CRiED CENTER FOR RESEARCH IN ISOTOPES AND ENVIRONMENTAL DYNAMICS

University of Tsukuba 筑波大学

Status of Cs migration studies at University of Tsukuba

Yuichi Onda

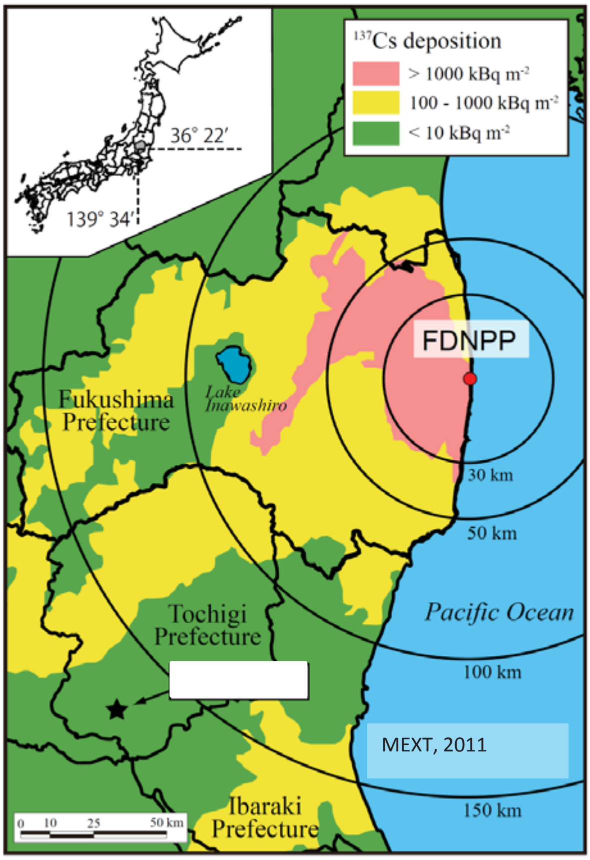
Center for Research in Isotopes and Environmental Dynamics

University of Tsukuba

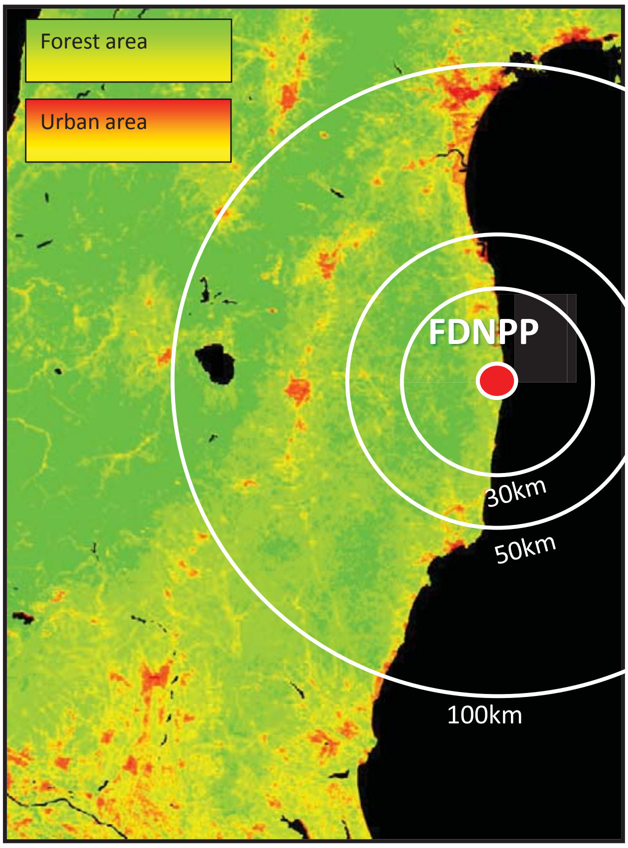
筑波大学 University of Tsukuba

Radioactive contamination of forest area

Radiocesium fallout



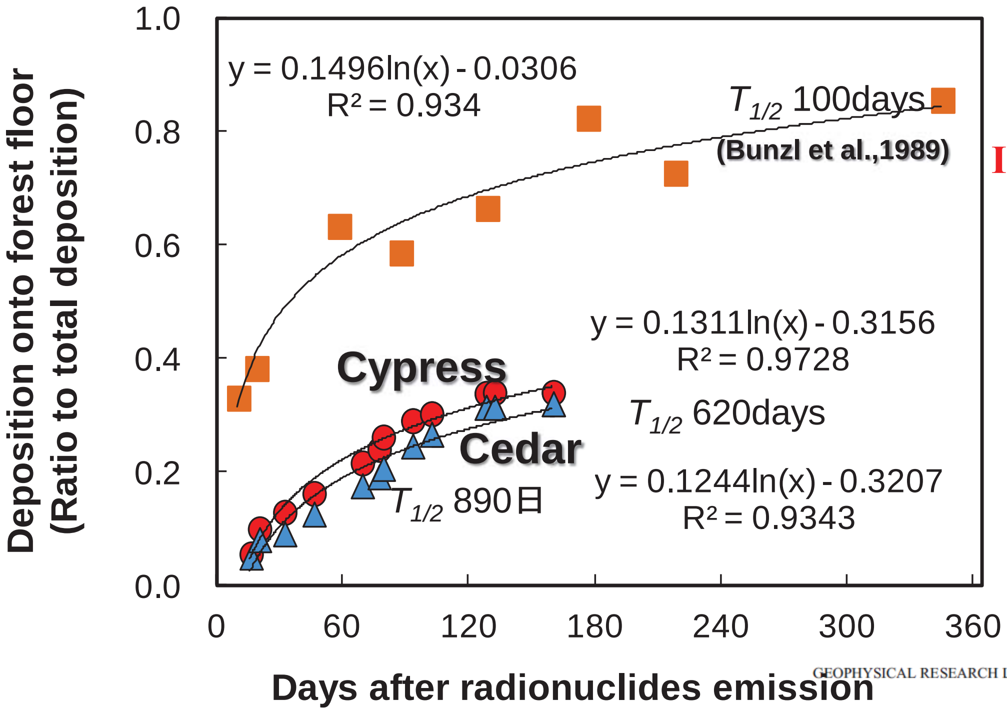
Forest area



Fallout as liquid form

Case study of **Cedar forest** in **Tochigi prefecture**

Sano , Tochigi



Initial interception
> 95% of fallout

Kato et al. (2012), GRL, 39(20), L20403.

GEOPHYSICAL RESEARCH LETTERS, VOL. 39, L20403, doi:10.1029/2012GL052928, 2012

Interception of the Fukushima reactor accident-derived ^{137}Cs, ^{134}Cs and ^{131}I by coniferous forest canopies

Hiroaki Kato,[1] Yuichi Onda,[1] and Takashi Gomi[2]

Monitoring period

Mar. 11~Aug. 19, 2011

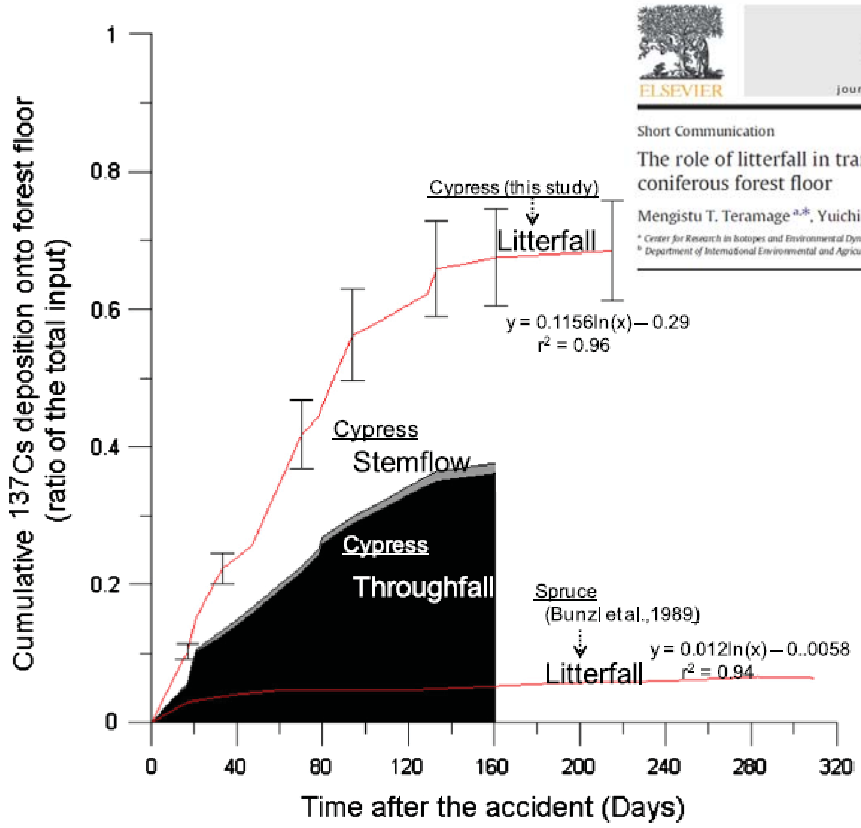


Fig. 3. Cumulative deposition of radiocesium onto the forest floor of a Japanese cypress forest following the FDNPP accident and comparison on radiocesium deposition onto the coniferous forest floor via *LF* route between spruce forest as reported by Bunzl et al. (1989) immediately after the Chernobyl power plant accident (April 1986). The error bars represent the ratio of cumulative ±1σ error to total radiocesium deposition of litter samples per sampling period.

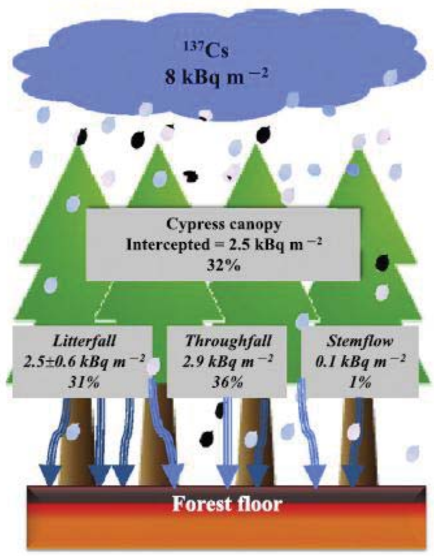
Contents lists available at ScienceDirect
Science of the Total Environment
journal homepage: www.elsevier.com/locate/scitotenv

Short Communication

The role of litterfall in transferring Fukushima-derived radiocesium to a coniferous forest floor

Mengistu T. Teramage [a,*], Yuichi Onda [a], Hiroaki Kato [a], Takashi Gomi [b]
[a] Center for Research in Isotopes and Environmental Dynamics, University of Tsukuba, Tennodai 1-1-1, Tsukuba shi, Ibaraki 305-8572, Japan
[b] Department of International Environmental and Agricultural Science, Tokyo University of Agriculture and Technology, Fuchu, Tokyo 183-8509, Japan

Schematic diagram summarizing the depositional routes of radiocesium in the cypress forest during the observation period (March to October, 2011)

