Global Design Workshop

Social ICT × Agriculture

December 5, 2012
GCL lecture

Remote Agricultural Fields Monitoring using ICT

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Introduction- field monitoring system

- Ubiquitous computing technology in agriculture
  - One new technology is the "Field Server (FS)"
    - developed by NARO in 2003
    - An on-site field monitoring equipment
    - collects data on crop, climate, soils
    - and sends the data
    - with high-resolution digital photos
    - to a laboratory via the Internet
    - Each FS communicates through a Wi-Fi network

- As a result of our long-term monitoring trials, unexpected problems are emerging

Field monitoring experiment
In a rainfed field in Khon Kaen, Thailand (2006)

- Meteorological data
  - air temperature
  - humidity
  - radiation
  - wind speed
  - Precipitation
- Soil data at 4, 8, 16, 32 cm
  - soil moisture content
  - temperature
  - electrical conductivity
- Image data of the site

2006 December 25

Soil sensor

http://www.decagon.com/

DECAGON DEVICES — We Measure the World

- Soil moisture sensors measure
  - volumetric water content accurately and economica
  - the dielectric permittivity of the soil
- Benefits include:
  - TDR-level performance at a fraction of the cost
  - Very low power requirement
  - Easy installation at any depth and orientation

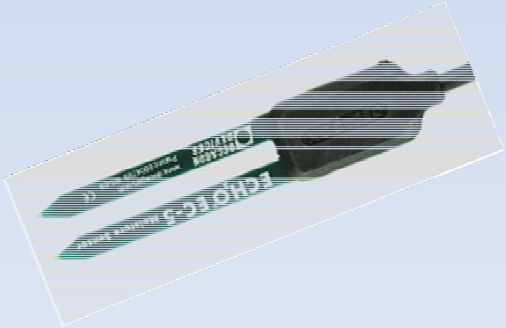
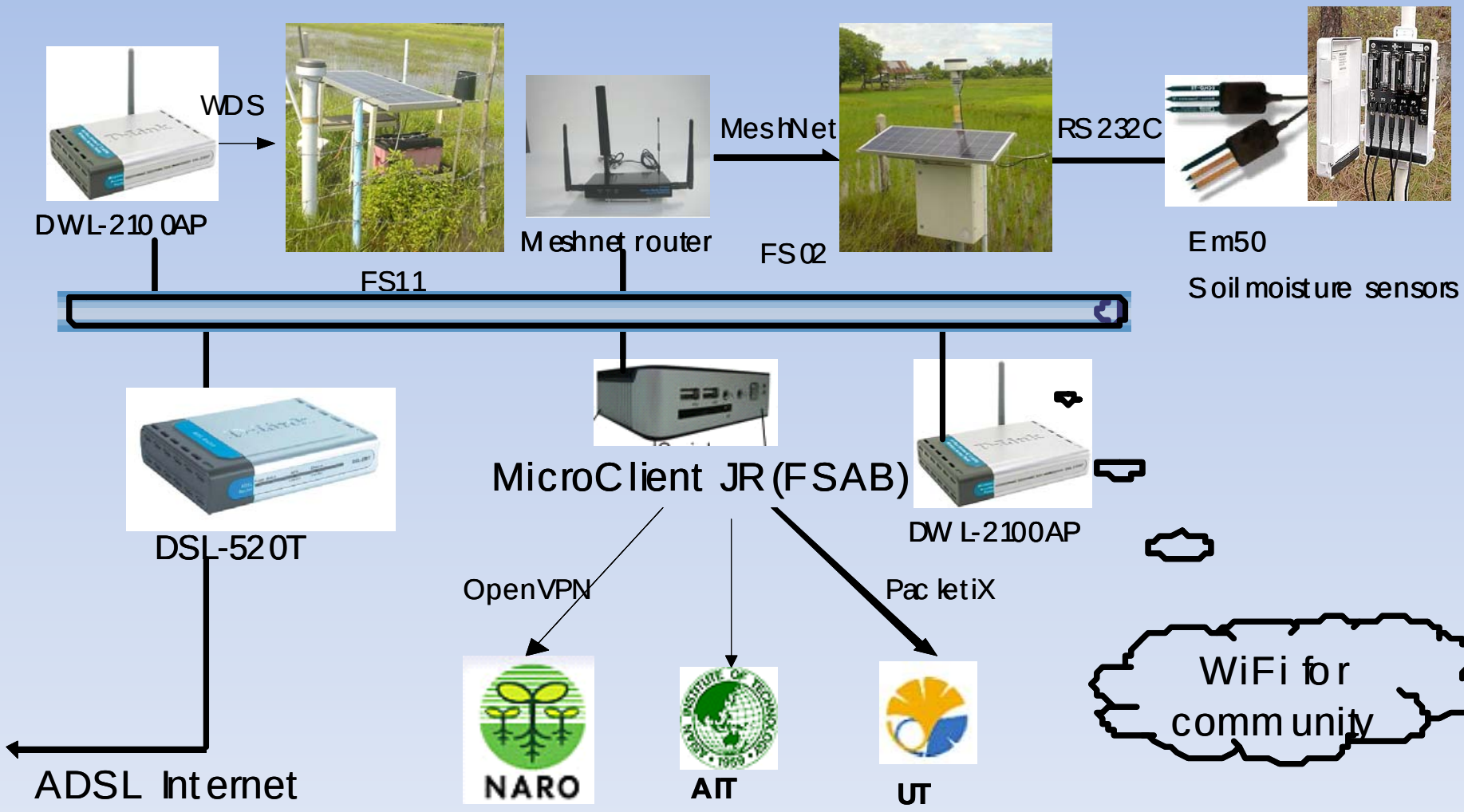
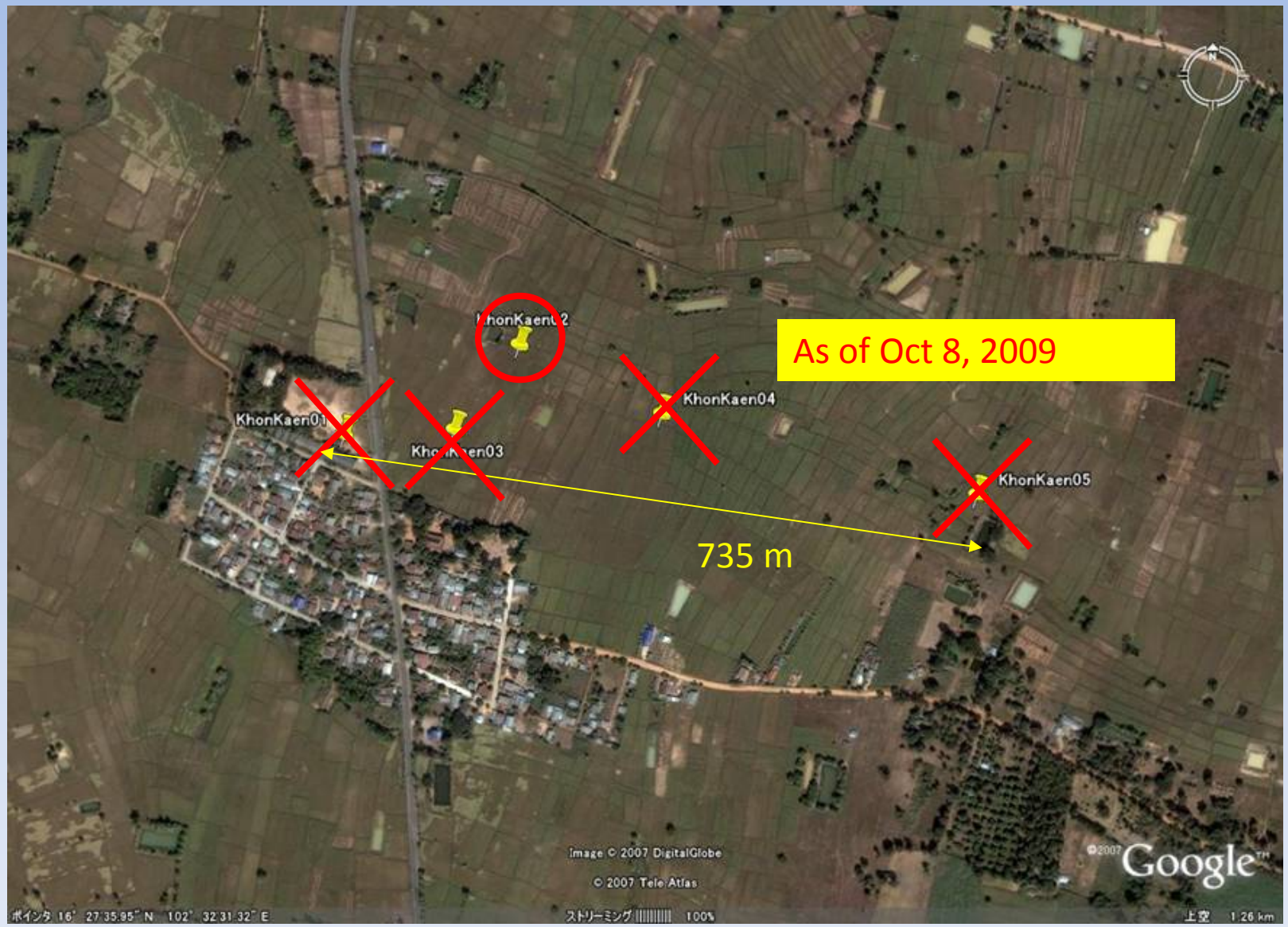


