

Introduction of the SCOSTEP's VarSITI program - Variability of the Sun and Its Terrestrial Impact

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The Scientific Committee on Solar Terrestrial Physics (SCOSTEP) is an interdisciplinary body of the International Council for Science (ICSU) to run international interdisciplinary scientific programs and promotes solar-terrestrial physics research. The last solar minimum in 2008-2009 and the current solar maximum of sunspot cycle 24 show much lower activities compared with the previous two solar cycles 22 and 23. The scientists in the solar-terrestrial physics are watching very low solar activities and their consequences on Earth, which have never been observed since modern scientific measurements become available. The SCOSTEP program "Variability of the Sun and Its Terrestrial Impact (VarSITI)" (2014-2018) will focus on this particular low solar activity and their consequences on Earth, for various times scales from the order of thousands years to milliseconds, and for various locations and their connections from the solar interior to the Earth's atmosphere. In order to elucidate various sun-earth connections, we encourage communication between solar scientists (solar interior, sun, and the heliosphere) and geospace scientists (magnetosphere, ionosphere, and atmosphere). Campaign observations will be promoted for particular interval in collaboration with relevant satellite and ground-based missions as well as modeling efforts. Four scientific projects will be carried out in VarSITI as (1) Solar Evolution and Extrema (SEE), (2) International Study of Earth-Affecting Solar Transients (ISEST/Minimax24), (3) Specification and Prediction of the Coupled Inner-Magnetospheric Environment (SPeCIMEN), and (4) Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate (ROSMIC). In this presentation we introduce the VarSITI program and its four projects to promote interdisciplinary studies among different fields.

Keywords: VarSITI, solar activity, climate change, atmosphere, magnetosphere and ionosphere, heliosphere

California Nino/Nina in boreal summer

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Anomalous warming/cooling in the coastal ocean off Baja and Alta California has attracted broad attention due to its significant impacts on the coastal marine ecosystem. The anomalous warming/cooling has been attributed, especially in boreal winter, to the remote forcing of the tropical El Nino/Southern Oscillation (ENSO) through both oceanic and atmospheric teleconnections and/or the ENSO-independent basin-wide atmospheric circulation anomalies in mid-latitudes. In the present study, we show for the first time the existence of coastal air-sea coupled phenomenon in the coastal ocean off Baja and Alta California in boreal summer. An initial decrease/increase in the southward alongshore surface winds along the coast weakens/strengthens the coastal upwelling and raises/lowers the coastal sea surface temperatures (SSTs) through oceanic mixed-layer processes. The resultant coastal warming/cooling, in turn, heats/cools the overlying atmosphere anomalously, decreases/increases the atmospheric pressure in the lower troposphere, generates an anomalous cross-shore pressure gradient, and thus reinforces or maintains the alongshore surface wind anomalies. The air-sea coupled phenomenon is analogous to the well-known ENSO in the tropical Pacific but with much smaller time and space scales, and referred to as California Nino/Nina (CAN) after the pioneer work that describe the warming events in the coastal ocean off Baja and Alta California as California El Nino.

Keywords: California Nino/Nina, coastal air-sea interaction

River discharges, ocean circulation and material transport in Japanese coastal waters: simulation with JCOPE ocean model

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The total volume of fresh water discharged by rivers into the world ocean is incompatible with the total mass of ocean waters; however these discharges contribute significantly into formation of fresher coastal waters and details of coastal ocean circulation.

This impact is not local, and supports presence of lower salinity waters in wide coastal areas along Japanese coast. In an absence of rivers in ocean model for appropriate reproducibility of ocean surface salinity it is often required to apply salinity restoration approach. Additionally, rivers could bring to ocean surface-floating, suspended and dissolved substances, some of which are hazardous, like radioactive materials initially dropped on the ground following such disasters as Fukushima Dai-Ichi nuclear power plant accident. These could be washed to rivers by strong rainfalls.

Method of counting inflow of fresh water from rivers as horizontal fluxes to the designated model cells is used. Demonstrated are direct impacts of rivers on formation of fresher waters along the coast of Japan and some cases of induced by discharges local ocean circulation patterns near the river mouth locations. A preliminary experiment when the model utilizes the hourly information on the amount of river discharges demonstrates an importance of such approach for the correct simulation of transport processes in extreme conditions like the typhoon-induced precipitations that often take place in Japan and East Asia. For achieving of this capacity, we are looking for utilization of simple land waters hydrological models for main river basins that could transfer the detailed meteorological precipitation forecast information into the approximate forecasts of river discharges.

