Development 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

We have developed an environmental transfer and dose assessment model (ETDAM) for radionuclides released from the first commercial nuclear fuel reprocessing plant in Japan, located in Rokkasho. The computer code system was developed on a PC to describe atmospheric dispersion, terrestrial and aquatic transfers, and dose calculations for the released radionuclides. We have used it to estimate areal and temporal distributions of the radionuclides around the plant and the radiation doses resulting from them. The aquatic transfer model targeted transfer of radionuclides in Lake Obuchi, a brackish lake neighboring the reprocessing plant. The Lake Obuchi model consists of a water current model and an ecosystem model including lower trophic level organisms. The advanced environmental transfer and dose assessment model (AdvETDAM) is now being developed. AdvETDAM will have the features of ETDAM, and furthermore include a meteorological model (MM5) for the atmospheric dispersion model, a catchment area model for Lake Obuchi, an ecosystem model of higher trophic level organisms for Lake Obuchi, and a coastal marine model. Development of AdvETDAM will be completed at the end of FY 2010.

Meteorological elements such as wind direction and velocity calculated by the meteorological model, were introduced into the dispersion model through the interface that was constructed in FY 2009. The wind field data from the meteorological model were also processed by the data nudging method to approximate data observed locally. Meteorological data observed at IES and JNFL were used for the nudging. Gamma-ray dose rate data at IES during 2007-2008 were affected by ^{85}Kr released from the spent nuclear fuel reprocessing plant. The simulated gamma-ray dose rate using the nudging method agreed fairly well with the measured data, however, there were occasional disagreements.

The catchment area model is being constructed to describe the inflow of radionuclides from the Futamata River, which is the main river flowing into Lake Obuchi. In FY 2009, the hydrological parameters describing water flow in the catchment area were optimized to represent observed water inflow data of the river. A function to handle transport of radionuclides (^{3}H and ^{137}Cs) by water in the catchment area was developed, and added to the model. A sub-model of fishes and benthos in Obuchi Lake was developed as a part of the ecosystem model of higher trophic level organisms in the lake. Biomass of several organisms, such as oysters and polychaete of the benthos, were not well simulated, and showed that parameters in the sub-model need to be optimized. The coastal marine model simulating water flow in the near-shore area around the release point of wastewater from the plant was also constructed. The near-shore current produced from the tidal flow and waves was introduced into this model. The coastal marine model simulated fairly well the flow data observed at the point located between the release point and Obuchi Fishing Port at the mouth of Lake Obuchi. Concentration of ^{3}H, which was released from the plant from July to December in 2008, in seawater was estimated by the model. Simulated ^{3}H concentrations in the fishing port agreed fairly well with the measured data with some exceptions.

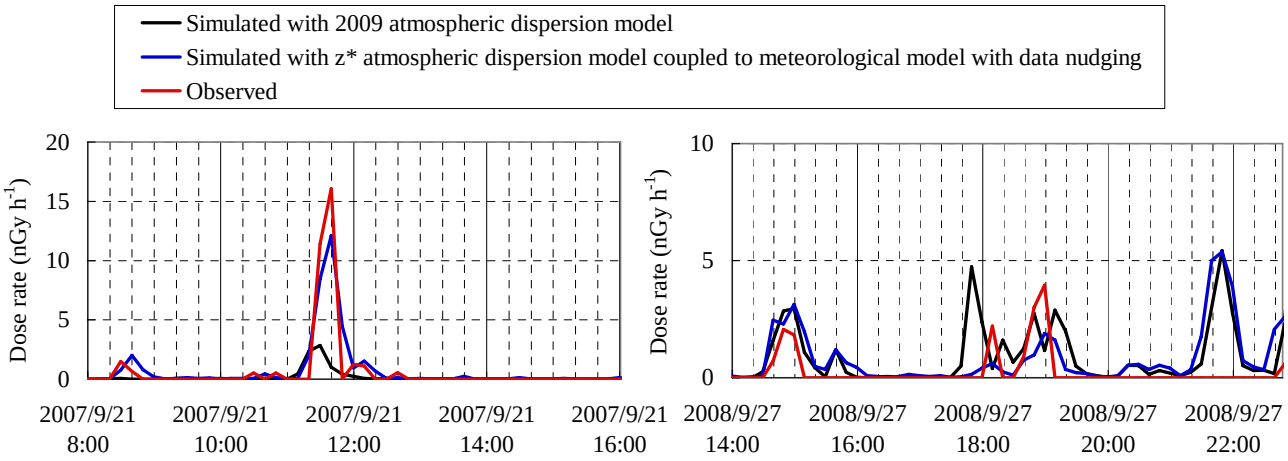

Fig.1 Dose simulated with ETDAM for ^{85}Kr release from the spent nuclear fuel reprocessing plant.