International Experts' Meeting on Decommissioning and
Remediation after a Nuclear Accident – Session Ⅲ –

Evaluation of Redistribution Effects of Cs by Wild Fire in Evacuation Area after Accident at Fukushima Daiichi Nuclear Power Site

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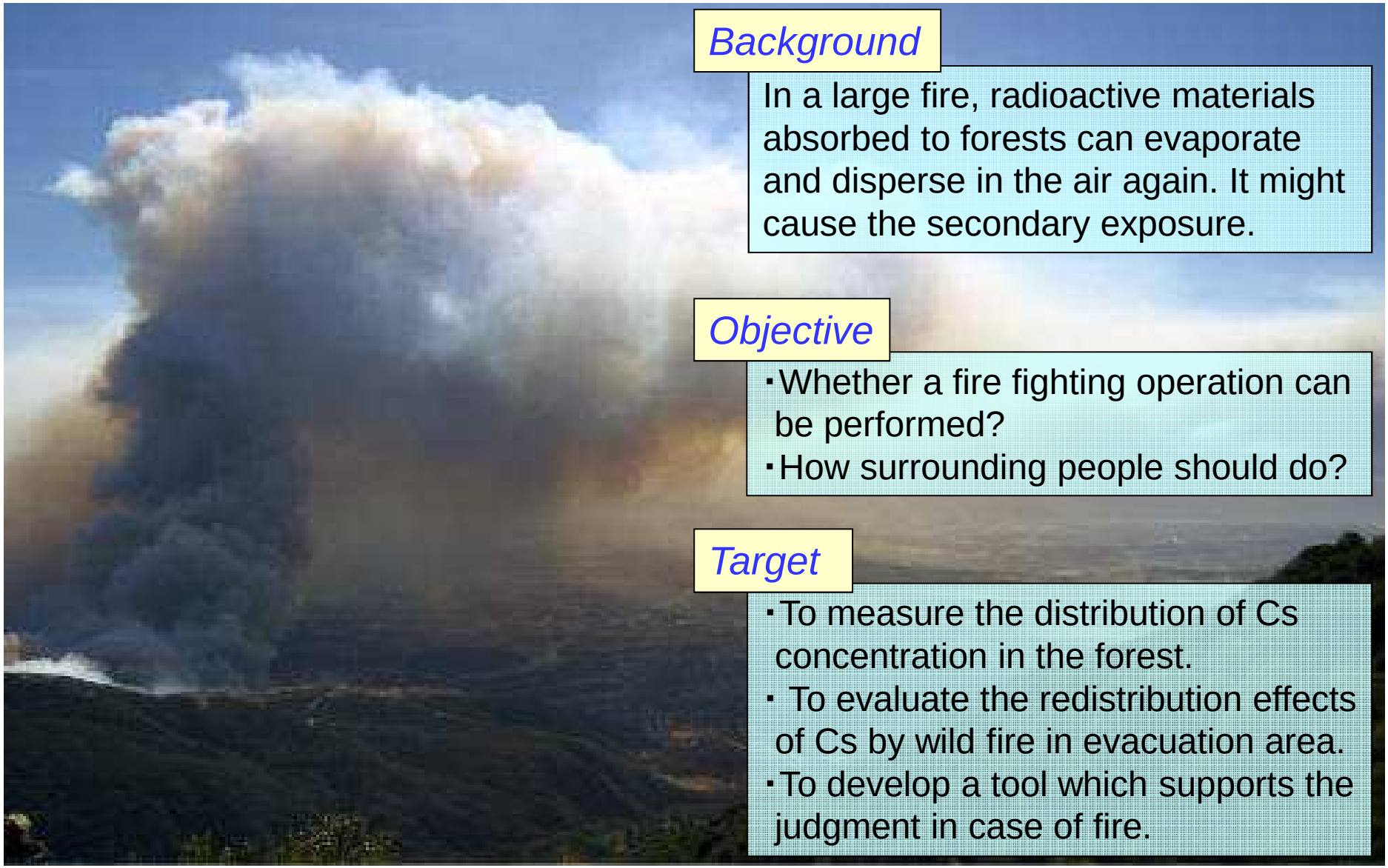
Redistribution Effects of Cs by Wild Fire in Evacuation Area



Background

In a large fire, radioactive materials absorbed to forests can evaporate and disperse in the air again. It might cause the secondary exposure.

