Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

U001-01 Room:304 Time:May 22 09:00-09:30

Coastal urbanization: challenges and opportunities for resilience

Mark Pelling[1*], Maki Tsujimura[2]

[1]King's College London, [2]University of Tsukuba

Resilience is establishing itself as a key term in policy and academia yet with only limited reflection on its meaning and implications for sustainable development policy. Dominant interpretations of resilience emphasis the capacity of systems to resist external stress or return to a pre-disturbance state, yet this denies the progressive potential of the term. An alternative conceptualisation sees resilience as a pathway to change - as a transformative concept. The stresses of climate change and urbanization mean that coastal cities will either be forced to change structure and functions, or can proactively choose a transformative path. This paper examines the nature of resilience and then applies this to examine the specific challenges and opportunities for moving towards a transformative vision of resilience for urbanizing coastal zones, and megacities in particular. The paper is an initial product of a review of global knowledge on urbanization and coasts undertaken by LOICZ and other partners for the IGBP and provides an opportunity for feedback and participation.

Keywords: LOICZ

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

U001-02 Room:304 Time:May 22 09:30-10:00

Flood and sewage control in historical coastal cities in Croatia

Yosuke Yamashiki[1*], Naoko Kimura[1], Nevenka Ozanic[2]

[1]DPRI Kyoto University, [2]University of Rijeka

In the coastal area of Croatia, there are beautiful touristic cities, Rijeka, Split, and Dubrovnik, located in Adriatic Sea. All of these cities are famous for their historical heritages which attract tourists from all over the world, especially from north and central Europe during summer season. Since those cities are build in centuries ago, the basic drainage system for flood protection sanitation are not modernized. Severe flushflood occurred in Dubrovnik in November 2010 which shows unpreparedness of those cities for such flood risk. On the other hands, all coastal zone in Adriatic Sea are famous for their beautiful coastal area with good quality of water. This presentation introduces the status of those cities focusing on both flood and water quality issues, also associated material circulation from mountain zone in surrounding city area into Adriatic Sea affecting water quality in Adriatic Sea.

Keywords: Adriatic Sea, Historical heritage, Coastal zone, Flushflood, Sanitation system

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

U001-03 Room:304 Time:May 22 10:00-10:15

Evaluation of natural capacity and social capability for sustainable use of subsurface environment in Asian cities

Makoto Taniguchi[1*], Jun Shimada[2], Yoichi Fukuda[3], Makoto Yamano[4], Shin-ichi Onodera[5], Shinji Kaneko[5], Akihisa Yoshikoshi[6]

[1]Research Institute for Humanity and Natu, [2]Kumamoto University, [3]Kyoto University, [4]ERI, University of Tokyo, [5]Hiroshima University, [6]Ritsumeikan University

In order to suggest sustainable management of subsurface environment in Asian coastal cities, natural capacities indices such as groundwater storage, recharge rate, redox etc., and changing society and environmental indices were evaluated for seven Asian cities during the last 100 years. Numerical modeling of the subsurface environment was established for Tokyo, Osaka, Bangkok, and Jakarta to evaluate the groundwater recharge rate/area, residence time, exchange of fresh/salt water. Using updated GRACE data, groundwater aging methods by CFCs and 85Kr, subsurface temperature analyses in urban and suburban area, and groundwater contamination analyses, revealed how deep did human impacts reach into the subsurface environment during the last 100 years. Changing society indices, such as population and income (Driving force), groundwater pumping and dependency (Pressure), groundwater level (State), land subsidence (Impact), and regulation of pumping (Response), have been made on a yearly basis for seven cities during the last 100 years. Five development stages of the city are recognized in Tokyo based on the DPSIR, and six other cities are compared with Tokyo for (1) land subsidence, (2) groundwater contamination, and (3) subsurface thermal anomaly. As results, we found that human impacts on subsurface environment reached to a few hundred meters depth during the last 100 years. The turnover time of groundwater was more than 10 times (acceleration of the groundwater circulation), material loads reached up to 3 to 6 times (Nitrogen), thermal storage was 2-3 times higher compared with the average increased by global warming during the last 100 years. Groundwater volume and material load to subsurface environment are manageable, however we need monitoring of material/heat accumulation in subsurface environment for sustainable use of subsurface environment. Integral management beyond the boundaries of surface-subsurface and land-ocean are necessary based on natural capacity and use of social capability such as late comers benefit.

