

Japan Geoscience Union Meeting 2011

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AHW025-01

Room:202

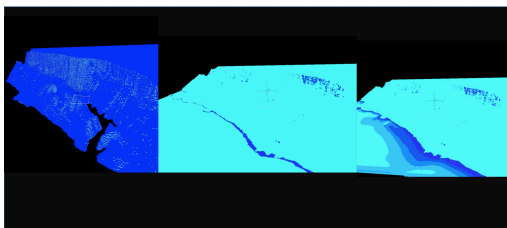
Time:May 22 14:15-14:30

Development of Hydro3D - a three dimensional hydrological modeling approach

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In order to develop hydrological model suitable for Karstic region, the traditional two dimensional approach may not be suitable due to the presence of many cracks and associated percolating water which flow into the surface hydrological regime at a certain distance. Also for the mountain region, hydrological processes in steep slopes are not identical to those in a gentle slope. In this study we propose a three dimensional hydrological modeling approach entitled as Hydro3D which combine 3D networking model for subsurface flow including percolating water and surface 1D-network and 2D shallow water modeling approach. The Hydro3D also include three dimensional hydraulic module which can illustrate lakes and reservoir in the continental region and bays/estuaries at the river mouth. The downsides of this modeling approach are- relative expensive computational resources when generating grids for whole catchment zone, difficulty in assuming appropriate dataset, and grid generation in vertical directions.



Keywords: Hydro3D, percolating water, hydrological processes, distributed model, reservoir

AHW025-02

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A study of the vegetation change and climate memory in Africa using a dynamic global vegetation model

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Various vegetation types are distributed in African continent, and those are results of interaction between land surface and the atmosphere. In particular, precipitation change strongly affects vegetation. Vegetation has a system, 'climate memory', that holds effect of precipitation anomaly even after it has been occurred. Vulnerability is also important concept for prediction of vegetation change because it is used for indicator of ecosystem stability. In this study, we applied a dynamic global vegetation model, SEIB-DGVM, to African continent and examined the effect of precipitation change on vegetation structure (e.g., LAI and tree height) and carbon / water balance. Then, we examined the vulnerability of vegetation among seven sites using the Sensitivity Index and Resilience Index. In the model, spatially explicit virtual forest is placed; growth, competition and decay of individual trees can be calculated. Input data is daily climatic data from 1979 to 2004 obtained from NCEP/NCAR reanalysis data. The spatial resolution of this data was coarse (192*94 global points); thus, the data was linearly interpolated for targeted site. However, NCEP/NCAR precipitation was corrected by monthly precipitation data by GPCP. The atmospheric CO₂ concentration was set to 358.6 ppm, which is the global mean from 1979 to 2004. We selected the seven sites in African continent from CarboAfrica. Climate memory and vulnerability for precipitation change was differed among the seven sites and it was thought as characteristics for each site. It caused by differences of climate zones, biome and plants characteristics (such as the root depth) in each site.

Keywords: Vegetation, Africa, Climate Memory, Vulnerability, Numerical Model

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AHW025-03

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Factors contributing to precipitation changes simulated by IPCC-AR4 models under the A1B scenario

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Different processes can be responsible for mean precipitation changes under increased greenhouse gas conditions, including the direct effect of air temperature change on saturation vapor pressure, but also changes in surface evaporation, relative humidity and large-scale atmospheric circulation. In this study, we analyze precipitation changes simulated by the IPCC-AR4 models between the last two decades of the 21st and 20th centuries based on the A1B scenario. Using daily output, the climatological-mean moisture flux divergence and surface evaporation terms at every grid point are decomposed into contributions from the individual factors mentioned above, in order to assess their relative contributions and their seasonal and geographical dependency. Early results indicate that all the contributions are important for understanding mean precipitation changes in the models.

Keywords: precipitation changes, IPCC-AR4, modelling, intercomparison

AHW025-04

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Time:May 22 15:00-15:15

Effect of heterogeneity of hydraulic conductivity on groundwater flow and spontaneous potential

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Spontaneous potential(SP) is the electrical potential mainly generated by thermoelectric, chemical and streaming potentials in the subsurface. The flow of groundwater is often recognized as a dominant source of SP. Using this feature, many attempts have been done to quantify groundwater flows in the soil.

