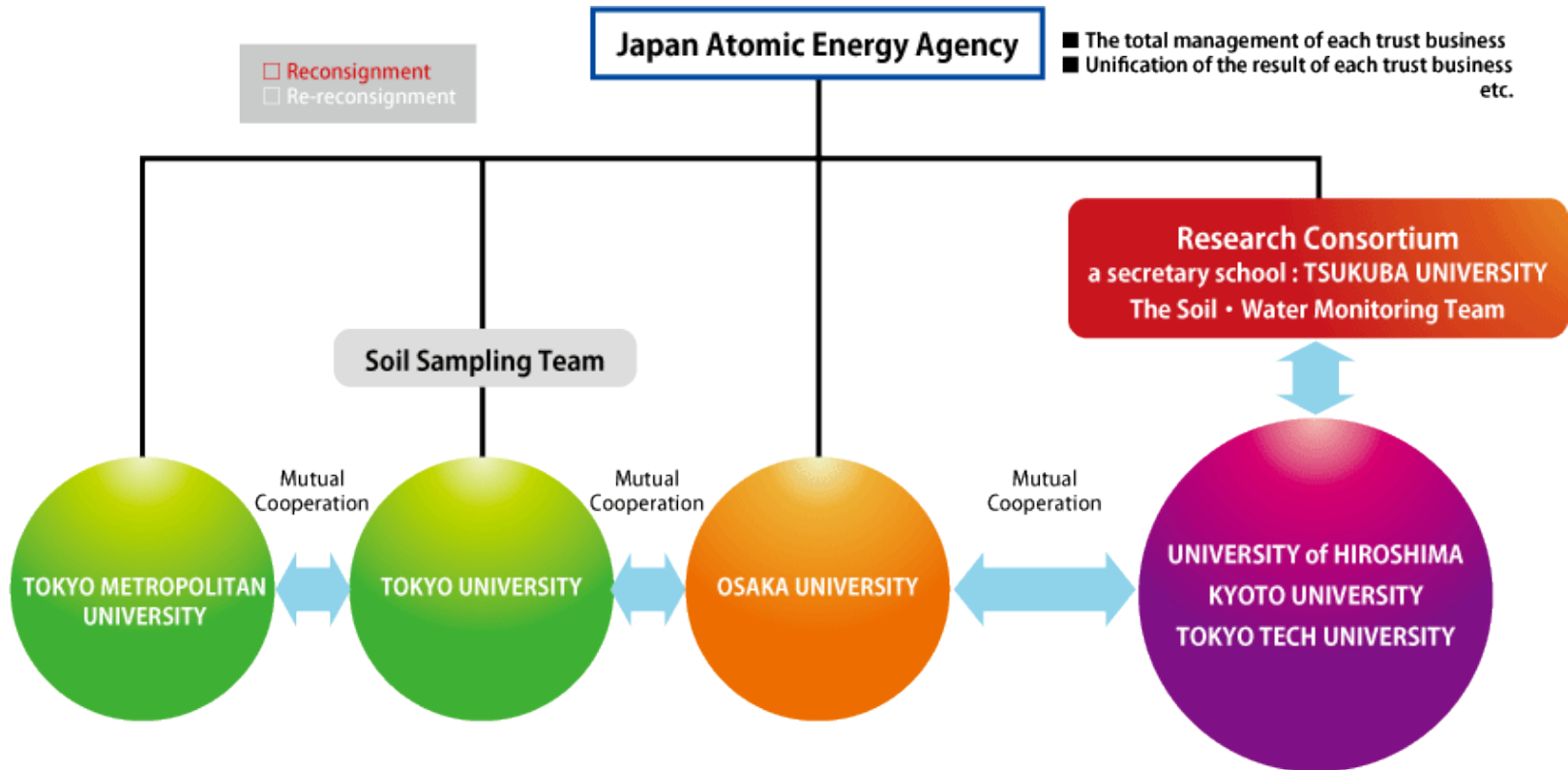


# Urgent Investigation Study on Radiological Distribution Situation Released with FUKUSHIMA NuClear Power Plant Accident



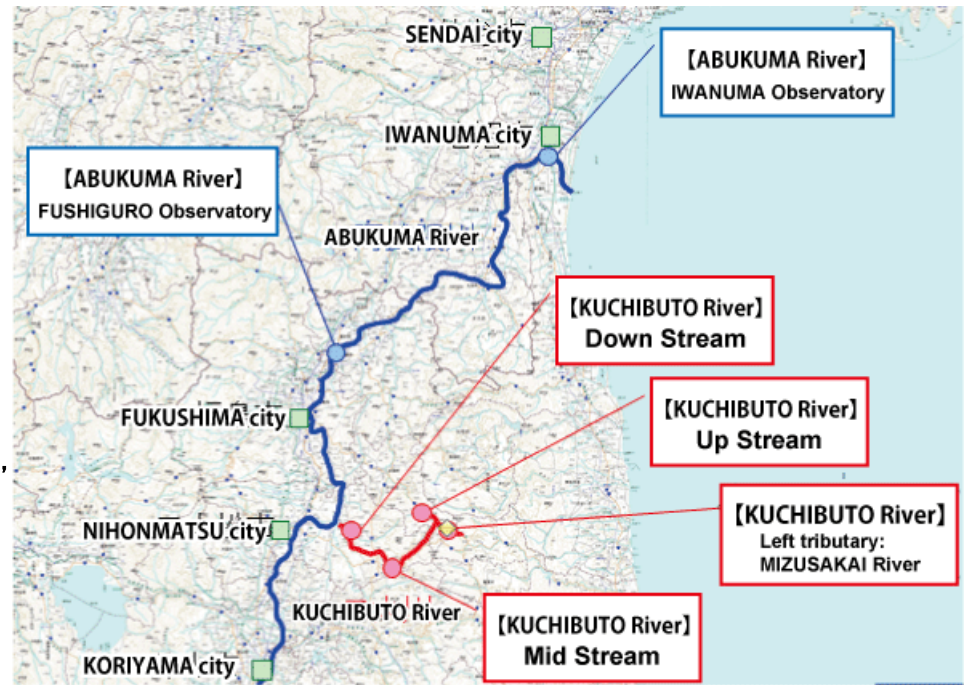
- A secretary school integrates the knowledge of each engine
- Utilize the human material resource of each engine effectively and Share research and carry it out
- Development of mobile research activity is possible by managing the direct fund with each engine

