

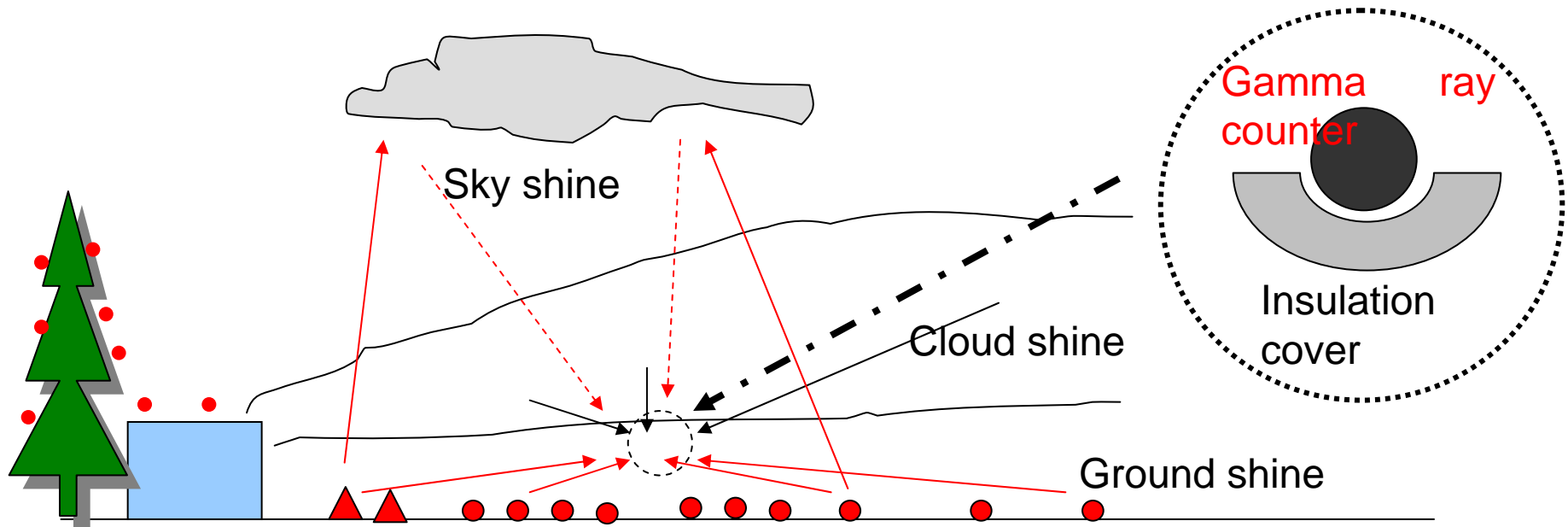
Survey of estimation method for amount of radioactive materials emitted from nuclear power station during severe accident

Dr. Ryohji Ohba (Nuclear Safety Research Association)