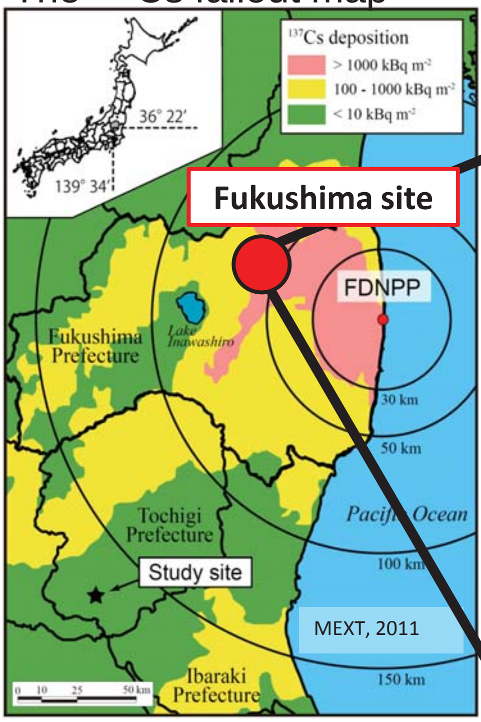


Study site

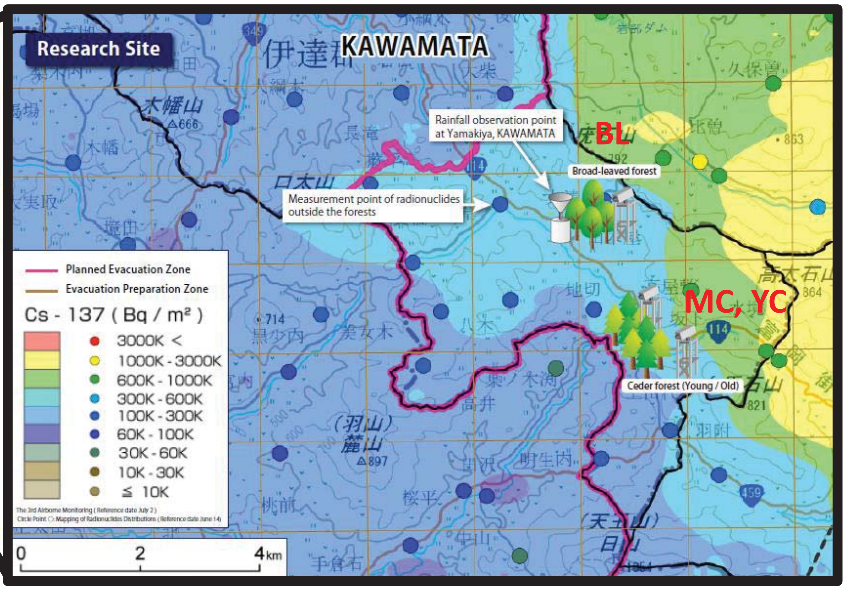
Kawamata, FUKUSHIMA

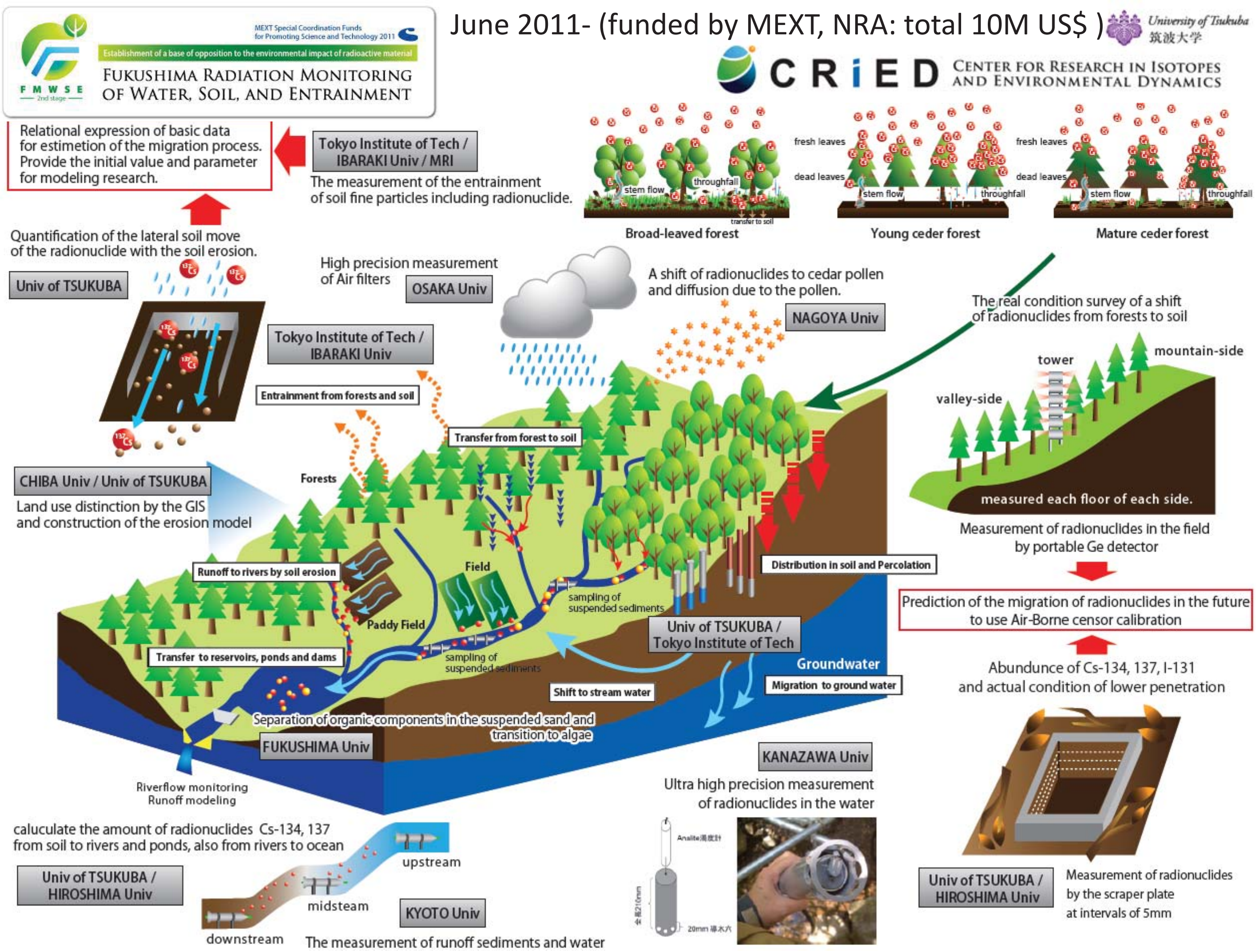
- Yamakiya-area, Kawamata town, Date district, Fukushima.
- 3 forest site were selected in a neighborhood.
- Total Cs-137 fallout: 300-600 kBq m^{-2} (3rd airborne survey).

The ^{137}Cs fallout map

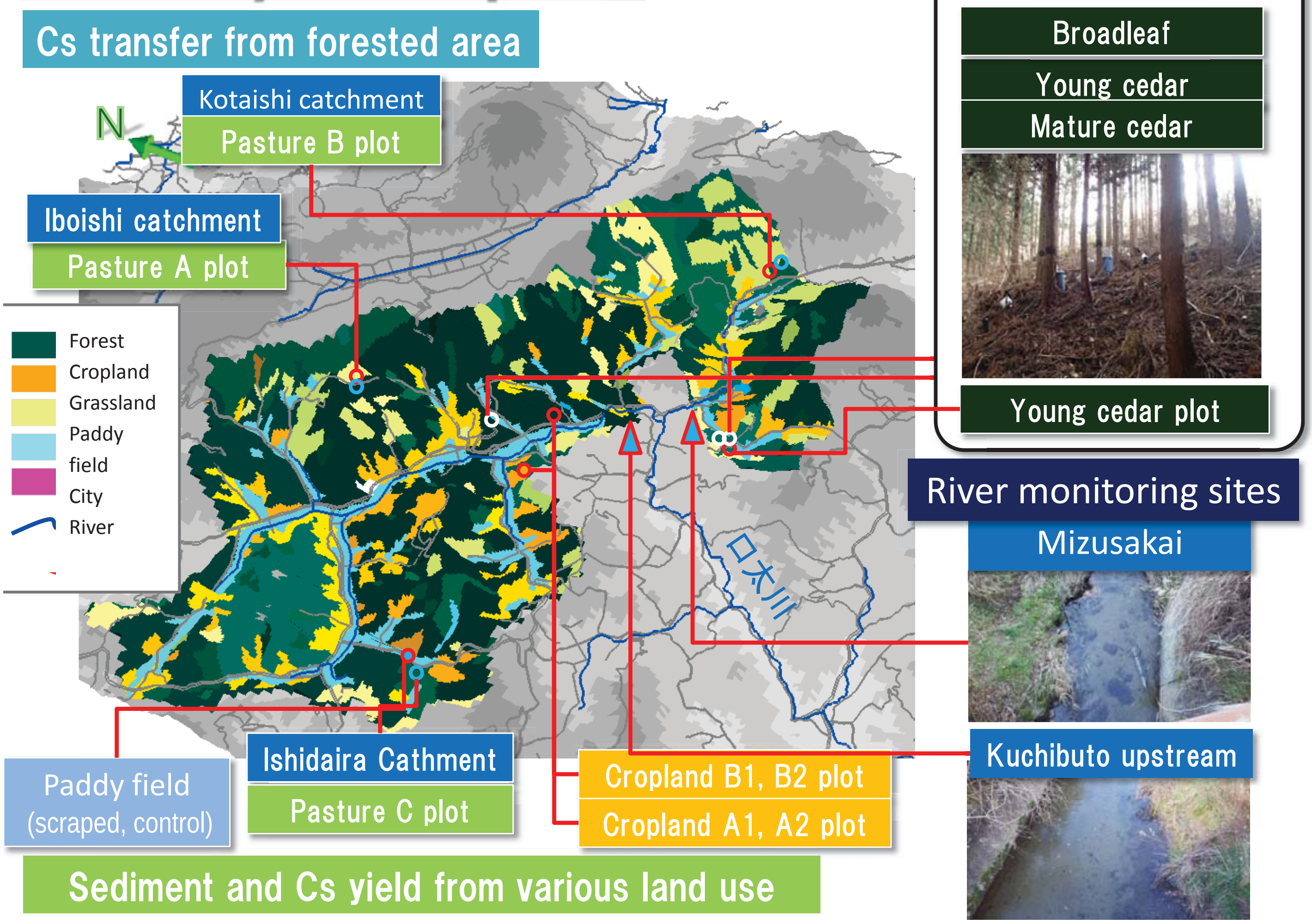


- Mature cedar, young cedar, and broad-leaved forest (< 150 m^2).



