Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

ACG07-01 Room:201B Time:May 27 09:00-09:30

Variability of the Sun

ISOBE, Hiroaki[1*]

[1]Unit of Synergetic Studies for Space, Kyoto University

The Sun is a variable star. In addition to the evolution of its internal structure and the rotational velocity as a main sequence star, its magnetic activity changes with time scales from seconds to millennia. Accordingly, the solar influence on the terrestrial environment also changes. The temporal variation of the solar magnetic activity results in the variation of the electromagnetic radiation, the solar wind and the energetic particles. The variation of the energetic particles consists of the variation of the solar energetic particles, which positively correlates with the solar magnetic activity, and the variation of the galactic cosmic rays, which negatively correlates with the solar magnetic activity. In this presentation I will summarize the current understandings of the mechanisms and the terrestrial consequences of the solar variability in various time scales. Then I will introduce selected recent topics, such as the UV/EUV radiation of the abnormally quiet minima in the last solar cycle, and the investigation of the past solar activities recorded in the historical documents.

Keywords: solar physics, solar variability, solar UV radiation, sunspots

Japan Geoscience Union Meeting 2015
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ACG07-02 Room:201B Time:May 27 09:30-09:45

A new set of Indo-China monsoon indices

BEHERA, Swadhin[1*] ; TSAI, Chin leong[2] ; WASEDA, Takuji[2]

[1]Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan, [2]OTPE, The University of Tokyo, Japan

Southeast Asia often suffers from severe floods and droughts, and these disasters have caused huge socio-economical impact to the region. For example, Thailand alone lost 50 million USD due droughts in 2010 and lost another 45.7 billion USD due to floods in the following year. Thailand flood in 2011 alone has caused an acute shortage of HDD in the global market, which shows the extent of the climate influence on the interconnected global economy in the modern world. Though several studies in the past have tried to link the region′s rainfall with the dominant modes of tropical climate variations, there still exist a lot of uncertainties. In a recent study, it is found that El Nino/Southern Oscillation (ENSO) and the recently found ENSO Modoki influence the southern Myanmar and Thailand rainfall but only during March-May. Interestingly, from the correlation and composite analyses, it is found that the variation in the large-scale monsoon influences the local monsoon wind and thereby the rainfall anomalies over those two regions through anomalous transports of moisture in boreal summer and fall seasons in addition to the boreal spring season. Furthermore, the regional monsoon winds that influence the local rainfall is in fact connected to the basin-scale Indian Monsoon and the Western North Pacific Monsoon through the large-scale processes. The variations of the regional monsoons are captured by a set of newly defined indices.

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ACG07-03 Room:201B Time:May 27 09:45-10:00

Oceanic response to river outflows

KIDA, Shinichiro[1*] ; YAMASHIKI, Yosuke[2]

[1]Application Laboratory, Japan Agency for Marine-Earth Science and Technology, [2]Graduate School of Advanced Integrated Studies in Human Survivability, Kyoto University

The oceanic response to river outflows is investigated using a new seamless hydrological-ocean coupled model, with a focus on high water discharge events. High frequency and vigorous events are often not well reproduced in climatological river-transport datasets that are used in ocean circulation models. When the model is forced with observed precipitation data, river discharges occur on land and a freshwater plume begins to form near the river mouth. This freshwater plume remains attached to the coastline with the land toward its right (northern hemisphere). The model shows the movement of the freshwater/seawater interface as the discharge rate change. As the discharge rate increases, the interface moves toward the sea as it thickens near the river mouth. With high water discharge rates, the Froude number of the river outflow also becomes over one near the river mouth and forces localized shear-driven diapycnal mixing. This mixing results in abrupt increase in the volume transport of the freshwater plume near the river mouth. We find the ocean to quickly respond to this mixing as well and establish a circulation to support the water mass lost to the freshwater plume.

Keywords: River outflows, High discharge event, Freshwater plumes

Japan Geoscience Union Meeting 2015
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ACG07-04 Room:201B Time:May 27 10:00-10:15

High resolution downscaled modeling of coastal ocean processes

VARLAMOV, Sergey[1*] ; MIYAZAWA, Yasumasa[1] ; YAMASHIKI, Yosuke[2]

[1]JAMSTEC, [2]Kyoto University

System of nested ocean circulation models is used for analysis of coastal oceanic processes including river discharges to the ocean along the Pacific coast of Japan. An accent is made on the coastal waters east off Tohoku area and on Abukuma river fresh waters propagation and diffusion in Pacific Ocean.

