THE UNIVERSITY OF TOKYO

In-situ measurement of vertical distribution of radiocaesium concentration in Fukushima soil

Shinya SUZUKI, Masaru MIZOGUCHI

Graduate school of Agriculture and Life Science, The University of Tokyo

Japan vs. California

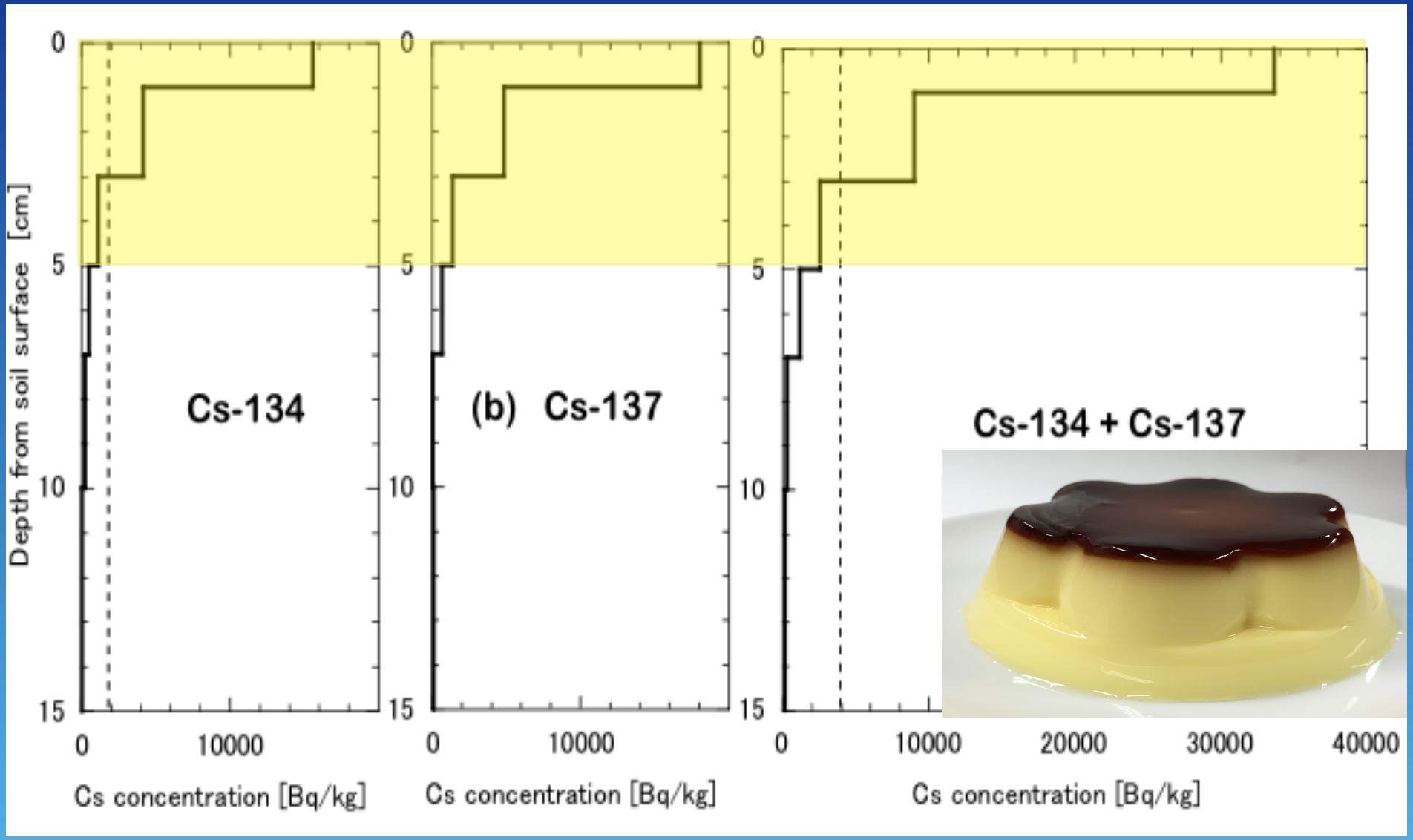
Fukushima Daiichi Nuclear Disaster

http://blog.goo.ne.jp/yampr7/e/3252e0611ebc1eabd36195cede8a2231

March 11 ,2011

The Great East Japan Earthquake

Vertical distribution of Cs in soil (24/5/2011)



Shiozawa et al. (2011): Vertical concentration profiles of radioactive cesium and convective velocity in soil in a paddy field in Fukushima. Radioisotopes 60 : 323-328

Situation of agricultural field after 3 years from the accident

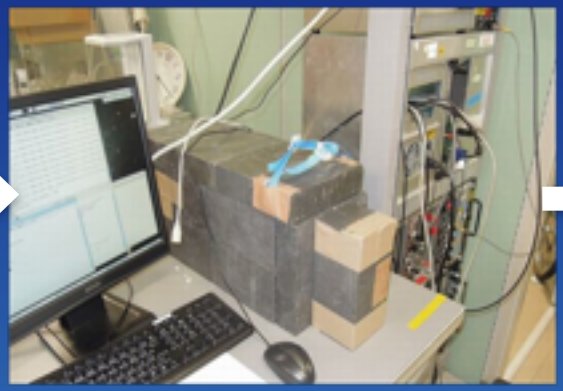
http://www.iai.ga.a.u-tokyo.ac.jp/mizo/edrp/fukushima/fsoil/PAWEES131030.pdf

