

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

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 employed conventional fallow irrigation while one uses drip irrigation method. Also one of the conventional fields was covered with mulching. In 2011 summer, one field employed 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

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

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

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 watershed. A total of 10 springs were monitored in a small headwater catchment underlain by sedimentary rock, Karasawan 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

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 delta 18O 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 1.6×10^3 t/yr, 1.7×10^3 t/yr and 0.5×10^3 t/yr, respectively. The total amount of NO₃⁻ from these rivers is approximately 25% of the entire rivers discharging into Toyama bay.

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

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 ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$), 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 $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ 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 $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ 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

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

3D Rain Gauge and rainfall observation at the summit of Mt.Fuji

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New rain gauge so-called 3-dimensional rain gauge was developed and is able to measure the quantity and also the direction of blowing rain drops of wide range from fog to heavy rainfall under strong wind conditions. Once a rain gauge had been installed on the top of Mt. Fuji, it was removed due to the question of data reliability under strong wind blowing. The authors tried and proved that the new rain gauge could work suitably on the top of Mt. Fuji.

Keywords: 3D Rain Gauge, Rainfall direction, Rainfall observation, Mt.Fuji summit



転倒マス雨量計
3次元雨量計
3D転倒マス雨量計
超音波3次元風向風速計
図2 富士山頂での設置状況

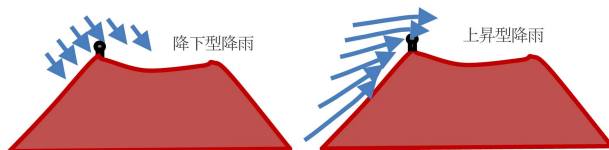


図3 降下型降雨と上昇型降雨の模式図

表-1 3次元雨量計の仕様

部位	項目	仕様
受水部	受水口(セル)数	12 (4方位×3傾斜)
	受水可能な雨水の飛来傾斜角	天頂から135°
	計算可能な雨水の飛来傾斜角	天頂から90°
計測部	解像度	1 drop
	最少計測雨水重量	0.1g
	分解能	20 drops/sec
	計測時間間隔	1sec以上、自由設定
	感応時間の長さ	2sec以内 (降雨開始直後を除く)

The development of disturbance on the atmospheric density stratification

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There are many unknown issues about line-shaped rainbands (LRBs) which is one of the meso-scale meteorological phenomena making torrential rainfall events in Japan. The LRBs caused severe floods and landslide disasters such as the Fukui heavy rainfall 2004, the Hokkaido heavy rainfall 2010 and the Niigata-Fukushima heavy rainfall 2011. For disaster prevention, it is very important to reveal the formation mechanism of LRBs. To know the mechanism, the authors try to examine the stability of the density stratification using the small amplitude wave theory. In this study, the rainfall and thermodynamic effects are not considered. To simplify the discussion, this theory notes only the up/down motion of disturbance in the stratified atmosphere.

It is considered that LRBs are generated by disturbance of the unstable stratified atmosphere. Here, the authors apply the ship wave theory to explain the LRBs. Ship wave is the water surface wave generated by moving ships or waterfowls, and we can regard this ship as the origin of disturbance in the stratified water and air. Thus, this phenomenon is similar to the LRBs formation mechanism in the disturbance of stratified fluid.

However, the disturbance form of ship wave is different from the LRBs. On the one hand ship wave is formed by diverging waves and transverse waves, on the other hand LRBs is the long linear cloud. Therefore, we have to explain that these two phenomena are not completely different, so the authors have decided to observe ship waves in detail. As the observation objects, the authors use the satellite images of lee waves which are known to make the cloud shapes like ship waves. Observing more than 500 lee waves images, the authors found some lee waves which are like LRBs. So we can say that ship wave may become the line-shaped disturbance if it satisfies some conditions.

