A Radiation Estimation Method for use in the Initial and Intermediate Stages of a Nuclear Accident

Ryohji Ohba, Minsik Kim, Masamichi Oura, Shinsuke Kato (The University of Tokyo),
Masayuki Takigawa (JAMSTEC) , Paul Bieringer (NCAR) , Bent Lauritzen , Martin Drews (RISO)

1. Introduction

The rapidly evolving series of events experienced during the Fukushima Dai-ichi nuclear power plant accident highlighted the need for a capability for rapidly defining the evacuation zones needed to protect people from the radiation exposure. To address this need, the University of Tokyo has conducted the 3-year research program, sponsored by the Ministry of Education, Culture, Sports, Science, and Technology (MEXT), since 2012FY.

2. Research schedule

Table 1 Research schedule

Subjects	FY2012 (Development of fundamental tech.)	FY2013 (Validation test)	FY2014 (System integration)	
(1)Source Term Estimation (Tokyo Univ.)	Programing	Validaiton test	System integration	Initial Stage (Few Weeks)
(2)Data pre-processing (MHI)	Programming	Installing input data	Integration test	
(3)Long term exposure (Tokyo Univ.)	Data analysis	Improvement of ERMIN code	Estimation of Long term radiation dose	Late Stage (Few years)
International collaborations	a)Kick-off meetings b)Invitations from LLNL and NCAR	a)Visiting at RISO b)Participation into international conf.	a)Closing meetings	

3. Results

3.1 Development of Source Term Estimation (STE) method

We developed the following new techniques for STE, in order to enhance the availability and to accelerate the computation speed.

1) To use the database system of Transfer Coefficient Matrix (TCM) calculated by meteorological models, such as WRF/CHEM, RAMS/HYPACT, WSPEEDI and so on, for the post re-analysis of the accidental release.

2) To use TCM calculated by the Gaussian plume model fitted with wind tunnel data for the standard monitoring point placed around the site boundary of nuclear power station, for the real-time analysis of the emergency response.

3) To easily adjust the averaging time of source intensity and the number of monitoring points, for the operational use by non-expert users.

