

## Simulation of daily precipitation time series using a new stochastic model

Chieko Gomi<sup>1\*</sup>, TACHINAMI, Setsuko<sup>1</sup>, KUZUHA, Yasuhisa<sup>1</sup>

<sup>1</sup>Graduate School of Bioresources, Mie University

Geoscientific fields such as clouds, spatial elevation data, temporal or spatial rainfall fields, and earthquake-slip fields are often modeled using fractals or multifractals. We first sought to apply fractional Brownian motion (fBm) or fractional Levy motion (fLm), which are simple fractal models, to simulate and generate time series of daily precipitation ( $R$ ) at 51 stations in Japan. [1] We conducted spectrum analysis of the anomalies of  $R$  ( $R_{\text{delta}}=R-R_{\text{ave}}$ ; where  $R_{\text{ave}}$  is the normal value of each day). However, we found that the fBm/fLm cannot be applied to the data because the relation between angular frequency  $\omega$  and power  $P(\omega)$  is not log-log linear, which is a necessary condition of a fractal. Therefore, we defined a new model, e-model, which describes the mutual relation between  $\omega$  and  $P(\omega)$ . In the e-model,  $P(\omega)$  is described as  $A \exp(-B \omega)$ , where  $A$  and  $B$  are approximation coefficients. [2] One generating fBm and fLm method is the filtering of white noise. If the white noise is Gaussian, then the model is fBm. However, if the white noise is Levy, then the model is fLm. Our model is not a fractal model such as fBm and fLm. However, the algorithm is similar to those. First, we generate white noise and filter the noise. Results show that, as for white noise for our model, the Levy noise is more appropriate than the Gaussian noise. [3] We simulate a time series of daily precipitation ( $R'$ ) using the e-model and Levy random number. The power spectrum of anomalies of  $R'$  ( $R'_{\text{delta}}$ ), which were generated by us showed a similar relation to those of the e-model, which indicated that the daily precipitation time series can be calculated using the e-model and Levy random number. [4] We assume the negative values of  $R'$  as zero (no-precipitation) (hereinafter, these time series are  $R''$ ). We conducted spectrum analysis of  $R''$ . Results show that the power spectrum of  $R''_{\text{delta}}$  resembles those of  $R_{\text{delta}}$ . To conclude, we presented the possibility of generating the time series of daily precipitation using e-model and Levy random number, which is a method resembling the filtering method for fBm/fLm.

Keywords: stochastic model, Levy random number, e-model, daily precipitation time series, simulation, filtering

## Comparative validation of the PCO<sub>2</sub> rates in Japanese rivers and its controls

Souya Otani<sup>1\*</sup>, KAWAHATA, Hodaka<sup>2</sup>, USHIE, Hiroyuki<sup>2</sup>, HIGASHI, Kengo<sup>1</sup>, MANAKA, Takuya<sup>1</sup>, SHINOZUKA, Megumi<sup>3</sup>

<sup>1</sup>Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo, <sup>2</sup>Atmosphere and Ocean Research Institute, The University of Tokyo, <sup>3</sup>Graduate School of Frontier Sciences, The University of Tokyo

Previous studies showed that total carbon rates are mainly controlled only by chemical weathering and soil respiration, and therefore, PCO<sub>2</sub> within the river water is also characterized by these parameters. This fact is confirmed by numerous studies in a local scale, but when standing on a more macro perspective, study results are still limited. Defining the behaviors of the PCO<sub>2</sub> within the river waters can lead to the understanding of the role of rivers within the global carbon cycle, which, moreover, can be essential in predicting future behaviors. Based on the hydrochemical dataset by Kobayashi (1960) and the further datasets of Kobayashi (Harashima et al., 2006), the PCO<sub>2</sub> of the Japanese river water were mapped. Then, through a comparison with various presumable parameters, we determined the controlling factors of the PCO<sub>2</sub> system.

As a general result, it can be said that (1) Japanese rivers' carbon dioxide are generally supersaturated with respect to the atmosphere, with an average of 3,300% atm as its partial pressure. (2) The Japanese river PCO<sub>2</sub> is mainly controlled by soil respiration, as far as we stand on a short term time scale. (3) Especially, Hokkaido, Kinki area, and the Kyushu area showed high partial pressure rates in average. (4) It is highly possible that alluvial plains, marsh areas, and volcanic areas is related to raising the PCO<sub>2</sub> rates of the river water. Further studies to confirm these results are expected.

Keywords: Carbon cycle, Japanese rivers, Land water, PCO<sub>2</sub>

## A pilot study based on ALOS/PALSAR for Hydrological monitoring of snowy highland Oze marsh

Natsuki Ito<sup>1</sup>, Yasuhiro Hisada<sup>1</sup>, shinichi sobue<sup>2</sup>, Yoshiko Ogawa<sup>1</sup>, Naru Hirata<sup>1</sup>, Hirohide Demura<sup>1\*</sup>

<sup>1</sup>The University of Aizu, <sup>2</sup>JAXA

We have not monitored hydrological environment of highland marsh with heavy snow, because the snow has prevented from our entering it in winter. One of the most famous highland marshes, Oze, has heavy snow more than 2 m in depth every year. We have analyzed data products of a kind of L-band radar, PALSAR/ALOS, from July in 2006 to April in 2011. This analysis showed existence of a water body under the snow. Although some researchers have reported the liquid water under the thick snow, this would be the first report for seasonal change of its distribution. Because we found a larger water body in midwinter season than that in snow-melt season, this water would be squeezed out from peat layers by the load of heavy snow, not melted snow.

Keywords: Oze, Hydrological Environment, PALSAR, Remote Sensing, Snow and Ice, peat

## Time Series Analysis to Determine the Aquifer Properties of a Fractured Aquifer

Wiki Li<sup>1\*</sup>, Chuen-Fa Ni<sup>1</sup>

<sup>1</sup>Graduate Institute of Applied Geology, National Central University, Taiwan

This study demonstrates a time series analyze method in the research well site near You-luo stream in Shinchu County, Taiwan. The rainfall, river stage, and well water table records from January 2010 to August 2012 were used for analyzing the aquifer properties, such as the hydraulic conductivity. Considering an aquifer nearby a stream, the input stress (far field rainfall) causes a rising of the water level in the stream. Wells with different distances from the stream will obtain the water table variations after the raising of water levels in the stream. The aquifer parameters can then be estimated by the time difference of the response between stream and the wells. This method were verified succeed with employed FEMWATER simulation model. Preliminary results show that the hydraulic conductivity in the well field is 2973 m/day. The scale effect may be the reason for the four times higher value than that in previous investigation.

