Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AHW29-01 Room:101A Time:May 21 09:00-09:15

Development of a cloud classification method by using satellite-observed brightness temperature

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Recently, there are some extreme meteorological phenomena such as heavy rain and drought all over the world. One of the extreme phenomena is 2011 Thailand floods which is used as the background of this study. There are some factors influencing the 2011 Thailand floods that are related to dynamic hydrological circulation and land-atmosphere-ocean system. To figure out the extreme phenomena such as heavy rain, the precipitation data is needed. However, there is a considerable shortage of meteorological stations in developing country and there is no precipitation forecasting models which work accurate enough both spatially and temporally. This is the reason why we need remote sensing observation that can comprehend rainfall data shortage. The reappearance of dynamic hydrological circulation is important for the resolution of extreme phenomena but -ship-observation is intermissive and it only cover some parts of the world. In general, cumulonimbus causes heavy intensity of rainfall. The convection cools down the moisture which remain lower layer and it becomes convective cloud. Furthermore, heavy rainfall is related to the cloud type distribution. This study is suggesting the cloud classification method which uses the infra-red data from remote sensing satellites. In this study we utilize meteorological satellite which is well known as Multi-functional Transport Satellite (MTSAT). The area of observation is from 80.02 degrees of east longitude to 160.02 degrees of west longitude and is from 59.98 degrees of north latitude to 59.98 degrees of south latitude. The MTSAT data as well as their calibration coefficient are downloaded from the database of Kochi University. MTSAT data has 4-5km spatial resolution and 1 hourly temporal resolution. When compared with the existing cloud classification method such as International Satellite Cloud Climatology Project (ISCCP), which has 200 to 300 km spatial resolution, and 3 hour temporal resolution. MTSAT has advantage for providing cloud type information in higher resolution. The method of analysis is by performing cloud type classification based on 10.8 micro-meter Infra-red (IR1) and 12 micro-meter Infra-red (IR2). The IR1 and IR2 are sometimes called split window and these are well known that they have different absorbing characteristics for water and ice particle. There are 6 cloud types used in the cloud classification, namely Cumulonimbus (Cb), Mature Cumulonimbus (MCb), Thick Cirrus (TkCi), Thin Cirrus (TiCi), Middle level cloud (MC) and Low level cloud (LC). We compared those of cloud type data with rainfall intensity derived from Tropical Rainfall Measuring Mission (TRMM) information. Result shows that Cb corresponds with high rainfall intensity over Bangkok in Thailand during flooding periods. We also perform the same analysis over larger coverage and time duration. The trend of heavy rainfall is also found not only in Southeast Asia but also in more global scale.

Keywords: cloud classification method, MTSAT, cumulonimbus

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AHW29-02 Room:101A Time:May 21 09:15-09:30

Eddy correlation approach to determine evapotranspiration in three crop fields with different irrigation methods

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Three fields covered with maize within the Nile delta were the target of the study. In 2010 summer, two fields emploied conventional fallow irrigation while one uses drip irrigation method. Also one of the conventional fileds was covered with mulching. In 2011 summer, one field emploied conventional fallow irrigation, one drip irrigation method, and last one newly developed narrow ditch irrigation. At three fields, an eddy correlation system with relevant meteorological, hydrological and vegetation measurements has been operation. Also made were two intensive measurements in the summer of 2010, 2011, in which various data were obtained in order to allow model application to separate evapotranspiration into transpiration and soil evaporation during growing season of maize.

As a result of the measurement, annual evapotranspiration was found to be in the range of 649-983mm, and the amount of evapotranspiration during summer growing season accounted for 43-48% of the annual totals. They are about the same among fields with different irrigation methods. Some results derived from the model analysis will also be presented.

Keywords: evapotranspiration, eddy correlation method, Maize, Nile Delta, irrigation, Force Restore method

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AHW29-03 Room:101A Time:May 21 09:30-09:45

Seasonal change of Casuarina sap flow and its use for windbreak trees to reduce evapotranspiration in the Nile-delta.

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Windbreak trees could reduce evaporation in an agricultural land. However, an evaluation of the effect needs also estimation of windbreak trees' transpiration. For that purpose, transpiration of windbreak trees, Casuarina, has been estimated continuously since the summer in 2011 by means of Granier method. As a result, sap flow was found to have a distinct seasonal change, and transpiration has similar seasonal change, too. Based on these results, transpiration in arbitrary period could be estimated by Penman-Monteith equation by setting a canopy resistance. From estimation of annual evapotranspiration reduction by windbreak trees, windbreak trees which have 50% porosity could reduce around 40% of annual evapotranspiration. Furthermore, transpiration of windbreak tree occupies only 10%.