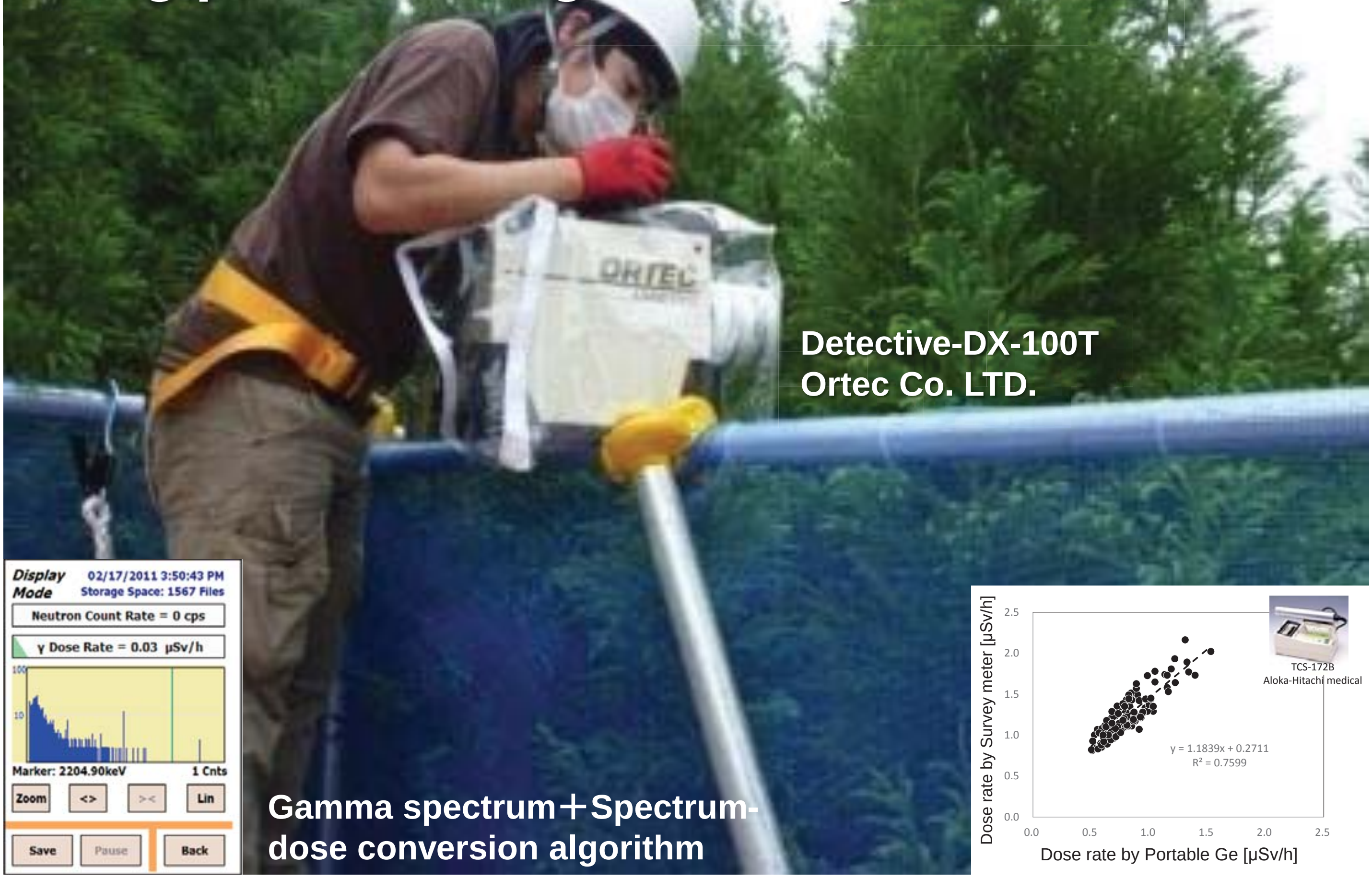


Yamakiya Study site

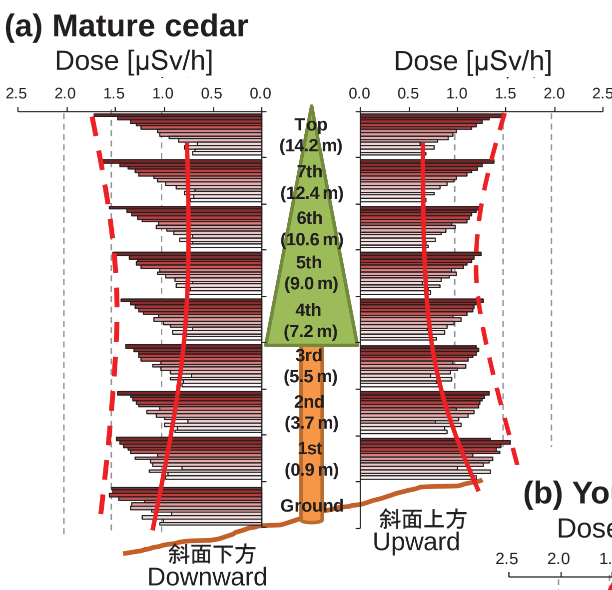


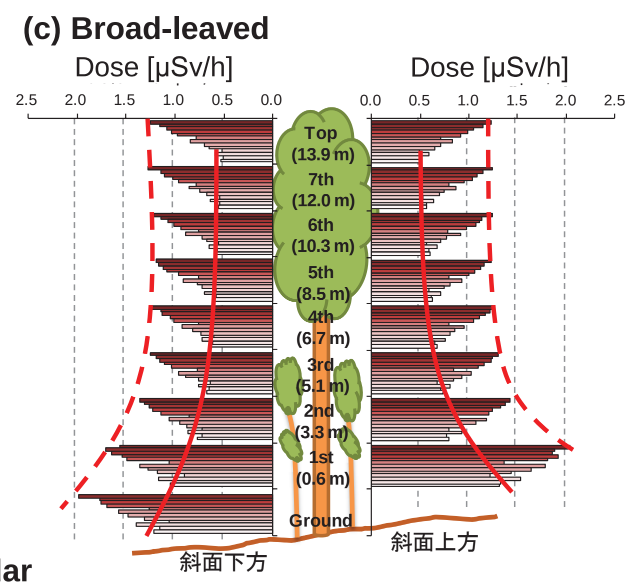
Experimental site

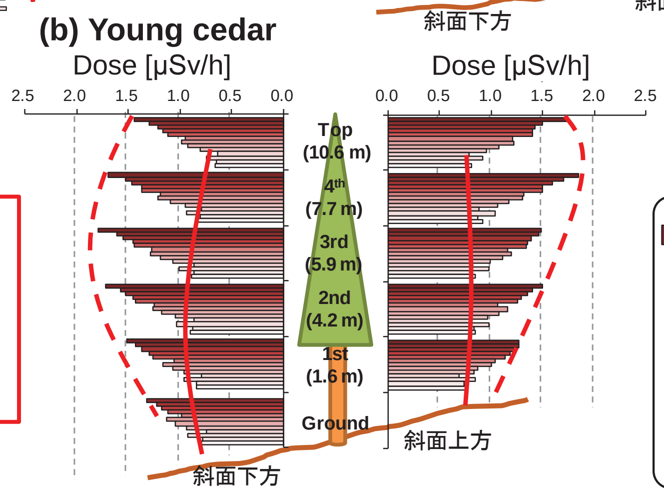
Ambient dose rate measurement using portable Ge gamma ray detector



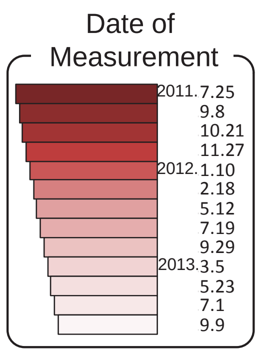
Ambient dose rate in Forest







13 measurements
From July 25, 2011
To Sepetmber 9, 2013
(still on-going)



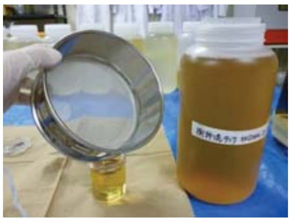
Sampling design and Laboratory analysis

- **3 open rainfall** sampler, **7 throughfall** collectors with evaporation suppressor, **3 stemflow** collectors, and **3 litter traps** in a the experimental plot (June 30, 2011 ~ Dec-Jan, 2013). 2 weeks – 1 month.
- ^{137}Cs concentration in each sample was determined by gamma spectrometry.
- All the measurement of radioactivity were corrected for the time of sampling.

Stemflow collector

Water samples

Filtering water by 100µm stainless mesh.

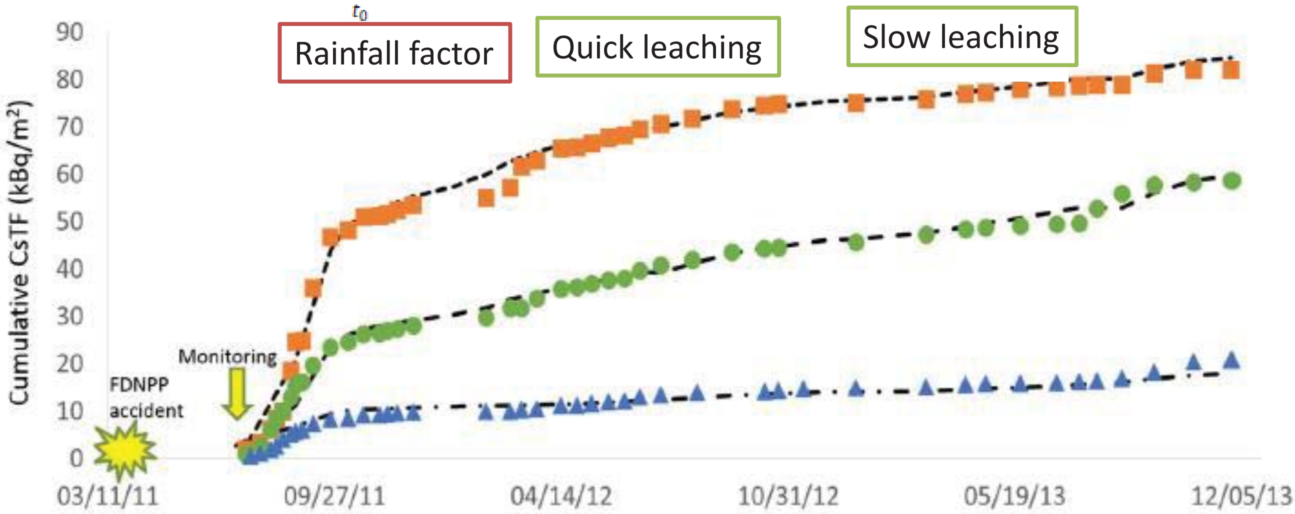


Litter samples

Leaves, twig, branch, bark were manually separated.

Throughfall input

$$CsTF_{mo2}(t) = \int_{t_0}^{t_{final}} \left[(b_1 \times rf) \times \left[A_1 \times \left(1 - e^{-k_1 \times t}\right) + A_2 \times \left(1 - e^{-k_2 \times t}\right) \right] \right]$$



Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

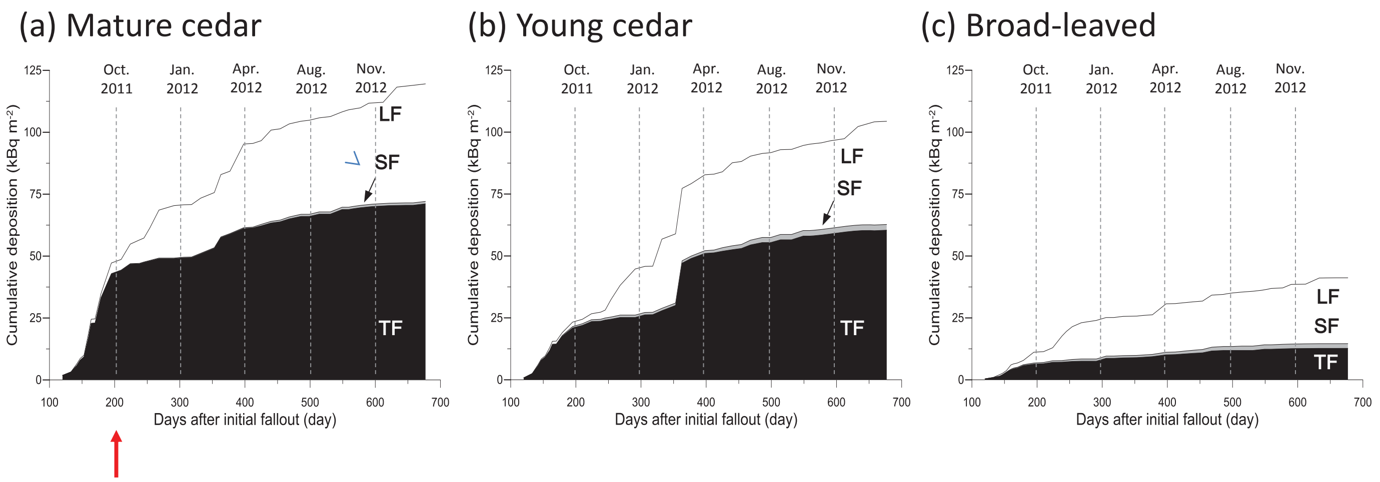
Modeling of leachable ^{137}Cs in throughfall and stemflow for Japanese forest canopies after Fukushima Daiichi Nuclear Power Plant accident

Nicolas Loffredo [a,*], Yuichi Onda [a], Ayumi Kawamori [b], Hiroaki Kato [a]

[a] Center for Research in Isotopes and Environmental Dynamics, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8572, Japan
[b] Graduate School of Life and Environmental Sciences, University of Tsukuba