Keywords: Time Series Analysis, Aquifer Properties, scale effect

## Simple estimation method of shallow groundwater level with groundwater aeration sound

Takayuki KAWAI<sup>1\*</sup>, TADA, Yasuyuki<sup>2</sup>, SHIOZAKI, Ichiro<sup>3</sup>, SAITO, Tadaomi<sup>4</sup>, MORII, Toshihiro<sup>5</sup>, SUZUKI, Tetsuya<sup>5</sup>

<sup>1</sup>Natural Hazards and Disaster Recovery Research Institute, Niigata University, <sup>2</sup>Forestry and Forest Products Research Institute, <sup>3</sup>Graduate School of Engineering, Tottori University, <sup>4</sup>Faculty of Agriculture, Tottori University, <sup>5</sup>Faculty of Agriculture, Niigata University

This study provides a new method of groundwater exploration using groundwater aeration sound and reports the results of observations in Tottori sand dune, Japan. The groundwater aeration sound (GAS) is that the aeration sound generated in the vicinity of the saturated / unsaturated boundary. We have developed a device that can collect this small sound from the ground surface. The device consists of an acceleration pickup, needle, amplifying system, and level meter with a filtering function. The total weight of the device is 0.9kg; it is highly portability and workability.

On the assumption that there is a relevance to GAS level and groundwater level, we conducted a survey using the existing wells in experimental natural dune. As the results, there is the logarithmic relationship between the GAS level and groundwater level. With this relational equation, we investigated the GAS survey to estimate continuous groundwater level in Tottori sand dune. As a result, we got a valid result on hydrogeology. From these results, the estimation accuracy of groundwater level by GAS was demonstrated.

Keywords: Groundwater aeration sound, Groundwater exploration, Shallow groundwater, Tottori sand dune

## Groundwater flow across divide in a headwater catchment underlain by sedimentary rocks

Yoshiei Horiuchi<sup>1\*</sup>, Maki Tsujimura<sup>2</sup>, Yuichi Onda<sup>2</sup>, Shimpei Kawaguchi<sup>1</sup>, Morihiko Wakabayashi<sup>3</sup>

<sup>1</sup>Grad. Sch. Life Env. Sci., Univ. Tsukuba, <sup>2</sup>Faculty, Life Env. Sci., Univ. Tsukuba, <sup>3</sup>Univ. Tsukuba

Spatial distribution of springs and streams were observed to estimate groundwater flow across divide between watersheds. A total of 10 springs and 12 streams in a head water catchment underlain by sandstone and chert, Karasawasan University Forest, Tokyo University of agriculture, Eastern Japan were monitored from May 2011 to 2013. Water level monitoring observed 6 spots of springs and streams. The samples were analyzed the solute concentration, CFCs and stable isotope.

The specific discharge of springs and streams was higher in the sandstone region than that in chert region in high-flow season. The quick flow ratio (defined by Hewlett and Hibbert, 1967) to the rainfall was higher in the sandstone basins than that in the chert basins, whereas the base flow rate during low-flow season was higher in the chert basins than that in the sandstone basins. The concentration of sodium and silica in springs and streams were higher in the sandstone basins than that in the chert basins. In addition The residence time was longer in the low-flow season than that in the high-flow season on sandstone basins.

The groundwater flow across divide between sandstone and chert basins are resulted by the reversing of hydraulic gradient .

Keywords: Headwater catchment, Sandstone, Chert, Specific discharge, Quick flow ratio, CFCs

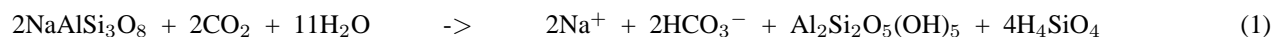
## Hydrochemistry of non-volcanic hot springs around the Kofu plutonic complex

YAGUCHI, Muga<sup>1\*</sup>, MURAMATSU, Yoichi<sup>2</sup>, CHIBA, Hitoshi<sup>3</sup>, OKUMURA, Fumiaki<sup>4</sup>, OHBA, Takeshi<sup>5</sup>, ANAZAWA, Katsuro<sup>1</sup>

<sup>1</sup>Gra.Shc.,The Univ.tokyo, <sup>2</sup>Fac.Sci.and Tech.,Tokyo Univ.Sci., <sup>3</sup>Fac.Sci.,Okayama Univ., <sup>4</sup>Japex, <sup>5</sup>Fac.Sci.,Tokai Univ.

Hot springs have great significance as local promotion and so on. A lot of hot springs have drilled in many parts of non-volcanic area in recent years, but most of the hydrochemistry of those hot springs are unclear. The purpose of this study is to explore the hydrochemistry of non-volcanic hot springs around the Kofu plutonic complex in Yamanashi prefecture. 13 samples of hot spring water were collected at 0-1500m depth to analyze major chemical components and isotopic compositions of oxygen, hydrogen and sulfur as sulfate anion.

Temperature measured onsite of water samples were from 18.8 degrees centigrade to 42.5 degrees centigrade, and pH values were from 7.3 to 10.2. Most of the sample waters were classified as Na-HCO<sub>3</sub> type (9 samples). The others were classified as Na-SO<sub>4</sub> type (3 samples), and Na-HCO<sub>3</sub>·SO<sub>4</sub>·Cl type (1 sample). Basic water quality of the hot spring waters in this area is the Na-HCO<sub>3</sub> type, and the relationships between Na<sup>+</sup> and the HCO<sub>3</sub><sup>-</sup> and the saturation index of sample waters for the kaolinite indicate that major chemical components were caused by the albite mineralization.



Constituent Granitoids of The Kofu plutonic complex were classified into magnetite-series and ilmenite-series granitoids based on magnetic susceptibility (e.g., Shimizu, 1986). Sample waters from magnetite-series area have positive delta <sup>34</sup>S values (1.7 to 10.0 per mill), while the water samples from ilmenite-series have negative values (-8.8 to -4.6 per mill). This tendency of heavy-light delta <sup>34</sup>S values of sample waters consist with that of the magnetite-series and ilmenite-series granitoids. These results suggest that the delta <sup>34</sup>S values of the water samples reflect the delta <sup>34</sup>S values of the granitic rock around the hot spring site.

Keywords: kofu plutonic complex, non-volcanic hot spring, chemical composition, genesis, recharge mechanisms, water-rock interaction

## Seasonal change in water chemistry of stream on Asama volcano

Nagayoshi Katsuta<sup>1\*</sup>, Mai Hattori<sup>1</sup>, Sayuri Naito<sup>1</sup>, Takuma Murakami<sup>2</sup>, Shin-ichi Kawakami<sup>1</sup>

<sup>1</sup>Faculty of Education, Gifu University, <sup>2</sup>Institute of Nature and Environmental Technology, Kanazawa University

There are many springs in the edifice and the surround area of Mt. Asama which is one of most active volcano in Japan islands. In the southern part of the crater, the laminated sediment was deposited in the river bottom. In order to elucidate the depositional process of the laminated sediment, we observe the water chemistry and the river bottom sediment component. In this session, we present the observation results and discuss the relationship of seasonal changes between water chemistry and sediment components.