Must measure vertical distribution and spatial distribution of Cs for decontamination

Procedure of concentration measurement and decontamination of Cs in agricultural field

【Current method】

Soil sampling



Analysis

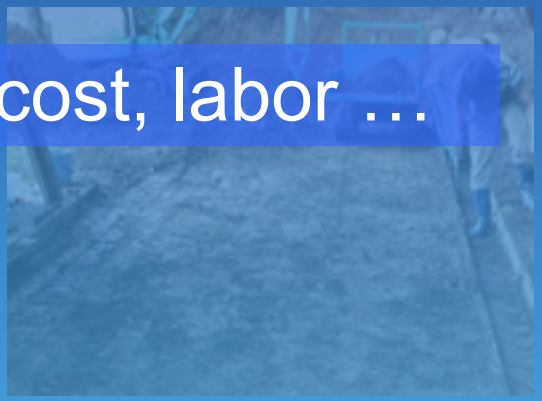
Decontamination

【Ideal method】

Taking a lot of time, cost, labor …

Device

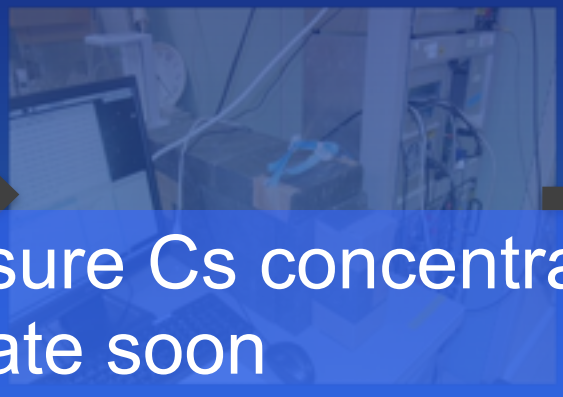
In-situ method



Decontamination

Procedure of concentration measurement and decontamination of Cs in agricultural field

【Current method】



Possible to measure Cs concentration in the field, and decontaminate soon

Soil sampling　　Analysis　　Decontamination

【Ideal method】

Device

In-situ method

Decontamination

Objective

Using a in-situ device we developed,

Evaluating to applicability of the in-situ device before and after decontamination

In-situ device for measuring the vertical distribution of Cs in soil using GM-tubes

DOJYO-kun

Detail of the device "DOJYO-kun"

Measurement Time: 3 min

GM tube: LND712
(LND, Inc.)

How to use the in-situ device “DOJYO-kun”

Methods

Vertical distribution of Cs in the field before and after decontamination

(1) Experimental area

Iitate Village, Fukushima, Japan. (19, 27/7/2014)

(2) Measurement Points

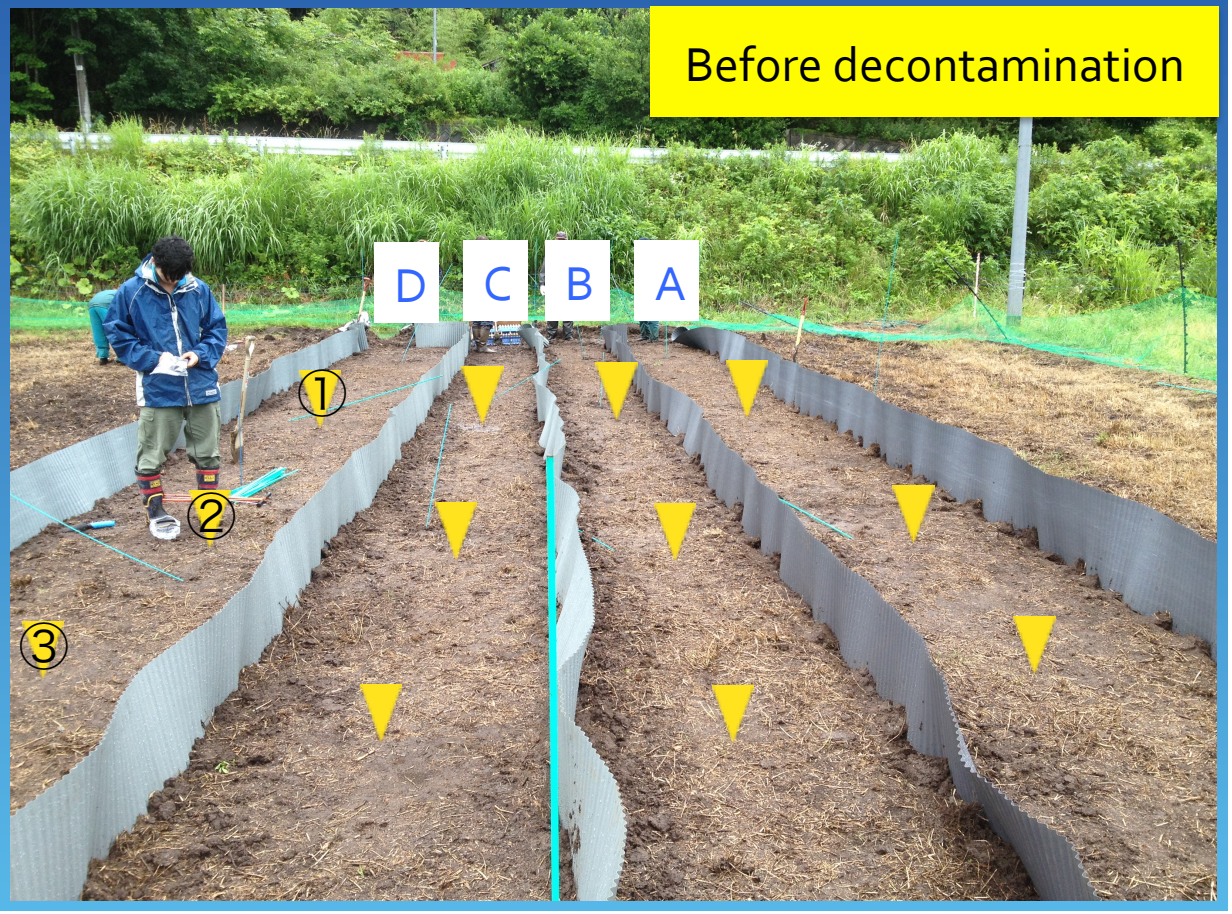
3×4 Points before and after decontamination