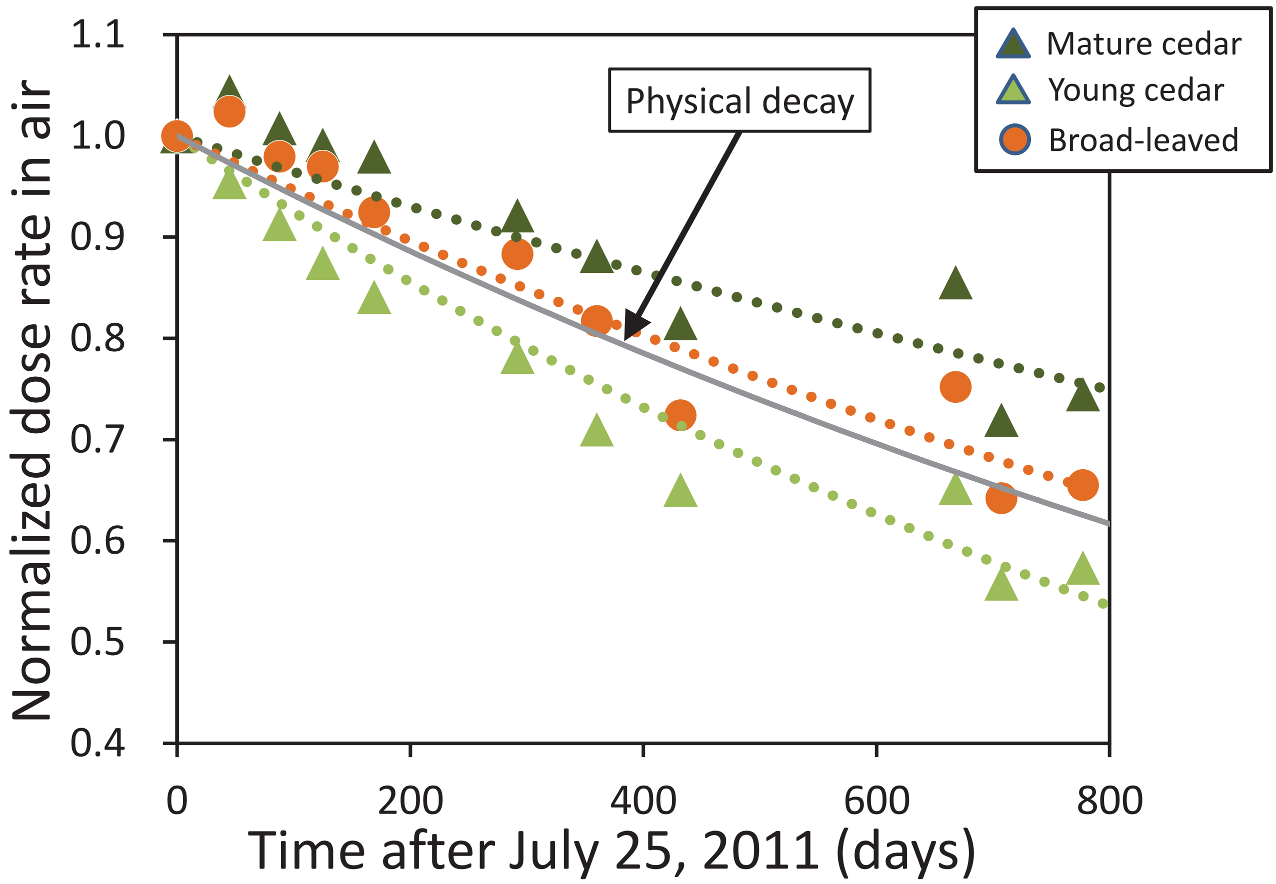
Throughfall + Litterfall input

Cumulative Cs-137 deposition (Bq m^{-2}) onto forest floor



200 days after the NPP accident

Temporal changes of dose rate at Forest floor



University of Tsukuba 筑波大学

CRiED Center for Research in Isotopes and Environmental Dynamics

Soil Erosion Plots

Bare land

Cultivated (gentle)

Grass land

Cultivated (Steep)

Forest (young ceder)

Pasture A

Pasture B

Contents lists available at ScienceDirect

Journal of Environmental Radioactivity

journal homepage: www.elsevier.com/locate/jenvrad

ELSEVIER

Evaluation of radiocaesium wash-off by soil erosion from various land uses using USLE plots

Kazuya Yoshimura*, Yuichi Onda, Hiroaki Kato

Center for Research in Isotopes and Environmental Dynamics, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8572, Japan

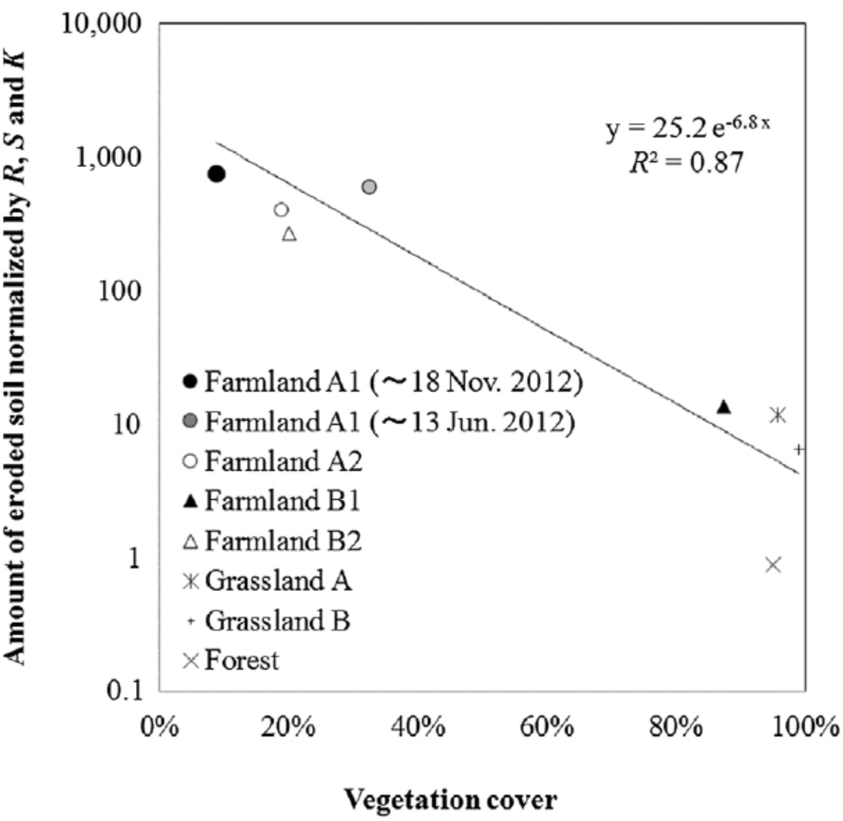


Fig. 7. Relationship between vegetation cover and soil loss during the monitoring period (kg ha^{-1}) normalised by the rainfall erosivity factor (R), soil erodibility factor (K) and slope steepness factor (S). Vegetation cover was averaged over the monitoring period as shown in the Table 1.

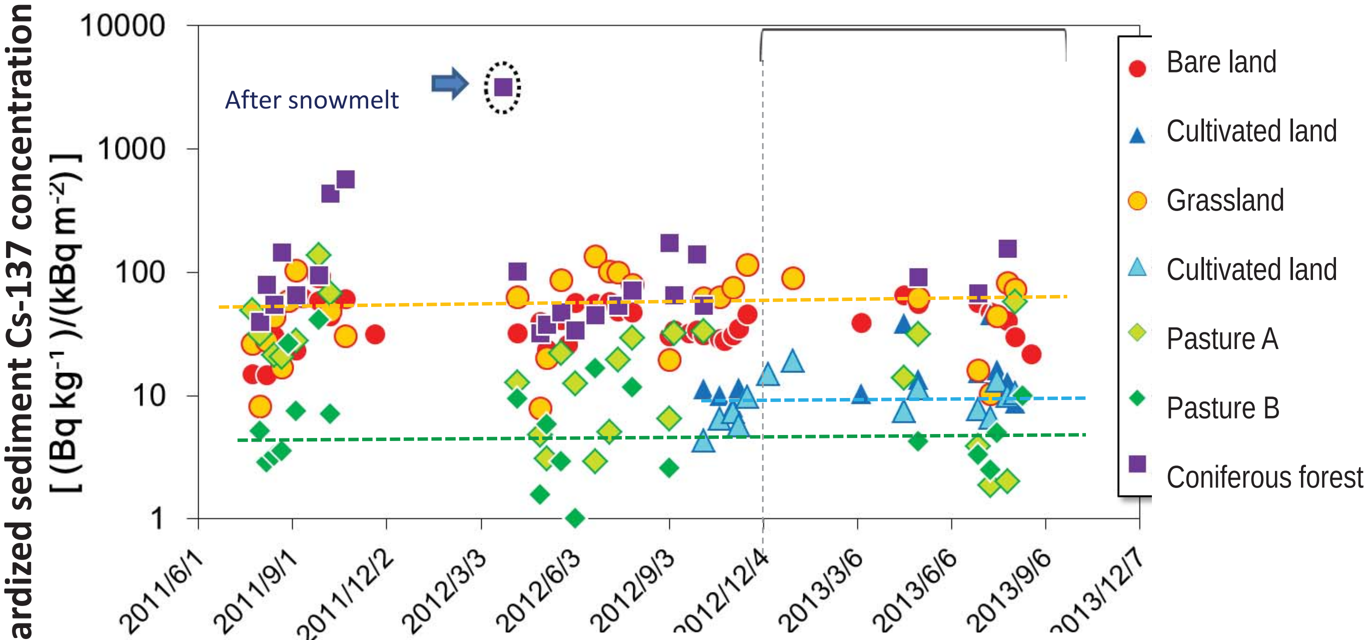


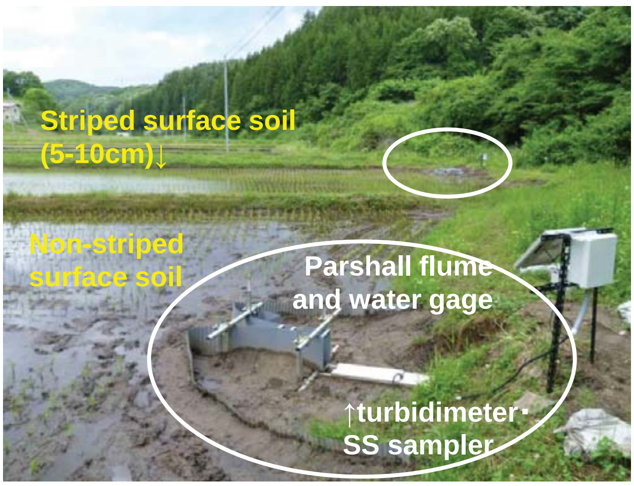
Table 2
Weighted-average S_c (Bq kg^{-1} Bq^{-1} m^2) based on the amount of eroded soil.

Land use	S_c
Farmland A1 (Uncultivated)	0.044
Farmland A2 (Cultivated)	0.011
Farmland B1 (Uncultivated)	0.054
Farmland B2 (Cultivated)	0.004
Grassland A	0.022
Grassland B	0.010
Forest	0.084

MEXT Special Coordination Funds for Promoting Science and Technology 2011
Establishment of a base of opposition to the environmental impact of radioactive material
FMWSE
FUKUSHIMA RADIATION MONITORING OF WATER, SOIL, AND ENTRAINMENT

Migration with cultivation

Migration of radionuclides from paddy field to river (and plant) by rice cultivation.