Based on the above, the authors attempt to give an origin of disturbance to the piecewise linear boundary layer which have a density interface using ship wave theory. This theory is based on the fundamental equation such as Navier-Stokes equation, continuity equation and invariant density equation, using small amplitude wave theory and method of stationary phase. These equations finally result in the dispersion relation and vertical direction velocity by disturbance. Calculating the disturbance amplitudes for all the wave numbers, the authors find three disturbance development forms. These forms are determined by the density difference and the internal Froude number as follow: 1) The stratification is stable. 2) The stratification is unstable and the internal Froude number is more than 1. 3) The stratification is unstable and the internal Froude number is less than 1. Among those three cases, the first case makes the form of ship wave. It is not important for the formation mechanism of LRBs which occur in the unstable atmosphere. The unstable stratification cases are the time development disturbance and change the horizontal existence region of disturbance by the base flow parameters. Especially, the second case changes its disturbance region significantly with the Froude number. The authors consider that this disturbance region is important for the form of LRBs.

Keywords: line-shaped rainbands, stability, ship wave, lee wave

Land-Sea Circulation between Ishikari and Tomakomai in boreal summer

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This paper deals with the horizontal scale land and sea breeze circulation (LSBC) between Ishikari and Tomakomai and sea surface temperature (SST). The diurnal variation of LSBC during August of 1985-2008 is investigated using the data from the Automated Meteorological Data Acquisition System (AMeDAS) and Sapporo City Multisensor(MULTI) and analysis data of sea condition.

Area from Ishikari to Tomakomai has a unique topography. This area lies between Japan sea and Pacific ocean and it is not known whether it is affected by Japan sea's LSBC or that by Pacific ocean's LSBC. This area accounts for 30 percent of the total population of Hokkaido. Therefore, it is important to understand the characteristic of climate in this area. To discuss the LSBC effect, this area is divided into three regions: The first plain is from Ishikari city to Sapporo city (hereafter abbreviated as IS) and second plain from Ebetsu city to Chitose city (EC), and third is from Atsuma city to Tomakomia city (AT).

LSBC was observed between Ishikari and Sapporo. When Japan SST was higher than climatological temperature by 1 degree celsius, LSBC appeared clear because sea breeze's sojourn time increased. On the other hand, when Japan SST was 1 degree celsius lower than climatological temperature, sea breeze's sojourn time decreased. Therefore, it can be considered that LSBC over this area and SST have interactions.

Area between Tomakomai and Atsuma could have LSBC, too. When Pacific SST increased by one degree or decreased by one degree compared with climatological temperature, Tomakomai and Atsuma's sea breeze's sojourn time increased.

Between Ebetsu and Chitose, regardless of Japan or Pacific SST, southerly wind could be observed all day long and wind speed is not changed. It was presumed that area between Ebetsu and Chitose didn't have LSBC. Therefore, it can be concluded that wind direction was not related to SST.

These results suggest that the climate characteristics over Hokkaido region may change if global warming continues.

Keywords: topography, thermal balance, horizontal scale

Influence of lake current, wave and local atmospheric circulation on bulk transfer coefficient over a lake surface

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The turbulence and atmospheric data have been collected at the center of Lake Kasumigaura since 2007, in order to develop an improved lake-atmosphere fluxes parameterization. To estimate the fluxes more accurately, the bulk transfer method which incorporates the water surface status including the effect of wave, wave age and lake current was considered. Also the atmosphere status such as atmosphere stability and gustiness induced by the convective circulations under calm mean winds were investigated. Considering above parameters, the roughness length for momentum, sensible heat, latent heat were calculated. These results were used to determine the factors affecting the bulk coefficients. The estimated fluxes with a bulk method were compared with measured fluxes.

Keywords: flux, bulk transfer coefficient, roughness, wave, lake current

Separation of evapotranspiration into soil evaporation and transpiration over three maize fields of different irrigation

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The amount of evapotranspiration was measured by the eddy correlation method at three maize fields under different irrigation system of Nile delta; this was separated into its component of transpiration and soil evaporation by using the chamber method and oxygen and hydrogen stable isotope ratios, respectively over three maize fields of different irrigation systems of the Nile delta. The ratios of soil evaporation to evapotranspiration (E/ET) during daytime are nearly 100% in wet soil condition immediately after surface irrigation. As soil dries condition, E/ET became smaller with LAI. E/ET of the drip irrigation is almost 60%. Moreover, E/ET is 40% in surface irrigation with mulching when soil moisture condition is dry. Finally, E/ET is nearly 100% when soil moisture condition is wet immediately after narrow furrows irrigation. To assess controlling evaporation effect, we estimated E/ET by using previous works (Kang, 2003) without LAI effect about transpiration. E/ET for LAI=1 is found to be 79%, 57%, 41% in surface irrigation and 40-50% in drip irrigation and 64% in wide furrows irrigation and 81% with mulching.

