Objectives of the Workshop and Overview of Remedial Actions and the Management of Waste and Soil in Fukushima








Fukushima Environmental Safety Center
Japan Atomic Energy Agency
(JAEA)

Mikazu Yui

Contents

- Status of off-site Fukushima remediation and the management of waste and soil
- Overall goals of workshop (➢Session 1)
- How to assess Cs movement and its future effects on the environments ? (➢Session 2 & 3)
- How to involve the public to resolve difficulties? (➢Session 4 a & b)
- How to treat wastes generated by decontamination to reduce their volume ? (➢Session 5)
- What can scientists do to address these concerns?

Status of off-site Fukushima remediation and the management of waste and soil

- Radioactivity measurements/Cs distribution
- R&D for implementation of decontamination
- Studies of Cs behavior

Status of

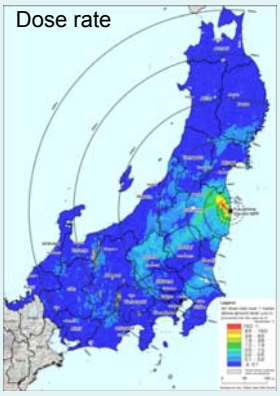
Radioactivity Measurements/ Cs Distribution

Airborne Monitoring

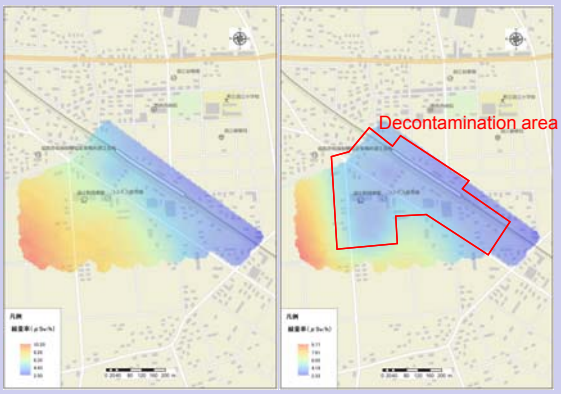
Range	Large Area 100 km >	Semi Large 10 km >	Mid Area 1 km >	Small Area ~100m
Aircraft	Helicopter	UAV w/ FW	AUH	Micro UAV
Alt.	~ 300m	~ 150m	~ 50m	≤ 10m

UAV – unmanned aerial vehicle
FW – fixed wing

Aerial radiation monitoring

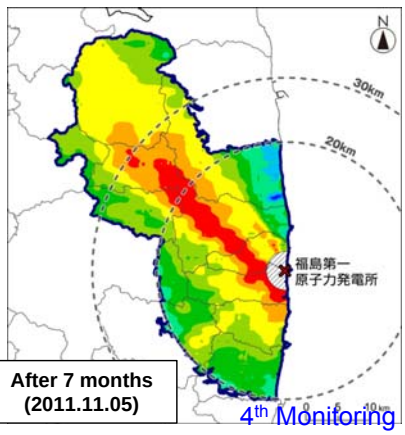


Autonomous Unmanned Helicopter

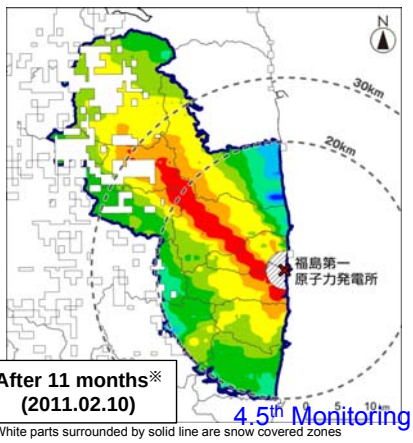


Dose Rate Distribution as a Function of Time

- Measurements by aircraft monitoring -

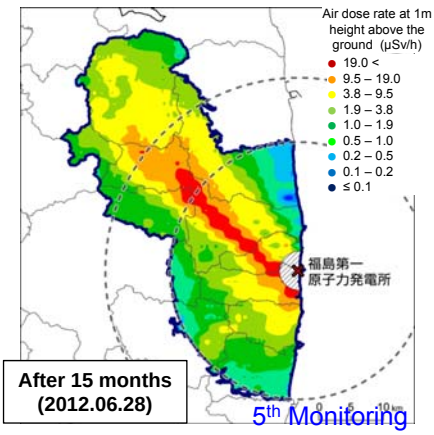


After 7 months (2011.11.05) — 4th Monitoring

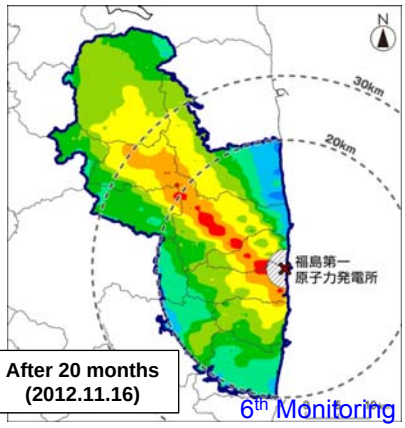


After 11 months※ (2011.02.10) — 4.5th Monitoring

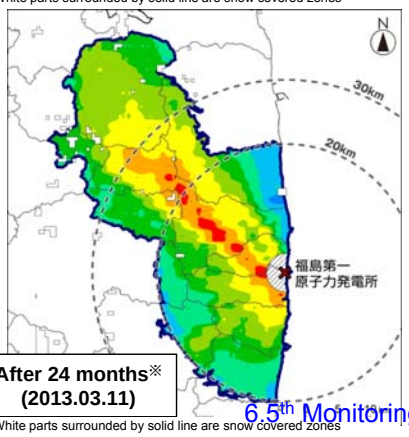
※White parts surrounded by solid line are snow covered zones



