Validation of the Advanced Environmental Transfer and Dose Assessment Model for Radionuclides Released from the Nuclear Fuel Reprocessing Plant in Rokkasho

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Abstract

The first commercial nuclear fuel reprocessing plant in Japan, located in Rokkasho, Aomori Prefecture finished its final testing using actual spent nuclear fuels and is now under safety assessment by the Nuclear Regulation Authority. The advanced environmental transfer and dose assessment model (AdvETDAM) was developed for estimating areal and temporal distributions of the radionuclides around the plant and the radiation doses resulting from these radionuclides. To validate the model using actual field data, we measured the concentrations of radionuclides (^{3}H, ^{14}C, ^{129}I, etc.) in environmental, agricultural, and livestock samples collected at points around the plant and the environmental γ-ray dose rates at IES. In FY2016, an experimental agricultural field was set up in IES, in which the atmospheric deposition and concentration of radionuclides are being measured, to study the transfer process of radionuclides to agricultural products. In addition, long term observations of suspended substance (SS) flux were started in two rivers, Futamata and Oippe Rivers, around the reprocessing plant to evaluate discharge rate of radionuclides with SS through the rivers.

Because no nuclear fuel rods have been sheared or dissolved at the plant since October 2008, we found concentration levels of the radionuclides in most environmental samples collected in FY 2016 were similar to the background ones before the plant test operation, excluding several samples. Iodine-129 deposited on soil and lake sediment surfaces around the plant has still remained at a higher level than each background level.

Since the AdvETDAM simulated the maximum ^{129}I atmospheric deposition during the plant test operation period at an unexpected point on the mountainside north of the reprocessing plant, we collected soil samples at the point and analyzed them for ^{129}I. However, the measured ^{129}I inventory was lower than that of the west side of the plant, showing that further study of both measurements and simulations is necessary.

To improve the accuracy of the model prediction in AdvETDAM, we investigated the distributions and transfer of radionuclides in terrestrial environment in Fukushima Prefecture after the accident at the Fukushima Dai-ichi Nuclear Power Plant. In FY 2016, we studied the following subjects: 1) the re-suspension rate of radiocesium and 2) the discharge rate of radiocesium via rivers. The wind direction weighted mean re-suspension factor of ^{137}Cs in Namie Town (1.0×10^{-11} - 1.0×10^{-9} in FY 2013 - 2016) has become similar to or lower than the annual mean resuspension factor, (atmospheric ^{137}Cs concentration)/(^{137}Cs deposition density), observed at Chernobyl and in European countries (1×10^{-10} - 1×10^{-6}). The discharge rate of ^{137}Cs from the river catchments of the two small rivers in Iitate Village during 2016 was less than 2% of ^{137}Cs deposited in the catchments, showing that most of the radiocesium has still remained on the soil surface in the catchments.

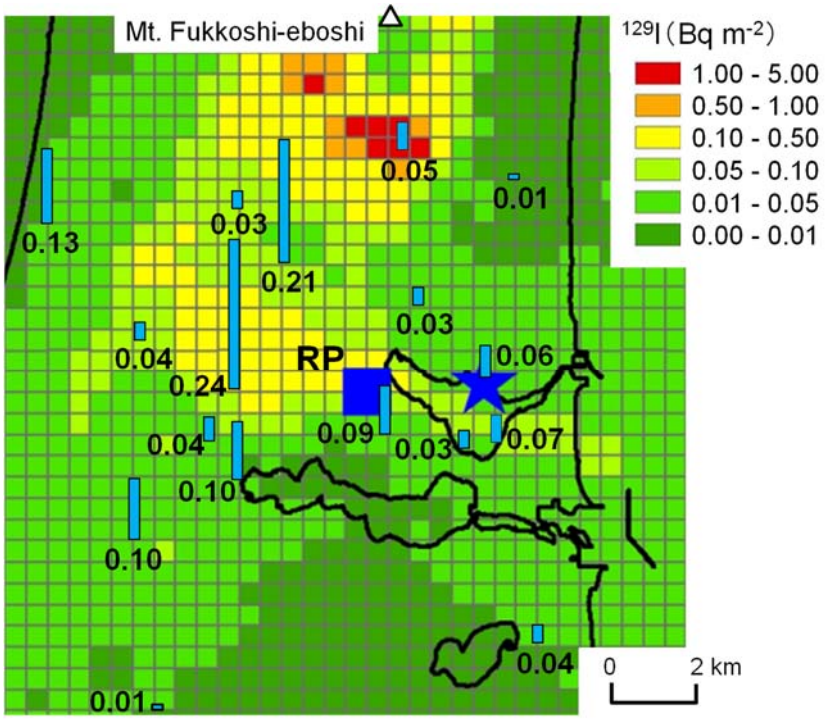

Fig.1 Distribution map of measured excess ^{129}I inventories from background in Rokkasho Village with a color map showing values predicted by AdvETDAM. RP indicates the nuclear fuel reprocessing plant.