## TEAM of UNIVERSITY

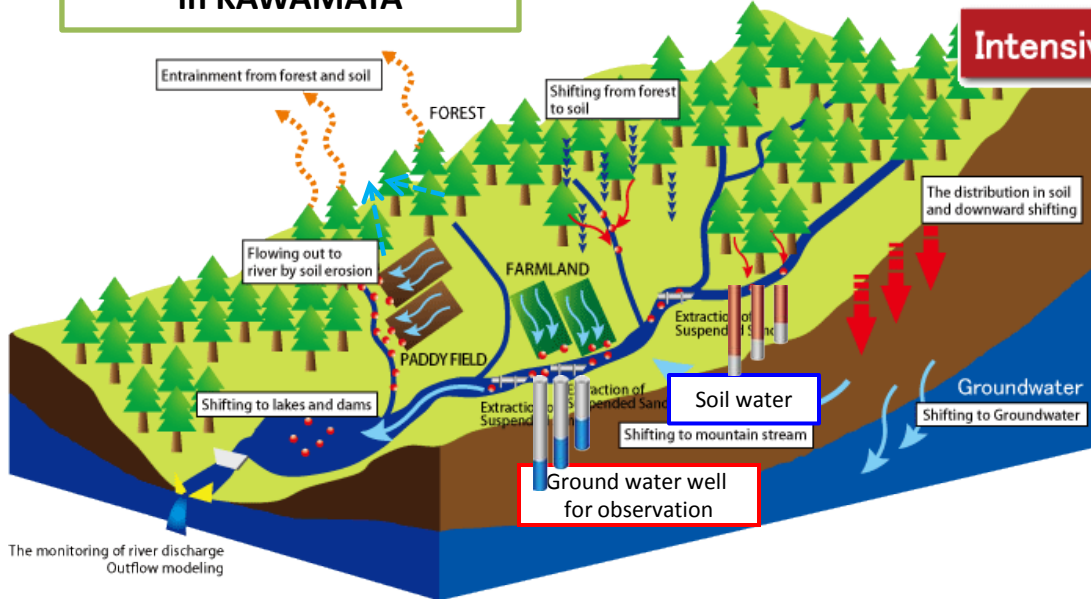
a provisional budget ¥1 million (for 3month)

- Research and Development in soil, groundwater, and river
- Monitoring water of the land area, vertical penetration of the soil, a series of inflows to the river or the high frequency
- Acquisition of the input data in a soil erosion model

### R and D at Yamakiya area in KAWAMATA



### Intensive Research Area: Yamakiya, KAWAMATA



**Quantification of the Soil Lateral Move of the Radionuclide with the Soil Erosion**

MRI / JMA / IBARAKI Univ / Tokyo Institute of Tech

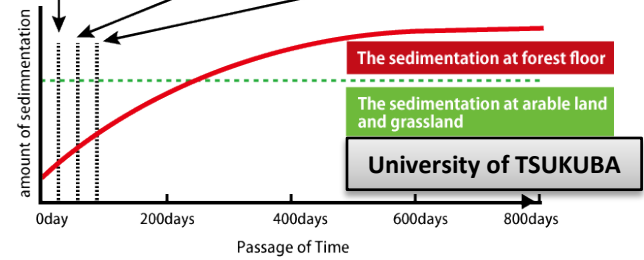
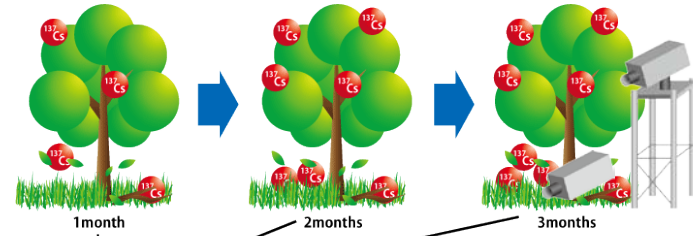
University of TSUKUBA

The observation by plots on slope for the amount of eroded soil

- 2pts at Meadow
- 2pts at Farmland
- 1pt at Paddy Field

Tokyo Institute of Tech/ IBARAKI Univ/ MRI

**Existing Condition's Clarification of the Shift of Radionuclide from Forest to Soil**



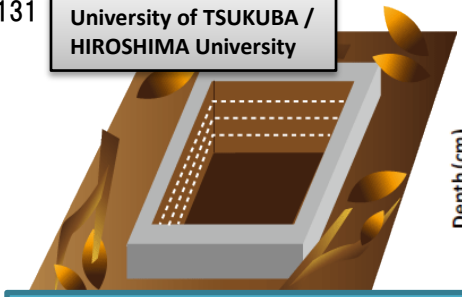
**The Radionuclide Measurement by Portable Ge Detector**

Proofreading of Air-Bone Censor for Regional Soil Mapping

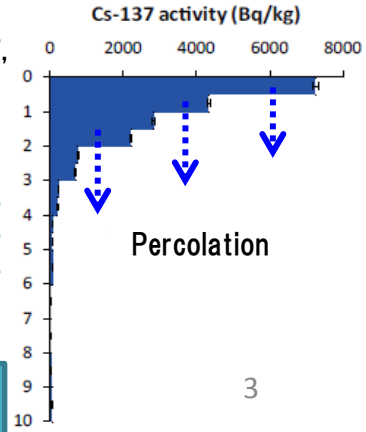
**Actual situation grasp of the abundance and percolation of Radionuclide Cs-134,137, I-131**

University of TSUKUBA / HIROSHIMA University

Super High-Precision Accumulator for Water Radionuclide  
Meteorological Research Institute

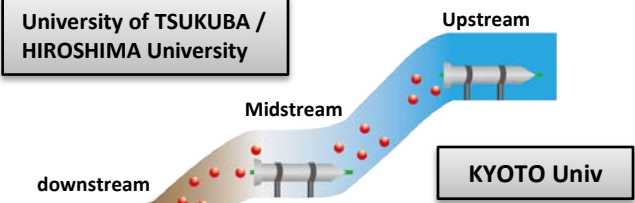


The Measurement of Radionuclide Abundance on Scraper Plate every 5mm



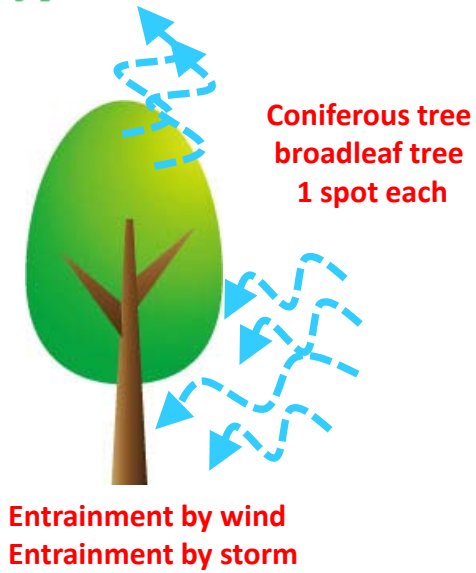
**Calculation of the loading dose of Radionuclide Cs-134,137**

