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Estimation of the source term of radioactive materials discharged into the atmosphere during the Fukushima Daiichi Nuclear Power Station accident

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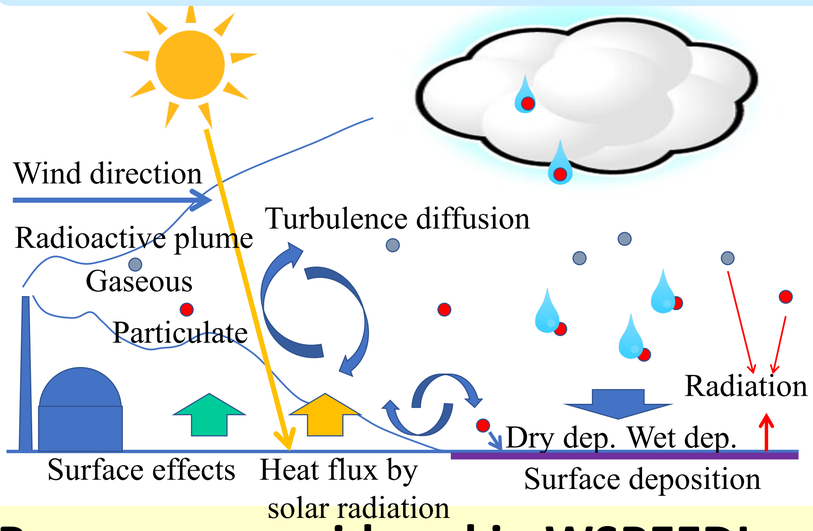
1. Introduction

- To evaluate the environmental impacts and resultant radiological doses to the public due to the accident, the source term of radioactive materials discharged into the atmosphere was estimated and updated in a series of research[1] conducted by Japan Atomic Energy Agency (JAEA).
- The source term was reversely estimated from environmental monitoring data with an analysis method using an atmospheric dispersion simulation model WSPEEDI[2] developed by JAEA.

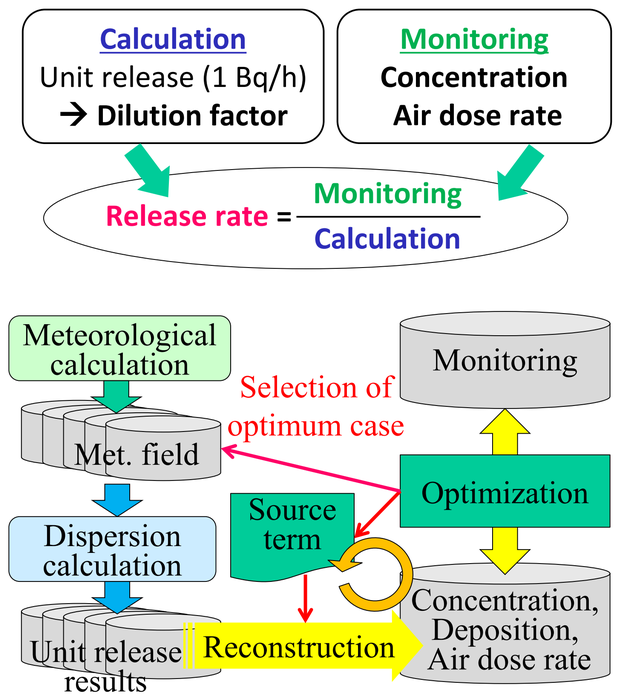
2. Method of source term estimation

Atmospheric dispersion simulation



Processes considered in WSPEEDI:
These processes are simulated by numerically solving the equations for meteorological conditions and atmospheric dispersions.

Reverse estimation method

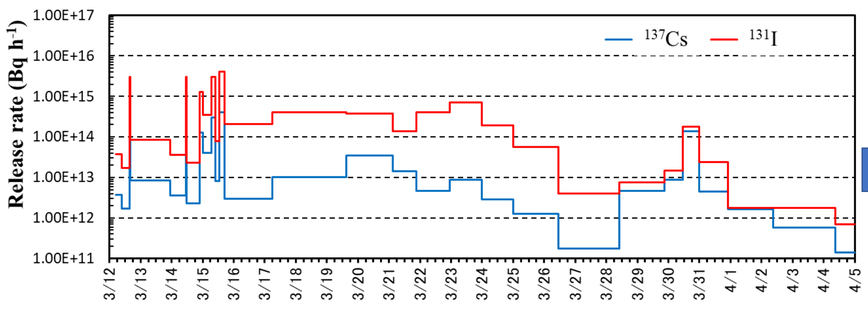


Simple method:
- Release rates at times corresponding to monitoring data were obtained by dividing measured air concentrations into calculated ones under the assumption of unit release rate (dilution factors).

New method:
- Combination of ensemble meteorological calculations and the Bayesian inference.
- Improve not only the source term but also meteorological field by selecting the optimum case from ensemble members of meteorological calculations.

