ISET-R News Letter

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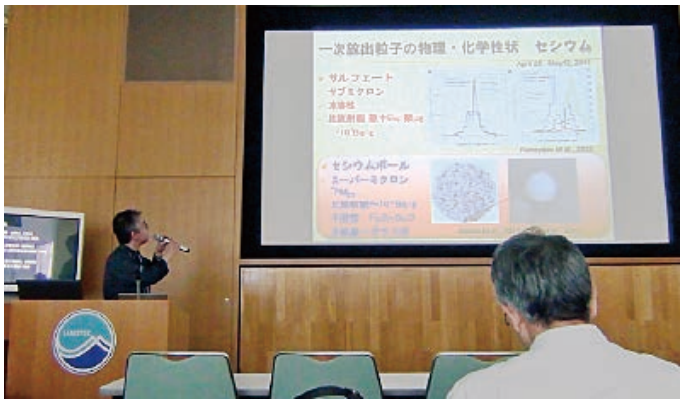
ISET-R
Interdisciplinary Study on Environmental Transfer of Radionuclides from the Fukushima Daiichi NPP Accident

ISET-R Plenary Conference

@Miyoshi Memoriam Auditorium of JAMSTEC Yokohama Institute for Earth Sciences July 2, 2016 (9:00 ～ 17:30)



ISET-R Plenary Conference was held on July 2 at JAMSTEC (Japan Agency for Marine-Earth Science and Technology) Yokohama Institute for Earth Sciences after the Fukushima session at Goldschmidt on January 1, 2016.

This is the last year for ISET-R, a 5-year project after the Fukushima Dai-ichi Nuclear Power Plant accident 5 years ago. The conference gathered eighty five participants, and an active discussion was held.

Each of four research groups made a presentation and discussed unsolved subjects for the final report.

Four research groups with four themes as follows are expected to create a new research field from an interdisciplinary study, and aims to strengthen the connection with each other.
Public offering research group belongs to one of four projects, aiming to consolidate a collaborative research and to create a new field.

What is the most notable for B04 research group is that the group collects the research results of environmental transfer of radionuclides and carries out an evaluation of radiation exposure in a specific area to feed them back to the residents and ecosystem.

B01 Estimation of deposition process of radionuclides based on the investigation, analysis and clarification of chemical status at the time of release and impact assessment of transfer [A01, A03, A04]

B02 Clarification of circulation process of radionuclides in forest environment and modeling of the process [A01, A03, A04]

B03 Clarification of transfer process of radionuclides from terrestrial environment to marine environment through river network [A02, A03, A04]

B04 Calculation of locational radiation exposure based on radionuclide behavior and transfer in the environment [A01, A02, A03, A04]

Presentation on recent developments of research by principle investigators of each research group

B01

Primary emission of Cs Chemical forms

Koji ADACHI (Meteorological Research Institute)
"insoluble cesium"
Keisuke SUEKI (University of Tsukuba)
"emission source of insoluble cesium"
Yoshinari ABE (Tokyo University of Science)
"insoluble cesium+ other chemical form"
Nobufumi FUJITA (Osaka University)
"simulation of insoluble cesium"

Secondary emission of Cs Chemical forms

Masahide ISHIZUKA (Kagawa University)
"dust from simulation test + examination of forests source"
Yasuhito IGARASHI (Meteorological Research Institute)
"Conclusion"

Experiment on primary emission of insoluble cesium by Dr. Adachi showed that the spherical cesium-bearing particles has the same particle diameter as PM2.5 and higher specific radioactivity, and is non-crystalline. And the experiment conducted by Dr. Yamaguchi and Dr. Kogure also showed that it has an internal structure. The origin and structure can be expected to be clearly detected through a high pressure electron microscope, while it is a notable discovery that the particle on the filter was confirmed by the method of using IP (Imaging plate) to discriminate particle. Dr. Fujita at Osaka University has found that spherical cesium-bearing particles can be made, which we hope makes clear of internal structure. It is still a challenge to find out "Where they come from" , how they respond to the environment and so on. As soil dust was supposed to be a major cause of the secondary emission and resuspension, it had been on the assumption that spherical cesium-bearing particles would come out when something burnt. Now we need to include bioaerosol, pollen, and spore as the cause.

Another challenge we should make clear is an unexpected phenomenon that the concentration gets thicker when it is raining and humid in summer although it is generally supposed to be removed from the air when it rains. This suggests that spherical cesium-bearing particles may not be removed but remained or emerge contrary in the common case. Observation should be conducted in line with modeling to include the study of flux.