Diagram of Field Server system



Field Sever in Khon Kaen, Thailand

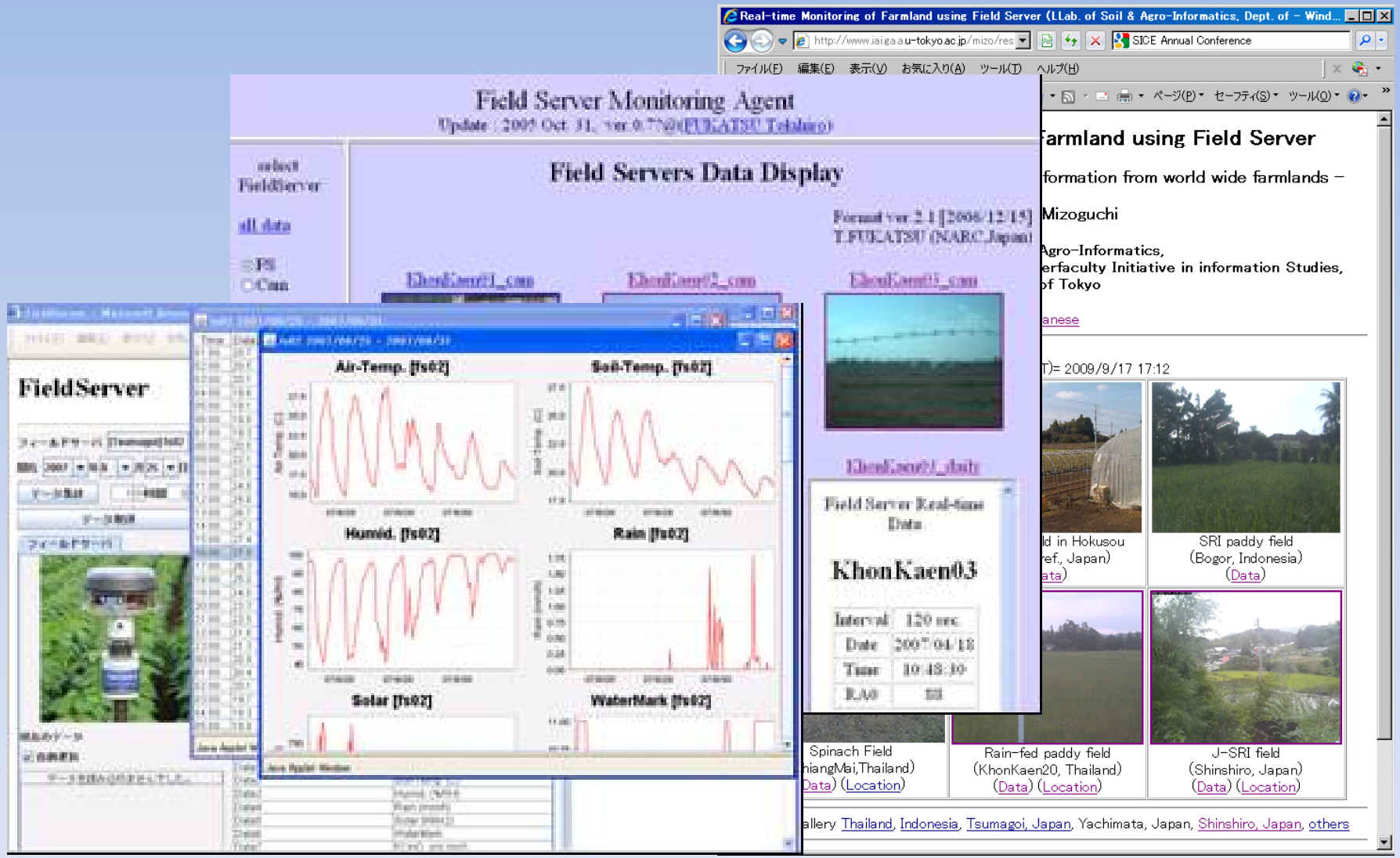


Dry and Rainy seasons of rain-fed paddy field in Khon Kaen, Thailand

↑ 2007.12.25 (Dry season)

↑ 2008.5.23 (Rainy season)

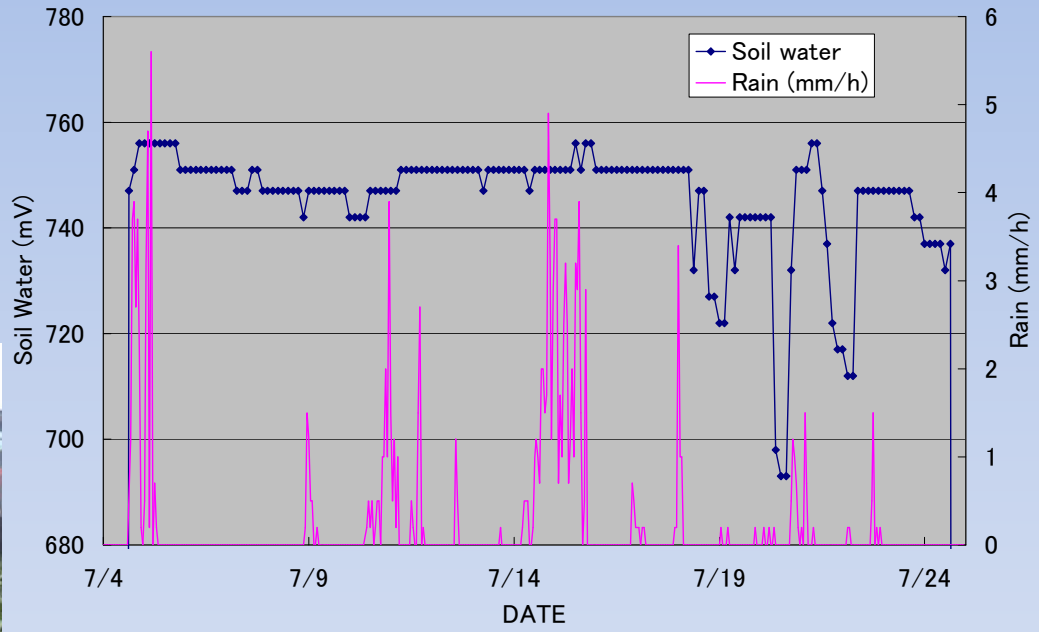
Data Access (Field - AIT - NARO - UT)



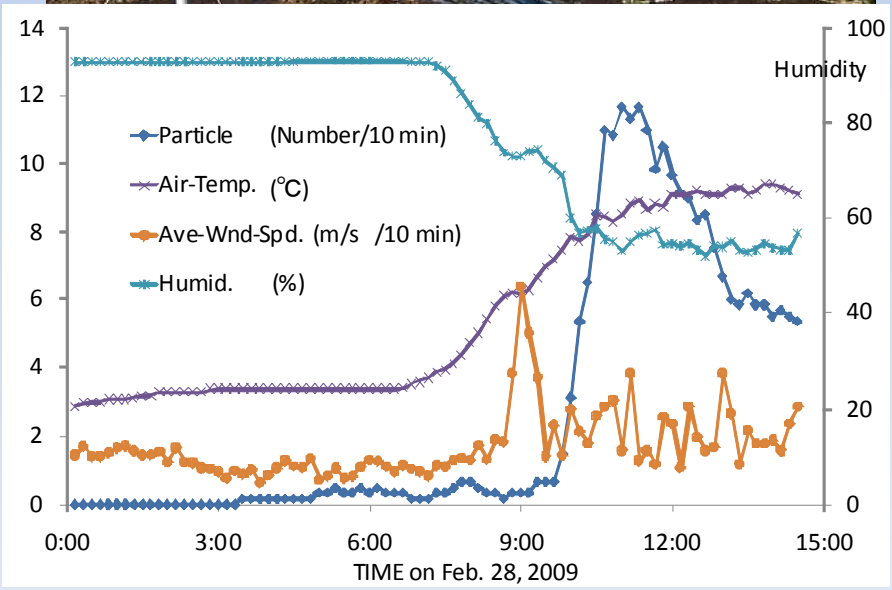
Dare are obtained as a xml-table and graphs via the Internet

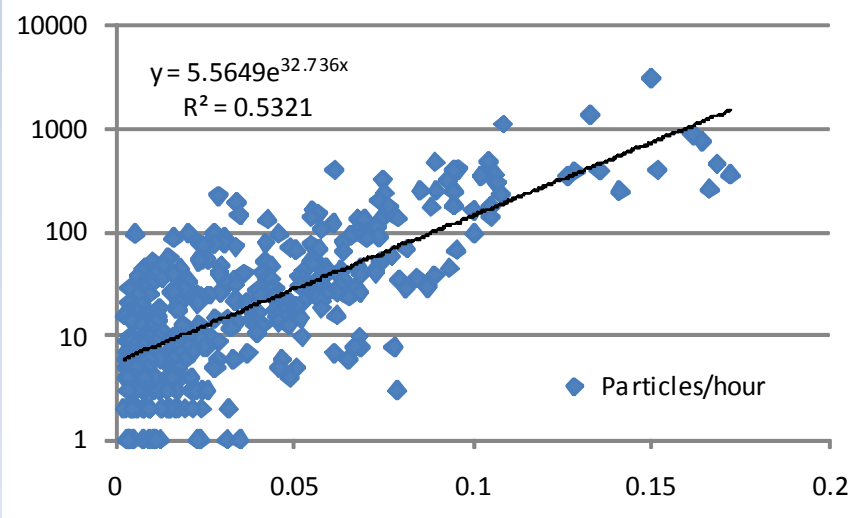
Soil moisture in Cabbage filed changes according to rain and vegetation (Tsumagoi, Japan)

To see is to believe!



Relationship between soil dust and meteorological conditions (Chiba, Japan)





Farm to Table Experiment of Imported Spinach with ICT for bridging Thai Producer and Japanese Consumer

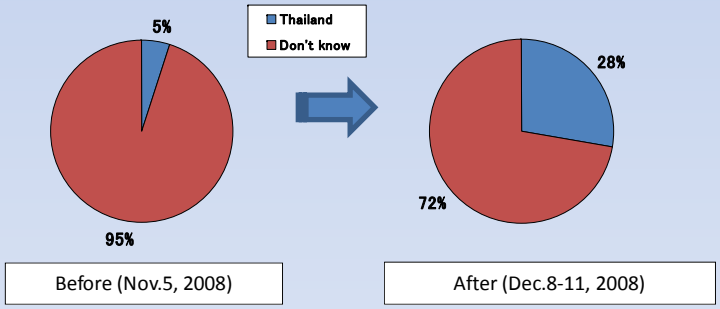
Fieldserver in Spinach field in Thailand

Information discovery tools

Display of real time monitoring in Univ. cafeteria

Imported spinach

Contents design and experiment by Mizo lab.