Keywords: subsurface environment, natural capacity, capability, urbanization, groundwater, contamination

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

U001-04 Room:304 Time:May 22 10:15-10:30

Groundwater vulnerability to Pollutions in Asian megacities

Shin-ichi Onodera[1*], Mitsuyo Saito[2], Makoto Taniguchi[3], Takahiro Hosono[4], Yu Umezawa[5], Yuta Shimizu[1]

[1]Hiroshima University, [2]Ehime University, [3]Research Institute of Humnity and Nation, [4]Kumamoto University, [5]Nagasaki University

Urbanization causes the convergence, consumption and disposal of material. Consequently, soil and groundwater pollution occurs at many cities. In the Material Group of the RIHN project conducted by Makoto Taniguchi, we have conducted the intensive researches of groundwater pollution in two different seasons at Bangkok, Jakarta and Manila as well as research in one season at Taipei and Seoul. In addition, we have conducted the monitoring of SGD and collection of rainwater, sediment core and porewater at the coastal zone at Osaka, Manila, Bangkok, and Jakarta. In my presentation, I would like to report the review of our researches.

The results are summarized as follows:

1) Our researches indicated huge accumulation amount of trace metal and dissolved nitrogen in groundwater, especially in Jakarta and Manila. Then, various N sources and denitrification were confirmed by using N isotope distribution in groundwater. In addition, As contamination in deep groundwater were detected at some cities. But As and NH4+ contamination originated by natural sources were suggested by some results.

2) Various groundwater salinisations were compared in Osaka, Bangkok and Jakarta. The difference of marine alluvium volume (same as topographic gradient), natural recharge and intensive pumping period controlled salinisation.

3) Soil pollution was confirmed in Bangkok. Trace metal content was higher in the central of the city than in the others. And organic pollution and metal pollution histories were reconstructed, using marine sediments. In addition, the differences of the peak in each trace metal were confirmed.

4) Less terrestrial submarine groundwater discharge but huge material flux by total SGD was confirmed. Spatial variation in SGD was estimated in around each cities, using topographic model and Rn measurements.

5) Some new methods were established. Firstly, analysis system of dissolved N2/Ar in groundwater was applied for reconstruction of dinitrification in groundwater and nitrate content during the groundwater recharge. Second one is Rn analysis system for the quantification of SGD and seawater intrusion. Third one is the purification method of organic chlorine pollution.

Keywords: megacity, pollution, groundwater, vulnearbility

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

U001-05 Room:304 Time:May 22 10:45-11:00

Research on Effect of Urban Thermal Mitigation by Heat Circulation through Tokyo Bay

Toshiaki Ichinose[1*], Kazunori SUZUKI[2], Kojiro SUZUKI[3], Satoko SEINO[4]

[1]NIES / Nagoya University, [2]Yachiyo Engineering Co., Ltd., [3]Port and Airport Research Institute, [4]Kyushu University

