterogeneity of soil physical and chemical properties may cause the simulation and prediction to be less accurate. We hypothesized that all parameters theoretically associated with the transport of Cs in soil were not always important for the prediction. Depending on specific field conditions, the prediction could be done solely based on fewer important parameters yet getting adequate prediction accuracy. This study aimed to elucidate the distribution and migration of Cs in surface soil, and to support future development of mechanism model for effectively predicting Cs transport in Iitate soil. Cs concentrations in top 30-cm surface soil were monitored in 2013-2015 at 12 plots in an abandoned forest located 40 kilometers northwest of the Fukushima Daiichi NPP. We used multivariate statistical analysis techniques to classify and compare the differences in distribution of Cs under field conditions. The analysis characterized the distribution states and pointed out the most important parameters that possibly influenced the migration of Cs in Iitate soil. A mechanism model was developed based on the physical and chemical processes associated with the above important parameters to simulate and predict Cs transport in surface soil. The results indicated soil organic carbon was highly associated with the distribution of Cs in soil. Soil erosion, and soil deposition tent to be the most important processes affect the transport of Cs in surface soil, while litter layers significantly affected the downward migration of Cs in soil profile.

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