The first emission's dependence on an event, its regional characterisitcs and the generating mechanism have become clearer while the relation to in-pile phenomenon, inventory and the long term behavior in the environment have not yet well understood. Influence from exposure to nuclide such as radioiodine should be examined more although it is too difficult to analyze to get a data.

Several processes of the secondary emission has become clear that it relates with dust, plants, and rainfall. Evaluation of flux have been conducted as well. Challenges we should work on are forest fire and particle diameter distribution.

B02

Clarification of circulation process of radionuclides in forest environment and modeling of the process

Chisato TAKENAKA (Nagoya University)
"General Explanation"
Hiroaki KATO (University of Tsukuba)
"Evaluation method of initial amount of deposition"
Chisato TAKENAKA (Nagoya University), Jun FURUKAWA (University of Tsukuba), Kazuya IIZUKA (Utsunomiya University), Dan AOKI (Nagoya University)
"Absorption of ^{137}Cs into trees and plants and its flux evaluation"
Hitoshi SEKIMOTO/Tatsuhiro Okubo (Utsunomiya University)
"Evaluation of ^{137}Cs flux into fallen leaves and in a process of humification"
Nobuhiro KANEKO (YOKOHAMA National University)
"Transport of ^{137}Cs through soil microbe and animals and the flux evaluation"
Masaaki KOGANEZAWA (Utsunomiya University)
"Transport of ^{137}Cs through deer and forests in Okunikko and the flux evaluation"
Yoshiko AYABE / Naoki HIJII (Nagoya University)
"^{137}Cs flux into a flock of arthropod"
Tsutomu KANASASHI (Nagoya University), Hiroaki KATO (University of Tsukuba)
"Regionwide evaluation of ^{137}Cs dynamics in forests"
Chisato TAKENAKA (Nagoya University)
"Comprehensive discussion"

Forest ecosystem has been assessed mainly with Tag (surface transfer coefficient). In regard to two tree species, Quercus serrata and cedar, Quercus serrata is in a static state. Tag measured in leaves is around 0.01 for Quercus mongolica and deciduous tree. On the other hand, it is still remained in A0 layer and A layer, and small size of insoluble substance may migrate into A layer rather than water solubility substance. Cedar has an unstable figure, and is one order lower than that of Quercus serrata. It is also different depending on a tree age. Tag in shallow root system of young trees shows a relatively high value. Bamboo grass belonging to an understory vegetation also shows a relatively high value in Tag, and deer that eat them show higher value, as they eat branches containing high tag. It is likely that deer and boars moving in a wide range could make a hot spot to some extent. Tag of mushrooms is high, and the quantity as a spore needs to be verified. Tag value of insects can be evaluated relatively low as in the case of flies that emerge from soil and spiders showing the value of 0.001. It is difficult to evaluate tag of old leaves and woods containing chemical form at the initial deposition, and it was suggested that they might still show the state of initial deposition.

We need to find out the relation to chemical form at the early stage and what basic data is necessary to evaluate the value of Tag. Consistency with data from aircraft monitoring is a huge discovery, which could be utilized for a broad-based assessment. If bacteria and bioaerosol are taken into consideration, amount of tag that bacteria spread and amount of deposition deriving from bioaerosol are considered to be several becquerel per square meter, which is understandable.

As the assessment is complicated, any subjects should be taken into consideration such as understory vegetation including not only bamboo but others for better understanding.

B03

Clarification of transfer process of radionuclides from terrestrial environment to marine environment through river network

Michio AOYAMA (Fukushima University)
[substitution : Daisuke TSUMUNE (Central Research Institute of Electric Power Industry)]
"Flux into the sea through the river"
Yuichi ONDA (University of Tsukuba)
"Time change and FLUX"
Kenji NANBA (Fukushima University)
[substitution: Yuichi ONDA (University of Tsukuba)]
"Urban area"
Takehiko FUKUSHIMA (University of Tsukuba)
[substitution : Hiroyuki ARAI (University of Tsukuba)]
"River influx into Kasumigaura"
Yoshifumi WAKIYAMA (Fukushima University)
"Effect of decontamination"
Chihiro Yoshimura (Tokyo Institute of Technology)
"Migration into algae in the river"
ZHANG Jing (TOYAMA University)
"Concentration - change in brackish water"
Yoshio TAKAHASHI (University of TOKYO)
"Adsorption and desorption in brackish water"
Daisuke TSUMUNE (Central Research Institute of Electric Power Industry)
"Outflow from the first floor"
Jyota KANDA, Takashi ISHIMARU (Tokyo University of Marine Science and Technology)
"Contamination-change of life"
Kimikazu SASA (University of Tsukuba)
"Migration from the river into the sea using I-129"
Kaeriyama HIDEKI (Fisheries Research Agency)
"Change of sediment"
General discussion

