Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

AHW26-01 Room:424 Time:May 1 14:15-14:30

Future Projection of flow regime and water quality in Arakawa river basin

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The research project of Core Research for Evolutional Science and Technology (CREST): ”Development of well-balanced urban water use systems adapted for climate change” (PI: Hiroaki FURUMAI, Univ. of Tokyo, Research area: Innovative Technology and System for Sustainable Water Use) have been conducted from 2009.

The objectives of this project are 1) to reexamine the current urban water use system, and 2) to propose a new urban water use system adaptive to the future climate change. In the new system, each water resource is properly allocated to each water use by considering the balance between supply potential of various water resources and demand. The information on available amount and detailed quality of water resources should be evaluated.

For the implementation of the project, 5 sub-groups were organized:
(1) Watershed Water Resources group
(2) Urban Rainwater Management and Use group
(3) Urban Groundwater Management and Use group
(4) Water Quality Assessment group
(5) Urban Water Use Design group

In this presentation, activities of Watershed Water Resources group (and collaborative work with Urban Groundwater Management and Use group) will be presented.

Keywords: climate change, water resources

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AHW26-02 Room:424 Time:May 1 14:30-14:45

Cl- concentration in pore water beneath Tokyo bay area, Urayasu, Chiba Japan

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We investigated Chloride concentration of Holocene and latest Pleistocene in Urayasu city, Chiba Japan. As a result of analysis, Chloride concentration of Holocene in this area is affected by flushing of rain and groudwater flow from Pleistocene.

Keywords: Alluvium, Profile of Cl- concentration, basal topography

Japan Geoscience Union Meeting 2014
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AHW26-03 Room:424 Time:May 1 14:45-15:00

An isotopic study on the origins of sulfate ion in shallow urban groundwater of the Musashino Plateau, Tokyo, Japan

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Shallow groundwater in the highly-urbanized Shakujii-gawa River basin on the Musashino Plateau, Tokyo, Japan shows a remarkable spatial variability of its sulfate ion concentration in the range between 7-135 mg/L. The average sulfate ion concentration is 35mg/L, 36mg/L, 33mg/L, 21mg/L, 19mg/L, and 28mg/L in Kita Ward, Itabashi Ward, Toshima Ward, Nerima Ward, Nishi-Tokyo City, and Kodaira City, respectively, indicating higher concentration in the lower reaches of the river where urbanization has started earlier and progressed more rapidly than its upper reaches. To discuss possible origins of sulfate ion in groundwater, a hydrologic study using stable isotope of sulfur was carried out in 2012 to 2013. Although a limited number of samples, higher sulfur isotope measurements (+10.5 and +10.6 per mil delta-34S for Toshima and Kita Wards, respectively) suggest contribution of leaking sewage from aging, deteriorated sewer pipes, accounting for an elevated sulfate ion concentration in the lower reaches of the river.

Keywords: urban groundwater, central Tokyo, shallow groundwater, sulfate ion, sulfur isotope

Japan Geoscience Union Meeting 2014
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AHW26-04 Room:424 Time:May 1 15:00-15:15

PPCPs polution in an urban watershed in Musashino upland, Tokyo

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Human activities discharge various chemical substances to water environment in urban area around the world. Some substances are concerned to affect health of human and aquatic organism because these substances are hardly decomposed not only in natural environment but also water treatment plant. We study on shallow groundwater environment in Musashino upland, Tokyo to evaluate sources and recharge processes of groundwater and present state of groundwater pollution by domestic wastewater (e.g. Hayashi et al., 2012; Nakamura et al., 2013; Yasuhara et al., 2013). Based on the result of our previous research, we newly collected water samples of river water and shallow unconfined groundwater in the watershed and measured PPCPs components. Three samples of river water were taken from two rivers: a natural river mainly recharged by groundwater and an artificial river recharged by treated waste water. 15 groundwater samples were collected from private wells that were distributed in the water shed of the natural river. A for PPCPs, 78 substances were measured by semi-quantitative analysis and another six substances (amantadine, caffeine, carbamazepine, crotamiton, ibuprofen, N,N-diethyl-m-toluamide) were measured quantitatively.

