Fukushima Mapping Project After the Fukushima Dai-ichi Nuclear Power Station Accident

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1. Introduction

An enormous amount of radionuclides were released from the Fukushima Dai-ichi Nuclear Power Station (FDNPS) accident, and part of them were deposited on ground in Japan. In order to obtain basic data to evaluate the impact of the accidental release, a national project for comprehensive environmental monitoring was launched in June 2011 [1], and is still continuing. In the so-called Fukushima mapping project, a series of large-scale environmental monitoring with diverse methods have been conducted, aiming to obtain information on contamination conditions in different aspects.

Several radionuclides released from the accident were observed in soil over wide areas soon after the accident. However, it turned out from rough estimation that radiocesium was far more important than other observed radionuclides from a viewpoint of long-term exposure doses [2]. Then, the environmental monitoring in the mapping project was mainly focused on radiocesium. Actually, gamma-radiation emitting radionuclides other than radiocesium have not been detected since 2013.

This article presents the measurement methodologies for distribution mapping of air dose rates and radionuclides deposition density adopted in our mapping project, and also discuss the temporal change in air dose rate and radiocesium deposition density through repeatedly conducted measurements.

2. Monitoring Methods

2.1 Monitoring in undisturbed field

To obtain fundamental data on contamination conditions in standardized places, measurements on air dose rate and deposition density have been carried out in undisturbed flat fields where the basic topographical features were similar and disturbance by human activities or flooding was unlikely to happen.

Air dose rates were measured using standard surveymeters basically at approximately 6500 locations in 80-km zone from the FDNPS [3]. While, for determining deposition densities, soil samples were collected and analyzed at laboratories in 2011[2], In-situ measurement using portable germanium detectors have been adopted basically at approximately 380 locations within the 80 km zone since 2012 [4].

2.2 Monitoring along roads

Important technology for measuring the air dose rate was the second generation of the car-borne survey system, KURAMA-II developed at Kyoto University [5]. KURAMA-II is compact and easy to operate; anyone can run the system by connecting a plug to a power supply of a car. This feature enabled us to construct a detailed air dose rate distribution map in a short time in collaboration with staff of municipalities. Consequently, the total mileage of the roadway measured per a campaign was approximately 85,000 km at maximum. Further, by carrying a KURAMA-II on walker's back, the air dose rate in living environment along roads including small paths where vehicles are difficult to access can be measured.

3. Result and discussion

Fig. 1 shows distribution maps of the air dose rates at 1 m above the ground as of six different occasions over five years (2011 – 2016) that were created from the obtained dose rate data and positional data. The air dose rates drastically decreased in five years after the accident. Excessive dose-rate reduction than physical decay in undisturbed flat fields is observed. The air dose rates above roads have decreased much faster than those at undisturbed flat fields. Human activities such as decontamination, car driving, cultivation, cleaning, weeding, etc. were considered to accelerate dose rate reduction. In contrast, the average deposition density of radiocesium in non-decontaminated filed was observed to have decreased almost according to physical decay both for ^{134}Cs and ^{137}Cs [4].

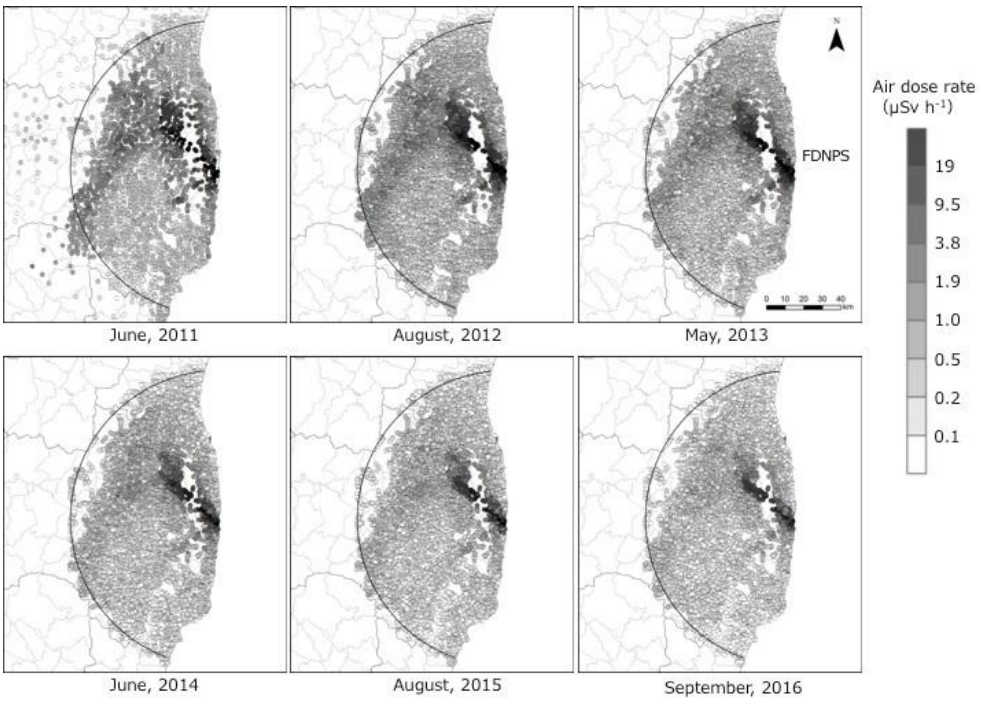

Fig. 1. Distribution maps of air dose rate around the Fukushima Dai-ichi Nuclear Power Station by handheld surveymeters.

4. Conclusion

The distribution maps on air dose rate and radiocesium deposition density were constructed on the measured data at different occasions. Then, the time-dependent deceasing tendency of air dose rate, and that of deposition density were shown on the basis of the monitoring results.

Acknowledgement

This report summarized the knowledge obtained in a series of commissioned studies called distribution- mapping project from the Nuclear Regulation Authority.

REFERENCES

[1] Saito, K., Onda, Y., Outline of the national mapping projects implemented after the Fukushima accident. J. Environ. Radioact. 139, 240-249. 2015.

[2] Saito, K., Tanihata, I., Fujiwara, M., Saito, T., Shimoura, S., Otsuka, T., Onda, Y., Hoshi, M., Ikeuchi, Y., Takahashi, F., Kinouchi, N., Saegusa, J., Seki, A., Takemiya, H., Shibata, T., 2015. Detailed deposition density maps constructed by large-scale soil sampling for gamma-ray emitting radioactive nuclides from the Fukushima Daiichi Nuclear Power Plant accident. J. Environ. Radioact. 139, 308-319.

[3] Mikami,S., Maeyama, T., Hoshide, Y., Sakamoto, R., Sato, S., Okuda, N., Sato, T., Takemiya, H., Saito, K., The air dose rate around the Fukushima Dai-ichi Nuclear Power Plant: its spatial characteristics and temporal changes until December 2012. J. Environ. Radioact. 139, 250-259. 2015.

[4] Mikami, S., Maeyama, T., Hoshide, Y., Sakamoto, R., Sato, S., Okuda, N., Demongeot, S., Gurriaran, R., Uwamino, Y., Kato, H., Fujiwara, M., Sato, T., Takemiya, H., Saito, K., Spatial distributions of radionuclides deposited onto ground soil around the Fukushima Dai-ichi Nuclear Power Plant and their temporal change until December 2012. J. Environ. Radioact. 139, 320-343. 2015.

[5] Tsuda, S., Yoshida, T., Tsutsumi, M., Saito, K., Characteristics and verification of a car-borne survey system for dose rates in air: KURAMA-II. J. Environ. Radioact. 139, 260-265. 2015.