Keywords: river discharge, ocean circulation, river-ocean interaction, coastal ocean processes

A spike-like input of perfluoroalkyl substances into the Western North Pacific from the Japanese Coast associated with t

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The recent great earthquake of magnitude 9.0 on 11 March 2011 followed by TSUNAMI and fire in Japan has resulted in serious environmental problems in and around Japan. A huge amount of materials has been discharged into the ocean after the tremendous flood damage by TSUNAMI. A research group of the National Institute of Advanced Industrial Science and Technology has sampled the perfluoroalkyl substances (PFAs), which are chemical materials included in the industrial products, in the Western North Pacific for past a few years. They found some evidences showing an abrupt increase of the PFAs concentration east of Japan in 2011 after the great earthquake. To confirm the anomalous input of two typical PFAs (PFOA and PFOS) from the Japanese coast into the ocean, we conducted a series of chemical tracer simulations using an eddy-resolving ocean reanalysis product, JCOPE2, by assuming the oceanic dispersion of the PFAs dissolved in sea water mainly driven by the ocean current. Comparison of the simulation results with the observation actually indicates a spike-like input of PFOA into the Western North Pacific after the great earthquake; however, the simulations could not well explain the observed distribution of PFOS, suggesting some differences in the oceanic dispersion processes between PFOA and PFOS. We discuss estimates of the total emission amounts of PFOA and PFOS based on a simple process representing the TSUNAMI effect on the emission from the land.

Keywords: perfluoroalkyl substances, the great earthquake 0311, oceanic dispersion, Tsunami, oceanic observation, numerical simulation

Super high resolution experiments of torrential rainfall events with the K super computer

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In Japan, localized torrential rainfalls sometimes cause severe disasters which impact on the society. (e.g., the urban flash flood disaster at the Toga-gawa River in Kobe in July 2008, and the debris flow disaster in Izu Ohshima Island in 2013). In these events, the precipitation amounts were very different in the small areas, and they were likely strongly affected by geographical features. In the Kobe event case, about 70 % of the initial flow of the flash flood is from the urban area that covers only about 30 % of the entire catchment area (14 square kilo meters). In the Izu Ohoshima case, two meteorological observation stations are in the northern part and the middle part (near the damaged area) in the island, and the distance between the two stations is only 4 km. However, the quantity of observed precipitation in the middle in island was about twice as much as north.

To understand these phenomena, high resolution (several hundred meter scale resolution) numerical weather simulation is necessary. Super high resolution experiments have been made by previous studies such as tornado for limited domains, however, a numerical weather simulation with wide domain is very few due to limitation of the computational resources. We conduct super high resolution numerical weather experiments for Japan area with the K computer and JMA nonhydrostatic model.

Keywords: Numerical weather prediction model, JMA-NHM, Kei super computer

Interannual variability of Kuroshio nitrate flux and transport along western boundary in the North Pacific

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An eddy-resolving coupled physical-biological ocean model has been employed to examine the interannual variability of nitrate flux and transport mechanism by the Kuroshio during 1995-2012. The Kuroshio provides an advective flux of nitrate carried in subsurface waters, redistributing nitrate from the tropics to the mid-latitude. Some observed data capture the nitrate flux and transport in the subsurface layers by the Kuroshio. The maximum nitrate flux core appears about 400 m depth in the East China Sea, and the nitrate transport by the Kuroshio had a mean of 170 kmol s⁻¹. The model reproduces the maximum nitrate flux core in the subsurface layer from the Luzon strait to the Kuroshio Extension with the downstream. Along the vertical section of east side of Taiwan (24N), west side of Okinawa (28N), south of Kagoshima (130E), the time series of nitrate flux, volume transport, and nitrate concentration show the interannual variation. The variability of nitrate flux is strongly correlated with the variability of Kuroshio volume transport, but the nitrate concentration shows the increasing trend between 1995 and 2008. This trend may be related to the variability of nitrate concentration in the upstream of Kuroshio.