SS sampler

図　調査対象地マップ


図　本宮市サイト（降雨取水）の概観

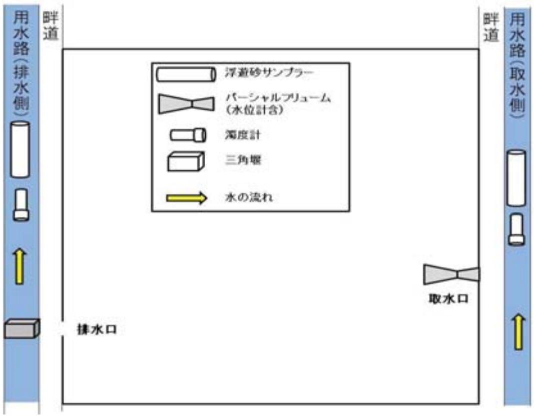


図　本宮市サイト（用水路取水）における機器設置概観

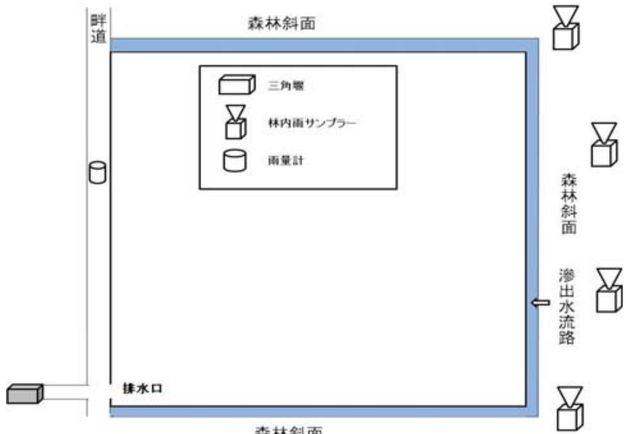
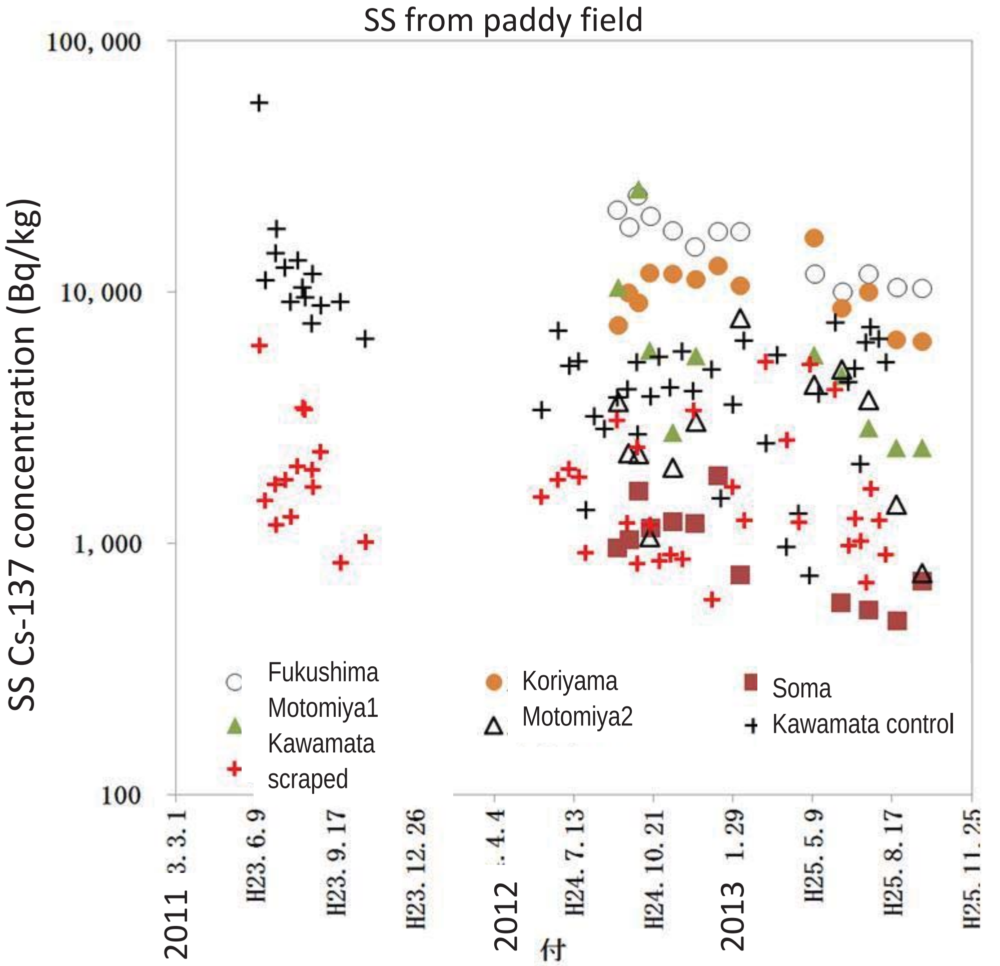
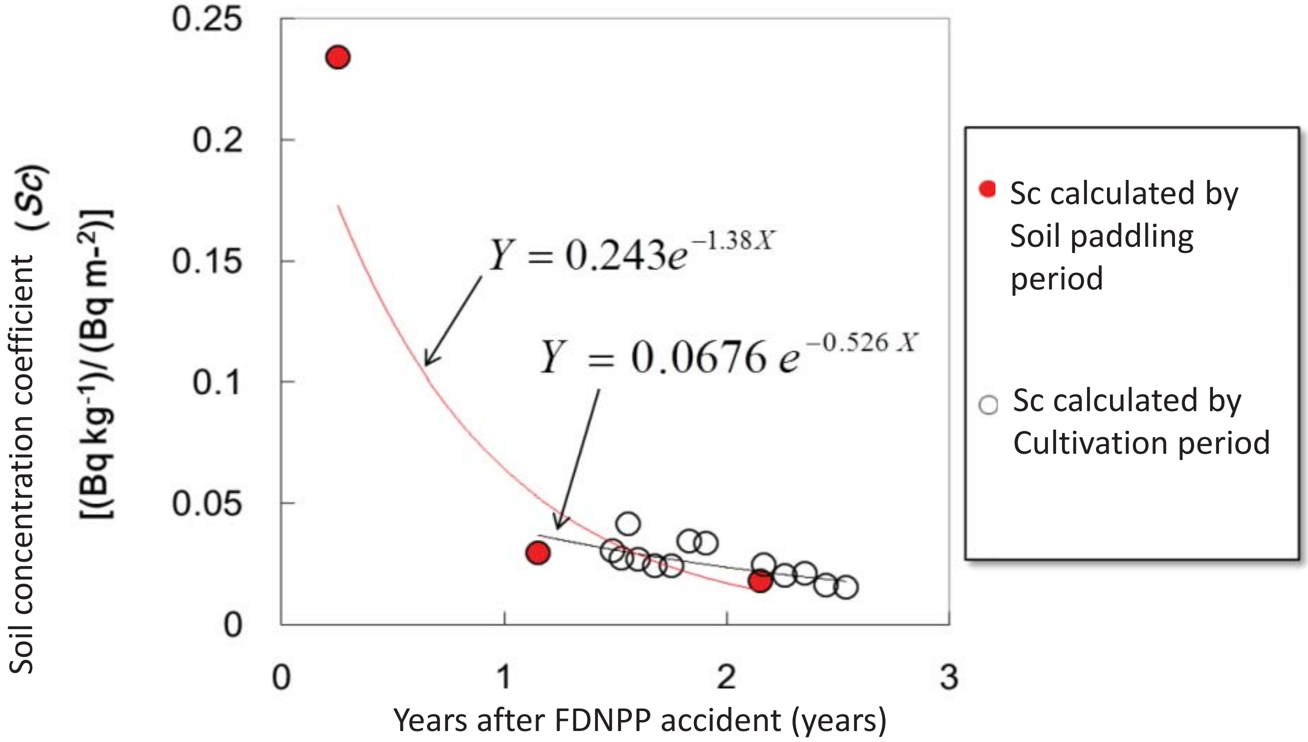