University of TSUKUBA / HIROSHIMA University

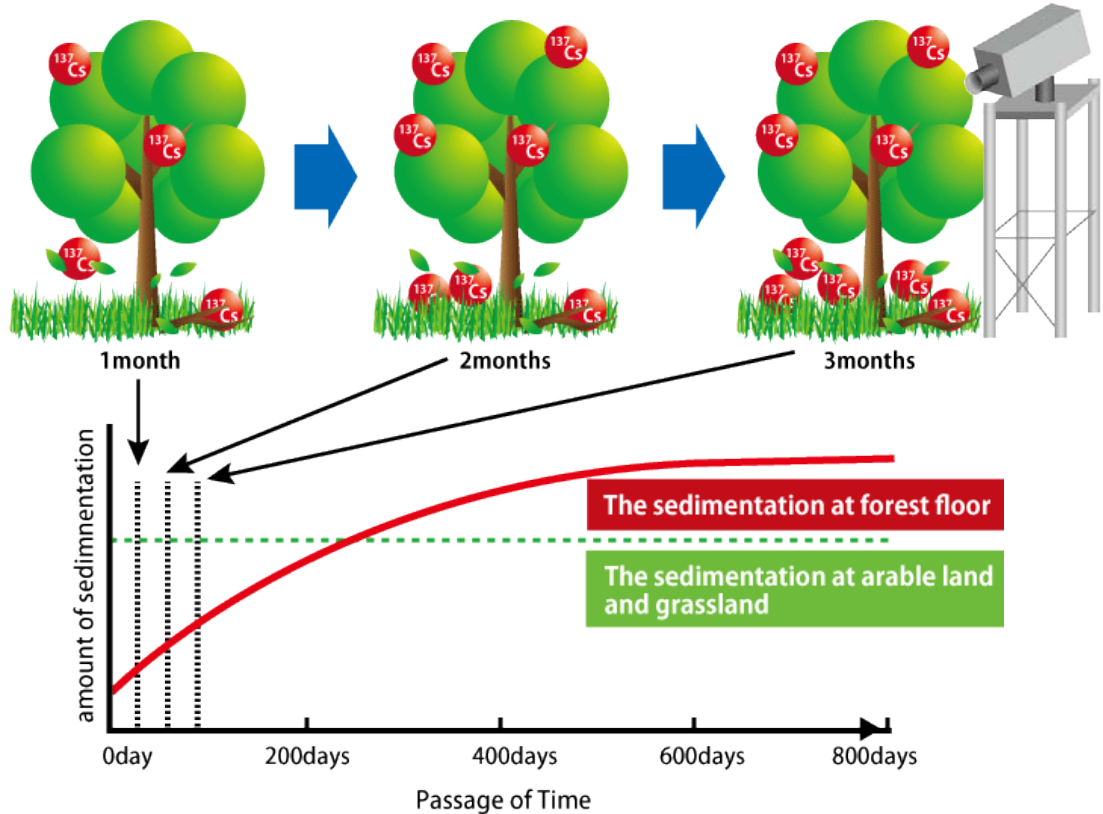


The Measurement of Runoff soil/Runoff water

## Entrainment From Vegetation



Accumulating the Time Change Distribution of Cs-137, Cs-134, I-131 on Canopy, Tree Form, and Forest Floor by Portable Ge Detector in Scaffold



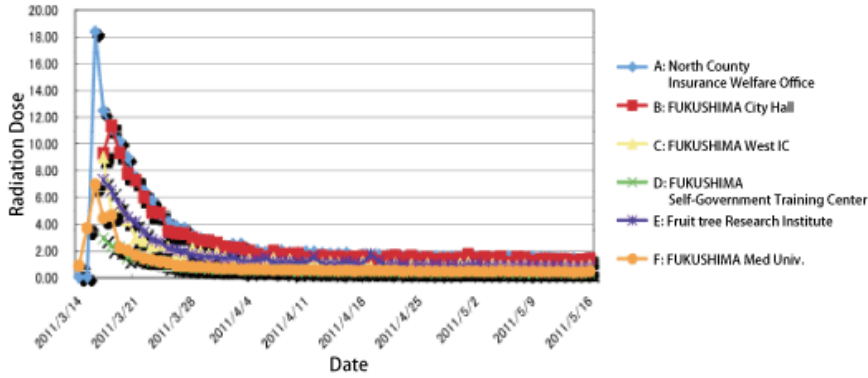
The Accumulation by Air-Sampler ( Low-Volume Sampler / High-Volume Sampler)



Example of Chernobyl:  
Today, Cs-137 is likely to exist on tree form.

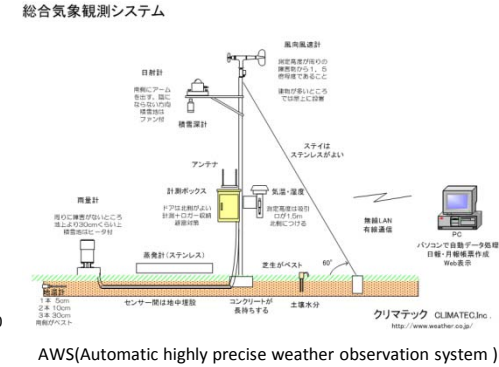
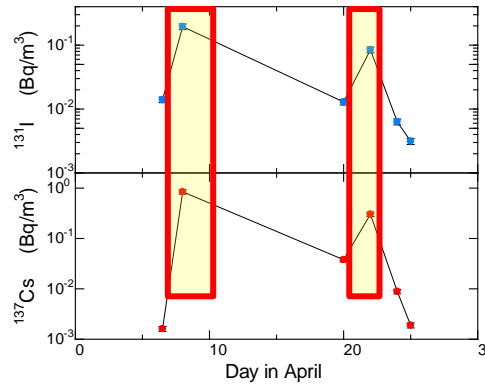
# Research in Radiation at Places for Various Uses by Entrainment

Change of the radiation dose in Fresh air in Fukushima-City ( $\mu$  Sv/h)

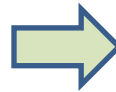


Change in the measured value of radiation at Mito City (accumulated by the Department of Science at IBARAKI Univ)

It rises one column of radiation dose in wind velocity 5m/s or more



⇒Radioactive material most come flying and are composed, or re-entrainment during the period between March 16-22, 2011.  
⇒Diffusion by soil pollution and the re-entrainment are concerned



Energy of the wind and an earth surface condition are established the relational expression of the quantity by AWS



The understanding of re-entrainment ⇒ It is very essential to estimate the elimination of radioactive material from soil and the future diffusion of it.  
◎Wind velocity dependence  
◎Surface of the earth condition dependence(the land use/soil water) Those should be clarified by actual survey.



Bare Ground  
School ground / Play ground



Five Law-Volume Sampler , WIND VANE and ANEMOMETER

When the wind velocity is high, the re-entrainment occurs because of turbulence. Surface of the earth states are different, and quantity of scattering varies according to the land use with the same wind velocity.

Hoist efficiency quantification every the land use

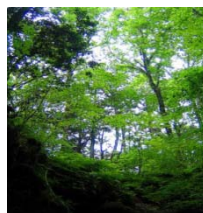
Farm land



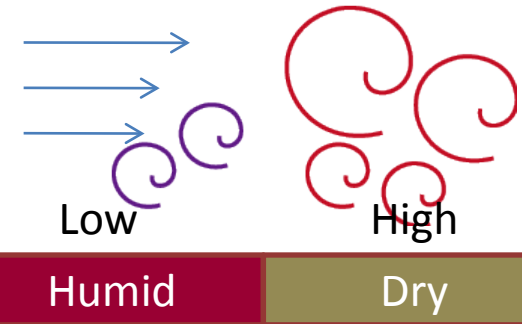
Paddy Field



Forest



City Area



# The Detailed Measurement of Aerosol Entrainment



Cascade Impactor

( Removable depending on a purpose )



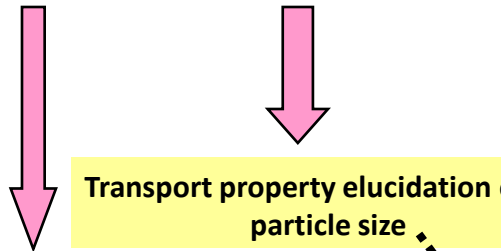
High-Volume Sampler(portable)