After 15 months (2012.06.28) — 5th Monitoring

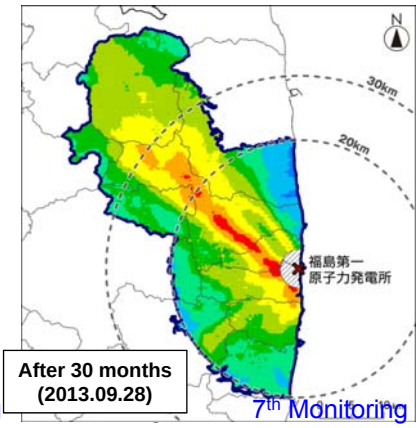


After 20 months (2012.11.16) — 6th Monitoring



After 24 months※ (2013.03.11) — 6.5th Monitoring

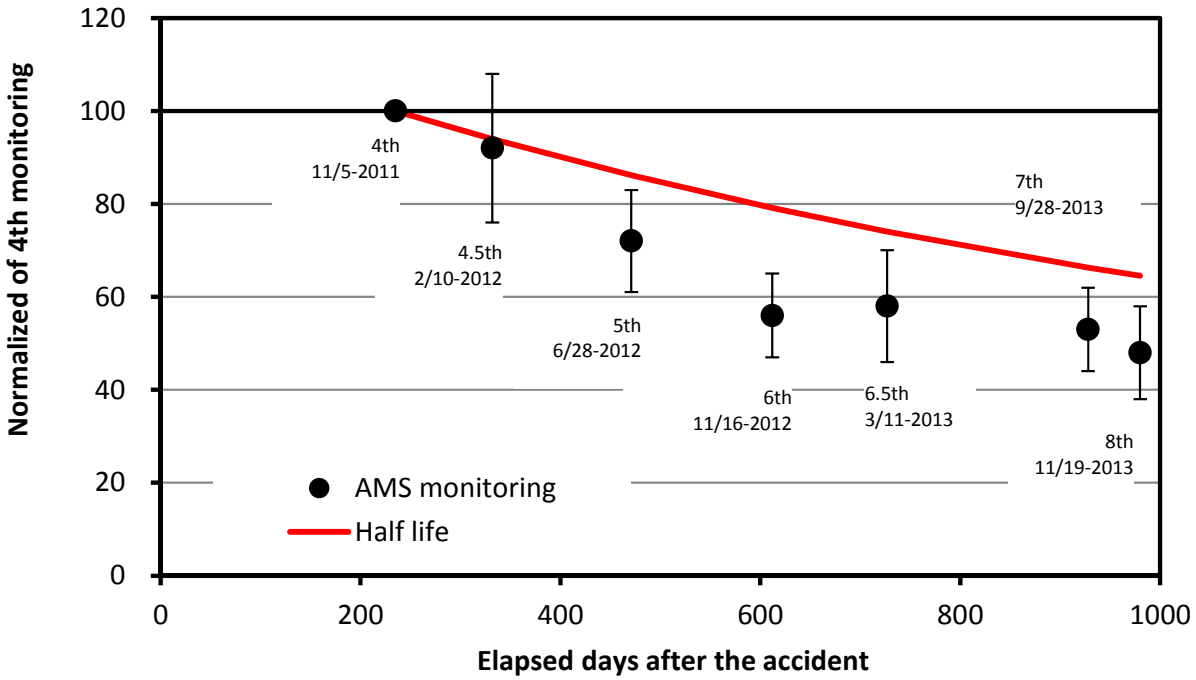
※White parts surrounded by solid line are snow covered zones



After 30 months (2013.09.28) — 7th Monitoring

Decrease in Dose Rate

- Time variation of air dose-rate at 1-m height above the ground -



Time variation of the mean dose rate of the area shown in the previous page
(on the basis of measurements with the fourth aerial monitoring)

Status of

R&D for Implementation of Decontamination

Decontamination Pilot Projects

Clean-up of Roads and Pavements

◆ high pressure water

road cleaner

◆ surface stripping

◆ blasting

Iron shot blasting

Ice blasting

Clean-up of Houses

Clean-up of Farmland

- plow

- turf stripping

- topsoil removal

Clean-up of Trees and Forest

- weeding
- removal of leaf mold
- clipping
- water horsing

clipping

clipping

curing

removal of leaf mold

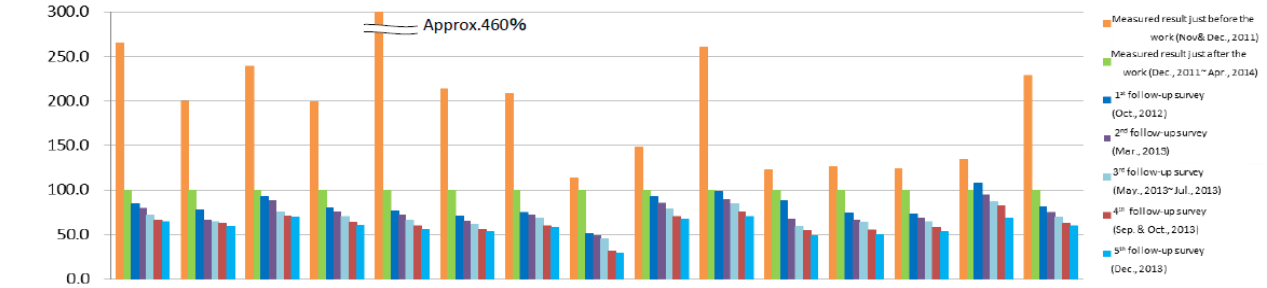
water jet

Post Decontamination Monitoring

- Decontamination effect in the decontamination model project area is almost maintained
- Air dose rate is decreased approx. 40% after a year and 9monthes of the work

Comparison of average figure on air dose rate
(assuming the figure after the work as 100)