(3) Measurement data

○ Cs concentration;

・Soil sampling: 0～16 cm,

・Device: 0～8 cm



Methods

Decontamination with tennis court brush

Before decontamination

After decontamination

3 times

Results

Vertical distribution of Cs in the field before and after decontamination (D3)

D

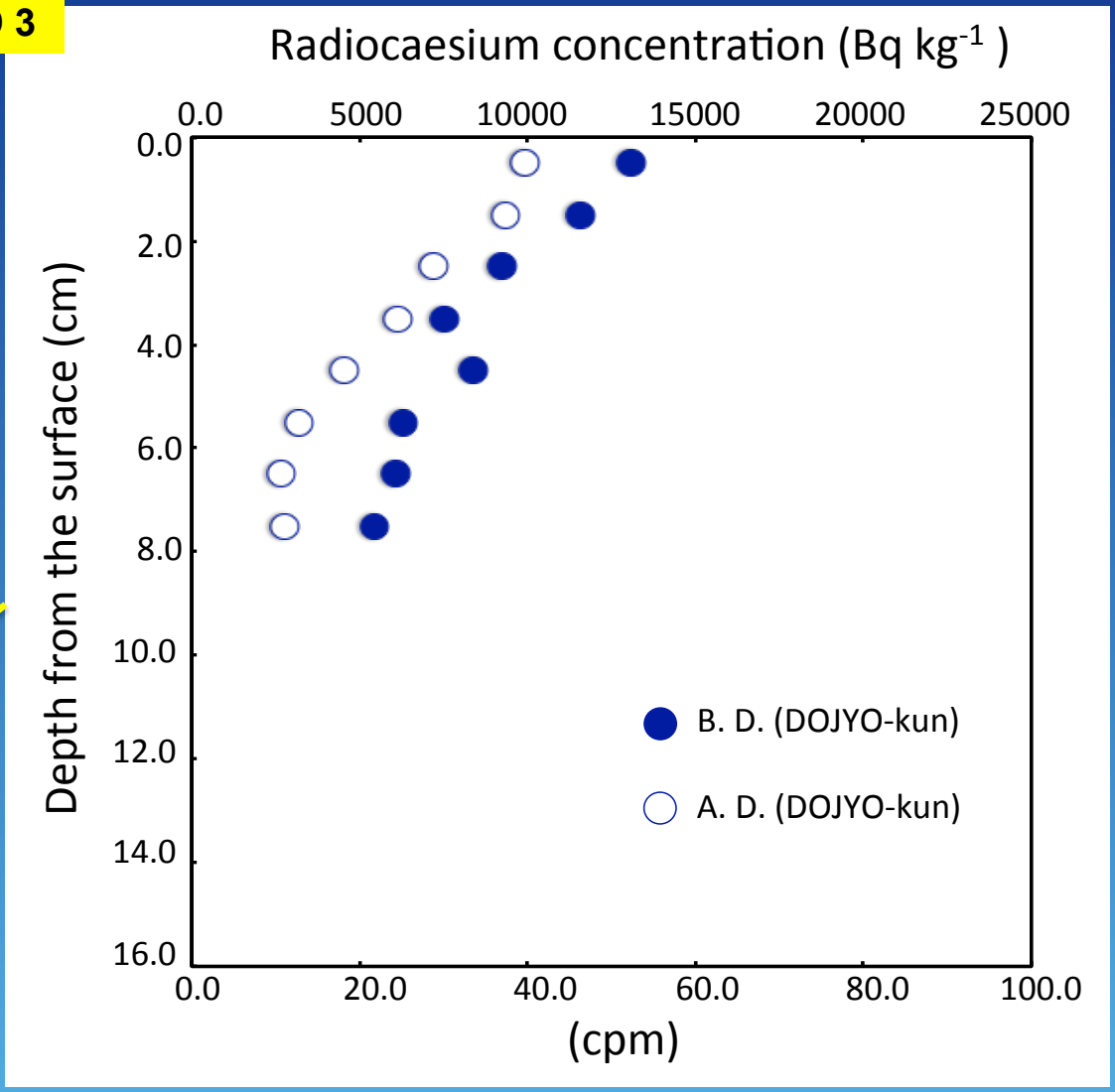
D1

D2

D3

Water flow

D 3



in-situ device

Results

Vertical distribution of Cs in the field before and after decontamination (D3)