The SP anomalies according to the groundwater are often associated with the direction of groundwater flow as a primary interpretation. Therefore, it is believed that the inverted gradient of SP corresponds with the direction of groundwater flow. However, the distribution of SP is influenced by not only the direction of groundwater flow but also the inhomogeneous of subsurface. Actually, the previous studies show that inhomogeneity of permeability and coupling coefficient has an effect to the SP anomaly. Thus, the distribution of SP is influenced by the existence of subsurface heterogeneity, but the detailed studies are few.

In this study, we developed the numerical codes for SP simulation: we simulated the natural groundwater flow and the distribution of SP according to the flow along a topographic slope. We discussed the effect of parameters, such as permeability and slope angle on the groundwater flow to the distribution of SP. Our simulation shows that the SP anomalies appear just above the boundaries of permeability. These anomalies are due to the charge that occur on the boundary- where the flow passes. This effect was prominent in case that the permeability contrast was large. In addition to this effect, our simulation results show that the additional SP anomaly appears at the discharge of groundwater caused by the effect of slope angle and permeability. Our simulation suggests that the SP is influenced by the groundwater flow and inhomogeneity of permeability and we suppose a new method to obtain the information of groundwater flow and permeability from the SP observation.

Keywords: spontaneous potential, hydraulic conductivity, groundwater flow

AHW025-05

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A study on effect of accuracy of topographical information to flood risk assessment in urban lowland: Barajima district

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A number of cities in Japan are located in plains and lowlands. Recently, many municipalities publish flood hazard maps because it has become hard to control flood disasters in urban regions with banks and so on. The manual that describes how to make a flood assumption zone map (basic map of flood hazard map) specifies the basic size of a ground height data to 50m grid (Flood Control Division, River Bureau, MLIT, 2005). Although, this size is not enough to depict topography of an area, especially in lowland. On the other hand, a flood assumption zone is highlighted in a flood hazard map. However, it is necessary to show flood risk including population, land use and others. From the above, this study aims to verify the accuracy of ground height data used in a flood hazard map and to clarify its effect to a flooding area or depth in Barajima district in Akita city, Akita prefecture. Barajima district is located along the Omono River and is in the lowest area of Akita city. In this district, elevation is relatively high in the central part and is relatively low in the western and eastern part. Land use of this district is composed of industrial area (western part), commercial area (central part) and residence area (eastern part). The Authors reconsidered several previous flood hazard maps and reassessed flood risk including land use and others in Barajima district.

To verify the accuracy of the 50m grid data used to make the Omono River flood assumption zone map that was the basic map of the flood hazard map of Akita city, the authors made a new TIN surface model by using a city planning maps with a scale of 1 to 2,500 and fieldwork. Then, we evaluated the differences about the area and the depth of flooding between the Omono River flood assumption zone map and new TIN surface model. ArcGIS 9.3.1 was used to analyze.

As a result, there were some differences between the Omono River flood assumption zone map and the new TIN surface model. This difference was considered to be caused by the accuracy of ground height data and procedure of surface modeling of the map. Thus, the flood assumption zone in the map had a margin of error, and there was a possibility that the residents and employees in industries misunderstood the flood risk. Considering that the factories and houses in Barajima district were concentrated in the relatively low altitude area and were much vulnerable to flood damage, residents and industrial activities will be damaged seriously by a flood and inundation.

Keywords: urban flood disaster, risk assessment, flood hazard map, DEM, land use, GIS

AHW025-06

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Analysis of hydrological circulation along to Shiratani River in The Yakushima Island

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The Yakushima Island has a large amount of precipitation. It is easy to analyze water cycle because of symmetrical conical shape. However, in the Yakushima Island, there are not enough data for river flow rate although it is important to measure river flow rate at the condition of high precipitation. Therefore, flow rates of river in the Yakushima Island are measured to estimate the amount of groundwater. The amount of groundwater is estimated from the surface runoff, evapotranspiration and precipitation and the water cycle is clarified at the granite island under the condition of high precipitation.

Precipitation and flow rate are measured along the Shiratani River to estimate the amount of groundwater. As a result, infiltration rate at small catchments from 200 to 1000m in height are about 70 % on average. The maximum and minimum infiltrate rates are 90 and 50 % respectively. Generally, infiltration rate is 35 % at the forest and 10 % with no trees. Although infiltration at the weathered granite rock and forest area is generally high, the estimated infiltration rate is too high. River flow rate is too small because the measuring day is almost fine day for safety and it changes with rain. Therefore, infiltration rate reaches high. Next, river flow rate depends on position along a small river. As most of water once infiltrates into soil and then effluents, river flow at the monitoring site between recharge point and discharge point is changeable and although each catchment is the same size and adjacent, infiltration rate may range from 50 to 90 %. At the next measuring, fresh basement with river flow must be selected as a monitoring site because small water between recharge and discharge migrates and almost recharged water discharges before the point.