The Japanese Ministry of the Environment recently has clarified that only 1 deg. C drop in the temperature during daytime in central Tokyo might be achieved by the following implementations conducted in all 23 wards in Tokyo: 1) the anthropogenic heat from office buildings (50 %) and traffic (20 %) can be reduced; 2) replacement of 50 % of asphalt-paved surfaces with permeable paving surfaces can reduce the heat; and 3) greenery planted on 50 % of rooftops of buildings can reduce the heat (MoE, 2001). To mitigate urban thermal conditions, we have formulated a new strategy that effectively uses the sea breezes flowing into the Tokyo Metropolitan Area from Tokyo Bay with efficiency, when the temperature goes above 30 deg. C on a typical summer day. Tokyo Bay can develop high sea surface temperatures in response to daily high levels of anthropogenic heat discharge. If cool breezes would flow into the Tokyo Metropolitan Area from Tokyo Bay on a typical summer day, then it would be possible to mitigate the urban heat islands more beneficially. Therefore, to decrease the bay surface temperatures and thus to enhance the cooling effect of the sea breezes, we need to bring deep-ocean water from about 300 m to the surface.

The authors performed interviews with several national experts in relevant disciplines. Most of the experts pointed out the fact that water quality control before releasing deep-ocean water into bay is necessary, especially in summer season, when the water is nutrients-poor. On the other hand, water in Tokyo Bay actually shows higher concentration of nutrients than deep-ocean water. In case of Tokyo Bay, releasing deep-ocean water into bay might not cause a large negative impact to the water quality.

Rough estimation of the heat island mitigation project costs for all 23 wards in Tokyo is as follows:

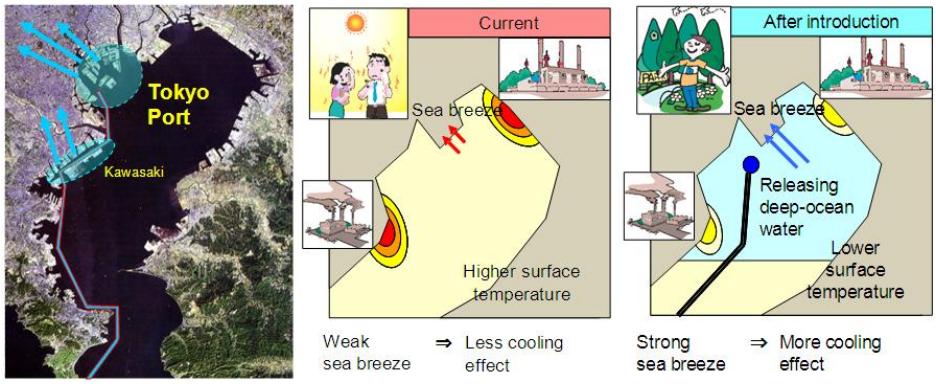
Water retentive pavement: 70 million (m2) x 18,000 (JPY/m2) = 1.30 trillion (JPY)
Rooftop vegetation: 140 million (m2) x 20,000 (JPY/m2) = 2.80 trillion (JPY)

Nowadays water quality problems in Tokyo Bay are not solved completely. The authors' idea is regarded to be available as a part of water pollution control in Tokyo Bay. Rough estimation of the initial costs on the water pollution control actions in Tokyo Bay is estimated to be 1.3 trillion (JPY) for the sewage treatment and 1.2 trillion (JPY) for the river management. On the other hand, cost for installing floating pipelines etc. to bring deep-ocean water to the surface is calculated as follows:

50 (km) x 2.5 billion (JPY/km) = 125 billion (JPY)

Based on monitoring data, Suzuki et al. (2004) showed that 9x1,000,000,000 (m3) of water, which is a half volume of Tokyo Bay, can be exchanged with outer-ocean water during 5 days in summer in an ordinary situation. This results support the authors' idea that transporting outer-ocean water to Tokyo Bay is reasonable. Southerly wind is a driving force of this in-flow at the surface layer of Tokyo Bay. A numerical simulation with CSU-MM (e.g. Ichinose, 2003) showed that 2 deg. C decrease in bay's sea surface temperature on fine days of late July would lead to 1 deg. C drop in air temperature in central part of Tokyo and to 1 m/s enhancement of the bay breeze.