Flux from the land into the sea is estimated 10^9 Bq per day. Simulation of concentration shows it is mostly transported from Oyashio-current and boundary, and the certain amount from 1F is detected along the coast. And it was found that the flux from the river has a very little impact on the environment. There is a case that the subtropics circulation brings radiation widely spread over North Pacific back to Japan island. An influence of the river and the direct leakage don't have much impact on whole flux, however, they can still be used as an oceanographic tracer.

Observation data in the river is continuously obtained, and a flux from the river into the sea and an initial state can be estimated to a certain extent. A speed of a declining concentration of radiocesium in rice fields is fast, while that of the woods is not so fast. Research spots have been added from 6 to 30 in the river for the observation. The declining speed of radiocesium in a main stream in Abukuma river is fast at an early stage, but getting slower after the early stage, while that of tributary in stream is fast on average with however less initial data is available. The declining trend of radionuclide concentration is very slow on Hama Dori (sea side area). Kd at river is much lower than that of Chernobyl, which is in 5 to 6 power

order. No initial data of suspended sediment has made it difficult to establish runoff model, but applying initial data to the model could lead to more meaningful calculation for flux. A research on how much dissolution occurs in the sea is necessary. Statistical analysis has found that concentration in a rural area is high, and that wider rural area makes the declining speed of radionuclide concentration slower. This is thought to be related to an issue of re-suspension, and to be crucial trend.

As for an influence of decontamination, there were large variation in concentration at early stage in Haramachi town in 2012, however, it has lowered significantly after 2014 after decontamination at farmland was well underway. It indicates that an amount of suspended sediment increases in proportion to an amount of precipitation after a decontamination. The future subject is to quantify where and how much flux is measured in relation to the progress of decontamination works and to study how it is related to cesium concentration.

As for a transfer into algae in the river, while absorption of cesium ion and potassium is in a competitive situation, speed of cesium absorption was estimated to some extent. Regarding cesium budget in Kasumigaura Lake, annual inflow of suspended ^{137}Cs after 2013 is 0.3~3.2% against the total amount of ^{137}Cs radiation in the lake, and 0.3~1% in a dissolved state. To make clear of a concentration change in brackish water, observation and experiment were done on how much leaching causes. As a result, leaking from resuspension objects and recirculating water account for about 60-80% as the major cause.

To measure the amount of transfer into sediments, adsorption experiment, molecular unit of analysis and thermodynamics model have been considered by quantifying a desorption reaction of Cs at the time of its transfer from the river into the ocean. Stirring of 1g of suspended particles（1 g/L, Kd=160 L/g）in clear sea water has resulted in 76% of Cs elution. This experiment has almost produced the similar figure reported by IAEA.

B04

Calculation of locational radiation exposure based on radionuclide behavior and transfer in the environment

Haruo TSURUTA (Remote Sensing Technology Center of Japan)

"General outline"

Teruyuki NAKAJIMA (Japan Aerospace Exploration Agency), Daisuke GOTO (National Institute for Environmental Studies)

"Improvement and comparison of atmospheric transport deposit model"

Haruo TSURUTA (Remote Sensing Technology Center of Japan), Yasuji OURA (Tokyo Metropolitan University), Mitsuru EBIHARA (Tokyo Metropolitan University)

"Space-time distribution of radio nuclide through SPM tape filter paper"

Yasuji OURA (Tokyo Metropolitan University), Mitsuru EBIHARA (Tokyo Metropolitan University)

"Measurement of I-129 by using atmospheric aerosol specimen"

Masayuki TAKIGAWA (Japan Agency for Marine-Earth Science and Technology)

"Case study of estimation on internal exposure dose at the early stage of the accident"

Yoshitaka ITO (Nagoya University)

"Current status of constructing radiation measurement meta database"