Keywords: Eddy correlation method, Chamber measurements, Oxygen and hydrogen stable isotope ratio, LAI, Soil moisture content

Assessment of areas at risk of inside water inundation by topographical and geographical characteristics

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In Tokyo, various countermeasures to inside water inundation are proceeding. However, some areas where floods occur repetitively or small-scale floods occur are identified. Thus, it is necessary to understand topography or land cover of these areas. In Shinjuku, Toshima and Bunkyo, inside water inundation occurs frequently and some areas where floods occur repetitively are found. Therefore, in this study, we analyzed topographical and geographical characteristics of inundation records in these three districts and assess areas at risk of inside water inundation.

Inundation records in study area were 107 in 1989 -2008. We classified of these flood areas into 3 groups, those occurred in lowland, upland and valley on upland. The properties that were extracted as those involved in topographical or geographical characteristics of the flood areas were depression depth, depression volume, catchment, land cover of catchment, mean slope of catchment, mean slope from a flood area to a catchment exit, difference between these two slopes (slope difference), length from upper most of catchment to a flood area, length from a flood area to a catchment exit, difference between these two lengths (length difference), valley depth, valley width. We used ArcGIS10 to extract these all properties. Those properties were examined by principle component analysis (PCA) to assess topographical and geographical characteristics of the flood areas, resulting in two major components in lowland, three major components in upland and four major components in valley on upland.

The first PC in lowland, upland and valley represented the size of catchment, and length difference and the higher the PCA score, the larger catchment, and length difference. In the first PC in lowland also represented the size of depression. The second PC in upland, valley and the fourth PC in valley showed the size of depression. In the second PC in lowland and the third PC in upland and valley, the higher the PCA score, the larger mean slope of catchment, slope difference.

We calculated these PCA scores in the flood areas and all study area. Then areas over the minimum all PCA scores of the flood areas were extracted from the study area as the ones at risk of inside water inundation.

Keywords: inside water inundation, urban area, topographical and geographical characteristics, principal component analysis, GIS, Tokyo

Investigating on the relationship between subsurface infiltration rate and hydraulic conductivity of forest soil

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The objective of this study was to closely investigate the relationship between infiltration rate and hydraulic conductivity of forest soil in forested hillslopes focusing approximately 0.1m below the ground surface. A total of 38 sampling points from forests with two different species (*Japanese cedar* and *Hiba arborvitae*) were selected with respect to their thinning period in Ishikawa prefecture. The study was conducted using artificial rainfall condition that employ oscillating nozzle simulator. Soil at different depth and surface vegetation samples were collected before and after thinning from each forest type. The collected soil samples of the specific depth then were used to determine the effect of thinning on the soil permeability and hydraulic conductivity. The soil permeability and hydraulic conductivity then were measured before and after thinning for each soil sample.

Results indicated that the maximum infiltration rate (FIR_{max}) on surface soil ranged from 142 to 562 and 93 to 641 mm/h in *Japanese cedar* and *Hiba arborvitae* plantation, respectively and these values were higher than predetermined rainfall intensity. Although higher rates of hydraulic conductivity were measured at depth of 5 and 5 -10 cm, surface runoff has been observed at both depths. Exceptionally, a single surface soil sample collected from *Japanese cedar* showed a small value as observed in aquiclude while its maximum infiltration rate was over 300mm/h without undergrowth but litter. The effect of time after thinning was not reflected on the maximum infiltration rate and hydraulic conductivity. Moreover, the influence of slope, amount of cover-materials and soil characteristics were not observed on both measured parameters. As an advantage, forest cover reduces the direct rain drop impact that prevents the pore space of soil from being clogged and as a result higher values of both maximum infiltration and hydraulic conductivity rates were found.