To mitigate urban thermal conditions in the Tokyo Metropolitan Area, we have formulated a new strategy that propose an effective use of the sea breezes flowing into the area from Tokyo Bay on a typical summer day. We also demonstrated (1) the mechanism of heat exchange between the water surface of the bay and the atmosphere; (2) the mechanism for keeping the water surface area of the bay cool after bringing the deep-ocean water up; and (3) the advantage of already well known counteractions, such as the rooftop vegetation and water retentive pavement, over the strategy described in the cost analysis.



Keywords: heat island, Tokyo Bay, deep-ocean water, sea breeze, environmental improvement

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

U001-06 Room:304 Time:May 22 11:00-11:15

Observation of Nitrous Oxide concentration in the water in the Yodo River estuary

Mitsuru Hayashi[1*]

[1]Kobe University

Nitrous Oxide (N_2O) is one of the greenhouse effect gases. N_2O is generated by nitrification and denitrification processes. Therefore its concentration in drinking water is high, and it of the waste water after the sewerage is considered also to be high. In this research, N_2O concentration in the water was observed in the Yodo River estuary to estimate N_2O flux from the ocean to the air. The Yodo River flows to the inner part of Osaka Bay, and has much water volume. A red tide happens frequently and there is much sediment in the inner part of Osaka Bay due to the nutrient supplying from rivers and so on. And the sewerage plant is in the Yodo River estuary. It was observed at 6 sites in the distance of 15 km between the headwater of the sewerage plant and the estuary. N_2O concentration in the surface water were highest in the middle part of the site which is near the river mouth. It was about 2 ppm and was about two times of the river and sea water. It is considered that generated N_2O by denirtificate in sediment was released and spread to the surface, because near the river mouth is shallow. And it was suggested that N_2O was generated by nirtificate in the surface seawater, too. Nitrification and denitrification in sediment and the water contributed to N_2O generation more than the waste water in the Yodo River estuary. And this high concentration N_2O was released to the air.

Keywords: Nitrous Oxide, Concentration in the water, Greenhouse effect gas, Yodo River, Estuary, Observation

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

U001-07 Room:304 Time:May 22 11:15-11:30

Challenge and Obstacles in Water Quality Improvement and Water Environment Conservation - Ujjani Lake Basin, India

Naoko Kimura[1*], Sandeep Joshi[2]

[1]DPRI - Kyoto University, [2]Shrishti Eco-Research Institute (SERI)

In this research, I will introduce a few practices on water quality improvement and the role of citizens' involvement for awareness-raising in the Ujjani Lake basin, India, as well as attempt to suggest recommendations for their further development. Pune city is one of major cities in India and located in western part of India, near Mumbai. Pune is now growing as a centre of IT industry in India and a number of IT related private sectors are coming into the city. There is Ujjani Lake (reservoir) located about 100km away from Pune. The lake basin has the Mula River and the Mula-Mutha River running through Pune and its outskirt area. One of severe problems in Ujjani Lake is degradation of water quality. The lake water exerts bad odor in some parts of its shore and creatures that habit in polluted water are observed. The amount of discharged water into the Mula River and the Mula-Mutha River has increased in proportion to the population growth and industrial development in Pune. With this background, there have been a various activities and movements taking place in Pune and its outskirt in order to improve water quality in the rivers and lake. Pune municipality government is conducting a project for sewage system development, and local experts and NGOs are working on water quality improvement project, tree planting on the river bank, paper-recycling promotion by women's groups, a campaign to stop throwing away garbage at the slums along the river, and citizens-driven water environment conservation with cultural experiences. Although there have been some difficulties in the process of developing mutual understanding between the municipality government and citizens, their awareness of water environment has been reached higher level than before. In particular, women's self-esteem has been obviously raised, and their spontaneous development has given a positive influence to raising-awareness in men. In the rural area, it is still not easy for women to participate to those activities, however, there seems to be excellent learning on water environment and respect to cultural value that have been taken over beyond the generation through those activities.

