Development of Source Term Estimation System for a Nuclear Accident

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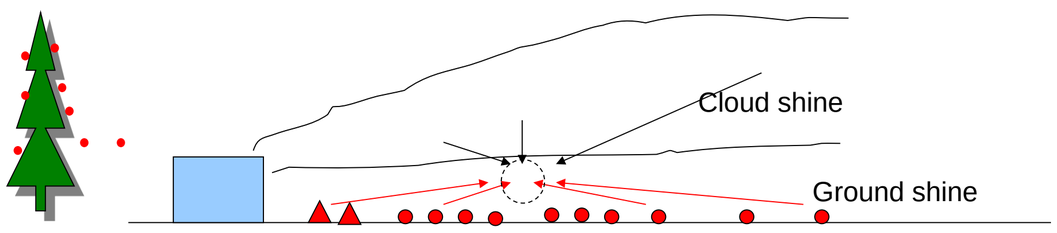
1.Introduction

For the aim of improving the accuracy of the emergency response system, we have developed techniques of Source Term Estimation (STE) in collaboration with The University of Tokyo. The technique gives us the amount of the radioactive substances released during a nuclear accident from observational dose data and transfer coefficient data which were made by atmospheric dispersion model, by solving the system of equations using the Residual method.

2. Needs to separate Cloud-shine and Ground-shine

Dose observation data need to be separated to cloud-shine dose and ground-shine dose, as an input to the STE program.

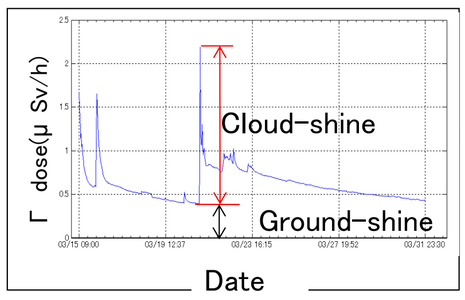


3. Data Filtering Technique

We have developed a digital filtering function which outputs the filtered data by finding high peaks from the time series of raw dose data automatically by high pass filter functions. This function enables us to estimate the source intensity from the radiation dose of observed data without the ground-shine, and the calculated one by dispersion model not deposition model.

Deposition model has more uncertainty than dispersion model. Therefore, we can estimate the source intensity from the filtered cloud-shine data with higher accuracy, than the conventional radiation dose data including the cloud-shine and the ground-shine data.

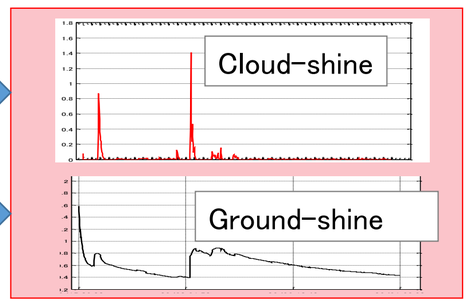
(a) Original data



High-pass filter

Low-pass filter

(b) Filtered data



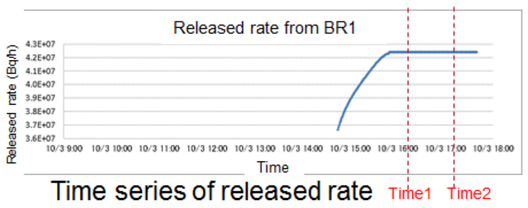
4. Uncertainty of wind direction

Using radiation dose data from a research reactor in Mol, Belgium, the STE method was validated from a viewpoint of the effect of wind direction uncertainty on the accuracy of STE. The meteorological model, RAMS, and Elite, which is atmospheric dispersion and dose evaluation model developed by MHI, were used for calculating transfer coefficient (TC) data. The TC data got the accuracy of STE to be low due to the difference of wind direction between the simulation and the observation. While, when the TC distribution is spatially shifted on purpose so that the difference gets smaller, the accuracy of STE was found to be improved.

