

Sensitivity analyses of crop yields and changes in climate variables simulated with iGAEZ

KENICHI, Tatsumi^{1*}, YAMASHIKI, Yosuke¹, TAKARA, Kaoru¹

¹Disaster Prevention Research Institute, Kyoto University

Changes in the diurnal temperature ranges (DTR) is widely considered as responsible for significant impact on crop yields in addition to changes in mean temperature. There is a nonlinear impact of changing DTR, in other words, an U-shaped relationship with regard to crop yields for major crops. Because of methodological uncertainties, analysis of crop yields in responses to DTR change can safely be ignored. The objective of this study is to evaluate the influence of which a minimum temperature, average temperature, maximum temperature has on a yield using iGAEZ model. Simulated yields on each grid cell for 1980-1999, in three leading producers of wheat, rice and maize, were combined with climate datasets to evaluate the relationships between temperature and simulated crop yields. Generalized additive model were evaluated to analyze changes in DTR and crop yields. Results differ among crops or region as to whether there was a clear positive/negative response of yields to daily temperature indices - DTIs (including DTR, T_{max} , T_{min} and T_{ave}). However, the effects of DTIs were statistically significant using generalized additive model for all crops and regions. To evaluate whether future changes in DTIs are relevant for impact assessment, yield responses to projected changes in DTIs by 2080-2099, from 18 climate models under SRES A2, B1 scenarios, were estimated. Among DTIs, DTR changes did significantly affect yield responses in several cases, such as in South Asia maize and rice yields under B1 scenario. The decreasing/increasing trend of DTIs have an important implication for estimating future impact of climate changes.

Keywords: diurnal temperature ranges, climate change, crop yield, iGAEZ

Impact assessment for rivers flowing into the Arctic Ocean by using Nutrient loading and Water Quality Index

TERAMOTO, Tomoko^{1*}, YAMASHIKI, Yosuke², TAKARA, Kaoru²

¹Graduate School of Eng, Kyoto University, ²DPRI, Kyoto University

Nutrients carried by rivers to oceans are important indicators. Especially in the Arctic, these fluxes are important due to the large volume of inputs and the small area of the Arctic Ocean. A major issue in arctic research is how much nutrient inputs to the Arctic Ocean vary with climate change. In this study we aim (1) to estimate nutrient loading from land zone throughout international river basin using the GEMS/Water (Global Environment Monitoring System/Water) data sets for the purpose of estimating the gross nutrient loading to the marine environment,(2) to calculate Water Quality Index(WQI) for the purpose of evaluation of water quality that flows into the sea from the river,(3)to compare nutrient loading and WQI for propose of knowing the relationship between nutrient loading and single indicator of water quality index. WQI is a numeric expression used to evaluate the quality of a given water body and it was developed for the purpose of providing a tool to simplify the water quality data. It is a tool that provides meaningful summaries of water quality data that are useful to technical and policy individuals as well as the general public interested in water quality. As a result, in the some rivers which flow through the Arctic Ocean the nutrient flux is decrease comparing 1980's and 1990's even river discharge almost same value. But in the other rivers nutrient flux in 1990's is same or higher than the 1980's, the result of WQI in those rivers is the almost same as the nutrient flux result.

Keywords: GEMS/Water, Water quality, Flux, Water Quality Index

A Study on Citizens' Awareness of Flood Risk and Infrastructure Development in Zagreb, Croatia

KIMURA, Naoko^{1*}, YAMASHIKI, Yosuke¹

¹DPRI-Kyoto University

This study will explore the relation between awareness of flood risk and infrastructure development in urban area, Zagreb, Croatia. Zagreb used to be suffered from several flood damages. The flood occurred in 1964 from the Sava River is one of the largest in its modern history. Having had this bitter experience, the government led extensive development plan of infrastructure on the Sava River and the mountain rivers. Zagreb City is located between the Sava River, a tributary of the Danube River, and Medvednica Mountain. The banks, retention dams, and a drainage canal (Sava-Odra Canal) were constructed after the severe flood, and thanks to them, the city has not longer had any major floods since then. Thus, they succeeded in protecting the city and its citizens from floods. On the other hand, people's awareness of floods is toward downward tendency though they have recognized the rainfall is getting more unpredictable and it is harder than expected. From the questionnaire survey, about the 70% thanks that there will be a flood in Zagreb city in 10 years, nevertheless many of them think they have good infrastructure protection in the city. This research will try to find a meaning of studying awareness of people toward flood risks in the area with fewer floods through exploring some findings from questionnaire survey and infrastructure site visits.