All nested models have same vertical resolution with 46 generalized sigma levels. The low spatial resolution (about 10 km) ocean model is an assimilative non-tidal JCOPE model, when intermediate (about 3 km) and high resolution (about 0.5 km) models are both tide-resolving models.

Results of modeling with these models are compared and high resolution dynamics of ocean variability is demonstrated and discusses.

Keywords: ocean modeling, downscaled simulation, coastal processes

Japan Geoscience Union Meeting 2015
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ACG07-05 Room:201B Time:May 27 10:15-10:30

MODELING RADIOCESIUM FLUX TO THE OCEAN FROM RIVERS IN FUKUSHIMA AND SENSITIVITY ANALYSIS ON INPUT DATA RESOLUTION

PRATAMA, Mochamad adhiraga[1*] ; YAMASHIKI, Yosuke[2] ; YONEDA, Minoru[1]

[1]Department of Environmental Engineering, Kyoto University, [2]Graduate School of Advance Integrated Studies in Human Survivability, Kyoto University

A large amount of radiocesium was released from The Fukushima Dai-Ichi Nuclear Power Plant (FDNPP) accident and deposited in the catchment of east coast rivers in Fukushima Prefecture. In the previous study, a compartment model has been developed and used for estimating the flux of radiocesium from Abukuma River. Since it gave a satisfactory result, the reliability of the model was evaluated by applying it on the east coast rivers in Fukushima Prefecture. We attempted to estimate the radiocesium flux into the Pacific Ocean from 16 rivers located in east coast of Fukushima Prefecture. Moreover, the future projection of the flux for 100 years has been estimated. The model relies on wash off process by which the values are provided on the various previous studies. Numerical technique was used to solve the established equations. During the first year after the accident, the rivers in the east coast released about 17 Tbq of radiocesium. By adding the flux from Abukuma River (10.1 Tbq), the total radiocesium flux from these rivers is higher than the direct discharge from FDNPP (17 Tbq). Based on the 100 years projection, it was estimated that the rivers will discharge about 125 Tbq of radiocesium. Summing up with the discharge from Abukuma River, the total discharge was estimated about 258 Tbq. The estimated data resulting from the model shows an spatial agreement with the observed data by achieving R^2 of 0.95. The accuracy of the model was evaluated by calculating Nash Efficiency Coefficient in which achieved by value of 0.9.This achievement was obtained by using fall out data as the radiocesium input based on the survey by MEXT on more than 200,000 sampling points. Thus, the sensitivity analysis on fall out data resolution was required in order to assess the accuracy of the model in a condition where the fall out data is limited. To create such condition, 3 scenarios were established. Scenario A uses 1000 sampling points as the radiocesium input which were randomly selected for 100 times from 200,000 sampling points. Scenario B and C uses 500 and 100 sampling points respectively. Then, the estimated radiocesium flux to the ocean as the results was compared to the observed data. The value of R^2 from scenario A,B and C are in the range of 0.81-0.85 indicating that even by using 100 sampling points, the trend of the observed data is still in agreement with the estimated data. Moreover, 100% and 99% of the Nash Coefficient values from scenario A and B are over 0.7 and only 7% of Nash Coefficient values from scenario C is below 0.65. This results show that during the condition where the fall out data is limited, the fall out data based on 100 sampling points could be used as the radiocesium input for the model and could produce a good estimation for the radiocesium flux from rivers to the ocean.

Keywords: radiocesium, compartment model, river, east coast of fukushima, sensitivity analysis, resolution of fall out data

Japan Geoscience Union Meeting 2015
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ACG07-06 Room:201B Time:May 27 10:30-10:45

Development of Biwa-3D to predict water quality in lakes and estuaries.

YAMASHIKI, Yosuke[1*] ; AZUMA, Masaki[4] ; SHWETA, Yadav[2] ; TAKARA, Kaoru[3] ; YONEDA, Minoru[2]

[1]GSAIS, Kyoto University, [2]Graduate School of Engineering, Kyoto University, [3]DPRI Kyoto University, [4]Mitsubishi Tokyo UFJ Bank

Biwa-3D, an integrated water quality model, has been developed for water quality assessment in lakes and estuary. Water temperature and dissolved oxygen in Lake Biwa has been numerically simulated using Biwa-3D with 250 m horizontal grid spacing. Calculated temperature has been compared with field observation results by Lake Biwa Environmental Research Institute (LBERI), showing good agreement especially in horizontal direction. The model outputs for dissolved oxygen concentration initially showed earlier decrease compared to the field observation results, which has been modified throughout adjusting vertical mixing procedure during stratified and non-stratified season. The model also showed non-uniform distribution in east-west section, which observation can not support due to the luck of sampling station. Seasonal change in Chlorophyll-a concentration is also simulated and compared with field observation data. Application of the model into different lakes, including Lake Tahoe, is introduced with relevant agreement with field observation dataset. Parallelization of the model enables us to perform long-term water quality prediction.