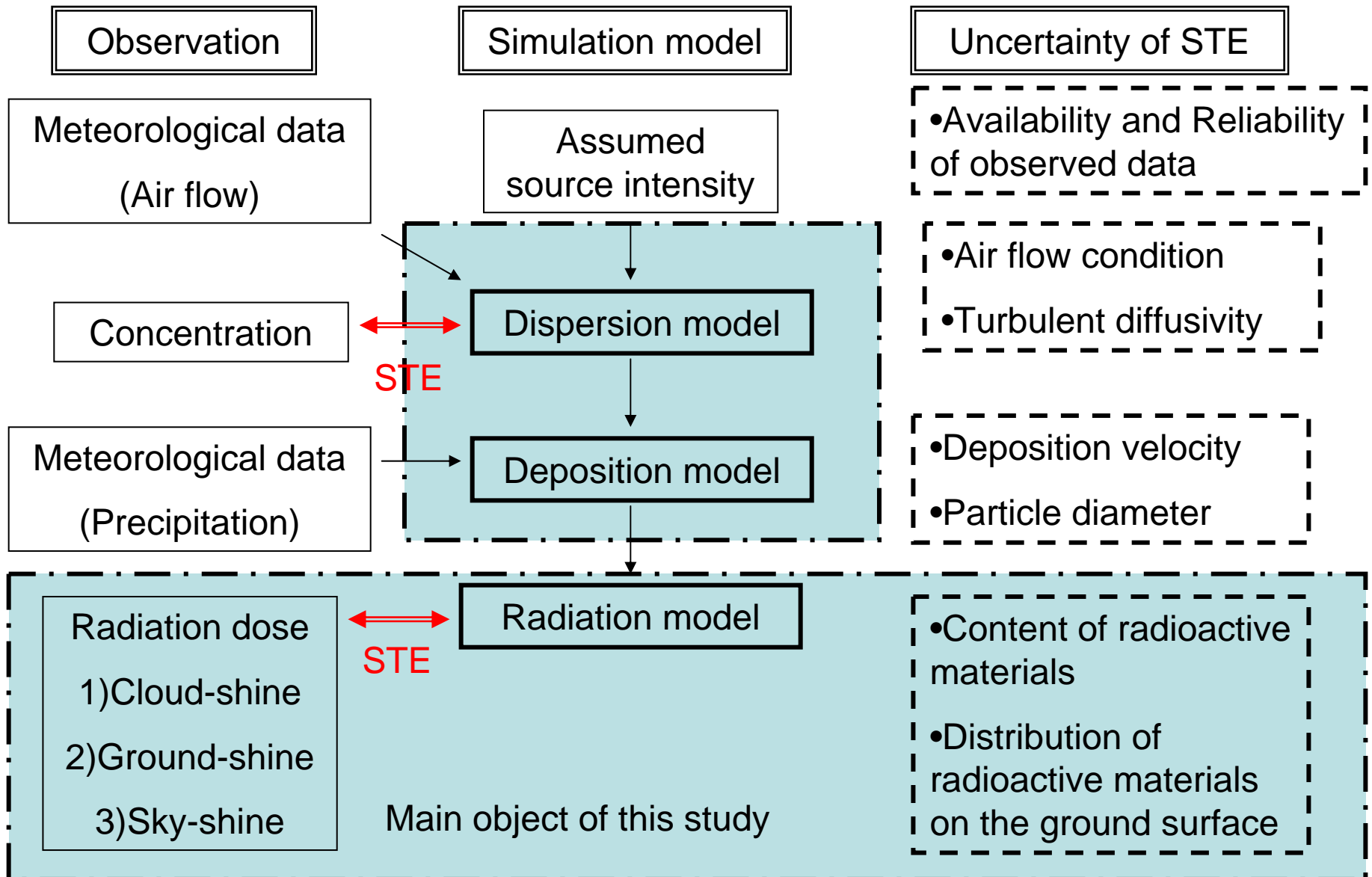
- Funded by Ministry of Education and Science (MEXT)
- Contracted by Japan Science and Technology Agency (JST)
- Conducted by Nuclear Safety Research Association (NSRA)

Actual difficulties of nuclear accident

- Unsteady wind field
- Cloud shine +ground shine +Sky shine
- Wet & Dry depositions
- Multiple radioactive materials released
- Limited data observed



Flow Chart of Source Term Estimation (STE)

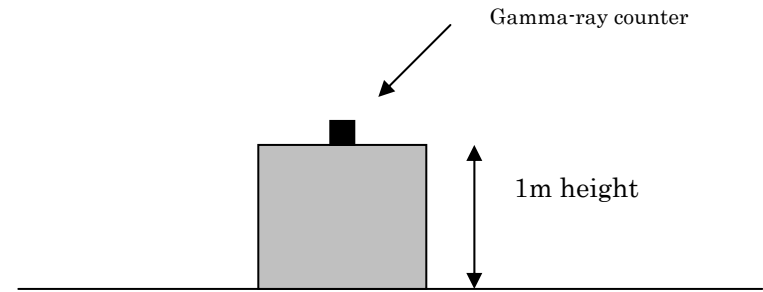


Examples of STE methods applicable for nuclear accident

Organization name (Code)	Observed data	Simulated data	Release condition	STE METHOD
JAEA (SPEEDI)	Dust sampler	Concentration in the air	Quasi-steady with time during 30 min.	Comparison between simulation & observation
	Radiation dose	Cloud, ground & sky-shines		
MHI (MEASURES)	Radiation dose	Cloud-shine	Unsteady with time	Variation technique
RISO (RIMPUFF)	Radiation dose	Cloud-shine	?	Kalman filter
LLNL (NRAC)				

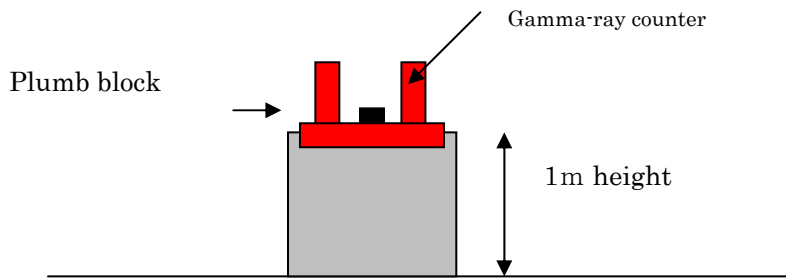
Measurement of radiation dose excluding ground and sky shines

