

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

Shun'ichi HISAMATSU, Takashi IYOGI, Shinji UEDA, Hidenao HASEGAWA, Koichi ABE
Department of Radioecology

Abstract

We have developed an environmental transfer and dose assessment model (ETDAM) for radionuclides released from the first Japanese commercial nuclear fuel reprocessing plant 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 the ETDAM to estimate areal and temporal distributions of the radionuclides around the plant and the radiation doses resulting from the radionuclides. 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.

To increase accuracy and target areas of ETDAM, 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 the lake, and a coastal marine model have been developed during FYs 2006 - 2010. Those models were bound to ETDAM, and integrated as the advanced environmental transfer and dose assessment model 1.0 (AdvETDAM 1.0) in FY 2010. Meteorological elements such as wind direction and velocity calculated by the meteorological model are introduced into the atmospheric dispersion model. The catchment area model describes the inflow of radionuclides from the Futamata River, which is the main river flowing into the lake. A sub-model including eelgrass (*Zostera marina*), fishes and benthos was developed as the ecosystem model of higher trophic level organisms in the lake. The coastal marine model for Rokkasho Coast simulates inflow of radionuclides from the Pacific Ocean into the lake through Obuchi Fishing Port at the mouth of the lake to the ocean.

The ^3H concentrations in lake water samples collected from Lake Obuchi in November 2007, which were higher than the background level, were simulated by using AdvETDAM 1.0 to confirm its function. The possible sources of ^3H in the lake water were surface deposition of atmospheric released ^3H , and inputs from the Futamata River and the Pacific Ocean. Estimated ^3H concentrations of surface lake water at the center of the lake agreed fairly well with the measured values; estimated values were 1.7 - 2.8 times lower than the measured values. The source of ^3H in the lake was considered as the liquid waste release from the plant to the ocean because of an underestimated factor of 9 - 10 without input from the ocean. The contributions of the atmospheric deposition and input from Futamata River were minor in comparison with the input from the ocean. Although AdvEDAM 1.0 simulated fairly well the ^3H concentrations in the lake water, the estimated concentrations were systematically lower than the observed ones. The input from the Futamata River was also overestimated with the model. Further study is required for improvement of simulation with AdvETDAM 1.0.

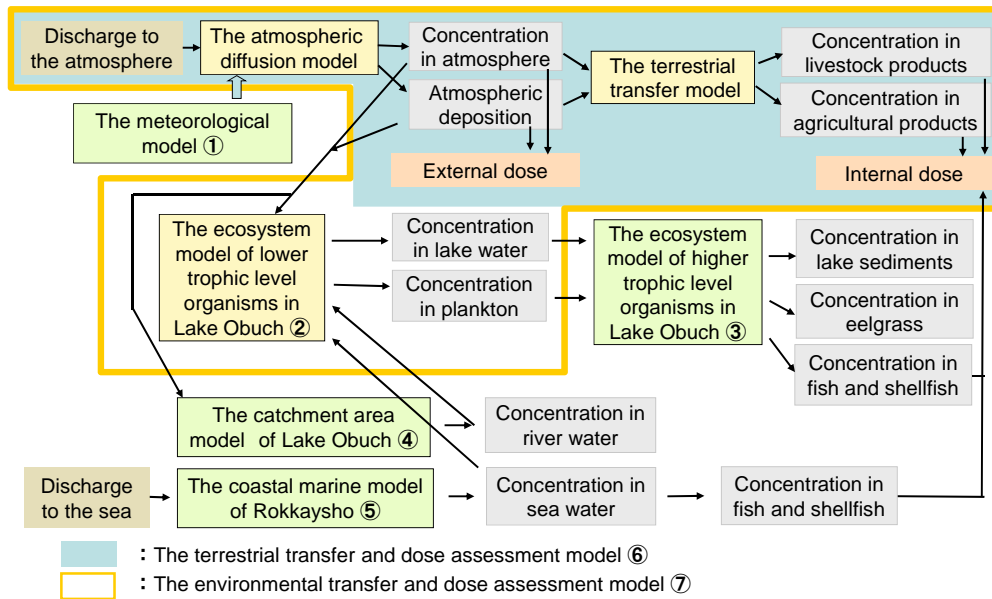


Fig.1 Scheme of the AdvETDAM 1.0 for transfer and dose assessment for radionuclides discharged from the nuclear fuel reprocessing plant in Rokkasho