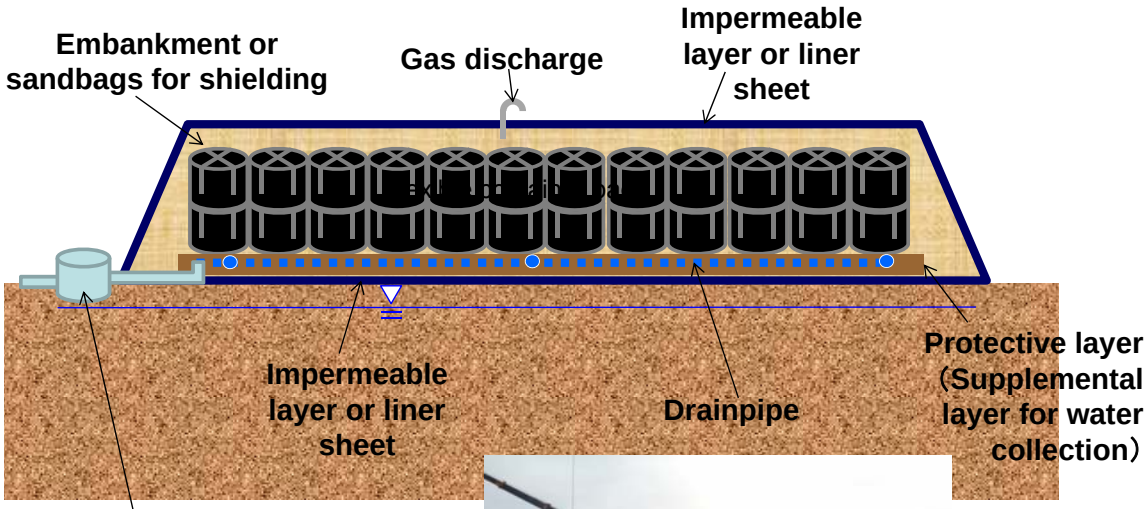
From MOE HP



	Ottozawa, Okuma	Okuma municipal office	Tsushima, Namie *	Yorunomori Park, Tomioka	Tomioka Daini junior high school	Gongendo, Namie	Kusano, Iitate *	Hayashi factory, Iitate *	Ichibankan, nursing home, in Iitate *	Kikuchi factory, Iitate *	Kainosaka, Kawauchi	Around municipal office in Katsurao	Around Kanabusa elementary school, Minami-Soma	Minami factory complex in Naraha	Average Value of 14 districts
Just after the work	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1st follow-up survey	84	77	93	81	76	71	75	51	92	98	87	73	70	108	81
2nd follow-up survey	80	67	89	76	72	66	73	49	86	89	68	67	67	95	75
3rd follow-up survey	72	64	75	70	66	61	68	46	79	84	58	63	62	87	69
4th follow-up survey	66	62	71	63	60	56	60	31	70	75	54	55	57	82	63
5th follow-up survey	64	59	69	61	56	53	57	29	67	70	49	51	53	68	60

* : Measurement result just after the decontamination work in Tsushima, Namie and Iitate, might be possibly low because of accumulated snow
Note 1: Measurement figure might be changed by environmental condition, e.g. climate condition, such as rainfall, snowfall,
Note 2: It's have passed about one year and nine months from measurement result just after the decontamination work until 5th follow-up survey, during that time, the dose rate resulting from radiocaesium, about 30% of reduction is expected by physical attenuation.

Temporary Storage of Waste



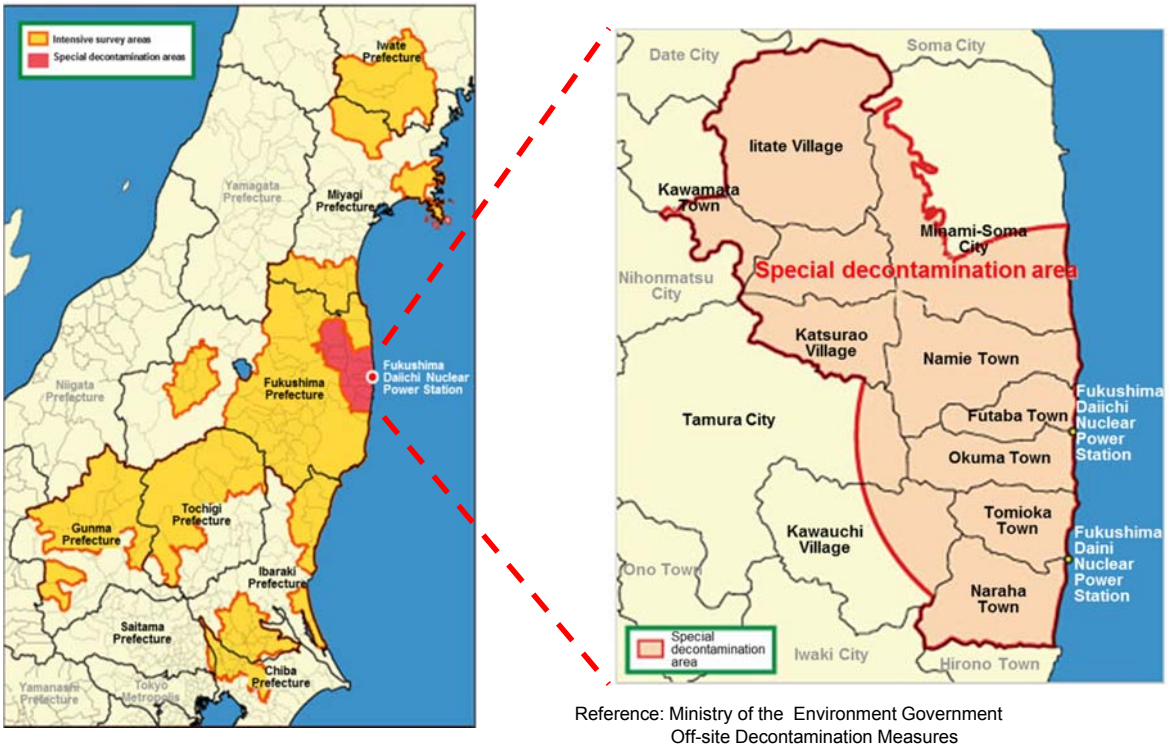
Temporary storage under construction

Decontamination Implementation

- **Special Decontamination Area (>20 mSv/y)** : 11 Municipalities **by National Government**
- **Intensive Contamination Survey Area (1 to 20mSv/y)** : 100 Municipalities, 8Prefecturs **by Each Municipality Funded by Government**
- **Based on the Guidelines for Decontamination Works Issued by Ministry of the Environment**

Guideline for Decontamination

Special Decontamination Area and Intensive Contamination Survey Area



Reference: Ministry of the Environment Government
Off-site Decontamination Measures
WWW Document,http://josen.env.go.jp/en/documents/pdf/documents_02.pdf

Rearrangement of the Evacuation Area

Ahead of the decontamination in Special Decontamination Area, the evacuation areas have been rearranged in August 2013.