Keywords: Infiltration rate, Hydraulic conductivity, Oscillating nozzle rainfall simulator, Japanese cedar, Hiba arborvitae

Interaction between Surface water and Groundwater in Baiyangdian Lake Watershed, North China Plain

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The people in North China Plain are mainly using groundwater as a major water resource. Because of an excessive pumping due to a rapid industrialization and expansion of the irrigated field, groundwater table drawdown and the water quality deteriorated recently in the North China Plain. On the other hand, as progress of scientific researches about the hydrology and the water resources, it has been clear that a development of either surface water or groundwater has affected on the quantity and the quality of the other. Therefore, it is urgently necessary to improve an understanding of the characteristic of the water quality and the groundwater processes in the North China Plain for sustainable water use.

The purpose of this study is to investigate the characteristics of the water quality and the groundwater flow process in Baiyangdian Lake watershed, the North China Plain. The field survey and the water sampling of the groundwater, the river water and the lake water were performed in June, 2011. Inorganic constituents and stable isotopic composition of deuterium and oxygen were determined on every water sample. The results of the study are as follows.

The water of Tang reservoir has a characteristic ion composition and the water of Baiyangdian has a distinctive isotopic composition and also water quality of Fu river is characterized high concentration of nitrate. So, each of surface water is affected by different process of water quality formation. Na^+ , SO_4^{2-} and NO_3^- concentrations and $\delta^{18}\text{O}$ distributions in groundwater suggest that ¹⁾ groundwater around Tang reservoir is recharged from Tang reservoir and flow in the direction of Northeast, ²⁾ groundwater around Baiyangdian is recharged from Baiyangdian which is influenced by high evaporation, ³⁾ in the region of Fu river, influence of interaction between surface water and groundwater is lighter than that of Tang or Baiyangdian region. Concentration of NO_3^- in deep groundwater indicate the intrusion of this contaminant from shallow to deep aquifers with downward groundwater flow, but in this study, we have few data of deep groundwater. To understand accurate mechanism of interaction between shallow groundwater and deep groundwater, we need more fruitful data.

Keywords: North China Plain, recharge of groundwater, water quality formation, stable isotope, cluster analysis

Age dating of spring water and estimation of water storage in mountainous watersheds using chlorofluorocarbons

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It is important to understand the groundwater flow system in quality and quantity for using the groundwater as major water resource sustainably and efficiently. The groundwater residence time and the water storage produce useful information for us. However, in the previous studies, there are few studies on age dating of the groundwater in large area with different geology, and evaluation of the water storage at the same time. In this study, the author performed age dating of the spring water using chlorofluorocarbons (CFCs) and estimation of the water storage, and then compared the groundwater flow system in geology conditions by showing the spatial distribution. The author sampled spring water in Kaikoma-type granite, Hoo-type granodiorite, the Tertiary deposit and the Paleozoic strata in Kamanashi River basin in Yamanashi prefecture, central Japan, in March, April, August, and November, 2011. The author analyzed water ion concentrations, hydrogen and oxygen stable isotope ratios, and CFCs concentrations of all spring water samples, and calculated the water storage volume using the age of the spring water.

The author estimated the residence time of the spring water by using Exponential Model. The age in the granite basin ranges from 11 to 36 years, in the Paleozoic strata ranges from 28 to 31 years, and in the Tertiary deposit ranges from 6 to 22 years.

In the granite basin, the difference of water quality and residence time suggests an existence of two types of the groundwater flow system. One is large contribution from the shallow groundwater flow in the composed granite, and the other is contribution from the preferential groundwater through the joint of decomposed bedrock or fracture zone. The smaller basin with the older age, it seems to contribute to the groundwater recharge flowing in the deep aquifers. On the other hand, in the Tertiary deposit, it is suggested that large-scale and the quick groundwater flow system is dominant due to the heterogeneity of the geological setting.

The water storage is estimated to be from 10^5 to 10^7 m³. It seems to be higher in the granite and lower in the Tertiary deposit. Therefore, the capacity of the water storage is higher in the granite and lower in the Tertiary deposit.