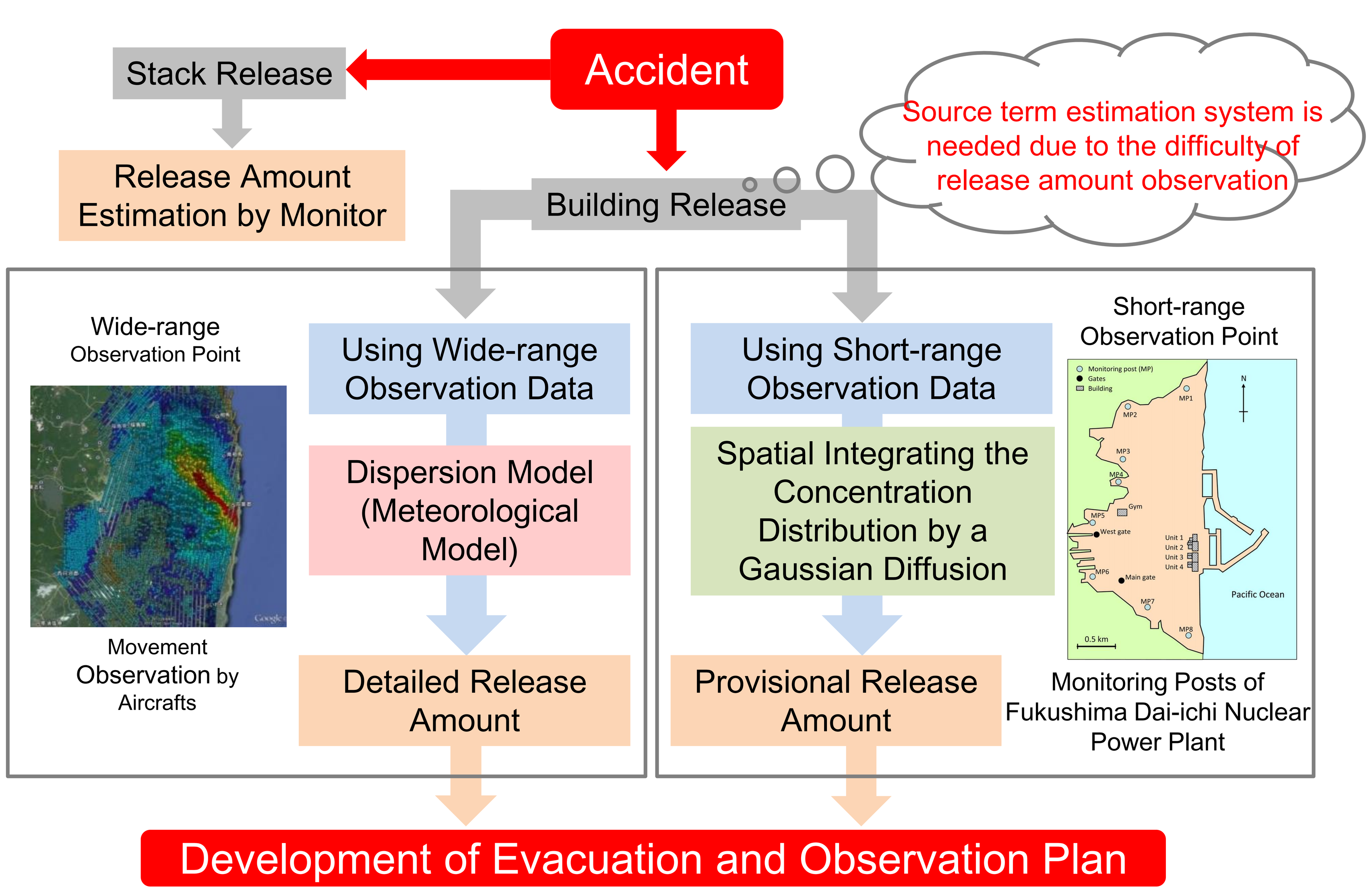

Fig.1 Calculation scheme of STE method developed

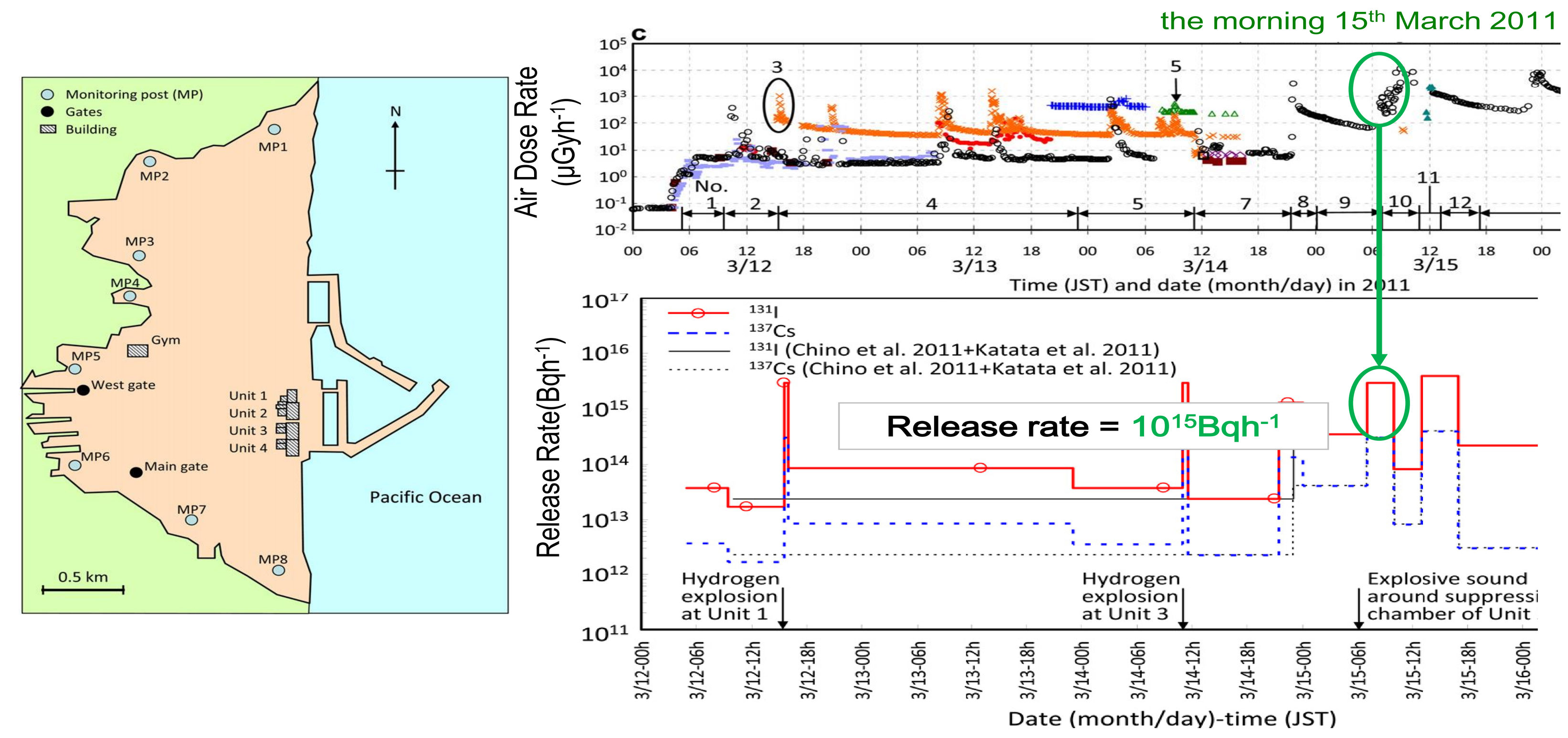

Fig. 2 Estimation of source intensity at Fukushima accident

3.2 Development of Integrated STE system

We developed the operational STE system integrating the following modules.

(1) Data pre-processing module
To filter, select and statistically process the observed data

(2) Source Term Estimation module

(3) Reliability evaluation module
To evaluate the reliability of the estimated results