D

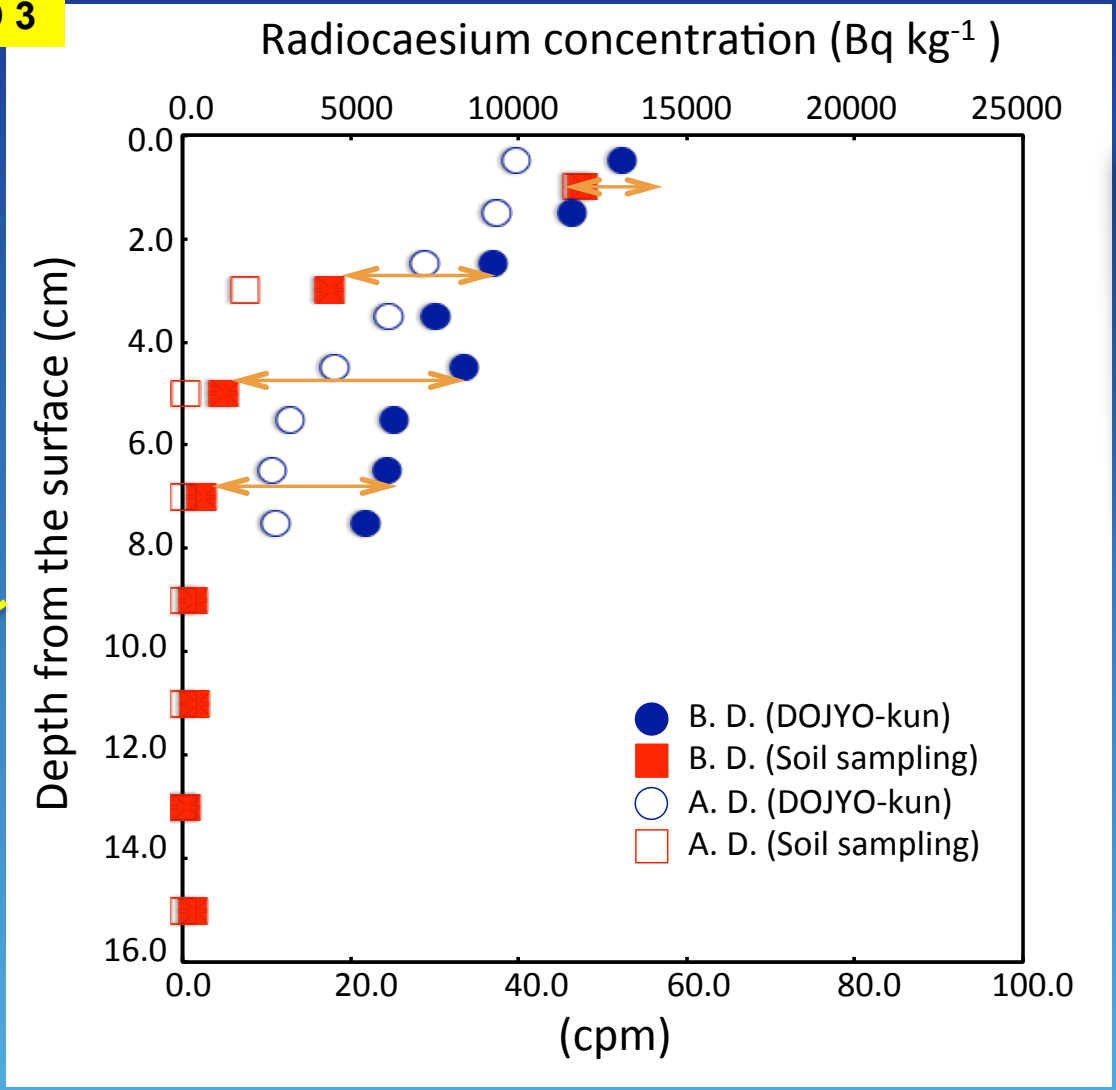
D1

D2

D3

Water flow

D 3



Soil sampling

in-situ device

Results

Vertical distribution of Cs in the field before and after decontamination (D1～D3)