Keywords: Nitrate transport, Kuroshio, Interannual variability, High-resolution ocean physical-biological model

High Resolution, Terrain Independent Radiation Mapping

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The University of Bristol has developed a terrain-independent, wide area radiation mapping system using an UAV (Unmanned Aerial Vehicle). At the heart of the system is a micro computer, carried by a semi-autonomous multi-rotor copter (drone), combining data from a lightweight gamma spectrometer, laser range finder, and GPS, to geospatially map radioactive anomalies.

Aerial vehicles can be purpose built, according to range/flight time required, payload/sensing strategy and operational environment. For example, an unmanned vehicle could be tailored for mapping over both land and sea areas, where it could land in the sea at different locations to make water based gamma measurements. The system is also adaptable for use on ground vehicles, or handheld, walking surveys.

Information is streamed in real-time, providing high resolution detail on source isotopes, intensity and location of the radiation anomaly. More than just a flying Geiger counter, the system can differentiate between natural and man-made anomalies - such as types of nuclear fuel, radioactive waste or spent munitions.

This is all achieved from a safe distance, keeping people and manned aircraft away from hazardous environments.

Examples of uses include;

*Rapid disaster response monitoring of nuclear events, providing real-time data on spread, source and intensity. This could range from site incidents to terrorist events.

*Routine monitoring of nuclear sites (internally and externally), mining operations and oil and gas facilities.

*Nuclear plants - new build: site survey and characterisation of pre and post construction and monitoring during plant life time.

*Environmental monitoring for site decommissioning.

*Environmental monitoring of war zones for spent depleted uranium munitions.

*Homeland security and nuclear material detection.

The instrument securely transmits the location, identity and intensity of radionuclide contamination to a remote operator or base station. Sub metre resolution is attainable by flying slowly, even to the point of a fixed hover, relatively close to the ground.

It can be operated manually, using traditional radio-controls or semi autonomously via programmed GPS waypoints. Grid lines are used to create survey routes that provide detailed geographical coverage of a designated area. Programming can include automated landing and take-off, such that the device can gather long exposure spectra of the region of interest.

Heat budget analysis on cooling events associated with typhoon passages in Seto Inland Sea, Japan

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Typhoons alter coastal oceans significantly through several mechanisms including the enhanced vertical mixing through increased surface wind and waves, resulting in extensive cooling of the upper oceans. In the present study, we investigate impacts of typhoon passages with a detailed ocean modeling in particular on the temperature structure in Seto Inland Sea, the largest semi-enclosed estuary in Japan. We develop a synoptic, double nested downscaling ROMS model (Shchepetkin and McWilliams, 2005; 2008) forced by the assimilative JCOPE2 oceanic reanalysis (Miyazawa *et al.*, 2009) and JMA GPV-MSM atmospheric reanalysis for the surface momentum, heat and radiation fluxes by exploiting a bulk formula developed for COAMPS. The horizontal grid refinement occurs from 1/12 degree (JCOPE2) to 2 km (ROMS-L1) and to 600 m (ROMS-L2), where the L2 model running for about two years (2012-2013) is our test bed for the comprehensive heat budget analysis. The persistent clockwise estuarine circulation and the eastward-flowing Kuroshio are key features that cause the overall circulations of the estuary.

In the fall 2012, SST is found to decrease about two degrees for a two-week period during three consecutive typhoons passing nearby. The first EOF mode of the modeled SST corresponds to the seasonal cooling along with mixed-layer deepening, whereas the effects of the typhoons appear in higher modes. Kuroshio interacts with the topography to form standing cyclonic cold-core eddies as extracted in the second mode, resulting in intermittent eastward cold-water transport beyond the headlands. The third and fourth modes jointly represent cold water formation associated with storm-driven coastal upwelling that propagates with the estuarine circulation. Similar EOF modes are detected in the SST during the fall 2013 when two typhoons attacked the study area.

In the falls in 2012 and 2013 after the mid September when a series of typhoons pass by the estuary, the heat budget analysis exhibits that the net heat flux at surface becomes negative to induce prominent surface cooling and cold-water formation in the upper ocean. Whereas divergence of the horizontal advective heat flux is crucial in the daily-averaged heat budget, the surface net heat flux is essential to long-term temperature variation. Latent heat flux is found to play a primary role in the negative net surface flux as well as decrease of downward shortwave (solar) radiation. Unstable lowest atmospheric planetary boundary layer leads to pronounced changes in the latent heat flux in response to surface wind and abrupt decrease of the near-surface humidity after the typhoon passages.