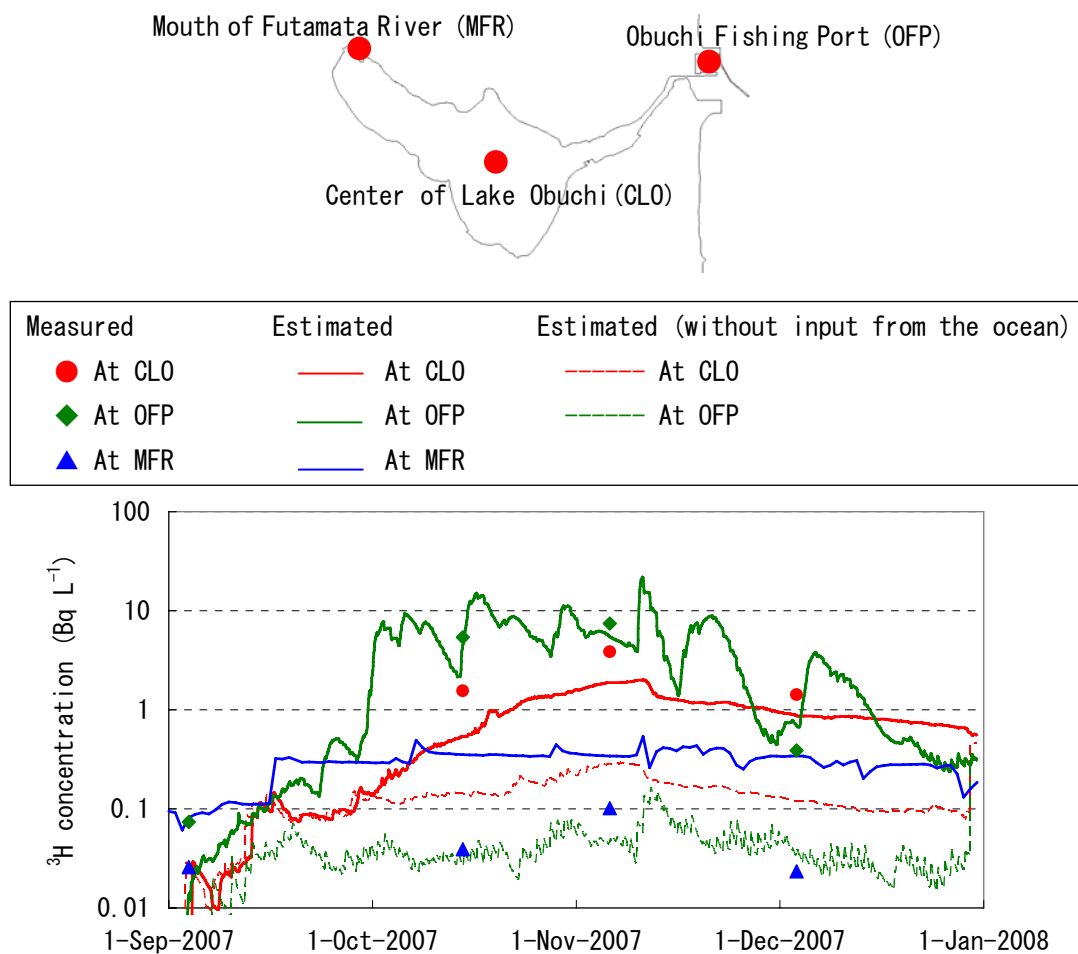


Fig.2 Concentrations of ^3H in surface water samples at the center of Lake Obuchi (CLO), Obuchi Fishing Port (OFP) and the mouth of Futamata River (MFR) estimated with AdvETDAM 1.0. The dashed line (in red and green) shows the simulation without input of ^3H from the ocean.