◆Test case：Field experiment in Mol, Belgium

◆Contents：

Estimate released rate during the period when the released rate is continuous（2001/10/3 16:00～17:00）

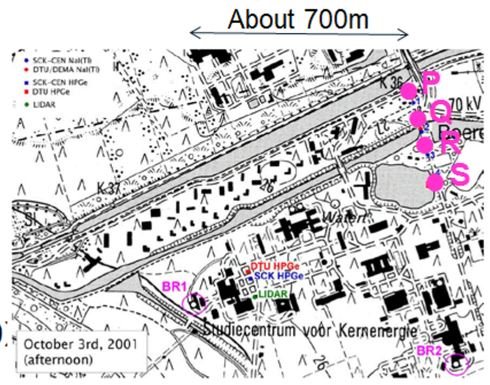


Time series of released rate Time1 Time2

Input Data

・Observed value：Dose rate at the points P～S
（10-minutes averaged data at 16:00 and17:00）

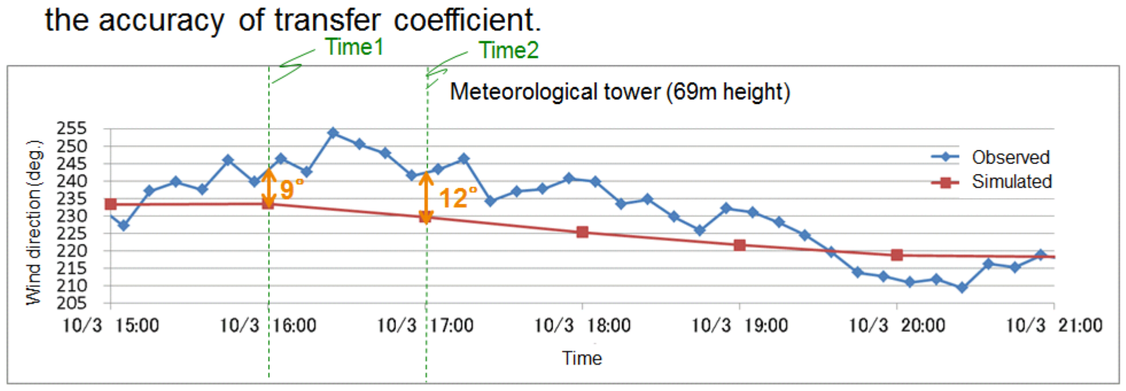
・Transfer coefficient：simulated dose values by MEASURES（source strength is 1 Bq/sec.）



Release point（BR1）
and Observation points(P,Q,R,S)

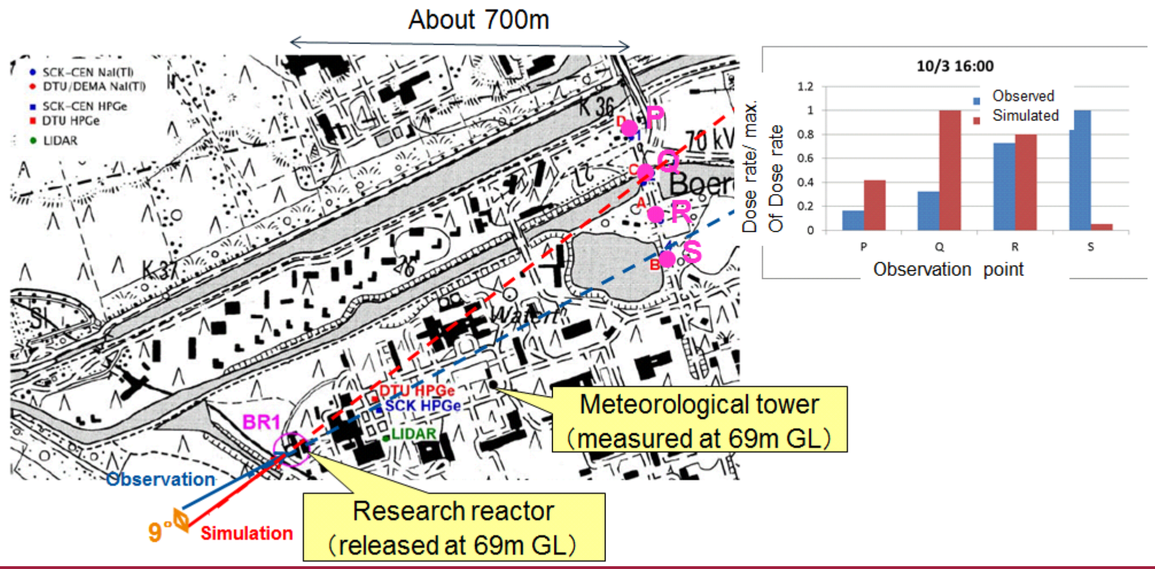
・The accuracy of STE depends of the accuracy of transfer coefficient .ie. dose distribution by atmospheric dispersion simulation.

・Wind direction in one of the uncertainty factors which attects the accuracy of transfer coefficient.