D

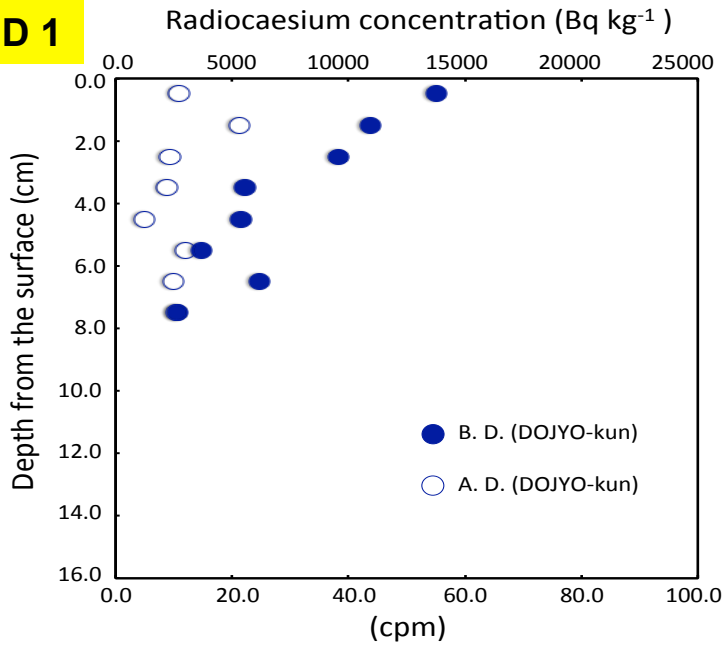
D1

D2

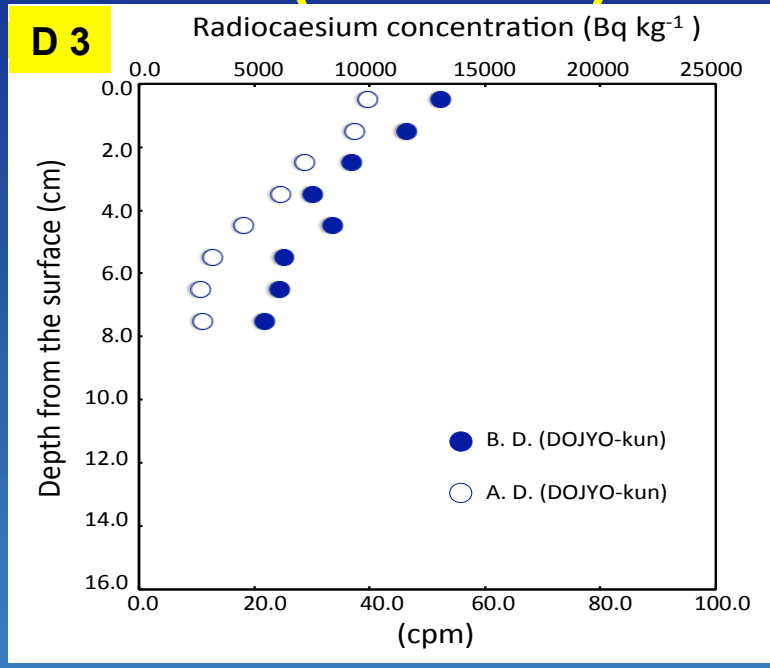
D3

Water flow

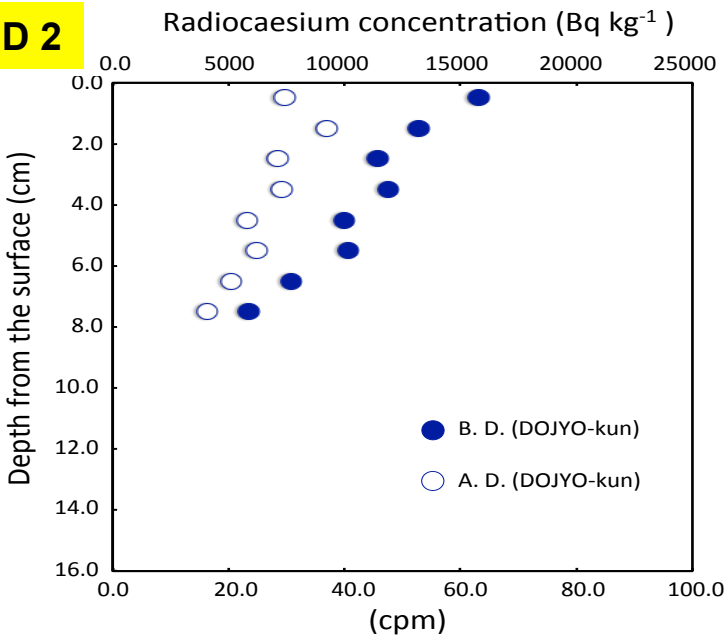
D 1



D 3



D 2



in-situ device

Results

Vertical distribution of Cs in the field before and after decontamination (D1～D3)

