Development of 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 weather model, a catchment area model and 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.

In FY 2008, we introduced the weather model to estimate metrological element data for more accurate calculations of dispersion and deposition of atmospheric particles. The MM5 (Mesoscale Modeling System 5th Generation) was introduced, and tested by using weather data at the reprocessing plant for one month in each of the four seasons in 2007. While the wind direction and speed estimated agreed well with the measured data (r=0.58 - 0.83), the difference between estimated precipitation rates and actual ones was large (r=0.36 - 0.66).

The catchment area model is being constructed to describe the inflow of radionuclides from Futamata River, which is the main river flowing into Lake Obuchi. In FY 2008, the hydrological parameters were optimized to represent water inflow data of the river. A sub-model for transfer of chemical substances such as N, P and C was also developed. A sub-model of a sea-grass colony in Obuchi Lake and marshland around the lake was developed as a part of the ecosystem model of higher trophic level organisms in the lake. While the model of the sea-grass colony well describes biomass and basic production rate, the marshland model needs to be improved for biomass representation. We also designed a 3D-hydrodynamic model as a base for the coastal marine model to predict behavior of radionuclides released from the reprocessing plant through its marine discharge pipe.

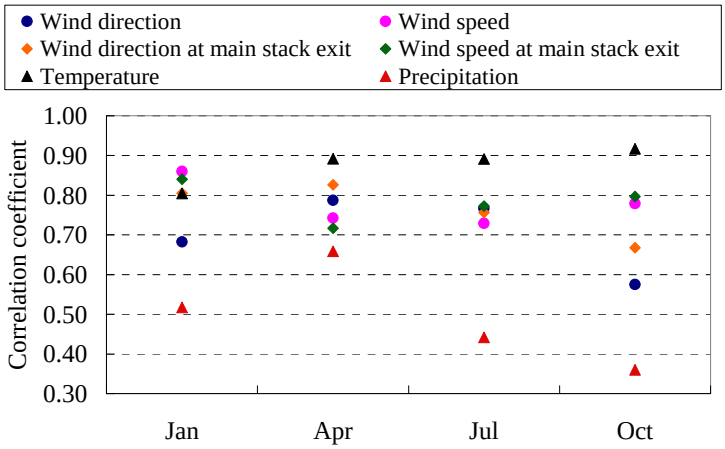

Fig. 1 Correlation coefficient between estimated and meteorological elements measured at the Rokkasho nuclear fuel reprocessing plant in for one month in each season in 2007. Meteorological elements are at ground level except for wind speed which is at the main stack exit.

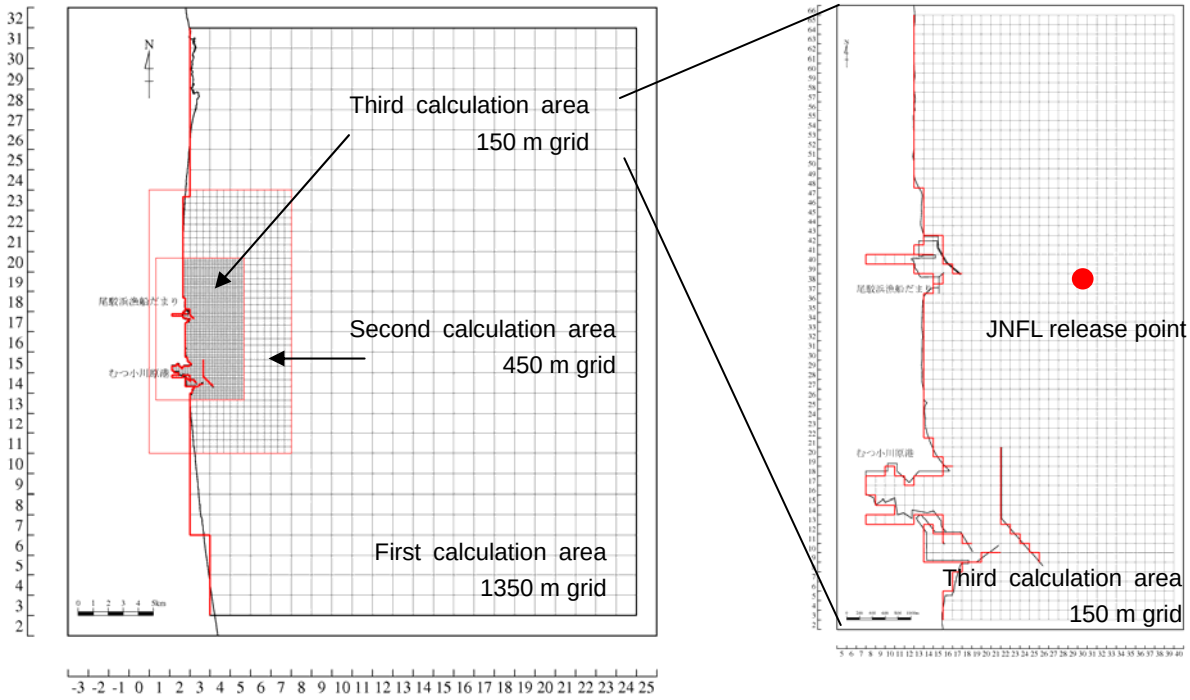

Fig. 2 Calculation area of coastal marine model for Rokkasho.