Keywords: Windbreak tree, Casuarina, Transpiration, Evaporation decrement

Japan Geoscience Union Meeting 2012
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AHW29-04 Room:101A Time:May 21 09:45-10:00

An estimation of soil moisture conditions using thermal inertia and its application

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Thermal inertia is a parameter of thermal physics which is the square root of the product of volumetric heat capacity and thermal conductivity. Both volumetric heat capacity and thermal conductivity of soil increase as the soil moisture increases. Hence, thermal inertia is also a function of soil moisture. One can estimate soil moisture employing thermal inertia due to this physical character. On the other hand, thermal inertia is a parameter of the force-restore method which can estimate land surface temperature. Hence, thermal inertia can be theoretically retrieved from the force-restore method incorporating land surface temperatures. From the above discussion, subsurface soil moisture conditions can be estimated using satellite data of land surface temperature over a wide area. In this presentation, Methods and potential of the thermal inertia method for estimating soil moisture conditions are demonstrated. Some potential applications of the thermal inertia method, which are estimating conditions of dust emission and a downscaling method of soil moisture estimates by satellite microwave radiometers, are also shown.

Keywords: thermal inertia, soil moisture, regional estimation, dust emission, downscaling

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AHW29-05 Room:101A Time:May 21 10:45-11:00

Spatial and temporal variation of spring water in a headwater catchment underlain by sedimentary rock

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Spatial and temporal distribution of spring water in quantity and quality was observed to investigate the groundwater flow beyond topographical watereshed. A total of 10 springs were monitored in a small headwater catchment underlain by sedimentary rock, Karasawasan University Forest, Tokyo University of Agriculture and Technology, Tochigi prefecture, Eastern Japan in May, early in August, late in August, October 2011. Also, the residence time for all water samples were estimated by dissolved CFCs concentration in the samples. The water chemistry shows a different characteristic between sandstone and chert areas, and the estimated residence times of the spring water ranged from 7 to 20 years.

Keywords: spring water, sedimentary rock, residence time, groundwater flow

Japan Geoscience Union Meeting 2012
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AHW29-06 Room:101A Time:May 21 11:00-11:15

Clarification of Nutrient Transport in Rapid Flow River by Nitrogen Isotopes Ratio

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Aquatic plants need many types of nutrients for growth, including nitrogen, phosphorus, and silica. A significant proportion of silicate, nitrate and phosphate in the river systems are derived mainly from anthropogenic. The purpose of this work is the determination of nutrients sources in the rivers water.

Total of 18 sites were selected from three rivers. From November 2009 to October 2011, total of 200 samples were collected from three rivers. Water samples were collected in new polyethylene bottles, which were rinsed in water three times prior to sample collection sealed cork. The physical parameters of water samples were measured in the field for temperature, pH and electrical conductivity. Major ions (Na, K, Ca, Mg, Cl, SO4, and NO3) were analyzed by ion chromatography. Alkalinity was determined by titration with HCl (0.01N). Ionic balance was computed for each sample and all samples exhibited imbalances lower than 5%. Silica was determined by the molybdenum-yellow method. A mass spectrometer was used for O and H isotope analysis of water samples. Analytical accuracy of plus minus 0.1 permil for delta18O and 1.0 for delta D.

Rivers water was characterized by Ca-HCO3, Na-SO4 and Na-Cl type. Water isotopes compositions were compared with the local meteoric water lines. All samples were plotted between local meteoric water lines. d-excess values data indicates rivers were recharge by spring season precipitation, but Kado and Katagai rivers recharge rate was slower than Hayatsuku river. Due to slow recharge rate, sources of recharge water mixed with other season of precipitation. Recharge areas were calculated to trace the sources of water.

NO3- concentrations were not varied with seasons in Hayatsuki, but Kado and Katagai rivers showed variation in NO3- concentrations, especially in the downstream. To trace the sources of NO3-, nitrogen isotope (15N) was measured. Nitrogen isotope (15N) did not show seasonal variation whereas Kado and Katagai rivers showed variation especially in the downstream in the same manner as NO3-. 15N values suggested that source of NO3- from forest. The amount of NO3- fluxing through Hayatsuki, Katagai, and Kado into Toyama bay are 1.6 x 10 3 t/yr, 1.7 x 10 3 t/yr and 0.5 x 10 3 t/yr, respectively. The total amount of NO3- from these rivers is approximately 25% of the entire rivers discharging into Toyama bay.

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AHW29-07 Room:101A Time:May 21 11:15-11:30

Characteristics and behavior of dissolved organic matter in the Kumaki River in Noto Peninsula, Japan

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[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 from 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 in progressing. In this presentation, we report seasonal dynamics of humic substances in Kumaki river waters collected on the rainless days in during the period from June 2009 to May 2010.