Keywords: Asama volcano, stream, sediment, water chemistry, calcite



## Chemical structure of Lakes Nyos and Monoun, Cameroon

Takeshi Ohba<sup>1\*</sup>, Yuka Sasaki<sup>1</sup>, Minoru Kusakabe<sup>3</sup>, Yutaka Yoshida<sup>4</sup>, Akira Ueda<sup>3</sup>, Katsuro Anazawa<sup>5</sup>, Katsuya Kaneko<sup>6</sup>, Yasuo Miyabuchi<sup>7</sup>, Issa Issa<sup>1</sup>, F. Aka<sup>2</sup>, F. Wilson<sup>2</sup>, G. Tanyileke<sup>2</sup>, J.V.Hell<sup>2</sup>

<sup>1</sup>Tokai Univ, <sup>2</sup>IRGM, Cameroon, <sup>3</sup>Toyama Univ, <sup>4</sup>Yoshida Engineer Office, <sup>5</sup>Univ Tokyo, <sup>6</sup>Kyoto Univ, <sup>7</sup>Kumamoto Univ

The explosive discharge of CO<sub>2</sub> gas (limnic eruption) in the mid 1980s at Lakes Nyos and Monoun in Cameroon killed about 1800 people around the lakes. The driving force of the limnic eruptions was the CO<sub>2</sub> gas dissolved in the lake water. A good knowledge of lake water chemistry and an elucidation of lake stratification are therefore important ingredients in preventing future limnic eruptions.

Water was collected at Lakes Nyos and Monoun in 2011 and 2012. Dissolved total-CO<sub>2</sub> (CO<sub>2</sub>aq + HCO<sub>3</sub><sup>-</sup>) concentration was determined by volumetric titration. The temperature, pH and dissolved O<sub>2</sub> of lakes was measured in situ by use of CTD.

With the temperature and chemistry, Lake Nyos was roughly divided into 3 layers. In the first layer, shallower than -10m, the temperature reaches 25C due to solar radiation, while the temperature of the second layer (-10 to -70m) lies between 21.5 and 22C. In the third layer, deeper than -70m, the temperature increases gradually with depth, reaching 25C close to the bottom (-210m). Except for near surface water, dissolved species (total-CO<sub>2</sub>, Cl<sup>-</sup>, Br<sup>-</sup>, SO<sub>4</sub><sup>-</sup>, Na<sup>+</sup>, K<sup>+</sup> and Mg<sup>2+</sup>) show depth-concentration profiles that parallel those of temperature, except Fe and Mn, which were low in the first layer, and increased abruptly from -80m. The concentration of dissolved O<sub>2</sub> was higher than 2 mg/L in the first and second layers, and less than 0.3 mg/L in the third layer, showing the anoxic environment.

In Lake Monoun, the first layer shallower than -10m was heated to 25C by solar radiation. The temperature of second layer (-10 to -50m) was uniform (19.5 to 20C). In the third layer (-50 to -80m), the temperature increases gradually towards the bottom. In the fourth layer (-80 to -90m) the temperature was uniform (22C). In the fifth layer, deeper than -90m, the temperature increases gradually towards the bottom of the lake at -100m. Like for Lake Nyos, depth-concentration profiles of chemical species in Lake Monoun parallel those of temperature. The dissolved O<sub>2</sub> concentration was higher than 1 mg/L in the first layer and less than 0.2 mg/L in the layers deeper than -10m.

The CO<sub>3</sub><sup>-</sup> concentration can be thermochemically estimated based on the total-CO<sub>2</sub> and pH. The estimated concentration was multiplied with Fe concentration to make the product, Q (a<sub>Fe</sub>\*a<sub>CO3</sub>), which was compared with K, the solubility product of FeCO<sub>3</sub>. The water of Lake Nyos was estimated to be under-saturated in terms of FeCO<sub>3</sub> in the first and second layers but oversaturated in the third layer. In Lake Monoun, the water deeper than -30m was oversaturated thoroughly. In Lake Nyos, the deep water has been lifted up to surface by the degassing pipes and Fe(OH)<sub>3</sub> precipitate was generated, making the color of lake red after April 2011. The Fe(OH)<sub>3</sub> precipitate sinks to third layer then dissolved to be Fe<sup>2+</sup> ion due the anoxic condition. The increased Fe<sup>2+</sup> ion meets with the high carbonate ion, resulting in the condition of oversaturation in terms of FeCO<sub>3</sub>

Keywords: Lake water, Chemistry, Cameroon, CO<sub>2</sub>, Limnic eruption

## Characteristics and runoff responses of DOM during rainfall events in the Kumaki River in Noto Peninsula, Japan

Tomoyo Suzuki<sup>1\*</sup>, Seiya Nagao<sup>2</sup>, Masayoshi Yamamoto<sup>2</sup>, Koji Nakamura<sup>2</sup>

<sup>1</sup>Graduate school of Natural Sciences & Technology, Kanazawa University, <sup>2</sup>Institute of Nature and Environmental Technology, Kanazawa University

### Introduction

The management of SATOYAMA is important to sustain material cycle and ecosystem. Recently, SATOYAMA faces to degradation of ecosystem caused by the abandonment of forest and farmland and then influence chemical properties of water in soil and river. Humic substances being high-molecular organic acid is concerned with the coastal biological productivity. The change in SATOYAMA environments caused by deforestation and unmanagement of forests and paddy fields may reduce transport of organic matter from watershed to coastal area. Therefore, we need to elucidate the migration behavior of humic substances on a scale not only local, but also watershed. The purpose of this study was to elucidate the variation of structural properties, concentration and migration behavior of organic matter caused by abandonment of farmland and forest area. We also assess the impact of the abandonment to ecological system in river - coastal environment. This study investigated at the Kumaki River and Nanao Bay, which is located on the Noto Peninsula in Ishikawa Prefecture. The coastal biological productivity is high in the Noto Peninsula, and the abandonment of forest and farmland has been progressing. In this presentation, we report characteristics and runoff responses of humic substances in the Kumaki river waters collected during the rainfall events from 2009 to 2011.

### Study sites and Methods

River water samples were collected at Kumaki River during the rainfall events in 13 July 2009, 27-28 July 2009 and 7-8 July 2011. Water samples were filtered through GF/F filters and then filtered samples were kept under freezing until analysis for three-dimensional excitation emission matrix (3D EEM) spectroscopy and high-performance size exclusion chromatography (HPSEC). Precipitation and water level data was provided by Ishikawa Prefecture River Total Information System (Ishikawa Prefecture, Civil Engineering Division).

### Results and Discussions

Three rainfall events were different in variation of water level with amount and duration of rainfall. The humic-like materials concentration showed two to three times different values by the rainfall amount and water level. However the concentrations and characteristics of humic-like materials showed similar variations by the rainfall events as follows.

Humic-like peaks were detected at Excitation (Ex.) / Emission (Em.) wavelength of 300-340 / 430-465 nm for 3D EEM spectra in all river water samples. Relative fluorescence intensities (RFI) of humic-like peaks were high values with elevation of water level in the rainfall events, and decreased with downward water level after the rainfall. To understand characteristics of humic-like materials, the river water samples were analyzed by HPSEC with detection wavelength of Ex. / Em. of 320 / 430 nm corresponding to humic fluorescence peak. Three sharp peaks were detected among retention values ranged from 8.4 to 9.7 ml (Peak 1-Peak 3), and Peak 2 was highest peak intensity. Peak intensity of Peak 2 was highest with elevation of water level in rainfall event, and decreased with downward water level after the rainfall. These demonstrate that there is a large contribution of humic-like materials with higher-molecular weight runoff to river.

