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

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

Abstract

We have developed the advanced environmental transfer and dose assessment model (AdvETDAM 1.1) for radionuclides released from the first Japanese commercial nuclear fuel reprocessing plant located in Rokkasho. The computer code system was developed on personal computers to describe atmospheric dispersion, terrestrial and aquatic transfers, and dose calculations for the released radionuclides. The model consists of an atmospheric dispersion model with a meteorological model (MM5), a terrestrial transfer model, an aquatic transfer model in Lake Obuchi, which is a brackish lake neighboring the reprocessing plant, and its catchment area, and a coastal marine model for the Rokkasho coast.

In FY 2013, to extend the aquatic transfer model to Lake Takahoko and its catchment area, we examined the basic design of the models. Coastal Sea Modeling System for Hydrodynamic Process (COSMOS) and Princeton Ocean Model (POM) were selected as candidates to simulate water currents in Lake Takahoko. In FY 2014, both models will be implemented and tested, and the better one will be adopted as the hydrological model. Also, as candidates to simulate water transfer in the catchment area in Lake Takahoko, Soil and Water Assessment Tool (SWAT) and Water and Energy Transfer Process (WEP) were selected and will be tested. Radionuclide transfer models will be added to the selected hydrological models in FY 2015.

We have collected basic hydrological data for Lake Takahoko to construct the hydrodynamic model, including the water currents in Lake Takahoko and characteristics in the lake bottom sediment (organic matter content, etc.). To construct the hydrological model for the Lake Takahoko catchment area, basic hydrological data, such as water flow rates in rivers flowing into Lake Takahoko and groundwater levels, have been collected. In FY 2013, electrical resistivity tomography in the subsurface ground was carried out in the river mouth areas to evaluated intrusion of seawater into these areas. In addition, a surface run-off ratio during a storm event, which is one of the most important factors for the hydrological model in a catchment area, was measured for the Muronokubo River and Tokusari River by using the difference of the stable isotopic ratios of oxygen in rainwater and groundwater. As a result, we estimated the surface run-off ratios in a storm event were 15% and 10% for the Muronokubo River and Tokusari River, respectively.

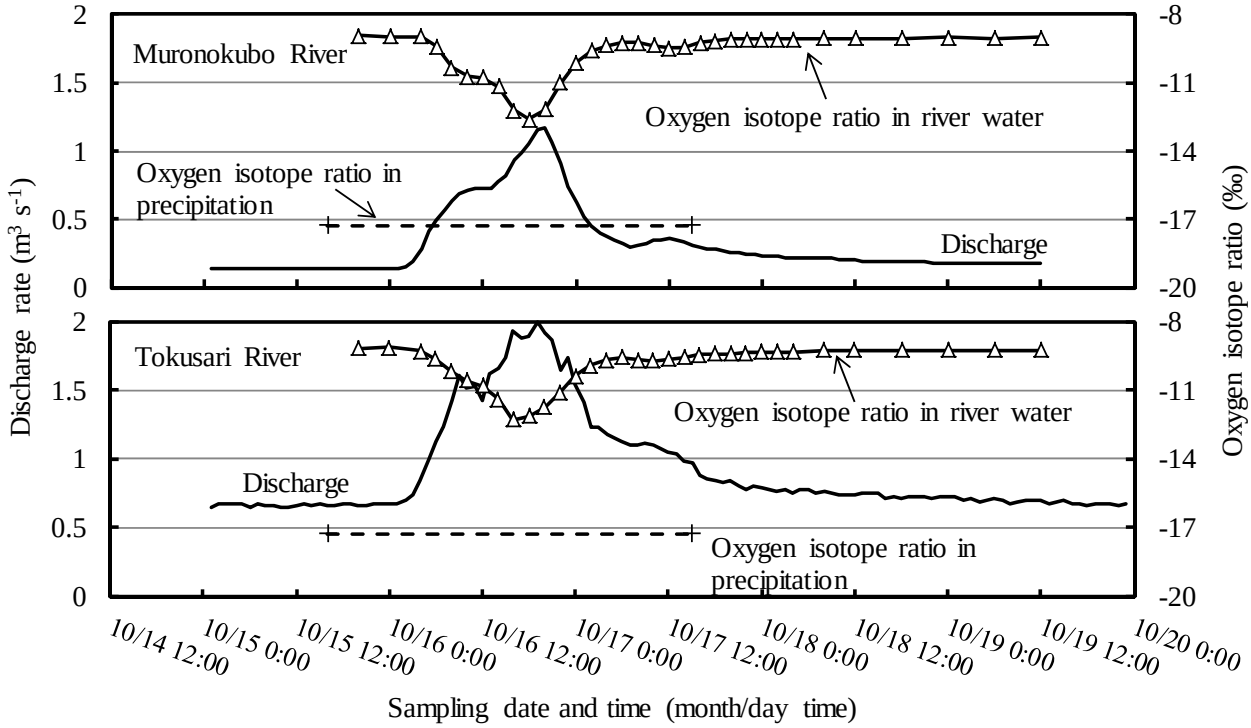

Fig. 1 Temporal variations of discharge (solid line) and oxygen isotope ratio of stream water (solid line with open triangles) during a storm event from 1:00 on October 16th to 15:00 on the 17th (JST). The broken line indicates the oxygen isotope ratio of precipitation during the storm in the Tokusari River catchment area.