Keywords: flood, awareness, infrastructure development, Croatia

Decadal Variations of Extreme Rainfall Events in South Africa

BEHERA, Swadhin^{1*}, Mathieu Rouault⁴, Venkata Ratnam Jayanthi¹, TOZUKA, Tomoki³, YAMAGATA, Toshio²

¹Research Institute for Global Change, JAMSTEC, Japan, ²Application Laboratory, JAMSTEC, Japan, ³University of Tokyo, Japan, ⁴University of Cape Town, South Africa

Extreme rainfall events over the continents cause severe damages to populated regions of the world. Because of their obvious influences on the river discharges, these extreme events could also affect the water composition and marine ecosystems near the large estuaries. Therefore, it is important to study the rainfall extremes in some of the vulnerable regions of the world for better assessments of the impacts and the associated processes.

In this study, the extreme rainfall events over South Africa were examined using daily gridded rainfall data of South Africa. The rainfall distribution is subjectively separated over space and time to understand the spatio-temporal variations of the rainfall. It is found that the regions in northeast and southwest show strong decadal variations. Linear trends though apparent are not significant in these regions. Decades with persistent years of extreme rainy events are found to be mostly associated with La Nina whereas decades with persistent years of extreme dry events are mostly associated with El Nino. This suggests that the large-scale climate variations have huge impacts on the extreme events of the region and thereby the associated changes in continental ecosystem.

Keywords: extreme, rain, south africa

Dynamics of surface water and groundwater interaction at a coastal zone in Saijo plain, Ehime prefecture, western Japan

TSUJIMURA, Maki^{1*}, Pankaj Kumar¹, NAKANO, Takanori², Minoru Tokumasu³

¹University of Tsukuba, ²Research Institute of Humanity and Nature, ³Saijo City Office, Ehime Prefecture

An interaction process of surface water and groundwater was investigated using a multi-tracer approach at a coastal zone of Saijo plain, Ehime prefecture, Shikoku island, Japan. The surface water and the groundwater were sampled in an alluvial fan and a coastal area, and the inorganic constituents concentrations, CFCs concentrations, stable isotopes of hydrogen and oxygen, strontium isotopes were determined for those samples. The three groundwater wells at the coastal region were especially monitored according with tidal fluctuations of the ocean. The diurnal variation of the tracing elements of the groundwater was explained by the hydrological processes and the geochemical processes under the effect of the tidal fluctuation.

Keywords: sea water intrusion, alluvial fan, coastal region, groundwater

Spatial patterns of tropical OLR intraseasonal anomalies, as revealed by a self-organizing map.

OETTLI, Pascal^{1*}, TOZUKA, Tomoki¹, Takeshi Izumo¹, YAMAGATA, Toshio²

¹The University of Tokyo, ²Application Laboratory, JAMSTEC

The Madden-Julian oscillation (MJO) is the dominant mode of the intraseasonal variability in the tropical atmosphere. This mode is characterized by an easterly propagation of moist convection and atmospheric circulation anomalies across the Indian and western Pacific oceans. The most commonly used method to depict the spatio-temporal evolution of the MJO is to perform an empirical orthogonal function (EOF) analysis on filtered outgoing longwave radiation (OLR, used as a proxy of the convection) and zonal wind. This method is efficient, but the first two leading modes, used to depict the MJO activity, are constrained by both linearity and orthogonality.

A non-linear classification method, the self-organizing map (SOM), is introduced, as a supplement to the EOF. The SOM is applied on OLR intraseasonal anomalies (20-100 days band-pass filter) within the tropical region over 1980-2009. A 4x4-node Kohonen map is used to describe intraseasonal convection spatial patterns. The 16 nodes capture the different MJO phases. Using the SOM to describe the MJO is a new approach, and seems to provide more temporal and spatial information on MJO activity and seasonality?

