Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG36-01 Room:102A Time:May 22 11:00-11:15

Changes in Carbon dioxide concentration in the air and surface seawater of Osaka Bay

Tomoyasu Fujii[1*]

[1]Nara University of Education

Continuous measurement technique of CO_2 concentration in surface seawater which was easy to use in the coastal sea is developed and applied to elucidate long-term CO_2 dynamics in the coastal regions, where the short-term change is significant. Continuous measurements of salinity, pH and DO were conducted at two stations in Osaka Bay. The values of pCO_2 were calculated using the "CO_2SYS" by CDIAC that uses pH and total alkalinity. As a result, the measurement technique which we developed had enough accuracy, and it became clear that long-term data could be acquired. In summer and autumn, surface water CO_2 fluctuation had large diurnal change by photosynthesis, and atmospheric CO_2 is absorbed to sea water. In the winter when the stratification disappears, CO_2 in seawater is released to the atmosphere.

Keywords: Carbon dioxide concentration, anoxic water mass, Osaka Bay

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG36-02 Room:102A Time:May 22 11:15-11:30

Salinization and heavy metal contamination in Tsunami disaster area

Shin-ichi Onodera[1*], Ichirow Kaihotsu[1], Koki Onishi[2], KIYOSHI SAIJO[3], Mitsuyo Saito[4]

[1]Integrated Sciences, Hiroshima University, [2]Fukken Co., [3]Miyagi Education University, [4]Ehime University

Tsunami caused instantaneously the supply of seawater and sediment deposited on the sea bed to the coastal land. That is a sudden interaction of land and sea. But its effect would continue for a long period. It is an important issue for our water and land resources. For managing and conserving the water resources and agricultural lands in Tsunami disaster area, we aim to confirm salinization and heavy metal contaminations from surface soil to groundwater. We conducted soil and water collections in around Sendai and Minami-Sanriku of Miyagi prefecture and Rikuzen-Takada and Kamaishi of Iwate Prefecture in June and September of 2011 and August of 2012.

We observed the saline crust on the land surface at the each place of Tsunami disaster area. Our observation of a surface soil from the coastal line to the edge of a Tsunami reach in southern Sendai indicated the exponential decline of saline content and the recovery of salinization for the three months from June to September. But the saline content at the most coastal plot increased, because saline accumulation occurred probably by the evaporation. On the other hand, groundwater was rapidly in terms of the recovery.

The chloride concentration at the surface soil from the ground surface to the depth of 1 cm has highest at the most plots in August in 2012. We observed the deposition of marine sand with the thickness of 15 cm above the original ground surface at the plot in Kamaishi. This saline content was highest in the all plots and the twice of sea content. In addition, we detected the higher heavy metal concentration than the water quality standard. Especially, the manganese and cupper were detected higher concentration than it at the surface soil of the every plots. We should notice to manage the surface soil as the contamination potential and to conserve the groundwater resources and agricultural soil.

Keywords: Tsunami, disaster, salinization, heavy metal pollution, groundwater

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG36-03 Room:102A Time:May 22 11:30-11:45

The water budget of a coastal lagoon and its relation to a previous mega tsunami

Abdullah Mamun[1*], Kazuhisa Chikita[2], Wataru Iwasaka[1]

[1]Graduate School of Science, Hokkaido University, [2]Faculty of Science, Hokkaido University

Five coastal lagoons, opening a few times per year to the Pacific Ocean, are located on the southeastern coast of Hokkaido, Japan. The opening to the ocean is produced by incising the sand bar from the overflow and discharge of lagoon water at the lowest site of the sand bar. The overflow results from an increase of the lagoon water level basically by snowmelt or rainfall river runoffs. The ecosystems of the lagoon and the back marsh are made up by climate conditions and water and material cycles between the lagoons and their drainage basins, and between the lagoons and the ocean. In order to understand the water-cycle system in the lagoons, the water budget of Oikamanai Lagoon, one of the five lagoons, was estimated by establishing a bathymetric map of high accuracy (0.2m depth interval), and by monitoring the meteorology, lagoon water level and river stage. The estimate of the water budget under closed condition of the lagoon revealed that the groundwater output to the ocean through the gravelly confined aquifer below the sand bar is balanced by river water input. The location of the gravelly confined aquifer is restricted to near the sea level along the sand bar about 2000 m long. This suggests that the whole sand bar was broken at a stroke by a previous mega tsunami (probably Keicho-Sanriku Tsunami in 1611) and then was again reconstructed. Here, the heat budget and hydrodynamics of the lagoon are also discussed.