Keywords: groundwater flow system, residence time, chlorofluorocarbons (CFCs), water storage

Flow history of deep groundwater in a sedimentary basin by fluorescence EEM spectroscopy

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Recent and wider usages of deep groundwater due to increased demands for industrial water and hot spring resources require better understanding of the nature of hydrologic deep groundwater flow patterns in a sedimentary basin from the point of view of conservation of groundwater and evaluation of environmental effect as well as utilization of underground spaces such as CO₂ storage and waste disposal. Although major elements and stable isotope ratios have been employed to examine deep groundwater flows, more indices would lead to a better understanding of the groundwater flow patterns. We focused to a fluorescence excitation-emission matrix (EEM) spectroscopy, which needs only a small amount of samples, as it is highly sensitive for dissolved organic matter (DOM) with conjugated bonds at natural abundance levels. In this study, origins of DOM in groundwater samples with varying depth in the eastern Tokachi sedimentary basin were investigated with the EEM spectroscopy. EEM spectra were collected for the groundwater samples and for isolated humic acid and fulvic acid samples from the groundwater. Parallel factor analysis (PARAFAC) modeling for the corrected spectra and subsequent principal component analysis statistics of the PARAFAC data showed that they distribute within three end-members, a humic-like component originated from soil and peat, a subsurface microbial fulvic-like component and a degraded humic-like component. The difference of the DOM nature depends on origins of the aquifer, which possibly shows interaction of groundwater with surrounding rocks. This result agrees well with groundwater flow patterns in this area investigated with major elements and stable isotope ratios; thus the EEM spectroscopy combined with PARAFAC could also evaluate hydrologic behavior of deep groundwater containing DOM.

Keywords: EEM spectroscopy, sedimentary rock, groundwater flow, DOM, Humic substances

Lake-level change history of Nojiriko and its impact to human society

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Lake level of Nojiri-ko changed drastically at eight times during the last 4500 years. Maxima of lake level can be correlated with abrupt cooling events, namely, Heinrich events, Bond events, etc. Although lake-level change ratio is very low, which is ca. 5 to 10 mm per year, possibility of emergence of water shortage is high. Global warming can lead more frequent water shortages. Intensity variation of winter monsoon is assumed to be the cause of lake-level change. Arctic Oscillation is thought to be the most probable working hypothesis of winter-monsoon oscillation at present.

Keywords: lake-level, history, sediment, Lake Nojiri

Nitrogen and sulfur isotope analyses of river water in the Northwestern Chiba Prefecture

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To identify anthropogenic sources of nitrogen in the river waters in the northwestern Chiba Prefecture, stable isotope composition of nitrogen and sulfur as well as nitrate concentration were determined.

Keywords: nitrogen pollution, nitrogen isotope, sulfur isotope, river water, Tone canal

Flow system and hydrochemistry of hot springs around Mt.Haruna,Central Japan.

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In this study,23 samples of water (including ground water) were collected to analyze major chemical components and isotopic compositions of oxygen,hydrogen and sulfur to discuss recharge mechanisms and Water-rock interaction

Keywords: Mt.Haruna, hot spring, water-rock interaction

Hydrochemical study of non-volcanic hot springs in Yamanashi Prefecture, Central Japan.

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Hot springs have great significance as local promotion and so on.

In this study, 60 samples of water (including ground water, and river water, and natural springs) were collected to analyze major chemical components and isotopic compositions of oxygen, hydrogen and sulfur to discuss recharge mechanisms and Water-rock interaction processes to make chemical properties of the fluids and flow system of deep fluids.

Keywords: Yamanashi, hot spring, non-volcanic, water-rock interaction

Hydrochemistry and isotopic composition of hot springs the East Matsumoto Basin Faults, Itoigawa-Shizuoka Tectonic Line

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Hydrochemistry and isotopic composition of hot springs the East Matsumoto Basin Faults, Itoigawa-Shizuoka Tectonic Line Active Fault System, Central Japan

Keywords: Itoigawa-Shizuoka Tectonic Line Active Fault System, hot springs