Environmental Monitoring of Soil Contaminated by Radiocaesium in Iitate Village using FMS developed in GRENEN project

Masaru Mizoguchi
Graduate School of Agricultural and Life Sciences
Univ. of Tokyo
Climatic changes and evaluation of their effects on agriculture in Asian monsoon region (CAAM)

Leader: Masaru Mizoguchi (The University of Tokyo)

Aims

1. To improve the reliability of future climate prediction, which will be useful to design adaptation and mitigation strategies in agriculture against the predicted climatic changes in Asian monsoon region.

2. To develop the information platform which will be useful to design adaptation and mitigation strategies in agriculture against the predicted climatic changes in Asian monsoon region.

Climate change research

- Development of Agro-climatological Data-base in the Developing Countries
  - Digitization of old observational data recorded in paper format
  - Agro-meteorological data base near real-time meteorological data acquisition system

- Estimation of the element of Agricultural Meteorology
  - Heat balance model

Impact of Land-Use/Land-Cover (LULC) Changes on the Asian Monsoon Climate - Land-Atmosphere Interaction Study -

- Use of climate-model output on the DIAS and a detailed land surface data
- Elucidation of the importance of land surface atmosphere interaction including the impact of anthropogenic Asian monsoon region

Agricultural effect research

- Climatic Changes and Evaluation of Their Effects on Agriculture Based on a Field Survey
  - Assessment System Using Meteorological Data and Crop Models
    - Construction of the system for crop simulation under various conditions
    - Evaluation of the impact of climate change on crop production
  - Validation of evaluation system by field survey
    - Survey of cropping
    - Comparison of simulation and real planting
    - Cultivation based on the simulation test

- Development of Information Platform to Design Adaptation and Mitigation Strategies of Major Crops against the Predicted Climatic Changes
  - Collection and maintenance of information related to land use and land management, soil and Agricultural Meteorology
  - Collection of basic data on greenhouse gas balance in agricultural land

Benefits

1. Development of basic environmental information and its application to decision-making in the Asian monsoon region
2. Training of young researchers to lead the study of global warming mitigation measures and adaptation research and climate change
3. Construction of information infrastructure for the realization of global warming adaptation and mitigation measures for agricultural sectors
In GRENE-CAAM

• Field monitoring is important for agricultural production in Asia monsoon region
  – Weather (air temp, precipitation, solar radiation, wind)
  – Soil (moisture, temp, nutrition)
  – Crop (growth, color)
  – Environment (radioactive material?)

• Agricultural field is not in the city
  – No electrical power, no WiFi

• Sensor networking for agriculture is needed
Field Monitoring System (FMS)

In-situ data → Telecom. → Data Server

Meteorological data

Field Router

Mobile internet

Internet

Image data

Data logger

Bluetooth adapter

Soil data

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

Laboratory
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

Fukui

Nagano
Quasi real-time Monitoring of Farmland using Field Router

Masaru Mizoguchi

Lab. of International Agro-Informatics, Dept. of Global Agricultural Science, Univ. of Tokyo

http://www.iai.ga.a.u-tokyo.ac.jp/mizo/edrp/
View of individual site

**Toyama01** last seen: 2011/05/11 12:30 (JST GMT+9)

- Weather and soil data can be downloaded in CSV format
  - The data can be processed freely using EXCEL
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8/27</td>
<td>8/28</td>
<td>8/29</td>
<td>8/30</td>
<td>8/31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/13</td>
<td>8/14</td>
<td>8/15</td>
<td>8/16</td>
<td>8/17</td>
<td>8/18</td>
<td>8/19</td>
</tr>
<tr>
<td>8/6</td>
<td>8/7</td>
<td>8/8</td>
<td>8/9</td>
<td>8/10</td>
<td>8/11</td>
<td>8/12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8/1</td>
<td>8/2</td>
<td>8/3</td>
<td>8/4</td>
<td>8/5</td>
</tr>
</tbody>
</table>
Environmental Monitoring of Soil Contaminated by Radiocaesium in Iitate Village using the FMS
Most of radiocaesium released from Fukushima Daiichi nuclear power plant has been accumulated in the topsoil within 5 cm.