As for river water samples, 19 substances from semi-quantitative analysis and six substances from quantitative analysis were detected in the artificial river, and three substances from semi-quantitative analysis and five substances from quantitative analysis were detected in the natural river. On the other hand, only one substance from semi-quantitative analysis and four substances (amantadine, carbamazepine, crotamiton, N,N-diethyl-m-toluamide) from quantitative analysis were detected in groundwater samples in both peri-urban upstream area and urbanized downstream area.

We present present characteristics of PPCPs components and spatial distribution in the study area.

Keywords: Musashino upland, urban river, shallow groundwater, pollution, PPCPs

Japan Geoscience Union Meeting 2014
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AHW26-05 Room:424 Time:May 1 15:15-15:30

Title: Household water treatment for the removal of contaminants in groundwaters in Hanoi, Vietnam

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Between 2000 and 2025, the urban population in Vietnam is expected to double from 19 million to 40 million. Therefore, urbanization and increasing water demand is one of the most important challenges in Vietnam, especially in Hanoi. At present, Hanoi city relies on groundwater as a main source of water supply, but it is going to shift to the surface water as the demand increases in the near future. However, variation of rainfall, dam construction in the upstream of the Red River and climate change in the near future make the surface water unreliable water source for water supply in Hanoi City. As the extension of water supply coverage is slow, many households still rely on groundwater as their drinking water sources. However, groundwater is contaminated by ammonia, arsenic, iron, bacteria and others. In order to obtain clean drinking and cooking water many households use point-of-use (POU) treatment devices including sand filters, ceramic filters, reverse-osmosis filters, and UV irradiation.

To identify the impact of POU usage to water consumption and water quality, a survey of POU usage in 170 households in six communes in Hanoi was carried out in 2012 and 2013 Water samples were also taken to investigate the treatment efficiency of those POUs. As a result of the household survey, it was found that many households in rural and suburban areas have multiple water sources and use them for different purposes, while the urban households use only piped water supply. The result indicated that between 18% and 76% of the households in these communes used POU water treatment devices, of which RO devices accounted for 58%. Groundwater was contaminated by arsenic (max 0.3 mg/L), ammonia (max. 26 mg/L), and manganese (max. 3 mg/L). Although most of the arsenic was As(III) form in groundwater, it was oxidized to As(V) in the sand filters. Thus, RO filtration was found quite effective in removal of arsenic from groundwaters.

Keywords: ammonia, arsenic, household water treatment, MDGs, reverse osmosis device, safe drinking water

Japan Geoscience Union Meeting 2014
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AHW26-06 Room:424 Time:May 1 15:30-15:45

Prevention of heavy metals release from natural soil

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In marine silts of bay areas, or volcanic ash rocks of mountainous areas, heavy metals derived from natural soils or rocks, such as lead or arsenic have become a problem. In this paper, prevention of arsenic release from soils is reported using laboratory tests results.

Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

AHW26-07 Room:424 Time:May 1 15:45-16:00

Recent surface displacement in Bangkok associated with groundwater recovery

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In many cities in the world, groundwater level decrease and subsequent land subsidence has been observed associated with groundwater pumping. Bangkok, the capital city of Thailand, is also one of the cities that had been suffered from land subsidence due to groundwater extraction. Since 1960s, groundwater has been extracted for commercial and personal use. Subsequently, the cumulative subsidence of about 1 m has been reported. Recently, Thailand government has implemented several measures to regulate groundwater use, and groundwater level recovery has been reported.