Keywords: Lake, Water Quality, Dissolved Oxygen, Chlorophyll-a, Long-term variation

Japan Geoscience Union Meeting 2015
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ACG07-07 Room:201B Time:May 27 11:00-11:30

Coastal dispersal of the land-derived tracer in an estuary and a continental shelf margin

UCHIYAMA, Yusuke[1*] ; SUZUE, Yota[1]

[1]Kobe University

Coastal marginal seas and estuaries are generally dumpsites for waster water from sewage and power plants (e.g., Uchiyama et al., 2014). Accidental leakage of toxic materials may result in serious hazardous incidents that should be predicted and assessed urgently upon the occurrence. We therefore develop an offline passive tracer model that computes 3D dispersal of arbitrary Eulerian tracers with a point source capability by exploiting 3D oceanic model reanalysis and prediction such as JCOPE2 (Miyazawa et al., 2009). The purposes of the present study are to investigate (1) reproducibility of the offline tracer dispersal against the online result, and (2) difference in spatiotemporal variability of the leaked tracers in a semi-enclosed estuary (viz., Seto Inland Sea, Japan; SIS) and in an open coast environment on the continental margin off Shizuoka Prefecture on the Pacific side of Japan.

For the first objective, we analyze with the double-nested JCOPE2-ROMS downscaling system for the entire SIS at the horizontal resolution of 600 m. The release site is chosen on the southern coast of the Iyo Sea. The tracer has been discharged for 11 days in 4 different seasons since the 1st day in Feb., May, Aug., and Nov., 2013, and tracked for 31 days after each release. Overall similarity in the dispersal pattern is obtained for both the online and offline cases, whereas some undesirable negative concentration arisen from a discrete advection scheme induces a slight deviation in the inventory of the released tracer between the two cases. Tidal oscillations enhance local dilution, while the month-long transport is dominated rather by inter-seasonal variability of the clockwise circulation of the SIS. The comparative offline tracer computation for the open coast off Shizuoka is conducted with another double-nested JCOPE2-ROMS downscaling model result for the Kuroshio region at the horizontal resolution of 1 km. The tracer release occurs near the Cape Omaezaki and is done in the same way as the SIS runs. The Kuroshio readily traps the released tracer in the offline open coast run, leading to immediate transport in the northeast direction. The seasonal difference of the tracer dispersal is apparent, depending on the locations of the Kuroshio axis.

Keywords: coastal dispersal, Eulerian passive tracer, offline tracer model, ROMS, downscaling ocean model, JCOPE2

Japan Geoscience Union Meeting 2015
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ACG07-08 Room:201B Time:May 27 11:30-11:45

Validation of a long-term tide-resolving oceanic simulation around the coastal areas, Japan

MIYAZAWA, Yasumasa[1*] ; VARLAMOV, Sergey[1] ; WASEDA, Takuji[2] ; MIYAMA, Toru[1] ; GUO, Xinyu[3]

[1]JAMSTEC, [2]The University of Tokyo, [3]Ehime University

In order to evaluate ocean renewal energy potential in Japan coastal ocean, we are conducting an oceanic simulation using an ocean general circulation model with horizontal 3km grid and 46 vertical layers for the period from 2002 to present. Targeted ocean renewal energy includes electric power generation using oceanic geostrophic and tidal currents, and temperature difference. Our simulation product of the oceanic condition will be utilized mainly for feasibility design of possible power plants rather than engineering design of the actual ones. Evaluation of uncertainty involved in the estimate of the energy potential is crucial for considering possible risks associated with planning the development of the power plants. We evaluate two types of the uncertainty related with natural variability and limitations of modeling. The former one could be represented to a considerable extent by a long-term simulation covering a wide range of phenomena with various time scales. The latter one is due to the limitations of model resolution, accuracy of model schemes, and quality of external forcing, etc. We present the model validation results using various kinds of reference data obtained by field observations and simulated by other ocean models, and discuss the uncertainty involved in the simulation.

