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 is now undergoing its final testing using actual spent nuclear fuels. 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 various environmental samples collected at various points around the plant and the environmental γ-ray dose rates at IES.

Because no nuclear fuel rods have been sheared or dissolved at the plant since October 2008, concentration levels of the radionuclides in most environmental samples collected in FY 2013 were similar to the background ones before the plant test operation, excluding several samples. Iodine-129 deposited on soil and sediment surfaces has still remained at a higher level than each background level.

Since the accident at the Fukushima Dai-ichi Nuclear Power Station (FDNPS) in 2011, we have studied the distribution and transfer of several radionuclides in Fukushima Prefecture to clarify their movement in the terrestrial environment. The obtained results will be used to improve the accuracy of the model prediction in AdvETDAM. In FY 2013, we studied the following subjects: 1) the re-suspension rate of radiocesium in Koriyama City and Namie Town, 2) the distribution of ^{3}H in plant and soil samples collected around the FDNPS, 3) the radiocesium interception potential (RIP) of farmland soil around Fukushima Prefecture, and 4) the discharge rate of radiocesium via two small rivers (the Hiso River and Wariki River) in a mountainous area in Iitate Village, Fukushima Prefecture.

The re-suspension rate of radiocesium ranged from 10^{-10} to 10^{-8}, which was comparable to other values reported in the literature. Higher free-water tritium (FWT) and organically bound tritium (OBT) concentrations than the background ^{3}H concentration were observed showing HTO release from the FDNPS accident. These concentrations have been gradually decreasing from 2011 to 2013. Soil-to-plant transfer factor for soybean samples collected from contaminated fields in 2012 was found to be negatively correlated with the radiocesium interception potential (RIP) value and exchangeable K content in soil. This showed that RIP and exchangeable K content in soil were useful indexes for predicting the transfer factor. The discharge rate of radiocesium from the river catchments during 2013 was less than that during 2011 and similar to that during 2012, showing that the most of the radiocesium deposited in the catchments has still remained on the soil surface.

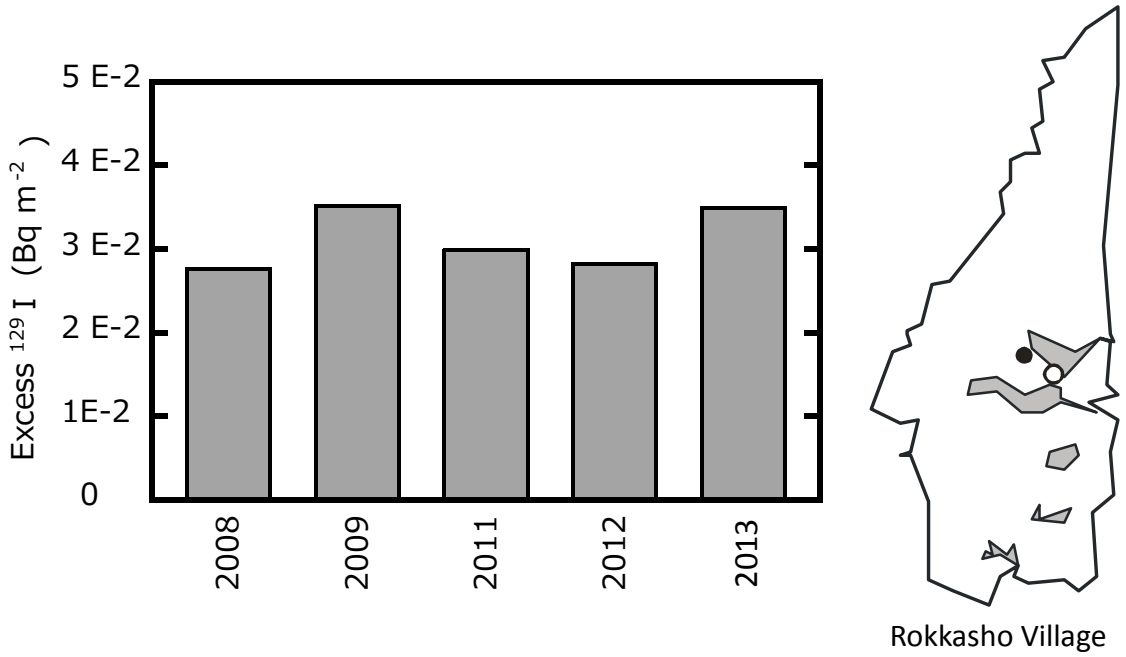

Fig. 1 Estimated ^{129}I inventories originating from the nuclear fuel reprocessing plant on the south side of brackish Lake Obuchi, Rokkasho, Japan. ○: Sampling point ●: Main stack of the nuclear fuel reprocessing plant

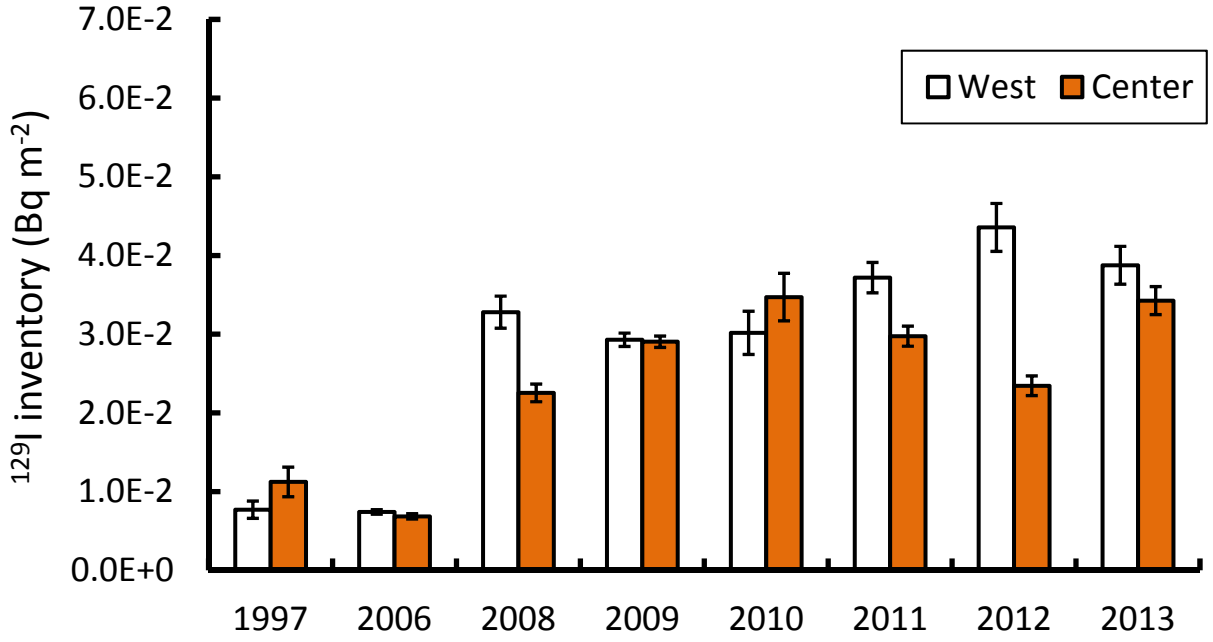

Fig. 2 Variation of the ^{129}I inventories in sediments from the western and central areas in brackish Lake Obuchi, Rokkasho, Japan.