Keywords: typhoon, estuary, heat budget analysis, EOF analysis, ROMS

Development of a hydro-ocean coupled model

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A new hydro-oceanic coupled model is developed for examining the basic dynamics of river-ocean interaction in estuary zones during high water discharge events. These high frequency and vigorous events are not reproduced in climatological river transport data sets that are often used in ocean circulation models. The new hydro-oceanic model is based on an isopycnal layer model. It treats continental and oceanic water with separate layers but allows dynamical interaction between the two. Mixing between the two layers occurs through a Richardson number criterion. When the model is forced with Radar-Rain gauge analyzed precipitation data around eastern Japan, the model simulates the river discharge of Abukuma river basin that is analogous to observations. The abrupt changes in the water mass transport at upstream and downstream locations are well captured, showing its applicability for hydrological basin analysis. Freshwater plumes that hug along the oceanic coasts are also well captured. We find the model, based on single dynamical core, useful for both hydrological catchment and estuary mixing zone and can be used for examining the impact of weather related events.

Keywords: Ocean model, Hydrological model

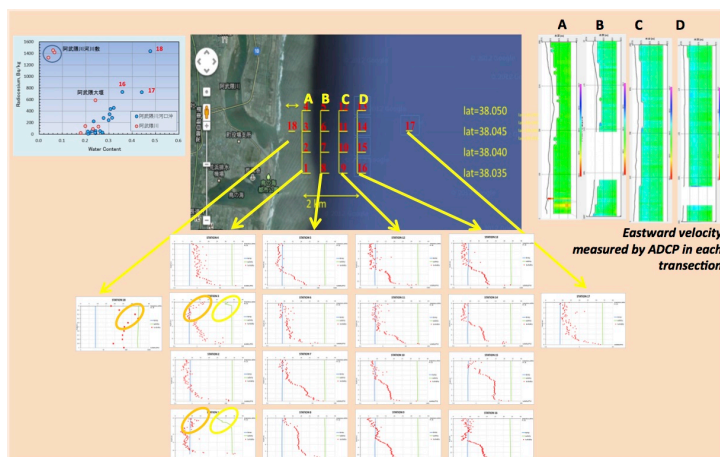
FIELD OBSERVATION ON PHYSICAL CHARACTERISTICS OF ABUKUMA RIVER ESTUARY IN SENDAI BAY

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Higher amount of radiocaesium transport from Abukuma river into Pacific Ocean, especially during the extreme events, has already estimated. The current study aims to clarify the following: i) to survey estuary mixing processes during freshwater and turbidity intrusion from Abukuma river mouth, largest river basin affected fallout, where annual radiocaesium flux reached 10 Terabecquerel during our observation in 2011-2012; ii) To identify bottom-sediment contamination along the river mouth by sediment sampling. Field observation was conducted both in March 18 and September 2-3 in Sendai Bay. Vertical temperature and turbidity, together with the salinity field are observed using fishing vessel. We analyzed also vertical velocity profile using ADCP to identify the current movement of the bay. The velocity fields in Sendai Bay of the observation date are illustrated using JCOPE2 program. Figures 1 illustrates observation points, vertical salinity, turbidity and temperature field in each points, and vertical velocity profile observed in 18 March 2013. The eastward surface current was observed in each transection line. At near bottom of the sea, westward current was observed, indicating estuary circulation. Southward surface current was observed in most of latitudinal section, weak northward bottom current was also found. Freshwater intrusion was observed on some of the stations in transection A which is located near the mouth of Abukuma River. In most of the station, turbidity peak was observed in near bottom of the sea, except in some station in transection A where the peak of turbidity was found in surface similar to the location of freshwater intrusion. Higher concentration of radiocaesium in the bottom sediment near the Abukuma river mouth is observed where fine argilliferous soil are found, much higher than that in surrounded area, giving important evidence of radiocaesium in particulate form supplied from Abukuma River. Peaks of turbidity near the river mouth were found at slightly lower position than the freshwater-saline boundary at stations 1 and 3 (March 20), implying that the occurrence of coagulation of suspended particulate matter through mixing with saline water, supporting the observed concentration found in (1).