As compared fluorescence spectra of river water with the normal condition and rainfall events, humic-like peak was detected at higher wavelength in fluorescence spectra at the rainfall events. However in low water level after the rainfall, fluorescence spectra show similar features at normal condition. Moreover, peak height ratio of Peak 2 and 3 detected HPSEC was almost twice higher than that of normal condition. This result shows that runoff of humic-like materials with higher molecular weight occurred by the rainfall events. After the rainfall events, concentrations and molecular weight of humic-like materials decreased to those of the normal condition.

Keywords: Noto Peninsula, DOM, Humic substances, 3-D EEM spectroscopy, HPSEC, Rainfall event

## Catchment environmental changes inferred from reservoir sediment in northern area of Noto Peninsula

Shinya Ochiai<sup>1\*</sup>, Seiya Nagao<sup>1</sup>, YONEBAYASHI, Koyo<sup>2</sup>, FUKUYAMA, Taijiro<sup>3</sup>, YAMAMOTO, Masayoshi<sup>1</sup>, Kenji Kashiwaya<sup>1</sup>, NAKAMURA, Koji<sup>1</sup>

<sup>1</sup>Institute of Nature and Environmental Technology, Kanazawa University, <sup>2</sup>Faculty of Bioresources and Environmental Sciences, Ishikawa Prefectural University, <sup>3</sup>Faculty of Agriculture, Shinshu University

This study aims to reveal the sedimentation records and the transport processes of organic matter in the reservoir-catchment system in Noto Peninsula in the central Japan. This area confronts the catchment environmental changes (vegetation and land use changes, etc.) related to change in human activities (population decrease and ageing, etc.) expected to affect the material transport. In Nanao Area, the central part of Noto Peninsula, our previous study suggested that the discharge of organic matter from the catchment was influenced by the deforestation of broadleaf forest and the cedar plantation during 1970s. In this study, the reservoir with the different vegetation history was investigated.

Study site is a small reservoir Shin-ike located in the northern part of Noto peninsula. Surface sediment core (31 cm length) was collected from the reservoir using a HR type core sampler (Rigo, Japan) in October, 2009. The contents of total organic carbon (TOC) and total nitrogen (TN), carbon and nitrogen isotope ratios ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ), and grain size were analyzed for 1 cm interval. Vertical profiles of radionuclide activity concentration ( $^{210}\text{Pb}$  and  $^{137}\text{Cs}$ ) were also measured to estimate sedimentation rate and age of the core.

The present vegetation of the Shin-ike catchment mainly consists of broadleaf and pine tree forest. The cedar plantation is not significant in this site. The observation based on the aerial photos suggests that vegetation has developed and not disturbed since the small deforestation in 1960s.

The age of the core were estimated at about 90 years based on the  $^{210}\text{Pb}$  method. The  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  of organic matter were constant from 1920s to 1950s. They decreased with some fluctuations since 1950s and then the  $\delta^{15}\text{N}$  slightly increased since 1970s. These fluctuations may be attributed to the decreasing contribution of soil organic matter and the increasing contribution of plankton to reservoir sediment. These results suggest that the discharge of organic matter from the catchment has changed related to the vegetation development in the Shin-ike catchment since 1950s.

Keywords: reservoir sediment, organic matter, carbon and nitrogen isotope ratios, Noto Peninsula

## Transport and sedimentation of terrestrial particulate organic matter in Lake Akkeshi

Seiya Nagao<sup>1\*</sup>, SEKI, Osamu<sup>2</sup>, SUZUKI, Tomoyo<sup>3</sup>, OCHIAI, Shinya<sup>1</sup>, NISHIMURA, Shusaku<sup>1</sup>, KAMAUCHI, Hiromitsu<sup>4</sup>, TANAKA, Takayuki<sup>5</sup>, ARAMAKI, Takahumi<sup>6</sup>, YAMAMOTO, Masayoshi<sup>1</sup>

<sup>1</sup>LLRL, INET, Kanazawa University, <sup>2</sup>ILTS, Hokkaido University, <sup>3</sup>Grad. School of NST, Kanazawa University, <sup>4</sup>Akkeshi Mar. Station, Hokkaido University, <sup>5</sup>Japan Atomic Energy Research Institute, <sup>6</sup>National Inst. for Environmental Studies

The sources of organic matter in estuarine and coastal sediments and their distribution are important to the understanding of global biogeochemical cycles. In these transitional systems, primary production generates large amounts of organic matter of which a significant portion sinks through the water column. Therefore, these areas show the complex nature of organic matter in estuarine sediment. A variety of parameters ( $\delta^{13}\text{C}$ , C/N ratio, biomarkers) have been used to determine the sources of organic matter. The objective of this study is to elucidate the transport and sedimentation of terrestrial organic matter from a wetland region to coastal ocean using carbon isotopic signatures.

Field experiments were carried out at a small river, Bekanbeushi River, along a low moor in Bekanbeushi Moor, and a brackish lake, Lake Akkeshi located in eastern Hokkaido, Japan during 2004-2011. We collected suspended solids in river waters from the Bekanbeushi River and surface sediments in Lake Akkeshi. Stable carbon isotopic ratio of a sample and the VPDB standard used for normalization were made by analyzing a triple collector mass spectrometer with a precision of  $\pm 0.05$  permil as  $\delta^{13}\text{C}$  value. Radiocarbon was determined using accelerator mass spectrometry at the National Institute for Environmental Studies and the Japan Atomic Energy Agency. Radiocarbon values were reported as  $\Delta^{14}\text{C}$  corrected for sample  $\delta^{13}\text{C}$  with absolute error less than 10 permil.

Organic matter in riverine suspended solids shows almost constant: -29.1 permil to -28.7 permil for  $\delta^{13}\text{C}$  value. In contrast, the  $\Delta^{14}\text{C}$  value shows wide variations from -103 permil during snowmelt event to +9  $\pm$  16 permil during summer and winter. The river mouth sediments show wide variations in carbon isotopes. The  $\delta^{13}\text{C}$  value increases from -27.3 permil at the river mouth to -21.5 permil at off the mouth. On the other hand, the  $\Delta^{14}\text{C}$  value decreases with increasing the distance from the river mouth, ranging from -44 permil to -157 permil. The surface sediments in Lake Akkeshi show a small variation in  $\delta^{13}\text{C}$  value from -20.0 to -18.7 permil and  $\Delta^{14}\text{C}$  value from -168 to -139 permil. These results indicate that the sedimentation of particulate organic matter derived from wetland occurs at the restricted area near the river mouth. However, major part of terrestrial organic matter may be transported from Lake Akkeshi to Akkeshi Bay.