[Study sites and Methods]

Water and sediment samples were collected from river, paddy and drainage at Kumaki River, Hiyou River and Ninomiya River during the period from June 2009 to November 2011. We also collected water and sediment samples at the western part of Nanao Bay in August 2011. Water samples were filtered through GF/F filter and kept under freezing until analysis. To reveal the structural properties and concentration of dissolved organic matter (DOM), river water samples were measured by 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]

Humic-like peaks were detected at Excitation / Emission: 300-340 / 430-465 nm for 3D EEM spectra in all river water samples. Relative fluorescence intensities (RFI) of humic-like peaks increase downward from upstream to downstream. This is considered that humic-like materials flowing into the river between midstream and downstream. The peak position of the highest RFI of four humic-like peaks (Peak H1-H4) was different from upstream and downstream. Whereas upstream and midstream river waters has a higher RFI of Peak H1, but downstream river water has a higher RFI of Peak H2.

Moreover, to understand characteristics of humic-like materials, the river water samples were analyzed by HPSEC with detection wavelength of Ex. / Em.: 320 / 430 nm corresponding to humic fluorescence peak. Three sharp peaks were detected among retention time 8.5 - 10.5 minutes (Peak 1-Peak 3), and Peak 2 was highest peak intensity. Intensity ratio of Peak 1 and Peak 2 was lower in midstream and downstream than upstream. The low peak intensity ratio shows the contribution of low-molecular fraction. This is considered that low-molecular materials are supplied from paddy fields expending from midstream to downstream watershed. These results indicate that humic-like materials are loaded from midstream and downstream have different properties.

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

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AHW29-08 Room:101A Time:May 21 11:30-11:45

Catchment environmental changes inferred from reservoir sediments in Noto Peninsula

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This study aims to reveal the sedimentation records and the transport processes of organic matter and sediment in the reservoir-catchment systems in Noto Peninsula, 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. Small reservoir-catchment system is suitable for clarifying material transport processes and responses to the natural and artificial environmental changes because of its sensitivity.

Study sites are two small reservoirs (Bishaguso-ike and Shin-ike) located in Noto peninsula in the central Japan. Surface sediment cores (26 cm and 31 cm length, respectively) were collected from these reservoirs 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}C and delta ^{15}N), and grain size were analyzed for 1 cm interval. Vertical profiles of radionuclide activity concentration (^{210}Pb and ^{137}Cs) were also measured to estimate sedimentation rate and age of the cores.

In Bishaguso-ike, the age of the core was estimated at about 40 years based on the ^{210}Pb dating method. It also indicates that sedimentation rate of the reservoir decreased to 25 % of previous value in 1980s. The C/N ratio of reservoir sediment decreased from 13 to 10 corresponding to the change in sedimentation rate. The delta ^{13}C and delta ^{15}N and the grain size also decrease since 1980s. These changes suggest that the contribution of catchment-derived organic matter and sediment has decreased since 1980s. These results suggest that catchment environmental changes which decrease sediment erosion occurred in the Bishaguso-ike catchment.

In Shin-ike, the age of the core were estimated at about 90 years based on the ^{210}Pb method. The delta ^{13}C and delta ^{15}N has decreased with some fluctuations since 1960s, implying the change in organic matter sources of reservoir sediment. The sedimentation rate (five times higher than other period), C/N ratio and grain size increased during about 1970s. These results suggest that the shift of organic matter source with some erosion events has occurred in the Shin-ike catchment. These changes in organic matter in both reservoirs may be attributed to the vegetation and land use changes in Noto Peninsula from 1960s to 1980s.

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

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AHW29-09 Room:101A Time:May 21 11:45-12:00

Assessment of water quality changes in reservoirs in Japan affected by global warming

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Reservoirs are important infrastructure in that they occupy a major fraction of water resources in our society. In Japan, more than 50% of domestic and industrial water is covered by reservoirs. However, because of their characteristics of closed water body, influences of water quality deterioration tend to accumulate. Therefore, improvement of water quality is generally takes a long time once a reservoir is polluted. In order to project potential influences from climate change on water quality in water resource reservoirs in Japan, assessment has been tried through structure of water temperature by the use of vertical 1-dimensional numerical simulations.

Thirty-seven multipurpose reservoirs including domestic water supply for their purpose were chosen for the assessment in this study, considering geographical distribution and hydraulic characteristics of the reservoirs. Meteorological conditions of atmospheric temperature and solar radiation for computations in this study were prepared using outputs from a GCM, MIROC 3.2 (hires). Water quality was evaluated in terms of chlorophyll a from water temperature conditions near the water surface, where phytoplankton tends to grow.

The results of chlorophyll a estimation indicated that number of reservoirs classified as eutrophic according to the criteria proposed by OECD in the present period of 1980-1999 was 10. However, number of eutrophic reservoir would increase as many as 21 at the period of the end of the century of 2080-2099.

Keywords: reservoir, climate change, water quality, water resources