For each node, the tropical and subtropical convection is analyzed. Results show the delayed effect of the MJO on subtropical atmosphere dynamic and rainfall. They also confirm that both intraseasonal and interannual variability in the tropics influence subtropical climate. This emphasizes the need for a better understanding of the interactions between tropics and subtropics to enhance numerical modeling and forecasting.

Keywords: Madden-Julian Oscillation, Self-Organizing Map, Intraseasonal variability

Trajectory Modelling of Marine Debris Drifting at Bali Straits

Farica Edgina Yosafat^{1*}, Ivonne Radjawane², SUPRIJO, Totok²

¹Graduate School of Earth Sciences, Institute of Technology Bandung, ²Faculty of Earth Sciences and Technology, Institute of Technology Bandung

Marine debris is a global problem that affects everything: from environment to economy, from fishing and navigation to human health and safety. Marine debris is a serious problem at west coast of Bali, Indonesia. Seasonal marine debris from Bali Strait stranded at the west coast of Bali Island during January until April, when northwest monsoon wind blows over the straits. The drifting of marine debris at the Bali Straits was simulated in this study by using a couple model of hydrodynamic and particle trajectory. The results of hydrodynamic model are verified with observation data of ocean currents and water elevation. The discrepancies between simulation result and data is less than 10%, therefore the hydrodynamic model is able to simulate current circulation in Bali Strait. Simulation result also shows that marine debris from east coast of Java drifts along the west coast of Bali and stranded at Kuta coast, which is a famous tourism spot. It is concluded from this study that marine debris stranded at the west coast of Bali is seasonal marine debris and it comes from east coast of Java facing the Bali Strait.

Keywords: hydrodynamics, particle tracking, monsoon, marine debris, trajectory, Bali strait

Impacts of river discharge on the circulation in Tokyo Bay

LU, Li-Feng^{1*}, Shinichiro Kida¹, Keiko Takahashi¹

¹Japan Agency for Marine-Earth Science and Technology

Tokyo Bay is a semi-closed bay which is surrounded by several metropolis including Tokyo City as well as a number of industrial areas. Since it has a close relationship with many human activities, a lot of observations and modeling efforts have been made within this area. Despite these previous studies, a further understanding of current structure is still necessary. In our study, a hydrostatic, incompressible, z-level model – MSSG model is used to simulate the variations of circulation in the Tokyo Bay. The model has a horizontal resolution of 200 m and 30 vertical levels and is driven by the climatological monthly mean forcing as well as four major river discharges, which includes Tama River, Tsurumi River, Arakawa River, and Edogawa River. And the impacts of these rivers on the circulation in Tokyo Bay are discussed in our study.

Keywords: river discharge, circulation, Tokyo Bay

Evaluation of Radioactive sediment transport in Tokyo Bay released from TMR

YAMASHIKI, Yosuke^{1*}

¹Disaster Prevention Research Institute Kyoto University, ²APL JAMSTEC

Radioactive contaminants released from TEPCO Fukushima nuclear powerplant into Tokyo Metropolitan Region (TMR), mainly on 21-22 March 2011, are accumulated via hydrological cycle and released into the shallow estuary ? Tokyo Bay. Major streams (Edo, Ara, and Tama) carry radioactive contaminants via suspended particulate form. Some of them may stay in the riverbed and finally transported into the river outlets. In this study, numerical modeling approach using Hydro3D -an catchment-estuary integrated model ? is introduced. Three-major Fission Products (Cs137, Cs134, I131) are calculated based on the initial radioactive distribution recomposed from aerial radioactive monitoring by METI. Fission Products (FP) transport in TMR are calculated using both Euler surface dissolved / non-dissolved transport and Lagrangian form sediment-marker transport models, showing serious accumulation into major streams. Effects of particle coagulation at the river outlets are calculated according to the salinity and diameter of suspended particulate material. Those released materials into Tokyo Bay are calculated using three-dimensional estuary model and bottom-sediment transport model. According to the numerical simulation, the radioactive sediment concentration composed with Fission Products in Tokyo Bay may increase due to increase of hydrological transport within three years (mainly induced by the Cs137/134) and then last more than 10 years (mainly by Cs137). Bottom-sediment contamination near the Obitsu River outlet is predicted by the numerical simulation, in addition to the hotspots predicted at outlets of Edo and Ara rivers.