Keywords: Ocean general circulation simulation, tide, temperature, ocean renewal energy

Japan Geoscience Union Meeting 2015
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ACG07-09 Room:201B Time:May 27 11:45-12:00

CHARACTERISATION OF RADIOCESIUM IN SEDIMENT OF THE SENDAI BAY OFF THE ABUKUMA RIVER DELTA

YAMASHIKI, Yosuke[1*] ; PRATAMA, Mochamad adhiraga[2] ; YAMAZAKI, Hideo[3] ; ISHIDA, Masanobu[3] ; NIWA, Yoshihiro[4]

[1]GSAIS Kyoto University, [2]GSE Kyoto University, [3]Kinki University, [4]GSS The University of Tokyo

Seasonal variation of radiocaesium concentration in the bottom sediment near Abukuma River mouth were observed in order to verify the potential impact of high radiocaesium flux from Abukuma River into the Pacific Ocean. Based on the hydrodynamic parameter obtained in the bay, complex estuary circulation were affecting contaminated suspended material along the shoreline, indicating that contaminated bottom sediment are always in the motion both affected by the river flow and estuary circulation. According to the numerical estimation of radiocaesium flux from Abukuma river basin, it was indicated that the highest concentration of bottom sediment may occur just after the heavy rainy season, whereas during dry season concentration of the bottom sediment might be reduced. Our seasonal observation showed that highest concentrations were observed in September, when the precipitation and thus total road from Abukuma river basin was highest in 2013, where observation in the dry season showed lower concentration of radiocaesium. It was first observed proof which, bottom sediment contamination is affected directly by the seasonal changes of radiocaesium flux of inflowing river basin affected direct fallout from FDNPP.

Keywords: Abukuma River, Radiocaesium, Bottom Sediment

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ACG07-10 Room:201B Time:May 27 12:00-12:15

Consequences of the Typhoon 18 (Sep. 2013) and associated runoff on Lake Biwa.

AUGER, Guillaume[1*] ; KANETSUKI, Yasutomo[2] ; WELLS, John[1]

[1] Department of Civil engineering, Ritsumeikan University, [2]Ritsumeikan University Graduate School of Information Science and Engineering

Lake Biwa experiences storm with strong winds and heavy rains every year, leading to potential substantial changes in the ecosystem of the lake. The impact can be seen with sudden increase of rivers inflow from the rivers. The fact that several agricultural and industrial water treatment facilities surround the lake may lead to worrisome scenarios for the lake's ecosystem. Typhoon 18 (September 2013) is an example of the consequences of runoffs upon the lake, with an increase of turbid water influx into the lake and strong winds. The combination of rivers runoffs and high wind is complex, and the consequences of this combination should be better understood.

To clarify the impact of Typhoon 18 on the lake, we performed a three dimensional simulation of the typhoon event by using observed wind from the Japanese Meteorological Agency and we compare with space-borne images of the lake surface for consistency. To provide informations on the turbid water we included in the simulation the advection of a passive tracer (that can be associated to dissolved materials for instance dissolved oxygen) and a sediment module.

With the aim of understanding and providing more information on the particles propagation within the lake we added a particle tracking algorithm. Our algorithm uses the results of the simulation.

During this presentation we show the results of the numerical simulation on the typhoon 18 event (September 2013), in including passive tracer, sediment and particle computations. We conclude the presentation by stating what we learned from this work about the run-offs that occurred during the Typhoon 18.

Keywords: Lake Biwa, runoff, typhoon, sediment, particle tracking

Japan Geoscience Union Meeting 2015
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ACG07-11 Room:201B Time:May 27 12:15-12:30

Estimation for Chlorophyll a concentration excluding the impact of aquatic plants in Lake Biwa using Landsat-5 TM data

TERAMOTO, Tomoko[1*] ; YAMASHIKI, Yosuke[2] ; KOBAYASHI, Takeshi[3] ; NAKANO, Fujio[4]

[1]Graduate School of Engineering ,Kyoto University, [2]Graduate School of Advanced Integrated Studies in Human Survivability, [3]HORIBA, Ltd, [4]Japan Aerospace Exploration Agency

Lake Biwa is freshwater lake that is the source of drinking water of Shiga, Kyoto, Osaka, and Hyogo area. However of expanding blue-green algae or aquatic plant are anxious about the influence of the lake in recent years.

Therefore, various monitoring methodology of those mechanisms is examined. The satellite remote sensing is expected as a leading monitoring tool. The concentration Chlorophyll-a of Lake Biwa is a challenging environment of remote sensing because its concentration is too low and blocked by aquatic plant

The utility of satellite imagery for water quality studies in Lake Biwa is investigated.