Recognition increased that "Spinach is from Thailand"

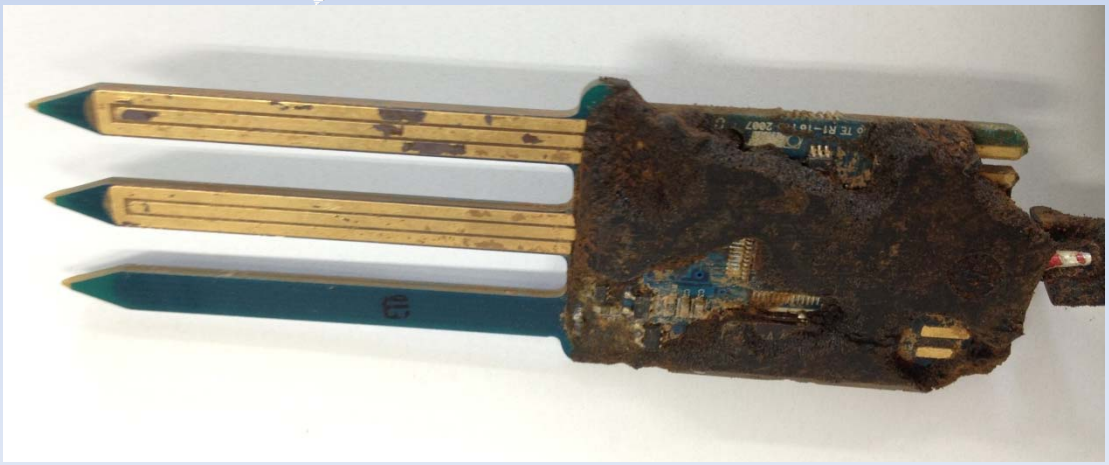
Food communication

Field monitoring in harsh environments

- We must
  - take into account
    the characteristics
    of the field environment
  - choose appropriate
    materials for FS

Insect nest built on CPU board of FS

Broken soil sensor in field



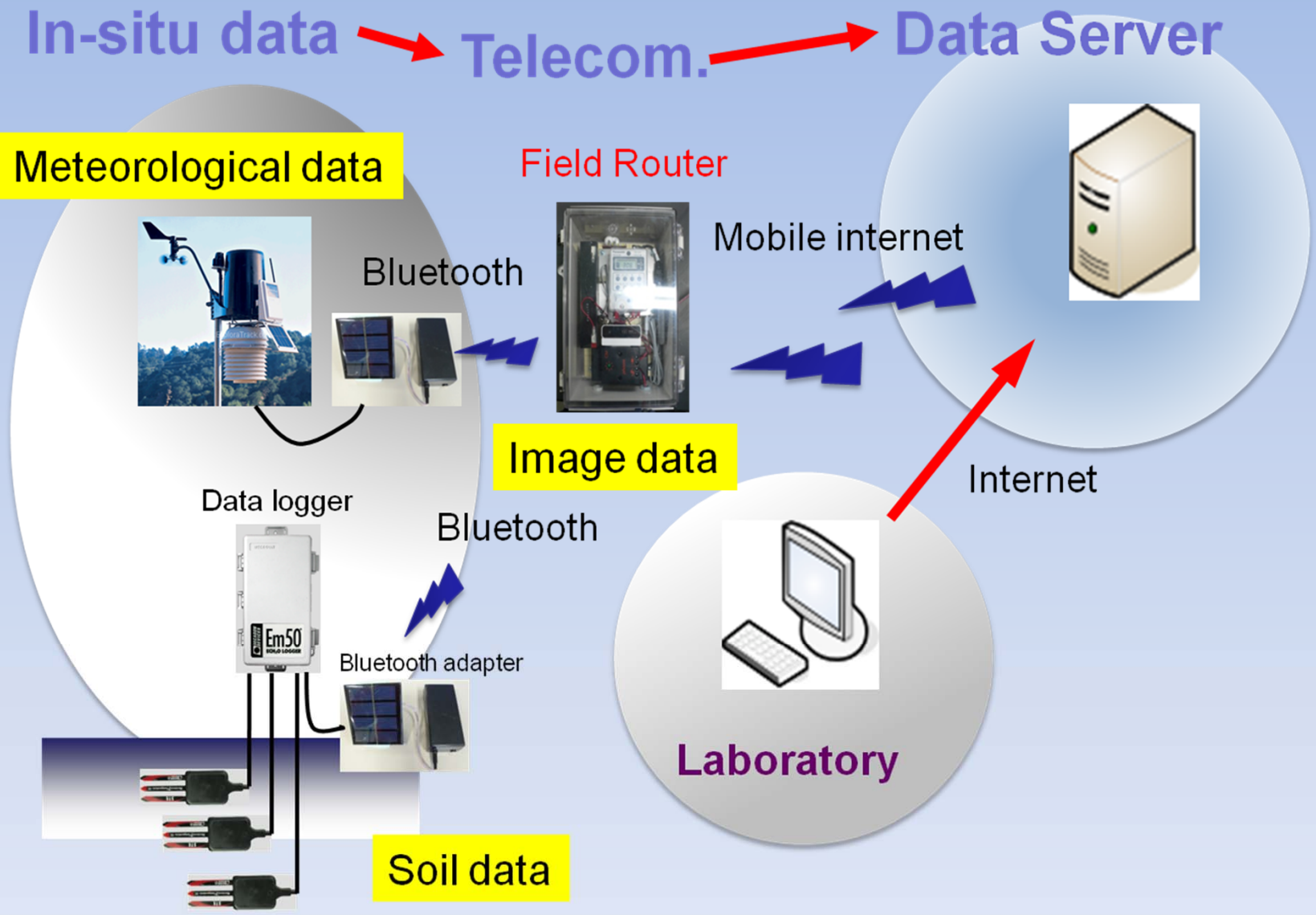
The Field Server is useful, but…

- only when the Internet connection and the power supply are stable
- However, such conditions are limited in rural areas

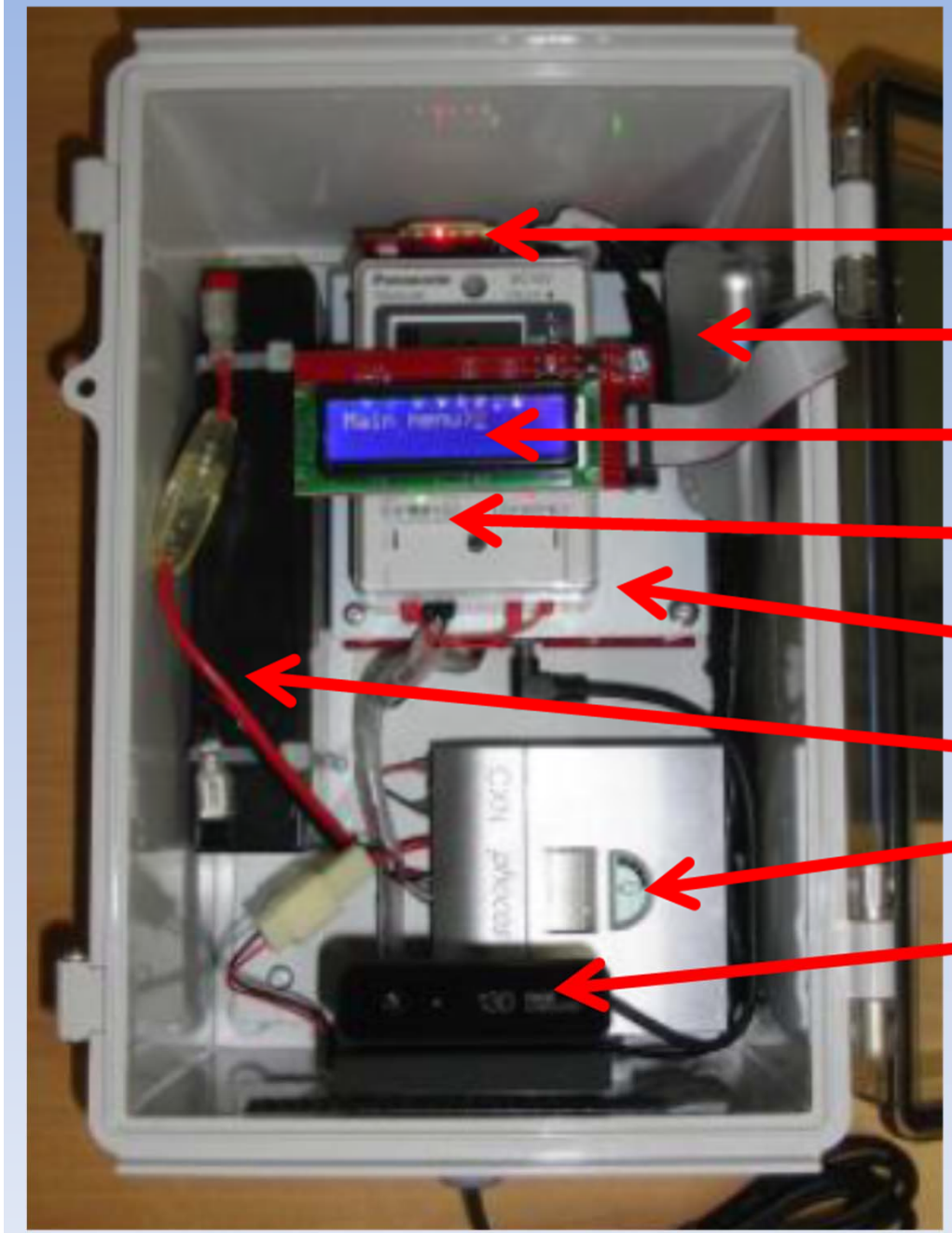
- If a problem arises
  - we ourselves must visit the site on account of a shortage of FS engineers
  - Maintenance costs increase in proportion to the distance to the site.