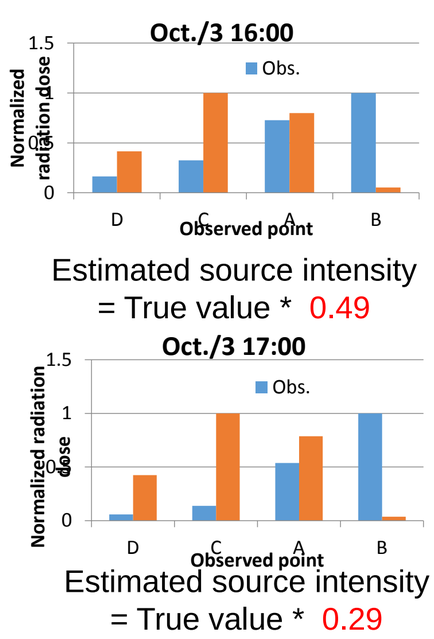


Comparison of simulation and observation

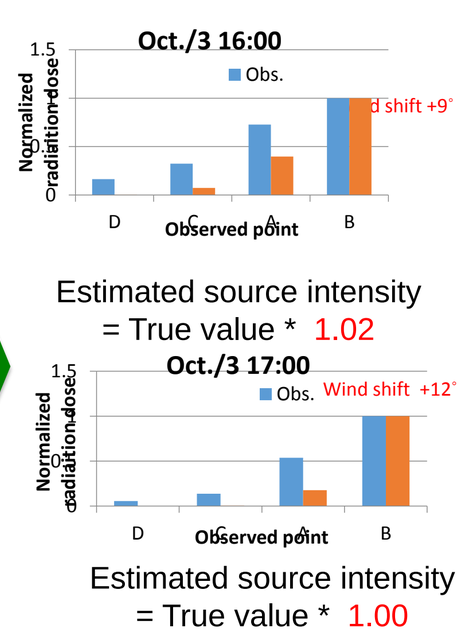
Wind direction and Dose distribution



Without shift od wind direction

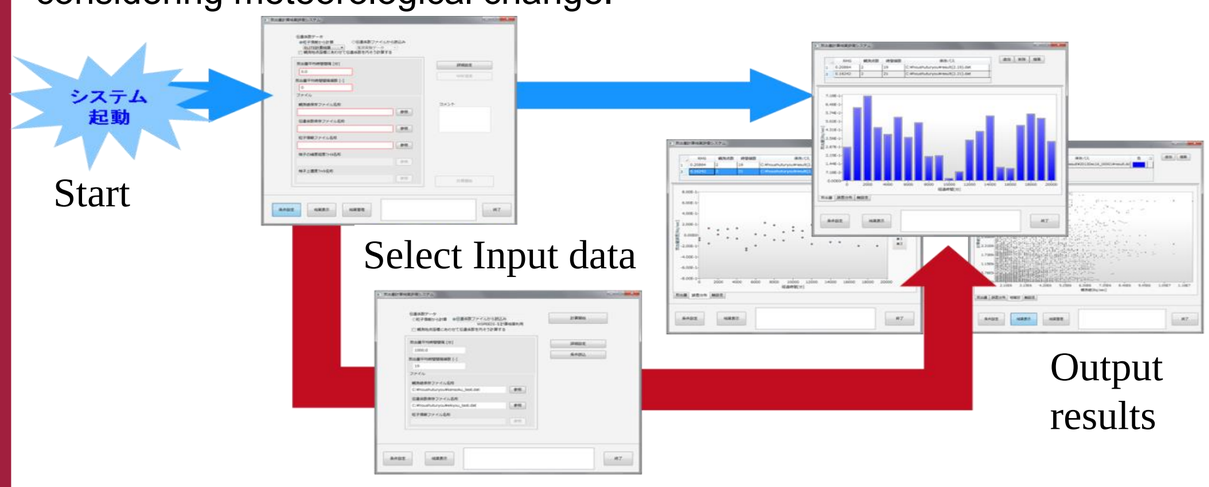


With shift of wind direction



5. Integrated Source Term Estimation System

Utilizing the data filtering function and the STE method, we have developed an integration system for STE for a nuclear accident. The system consists of 3 kinds of subsystems; observational data filtering subsystem, STE subsystem for emergent response, and STE subsytem for detail analysis. The second subsystem is used when you want to know the amount of relseased substances within an hour more or less, while the last subsystem is used when you want to analyze it, considering meteorological change.



Acknowledgements

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