1. Without shield (conventional method)

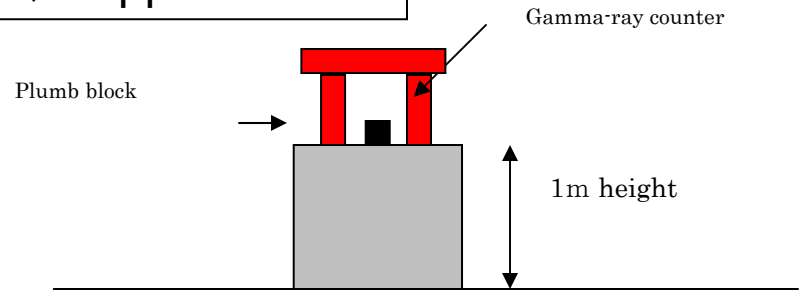


2. With shield (Improved method)

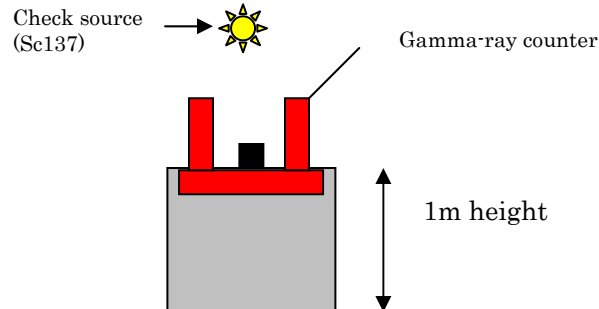
2-a) Lower shield



2-b) Upper shield



2-c) Lower shield
+ Check source



- in Tokai nuclear power station
- 2011.12.16

Photos of measurement condition

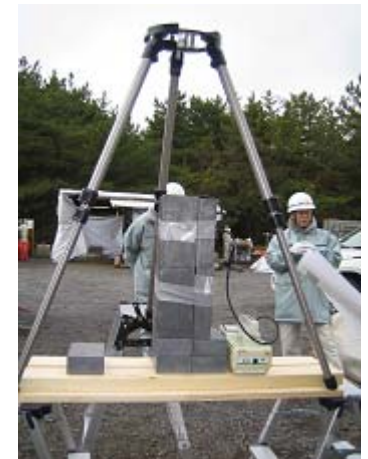
2-a) Lower shield



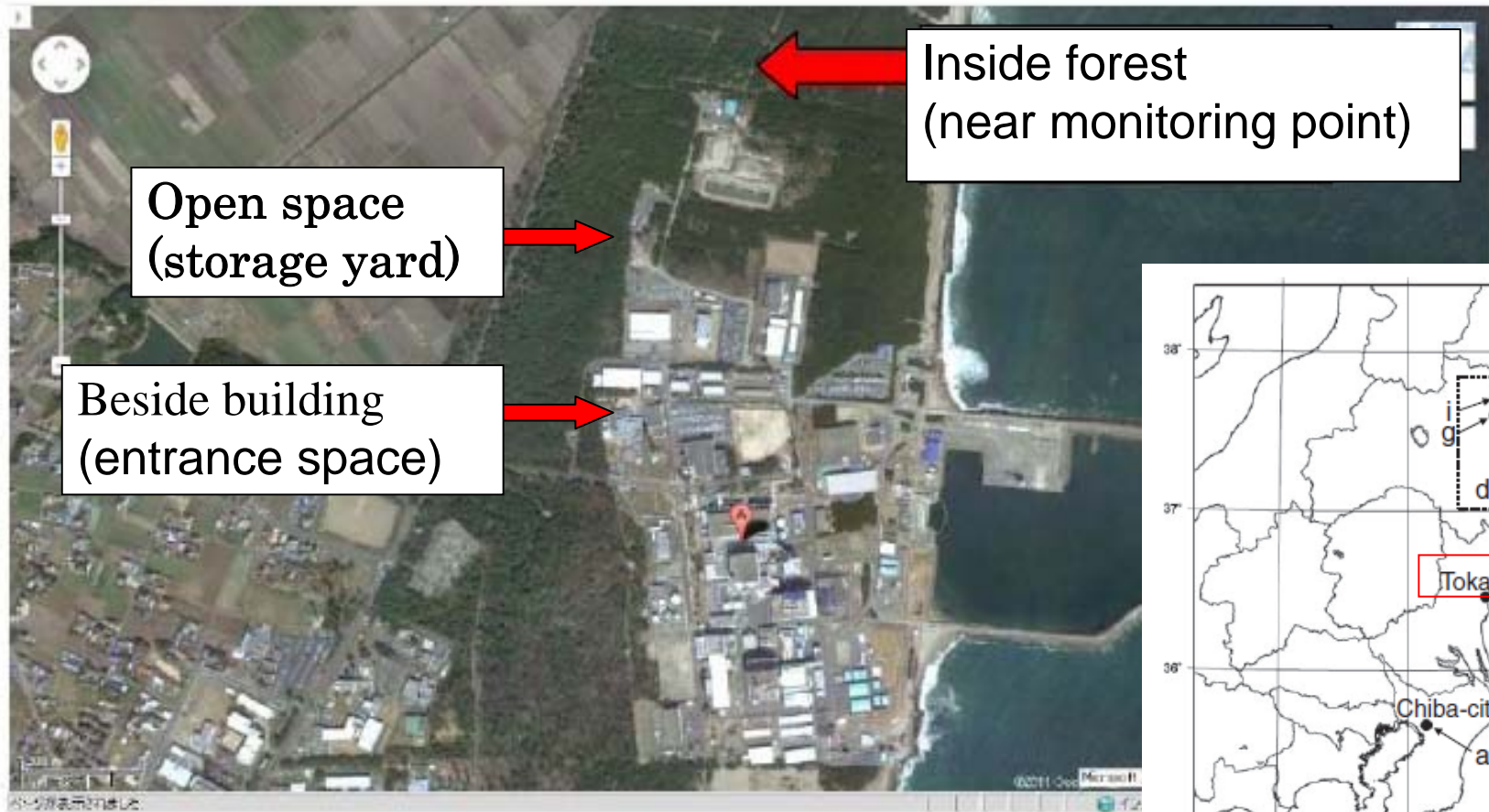
2-b) Upper shield



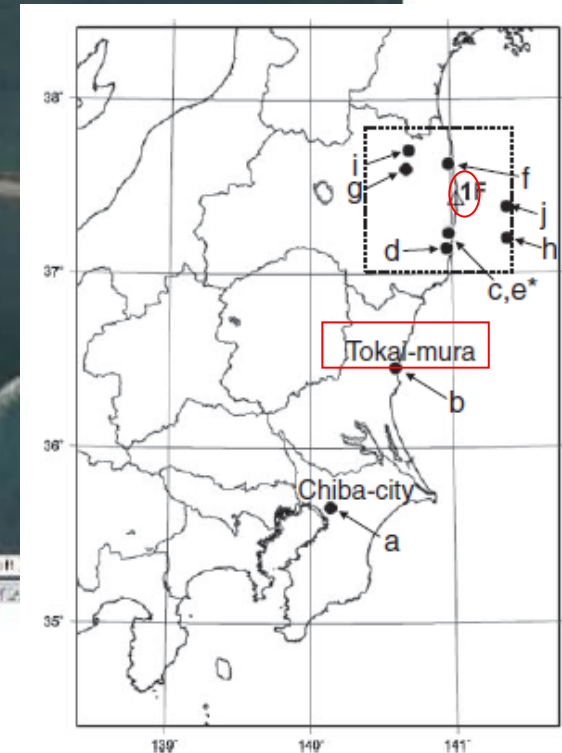
2-c) Lower shield + Check source