- In fact,
  - we have wasted a lot of time and cost maintaining the Field Servers

Field Monitoring System (FMS)



(Soil sensor : Soil moisture, temperature, electrical conductivity…)



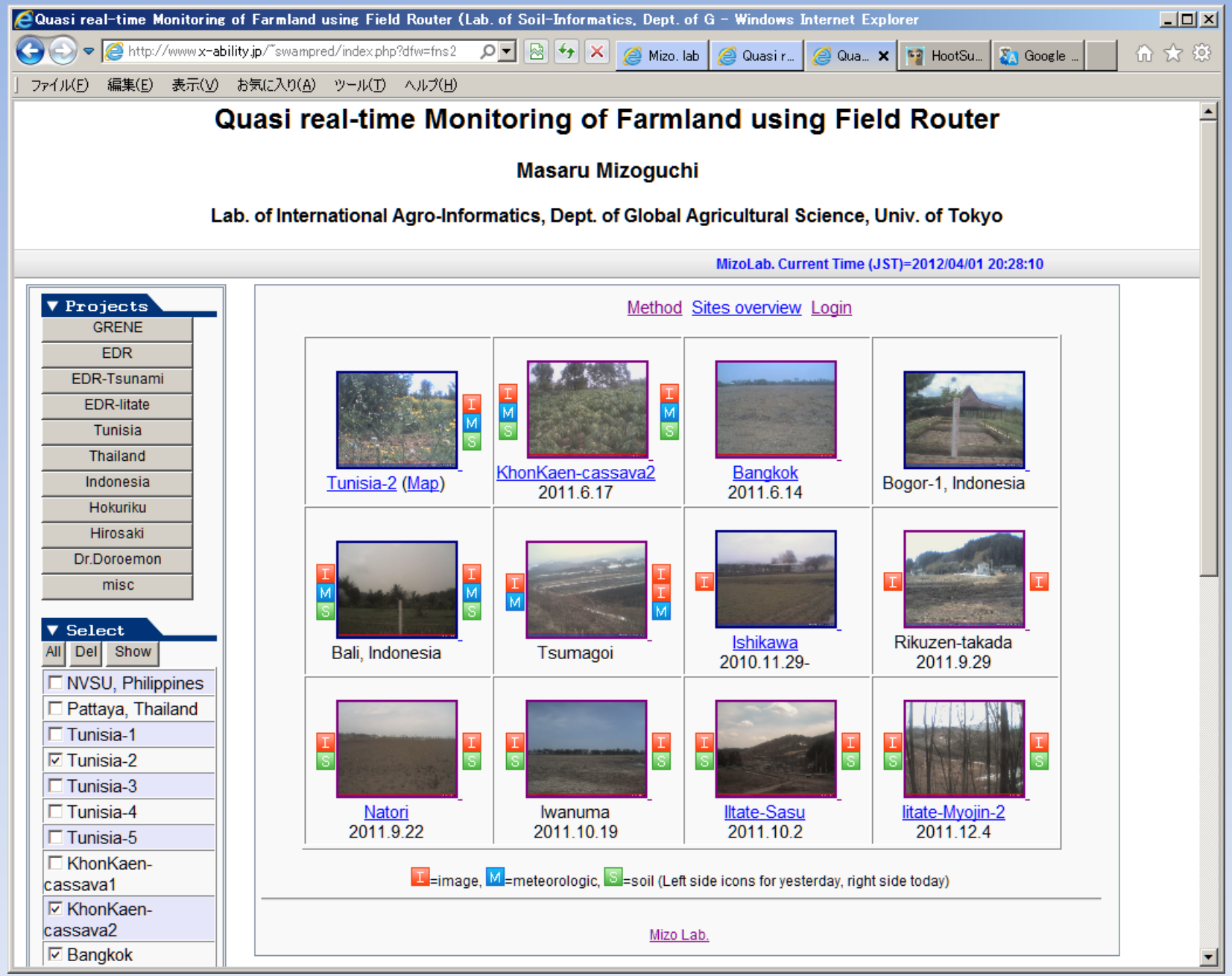
FieldRouter

- Status lamp
- USB modem
- Status display
- Timer
- Micro-PC
- Battery
- Charge controller
- Web camera

(38 cm x 25 cm x 10 cm)