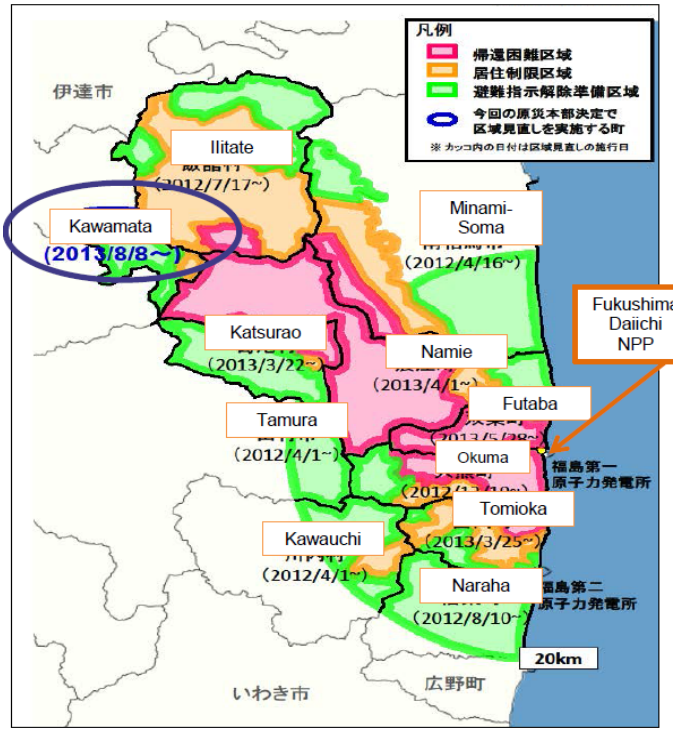
3 categories after the rearrangement:

Area 1: <20mSv/yr
Evacuation orders are ready to be lifted:

Area 2: 20 – 50 mSv/yr
Residents are not permitted to live:

Area3: >50 mSv/yr
Residents will have difficulties in returning for a long time:

From MOE HP

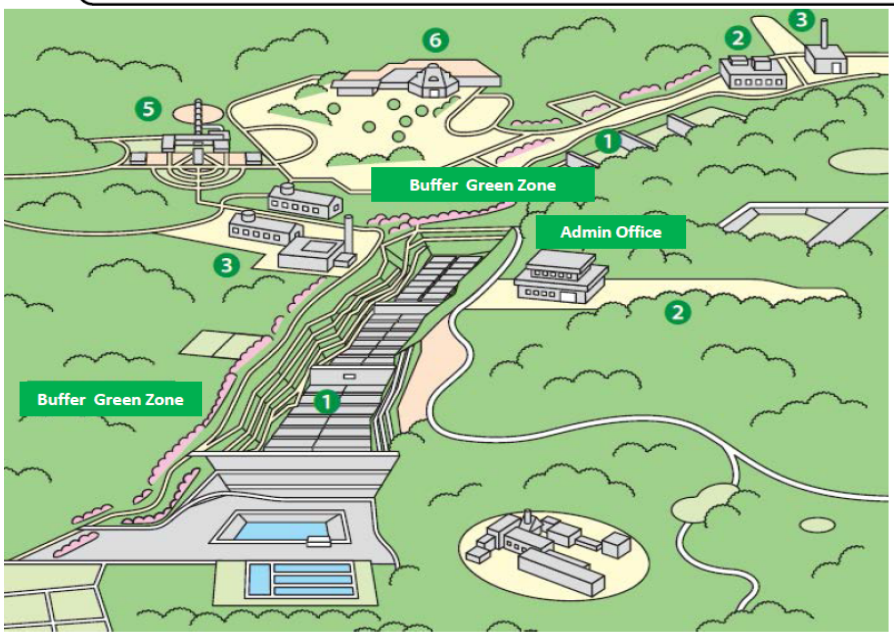


Before & After the Decontamination Work

Tamura city, from MOE HP

Illustration of Interim Storage Facility

ISF will be consisted of facilities with various functions



①Storage Facility

②Emplacement & Segregation Facility

③Volume Reduction Facility

④24-hour monitoring Equipment(placed in several points, not specifically indicated in the figure)

⑤R & D Facility

⑥Public information Center

Scale of the whole facility (estimation)
Total storage volume ranges between 15-28 million ㎥, which is 12-23 times big as a baseball stadium(approx. 1.24million ㎥)

From MOE HP

Status of

Studies on Cs Behavior

Further Studies Needed for Decontamination work

- Cs Migration from and Countermeasures for Untreated Forest
- Volume Reduction of Waste Generated by Decontamination
- Waste Storage and Disposal
- Possible Recontamination Processes

Based on Understanding of Cs Behavior in the Environment: In many cases may be dominated by sorption on clay minerals in the soil zone