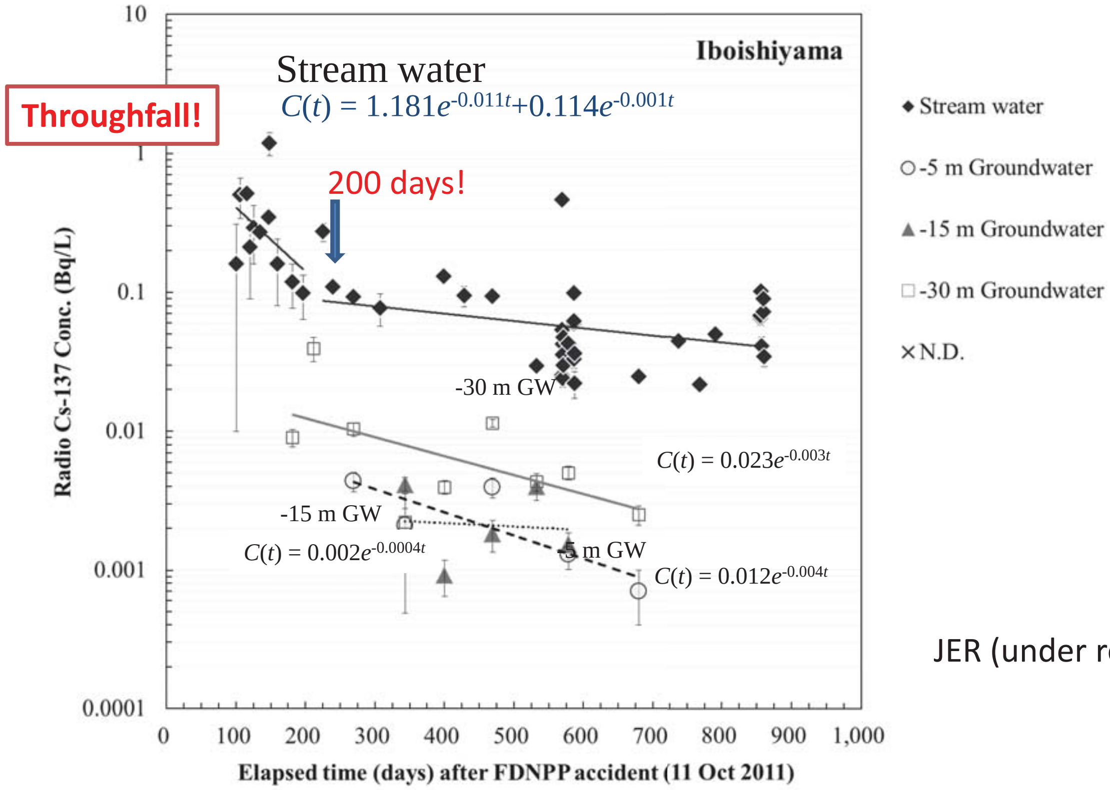
図　本宮市サイト（降雨取水）における機器設置概観



Cs conentration of suspended sediment from paddy discharge



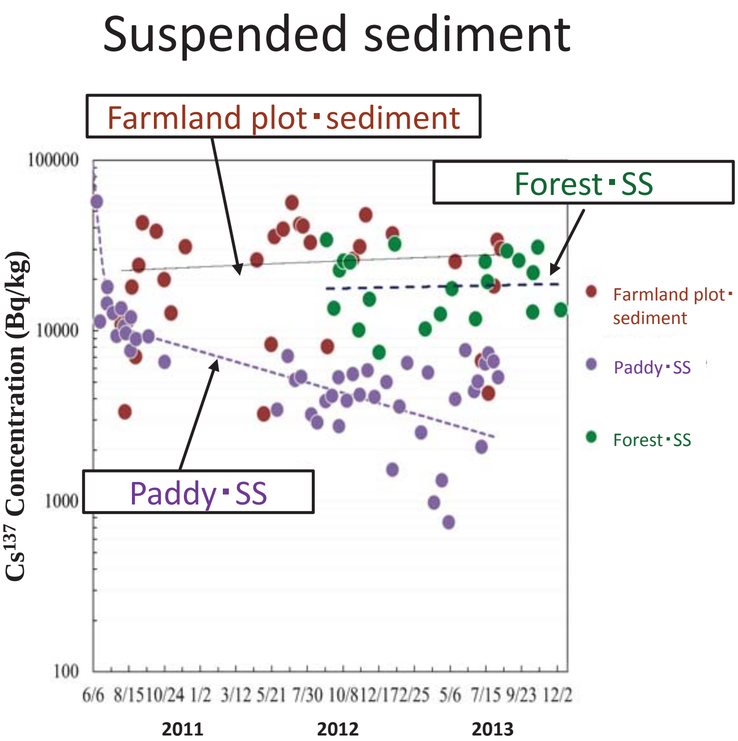
Headwater catchment

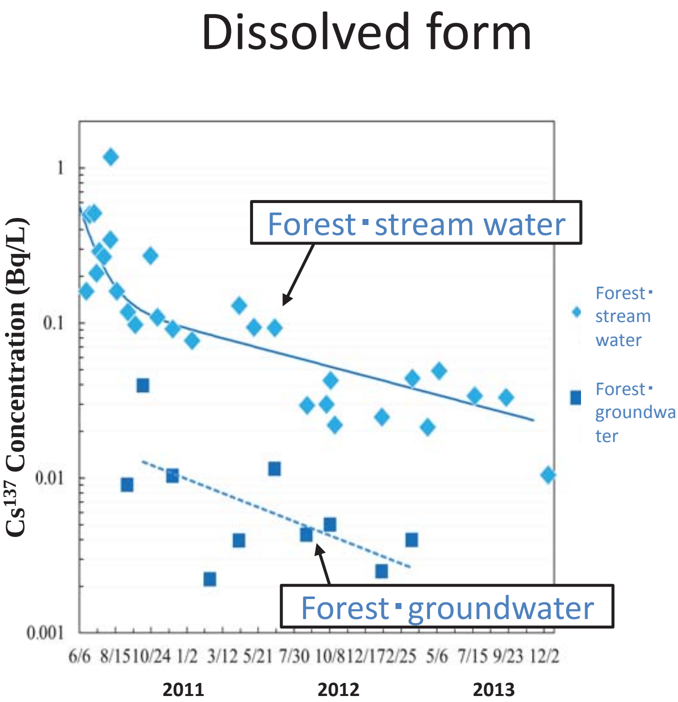


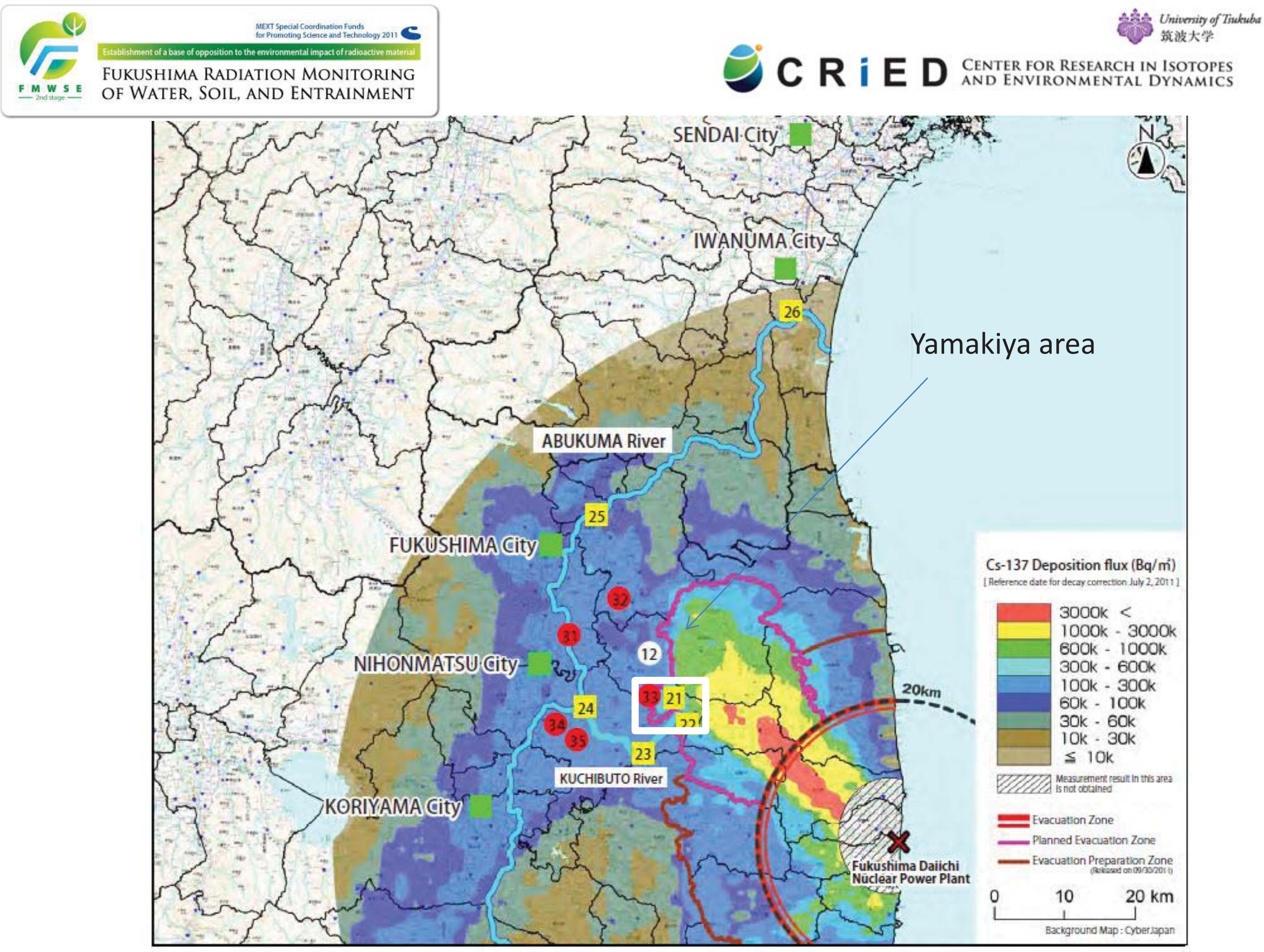
JER (under review)

Time series of dissolved ^{137}Cs concentration in stream water at Iboishiyama and time series of dissolved ^{137}Cs concentration in groundwater at Iboishiyama with exponential approximate line.

Summary of time changes of wash off from various landuse







【Outline of observation equipment】

- Suspended sand sampler
- Pressure water level sensor
- Turbidimeter
- Rain gauge
- Data logger and solar panel

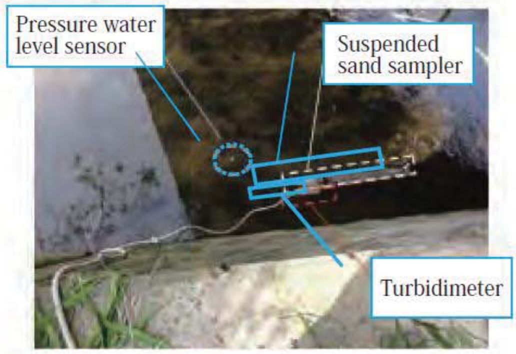


Photo 4
Installation of suspended sand sampler, turbidimeter sensor and pressure water level sensor (Upstream of Kuchibuto River)


Photo 1 Suspended sand sampler


Photo 3 Turbidimeter


Photo 2 Pressure water level sensor

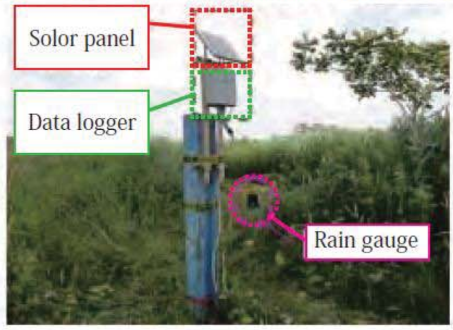


Photo 5
Installation of data logger, solar panel and rain gauge (Iwanuma observatory)

Radionuclide migration to rivers and ocean (initial 6 sites)


SCIENTIFIC REPORTS

OPEN

SUBJECT AREAS:
ENVIRONMENTAL MONITORING
SUSTAINABILITY

Received
21 November 2013

Initial flux of sediment-associated radiocesium to the ocean from the largest river impacted by Fukushima Daiichi Nuclear Power Plant

Yosuke Yamashiki[1], Yuichi Onda[2], Hugh G. Smith[3], William H. Blake[3], Taeko Wakahara[4],

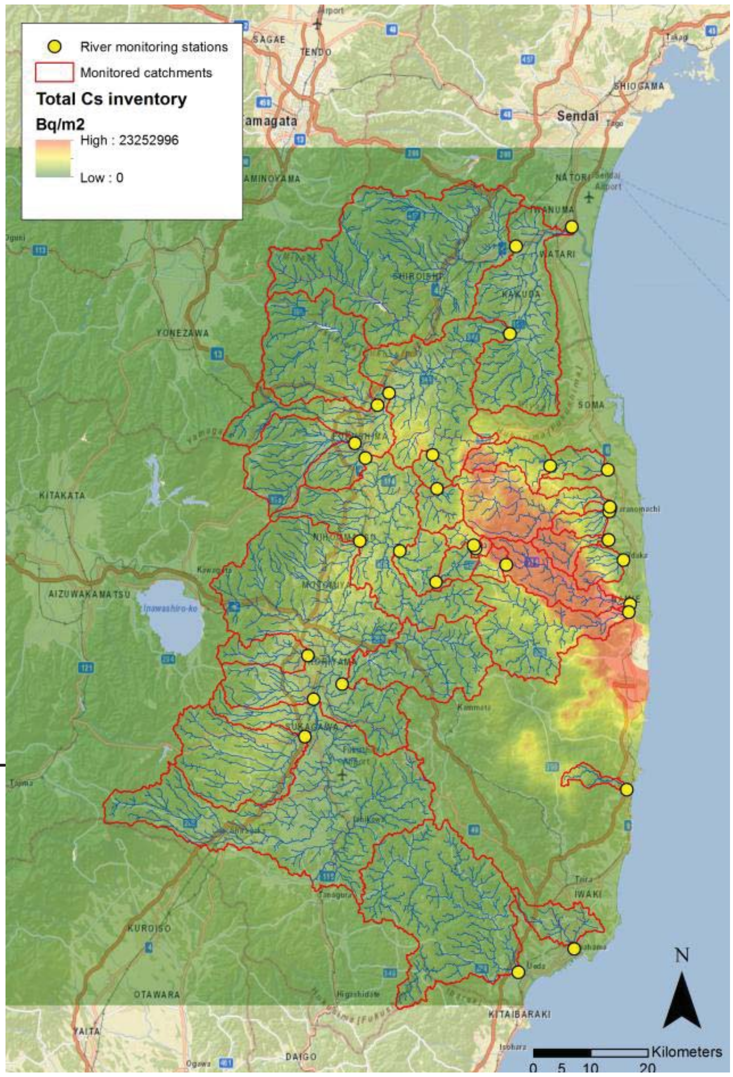
From 10 August 2011 to 11 May 2012 The total flux of radiocesium into the Pacific Ocean estimated was corresponding to 1.13%of the total estimated radiocesium fallout over the basin catchment.