Keywords: coastal lagoon, water budget, confined groundwater, mega tsunami

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG36-04 Room:102A Time:May 22 11:45-12:00

The characteristics of sediment load from a coastal forested drainage basin and their agents

Wataru Iwasaka[1], Kazuhisa Chikita[2*], Abdullah Mamun[1], Md Motaleb Hossain[1]

[1]Graduate School of Science, Hokkaido University, [2]Faculty of Science, Hokkaido University

The five coastal lagoons in the Tokachi region of southeastern Hokkaido open a few times per year to the Pacific Ocean. The openings affects water quality and deposits in the marine coastal region by discharging the lagoon water offshore. The Oikamanai River is a main river flowing into the Oikamanai Lagoon. The river basin is almost forested (ca. 88 % in area), from which the discharge and sediment load build up the ecosystem of the lagoon and its back marsh. The sand bar damming up the lagoon involves the gravelly confined aquifer of some thickness near the sea level. Such an internal sedimentary structure was probably constructed after the destruction of the sand bar by a previous mega tsunami (probably Keicho-Sanriku Tsumani in 1611). In order to explore how the suspended sediment discharges into the Oikamanai Lagoon, we obtained hourly time series of discharge, Q (m3/s), and suspended sediment concentration, C (mg/L), in the upper Oikamanai River. As a result, 50% of twenty Q vs C relations exhibited the counterclockwise hysteresis (i.e., the peak C is preceded by the peak Q). This suggests that the sediment source is located in the subsurface zone of the river basin.

Keywords: river sediment load, coastal region, forested river bain, hysteresis

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG36-05 Room:102A Time:May 22 12:00-12:15

Role of river runoffs on ocean environment and fishery production around Funka Bay, Japan

Satoshi Nakada[1*], Yoichi ISHIKAWA[2], Toshiyuki AWAJI[3], Teiji IN[4], Koji KOYAMADA[1], Sei-ichi SAITOH[5]

[1]Institute for the Promotion of Excellence in Higher Education, Kyoto University, [2]Japan Agency for Marine-Earth Science and Technology, [3]Kyoto University, [4]Japan Marine Science Foundation, [5]Faculty of Fisheries Sciences, Hokkaido University

The land-sea interaction can be comprehensively analyzed by using high-resolution datasets produced by a land-sea-coupled simulation that are well validated based on observational datasets. Recently, a land-sea-coupled model was developed toward an operational ocean prediction system in semi-enclosed Funka Bay (located in northern Japan) to inform fishermen of the real-time ocean state.

Subarctic Oyashio (OW) and subtropical Tsugaru waters (TW) originating from the Kuroshio alternately flow into Funka Bay from the North Pacific and mix at various timescales, leading to unique oceanographic features. The rivers flowing into Funka Bay have small watersheds facing the bay (up to approximately 500 km^2) and supply buoyancy through the snowmelt runoff. These unique features are key for fishery resources managements (e.g., skipjack, salmon, and kelp) and ocean biodiversity.

In this paper, we investigate the role of the river runoff on the formation of water masses and velocity field in the bay based on the high-resolution simulation outputs. We discuss about the influence of the interannual changes of land-ocean environment on the fishery production of kelp. The main factor for poor production of kelp in 2009 is examined by analyzing the remarkable contrast of the land-ocean condition and kelp production between 2008 and 2009.

A coupled land-ocean model was composed of the Kyoto Ocean General Circulation Model (OGCM) using the four-dimensional variational data-assimilation and Hydrometeorological and multi-Runoff Utility Model (HaRUM). The high-resolution simulation was conducted by the three-step nesting method to reproduce the eddy-resolving circulation in/around the bay. HaRUM employed a distributed tank model based on the water mass and heat budgets to estimate the runoff on a daily basis.

The coupled model reproduced a surface salinity field that was in good agreement with observational results and simulated outputs in the bay from 2008 to 2009. The clockwise circulation was generated by wind and river runoff in spring and its vorticity was intensified from March to May. The freshwater discharge takes a seasonal maximum associated with snow-melting events from March to June, indicating that the buoyancy provided by snowmelt runoff intensified the vorticity of the clockwise circulation.

The clear contrast was found in both physical features observed in 2008 and 2009 in the bay. The clockwise circulation in 2009 was stronger than that in 2009. This was induced by higher snowmelt runoff in 2009 than that in 2008. The amount of the summer-time surface water in Funka Bay (FS) was greater in 2009 than in 2008, which is attributable to a larger amount of snowmelt runoff. The intrusion of TW and OW in 2008 was found, but both were hardly found in 2009, leading to the interannual difference in the stratification inherent in the bay. This ocean condition in 2009 affected the annual production and growth rate of kelp.

