Priority Subjects with Limited Terms — **Establishment of Optimal Risk Management**

Assessment of Radioactive Material Diffusion and its Environmental Impact Evaluation

Background and Objective

In order to evaluate and continuously improve the safety of nuclear power plants, it is necessary to carry out preliminary assessments of the environmental impact of radioactive materials on the atmosphere and ocean in the case of severe accidents, as well as the effectiveness of preventive measures against nuclear power plant accidents.
The target of this study is to develop techniques for predicting the dispersion of radioactive materials into the atmosphere and ocean, as well as for monitoring radioactive materials and assessing the migration of radioactive materials in marine organisms and forests. Through the development of these techniques, we aim to contribute to improving the safety of nuclear power plants via the assessment of environmental impact.

Main results

1 Prediction of atmospheric dispersion of radioactive materials emitted from nuclear power plants

A coupled model of meteorological and atmospheric dispersion models has been developed to predict near-field-scale dispersion of radioactive materials emitted from nuclear power plants. The model has a fine computational grid in units of hundred meters, and is validated with a series of observation data from a field tracer experiment. The model predicts axial surface concentrations*1 with satisfactory accuracy for almost all atmospheric conditions (Fig. 1) (O14004). We have also conducted a survey on the case examples of probabilistic risk assessment (level 3 PRA) conducted in the U.S. and Europe. Issues and future tasks of level 3 PRA were summarized through the survey for its application in Japan.

2 Developing techniques for the assessment of radioactive material oceanic dispersion and transfer to marine organisms

We developed an oceanic dispersion model and transfer model to marine organisms and sediment in order to assess the impact of radioactive materials on a marine environment. The oceanic dispersion model simulated the reduction of ^{137}Cs activity in seawater for three and half years [1]. The simulation of ^{137}Cs transfer to marine sediment estimated that the total amount in marine sediment was less than 10% of the total amount in seawater (Fig. 2) [2]. The biological simulation demonstrated that the transfer of ^{137}Cs via prey organisms is likely to delay radionuclide depuration from demersal fish [3].

3 Development of a simple monitoring method for a specific environmental radioactivity using a cumulative gamma radiation dosimeter

A simple monitoring method was developed as an alternative to inconvenient conventional methods (e.g., GM survey meter) to observe radiocesium translocation/circulation in forest ecosystems [4] using a cumulative gamma radiation dosimeter (Fig. 3). Results showed the detection significance of a specific dose of boughs/trunks of Japanese cherry trees and cedar trees from the background was comparable to that of conventional methods, although the correlation between dose and radiocesium activity concentration was low. Further improvement is necessary to increase the correlation by considering the self-shielding effect of tree bodies and radiocesium distribution in the bodies (O14002).

*1 Maximum surface concentration of a tracer on an equidistance arc from a source.

[1] TSUMUNE DAISUKE, Isotope news, 729, 36-40, 2015. (In Japanese).
[2] MISUMI KAZUHIRO, et al., Journal of Environmental Radioactivity, 136, 218-228, 2014.
[3] TATEDA YUTAKA, et al., Journal of Environmental Radioactivity, accepted, 2015.
[4] Yoshihara et al., Journal of Environmental Radioactivity, 138: 220-226 (2014).

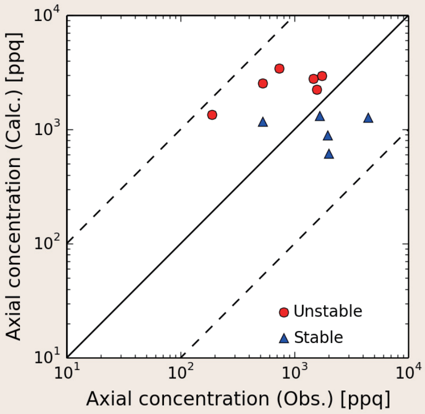

Fig. 1: Comparison of axial surface concentrations*1 (30 minutes average)

Observed and predicted axial surface concentrations on the equidistance arc of 1500 m from the source are compared. All data is plotted within the range of one tenth and ten times of the observation values under both the unstable and stable atmospheric conditions.

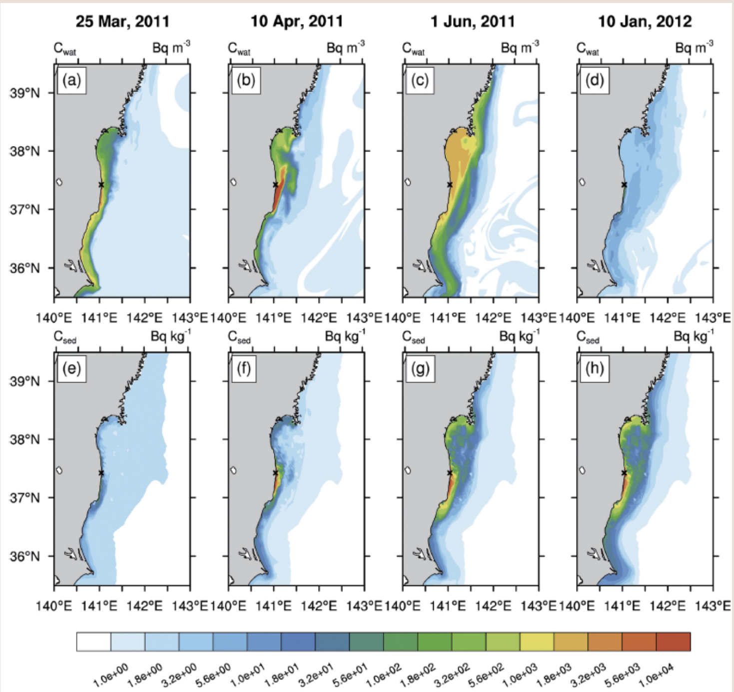

Fig. 2: Simulated ^{137}Cs activities in seawater and marine sediments

Simulated ^{137}Cs activities in seawater was reduced as a result of a decrease in direct release, however, simulated ^{137}Cs activities in sediment was increased due to transfer from seawater. Simulated values are in good agreement with observed values. Total amount of ^{137}Cs in sediment was estimated to be less than 10% of the total ^{137}Cs released into the ocean.

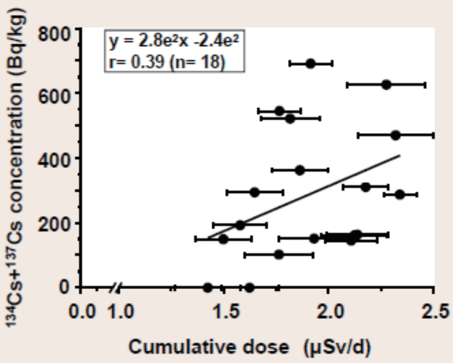

Fig. 3: A correlation between dose and radiocesium activity concentration by monitoring Japanese cedar trunks in a forest

Upper left: The cumulative dosimeter (D-shuttle, Chiyoda technol Co., Tokyo, Japan; 68×34×14 mm, 23 g) and the lead shield (3 cm thickness). Upper right: The attachment of the dosimeter in the shield on Japanese cedar. Bottom: A correlation between dose and radiocesium activity concentration observed under a contaminated BG (5.8 μSv/d).