A large quantity of collection of all aerosol

*The Tokyo Institute of Technology, Yoshida and others perform quantitative analysis of the isotope cyclical change of materials using a mass spectrometer, a scintillation detector and put up a large number of result including seven volumes of Nature.*

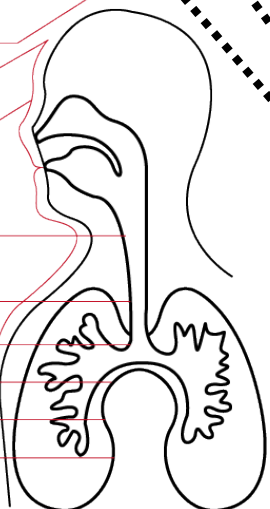
Installed in three places including the forest neighborhood in Fukushima

Aerosol collection by the particle size



Human body impact statement

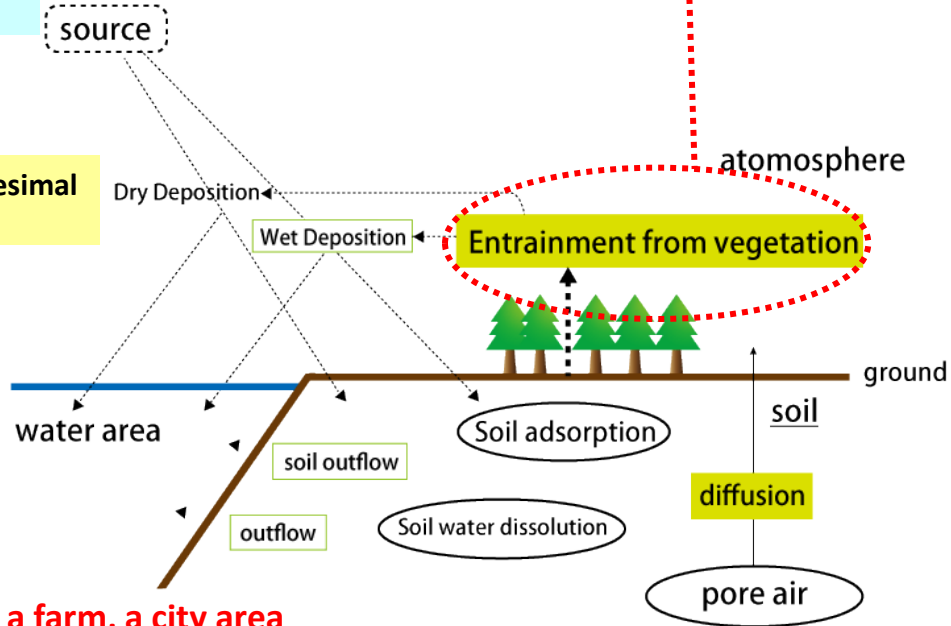
- over  $10\mu$
- STAGE 0 over  $9.0 \sim 10\mu$
- STAGE 1 over  $5.8 \sim 9.0\mu$
- STAGE 2  $4.7 \sim 5.8\mu$  larynx
- STAGE 3  $3.3 \sim 4.7\mu$  trachea and primary bronchi
- STAGE 4  $2.1 \sim 3.3\mu$  Secondary bronchus
- STAGE 5  $1.1 \sim 2.1\mu$  bronchiole
- STAGE 6  $0.65 \sim 1.1\mu$  alveolus
- STAGE 7  $0.43 \sim 0.65\mu$  alveolus



Fixed-quantity of the infinitesimal radionuclide

Cyclical change of materials analysis of the atmosphere - vegetation - human being

Measured in the forest, a farm, a city area

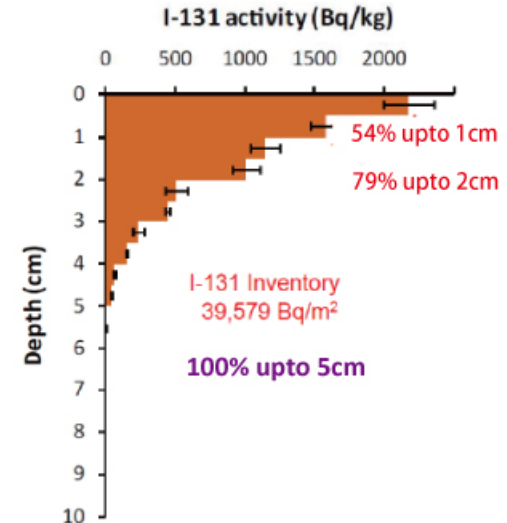
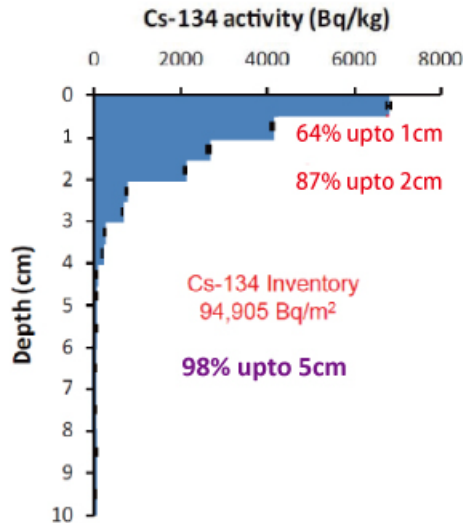
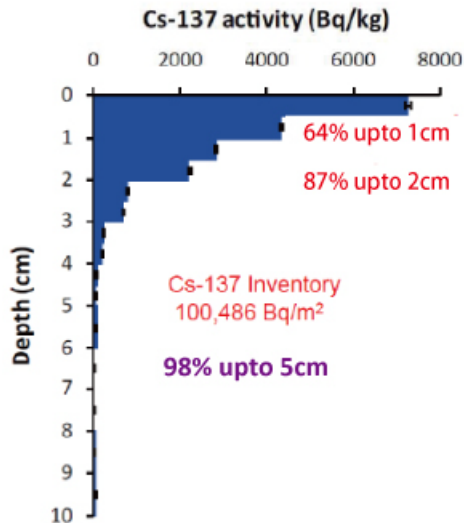


# Soil Percolation

Grasp of the detailed depth distribution of the 5mm interval with the scraper plate

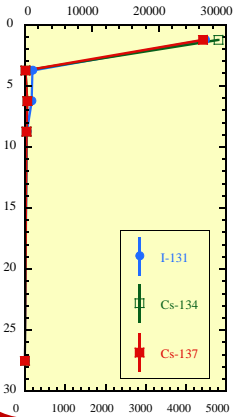


## Depth profile in the Kawamata-cho Kotsunagi district



## Elucidation of Chemical Species and the Change of the Radionuclide in the Fukushima Soil

### What We Understand so far



The Fukushima Soil : Iodine, Cesium  
The surface of soil Mapping & Depth Profile

#### QUESTIONS

- What kind of chemical species does the radionuclide become? What kind of move does it make in the soil?
- How about in the case of aerosol and suspended particle?