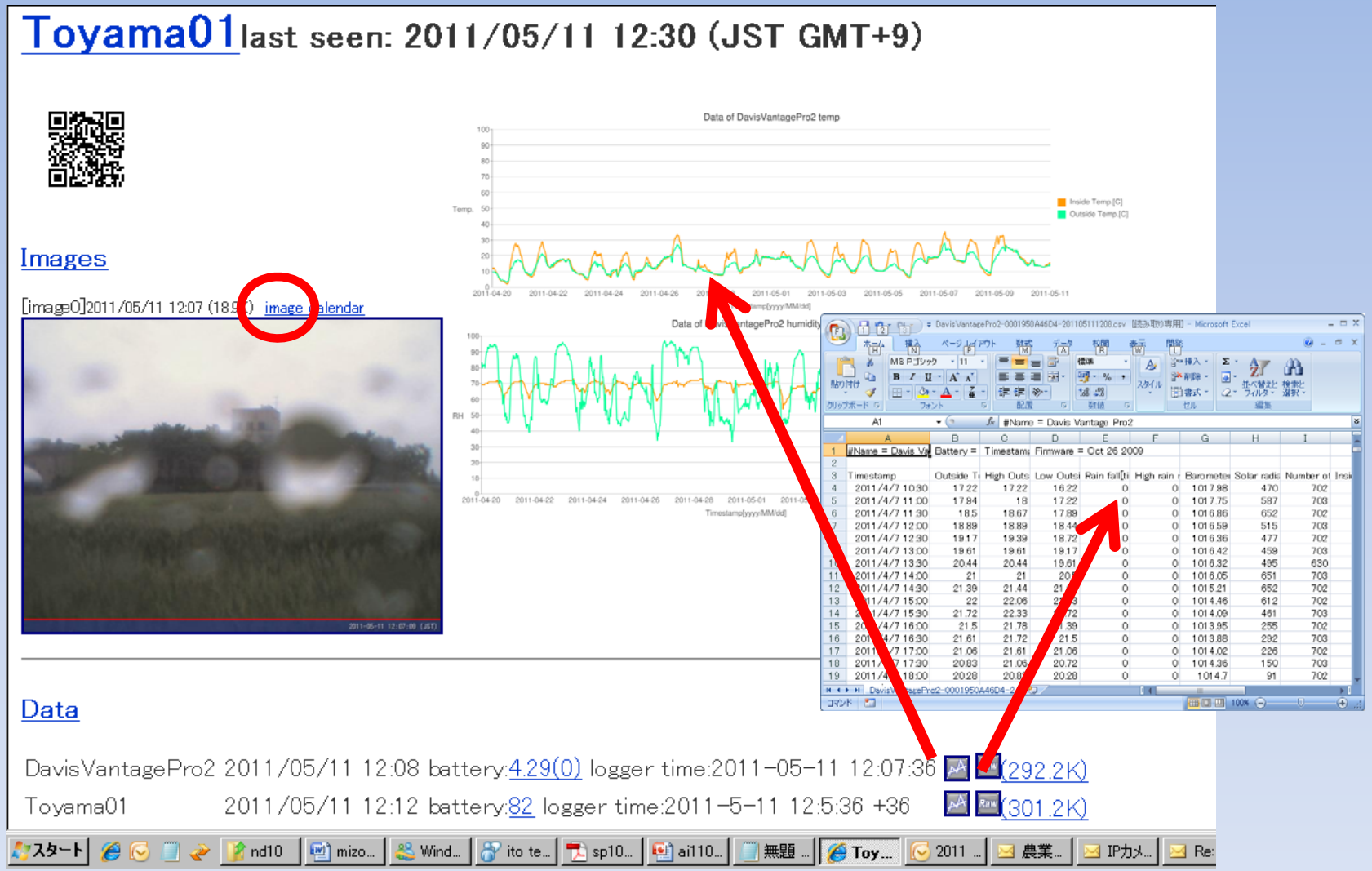
Setup images of FMS

Ina, Nagano Prefecture in Japan



http://www.iai.ga.a.u-tokyo.ac.jp/mizo/

View of individual site



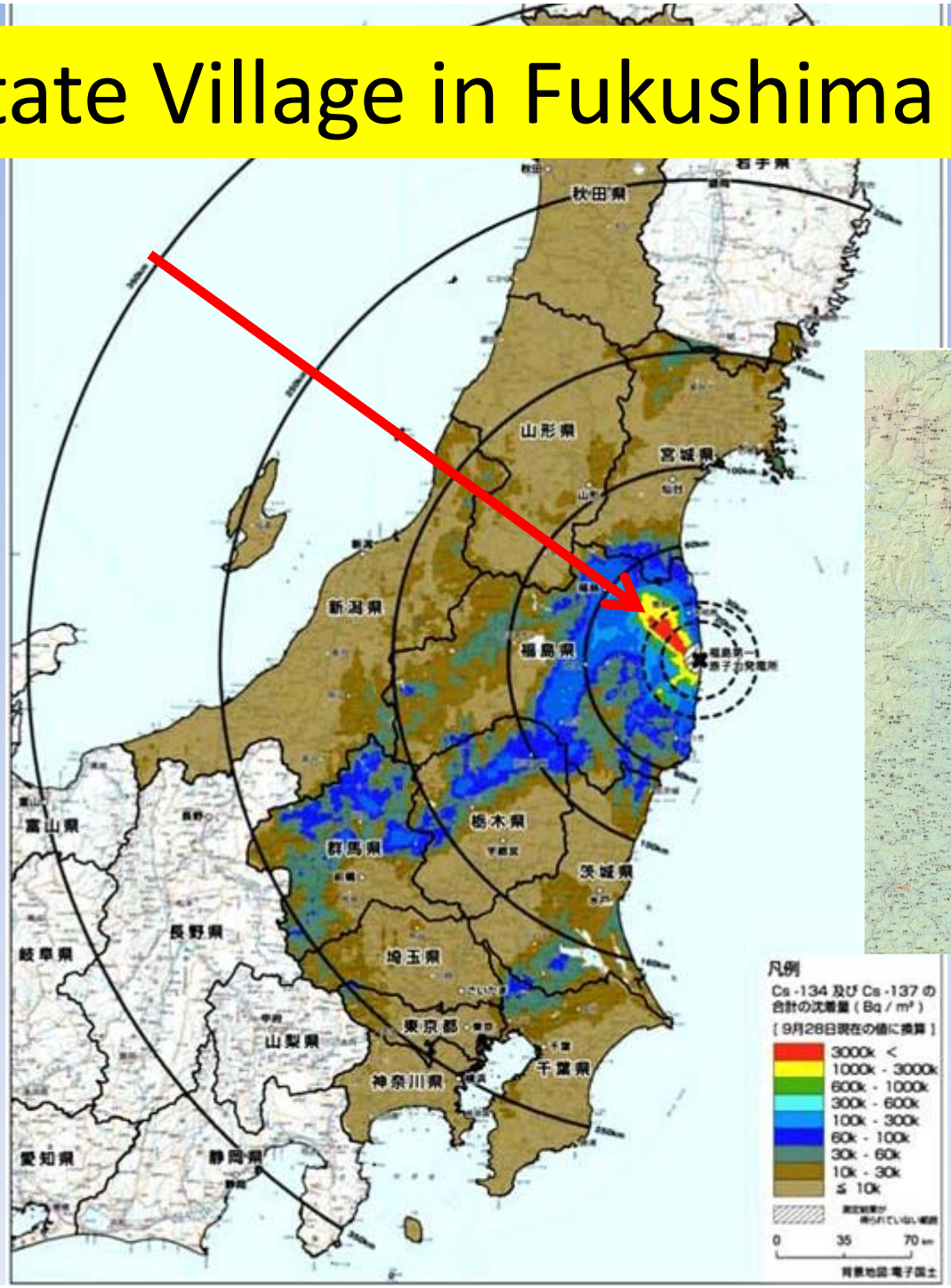
- Weather and soil data can be downloaded in CSV format
  - The data can be processed freely using EXCEL

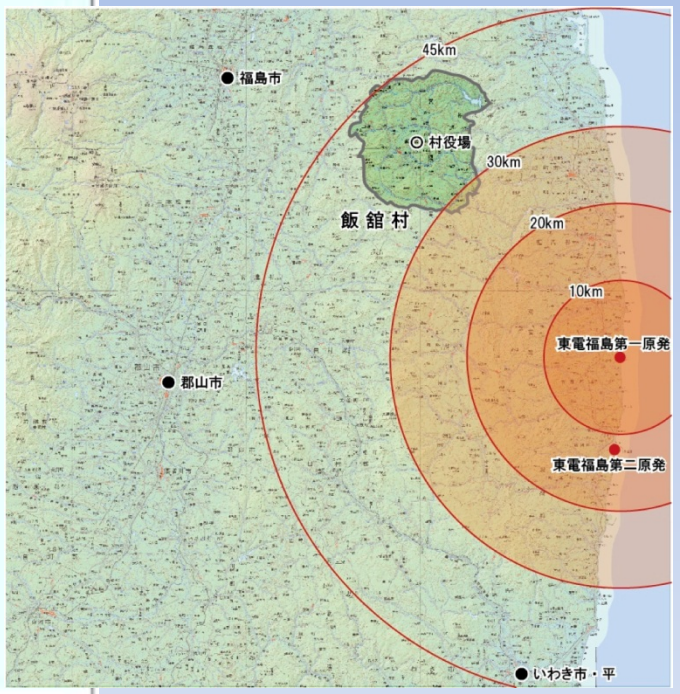
Calendar view function

2012 / 8						
Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Sun.
 8/27	 8/28	 8/29	 8/30	 8/31		
 8/20	 8/21	 8/22	 8/23	 8/24	 8/25	 8/26
 8/13	 8/14	 8/15	 8/16	 8/17	 8/18	 8/19
 8/6	 8/7	 8/8	 8/9	 8/10	 8/11	 8/12
		 8/1	 8/2	 8/3	 8/4	 8/5

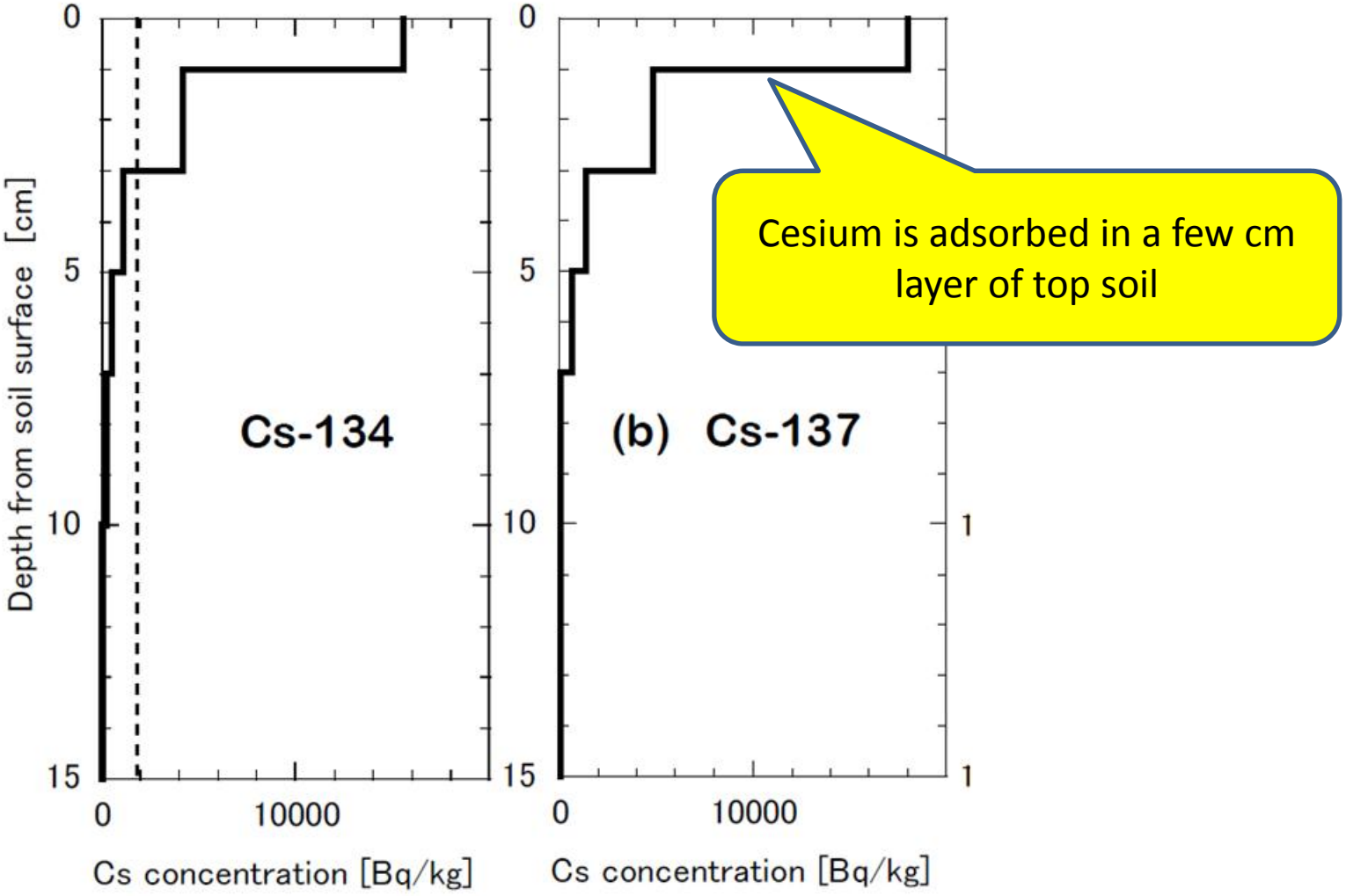
Introduction of the FMS with a radiation sensor to a village contaminated by radioactive cesium