In this study, we used persistent scatterer SAR interferometry (PS-InSAR) analysis, which is the method to process a series of SAR data equipped on repeat-pass satellite, to estimate ground displacement in Bangkok from November 2007 to December 2010. Since SAR data is acquired by satellite, PS-InSAR analysis has an advantage for mapping displacement pattern in wide area with high spatial density.

As a result, we estimated ground uplift with the rate of about 1 cm/year. The secular uplift has decayed over time, and can be modeled by exponential function of time. Since the groundwater recovery has been observed in areas where uplift was estimated, this uplift is likely associated with groundwater recovery. Moreover, we also estimated seasonal displacement correlated with the cycle of precipitation in eastside of Bangkok.

Keywords: groundwater recovery, surface displacement, Bangkok, persistent scatterer SAR interferometry

Japan Geoscience Union Meeting 2014
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AHW26-08 Room:424 Time:May 1 16:15-16:30

The Use of Isotopic Technique to the Assessment of River Recharge to the Depleted Ground Water Systems in Dhaka, Banglad

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Surveys of groundwater quality across Dhaka demonstrate the impact of intensive groundwater abstraction, which has led to invasion of the Dupi Tila aquifer by lower quality water in parts of the city. Groundwater chemical/isotopic monitoring is capable of discriminating between the effects of induced recharge from the polluted River Buriganga and of enhanced vertical leakage through the Madhupur Clay in contaminated urban areas. Over-exploitation of the aquifer has led to a progressive decline in water levels. The resulting cone of depression is thought likely to be causing the infiltration of polluted surface water. Stable isotopic techniques were used to characterize the hydrogeology and water sources the Dupi Tila aquifer beneath Dhaka. An interpretation of the linear δ^{18}O versus δ^{2}H relationship as a simple two-member mixing series between river water and recent meteoric recharge suggests that all groundwater in the lower Dupi Tila aquifer of Dhaka contains at least 30% river water.

Environmental isotope distributions approaches identify the polluted River Buriganga as the main threat to groundwater quality, indicating priorities for monitoring and aquifer protection.

Keywords: Ground Water, Dupi Tila Aquifer, Isotopic Technique, Dhaka

Japan Geoscience Union Meeting 2014
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AHW26-09 Room:424 Time:May 1 16:30-16:45

Groundwater Level and Flow Rate Model and Barometric Response of Water Level of Well at Otomeyama Park in Shinjuku Ward

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Spring at Otomeyama Park in Shinjuku Ward is one of the 57 Great Springs of Tokyo, Japan. Recently, decreasing of the spring water quantity at Otomeyama Park has been at issue. In order to figure out long-term variations of the spring water quantity, the flow rate and the groundwater level have been continuously observed by Kaijo Earth Science Club since 2011. In this paper, we report the results of the examination concerning the groundwater level variation and the model, which can express the groundwater level and the flow rate simultaneously.

Otomeyama Park is located at Ochiai escarpment on the eastern part of Musashino plateau. The stratum near Otomeyama park are Kanto loam layer, Shimosueyoshi loam layer (tuffaceous clay layer), Musashino gravel layer, Tokyo layer (sand layer or clay layer) and Tokyo gravel layer from the top. Sato et al. (2013) estimated that the aquifer of the spring water is Musashino gravel layer and the catchment area is about 10-100 ha. The spring water finally joins Kanda River through the water way in the park.

Based on the flow rate observation at Otomeyama Park for more than one year, the arithmetic mean flow rate was about 20 L/min. The flow rate intensely responded to precipitation. The flow rate increased from 4 L/min to 50 L/min in 35 hours at the rainfall event in April 2-3, 2012, whose total amount of rainfall was 118 mm.

The water level of wells were observed at three stations: well No.1 (at Otomeyama park), well No.2 (at Otomeyama park) and Mejiro well (at Shinjuku Ward, 0.5 km to the north from Otomeyama park). The water level of the wells was calculated by subtracting atmospheric pressure from the water pressure in aquifer. The aquifer of well No.1 is Musashino gravel layer and is confined, while the aquifer of well No.2 is Tokyo gravel layer and is confined. The aquifer of Mejiro well is Kanto loam layer and is unconfined.