Keywords: river water, radiocarbon, suspended solids, coastal marine sediments, terrestrial organic matter, land-ocean interaction

## Development of a satellite land data assimilation system coupled with a numerical weather prediction model, WRF

RIE SETO<sup>1\*</sup>, KOIKE, Toshio<sup>1</sup>, RASMY, Mohamed<sup>1</sup>

<sup>1</sup>School of Engineering the University of Tokyo

A satellite Land Data Assimilation System (LDAS-WRF) was developed by coupling the Weather Research and Forecasting Model (WRF), as an atmospheric driver, to physically introduce the soil moisture observations and improve the representation of land surface and lower boundary conditions in Numerical Weather Prediction (NWP) online. The LDAS-WRF consists of Simple Biosphere model version 2 (SiB2) as a land surface driver and a model operator of the system, a radiative transfer model (RTM) as an observation operator, and Ensemble Kalman Filter (EnKF) as a sequential assimilation algorithm. The LDAS-WRF assimilates the soil moisture heterogeneity, using passive microwave brightness temperature at the lower frequency, which has a high sensitivity to soil moisture, and the RTM treats surface and volume scattering of surface soil layer.

The LDAS-WRF was applied to a mesoscale region in the Tibetan Plateau, where the land-atmosphere interactions affect the atmospheric dynamics considerably to evaluate the capability of the system. The experimental results show that the soil moisture and land surface energy fluxes obtained by the LDAS-WRF are successfully improved compared with no assimilation case. It was demonstrated that the LDAS-WRF has ability to apply satellite land observations to estimation of land conditions with high accuracy and provide more correct lower boundary condition to atmosphere in NWP.

Keywords: data assimilation, land-atmosphere interactions, satellite observations, WRF

## Spatiotemporal variability of dryness/wetness status in Japan

Rumi Takahashi<sup>1</sup>, Ayumi Kotani<sup>1\*</sup>

<sup>1</sup>Graduate School of Bioagricultural Sciences, Nagoya University

Spatiotemporal variability in dryness and wetness status over Japan from 1961 to 2010 was analysed using Palmer Drought Severity Index (PDSI), which was derived based on water balance model of two soil layer. Monthly value of PDSI was calculated with monthly mean air temperature and precipitation of 136 stations. During the analysis period, number of wet months decreased and that of dry months increased throughout Japan, while decrease of wet month was remarkable at northern area and distribution of dry area expanded. We employed Empirical Orthogonal Function (EOF) analysis to PDSI dataset, and obtained following results: the first EOF (EOF1) represented a dominant pattern of increasing dryness throughout Japan. Spatial contrast between the northern and southern area of eastern part of Japan was shown by EOF2, in which drying trend in northern area and wetting (suppressing drying) trend in southern area was clear. Spatial contrast between western and eastern part of Japan, which was shown by EOF3, was probably influenced by the variability of longitudinal distribution of the sea surface temperature.

## Bulk coefficients over a water surface under calm wind condition: an influence of large-scale atmospheric circulation?

Zhongwang Wei<sup>1\*</sup>, Michiaki Sugita<sup>1</sup>

<sup>1</sup>Geoscience, Life & Env Sci., Univ.Tsukuba

Over the Lake Kasumigaura, 10 Hz fluxes data have been obtained since June of 2007, and characteristics of the bulk transfer coefficients of momentum  $C_{dn}$  and of water vapor and heat have been studied with emphasis on the possible influence of the large-scale convection to surface fluxes. Increase of  $C_{dn}$  when mean wind speed  $u$  becomes smaller in the range of  $u < 4$  m/s was found. By applying the cospectral and ogive analyses, a possible cause of this increase was the influence of convective circulation, as manifested by the mismatch of characteristic time scale of the flux (2nd moment) and mean wind speed (1st moment). Possible solutions to this the mismatch of time scale under weak wind speed was studied which include adaptation of the effective wind speed  $U_e$  instead of the traditional vector-averaged mean wind speed. However, complete solution is not likely available since this problem arises from ill-defined nature of  $C_{dn}$  under light wind condition.

Keywords: Lake Kasumigaura, Bulk coefficients, ogive, large-scale convection, fluxes

## Estimation of infiltration rate in runoff plots for various surface covers and slopes under natural rainfall in Hebei an

Yoshitaka Komatsu<sup>1</sup>, Yuichi Onda<sup>1\*</sup>, Xianfang Song<sup>2</sup>, Zhu Bo<sup>2</sup>, Tao Wang<sup>2</sup>, Lihu Yang<sup>2</sup>

<sup>1</sup>University of Tsukuba, <sup>2</sup>Chinese Academy of Sciences

We are investigating the effect of surface cover and slope on the infiltration rate in runoff plots in two provinces of China, namely; Hebei and Sichuan Provinces. Temporal rainfall measurements and discharge of runoff plots were conducted for different surface cover and slopes during the rainy season from July to October 2012. Four land uses (bare soil, forest and two grasslands) were investigated in Yi Xian with 5m \* 20m plots. On the other hand, in Yan Ting Xian, we monitored four plots of 1.5m \* 5m with various slopes (15, 20, 25, 30 degrees) and three plots of 5m \* 20m with maize and bare soil. In order to understand the variability of the infiltration rate, the collected data was analyzed in the light of a model that integrates the spatial infiltration variabilities within a plot. The relationship between rainfall intensity and infiltration rate have been developed in previous study using rainfall simulations for similar land uses which demonstrated that the infiltration rate increases with the rainfall intensity and gradually takes an asymptotic approach to the Maximum Infiltration Rate ( $FIR_{max}$ ). The effect of different slope range and various land covers will be analyzed so as to draw a profound conclusion. The infiltration rate tends to have a certain relationship between land cover and slope in runoff plots in two provinces of China.

Keywords: Infiltration rate, Natural rainfall, Runoff plot, Slope, Surface cover



## Changes in throughfall and its stable isotopic compositions after stripe thinning in a Japanese cypress plantation

Akiko Hirata<sup>1\*</sup>, ONDA, Yuichi<sup>2</sup>, KATO, Hiroaki<sup>2</sup>, NANKO, Kazuki<sup>3</sup>, GOMI, Takashi<sup>4</sup>

<sup>1</sup>Faculty of Life and Environmental Sciences, University of Tsukuba, <sup>2</sup>Center for Research in Isotopes and Environmental Dynamics, University of Tsukuba, <sup>3</sup>Forestry and Forest Products Research Institute, <sup>4</sup>Tokyo University of Agriculture and Technology

We investigated changes in throughfall and its isotopic composition due to forest thinning for examining changes in canopy interception processes. For one headwater catchment in a Tochigi site which covered by 20 to 50 years old Japanese cypress and cedar plantations, 50% line strip cutting methods were conducted at December 2011 for the efficiency of timber use. Monitoring periods were from May 2010 to October 2012. Throughfall was measured and collected using twenty tipping bucket rain gauges and collectors in a 10 by 10 m area with a grid pattern. Using the relationship between cumulative gross rainfall and cumulative throughfall (Link et al. 2004), throughfall was separated into two components, direct throughfall and drains from the canopy. The isotopic composition of throughfall and open rainfall were analyzed and compared for each rainfall event. After the thinning, amount of throughfall and direct throughfall were increased. The mean difference of  $d^{18}\text{O}$  values between throughfall and open rainfall during the post-thinning periods was larger than that during pre-thinning periods; however, the difference of these values was small. Spatial variability of the throughfall rate and the  $d^{18}\text{O}$  values in throughfall were affected by canopy structure only during post-thinning periods. Changing in forest structure by thinning affect interception processes in plantations.

