



RADIATION MEASUREMENT IN PADDY SOIL LAYER THAT WAS BURIED CONTAMINATED TOPSOIL IN FUKUSHIMA

Masaru MIZOGUCHI^{1,2}, Yoichi TAO² and Muneo KANNO²

1) The University of Tokyo, 2) NPO: Resurrection of Fukushima



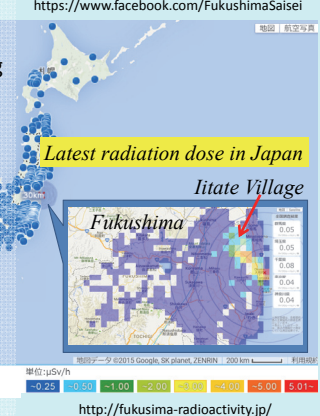
Abstract

Most of radiocesium released from Fukushima Daiichi nuclear power plant has been accumulated in the topsoil within 5 cm. For decontamination of the top soil, we have challenged some field tests that bury the contaminated soil under the ground in the paddy collaborating with a NPO and farmers.

In order to **measure the soil radiation of paddy soil layer**, in which contaminated topsoil was buried at the depth of 50-80 cm layer, we have developed a new instrument with 10 pieces of GM tube arranged at 10 cm intervals. In addition, a PVC pipe in inner diameter 10 cm and 200 cm long was installed at the depth of 150 cm to the height of 50 cm over the ground. We measured the soil radiation of each depth pulling the instrument by 20 cm each from the bottom of the PVC pipe in March 2015 after harvesting rice planted in the flooded paddy in 2014. As a result, **Gaussian distribution of the soil radiation was observed** with a peak at around the depth of 70cm. This result indicates that **radiocesium will not move although water infiltrated constantly** into the ground during rice cropping. The distribution shape was calculated by a simple model that takes into account the attenuation of the radiation by the soil. As a result, **the calculation result agreed well to the observation result**. However, we cannot understand the reason why the simple model succeeded to simulate the observation result. In this presentation, we would like to discuss the attenuation process of the radiation in soil.

Introduction

Most of radiocesium released from Fukushima Daiichi nuclear power plant has been accumulated in the topsoil within 5 cm. For decontamination of the top soil, Japanese government has authorized three methods: topsoil stripping method, puddling method, and plowing method to replace surface soil with subsoil. Among three methods, the topsoil stripping method is being carried out and a lot of flexible container bags containing contaminated topsoil are piled up in the paddy field. However, 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.



Experimental method

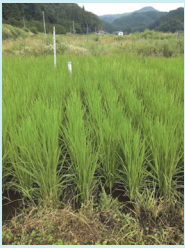
1. buried contaminated top soil under the ground with a PCV well, and covered with non-contaminated soil.
2. planted rice on this paddy field.
3. measured soil radiation using a new instrument



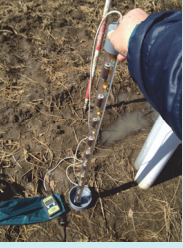
2. June 1, 2014



1. May 18, 2014



2. August, 2014



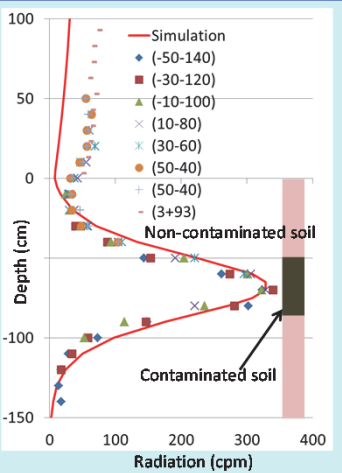
3. March 21, 2015

New Instrument

- Easy to measure soil radiation in a well
- 1 m long, 3 cm in diameter with 10 pieces of GM tube arranged at 10cm intervals
- Only 3 min to measure

Result and Discussion

- has Gaussian distribution with a peak at around the depth of 70cm
- is lower in the soil under the buried contaminated soil than in the topsoil.
- No movement of cesium
- can be simulated with a model



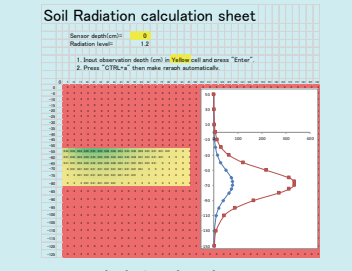
A profile of radiation dose in paddy soil layer. The (-50-140) denotes the highest and the lowest positions of GM tubes are -50 and -140 cm, respectively.

Soil radiation model

$$I(h) = \int_a^b \frac{pe^{-\mu\sqrt{x^2+(y-h)^2}}}{4\pi\{x^2+(y-h)^2\}^{3/2}} 2\pi x dx$$

- x: horizontal radius from the center of PVC pipe (cm)
- y: height of measurement (cm)
- h: height of GM tube (cm)
- μ : attenuation coefficient of radiation (1/100 for 50 cm soil thickness)
- p: concentration of cesium of soil
- a: radius of PVC pipe (5cm)
- b: radius of buried contaminated soil (cm)

Simulation



Calculation sheet by EXCEL. The soil radiation in a well can be calculated as a summation of each cell of EXCEL.

More information

• Collection of Mizo's works on Fukushima
http://www.iai.ga.a-u-tokyo.ac.jp/mizo/edrp/fukushima/Fukushima_articles.html



Conclusion

1. The local buried method is effective for remediation of farmland contaminated by radiocesium.
2. Gaussian distribution of the soil radiation was observed in paddy soil layer in which contaminated topsoil is buried at the depth of 50-80cm.
3. The observed result was simulated by a model that takes into account the radiation attenuation by soil.
4. Radiocesium may not leak from the buried-contaminated soil even if rice is grown normally under the flood condition in paddy field.
5. We need long-term monitoring and prediction of radiocesium movement in soil.