Semidiurnal fluctuation of water level was observed at well No.1 and No.2. The daily composites of water level of well No.1 in dry periods showed that the atmospheric pressure was at its top at about 9 a.m. and 9 p.m. (JST) in Tokyo by atmospheric tide, while the water level of well fluctuated anti-phase to atmospheric pressure. This barometric response caused by balancing the water level variation of well with atmospheric loading when pore pressure of aquifer is not affected by atmospheric loading (Rojstaczer, 1988). This is attributed to three reasons for the barometric response of water level of well No.1. The mouse of the well is open, so that barometric fluctuation is directly transferred to the water surface in the well. Since the well diameter is 51mm, small water exchange between the well and the aquifer can change the water level in the well. Simosueyoshi loam layer above the aquifer is difficult to infiltrate atmospheric pressure. In contrast, the water level of Mejiro well was not responded to atmospheric load, since there is no air-barrier layer above Kanto loam layer.

Better performance model is needed to figure out long-term variations of the spring water quantity. Sato et al. (2013) predicted flow rate from precipitation using two-tank model, but the model did not utilize groundwater level. We developed a model, which express both flow rate and groundwater level. Our model was based on three-tank model. The first tank of the model represents intermediate flow. The second tank infiltrates water into the third tank but does not have side outlet. The third tank corresponds to the groundwater level. The model parameters were estimated for the flow rate and the water level of Mejiro well by means of SCE-UA method (Duan et al., 1993). In the simulation, the model accurately reproduced the observed value.

Keywords: spring water, groundwater level, tank model, barometric response, atmospheric tides

Japan Geoscience Union Meeting 2014
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AHW26-10 Room:424 Time:May 1 16:45-17:00

The Seasonal variation of the amount of flowing artesian well springwater in the Ashigara Plain, Kanagawa Prefecture.

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Introduction

Many of cities are located in the alluvial plain of an area along the shore for our country which is an island country. In the alluvial plain, the confined groundwater cultivated in an upside fan or mountain area is used as the source of industrial water, or a source of tap water with river water. Overuse of groundwater in the city region in period of high economic growth caused groundwater obstacles, such as ground subsidence as one of the seven typical pollution and depleted of springwater.

Also in the flowing artesian well area from which is distributed in the Ashigara plain in the western area of Kanagawa prefecture decline has been reported after the 1960s. Moreover, the investigation in 2011 showed that there were 1,000 or more flowing artesian wells in the whole Ashigara plain. Furthermore, it turned out that about 50,000 tons per day of from the whole artesian wells . However, although relation with the irrigation to a paddy field is pointed out about the seasonal variation of the amount of the springwater from flowing artesian wells, there are many questions about details.

So, in this study, investigation over one year was conducted about the flowing artesian well springwater distributed in the Ashigara plain, and seasonal variation of the amount of springwater which gushes from a flowing artesian well was clarified.

Results of an investigation and consideration

Investigation conducted one investigation per month for 205 flowing artesian wells for June, 2013 to one year, and performed measurement of the amount of natural flows, water temperature, electrical conductivity, pH, and dissolved ion concentration. Since the amount of natural flows measured at 205 points had the large variation in the amount of natural flows for every point, it standard scoreized the amount of natural flows of every month, and grouped by cluster analysis for every point where the change pattern of the amount of natural flows was alike.

As a result, the change pattern of the amount of natural flows was able to be classified into ”the type corresponding to an irrigation term” which increases to the irrigation term to a paddy field, and ”the type corresponding to un- irrigation term ” with which a remarkable changing trend is not seen through every year. Moreover, many flowing artesian wells on the west side of the Sakawa river of ”the type corresponding to an irrigation term” classified according to the above-mentioned method were distributed, and ”the type corresponding to un-irrigation term” was mostly distributed on the east side of the Sakawa river.