Keywords: canopy interception, stable isotope, stripe thinning, Japanese cypress plantation

## The geochemical analysis about formation of groundwater in Aso caldera, Japan

Minoru Takahashi<sup>1\*</sup>, Jun-ichiro Ishibashi<sup>2</sup>, Hiroshi Naraoka<sup>2</sup>

<sup>1</sup>Graduate School of Sciences, Kyushu University, <sup>2</sup>Faculty of Sciences, Kyushu University

Aso caldera is known as rich in groundwaters. Among them, it is notable wide distribution of Fe-rich groundwater (called as Akamizu) in the western part of Aso-dani (north floor of the Aso caldera). In order to reveal relationship between the Fe-rich groundwater (Akamizu) and hot spring waters which are pumped up from aquifers in deeper depth, we studied their chemical composition.

Hot spring waters were collected from 8 sites (depth: 150 m, 400 m~1500 m) in October 2012. Temperature, pH, electric conductivity (EC) and oxidation-reduction potential (ORP) were measured *in situ*. Cations ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ , total Fe) were analyzed with ICP-AES and  $\text{Rb}^+$ ,  $\text{Cs}^+$ ,  $\text{La}^{2+}$  were analyzed with ICP-MS. Si was analyzed by colorimetry. Anions ( $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ ) were analyzed by Ion Chromatography. Alkalinity was determined by acid titration. Sulfur isotopic composition of dissolved  $\text{SO}_4^{2-}$  was measured by IR-MS.

Concentrations of major cation showed positive correlation with  $\text{Cl}^-$  concentration, although total Fe did not show clear relationship. Trace elements,  $\text{Rb}^+$  showed positive correlation with  $\text{Cl}^-$  concentration, but concentrations of  $\text{Cs}^+$  and  $\text{La}^{2+}$  are lower than detection limit.  $\delta\text{-}^{34}\text{S}$  values showed a range of from +13.4 per-mill to +16.0 per-mill, which showed local difference tend to increasing from the east to the west.

Relationship among concentrations of dissolved ions and  $\delta\text{-}^{34}\text{S}$  values in the hot spring waters are well explained by mixing between two or three end-members, one of which could be considered as a geothermal fluid. Moreover, chemical composition of Fe-rich groundwater (Akamizu) is explained by the same end-members, which suggests contribution from the geothermal fluid.

Keywords: Aso, hot spring, groundwater, isotope

## On the underground water flow circulation system in Tottori sand dune based on the geoelectrical method

Ichiro Shiozaki<sup>1\*</sup>, Yuya Nishio<sup>2</sup>, Yojiro Yasuda<sup>1</sup>, Tatsuya Noguchi<sup>1</sup>, Takayuki KAWAI<sup>3</sup>, Tadaomi Saito<sup>4</sup>

<sup>1</sup>Graduate School of Engineering, Tottori University, <sup>2</sup>Graduate School of Landscape Design and Management, University of Hyogo, <sup>3</sup>Research Institute for Natural Hazards and Disaster Recovery, Niigata University, <sup>4</sup>Faculty of Agriculture, Tottori University

The purpose of this study is to clarify and construct the underground water circulation system beneath whole Tottori sand dune symbolized by the generation mechanism of oasis in the sand dune having a high natural cultural value, through the investigation research based on the geoelectrical method.

Tottori sand dune is positioned in the Sanin Kaigan National Park. A good condition of the natural coast can be preserved and the information of a wide variety of natural phenomena such as the interaction of wind and sand and the history of special topography formation has been accumulated since long ago, there. A small spring area called oasis naturally formed in the sand dune is seen as one of valuable natural phenomena in Tottori sand dune. This oasis is positioned right under a big slope called Umanose and plays an important role as a landscape factor forming the natural scenery of Tottori sand dune.

What is the carrier of underground water such as oasis spring? Referring to the Tottori sand dune columnar section shown by Akagi (1991), in Tottori sand dune, a volcanic ash layer, including Daisen-Kurayoshi pumice originating from Daisen volcano, exists above the bedrock as a key bed and the sand dune is separated into two parts by this layer as a border, the upper part of New sand dune and the lower part of old sand dune. In the volcanic ash layer, an impermeable layer that water can hardly penetrate, consisting of clayey volcanic ash soil, clayey loam and clayey soil, and a permeable layer consisting of pumice are found. In this paper, as a candidate, the volcanic ash layer can be assumed as an impermeable layer an aquifer. If the underground water surface were formed by such mechanism, a linear relation between the difference of self potential measured on the two points in the sand dune and the layer thickness from the surface to the underground water level on the two points should be expected from the observation values.

In this study, a Self Potential (SP) measurement was implemented in the whole Tottori sand dune including the oasis spring area and the volcanic ash exposing area to attain the study purpose. The SP measurement result generally shows that the SP in a high altitude area becomes low and that in a low altitude area becomes high. As mentioned above, it is known that such a relation is found when an electrokinetic phenomenon (streaming potential) caused by underground water flow with undulations of topography is observed. In the sand dune, the same measurement result was obtained. Examined the relation between SP (mV) and altitude (m), a clear correlation having a streaming potential coefficient that appears to be -3mV/m was found. However, it was found there was a big difference in the coefficient between around the volcanic ash exposing area, especially the area where volcanic ash is expected to exist beneath, and the area where it is not expected.

Assuming the predicted result mentioned above could be effective, the underground water level in the sand dune area was estimated by using the SP measurement result. The equation (14) of Zlotnicki and Nishida(2003) was used as the one to find the underground water level. In the sand dune area, as a few academic borings have been done so far, the validity of the estimated result in this study was examined by using the data in the past borings. Examined and compared the results about the four points near the measurement points where the borings were done, the both was found to almost accord. We would like to discuss about the effectiveness of the SP method applied to the underground water distribution investigation under Tottori sand dune by comparing with the resistivity structure obtained from other methods such as an electrical investigation, hereafter.

Keywords: Tottori sand dune, underground water, geoelectrical method

## Mechanism of occurrence of "Ikenotaira"-pond appear from time to time in the Misakubo town, Shizuoka Prefecture

TAKAHASHI, Yukaya<sup>1\*</sup>, KONO, Tadashi<sup>2</sup>

<sup>1</sup>Graduate School of Geo-environmental Science,Rissho University, <sup>2</sup>Faculty of Geo-environmental Science,Rissho University

### 1.Introduction

There is a pond told to appear in a cycle of about seven years in the basin located in 654m above sea level of Misakubo Town, Hamamatsu City, Shizuoka Prefecture.