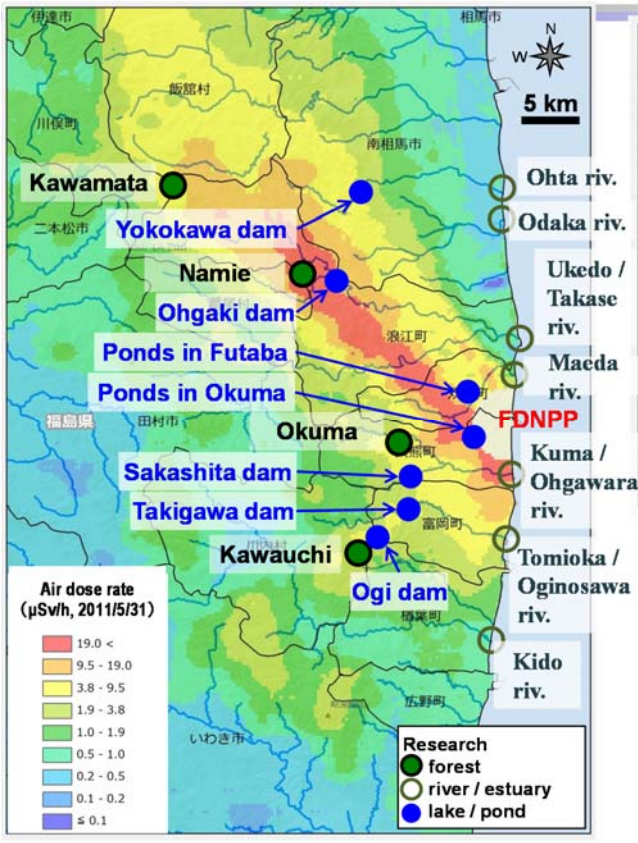
Fukushima-TRACE Project

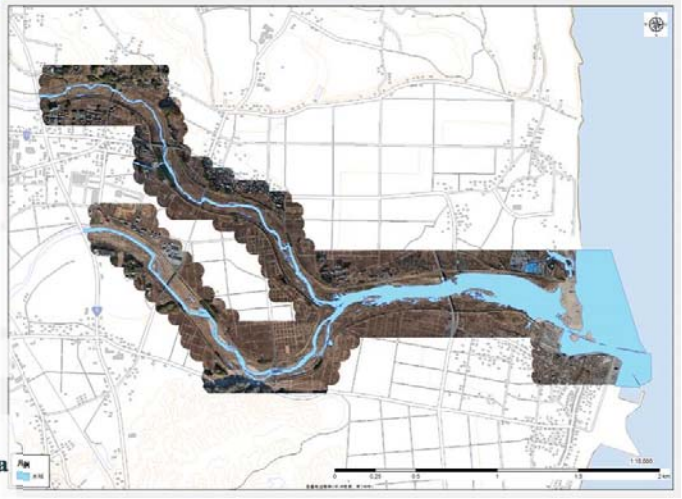
Long-term assessment of Transport of RAdioactive Contaminant in the Environment of Fukushima

⇨Studies on Cs Transport in the Forest~ River
~ Reservoir (Dam, Lake)
~Estuary System.

F-TRACE PROJECT

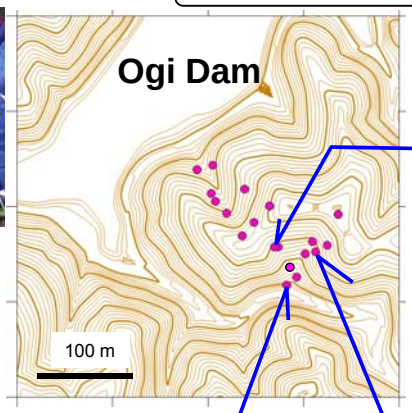
Current Research Area for River Systems

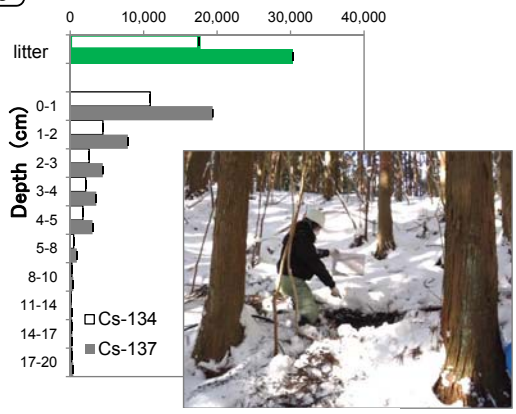


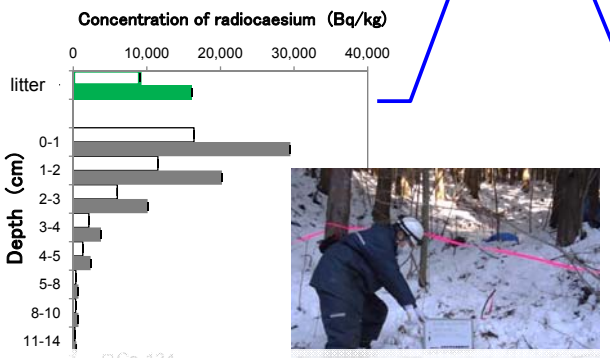


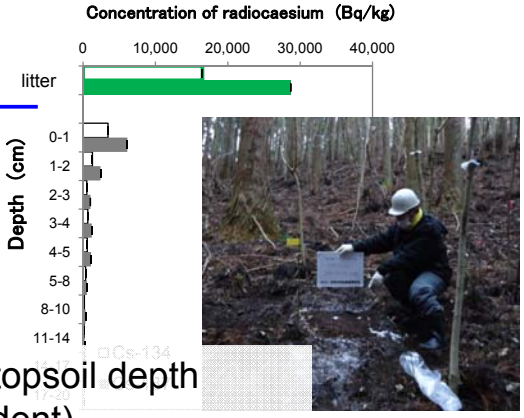
Depth Profiles of Cs in Forest Topsoil

❑ **Soil sampling by scraper plate**
- Up to 20 cm depth
- 1 cm intervals until 10 cm depth, then 2 cm intervals



