5-1 Testing Environmental Assessment Models Using Chernobyl Data
—Validation of OSCAAR Models for Assessing Accident Consequences—

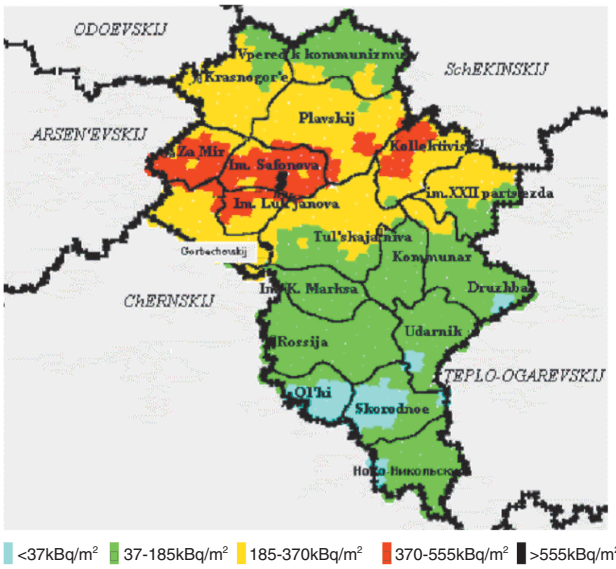

Fig.5-2 Soil contamination of ^{137}Cs in the Plavsk region
The model validation exercise was carried out with environmental data available on the Chernobyl accident in the Plavsk district about 200km south of Moscow. Although no measurements of ^{131}I concentrations in air and soil were made, the levels of ^{137}Cs soil contamination in all the settlements as well as meteorological data and information on inhabitants' lifestyle and food habits were available for testing model calculations. Soil contamination of ^{137}Cs was heterogeneous, ranging from 20 to 600kBq/m^2 due to rainfall during the movement of the radioactive cloud. Participants in this exercise were requested to estimate the contamination of ^{131}I in soil, transfer of ^{131}I in the food chain and thyroid dose to the residents.

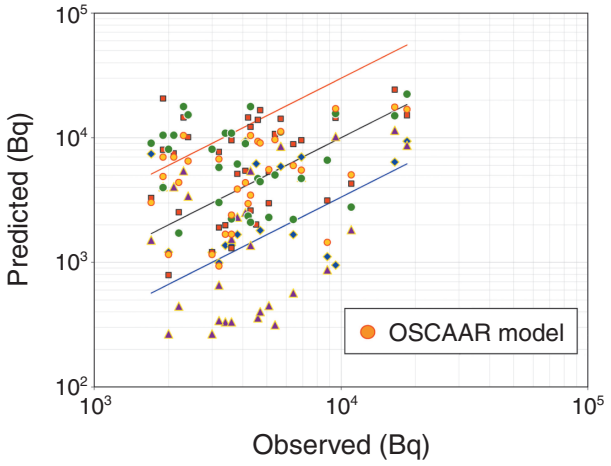

Fig.5-3 ^{131}I contents in thyroid of residents in the Plavsk region
This shows the predicted versus observed data of ^{131}I contents in thyroids of individuals from 15 settlements and Plavsk town. The results from five models including OSCAAR were shown in this figure. The blue and red lines indicate the range of 1/3 to 3 times the observed value. About 70% of the model predictions of ^{131}I contents in thyroid were within a factor of three of the observed values. The main uptake routes of radioiodine were inhalation of contaminated air and ingestion of contaminated food. This exercise showed that the iodine metabolic model which most participants used reasonably predicted the ^{131}I content in thyroids if the intake of radioiodine through the air-pasture-milk pathway was correctly inputted. The contribution of inhalation to ^{131}I content in thyroids was less than 10% of the total content.

Various kinds of mathematical models are used to assess the transport of radionuclides in the environment and to predict the potential pathways and levels of human exposure to the radionuclides. These models are used primarily to estimate the consequences to the public and the environment in which complete sets of measurements cannot be obtained: safety analysis of routine operations and accident situations of nuclear installations in a regulatory process, or dose reconstruction from past releases of radionuclides. When decisions on safety or acceptable levels of contamination for regulatory purposes are based on model results, it is essential to establish a degree of confidence in these results for the sake of scientific and public credibility.

In this regard, JAEA is conducting the research on validation of transport models of radionuclides in the environment using field measurements of various kinds of exposure situations, environmental media, and radionuclides through participation in international exercises aimed at the testing and validation of such models which have been conducted since the Swedish sponsored BIOMOVS program started in 1986.

In the BIOMASS and EMRAS programs organized by IAEA, particular attention was given to ^{131}I and ^{137}Cs which are important radionuclides for environmental assessment that are products of operation of nuclear power plants and fuel cycle facilities. We have tested the predictive capabilities of biosphere transport and exposure models in the OSCAAR computer code developed by JAEA for the probabilistic safety assessment of nuclear installations. Examples of model predictions compared with observed data are shown in Figs.5-2 and 5-3 for a test in which the transport models of radionuclides from air to plants, pasture to animal products and the metabolic model of radioiodine in human body were validated using observed data of ^{131}I and ^{137}Cs in media of the environment such as air, soil, plants and animals. Such exercises provided good opportunities for testing the predictive capabilities of models, evaluating the uncertainty in models and parameters, and improving the credibility of environmental assessment models.

Reference

Homma, T., Validation of Environmental Assessment Models and Assessment of Effectiveness of Protective Measures Using Data from Chernobyl ^{131}I Releases; IAEA EMRAS Programme, Hoken Butsuri, vol.43, no.3, 2008, p.234-245 (in Japanese).