It is a basin without water usually and covered with artificial plantations, such as a Japan cedar and a cypress.

It is a lot of rain checked before the pond appear.

Sugimori (2001) etc. reported geological features and rain influence the groundwater level and appear pond.

Moreover, although it hands down that it had appeared 400 years or more before, it is not known that it is detailed.

The reason for clear generating conditions or mechanism not being solved but appearing periodically now, still now of this pond is also still unknown.

In this study, it aimed at solving an appearance mechanism based on the natural conditions of precipitation or a spot.

This time, we report the result of having performed the lake basin survey in the field and the water quality analysis in July and December,2012.

### 2. Research Region

Ikenotaira pond is in the basin of the place which went down about 200m the Mt.Kamenoko peak in Oryoke, Misakubo Town.

The path has been in the state near ruin road since the Sakuma Dam was constructed.

The path has many collapsed parts and it can observe that the whole mountain is a landslide place.

### 3. Investigation / Research Technique

We ran the basin survey, geological features survey using soil auger, sampled the spring water and stream water.

We measured electrical conductivity, ORP, pH, and water temperature there.

We run ingredients of inorganic ion analysis of brought sampling and the pond water using ion chromatography.

### 4. Result and Consideration

As a result of the lake basin survey near the 654 m above sea level and showing a depth contour, the maximum length of this pond is 130m, the maximum breadth of 50m, the circumferences is 130m, the area is 4325m<sup>2</sup>, and the capacity is 11375m<sup>3</sup>.

As a result of water quality analysis, the sample(2010) became clear that same as rain because each mass of dissolved ingredients are poor.

It compares the sampling go down 100m from the water quality analysis of pond and the sampling(2010), showed that each mass of dissolved ingredients are higher and especially the value of Ca<sup>+</sup> is 6.73ml/g.

### 5. Future task

We constructed the automatic water level gauge in basin and rainwater sampler and tipping bucket rain gauge in Misakubo Town Hall for the occurrence mechanism elucidation.

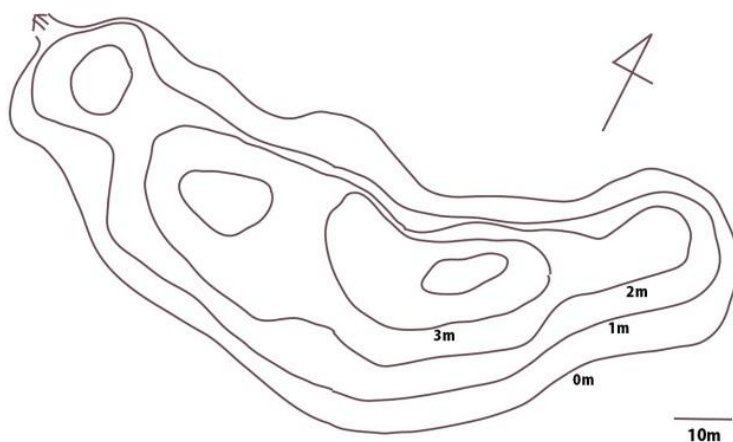
It is a plan to estimate the cultivation source using technique of the isotope hydrology.

Keywords: Ikenotaira, lake basin, water quality, hydrology

AHW29-P08

Room:Convention Hall

Time:May 23 18:15-19:30



## A Method for Creating Inland Flooding Hazard Map Based on Topographical and Geographical Characteristics

Rina Sato<sup>1\*</sup>, Takeshi Hayashi<sup>2</sup>

<sup>1</sup>Graduate School of Education, Akita University, <sup>2</sup>Faculty of Education and Human Studies, Akita University

In Tokyo Metropolis, especially in wards district, inland flooding has caused much damage. Recently, many local-scale floods have been induced repetitively by torrential downpours. Thus, we focused on topographical and geographical characteristics of the flooded areas. In this study, we analyzed topographical and geographical characteristics of flooded areas in Shinjuku, Toshima and Bunkyo wards and made a simple hazard map based on this analysis. In these wards, inland flooding has occurred frequently and repeatedly in recent years.

According to the records of flooding that were compiled by Tokyo Metropolitan Government, there were 107 inundations between 1989 and 2009 in the study area. We classified these flooded areas into three groups: lowland type, upland type and valley on upland type, and extracted topographical and geographical parameters: depression depth, depression volume, catchment area, land coverage of catchment area, mean slope of catchment, mean slope from a flooded area to a discharge point of catchment, difference between these two slopes, length from upper most of catchment to a flooded area, length from a flooded area to a discharge point of catchment, difference between these two lengths, valley depth, valley width, of the flooded areas by using ArcGIS 10. These parameters were examined by principal component analysis (PCA) to evaluate topographical and geographical characteristics of the flooded areas.

The result of PCA gave two major components in lowland type, three major components in upland type and four major components in valley on upland type. We calculated these PCA scores in the whole study area. Then, we extracted the area that each PCA score was higher than the lowest score of the flooded areas and the total of all PCA scores was higher than the lowest ones of the flooded areas as the one that has risk of inside water inundation.

Risk map was made from this extracted area. We classified the area that has risk of inland flooding into two classes: very strong type and strong type. Very strong type is the area that at least one PCA score is ranked in the top 50%. Strong type is the area that all PCA scores are not ranked in the top 50%.

Keywords: inland flooding, urban area, topographical and geographical characteristics, principal component analysis, hazard map

## Properties of humic acid fraction of northern Ariake Sea estuarine and riverine surface sediment

IWAMOTO, Yuya<sup>1</sup>, Noriaki YAMAUCHI<sup>2\*</sup>

<sup>1</sup>Dept. Earth and Planetari Sci., Grad. School Sci., Kyushu Univ., <sup>2</sup>Dept. Earth and Planetari Sci., Fac. Sci., Kyushu Univ.

Estuarine field has high bioproductivity, and is important for many living organism to spawn and spend a larval stage of life. Riverine and terrigenous organic material are precipitated and accumulated at the estuarine field. Further, coastal marine organic materials and the organic molecules produced by the estuarine living organism are added to form higher molecular organic material such as humic-like substances. However, the knowledge for the structural feature of the estuarine humic substances is not enough because of high complexity of the organic molecule and the relation of sedimentation rate and higher molecular organic material formation at the field.

We have investigated to the structural feature of humic acid fraction of the sedimental organic material at the surface sediment of northern part of Ariake Sea estuarine field. Now, it is summarized the fundamental characteristics of the structural feature of humic acid Chikago River downstream and corresponding estuarine field. A certain relationships were observed between the several fundamental analytical data of organic material and environmental factor about the estimation of the contribution of terrigenous organics, formation of higher organic material from the terrigenous organics, and several environmental factors.