Keywords: yakusima, hydrological circulation, groundwater, quantity of flow

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AHW025-07

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Hydrochemistory of non-volcanic springs, Yamanashi Prefecture, Japan

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

In this study, 29 samples of water from twenty four wells, four springs, and from a river were collected to analyze major chemical components and isotopic compositions of oxygen, hydrogen, sulfur to discuss recharge mechanisms, Water-rock interaction processes to make chemical properties of the fluids and flow system of deep fluids. Precipitation at altitude of 330 to 2360m were also collected to calculate the altitude effect of delta ¹⁸O and delta D. Respectively, the effect was -0.41per mill/100m and -3.7per mill/100m.

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AHW025-08

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Research on outflow of nutritive salt from field in river

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It is at 1999 that the nitrate nitrogen and the nitrite nitrogen in the river were provided in our country as a health item of environmental standards (10mg/L). A lot of underground water pollutions are reported regardless of the inside and outside in the country. However, the report of surface water is few. Then, we investigated two rivers where with a vast field in the valley.

[Research]

It is a clement climate that faces both valleys and the Pacific Ocean, and the farm production is an active region. Especially, it centers on the production of the outdoors vegetables such as the cabbages.

The valley in both rivers was surveyed, and obtaining water, pH, EC, and the flow measurement were done.

[Result and consideration]

At Ttakada river, the density of nitrate nitrogen exceeded standard 10mg/l excluding part. Having been polluted by the nitrate nitrogen with a high density the entire valley became clear. At Umeda river, it was standard value 10mg/l or less in the environmental standards point. However, in the point that flowed in the region where the field extended, the point where the standard value was greatly exceeded became clear.

Keywords: Non-point source, Nitrate Nitrogen, Surface Water

AHW025-09

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The behavior of vanadium between water and basalt

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Dissolved chemical compositions in ground water and river water in the area, where is not contaminated by human, are derived mainly from rains, soils and rocks. A regional water quality could be characterized by them. In the surrounding area of Mt. Fuji, it has been reported that vanadium concentration is relatively high 0.05-0.1(mg/l) in ground water and river water, due to the dissolution of vanadium from basalt. This concentration is 50 to 100 times high compared to the normal concentration of vanadium in natural waters. However a relationship between inland waters and rocks has not been reported. The reason is that most previous studies examined the relationship between land and water and rocks, which applies to water pollution. Vanadium is not considered a contaminant in the water. Therefore, this study examines the behavior of vanadium between basalt and groundwater, and the behavior of vanadium in groundwater in the surrounding area of Mt. Fuji. In the experiment, the basalts samples of different ages were used and the dissolution experiment between them and water was performed. The behavior of vanadium dissolved in aquifers in Mt. Fuji area was considered. The results of the dissolution experiments showed that the dissolved vanadium species in water were affected by pH and dissolved oxygen. In addition, the vanadium in basalts is considered to be contained in magnetite, in pyroxene and in the glass and to have adsorbed onto each minerals surface. The experiment of extracting vanadium from them revealed the existing forms of vanadium in basalts.

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WATER BALANCE OF GLACIERIZED CATCHMENTS IN BOLIVIAN ANDES

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The continuous worldwide glacier retreat since 1850s rapidly and greatly affects the availability of fresh water, for domestic, agricultural and industrial use in the regions where depend on glacier-melt. The situation is particularly acute in South America, which has about 99% of worldwide tropical glaciers in Andes Mountains. In the joint project "GRANDE (Glacier Retreat impact Assessment and National policy DEvelopment)", Glacier Condoriri, Tuni and Huayna Potosi in Cordillera Real (68.12W, 16.13S) are under study as which are the main water resources of human consumption and hydropower generation for the city of La Paz and El Alto in Bolivia.