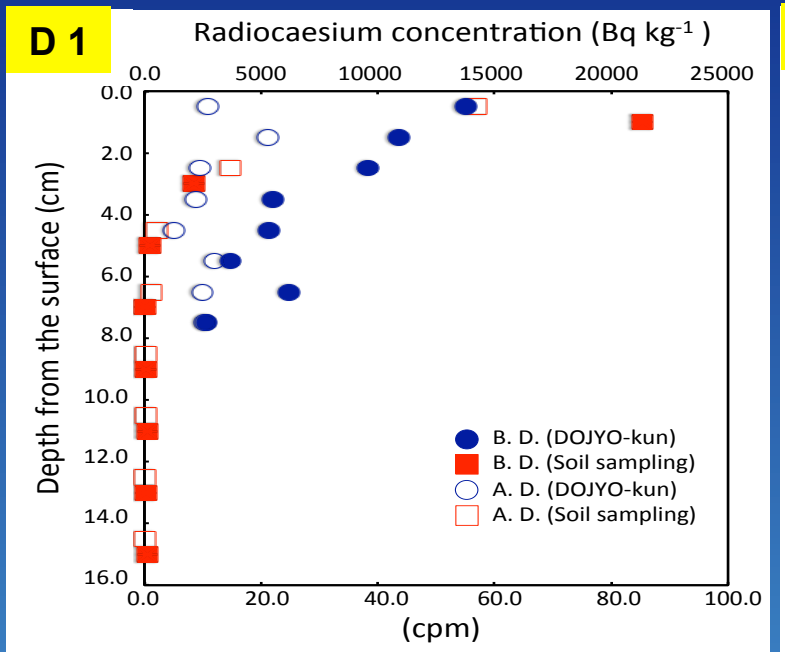
D

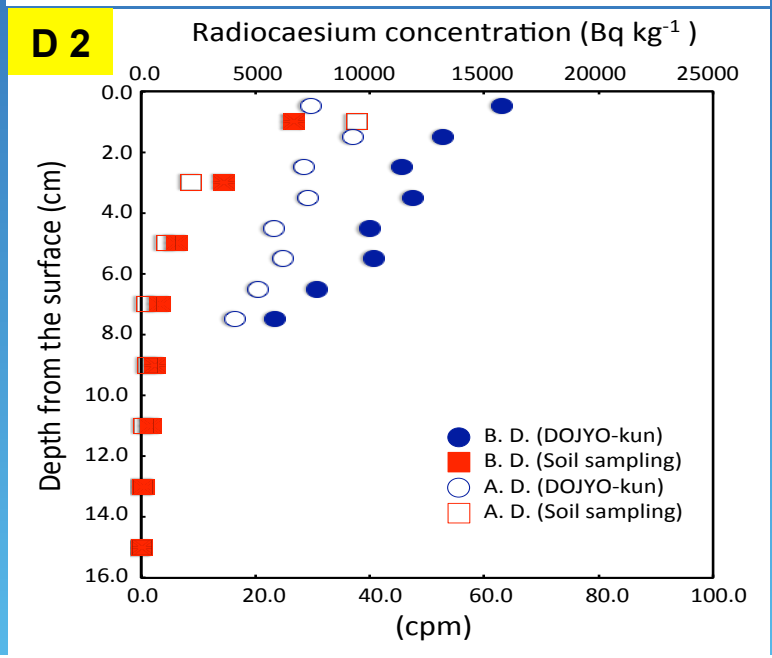
D1

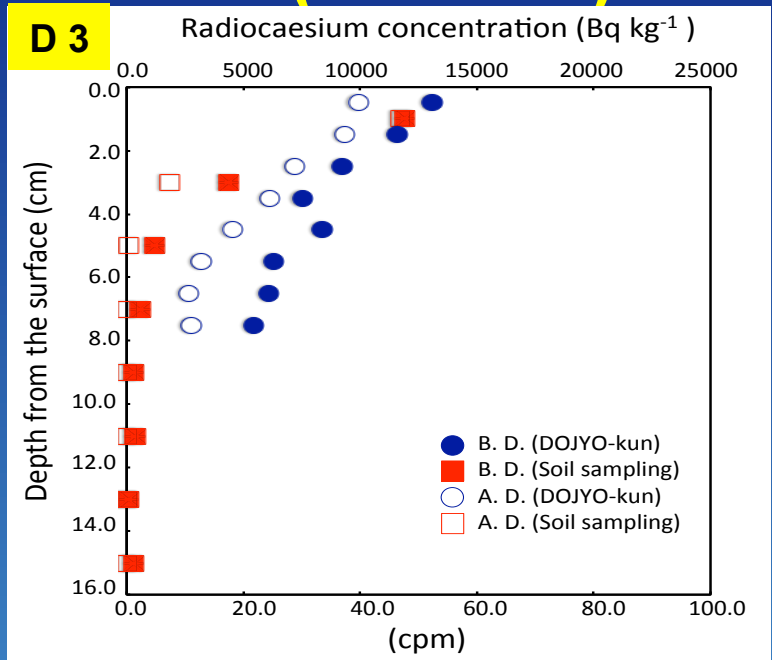
D2

D3

Water flow







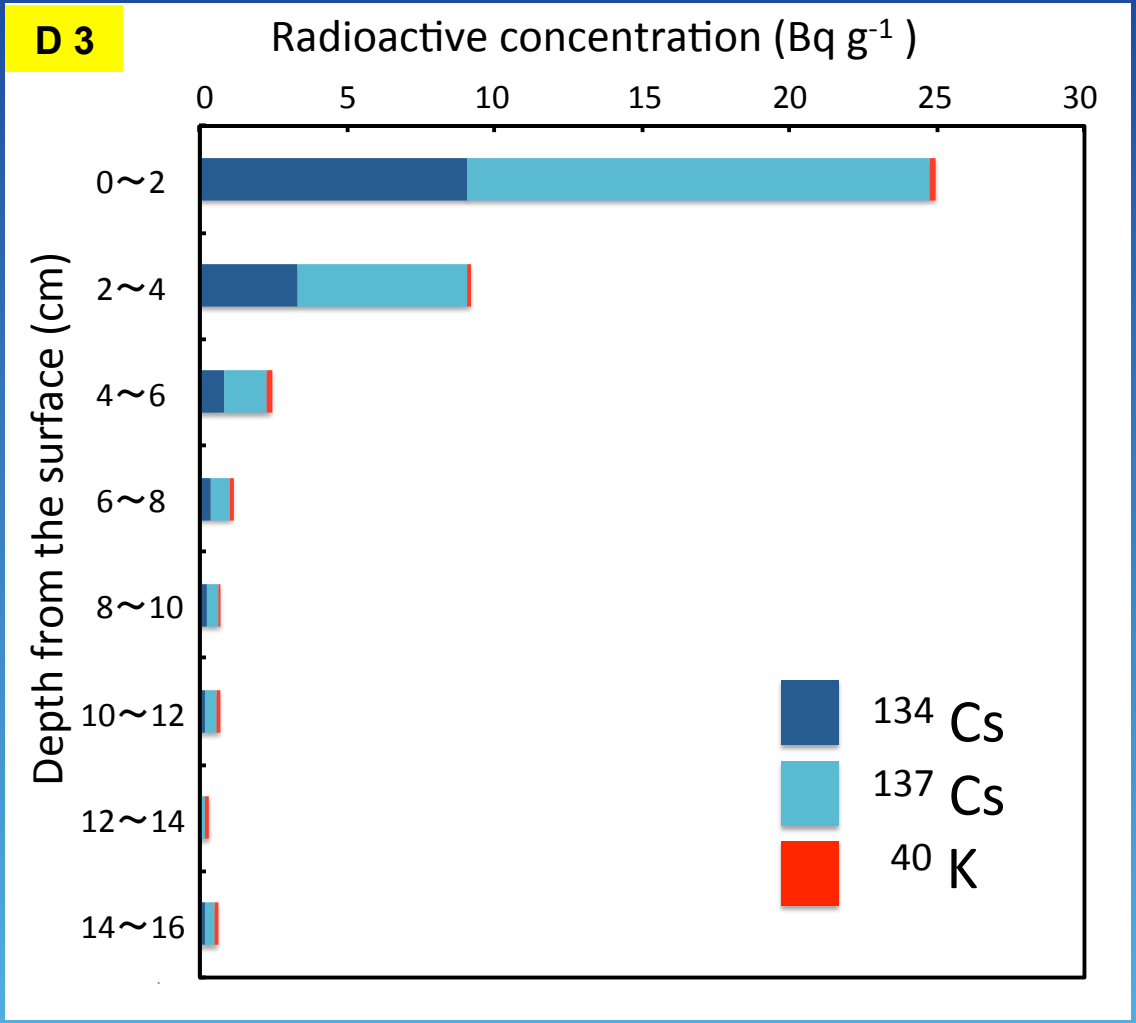
Soil sampling

in-situ device

Results

Radioactive concentration of ^{134}Cs, ^{137}Cs, ^{40}K in each depth

Using Ge scintillation detector



○ Rate of ^{40}K

0.6%

1.5%

5.7%

10.8%

15.3%

19.5%

47.0%

21.6%

^{40}K has an insignificant effect on our device

Discussions

Vertical distribution of Cs in field before and after decontamination

○ The device could detect the decrease of Cs concentration after decontaminating in the field

○ Some differences were found between device and soil sampling, however these causes were not clearly

Considered causes

- Disturbance of the top soil when we set the device