Observation points in Tokai nuclear power station

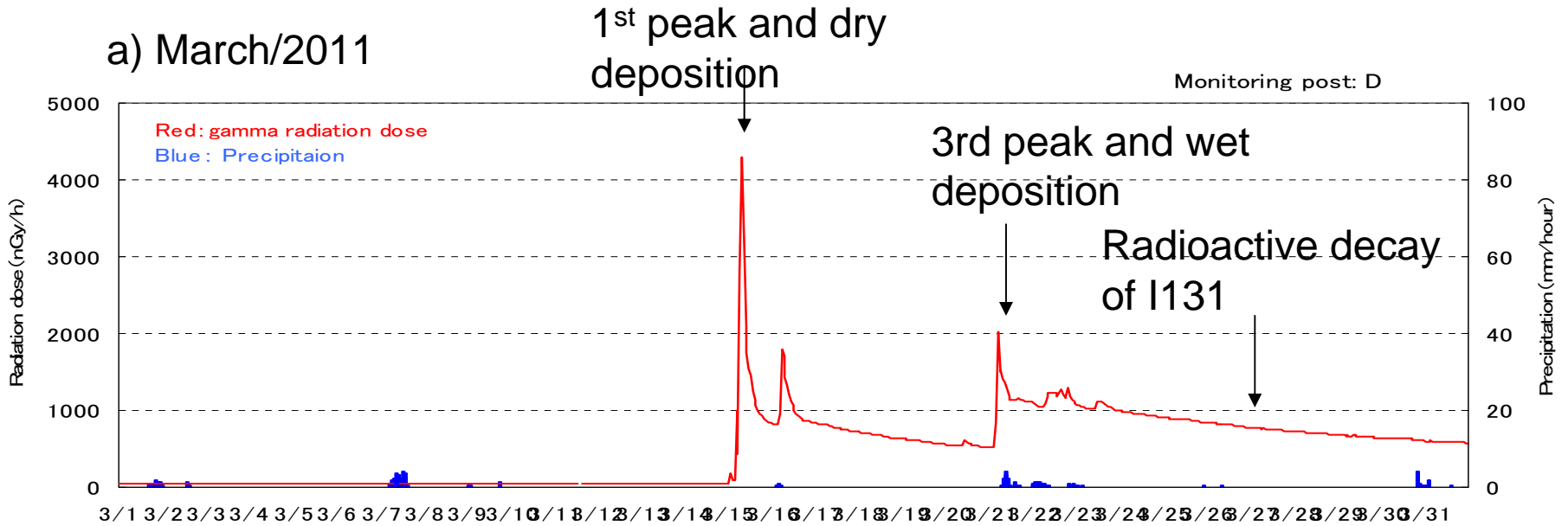


• observation in
2011.12.16

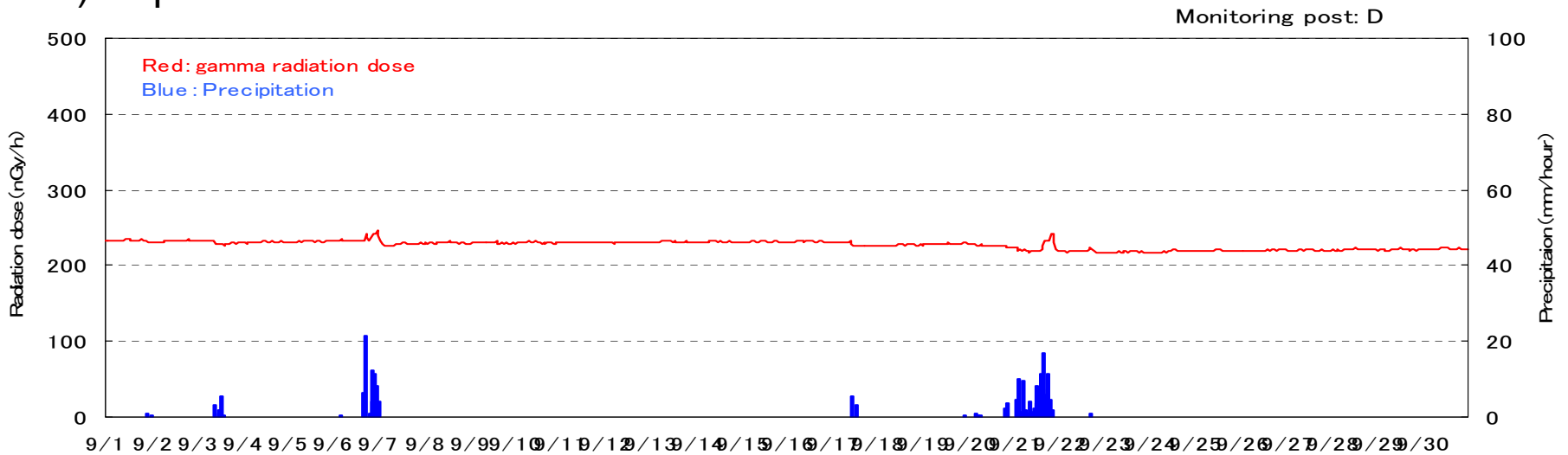


Time history of monitoring data

a) March/2011



b) September/2011



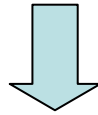
Observed data (μ Sv/h)

Shield condition	Beside building	Open space	Inside forest	Notes
Case1 (No shield)	0.10	0.16	0.25	
Case2-a (Lower shield)	0.01	0.01	0.01	
Case2-b (Upper shield)	0.03	0.04	0.05	
Case2-c (+ 1Check source)	0.02	0.03	0.03	
Case2-c' (+ 4Check sources)	0.04	0.09	0.09	

• observation in Tokai, 2011.12.16

The emergency response system of the government, named SPEEDI could not be well operated at the Fukushima accident, due to the lack of data on source intensity.

1. Most of radioactive material was released from broken space of the reactor building, not the stack, instantaneously at the time of explosion on 15th March
2. Monitoring and network systems stopped after the earthquake, due to the shutdown of electric power