Keywords: basin management, water quality improvement, participation, gender

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

U001-08 Room:304 Time:May 22 11:30-11:45

Apparent groundwater age rejuvenation caused by excessive groundwater pumping in the Jakarta area, Indonesia

Makoto Kagabu[1*], Jun Shimada[1], Toshio Nakamura[2], Makoto Taniguchi[3]

[1]Grad.Sch.of Sci.&Tech., Kumamoto Univ., [2]Center for Chronol. Res., Nagoya Univ., [3]Research Inst. for Humanity and Nature

In the Jakarta area (Indonesia), excessive groundwater pumping due to the rapidly increasing population has caused groundwater-related problems such as brackish water contamination in coastal areas and land subsidence. These problems have emerged recently in some hydrological studies. A comparison of ^{14}C activity between 1985 and 2008 shows apparent groundwater age rejuvenation in the deep aquifer under the DKI Jakarta. We use a numerical groundwater flow model to discuss and evaluate the process of this rejuvenation in the urbanized area. Before 1983, groundwater pumping was not intense and the groundwater discharge flow toward the coastline was dominant; however, this outward flux changed to inward flux into the deeper aquifer after the mid-1980s because of over-pumping in the urban area. The largest flux among six flux directions toward the deep aquifer under the DKI Jakarta became the 'vertical downward flux,' indicating shallower groundwater intruding into the deep aquifer due to excessive groundwater pumping from the mid-1980s. This flux increased to approximately 50% in the 2000s. This result is consistent with the detection of CFC-12 and SF_6, an indicator of young groundwater, appearing in deep groundwater. As the rejuvenation ratio 'R' was determined by using the ^{14}C activity in the groundwater, R increased with the CFC-12 concentration, exhibiting good correlation between R and the CFCs. We also estimated the 'vertical downward flux' at each well's screen depth using a numerical model estimation. The results show that the flux was larger in the urban groundwater depression area, especially in the shallower part of the deep aquifer, affecting the magnitude of the shallow groundwater intrusion. If this trend continues into the future, the groundwater potential would decline further and the deeper groundwater would be even more affected by shallow groundwater that is highly polluted by urban contaminants such as NO_3^- and by seawater intrusion. This would cause deterioration in the quality of the deep groundwater, posing a high risk for those using it as potable water. Although stopping excessive pumping is a difficult task for the rapidly urbanizing Jakarta area, it is necessary to reduce this over-pumping situation by either securing alternative water resources or introducing pumping regulations such as groundwater tax.

Keywords: Groundwater age, Apparent age rejuvenation, ^{14}C, Groundwater flow simulation, Jakarta

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

U001-09 Room:304 Time:May 22 11:45-12:00

Anthropogenic effect on groundwater flow system in Bangkok metropolitan area, Thailand

Maki Tsujimura[1*], Atsushi Hagihara[2], Tsutomu Yamanaka[1], Jun Shimada[3], Makoto Taniguchi[4]

[1]University of Tsukuba, [2]Yamanashi Prefectural Office, [3]Kumamoto University, [4]Res Inst Humanity and Nature

Multi tracers approach using CFCs and stable isotopes was applied to investigate an anthropogenic effect on the groundwater in Bangkok, Thailand. The CFCs concentrations were observed in the deep groundwater at the depth of 200 m in the regions where the drawdown of the groundwater level was clearly monitored in Bangkok metropolitan area. This suggests a vertical groundwater recharge is induced and a mixing of the shallow and deep groundwater occurs due to the excess pumping up.

A numerical simulation was conducted to present the mixing of the shallow groundwater into the deep groundwater due to the induced recharge. The mixture ratio of the shallow groundwater containing the CFCs in the deep groundwater was estimated to be approximately 10%.

The mixture of the shallow and deep groundwater should cause an underestimation of the average residence tome of the deep groundwater to be approximately 1000 years.

Keywords: Groundwater flow system, Anthropogenic effect, Induced recharge, CFCs, Bangkok