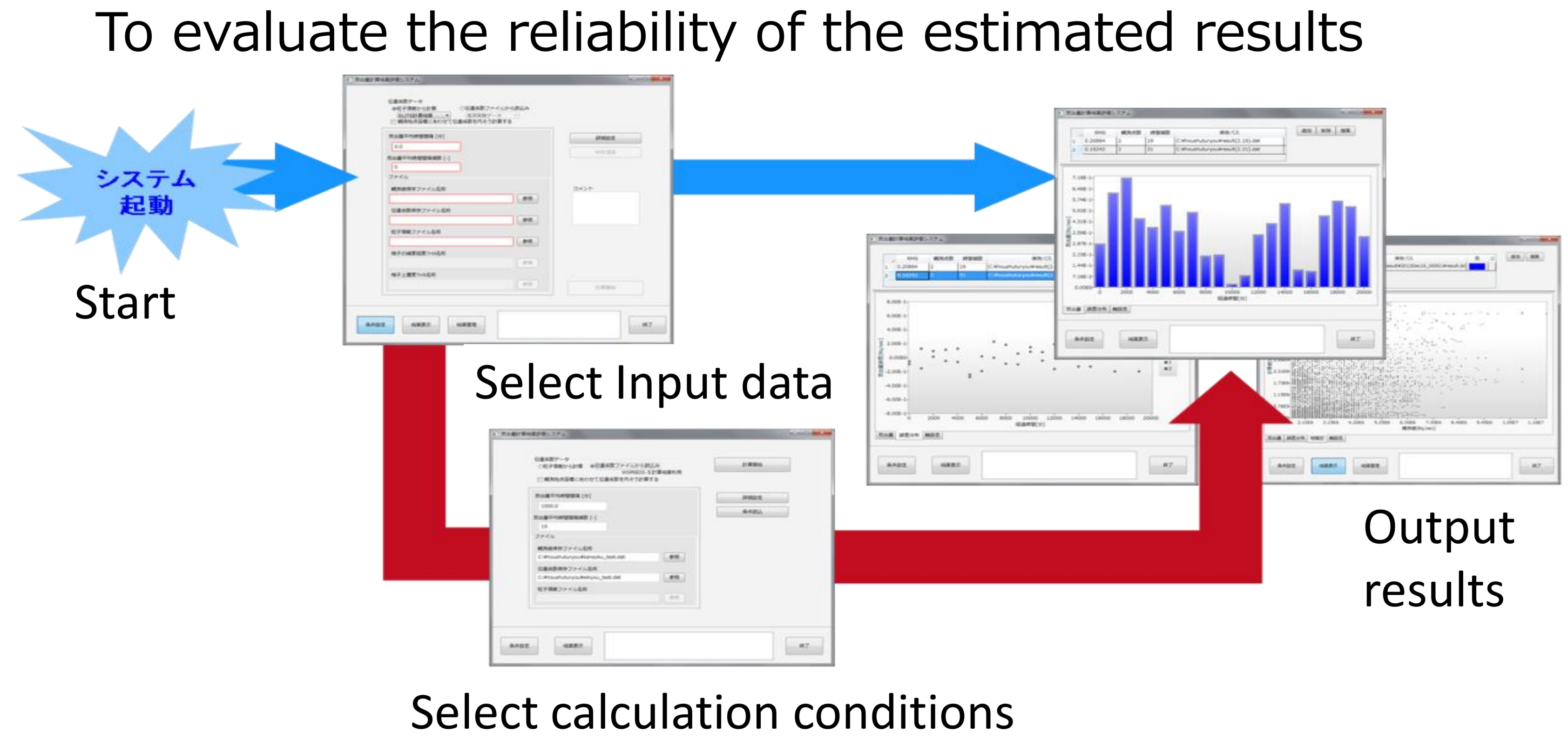

Fig. 3 Integrated Source Term Estimation system

3.3 Validation of ERMIN code for long term radiation dose in Fukushima area

We validated ERMIN (EuRopean Model for INhabited areas) code with the observed data on radiation dose rate in Fukushima area, as shown in Fig. 4. It was found from Fig. 4 that ERMIN code can estimate the long term radiation dose in Fukushima area in consideration with the de-contamination measures.

We also analyzed the deposition velocity and the re-suspension factor from the observed data of concentration, falling dust amount and soil contamination. They were also found to match with the default data of ERMIN code.

a)Fukushima city b)Kouriyama city

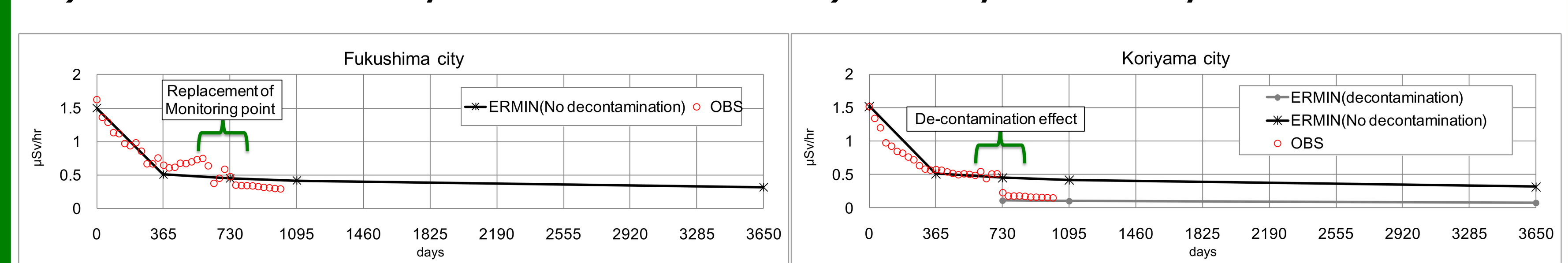

Fig. 4 Comparison of observed and estimated radiation dose rate

Acknowledgements

The present study has been conducted with the technical support of many international collaborators in US and EU.
This study is the result carried out under the Strategic Promotion Program for Basic Nuclear Research by the Ministry of Education, Culture, Sports, Science and Technology of Japan.

(Corresponding author(s): Ryohji Ohba, 0hba@iis.u-tokyo.ac.jp)