Keywords: flowing artesian well, Ashigara Plain, amount of flowing artesian well springwater, seasonal variation, irrigation to a paddy field

Japan Geoscience Union Meeting 2014
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AHW26-P01 Room:Poster Time:May 1 18:15-19:30

Three-dimensional mapping of geochemical and isotopic characteristics of groundwater beneath the Osaka Plain

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Osaka Basin, which is a large Quaternary sedimentary basin beneath the Osaka Plain, is a large reservoir of groundwater resources. The uptake of groundwater has been strictly regulated since 1960 to avoid land subsidence, which actively occurred in the period of rapid economic growth. Although the land subsidence has stopped since 1970s because of the regulation, it became a threat again due to start of uptake of groundwater for private water supplies after 2000 ' s. Excess groundwater uptake from 100 to 300 m depths for those purposes would squeeze porewater from impermeable marine clay layers causing subsidence again.

In this study, groundwaters were mainly sampled from the wells >100 m depths, and stable hydrogen and oxygen isotope ratios and major chemical components were determined to estimate origins of water. Combining the results of our and previous studies, overall picture of three-dimensional mapping of groundwater geochemistry was drawn to discuss the groundwater flow system and the relationship to the land subsidence.

In the coastal region below sea level, seawater invaded into the groundwater aquifers <100 m depth. Stable isotope ratios of the groundwater at >100m of this area(δ^2H:-50 ‰~ -60 ‰,δ^{18}O:-8 ‰~ -9 ‰) is smaller than those of groundwater at <100m(δ^2H:-40 ‰~ -50 ‰,δ^{18}O:-6 ‰~ -7 ‰). Especially low isotope ratios of the groundwaters, of which chemistry was diluted Na-HCO3 type, from the lowland west of Uemachi plateau suggest squeezing the pore water from clay layers.

In the same area, high electric conductivity and Na-Cl type chemistry indicates seawater invasion into the groundwater aquifers <100 m depth. Uemachi Fault works as recharging path for the groundwater aquifers <100 m along the western edge of Uemachi plateau. However, the recharge is not enough to fill the aquifer >200 m apart from the fault. These observations indicate that the aquifers in the aquifers beneath western lowland of Osaka Plain have not been recovered by newly recharged groundwater.

Keywords: groundwater, isotope

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Source of nitrate in shallow groundwater in the Shakujii river catchment, central Tokyo, Japan

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Water chemistry of shallow groundwater in the Shakujii river catchment in the downtown Tokyo is discussed with special reference to its nitrate and chloride concentrations. The catchment is divided into the highly urbanized lower reaches (Toshima, Kita and Itabashi Wards) and the upper reaches which have been urbanized to a lesser extent (Nerima Ward, and Nishi-Tokyo and Kodaira Cities). Shallow groundwater samples were collected from 28 wells of less than 10m deep at October 2012 and October 2013. Groundwater aquifer is in the Kanto loam layer and/or underlying stream terrace gravels. The nitrate-nitrogen concentration had wide ranges (from 0.1 to 13.6mg/l). The total coliform was detected from all shallow groundwater samples. The nitrate nitrogen isotope ranges from 5.6 to 12.3 permil, which overlaps fertilized soil and wastewater nitrogen. Moreover, End-member mixing analysis using hydrogen and oxygen isotope values revealed spatial distribution in the contribution ratios of the local precipitation and domestic water (sewage and tap). The concentration of nitrate nitrogen and total coliform was increasing along with contribution ratios of precipitation in shallow groundwater, except some samples that has high nitrogen isotope and chloride concentration. This trend suggests that the nitrate source in this area is not only from sewage leakage. It also needs to consider the loading of the nitrogen fertilizer to shallow groundwater by the precipitation infiltration.

Keywords: tokyo, urban, groundwater, nitrate nitrogen and oxygen isotopes