The main purposes of this study are to present Chlorophyll-a mapping of Lake Biwa and exclude aquatic plant influence and the accuracy was checked. Moreover, the Chlorophyll-a distribution characteristic in this lake was considered using the proposed algorithm.

The satellite data used is five scenes from 1984,1989,1994,1997 and 2002 The Landsat-5 TM Level 1 product data was downloaded through the Internet site “Earth Explorer.” The value of water observation point of Band1 (0.45 - 0.52 μm), Band2 (0.52 - 0.60 μm), Band3 (0.63 - 0.69 μm), Band4 (0.76 - 0.90 μm), Band5 (1.55 - 1.75 μm) and Band7 (2.08 - 2.35 μm) in these lakes was extracted from the obtained satellite data. On the other hand, the Chlorophyll-a data was obtained from the Water Information System of Ministry of Land, Infrastructure and Transport. And Water quality data are compared to imagery from the Landsat TM data.

The Chlorophyll-a value were compared with Digital Number values of Landsat 5 bands using different band combination of empirical algorithms.

Generally, the results of analysis showed significant correlation between these models and water quality parameters.

Moreover, the value of Digital Number is increasing by 1.3(B1), 0.75(B2), 0.2(B4), 0.2(B5) and 0.55(B7) respectively when the coverage of aquatic plant is decreasing 25%.

Keywords: Chlorophyll-a, satellite, remote sensing, lake, acatic plant

Japan Geoscience Union Meeting 2015
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ACG07-12 Room:201B Time:May 27 12:30-12:45

The role of suspended particles in rivers play in the advection of radioactive cesium released from the FDNPS accident

ISHIDA, Masanobu[1*] ; YAMASHIKI, Yosuke[2] ; SEKIGUCHI, Hideo[3] ; HARAGUCHI, Tsuyoshi[3] ; AZUMA, Ryokei[4] ; YAMAZAKI, Hideo[1]

[1]Graduate School of Science and Engineering, Kinki University, [2]Graduate School of Advanced Integrated Studies in Human Survivability, Kyoto University, [3]Graduate School of Science, Osaka City University, [4]Disaster Prevention Research Institute, Kyoto University

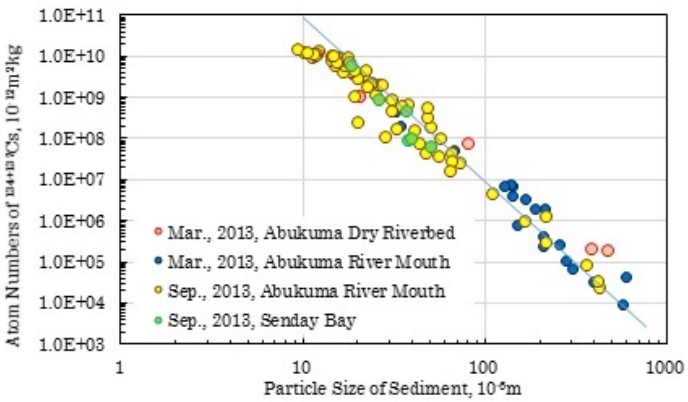
Transportation process of radioactive cesium from the terrestrial environment of East Japan that has been contaminated with the released radioactive cesium from Fukushima Daiichi Nuclear Power Station (FDNPS) has been investigated. The estuarine sediments of Abkumagawa River, Edogawa River and Shinanogawa River were analyzed. Abukumagawa flows through the high-contaminated areas of Fukushima Prefecture, there is close to FDNPS. Since the river mouth faces the Pacific Ocean, it is considered a contaminated suspended particles carried in the river water is precipitated by diffusing extensively. Edogawa flows through the metropolitan area of pollution zone, the river water flows into the enclosed Tokyo Bay. Therefore, it is expected that the suspended particles carried in the river water are precipitated near the estuary without diffuse seawater. On the other hand, Shinanogawa far from FDNPS, despite its catchment area is hardly contamination, high concentration of radioactive cesium has been detected from the estuary sediment. In this study, it is possible to analyze the spatial-temporal distribution of radioactive cesium in the estuary sediments, the dynamics of the radioactive cesium that advection from land to sea has been assessed.