Achievement of the department of Earth Planet in HIROSHIMA University

- Research in environmental radiation  
(More than 30 related articles (the past 9 yrs))
- The behavior analysis study of element by the radiated light  
(More than 100 related articles (the past 12 yrs))

### The clarification of chemical species of the radionuclide in environment

- Cesium : Why does Cesium remain on the surface?
- Iodine : Does it shift or not?  
Why does it shift to a plant and milk?  
How about the shift process from aerosol?

It depends on what kind of chemical species it is.

Ex : Iodine → I<sup>-</sup> is easy to shift.



Elucidation of the chemical process by radiated light



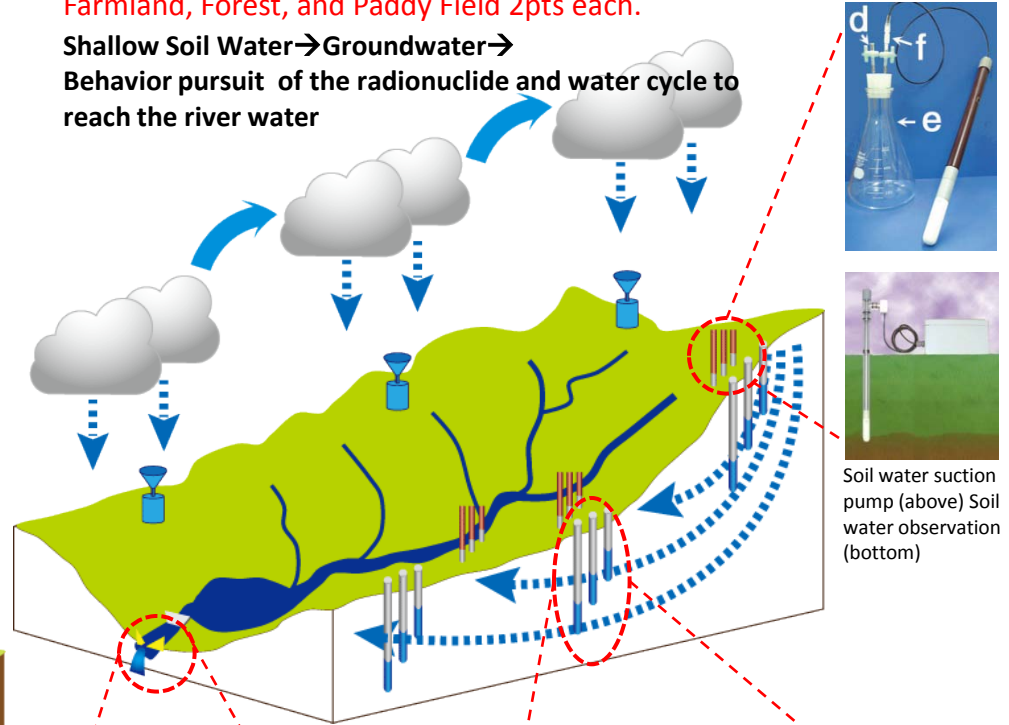
Achievements regarding to radiated light study of Iodine in environment

1. Identification of the host aspect of cesium by Auto-Radiography and the EPMA analysis.
2. Estimate of the chemical species by the selective extraction and particle size distribution.
3. Elucidation of the adsorption structure to clay minerals.



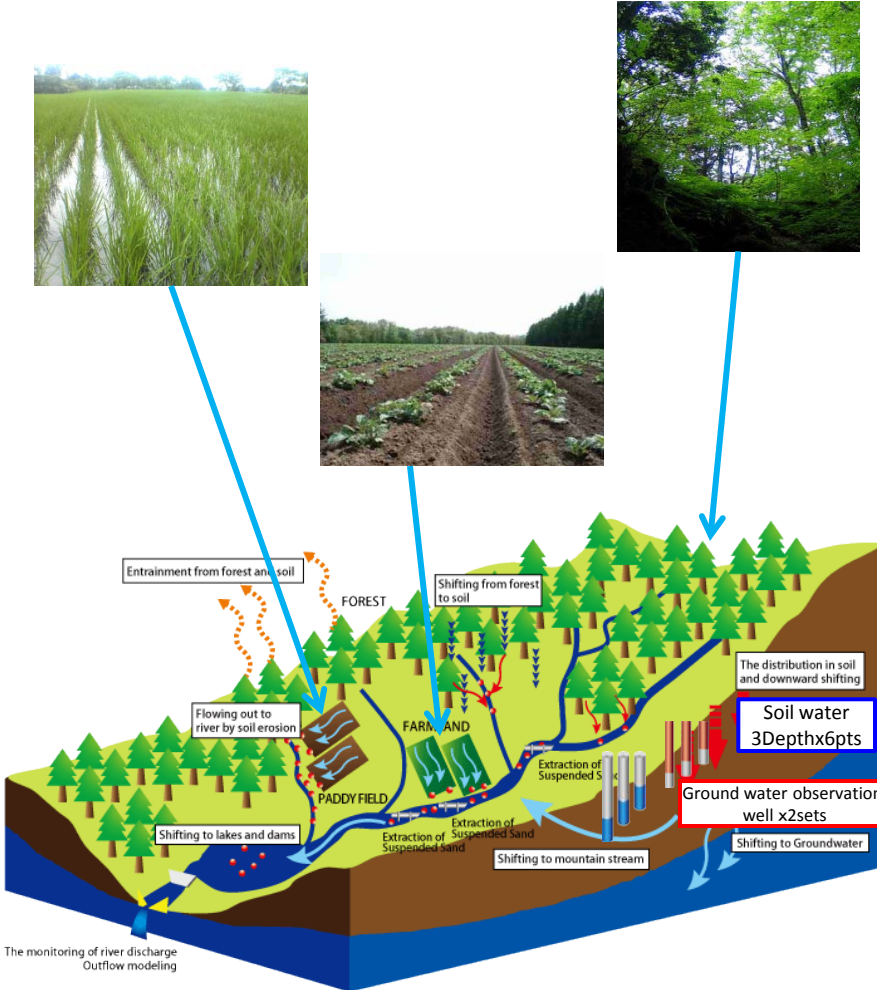
# Behavior analysis of the radionuclide with the movement of water /earth and sand

Farmland, Forest, and Paddy Field 2pts each.  
 Shallow Soil Water → Groundwater →  
 Behavior pursuit of the radionuclide and water cycle to reach the river water



Farmland, Forest, and Paddy Field 2pts each.

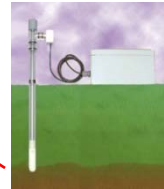
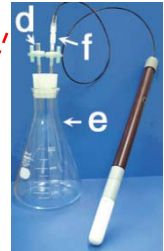
Farmland and Forest 1pt each.