General discussion

Model has improved compared to a prior international model. The second model comparison will take place (the Grants - in - aid for Scientific Research). Deposition rate into continental area is estimated to be 27±10%,

and the figure accords with 20% (SCJ report, 2014) in the report of MEXT and 20% (MRI model result was 38% in the SCJ report) reported by Dr. Kajino (Kajino et al. (ACPD' 16)), although it still needs to be examined. Wet deposition model is not satisfying（SCJ report, siga/mean= 30%), and an effect of weak rain measured by Dr. Wakatsuki should be take into account for further research. Focusing on the boundary layer transport is crucial, but is not yet well conducted because of its difficulty. It is true that various models and observation comparison have improved a discharge scenario. Latest model may improve the concentration gap. Inverse estimation using a deposition amount reduce the error, and using data of SPM is necessary as well. Model calculation for gaseous and particulate concentration of iodine and exposure dose is being conducted. (promotion expenses from Prof. Moriguchi)

There is a possibility that re-suspension could derive from soil and flora due to its dependency on a seasonal variation, and model assessment was conducted. Explaining an observation figure requires big data of coefficient-exchange and a long term calculation. It is possible to make a relocation calculation in a several km resolution on a soil and flora origin with a giving data of deposition amount. Calculation in several dozen meter resolution requires a comparison with the method by Kinase et al., (2016).

It was confirmed that ^{129}I was contained in a tape filter of SPM used at the time of the Fukushima Dai-ichi Nuclear Power Plant accident, and an analysis method of ^{129}I contained in a tape filter of SPM has been established. It was found that quantitative value measured by filter made of fluororesin is systematically underestimated compared to that by filter made of glass fiber. Existence of high level radioactivity makes the ratio of ^{129}I/^{137}Cs in a specimen inconsistent, therefore partial analysis on specimen requires careful attention. Analysis on specimen of suspended particle which quantified ^{131}I has provided activity ratio of ^{131}I/^{129}I. This has showed that SPM measurement using tape filter is very effective, so we' d like to conduct an analysis on cesium, iodine, form and composition as well.

As for an initial exposure, understanding of meteorological field, emission variation, and discharging form is insufficient, even if there is a difference in degree. Meteorological Agency and Meteorological Research Institute have created area weather assimilative dataset, but frontal passage has a several hours gap from the observation. Quality of data in an area of a small amount of precipitation has improved, while it hasn' t reproduced a perfect observation. Emission is being analyzed with a study of in-pile phenomenon. As it is impossible to perfectly set boundary conditions and input condition, analysis by ensemble modeling using several models and estimating the damage using maximum likelihood estimate of internal exposure is planned to be conducted.

Current status of constructing metadatabase of radioactive measurement

(Group of public offering: Yoshitaka ITO)

[Data base: Jun ASANUMA, Kazuyuki KITA]

Our goal is to discover a radiation measurement data and to catalogue it for a better use. Especially, data useful to an estimation of initial internal exposure is much required, so we' d like to discover and get as much data measured at the early stage as possible. Private data provided by common people and on the internet should be collected regardless of the quality. Eventually, we will make metadata that catalogues a presence and surrounding of data, make the system available for searching, and archive it.

We have collected 210 data on the internet and 39 of surveys from associations, and have made a tool that converts information of metadata into XML and visualizing tool (map, chart) as well. We will collect metadata measured through ISET-R project, and conduct a survey to associations, make a searching tool, and release them in ISET-R. Professor Asanuma will collect metadata and be in charge of constructing metadata base provided by ISET-R project, and will request for collecting data and record more detailed content.

Conclusion

We have pledged to have 10 more students and young researchers attend lectures in three other research areas except the one they belong to at a project for fostering young researchers (Atmosphere, Ocean, Land, and Chemical forms), so we should work on it to reach the goal.

The next general meeting will be held next March, and we need to prepare for the final report deadline of which is May. We have a task of B group aside from A group, so discussion in B group meeting in line with A group is necessary. We have a plan to publish a book from University of Tokyo Press, and would like it aimed at specialists.

Comments from advisors

Prof. Moriguchi

I listened to the discussion of B group with a great interest. Especially, B02 group' s illustration with a figure has shown a bright prospect. If each of B groups could organize ideas in the similar way, I think that would lead to a better understanding. Thank you very much..

Prof. Shibata

I have attended the general meeting for the past years, and I think the meetings have made the theme clearer. You need to make it into a concrete shape in half a year, the rest of the project years. In the process, you might find that there is a limit for a certain research, or that there is no meaning if you give it up. So, I would suggest that you need to organize what you have done and let it lead to the next step. Thank you very much.

Prof. Gamo

I was overwhelmed by reports by everyone here today. I have a feeling that five years have passed very fast. During the term, you have produced significant results, and collected very valuable research data which can be collected only at this opportunity. The project is going into the conclusive final stage, so I' d like to expect all of you to enhance your eagerness to finalize the project in the remaining half a year.

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