- Insufficient evaluation of radiation scattering and attenuation

Application

Spatial distribution of Cs in the field

(1) Experimental area

litate Village, Fukushima, Japan.

(19, 26, 27/4/2014)

(2) Measurement Points

○ Undisturbed paddy field (10 m × 20 m)

2.5 m mesh; 5×9 Points

0.8 m, 1.6 m from center ; 2×2 Points

Total 49 Points

(3) Measurement data

○ Cs concentration;

- Soil sampling: 0～16 cm,
- Device (DOJYO-kun): 0～8 cm

○ Ground elevation

○ Volumetric water content

Application

Spatial distribution of Cs in the field

(1) Experimental area

litate Village, Fukushima, Japan.

(19, 26, 27/4/2014)

(2) Measurement Points

○ Undisturbed paddy field (10 m × 20 m)

2.5 m mesh; 5×9 Points

0.8 m, 1.6 m from center ; 2×2 Points

Total 49 Points

(3) Measurement data

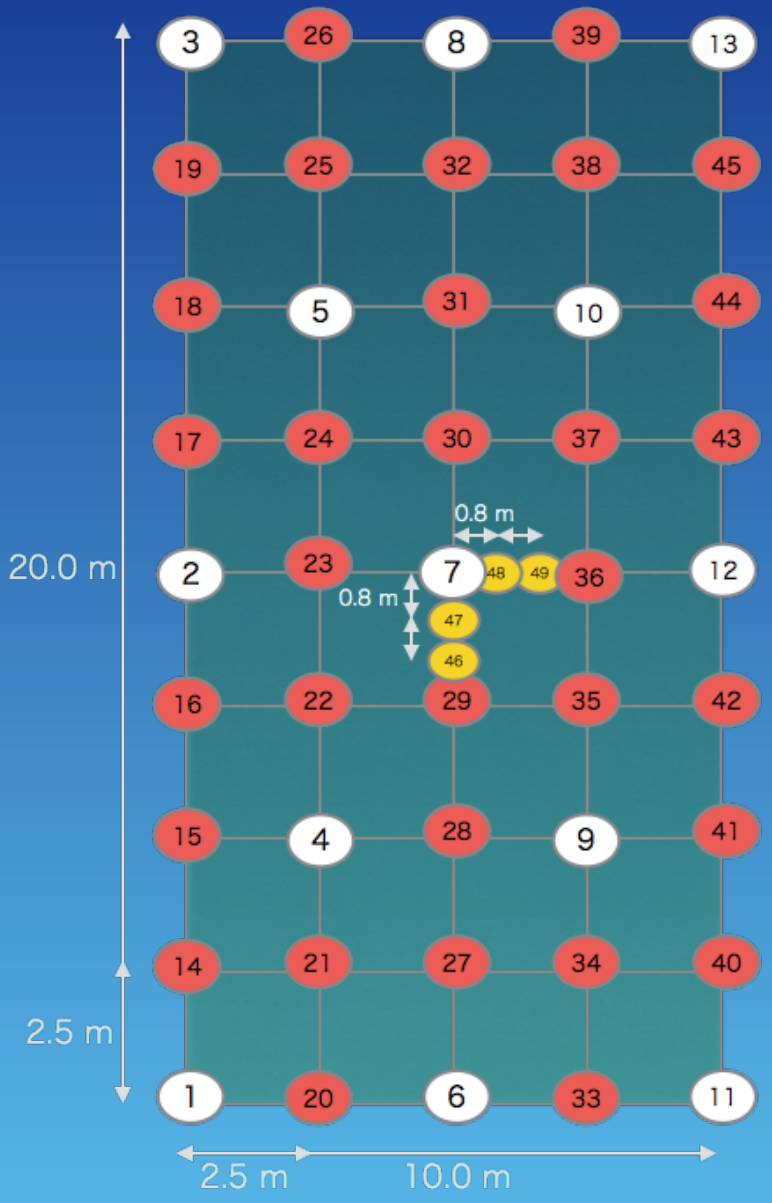
○ Cs concentration;