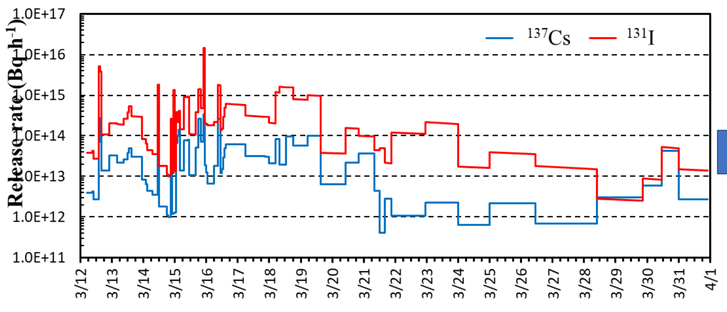
3. Results

Estimated source term



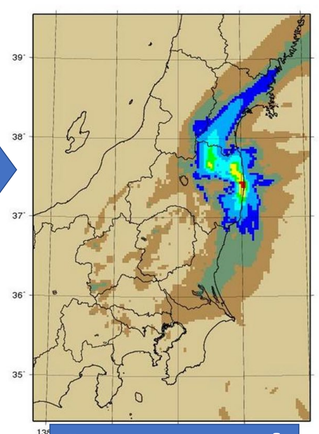
Terada et al. 2012: simple method
→ used in UNSCEAR 2013 report

Updated

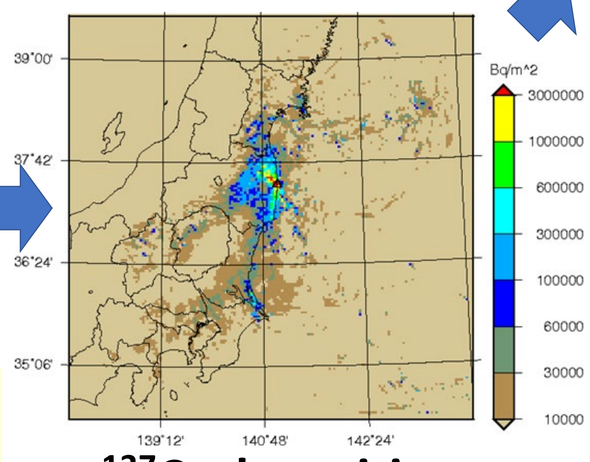


Terada et al. 2020: new method with new model and data

Simulation results

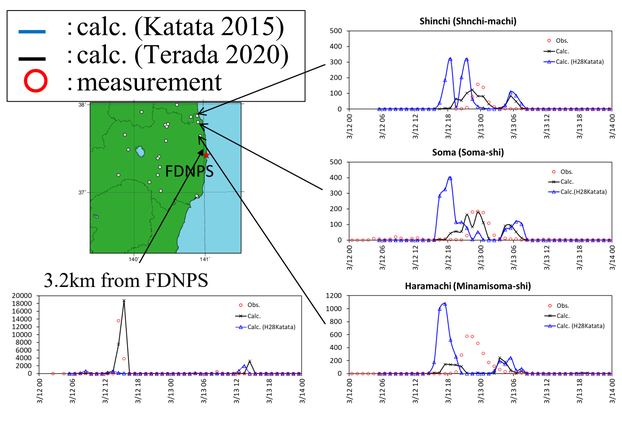


Improved



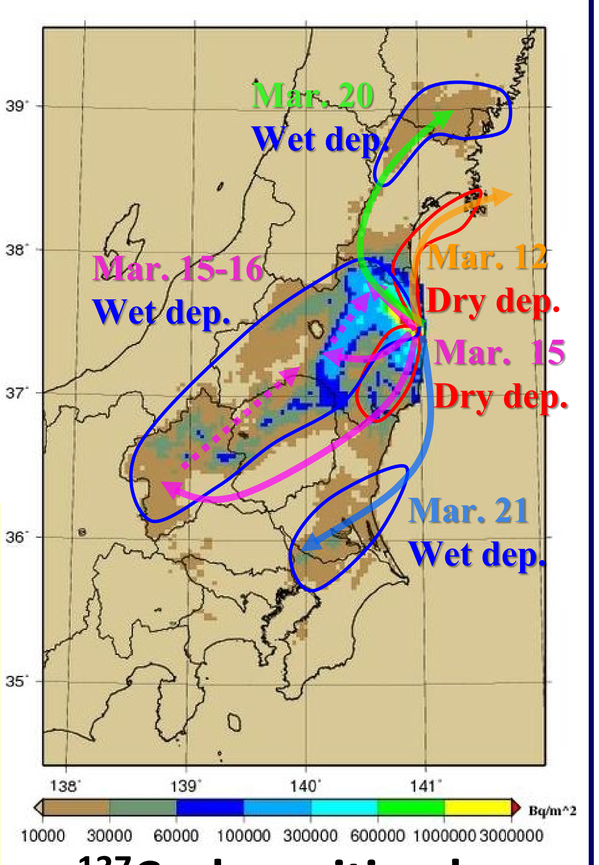
^{137}Cs deposition

Formation process of deposition



^{137}Cs concentration

- Successfully reproduced air concentrations at monitoring points and surface depositions by airborne monitoring.
- Elucidated formation process of land surface contamination.
- Used in the dose estimation project[3].



^{137}Cs deposition by airborne monitoring & formation process

References: [1] Chino et al. 2011: J. Nucl. Sci. Technol. 48, 1129; Terada et al. 2012: J. Environ. Radioactiv., 112, 141; Katata et al. 2015: Atmos. Chem. Phys. 15, 1029; Chino et al. 2016: Sci. Rep., 6, 31376; Terada et al. 2020: J. Environ. Radioactiv., 213, 106104. **[2]** Terada et al. 2020: J. Nucl. Sci. Technol., 57, 745. [3] Ohba et al. 2020: Sci. Rep., 10, 3639.