In this study, glacierized area change in Cordillera Real was observed using semi-automated method extracted from Landsat Thematic Mapper (TM) scenes from 1980s to 2007 using a band ratio as TM4/TM5. The analysis results illustrated that the glacier melting process is accelerated in the past 20 years and disappearing around 2030 to 2050. Meanwhile, based on limited meteorological and hydrological data, water balance in this region was analyzed. The results proved the glacier melting acceleration observation and how glacier melting water behaved as major water recourse in the study region. Among all 3 glacierized sub-catchments, Condoriri has the biggest runoff coefficient (runoff depth (mm) / precipitation (mm)), which was as high as 2.02 in 2004 to 2005, while Tuni has the smallest runoff coefficient, which was 1.39 in 2004 to 2005. However, the area of Condoriri and Huayna Potosi each is more than twice as much as Tuni. According to the percentage lost of Tuni glacier observed in the latest 20 years, Tuni is predicted to be the first disappeared.

Keywords: glacier, water balance, Landsat, band ratio

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AHW025-11

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Stable isotope and chamber method to separate evapotranspiration components of Nile Delta farmlands

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Nile delta is faced with future water shortage. To make use of available water, it is necessary to reduce consumptive use of evaporation of farmlands. To investigate into possible strategies for this aim, we estimated evapotranspiration (ET) by eddy correlation method, and separated (ET) into soil evaporation (E) and transpiration (T) by chamber and stable isotope ratios measurements. From summer intensive measurements, preliminary results on T/ET ratio relation with LAI, irrigation methods, farmland management, and soil moisture were obtained.

Keywords: Chamber method, Stable isotope ratio, Mulching, Drip irrigation

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AHW025-12

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Interaction between surface water and groundwater in Sbiba, Tunisia

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The purpose of this work is to understand the process of groundwater recharge from the surface water in semi-arid area using the tracer elements and stream flow observation.

The Sbiba basin is semi-arid area located in inland region, northern Tunisia. In the downstream area, there is the drawdown of groundwater and the disappearance of river as the result of the overexploitation for irrigation.

The groundwater flow in Sbiba basin was estimated by dissolved inorganic ion. There is interaction between shallow aquifer and surface water from upstream to downstream. The another aquifer exists in deeper layer which have poor connection with other aquifers. For these reasons, upstream well, midstream river, and dam are estimated to be the end-member of the downstream groundwater. The contribution of the dam to the groundwater is estimated to be 38.4% by end-member mixing analysis.

The ratio of outflow to input flow in the river is also estimated with tracer elements and measured stream flow. The evaporation rate from the river is estimated to be 4.7-11.5% of input flow, groundwater recharge is 30.0%, and artificial withdrawal for irrigation is 53.6%.

Keywords: semi-arid, groundwater recharge, end-member mixing analysis, tracer, Sbiba

AHW025-13

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Groundwater and surface water interaction in Ulaanbaatar capital city, Mongolia

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In order to clarify relationship between groundwater and river water exchange, we perform water quality survey and quantitative evaluation in Tuul river basin, around Ulaanbaatar city. An investigation of groundwater level on floodplain in Ulaanbaatar, it showed that the groundwater flowing to the east along southwest along Tuul river. This indicates the importance of the Tuul river as a source of groundwater recharge. It seems that groundwater from the north tributaries and south mountains flows into the floodplain. The floodplain groundwater quality showed a concentration of Tuul river water quality. This is considered to support exchange of groundwater and river water shown with groundwater level. North tributary groundwater concentration was higher than Tuul river water. Since, effect of north tributaries showed in the floodplain, it is seemed to be important factor in the floodplain inflow from the north tributaries.

The results of oxygen and hydrogen isotopes, in the floodplain, north tributaries and south mountain groundwater showed different trends. This shows that the different recharge process in each areas. Isotopes in north and south tributaries showed values between Tuul river water and precipitation. This suggests that groundwater in the tributaries are mixture of river and precipitation. The north tributary groundwater showed a small influence of evaporation. In the floodplain groundwater were confirmed with the lower delta value water than Tuul river water, north tributary groundwater and south mountain groundwater. Winter precipitation as a percentage of the total precipitation is very small, although winter precipitation values have lower delta values, it suggest the possibility that effective for groundwater recharge. Furthermore, using tracer of HCO_3^- and SiO_2 , End Member Mixing Analysis determined the relative contribution of origin waters in the floodplain groundwater. Consequently, the floodplain groundwater originate from 46% to 95% of Tuul river water, 2% to 54% of groundwater of north tributary, 0% to 14% of groundwater of south mountain.

Keywords: groundwater recharge, relative contribution, EMMA, semi-arid region