・Soil sampling: 0～16 cm,

・Device (DOJYO-kun): 0～8 cm

○ Ground elevation

○ Volumetric water content

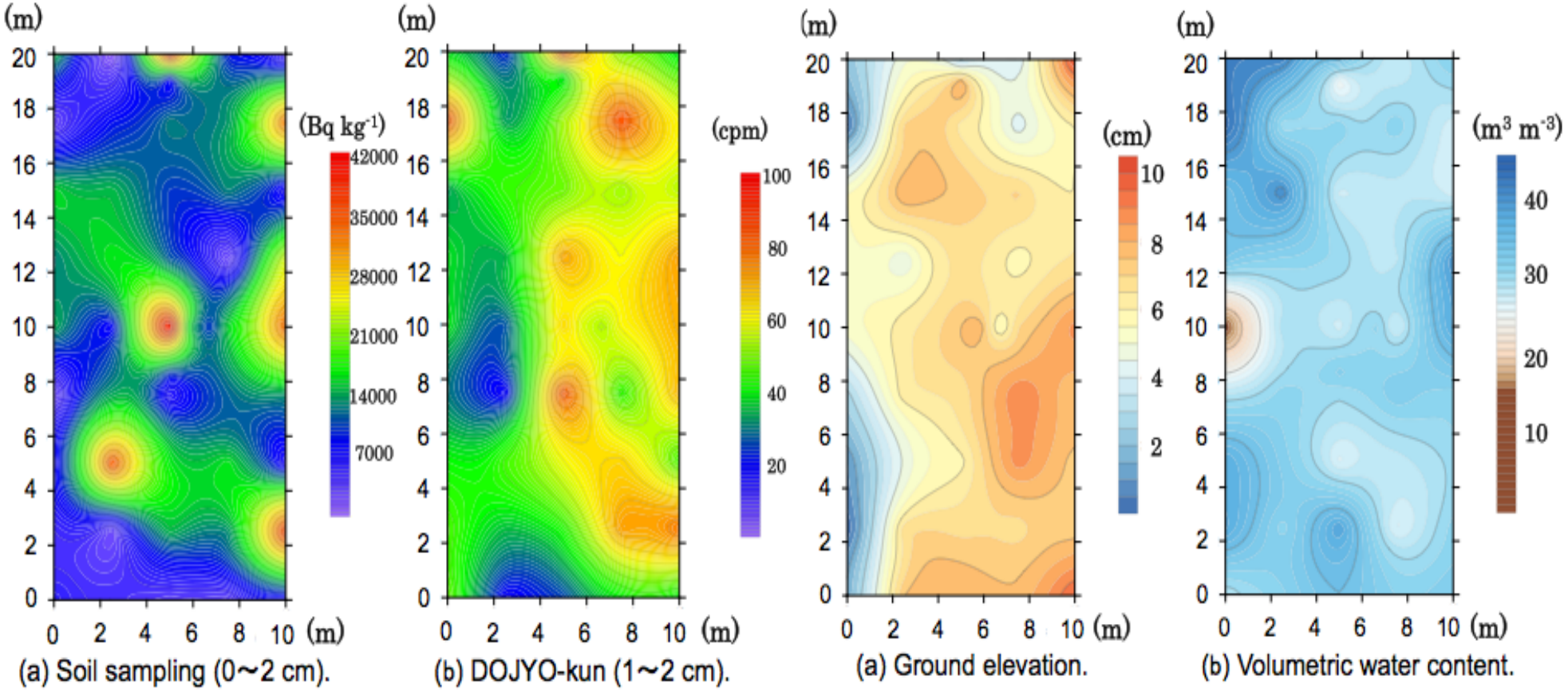


Application

Spatial distribution in paddy the field

Average: 0～8 cm

6,944±7,851 (Bq kg^{-1}) **44.14±17.50 (cpm)**



- Spatial distribution of Cs was inhomogeneous
- High Cs concentration were located around the high ground elevation

Conclusions

○ More precise calibration considering radiation scattering and attenuation is needed to use the in-situ device in the actual field

○ It is possible to know the spatial distribution of Cs easily

○ The in-situ device "DOJYO-kun" is promising to evaluate the decontamination rate in a short time in the field, Fukushima

(Current method: 10 h → Ideal method: **3 min**)

Acknowledgements

Hiroshi Iwase (High Energy Accelerator Research Organization),

All members of "Resurrection of Fukushima",

All members of International Agro. Informatics lab.
(The University of Tokyo).

This work was supported by Misao Network Inc. to develop the device, also one of the commissioned works from NTC Consultants Inc. to Resurrection of Fukushima.