Iitate Village in Fukushima Prefecture



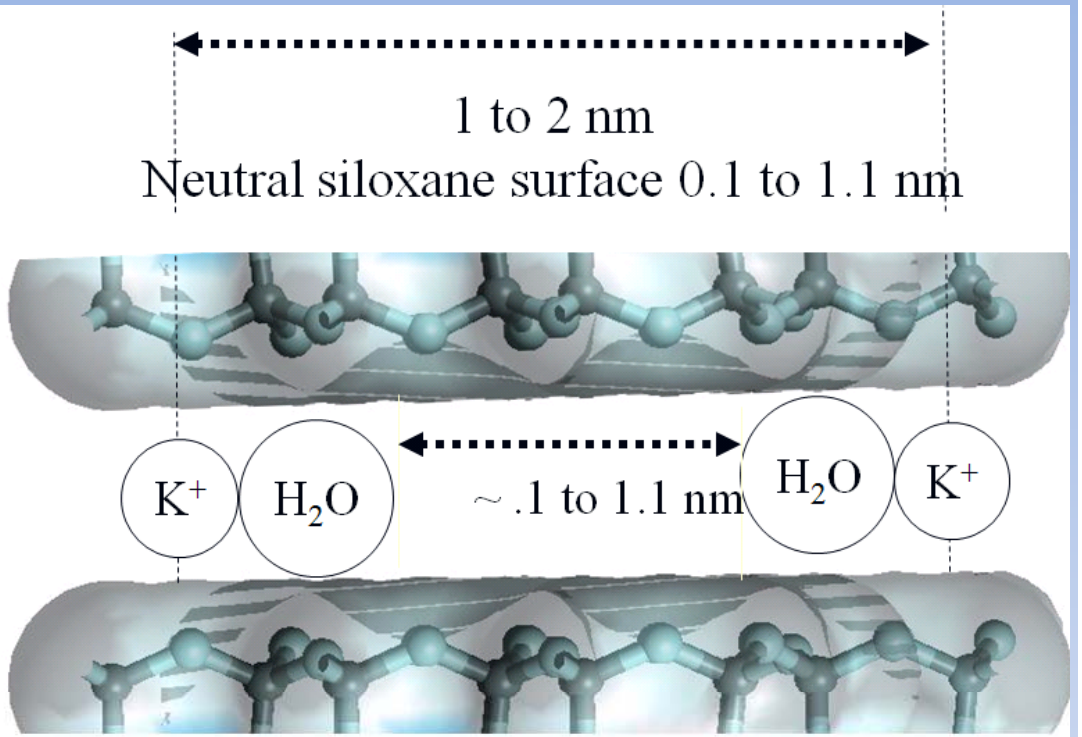


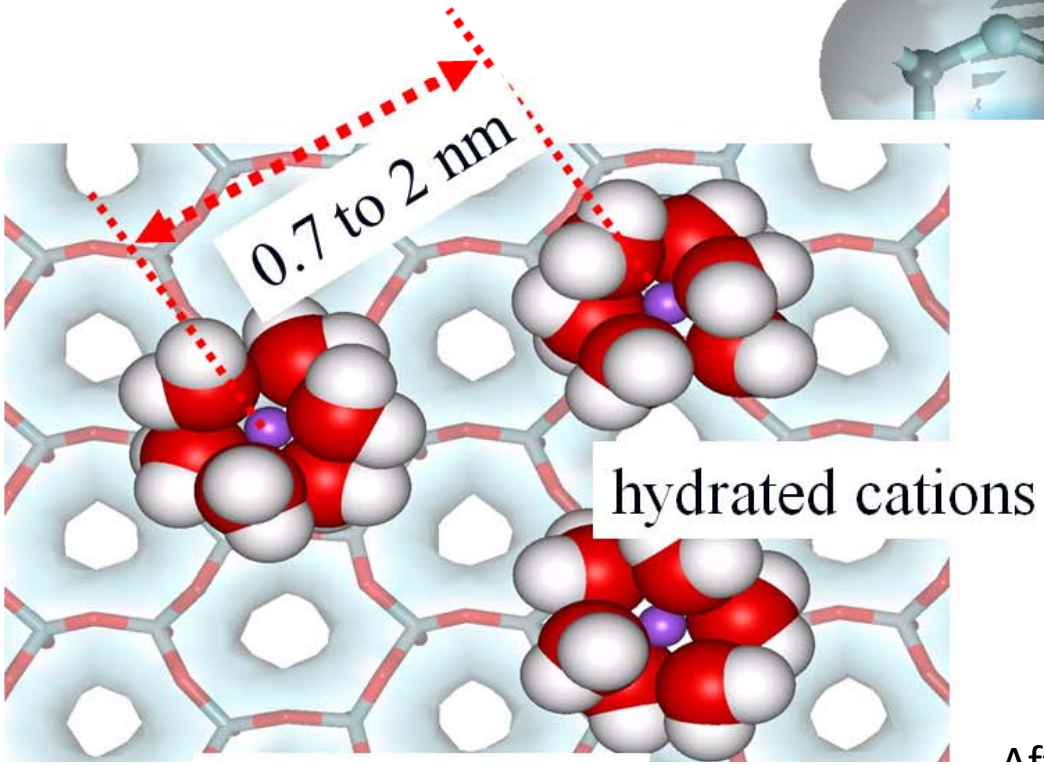
Radioactive Cesium Conc. In soils (2011.5.24)



Shiozawa, et.al: Vertical Concentration Profiles of Radioactive Cesium and Convective Velocity in Soil in a Paddy Field in Fukushima, RADIOISOTOPES, 60, 323-328 (2011)

Radioactive cesium and clay



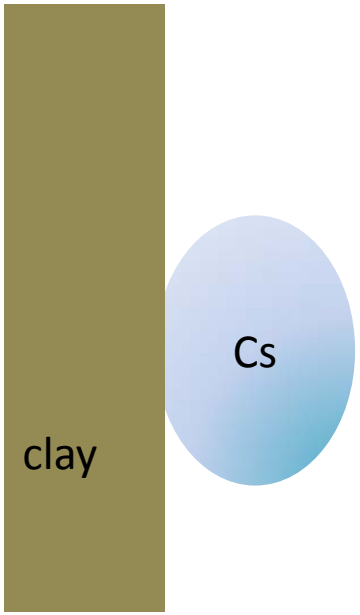


Cation exchange and cation fixation

After a material of seminar by C.T. Johnston

How to think of radioactive cesium

- Regard as a complex of cesium and clay particles
  - Clay colloid
- Note the movement of the clay
- Think the removal of the clay
  - Absorbing radioactive cesium



Measurement of radiation dose on a slope near the Iitate Village office (2011.6.25; Mizoguchi and Noborio)

2.5 µSv/h

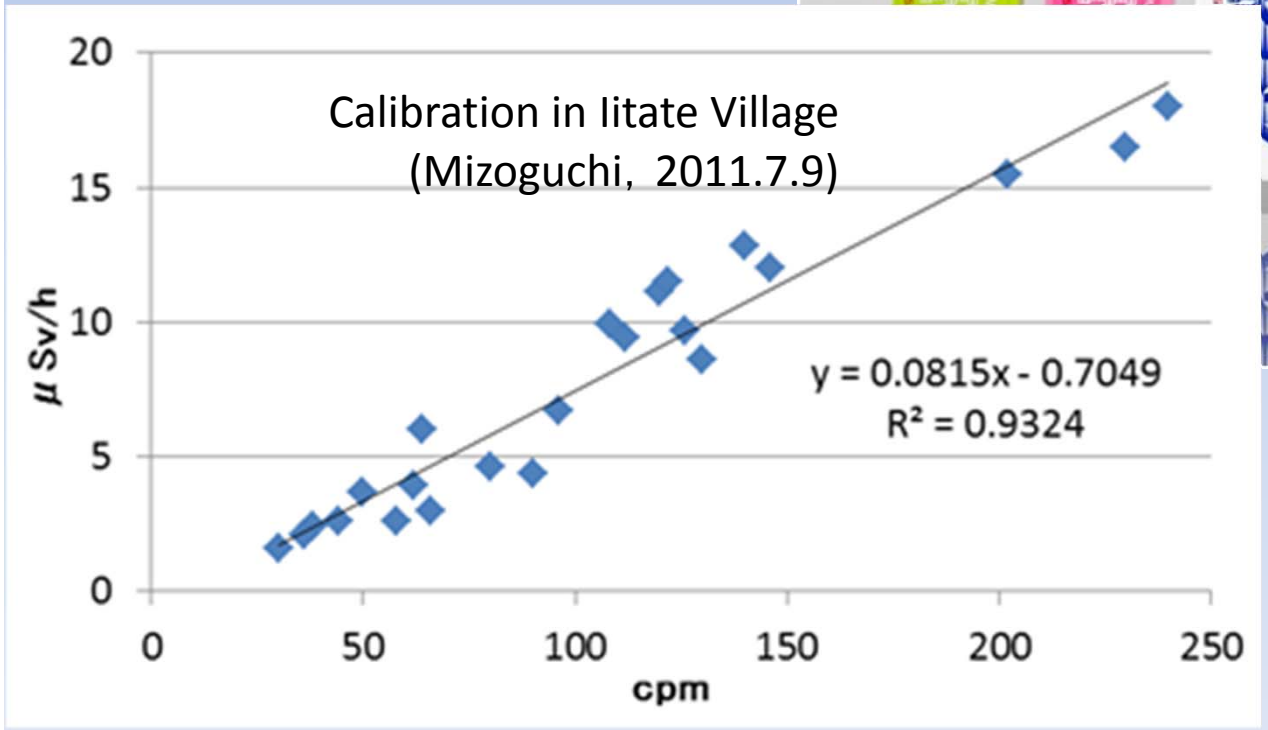
3.5 µSv/h

7.0 µSv/h

Radiation dose was higher at the bottom of the slope than at the top of the slope

Pocket-radiation sensor

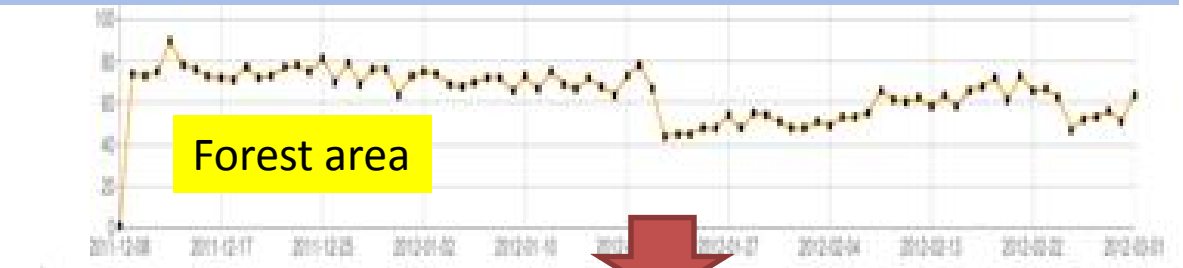
(non-profit project “radiation-watch.org”, 2011)