Samples were obtained at the surface (~ 5 cm) sediment of estuarine field (3 stations) and downstream field (2 stations) at and around the Chikugo River at May, August, and November 2012. The sediments were dried and humic acid fraction was extracted and fractionated along with the method for the terrestrial humic acid extraction protocol. Elemental analysis and molecular ratio estimation (O/C, H/C, C/N) from the analytical data, UV absorption spectra and the ratio of the two characteristic UV- visible absorbance (270 and 407 nm, ( $A_2/A_4$ )), carbon and nitrogen isotope ratio was measured. And the relation of the data and the several geographical and environmental factors such as distance from the river mouse, the formation of high-molecular organic material such as humic acid with the counterclockwise ocean current were investigated.

The C/N ratio and carbon isotope ratio is well-known indicator of the contribution of terrigenous organic material at temperate zone. Our data also shows the similar trend for the distance from the river mouse and changes of the two data and good correlation were observed. Further, the ratio of the UV-visible absorbance ( $A_2/A_4$  ratio) and C/N ratio, carbon isotope ratio show a similar trend about the influence of terrigenous compound and good correlation to the change of values of the three. It indicates the  $A_2/A_4$  ratio is alternative for the estimation of contribution of terrigenous organics at a certain river and river-mouse estuarine system.

In July 14th 2012, northern Kyushu field hit by a massive flood and heavy damages around the Chikugo River basin were occurred. At the samples from August 2012, increasing of terrestrial organic were observed for several data. The surface sediment of the system may be influenced by such an accidental event. The results also suggest that organic portion of the organic material deposited in terrestrial estuaries are those that have been caused by higher huminification.

Pyrolysis gas chromatography of the degradation products will be conducted to the precise structural analysis of their extracted humic acid. Also, we will continue the collection of the samples and extraction in February 2013, and seasonal changes observation will be reported at the presentation.

Keywords: humic acid, estuarine, Ariake Sea, carbon isotope, UV absorption

## Effect of Carbide on Adsorption of Dissolved Organic Matter Contained in Under Drainage of Reclaimed Land

Tadayoshi Hitomi<sup>1\*</sup>, Tomijiro Kubota<sup>1</sup>, Koji Hamada<sup>1</sup>

<sup>1</sup>National Institute for Rural Engineering, National Agriculture and Food Research Organization

The object of this study was to examine the effect of carbide on adsorption of dissolved organic matter contained in under drainage of reclaimed land. From the batch test, the carbide adsorbed the dissolved organic matter quickly, and then reached the equilibrium state in a few hours. On the other hand, the adsorption effect could not be observed in the chaff and sand, which are generally used as a filter material for under drain. These results described above suggest that we couldn't get much effect of the under drain constructed generally on removing dissolved organic matter discharged from the under drain of the reclaimed land. Concentration of the total organic carbon in the under drainage of reclaimed land was 10.1 mg/L on average, and dissolved organic matter comprised 97% of the total. Application of the carbide which has a strong effect on the adsorption to purifying materials is considered to be an effective measure for water conservation.

Keywords: batch test, total organic carbon, water conservation measure



## Characterization of dissolved organic matter using FT-ICR MS and fluorescence spectrometry in a Japanese cypress forest

Mina Moritani<sup>1\*</sup>, OHASHI, Mizue<sup>1</sup>, TAKAHASHI, Katsutoshi<sup>2</sup>, HARA, Miyako<sup>1</sup>, OHTE, Nobuhito<sup>3</sup>, FUJITAKE, Nobuhide<sup>4</sup>, YAMASE, Keitarou<sup>5</sup>, NAKATA, Yasushi<sup>6</sup>, KUMAGAI, Tetsu<sup>1</sup>, SUGIYAMA, Yuko<sup>1</sup>

<sup>1</sup>Graduate school of Human science and Environment, University of Hyogo, <sup>2</sup>National Institute of Advanced Industrial Science and Technology, <sup>3</sup>Graduate school of Agricultural and Life science, University of Tokyo, <sup>4</sup>Faculty of Agriculture, Kobe University, <sup>5</sup>Hyogo Prefectural Technology Center for Agriculture Forestry and Fisheries, <sup>6</sup>HORIBA, Ltd

In forest ecosystem, DOM plays important roles such as: being a main energy source of microorganisms which control material cycles in the pedosphere; making complex with iron, aluminum, other trace metals, or organic pollutants and affects their mobility or toxicity in the hydrosphere. Thus, DOM is one of the important materials for water quality. In Japan, forest covers about 70% of the land and stores large amount of freshwater supporting human life. Forest also stabilizes the freshwater supply to river and controls the water quality. Therefore, it is important to study the chemical characteristics of DOM and its alteration processes in forest ecosystem. Recently, Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) was developed and applied to molecular-level study of DOM. FT-ICR MS has quite high resolution power and makes it possible to calculate the molecular formula from the charge to mass ratio ( $m/z$ ) of the peaks detected. We further can estimate the molecular class of the each peak from its elemental ratio of O/C and H/C. The objective of this study was to apply FT-ICR MS to the DOM in a cypress forest ecosystem and try to elucidate the cycling of DOM and alteration processes in the ecosystem. Samples were collected from Shiso, Hyogo-pref., Japan in July 2011. Main vegetation of the experimental field was 50 years' Hinoki cypress (*Chamaecyparis obtusa*) and the soil type was Andosol. We collected rainfall, throughfall, stem flow, soil waters (middle of A-horizon: 10 cm, bottom of A-horizon:25 cm, middle of B-horizon: 40 cm, bottom of B-horizon: 60 cm), and stream waters. All samples were filtered by precombusted GF/F filters. The filtrated samples were subjected to dissolved organic carbon (DOC) measurement and three dimensional excitation-emission matrix fluorescence spectroscopy analysis. After C18 solid phase extraction, FT-ICR MS analysis was applied. We calculated the expected molecular formula for  $m/z$  values of the peaks and made the van Krevelen diagrams by plotting the atomic ratios of H/C and O/C of the formula. In rainfall samples, low DOC concentration (1.3 mgC/L) and no clear fluorescence peak were observed. Both of these increased at throughfall (13.0 mgC/L), stem flow (31.7 mgC/L) and middle of A horizon (28.7 mgC/L). Both DOC concentration and humic-like peak intensity decreased greatly from the middle to bottom of A horizon (2.5 mgC/L). The active aluminum in A horizon consists of Andosol likely adsorbed DOM especially humic substances and removed it from the soil water. From the van Krevelen diagrams, especially in throughfall, stemflow, and soil water samples, great number of mass peaks appeared in the lignin region ( $0.7 < H/C < 1.5$ ,  $0.1 < O/C < 0.67$ ) with high relative intensities. The number of mass peaks which corresponded to the protein region ( $1.5 < H/C$ ,  $0.3 < O/C < 0.67$ ) decreased as the water percolated deeper through the soil. Polar molecules with high O/C ratios might be decomposed more rapidly or removed preferentially by adsorption. In contrast, mass peaks in the lignin and the lipid regions ( $1.5 < H/C$ ,  $0.1 < O/C < 0.3$ ) remained even in deeper B horizon soil water.

Keywords: Dissolved organic matter, Forest ecosystem