River flow quantity observation with the triangle dam (the left) River water sampling with the automatic sampler(the right)



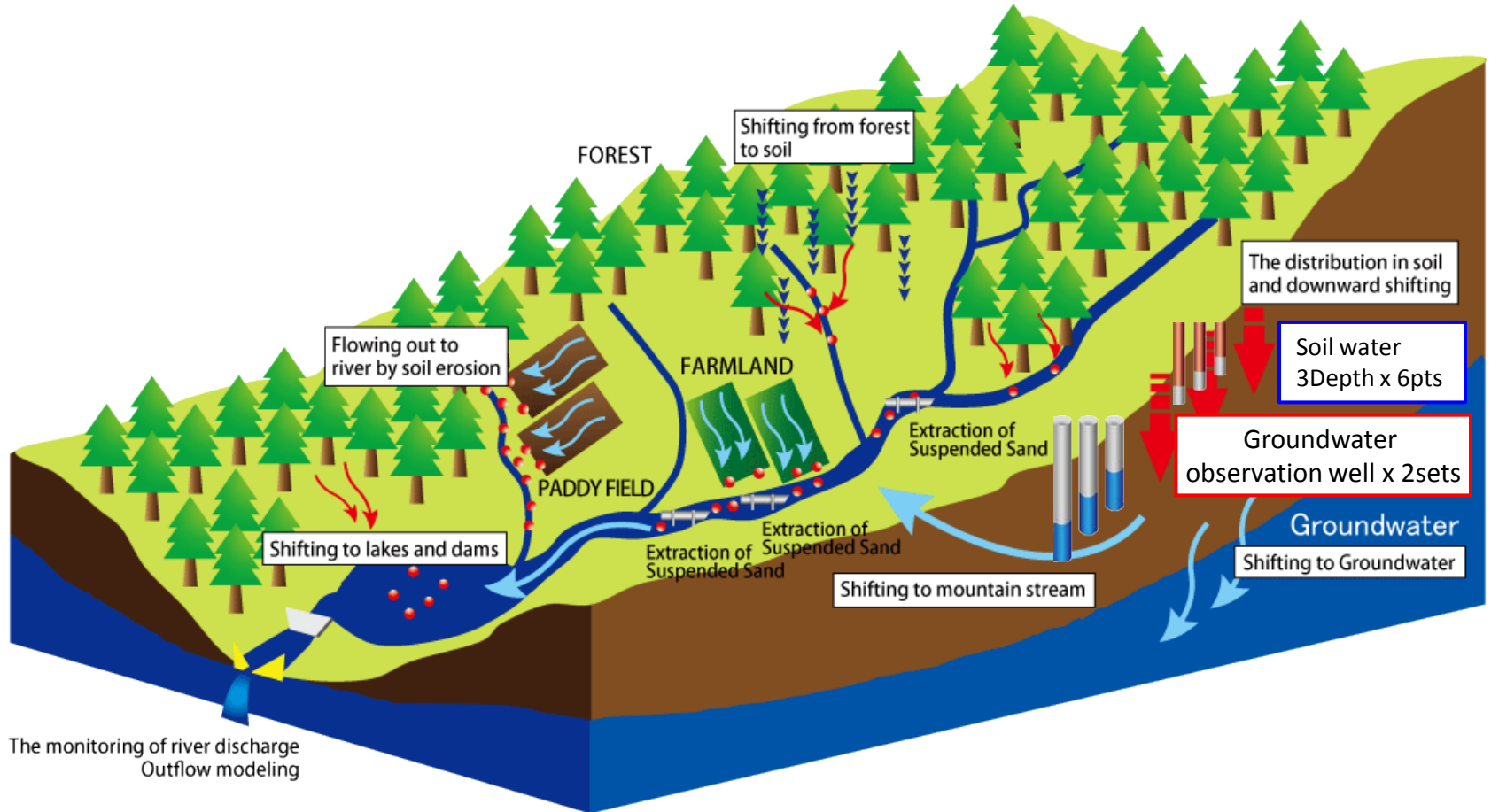
Groundwater sampling using the pump (the right) in observation well (water level monitoring) (the left)



Soil water suction pump (above) Soil water observation (bottom)



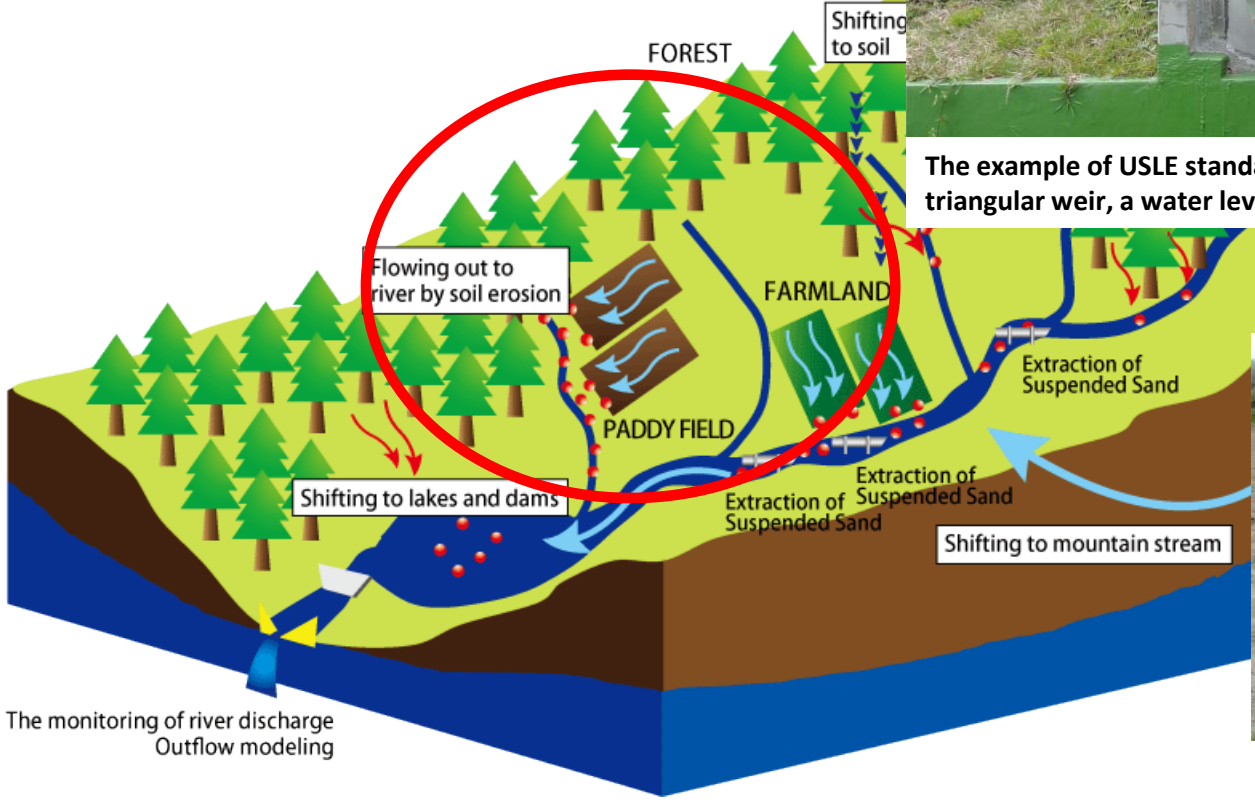
## The shift of water, the earth and sand in the source area



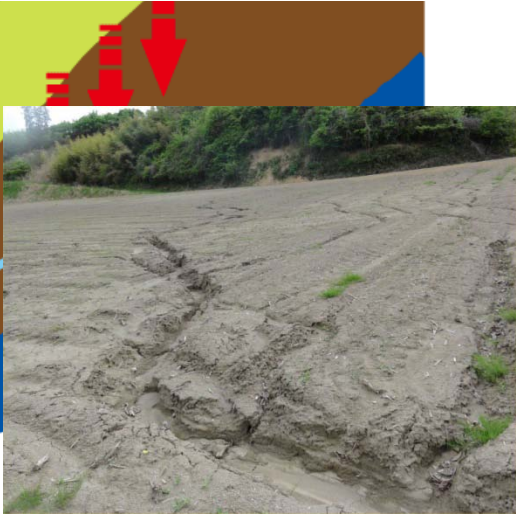
# Plot Scale



The example of USLE standard size plot (Taiwan) consisting of triangular weir, a water level sensor, the reservoir of earth and sand.