Necessary research subject

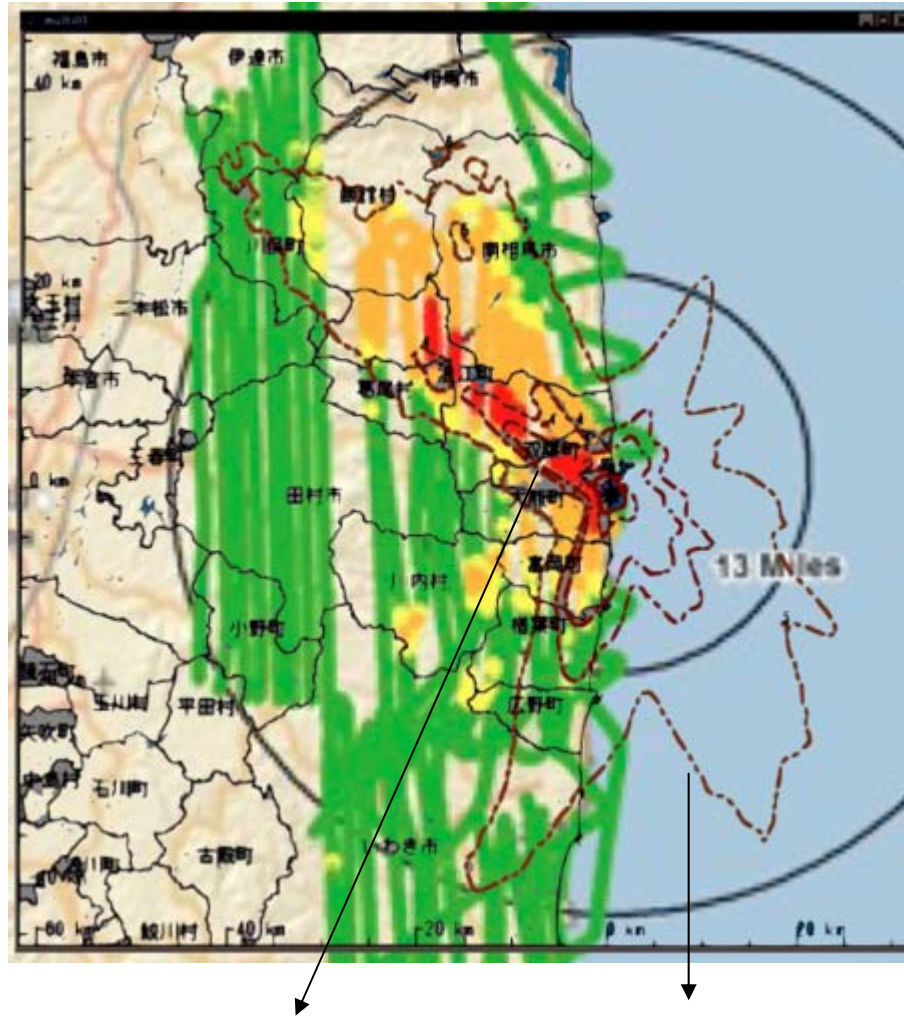
Technique for Identification of source intensity from

- ① Data of radiation dose measured by mobile gamma ray counter, including the effect of the ground shine due to radioactive materials deposited on the ground surface (real time data)
- ② Data of concentration measured by dust sampler (time averaged data)

Draft plan of the proposal to Japan Science and Technology Agency

items	Japan	USA
Project leader	Dr. M. Yagawa (President, Nuclear Safety Research Association: NSRA)	Dr. Paul Bieringer (National Center for Atmospheric Research)
Research members	Prof. Shinsuke Kato (Tokyo Univ.) Prof. Hiromi Yamazawa (Nagoya Univ.) Dr. Haruyasu Nagai(JAEA) Dr. R. Ohba (NSRA) et al.	Dr. Steve Hanna (Harvard Univ.) Luca Delle Monache Jeff Copeland George Bieberbach Ian Sykes
Tasks	<ol style="list-style-type: none"> 1) Analysis of data on radiation dose of gamma ray and dust sampler 3) Making of a final report 	<ol style="list-style-type: none"> 1) Joint technical meeting 2) Information on source term estimation techniques
Sponsor	Japan Science and Technology Agency (JST) and Ministry of Education and Science	DTRA

Information on Fukushima Accident(1)



Airplane measuring data by US/DOE (color) and calculated results by Japan/SPEEDI (contour)
(airplane data: converted from measured radiation data at high level to surface, green color is flight route)
(source intensity of SPEEDI is estimated from dust sampling data near the power station)

Information on Fukushima Accident(2)