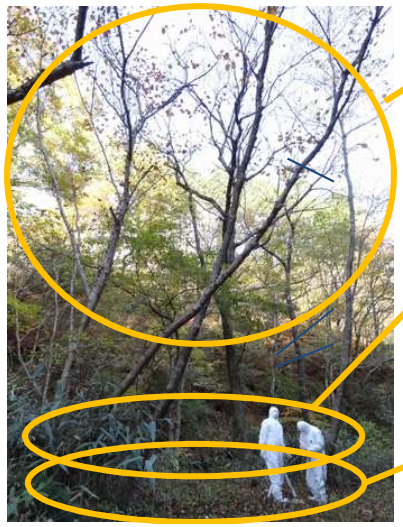
Objective

- Whether a fire fighting operation can be performed?
- How surrounding people should do?

Target

- To measure the distribution of Cs concentration in the forest.
- To evaluate the redistribution effects of Cs by wild fire in evacuation area.
- To develop a tool which supports the judgment in case of fire.

Investigation of contamination status of sample forests



Branches & leaves

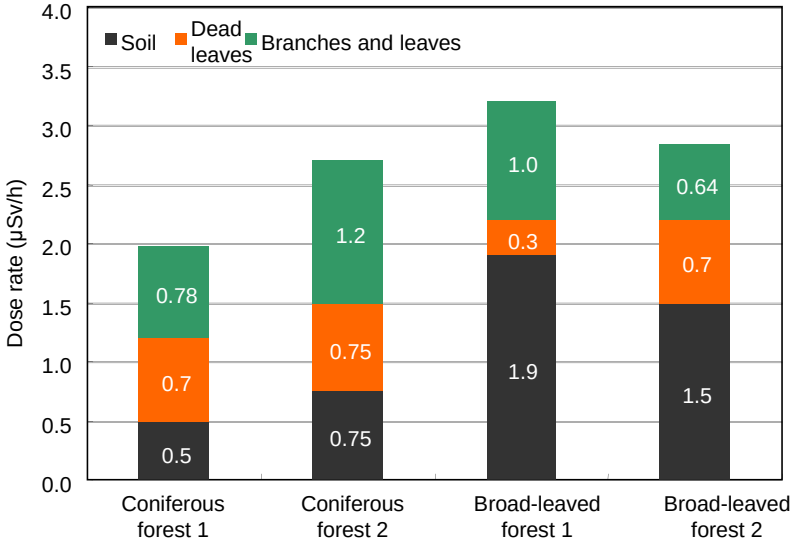
Undergrowth & dead leaves

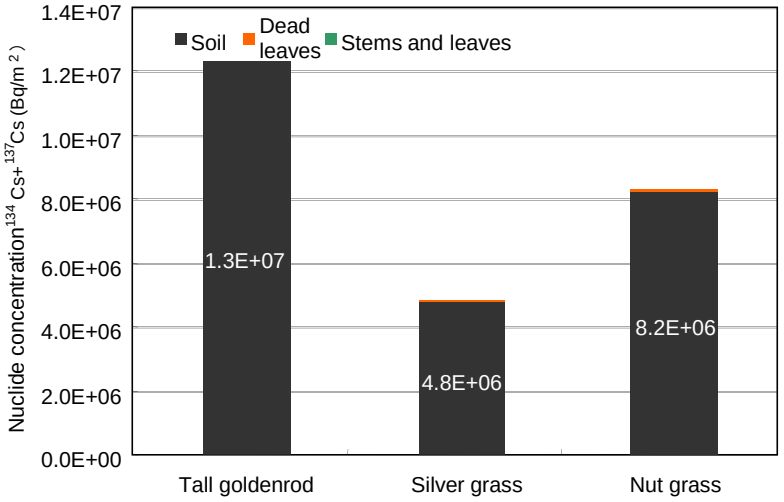
40-80%

This part burns to disperse Cs

Soil layer

60-20% (99% on grassland)





- forest fire : large part of Cs is dispersed.
- non-forest fire : large part of Cs remains.