The monitoring of river discharge  
Outflow modeling



Soil erosion of the cigarette field

Plots of the USLE standard size are installed at two places of farms and two places of meadows, and measure sediment runoff and radionuclide runoff. By providing the flooded examination paddy field, it estimates the outflow from the paddy field by measuring its suspended solids.

# Paddy Fields' Plot



The field devised manure

The field which stripped off surface soil

Field of the normal cultivation



High-performance turbidity logger which is able to usually receive up to 30000NTU and floating sand sampler are installed at the field which stripped off surface soil and the field of the normal cultivation.  
The maddy water sampling and analysis by HIROSHIMA University

# The Calculation of the Quantity of Radionuclide Load from the Soil to a River, the River to the Ocean

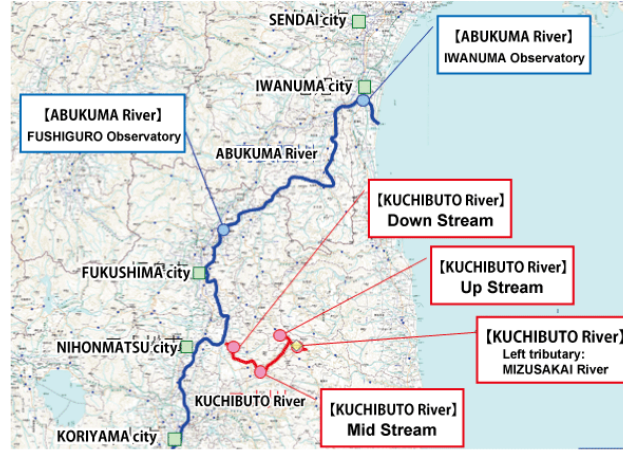
Floating sand sampler (Phillips et al, 2000)  
Collection of the floating sand using the floating sand sampler, Cs -137 analyses (Mizugaki et al., 2008, Fukuyama et al 2010)

The use of the current floating sand sampler

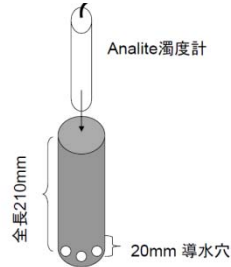


The collection of rainfall data and space, time data interpolation (analysis of rain gauge data and radar AMEDAS data)

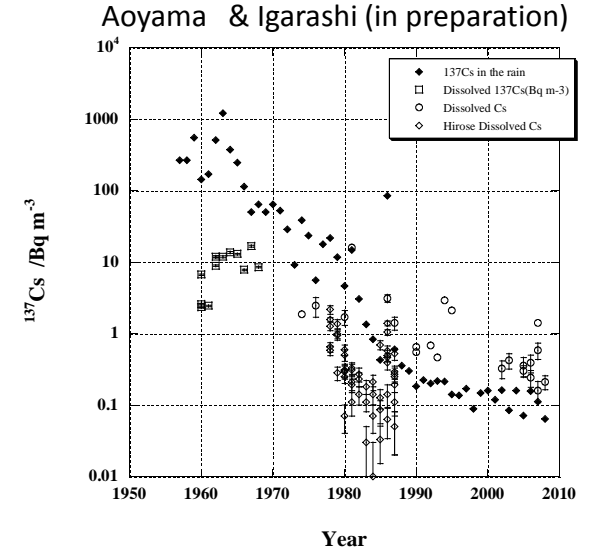
Grasp of the overview of the movement process of the radionuclide from the river to the large basin / sea area based on these observation and estimated result.



Intensive Research Area: Yamakiya, KAWAMATA



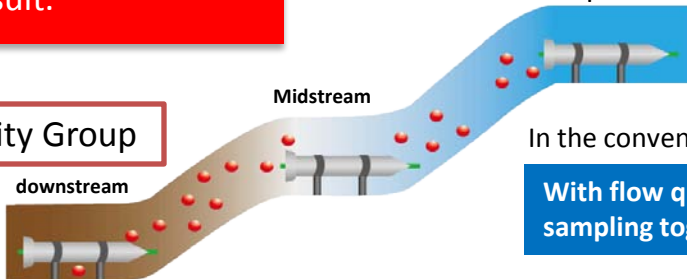
A turbidity meter and the setting situation Upstream



The high precision measurement of the radionuclide of the water by absorbing it in resin.

There are no analysis results at the analysis center.  
**Device of the Meteorological Research Institute and the use of the know-how are necessary. (duties trust)**