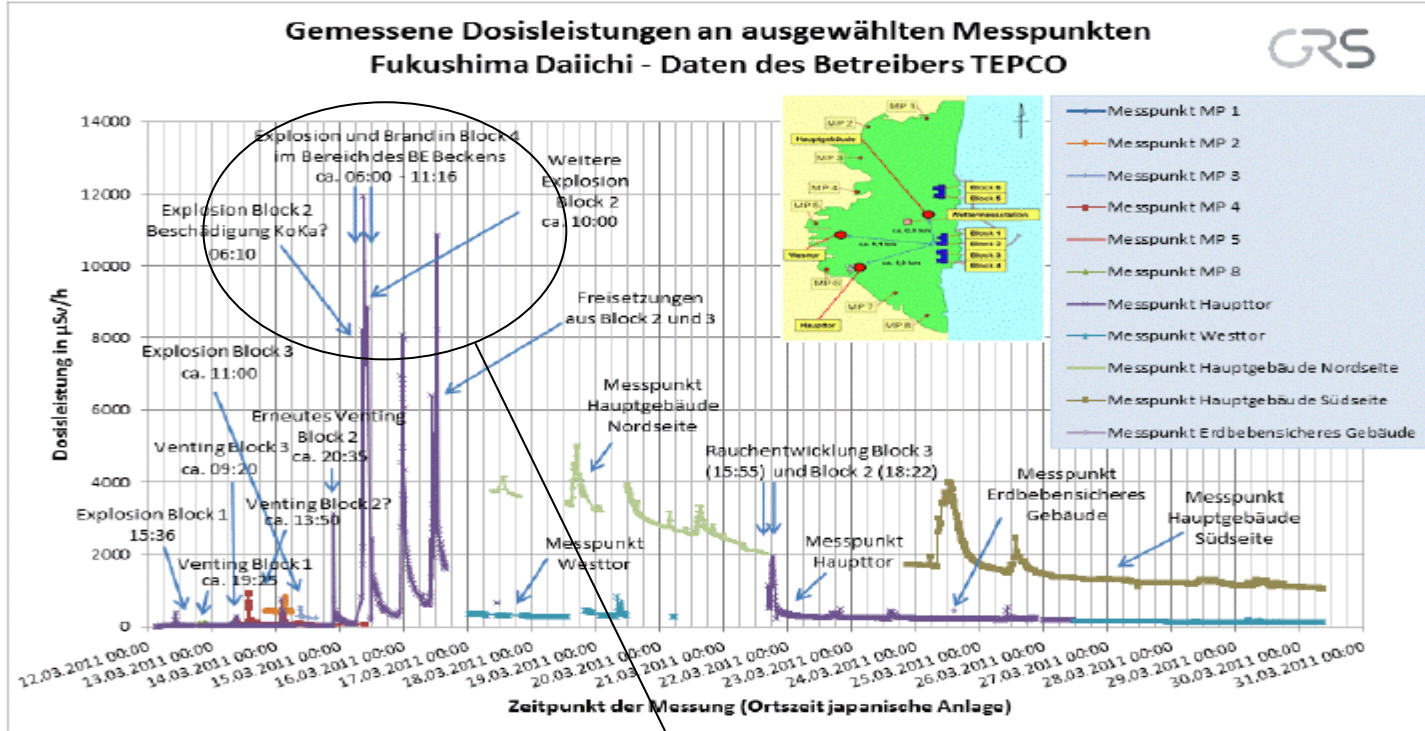
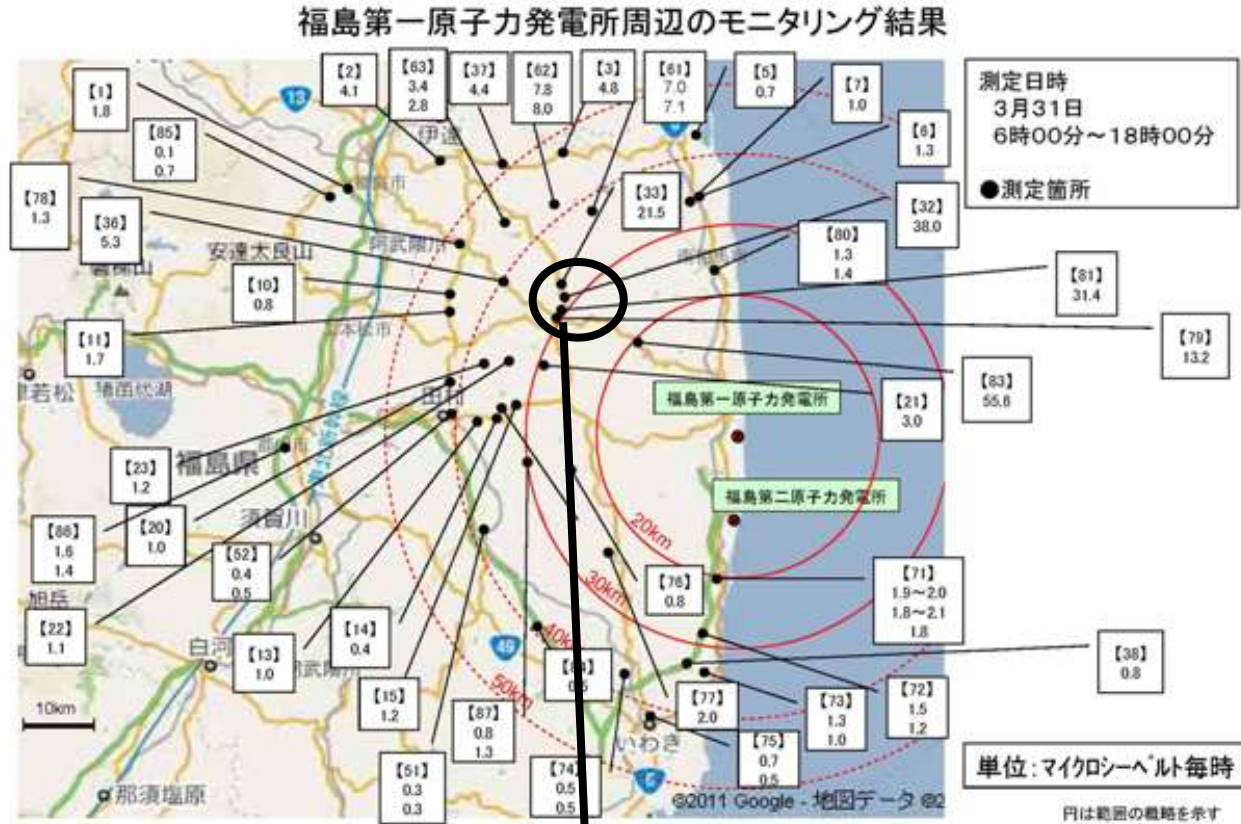