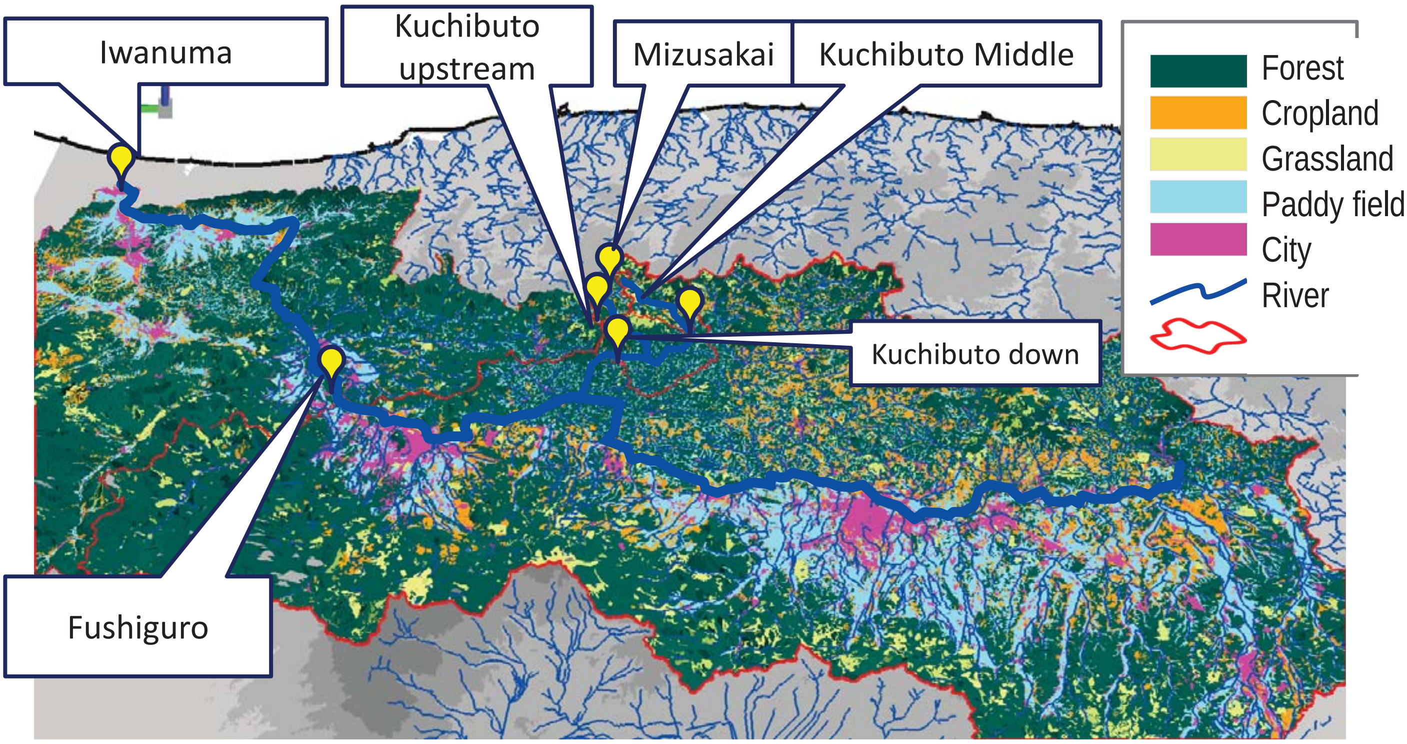
River monitoring sites

1. **Longer-term Abukuma sites (n = 6):**
   - Established from June 2011

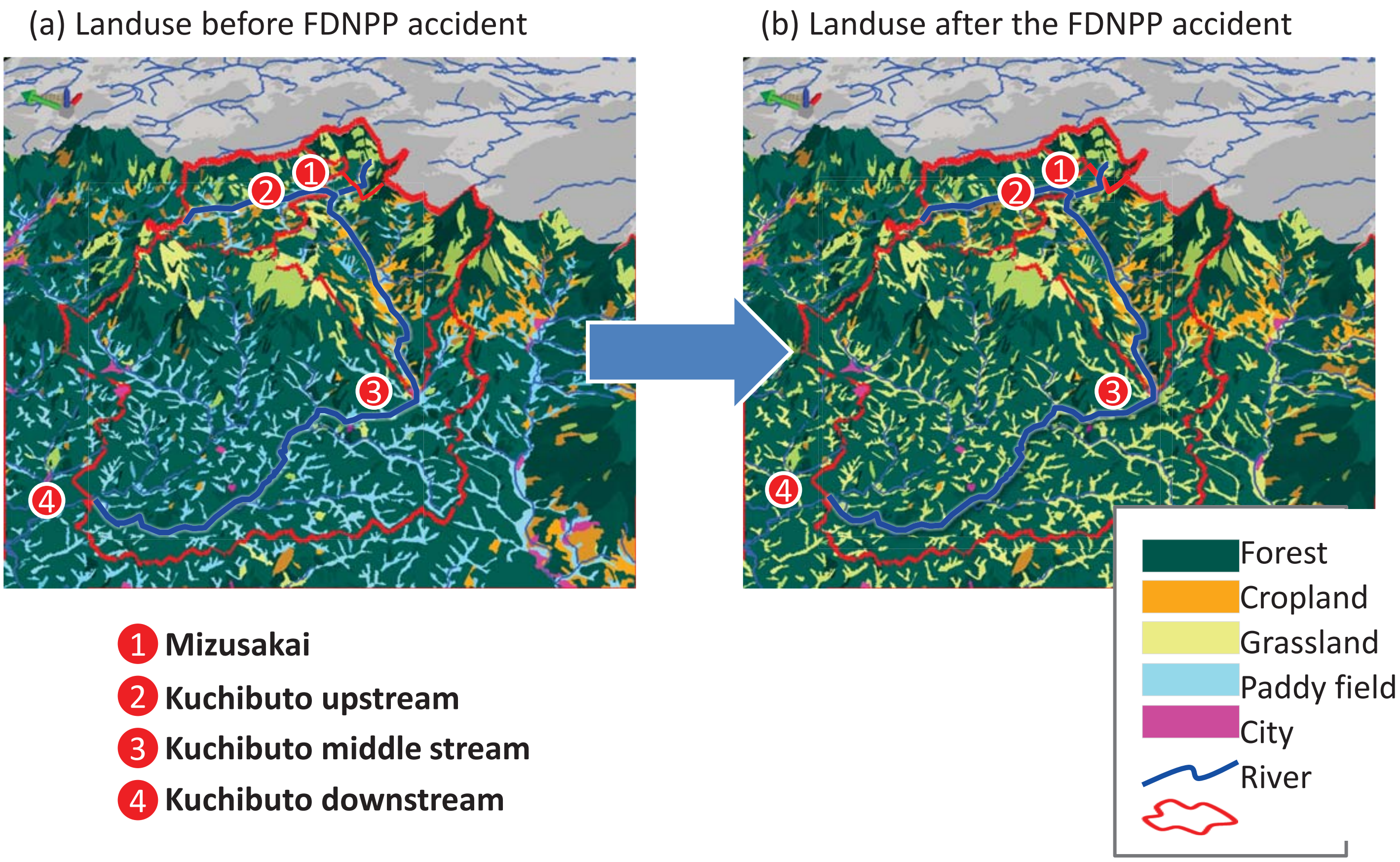
2. **New sites (n = 24):**
   - Abukuma Basin and small coastal catchments
   - Established in October-December 2012

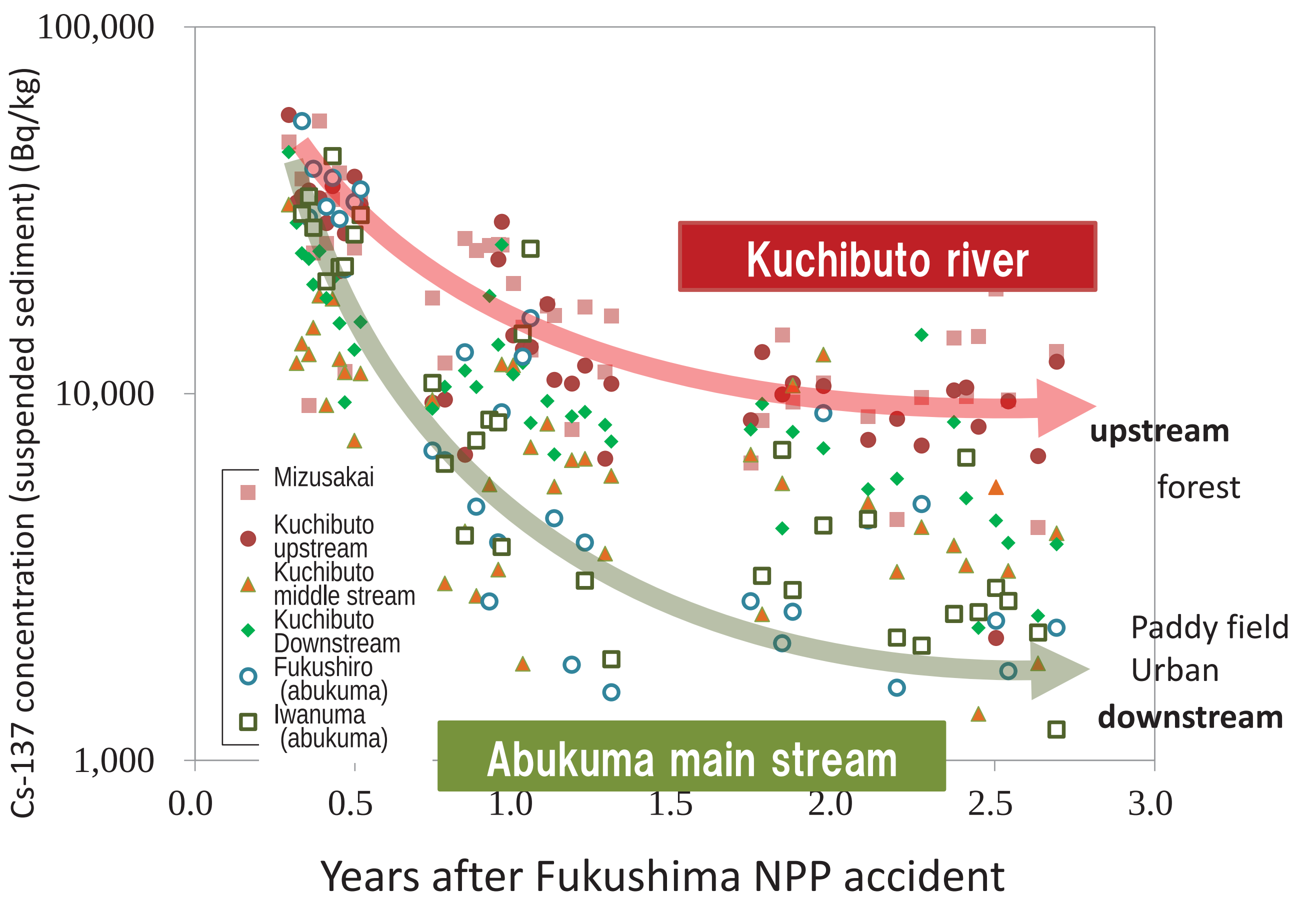
- Catchment areas range from 7.6 – 5,170 km^2
- Average inventories based on MEXT
- Cs-137: 19-2380 kBq m^{-2}