Keywords: Abukuma river, Coastal zone, Estuary circulation, Mixing zone, Radiocaesium



Development of Satellite data manipulator for geography analysis

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Development of Satellite data manipulator for geography analysis

ALOS (Advanced Land Observing Satellite: common name "Daichi") carried the sensor PRISM which can observe earth surface in high accuracy, and enabled acquisition of DSM (Digital Surface Model) data. By utilizing the data acquired by such an advanced sensor, it becomes possible to display high-precision three-dimensional satellite data. Using satellite data as three dimensions means expansion of the utilization range, and it can expect unprecedented multi-functionalization. Furthermore, three-dimensional satellite data was displayed on iPad interlocked with GPS in various satellite data including ALOS data, and "Geo-Sim" which can be used also in area without communication environment was developed. Thereby, the generating situation of a mudflow or the ancient coastline is reproduced by CG, and the matching operation on-site becomes possible.

Keywords: ALOS, AVNIR-2, PRISM/DSM, DEM, Geo-Sim



Fig.1. Manipulation of 3D data on iPad display

Land-Ocean Mutual Interaction: Sediment Transportation Processes in Coastal Zone Induced by Abukuma River Mouth Runoff

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1. Introduction

Modeling of a contact zone between a river coming from potentially contaminated basin and an ocean is especially sensitive case for Land-Ocean coupling interaction due to significant risk of major environmental disaster which can occur in the case of contamination of the coastal zone. Therefore, it is of great importance to study and develop integrated modeling approach to comprehend the complex interaction processes in the contact zone in order to minimize disaster risk potential, which can consequently cause undesirable social and economical costs.

2. Objectives

The focus of this study is to promote relevant numerical simulation on Land-Ocean coupling modeling approach applicable for the bay and estuary zone affected by river inflow and associated sediment transportation from the Abukuma river basin in Japan. By conducting several field observations, we found interesting and unusual temporal and spatial distribution of radionuclides within the coastal zone near the river mouth. Sediment transportation processes which have led to the distribution as well as influence of near-shore bathymetry to sediment dispersion are of close interest for the study. Calculation was conducted by simulating stages and conditions for mechanisms of sediment transport in the coastal zone, from initial deposition onto river bed to final deposition onto ocean floor, with special focus on processes which are occurring during high water periods.

3. Model Description

The modeling approach has been studied by combining river mouth runoff boundary conditions by using Lagrangian particle tracking model for simulating sediment transportation, with coupled atmosphere-ocean-land model (MSSG model, JAMSTEC) which used fine resolution grid, and associated downscaling techniques for oceanic boundary conditions (JCOPE2 model, JAMSTEC) which used coarse resolution grid. We have simulated two different cases, at first circulation of ocean itself in non-equilibrium quasi stationary state, where its dynamics was induced only by its own temperature and salinity data differences among adjacent cells, and at second response of the ocean circulation to inflow from the river outlet, simulated under various boundary conditions and external effects.

ETOPO1, 1 Arc Minute Global Relief Model was chosen as initial database for bathymetry data, while World Ocean Atlas 2005 database was chosen as initial 3D database for temperature, salinity, pressure, and velocity field data. Incompressible Navier-Stokes equation and Yin-Yang grid were used in the calculation of the flow field.

4. Conclusions and follow up

The study is continuous part of the PhD study of the first author, so the results are about to be improved as the course will continue. So far, results neither confirmed nor denied the hypothesis that near-shore bathymetry may have important role in spatial dispersion of radionuclides, so the question still remains open and subject for discussion. Our assumption is that using fine resolution grid within the contact zone between two different fluids should give us better insight into the problem, while simultaneously proper downscaling of outer oceanic boundary conditions and proper coupling with sediment transportation model are needed to be done in order to maintain satisfactory level of simulated physics of processes during the calculation. In follow up of the study, we will try to simulate hydrograph based water wave rather than constant inflow from the river mouth, as well as try to put ocean side into initial dynamic state rather than non-equilibrium quasi stationary state. Also, more focus will be aimed to the physical processes behind mechanisms of radionuclide transportation from the basin towards the river mouth.