Figure 1 (all times local time)

Dose rates measured in selected measuring locations (MP) at Fukushima Daiichi – Data provided by the operator TEPCO

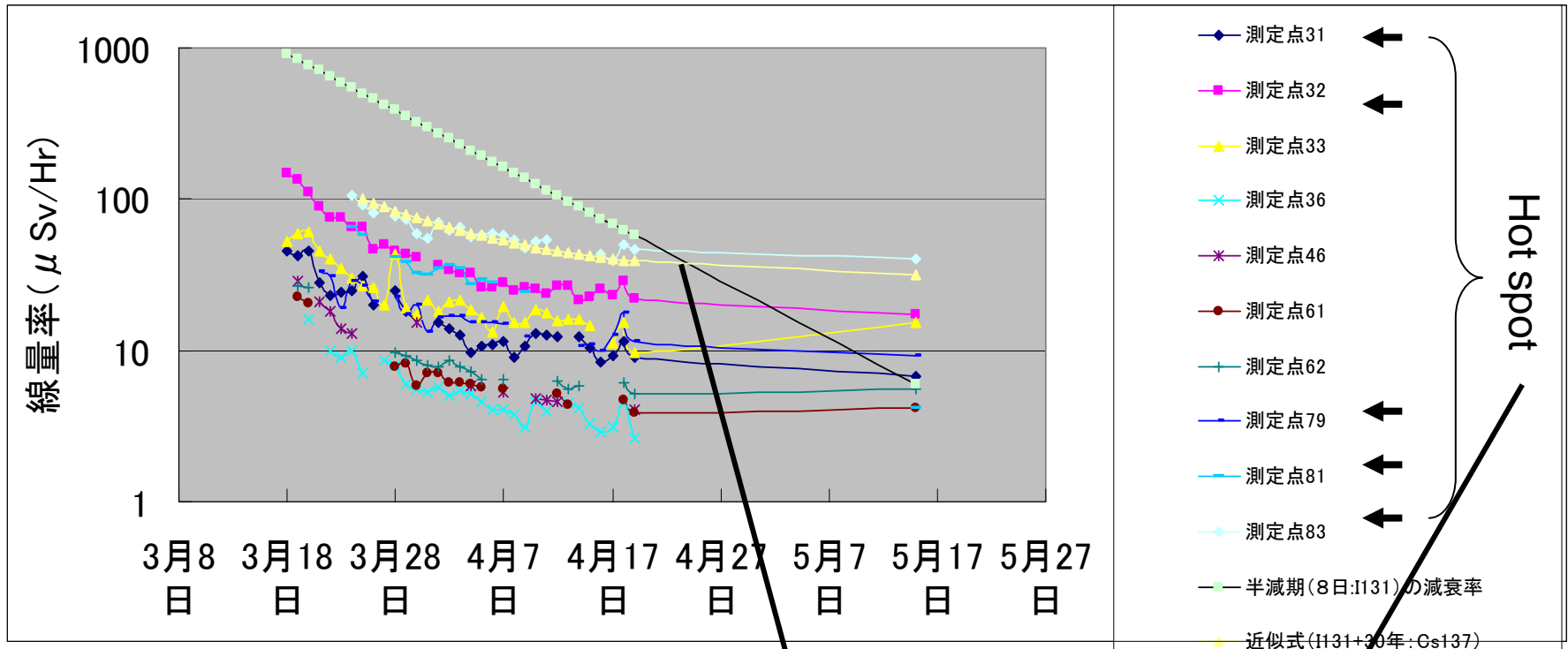
Time history of radiation dose indicates the explosive event at 15,16,17th)

Information on Fukushima Accident(3)



Measured data of radiation dose by car
(hot spot is observed beyond 30km)

Information on Fukushima Accident(4)



Measured data of radiation dose near ground surface

- Change from effect of I131 to Cs137
- radiation dose is influence mainly by deposition material, not cloud
- Additional evacuation zone beyond 30km, more than 100mSv/year ($11 \mu \text{ Sv/hr}$)