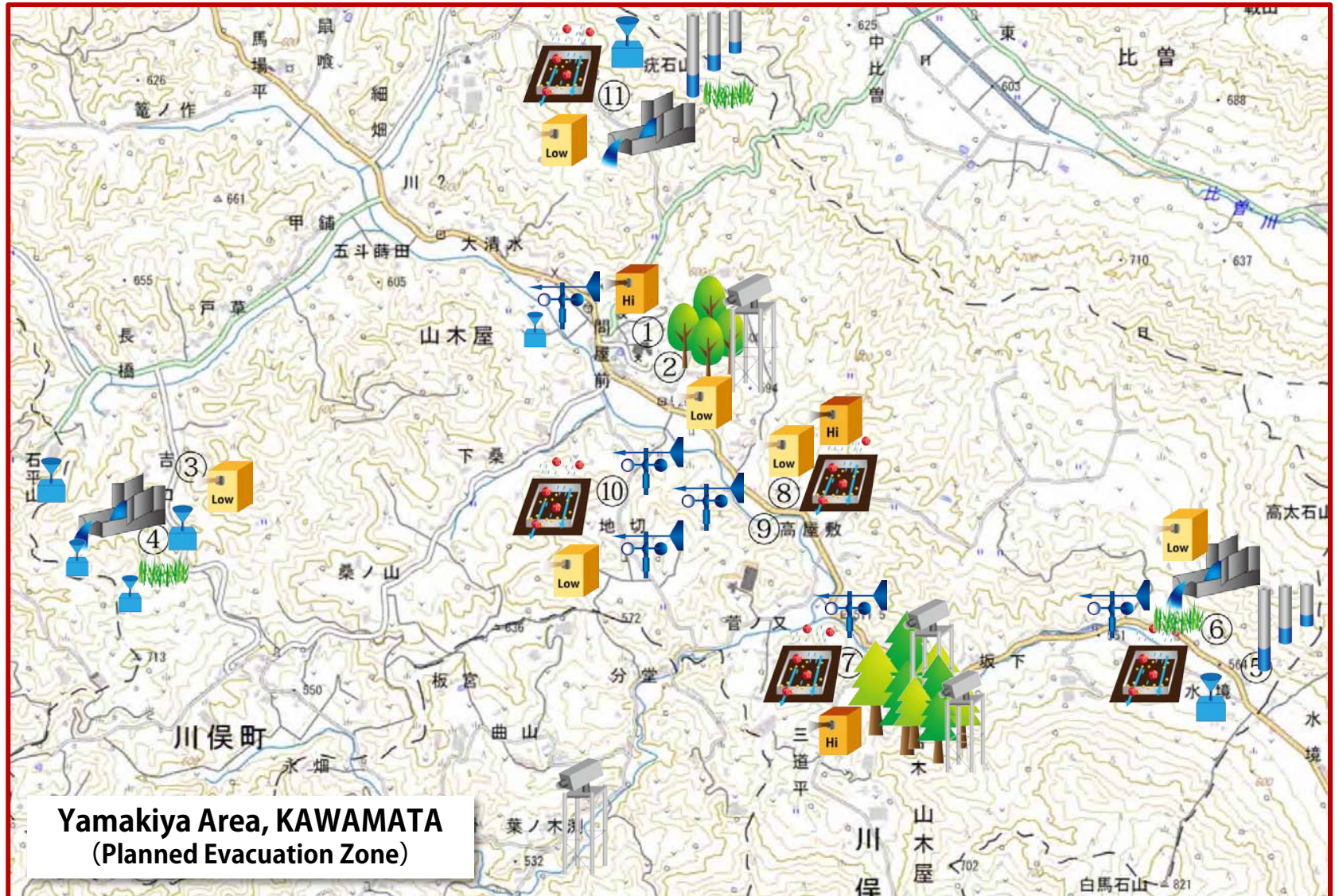
KYOTO University Group

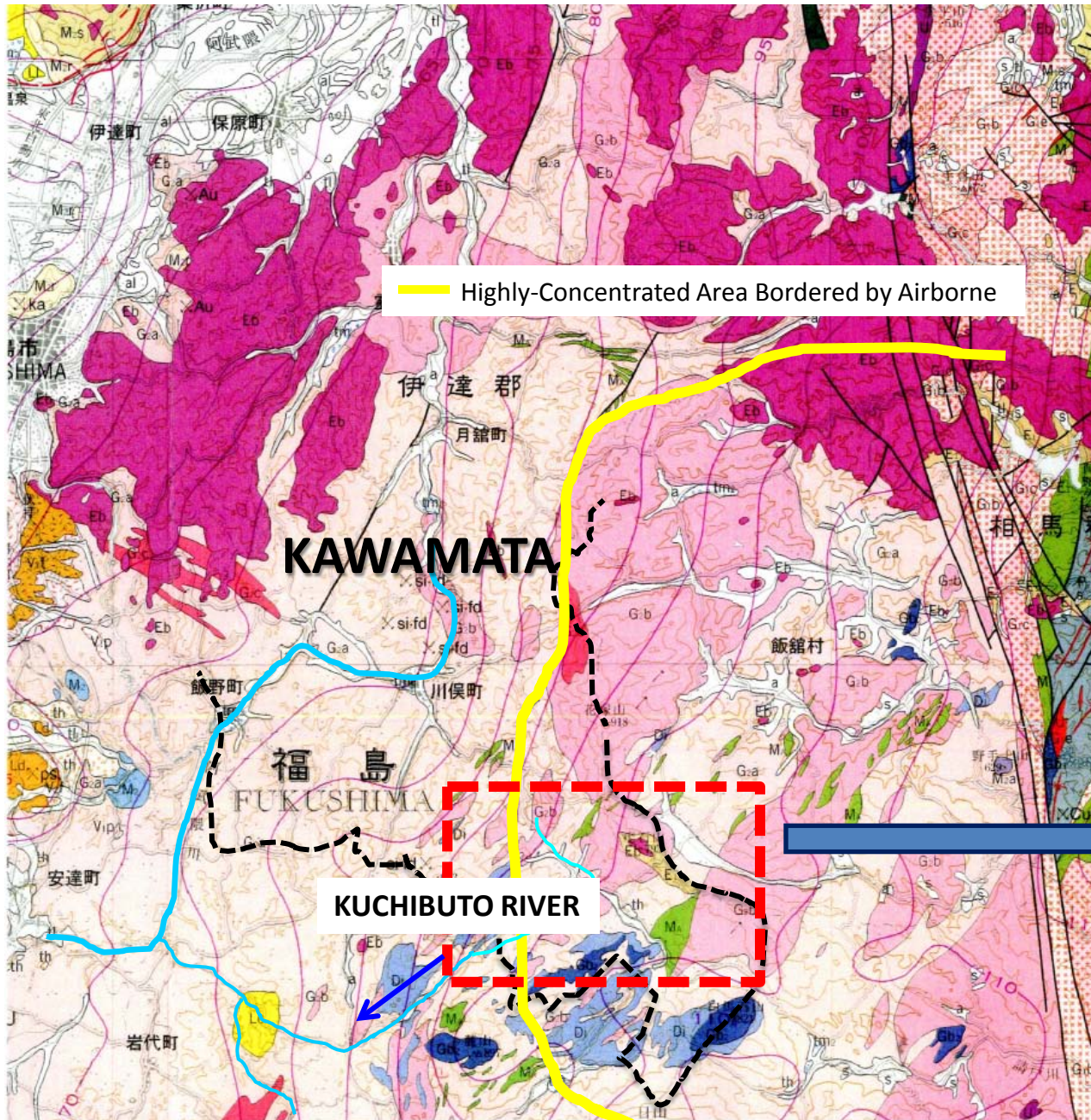


In the conventional study, most Cs -137 flows down as floating sand (Matsunaga,2001)

With flow quantity, the floating sand sampler + turbidity meter, and putting water sampling together, Cs-137 outflow fluxes are precisely calculated.

# Research Map : Kawamata Area





Highly-Concentrated Area Bordered by Airborne

KUCHIBUTO RIVER

- G-c 白雲母黒雲母花崗岩  
Muscovite-biotite granite
- G-b 黒雲母花崗岩 (淡紅色黒雲母花崗岩, 灰色黒雲母花崗岩)・  
角閃石含有黒雲母花崗閃緑岩  
Biotite granite (Pink biotite granite, Gray biotite granite) and  
hornblende-bearing biotite granodiorite
- G-a 角閃石黒雲母花崗閃緑岩・片状角閃石黒雲母トータル岩  
Hornblende-biotite granodiorite and foliated  
hornblende-biotite tonalite
- Di 細粒角閃石黒雲母閃緑岩  
Fine-grained hornblende-biotite diorite
- G-b 角閃石斑れい岩・単斜輝石斜方輝石斑れい岩・  
コートランドタイトなど  
Hornblende gabbro, clinopyroxene-orthopyroxene gabbro,  
cortlandite and others

Most soil of the Highly-Concentrated Area become Granitoids (Sandy soil : Masa soil), and the quality of soil is approximately homogeneous.

Intensive Research Area :  
KAWAMATA  
Upstream of Kuchibuto River :  
YAMAKIYA Area  
Most are granite and diorite.  
⇒ Those represents the quality of soil at the highly-concentrated area.