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Keywords: River-ocean interaction, Integrated atmosphere-land-ocean model, Sediment transportation of radionuclides, Lagrangian particle tracking model, Near-shore bathymetry influence

modelling of radiocesium movement in catchment area of abukuma river, japan

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The great earthquake on March of 2011 followed by tsunami caused Fukushima Dai-ichi reactor meltdown which led to explosion and emission of radioactive substances into environment. As a result, Abukuma River, one of the most important rivers in Japan and its catchment area, received up to 2.25×10^6 Bq/m² of radiocesium. Previous study found that 80-90% of radiocesium influx to Abukuma River was in particulate form and it was estimated that 10 TBq of the radionuclide was released into the end point of the river, coastal sea of Sendai Bay. A lot of models of radionuclides movement had been developed, however just few models that account solid wash off process in catchment area. This study tried to simulate the influx of radiocesium into Abukuma River from its catchment area by modifying MOIRA model with addition on solid transport which was calculated with SWAT model. Deposition of the radiocesium was used as an input of the model. Then after, fixation process into surface ground, liquid wash-off by surface run off, and solid wash off by erosion are the mechanisms which govern the dynamic of the radiocesium in this model. The result at the model shows an agreement compared to the observed data. With R² value of 0.8 showed that the model could explain seasonal variability of observed data. However, as several uncertainties were observed such as quantification of storm effect and decontamination activities, further study to optimize and improve the result of the model is deemed necessary

Keywords: model, influx, radiocesium, Abukuma River

A Study of Contribution of "Nanohana Project" and Agricultural restoration in Sukagawa, Fukushima, Japan

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This paper explores for what and to what extent "Nanohana Project" contributes to restoration in Sukagawa, Fukushima Prefecture, Japan. Since the huge earthquake and tsunami occurred in March 2011, agricultural fields in these cities have been suffering damages caused by radionuclides classified as nuclear-fission products from the Fukushima No.1 Nuclear Power Plant (Tokyo Electricity Power Company (TEPCO)) due to the accident. Agricultural field restoration, especially decontamination of radionuclides from the soil, is one of the most important issues to be tackled for local farmers. This research reviews literatures regarding and conducted an interview to an agricultural production corporation in Sukagawa in order to grasp what initiatives has been taken to reduce radionuclides in their products as well as to fight to bad rumors among general public. "Nanohana Project" has been implemented with local stakeholders in Sukagawa since 2007. They grow Nanohana (rapeseed flower or colza, Brassica Napus) and produce Biodiesel fuel (BDF) from seeds as well as biogas (BG) out of the pomace (leaves and stems after producing BDF), and they use the BDF and BG in the local area. The Nanohana absorbs some radionuclides in the soil in its growing process, and there was attention to it after disaster, however some scientific researches found that the absorption amount is limited and may not be a remedy itself for decontamination of radionuclides. Nevertheless, "Nanohana Project" has been ongoing and the network is expanding in Sukagawa. This paper discusses contribution of "Nanohana Project" and initiatives by an agricultural production corporation for restoration through qualitative analysis of interview and some key figures in order to speculate the Project's possible roles for future reconstruction in the region.

Keywords: Nanohana, decontamination, restoration, agricultural production corporation, Sukagawa

The relationship between monthly and yearly trend of Ammonia and SS loading at Rhine River and land use change

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Rhine River is the international river, which flows through several countries, so it is important to know and maintain the water quality. To estimate the gross loading to the marine environment is necessary for assessment of the current status of the coastal zone, especially for the water quality of Bays and Estuary zone.

In this study, we estimate Ammonia SS loading at Rhine River by using GEMS/Water (Global Environment Monitoring System/ Water) Dataset and GRDC (Global Runoff Data Centre) Dataset.

The procedure of this research is three steps. First, we have used the set of discharge data obtained from GRDC to be used for the loading estimation based on the observed data. Second, the locations of GEMS/Water and GRDC station have been compared to identify appropriate station to set the calculation loading. Finally, we have multiplied concentration and discharge to get the loading.

The characteristics land use of Rhine River basin has been analyzed using the Global Land Cover Characterization dataset prepared by USGS.

For land use change of Rhine River basin has been analyzed by using landsat5 and landsat7 images.

The concentration and loading results show seven things : (1) From December to February, Ammonia concentration was higher than other months. (2) From January to march, Ammonia loading was higher than other months. (3) Ammonia concentration was gradually decreasing except through 1983 to 1987. (4) Ammonia loading was decreasing and the number suddenly dropped at 1989 (5) SS concentration was stable through 1979 to 1994 except 1983, 1984 and 1995. (6) From December to February SS loading was higher than other months. (7) SS loading was gradually decreasing and the number suddenly dropped at 1989.

The Rhine river watershed is mainly forest and grassland by analyzing land use from USGS data. This land use affects water quality

Keywords: Water Quality, loading, land use, Rhine River