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

Hidenao HASEGAWA, Hideki KAKIUCHI, Yuhi SATOH, Shinji UEDA
Yuichi TAKAKU, Shun'ichi HISAMATSU
Department of Radioecology

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 it is now preparing for full operation. The advanced environmental transfer and dose assessment model (AdvETDAM) was developed to estimate 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 we also measured the environmental γ-ray dose rates at IES.

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 2019 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. The ^{129}I inventories in lake sediments (0-25 cm) collected in Lake Obuchi adjacent to the reprocessing plant have not changed since 2008. On the other hand, ^{129}I/^{127}I atomic ratio in surface sediments (0-5 cm) has gradually decreased. These results suggest the following possibilities: the balance between the inflow and outflow of ^{129}I has been kept almost constant; or ^{129}I deposited on the surface sediment simply migrated to the lower layers.

To improve the accuracy of the model prediction in AdvETDAM, we investigated the distributions and transfer of radionuclides in a terrestrial environment in Fukushima Prefecture after the accident at the Fukushima Dai-ichi Nuclear Power Plant. In FY 2019, we continuously studied two subjects: the re-suspension rate of radiocesium; and the discharge rate of radiocesium via rivers. The atmospheric concentrations and fluxes of ^{137}Cs gradually decreased during FYs 2012 to 2015 with different effective half-lives, however, both values after 2015 have become nearly constant. The clear seasonality with high atmospheric ^{137}Cs concentration in summer and low concentration in winter that we reported in our previous studies was not found. The estimated discharge rate of ^{137}Cs from the river catchments of the two small rivers in Iitate Village since 2011 was less than 2% of ^{137}Cs deposited in the catchments, showing that most of the ^{137}Cs has still remained on the soil surface in the catchments.

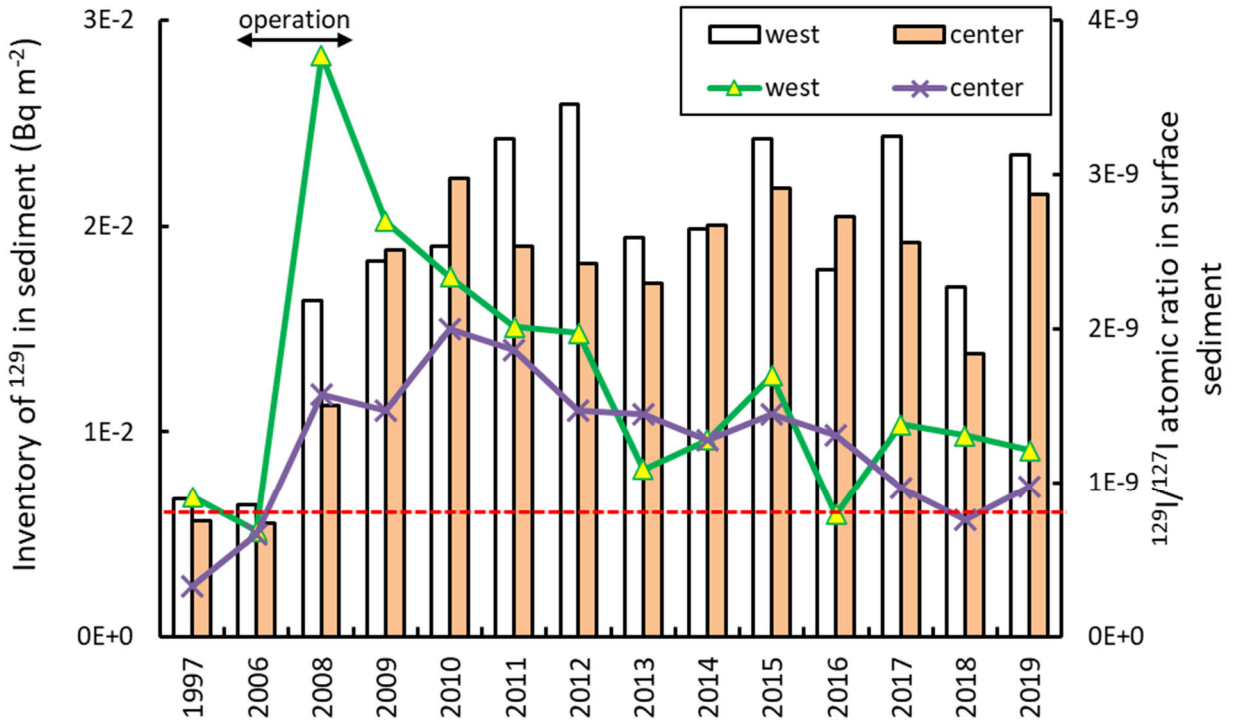

Fig. 1 Temporal variations of ^{129}I inventory and $^{129}I/^{127}I$ atomic ratio in sediment samples collected in Lake Obuchi. The red dotted line and "operation" arrow indicate background level and the test operation duration, respectively.