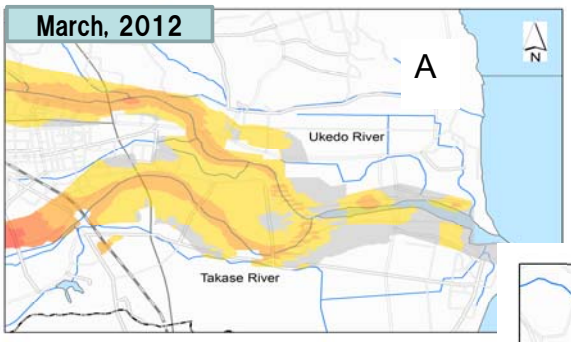


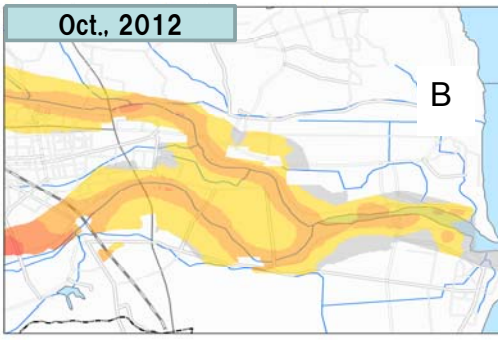


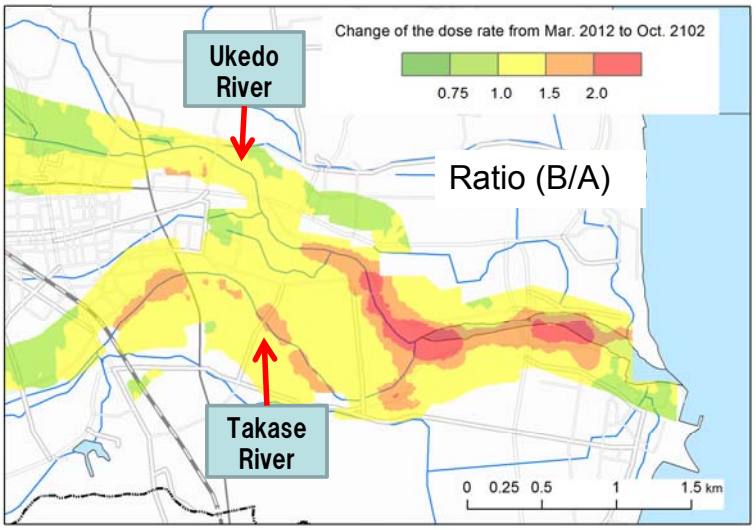


- More than 90% of Cs remains within 5 cm topsoil depth including the litter layer (~2 y after the accident).

Radiation Measurement by Autonomous Unmanned Helicopter



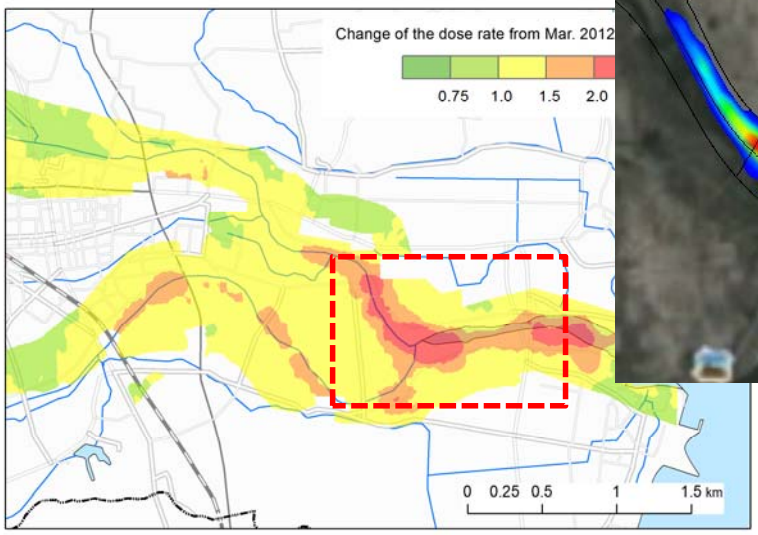




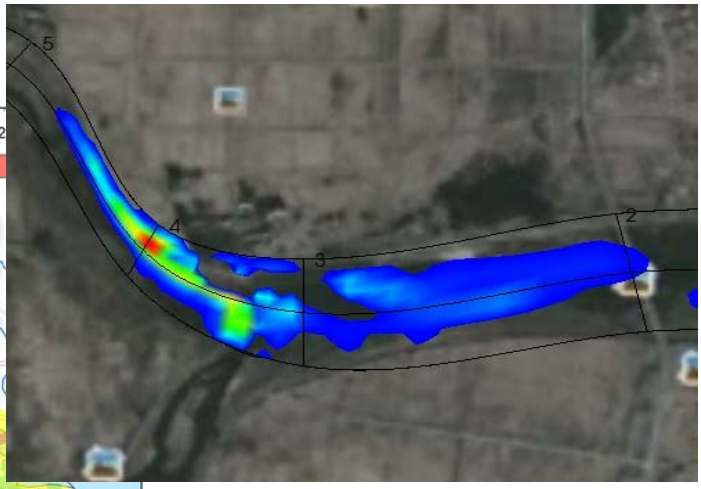
Caesium deposited at flood channel during flood
⇒Remediation planning

Comparison between Measurement and Modeling of Cs Transport

Modeling by 2D River Flow Model iRIC（International River Interface Cooperative）



Measurement: Evolution Ratio of Does Rate by Autonomous Helicopter

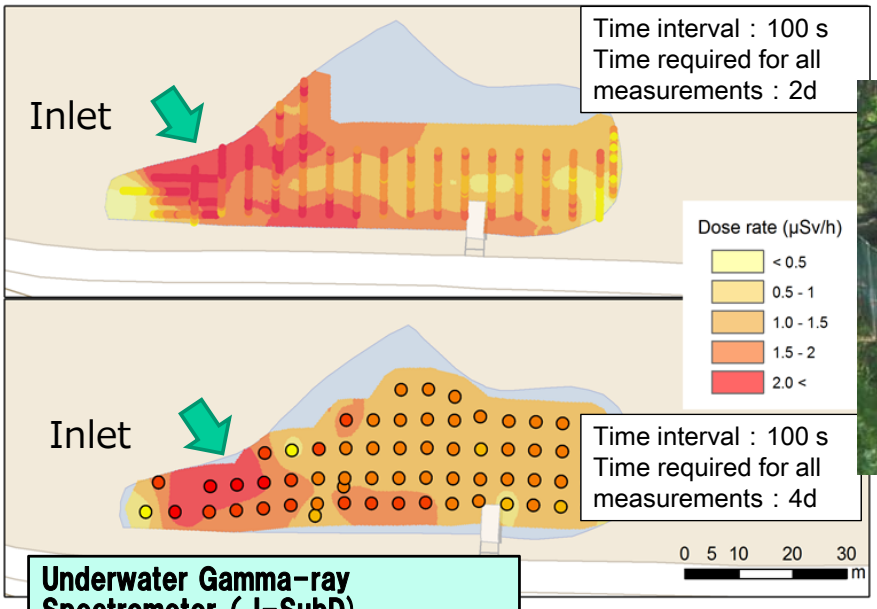


Modeling: Sediment Deposition by iRIC

Reservoir Investigation: Radiation Measurement of Pond Soil

Plastic Scintillation Fiber（PSF）
- Line Measurement
- Widely Measurable at a Time