The topsoil stripping method is being carried out
- A lot of flexible container bags containing contaminated topsoil are piled up in the paddy field.
- We have not yet found the final disposal site of the contaminated soil.

For agricultural regeneration and early return village, it is important to find a feasible decontamination method that farmers can conduct by themselves.
- We are challenging a field test that buried the contaminated soil in the ground in Iitate, Fukushima Prefecture.
- We are monitoring the radiation level from the buried contaminated soil by using a soil radiation sensor combined to the Field Monitoring System (FMS) that we developed for agricultural use in GRENE project.
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)

Cesium is adsorbed in a few cm layer of top soil
Radioactive-Cs is replaced with K and fixed to the clay particles.

- Egg pack = a pair of clay sheets
- White egg = K
- Red egg = Radioactive-Cs

Radioactive-Cs is dropped into the hole in the clay surface!

by Prof. C.T Johnston @Purdue Univ.
Official decontamination methods by Government

MAFF
Ministry of Agriculture, Forestry and Fisheries

From August, 2012

Stripping topsoil method

Soil puddling method

Deep plowing method
Where is the destination of a pile of flexible container bag containing the contaminated soil

Kusano, iitate, Fukushima (2012.6.24)

Sugaya, iitate, Fukushima (2013.8.17)
What about the paddy field decontamination of mountainous land?

Weed cut
(2013.8.3)

Harm of wild boar
(2012.4.14)

Harm of monkey
The purpose of the field test

- **Madei-method**
  - Development of combination decontamination method that farmers can do by themselves
    - Stripping topsoil + Deep plowing method
    - Soil puddling + Deep plowing method

- **Madei-monitoring**
  - Monitoring of living space and farmland
    - Crop cultivation and after decontamination
    - Environmental change and weather conditions
    - Soil radiation dose and dose space

Madei means "carefully“ and “heartfully" in the dialect of Iitate village, Fukushima
Practices utilizing the properties of cesium and clay

Rotary weeder method
(2012.4.1)

decontamination method by stripping frozen soil
(2012.1.8)
Made-method-1 (Komiya method)
Soil puddling + Deep plowing method

(2013.5.18)
Pour contaminated muddy water into the drain

A result of the radioactivity measured at each depth by sampling the soil of the bottom and sides of the groove after a dried-up Cesium is not expected to immersion in the soil!
Made-method-1 (Sasu method)
Stripping topsoil + Deep plowing method

Burial of contaminated soil
Compaction of soil

2012.12.1
Contaminated soil should be buried in the bare hole!

Radiation dose is 1/100 to 1/1000 just bury 50cm deep!
Environmental monitoring of Iitate village

1.2 m high Radiation dose
Air temperature
Relative humidity
Precipitation
Solar radiation
Wind direction, wind speed
Soil moisture, soil temperature, and electrical conductivity

Garden of a house
In Forest
Out of forest (deforestation area)
Radiation dose monitoring of soil

Radioactive cesium is not moved even if water penetrates!
Rice planting in paddy that contaminated soil was buried (Susu, 2013.6.8)

Changes in soil radiation dose (cpm) and water level in a well in flooded rice field

Radioactive cesium is not moved even if water penetrates!
Radiation shielding by snow in Iitate

2014/03/09 12:23

Snow fall
Conclusions

• We are monitoring soil and environment contaminated by Radiocaesium in Iitate
  – using the Field Monitoring System (FMS) that we developed for agricultural use in GRENE project.
  – have a lot of monitoring data

• I would like to build a useful soil and environment database in Fukushima as one of important global data

• I am expecting the platform of DIAS in data integration and analysis of various data in Fukushima
Thank you for your kind attention

amizo@mail.ecc.u-tokyo.ac.jp