Modeling of Cs diffusion with wild fire plume

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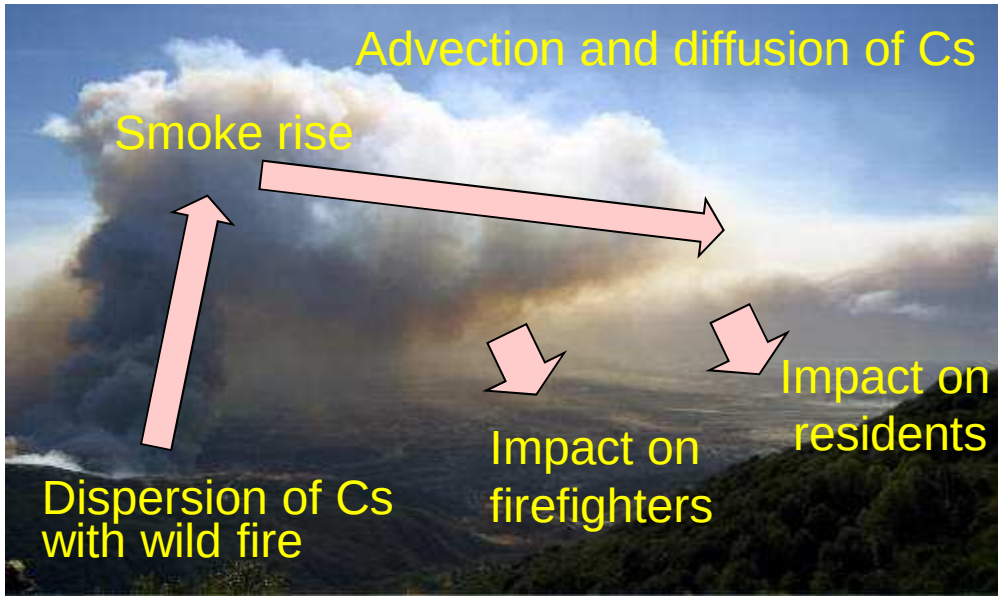
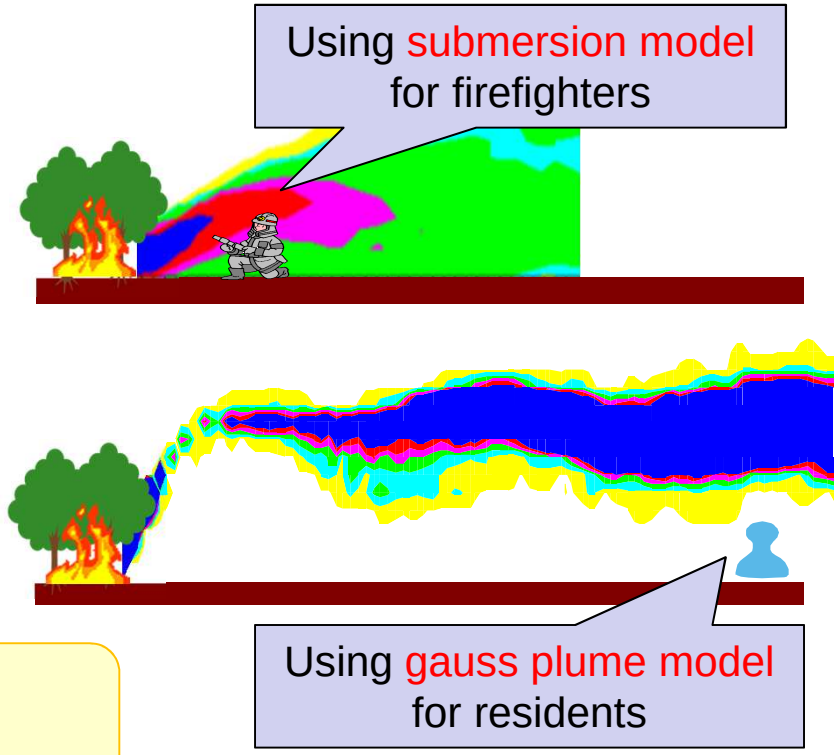
Concept of Cs redistribution



Cs concentration in the air



Exposure dose (μSv)
(effective dose from external exposure
+committed effective dose from internal exposure)

= Radioactive material concentration indicator at the fire site × Terrain indicator × Land use indicator at the fire site

× Protective mask indicator × Wind velocity indicator × Wind direction indicator

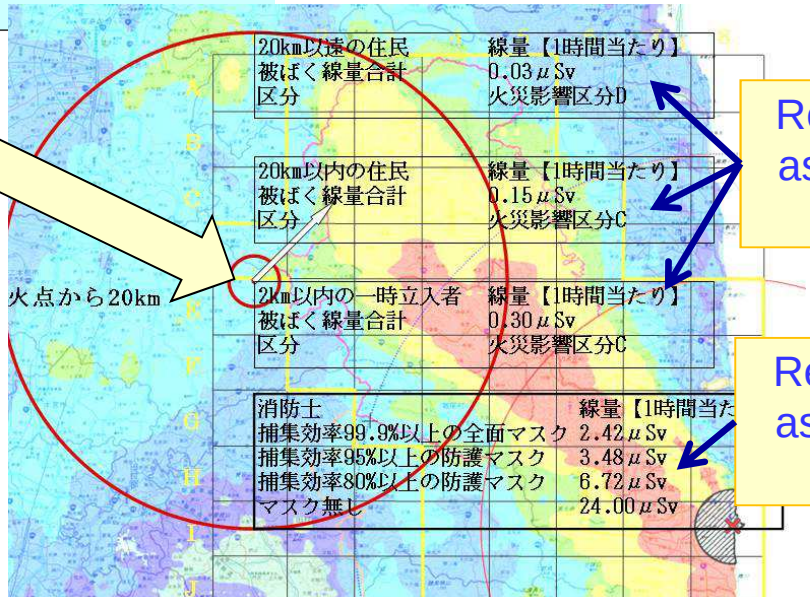
Development of a simple and quick evaluation tool