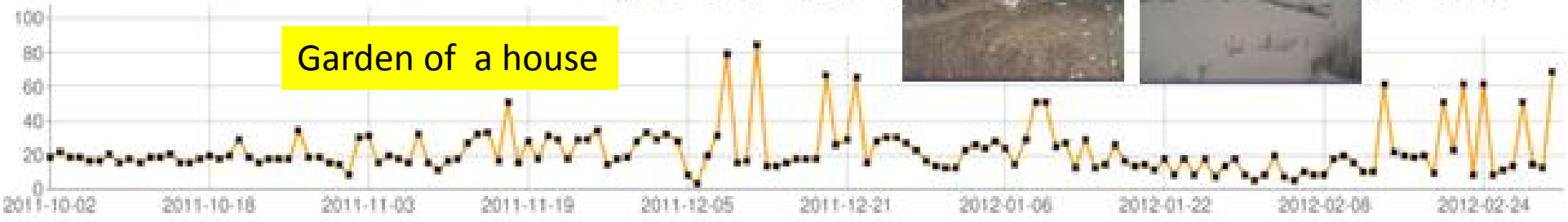


1,850 Yen

http://www.radiation-watch.org/

Radiation watch in the village





Field monitoring reveals:

1. Snow cover decreases radioactive dose of village
2. Radioactive dose is high on a fine and low humid day

How to remediate soil contaminated by radioactive substances

(1)Soil puddling method

(2) Stripping topsoil method

(3) Inversion tillage method

(4) Stripping frozen topsoil method

Stripping topsoil method

農林水産省

Official decontamination methods by Government

MAFF

Ministry of Agriculture, Forestry and Fisheries

From August, 2012

Soil puddling method

Deep plowing method

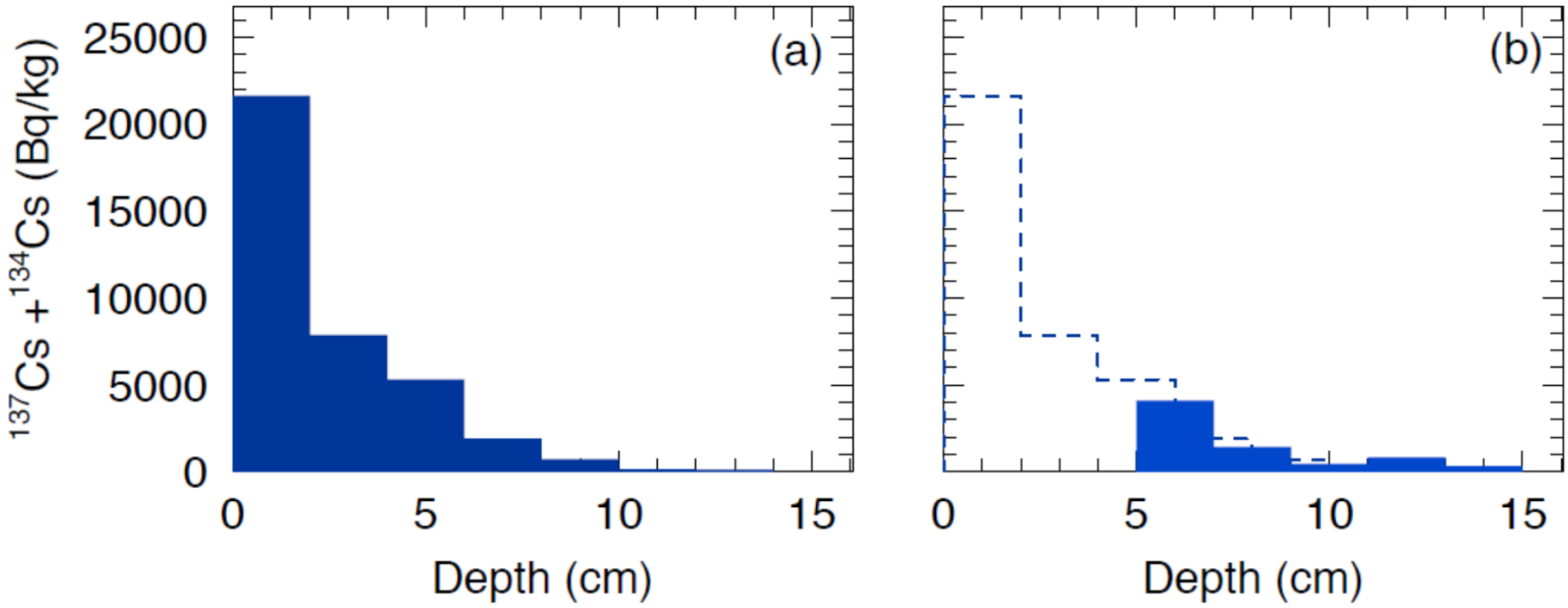
Stripping test of frozen topsoil (January 8, 2012)

5 cm thick frozen soil as a plate

1.28μSv/h → 0.16μSv/h

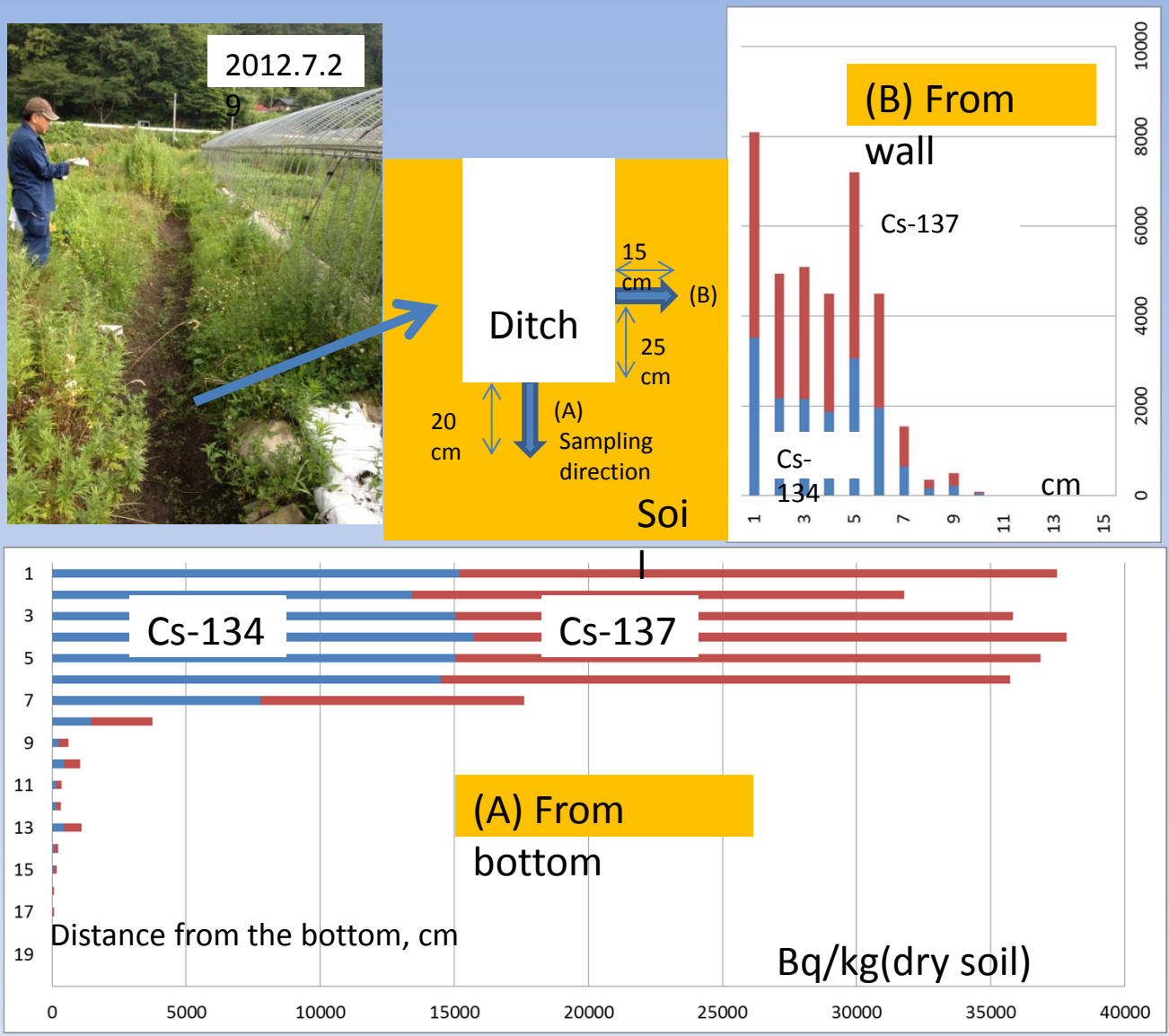
Rotary weeder method that was tested by a volunteer group（2012.4）