The concentration of radioactive cesium of 66 samples collected at Ekman sampler at 22 point of Abukuma estuary in September 2013 has been measured. Values of radioactivity were shown in a decay correction to the March 16, 2011. Radioactive cesium concentration of the dry sediment of surface layer (0-5 cm) is ^{134}Cs: 8.5-5749 (2261±1623), ^{137}Cs: 9.0-5813 (2249±1618), $^{134+137}$Cs: 17.5-11563 (4510±3240) Bq/kg, respectively. Negative correlation was observed between the concentration of radioactive cesium and water content and particle size of the sediment. Since the correlation of radioactive cesium concentrations and particle sizes are according to the inverse square law, it is suggested that radioactive cesium is adsorbed to the particle surface. As shown in the Figure, between the atoms of radioactive cesium adsorbed therein and the specific surface area of the particles showed an inverse fourth power law for the particle size. Although not yet clear detailed mechanism cesium adsorbed to the particles, it was shown that the particle size are greatly affected.

The distribution and the behavior of radioactive cesium in the sediment collected Tokyo Bay and Shinanogawa will reported by comparing with the results of Abkumagawa.

Acknowledgment: This work was supported by KAKENHI Grant-in-Aid for Scientific Research (B) No. 24310014.

Keywords: radioactive cesium, suspended praticle, advection, sediment, particle size



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ACG07-13 Room:201B Time:May 27 14:15-14:30

Sediment Flux Separation on Interface Layer between River and Ocean Induced by Abukuma River Mouth Inflow

TROSELJ, Josko[1*] ; YAMASHIKI, Yosuke[2] ; TAKARA, Kaoru[3]

[1]Kyoto University, Graduate School of Engineering, [2]Kyoto University, Graduate School of Advanced Integrated Studies in Human Survivability, [3]Kyoto University, Disaster Prevention Research Institute

1. Introduction

The contamination of the land surface by radioactive fallout in the vicinity around the Fukushima Daiichi Nuclear Power Plant (FDNPP) is of much concern. While direct inputs of radionuclides from FDNPP to coastal waters have been estimated and modeled, less is known about the flux of radionuclides to the coastal zone derived from radioactive runoff into the river basin networks (Yamashiki et al., 2014) and about fate of the sediments during and after their transportation into the ocean.

2. Objective and motivation

The objective of this study is to give more detailed insight into fate of sediment particles when they approach the interface layer between river and ocean in order to better understand mechanisms of transportation of pollutants in estuaries. The study site is estuary zone affected by river inflow and associated sediment transportation from the Abukuma river basin in Japan.

The particular motivation for the study was unexpected vertical distribution of turbidity (Yamashiki et al., 2013), which showed turbidity peaks 500 meters from the river mouth towards the ocean at depths that correspond to middle water column of the river, while freshwater inflow at those depths was not simultaneously observed.

3. Methods

We used a general ocean circulation model MSSG with incompressible Navier-Stokes governing equations to solve the flow field. The turbulent-sediment transporting flow was nested separately together with MSSG model outputs, with finding relations between the two phase flows by using dimensional analysis similitude approach.

As our major intention was to consider influence of fluvial inflow towards the ocean, we manipulated with various boundary conditions mostly from the river side and briefly from the ocean, in order to find oceanic response to diverse fluvial conditions. Major emphasis was put on hydrodynamic processes during various rising limb stages of extreme fluvial discharge events.

4. Discussions

We found that relative relations among local bathymetry conditions, river inflow forcing and tidal ranges specific for the Abukuma river mouth contribute to strong vertical density stratification within the estuary zone and to occurrence of salt wedge, especially for moderate to higher discharges.

Unsteady flow conditions occurring during the rising limb stage of an extreme event are forcing the internal interfacial shear layer to become thinner and sharper up to the stage when we can describe it with similar physical similitude that is used for solving bottom boundary layers. Thus, the proposed new approach might be named as interface boundary layer (IBL) between two fluids. The biggest advantage of using the approach is proposed mechanism of linking it from the hydrodynamic phase flow towards suspended sediment transport phase.

Our assumption is that freshwater flow separation which is occurring within the laminar regime IBL may cause initial laminar inertia, while the flow separation occurring within the turbulent regime IBL may cause initial turbulent spinning and drag crisis applied to sediment particles. Thus, the particles from turbulent IBL would dissipate much of its velocity magnitude due to drag crisis caused by the separation, and would change tendency of its direction from upwards to downwards and from trajectory to spinning. The IBL flow regime transition would initially put part of particles into suspended state within the near-shore zone at middle water column depths, before being further influenced by ocean currents.

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Keywords: internal interfacial shear layer, sediment flux separation, river inflow, rising limb, oceanic response