・We developed a simple and quick evaluation tool.
→ To estimate conservative results even if available information is limited.
It can provide proper information to firefighters and surrounding people in the early phase of large fire.

[Input Data]

Fire duration	西暦	2011	年	11	月	5	日	12	時	0	分			
	西暦	2011	年	11	月	5	日	18	時	0	分			
Position of fire	住所													
	東経	140.60	度											
	北緯	37.60												
Cs concentration	0.3～0.6MBq/m2 （水色）													
Land use	◉ 森林 ○ 森林以外													
Terrain	○山間部◉山間部以外													
Fire scale	0.5～1ha													
Wind direction	南西													
Wind velocity	1～2m													
Temperature	25	℃												
Humidity	70	%												
Weather	薄曇り													

[Output Data]



Results of dose assessment for residents

Results of dose assessment for firefighters

Background：distribution of Cs concentration

The tool was provided to the fire fighting offices of Fukushima prefecture

Wild fire at 27 August in the restricted area

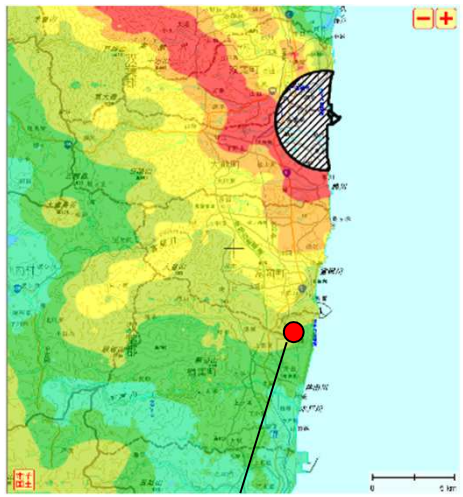
Wild fire at 27 August 2012

- 500m^2 of grass land at the hillside was burned, and brought under control within 1 hour. The maximum time of fire fighting was 100 minutes.
- Most of grasses and the surface of litter layer were burned.
- Firefighters were sent out, wearing tyvek suits and full face mask. Total amount of monitored maximum external exposure dose was about 5 μSv.

Evaluations for firefighters by using the tool

	With mask
Exposure from inhalation of plume and deposited ash	0.008 μSv
External exposure from plume and deposited ash	0.87 μSv
(External exposure from soil contamination before fire)	(8.73 μSv)

→ Total external exposure dose : 9.60 μSv



Fire outbreak

→ Results of dose assessment by the tool was appropriate.

Wild fire at 27 August in the restricted area

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Results of an investigation several days after the fire

We measured air dose rate by using a NaI with survey meter and collected sample materials for radioactivity analysis.

	Unburned Area	Burned Area
Air dose rate above 1m	1.5~1.7 μSv/h	1.7~1.9 μSv/h
above 10cm	1.9~2.7 μSv/h	1.7~2.6 μSv/h
Cs concentration in the air	ND	0.13～0.42 Bq/m^3

	Burned Area				
	Ash	Dried grass	Grass	Litter	Soil
Cs concentration	96.6~137.9 Bq/g	4.3 Bq/g	2.9 Bq/g	32.1 Bq/g	8.5~ 18.0 Bq/g

- There is no significant difference in the dose rate of unburned area and burned area .
  → Most of radioactive materials remain on the place.
- Cs concentration in the air is about 100 times lower than the regulatory limitation (Concentration limit of Cs for the air out of supervised area : 24 Bq/m^3).
- Cs concentration of ash is about 3~40 times higher than that of grass and litter.
  → Cs in ash has high leaching rate and is easy to migrate with water. It is necessary to take countermeasure when a large amount of ashes were generated.

⇒ We are planning to check the validity of the tool by comparing to actual data obtained when the wild fire happened and to improve the tool so that more realistic values can be obtained for various evaluation conditions.