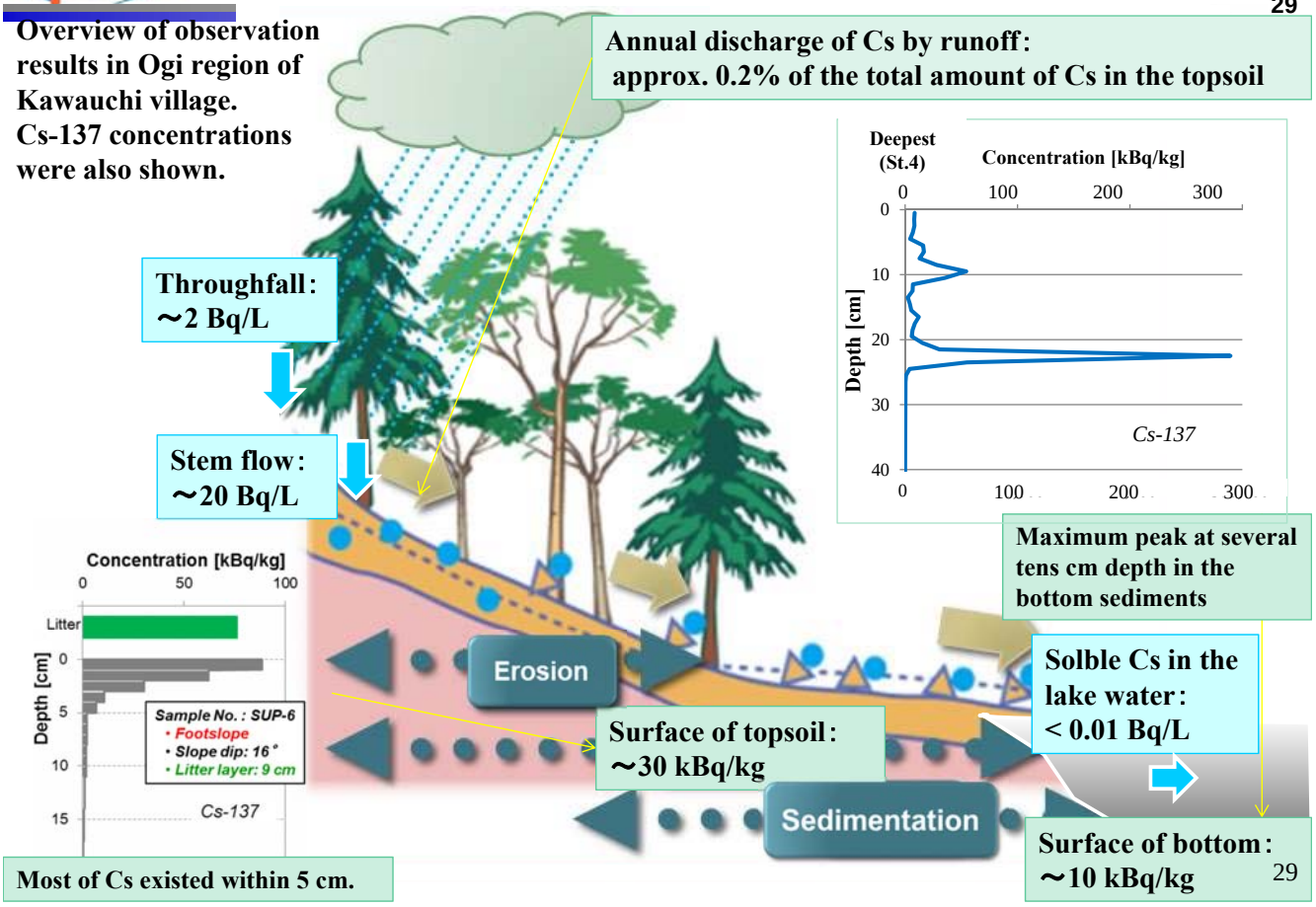
Measurement at Pond, Fukushima Univ.



Underwater Gamma-ray Spectrometer（J-SubD）
- Point Measurement
- High Resolution
- Spectrum Measurement

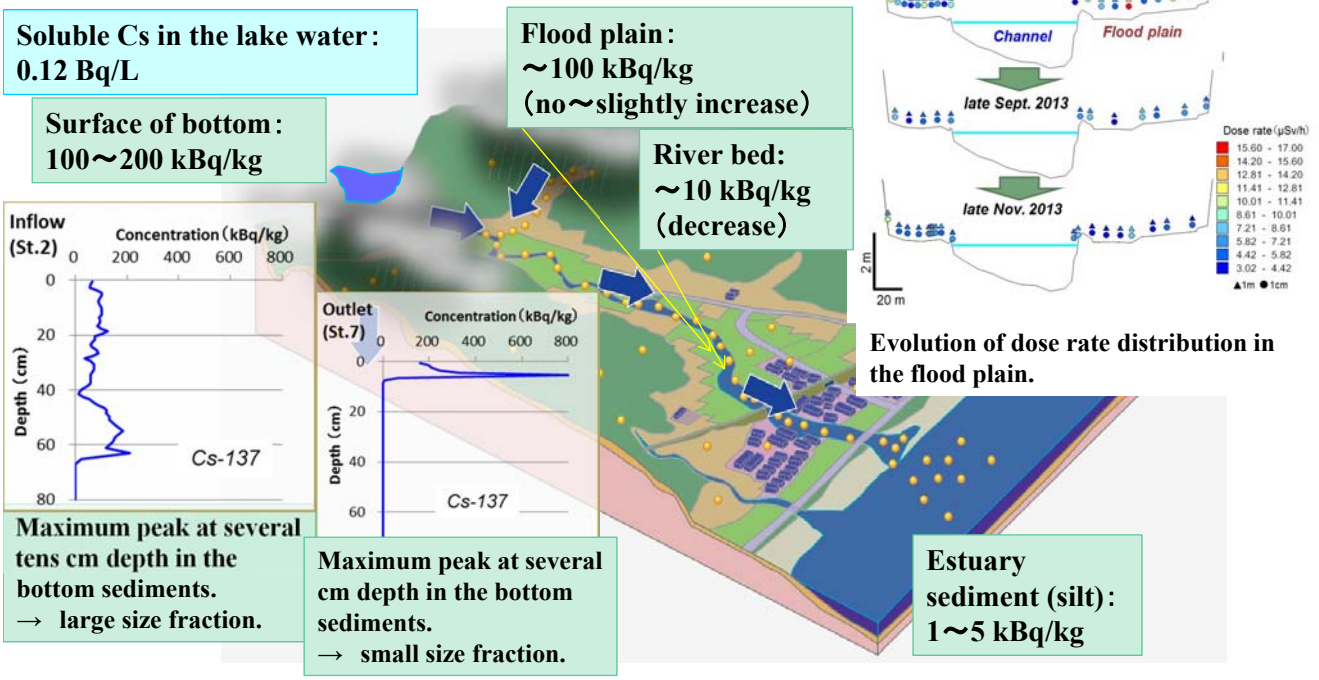
Behavior of Cs in the Forest to Dam Lake