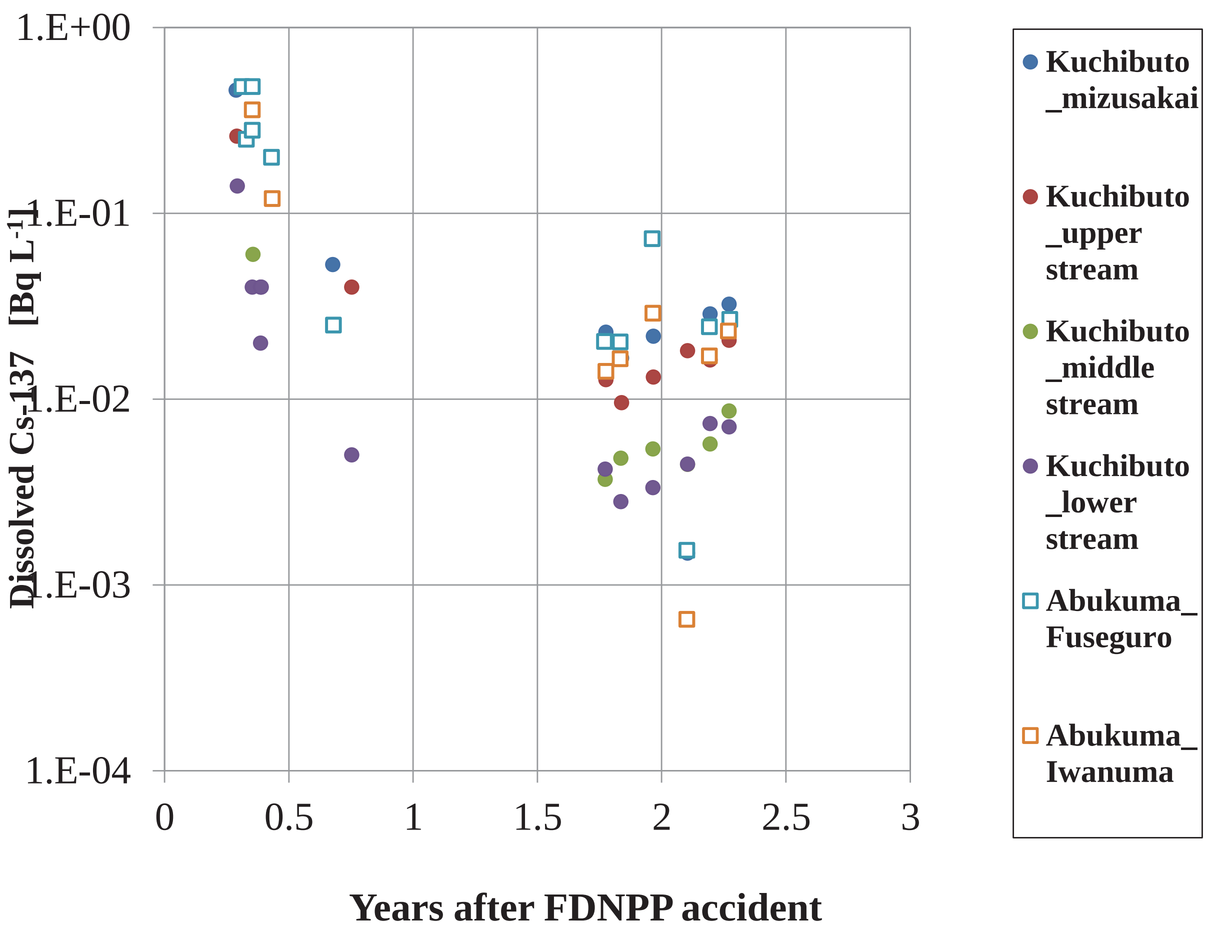




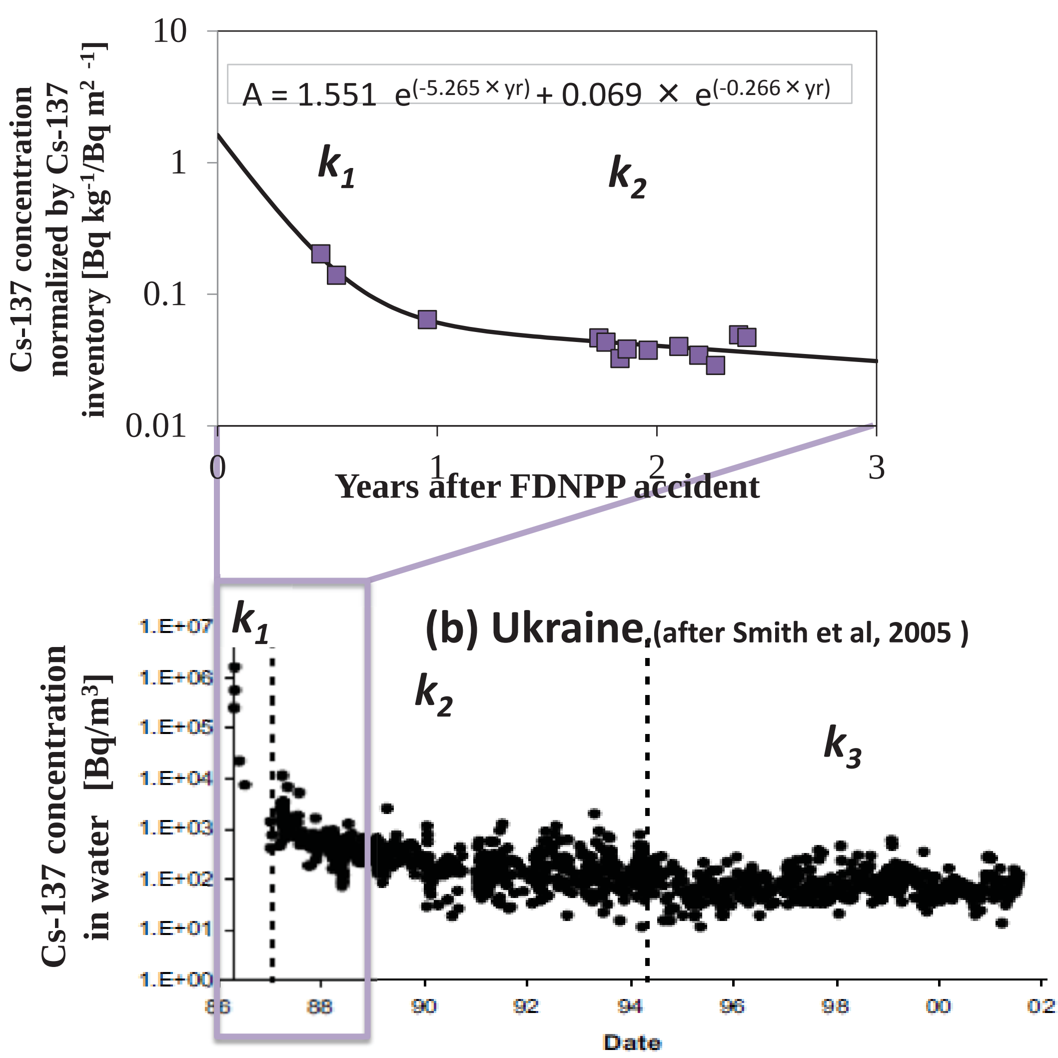
Landuse and landuse change in Kuchibuto catchment





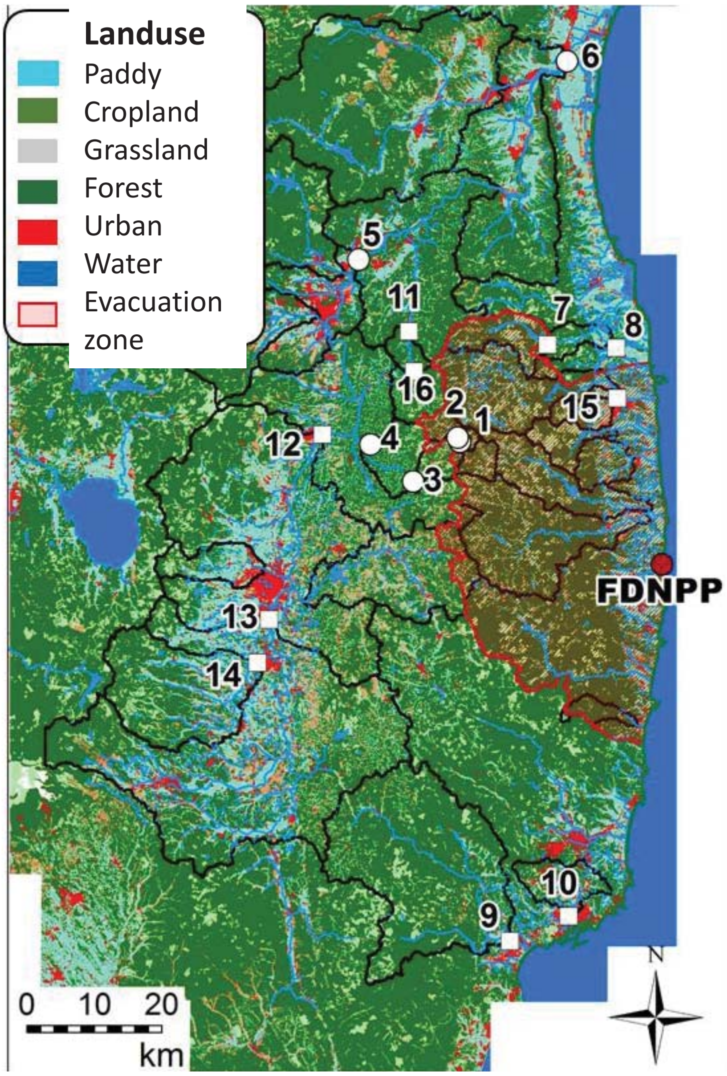


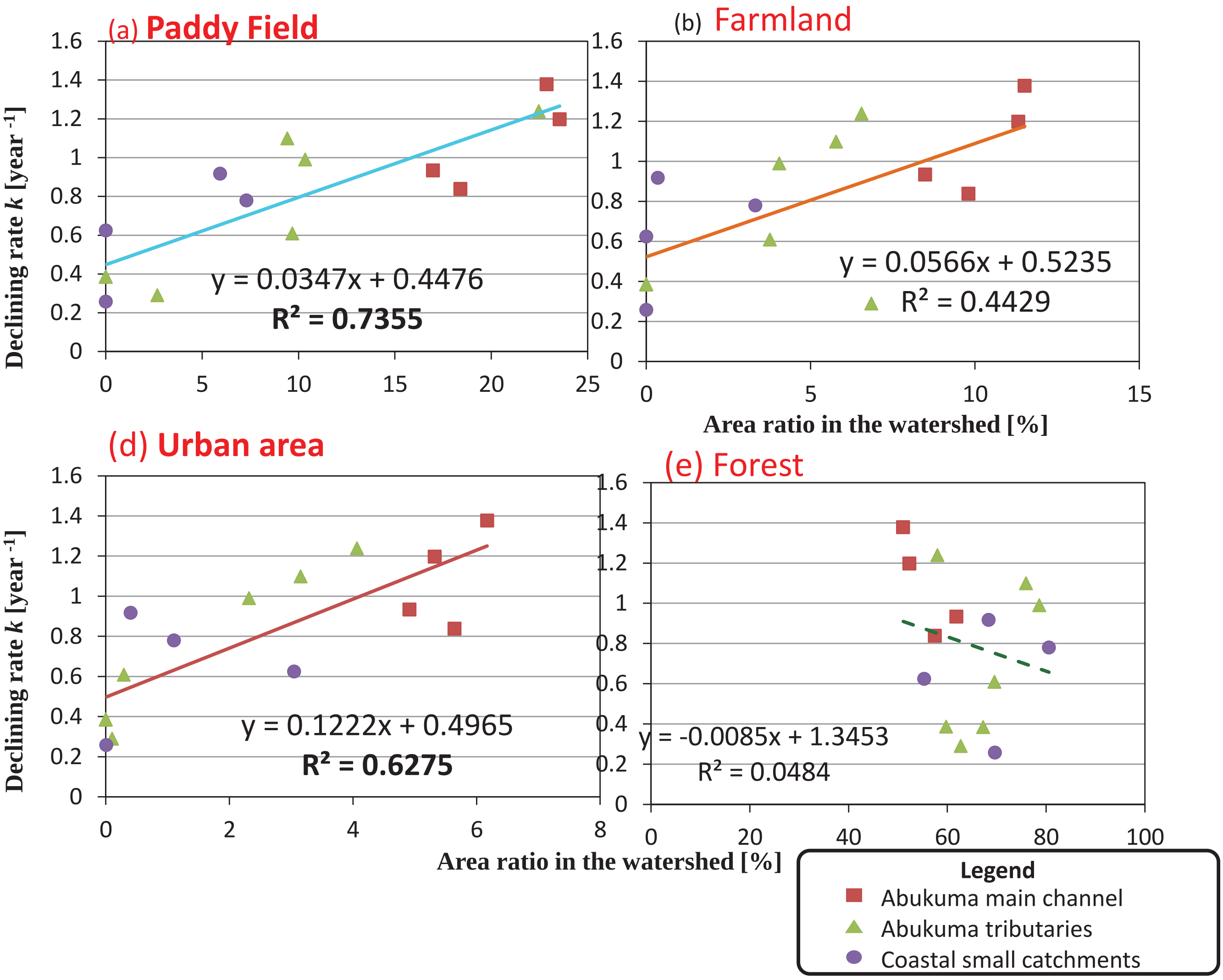
Dissolved Cs-137 [Bq L-1]
1.E+00
1.E-01
1.E-02
1.E-03
1.E-04
0
0.5
1
1.5
2
2.5
3
Years after FDNPP accident
Kuchibuto _mizusakai
Kuchibuto _upper stream
Kuchibuto _middle stream
Kuchibuto _lower stream
Abukuma_ Fuseguro
Abukuma_ Iwanuma



Cs-137 concentration normalized by Cs-137 inventory [Bq kg-1/Bq m2 -1]
10
1
0.1
0.01
A = 1.551 e(-5.265 × yr) + 0.069 × e(-0.266 × yr)
k1
k2
0
1
2
3
Years after FDNPP accident
(b) Ukraine,(after Smith et al, 2005)
Cs-137 concentration in water [Bq/m3]
1.E+07
1.E+06
1.E+05
1.E+04
1.E+03
1.E+02
1.E+01
1.E+00
k1
k2
k3
86
88
90
92
94
96
98
00
02
Date

Long time trend in SS concentration





Conclusion

Based on intesnsive field monitoring from June 2011-present reveal that the attenuation of Cs-137 differ between landuse.

This field finding is supported by 30 points of river montoring data.

University of Tsukuba
筑波大学
CRiED CENTER FOR RESEARCH IN ISOTOPES AND ENVIRONMENTAL DYNAMICS