Amount of radioactive cesium profiles before/after rotary weeder operation



Resurrection of Fukushima, 2012
http://www.fukushima-saisei.jp/

Treatment of muddy water



Concentration of radioactive cesium of soils surrounding the drainage ditch

Filtration of muddy water
Science comunication

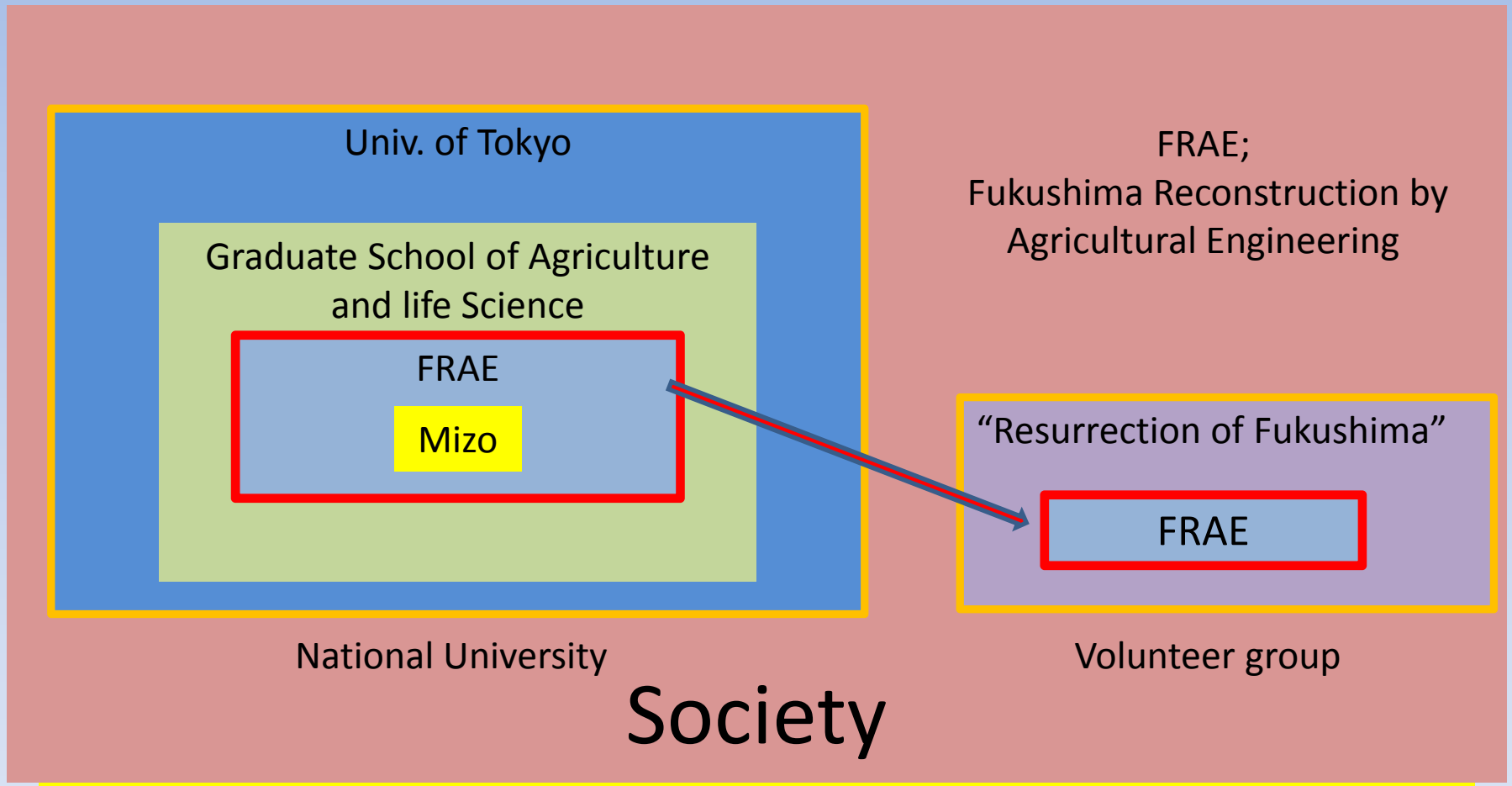
Left: fresh water, Right: muddy water

1. Fresh water comes out when muddy water is poured in the sand.

2. When this operation is repeated, fresh water becomes slow to comes out.

3. Clay particles with radioactive cesium are also trapped in the sand by this principle.

What is the role of a researcher in our society?



Young generation must think the meaning of research in the society for a new/unknown problem

Volunteer group activity by “Resurrection of Fukushima”

FRAE; Fukushima Reconstruction by Agricultural Engineering (2011.9.4)

若者の力、シニアの経験を世界の被災地「ふくしま」へ

ふくしま再生の会

English site

トップ

設立

活動

資

メデ

会員

会員

運営

現地活動を

お問合せ

Japanese Top Page

Top Page

Organizational Purpose

Activity Reports

Resurrection of Fukushima
Postal Address:
c/o Yu-iki Keikaku
Bunkyo-ku,
Honkomagome 1-1-17,
Kyurazu Honkomagome 9F,
Tokyo, 113-0021
Japan
TEL: +81-3-3823-5191
(Japanese speaking only)
FAX:+81-3-3823-5894
E-mail Address:
desk@fukushima-saisei.jp

Faceb

「Re

of F

ふくしま再

る

✓ いいね！

あなたが「いいね！」と言っています。

特定非営利活動法人
ふくしま再生の会
〒166-0004

Let's unite power of the young and experiences of seniors for Fukushima

Resurrection of Fukushima

We are a volunteer organization which aims at reconstruction of the lives and the industries in the area which were severely damaged by the Great East Japan Earthquake and the atomic power plant accident of Fukushima Dai-ichi nuclear power plant. Among the disaster stricken areas we have been conducting activities with a central focus on Fukushima Prefecture.

We established a base of activities in Iitate village in June 2011 and are advancing various projects toward resurrection/reconstitution of the area, finding the best way with the afflicted people.

Major projects that are now under development are shown below.

- Conducting thorough radiation measurements and drawing radiation dose survey maps
- Decontamination demonstrating experiments in houses, agricultural lands and forests
- Cares for the afflicted people by teams of professionals including medical doctors
- Sending out the real lives in the area stricken by the atomic power plant accident through information communication technologies

- 詳細な放射線計測と放射線マップの作成
- 家屋、農地、山林の除染実証実験
- 医師らによる被災者のケア
- 情報通信技術を活用し原発被災地の現実を発信

Social ICT × Agriculture

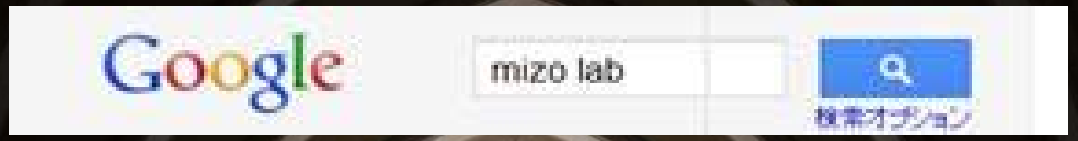
- Field
- Safe food production
- Community
- Education
- International collaboration
- Etc.

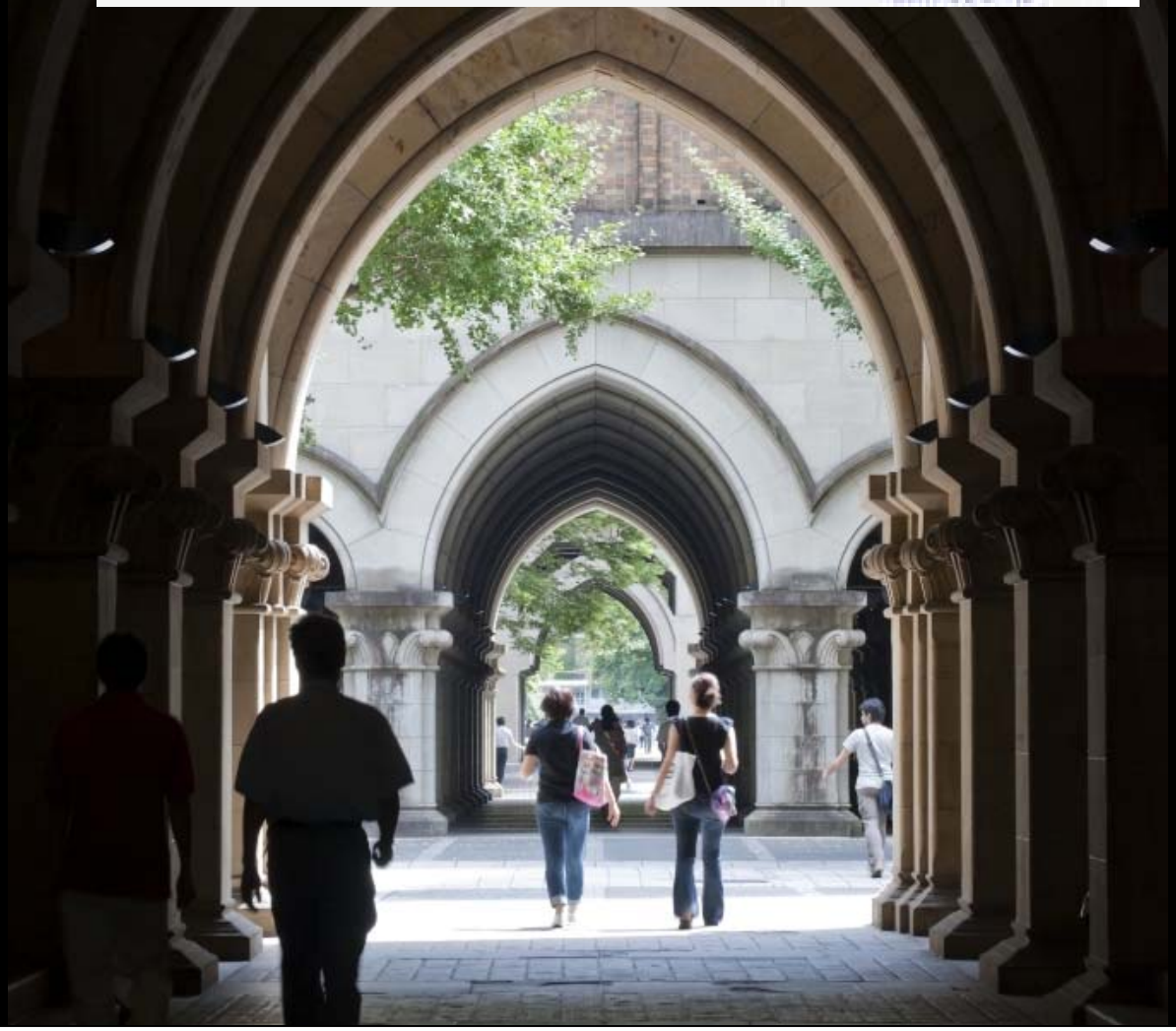
Fusion between agriculture and informatics

↓

Social agro-informatics

Thank you for your kind attention





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