The impacts of river runoff on the water mass distribution in the bay were evaluated by conducting the sensitivity experiment. Two numerical experiments were conducted; one case used the coupled land-ocean model, and the other used the OGCM without HaRUM in typical year, 2008. The experiment indicated that the FS in the case without HaRUM was much less than the case by the coupled model. The amount of the mixed water MW, a blending of mainly FS and TW through winter surface cooling, was formed in the case of the coupled model, which was much greater than that without HaRUM.

As a result, the river runoffs that supply fresh water, buoyancy, and nutrient into the bay are essential for formation of water masses, circulation, primary production in the bay, respectively. Our results underline the fact that implementation of hydrological processes into ocean simulations is a key factor for a better understanding of the water circulations driven by runoffs into semi-enclosed bays over interannual timescales.

Keywords: land-sea interaction, a land-sea-coupled model, snowmelt runoff, water mass formation, high-resolution simulation, Funka Bay

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG36-06 Room:102A Time:May 22 12:15-12:30

Interrelationship between water discharge and suspension transport of the Yangtze River

Tomohisa Irino[1*], Keita Saito[2], Ryuji Tada[2], Yoshiaki Suzuki[2], Chao Luo[3], Hongbo Zheng[4]

[1]Faculty of Environmental Earth Science, Hokkaido Univ., [2]Faculty of Science, Univ. of Tokyo, [3]Nanjing Univ., [4]Nanjing Normal Univ.

Water discharge and suspension load of a river are potentially recorded in sediments in the drainage and / or the river mouth. Isotope composition of fossil calcareous skeletons and detrital provenance and flux reconstructed from the sediment samples could provide us useful proxies for paleoclimatic study. Sediment load from the Yangtze River to the East China Sea (ECS) from the delta to the Okinawa Trough have been widely used to reconstruct the East Asian summer monsoon (EASM) in the past since the water discharge from the Yangtze would be highly affected by monsoon rain, which could deliver much fresh water and sediment to the ECS. The past impact of fresh water from the Yangtze could be reconstructed from stable oxygen isotope signal recorded in the fossil calcareous skeletons found in the ECS sediments, which has also been used as proxy for EASM.

Theoretically, sediment provenance and its yield could be changed from time to time depending on the distribution of precipitation which would control the balance of water discharges from the tributaries. Change in the precipitation distribution also affects the water isotopic composition of each tributary and then the main stream of the Yangtze. Although such variability could change the end-member composition and concentration of the fresh water and sediment load provided to the ECS, paleoceanographic studies in this region have not considered well about the potential change in the basic condition. Therefore, we need to know the water isotope and sediment budget along the Yangtze main stream with regards to the inputs from its major tributaries in order to understand the potential effects from the change in the distribution of the EASM precipitation.

For this purpose, we have started a systematic sampling of the Yangtze River water to determine the stable oxygen and hydrogen isotope ratios and suspension loads during summer in 2011 and winter in 2012. Water samples were taken at main junctions of the major tributaries. The amount of suspended solids (SS: mg/L) of water sample is determined from the weight of solid particles filtered out on nitrocellulose filter and the volume of water filtered. Hydrogen and oxygen isotope ratio of water sample was measured using ThermoFisher Scientific MAT253 Isotope Ratio Mass Spectormeter with GasBench II.

Water discharge of the Yangtze main stream is approximately 4 times higher in summer than in winter, and the summer discharge increases downstream from ˜6,000 m3/s in the Sichuan Basin to ˜40,000 m3/s at Nanjing. SS of mainstream is always higher than any other main branches and several to ten times higher in summer than winter. SS is diluted by the less turbid branch water and the summer SS decreases downstream from ˜430 mg/L in the Sichuan Basin to ˜85 mg/L in Nanjing. Though SS tends to be diluted at every junction with clean branch water, the total transported SS is maintained nearly constant along whole main stream path. Seasonal contrast of SS is significantly larger in the upstream than downstream, which suggests that the upstream responds more sensitively to a discharge event (e.g. heavy rain or flooding).

Summer oxygen isotope value in the upper Jinshajian is -14 permil VSMOW and the value is increased downstream to -8.2 permil VSMOW at Shanghai by the mixing of isotopically heavier water from branches. Slightly larger difference of isotope value between upstream and downstream in summer than in winter suggests the contribution of the EASM precipitation in the region close to the vapor source ocean and of lower altitude. However, summer isotope ratio and d-excess of the branches in the lower reach is higher than winter ones, which also suggests the effect of more active evaporation during summer.

Keywords: Yangtze River, discharge, suspension composition, suspension load