Overview of observation results in Ogi region of Kawauchi village.
Cs-137 concentrations were also shown.



Behavior of Cs in the Dam Lake, River System and Estuary

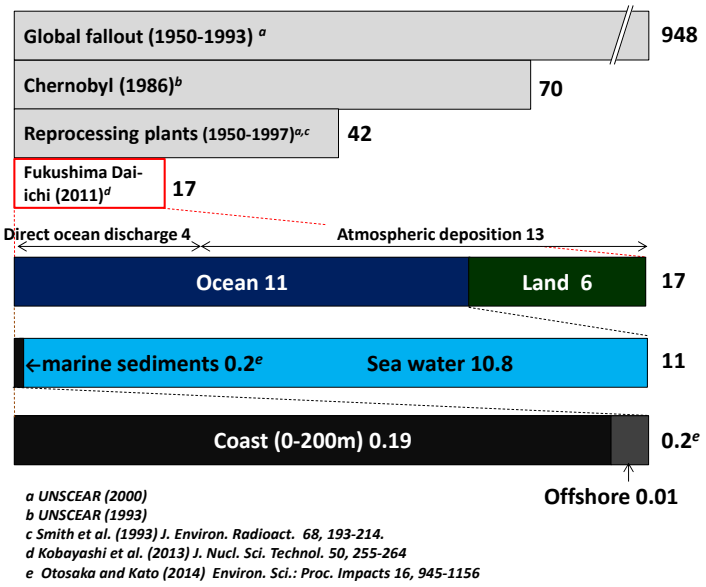
Overview of observation results in Ukedo river system of Namie Town.
Cs-137 concentrations were also shown.



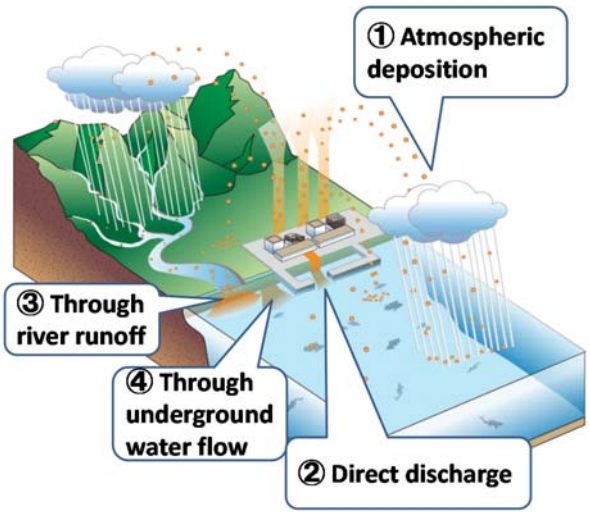
Evolution of dose rate distribution in the flood plain.

Depth profile of Cs concentration in the bottom sediment of Ogaki dam lake.

^{137}Cs Sources to the Environment in PBq (10^{15} Bq)



Otosaka (2014)



Buesseler (2014)

Summary of Status

➢Clear importance of understanding Cs behavior that will support development of practical ways for…

- Long-term assessment of the impact of Cs from untreated forest
- Reducing waste generated during cleanup

➢Continuous / focused/practical R&Ds are needed to decrease uncertainties and provide optimal countermeasures to assure a safe future for Fukushima based on international experiences.

Overall Goals of the Workshop

- Integrate and share recent developments in Fukushima restoration and identify key issues
- Understand the status of research investigations and modelling of Cs migration in the environment
- Provide a perspective on volume reduction of waste and soil generated by decontamination work
- How to involve the public ?: communication issues
  - Tritium problem
  - Forest management
  - Volume reduction of waste (reuse)

Session 2 – Discussion Points

- Understanding Cs movement in the environment via data acquisition and modelling
- The status and QA; for example,
  -Countermeasures to mitigate Cs transport such as particulate collection/filtration techniques
  -Analytical method : lowering the detection limit of Cs-137
- Status of technologies for the restoration of agricultural land

Session 3- Discussion Points

- Status of model development such as applicability, reliability
- How to verify/validate the models ?
- How to use models for contribution to the assessment of the external/internal dose rates after decontamination ?
- How to use models to validate countermeasures for contribution to the revitalization of agriculture ?

Session 4a- Discussion Points

- Tritium management
  What's the realistic resolution based on the state-of-the-art understanding of potential impacts on the Fukushima fishery industry and the technology supporting assessment of different management options ?
- Forest management
  What's the realistic resolution to mitigate concerns of the people living in forest areas, working in forestry and consuming forest products, with consideration of reviving the important Fukushima forest industry ?

Session 4b – Discussion Points

- How to improve / facilitate involvement of the public to optimise forest, river and waste management (including storage, recycling and disposal) ?
- What should be the role of experts ?
- What should be the role of mass-media ?
- What should be the role of education ?
- What should be the role of politicians ?
- • • • •

Session 5 – Discussion Points

- What's the holistic approach to reduce the waste generated by decontamination ?
- Effects of organic matter
- Longevity of temporal storage
- Development of final reuse/recycle and disposal options