Keywords: Fission Products, Radioactive sediment, Tokyo Bay, TMR, Hydrological Cycle

Data archiving of 44-year synoptic observation of solar chromosphere

KITAI, Reizaburo^{1*}

¹Kwasan and Hida Observatories, Kyoto University

Solar activity is known to cyclically change in 11 years. However, the amplitude of the variation is not constant but modulated in long term span. The long term variation of solar activity is thought as one of the origin of the global warming or cooling of the earth. In Kyoto University, a continuous synoptic observation of solar chromospheres in CaIIK monochromatic light had been done during the years 1926-1969. The images were taken on photographic plates. Last year we have started a research project to build a digital image database of these photographic plates and study the long term variation of the solar chromospheric activities. The project steps are as follows. (1) Compile the meta-data database and open to the public through IUGONET (Inter-university Upper atmosphere Global Observation NETwork). (2) Digital scanning of all the plates and open to the public similarly as the meta-data. (3) Study the origin of solar cyclic variation by searching for the similarity and difference between sunspot number and CaIIK index. (4) Apply the database analysis to the study of heating variation of the terrestrial upper atmosphere by using the CaIIK irradiation as a proxy of solar UV irradiation to the earth. In this paper, we will report the present status of the project and discuss some scientific prospects with reference to the research trends in the world. We will be very happy if specialists of geophysics give us suggestive discussions to our project.

Keywords: solar activity, chromosphere, UV irradiation, Upper atmosphere heating

Migration behavior of Cs-134 and Cs-137 derived from the Fukushima Daiichi NPP in river systems from Fukushima Prefecture

NAGAO, Seiya^{1*}, Masaki Kanamori², Shinya Ochiai¹, Masamitsu Iwata³, Kazuichi Hayakawa⁴, Masayoshi Yamamoto¹

¹Institute of Nature and Environmental Technology, Kanazawa University, ²Graduate School of Nature and Engineering Science, Kanazawa University, ³Aquamarine Fukushima, ⁴Institute of Medical, Pharmaceutical and Health Sciences, Kanazawa University

Nuclear accident at the Fukushima Daiichi Nuclear Power Plant (NPP) was occurred after the 2011 Tohoku Earthquake and Tsunami. About 15 PBq of radionuclides was released from the Fukushima Daiichi NPP due to vent and hydrogen explosion. The MEXT reported total surface deposition of Cs-134 and Cs-137 inside 80 km zone of Fukushima Daiichi NPP. The surface deposition reveals significance external radioactivity in a northwest zone from the NPP, about 20 km in wide and 50 to 70 km in length. River systems may play important role in dispersion of radionuclides in watershed environment. Therefore the short and long-term dispersion of radioactive cesium (Cs) has to monitor at upstream and downstream, and assesses the impact of radioactive pollution on living species in terrestrial and coastal marine environments. The aim of this study is to describe spatial distribution of radioactivity of Cs-134 and Cs-137 in river systems in Fukushima Prefecture during May to December in 2011.

The 20 L of river water samples were collected at monitoring stations in five river systems, Abukuma River, Uta River, Niita River, Natsui River and Same River in May, July, September and December in 2011. Watershed area is 5400 km² for the Abukuma River, but other rivers has small watershed from 106 to 749 km². The Cs-134 and Cs-137 were separated by coprecipitation with AMP and measured by gamma-ray spectrometry using low BKG Ge detector at LLRL and Ogoya URL of Kanazawa University for 1-3 days.

The radioactivity of Cs-137 ranges from 0.23 Bq/kg to 4.18 Bq/kg in May 20, from 0.064 to 1.54 Bq/kg in July 12-13 and from 0.02 to 0.79 Bq/kg in September 13-14. The variation pattern is in consistent with spatial distribution of Cs-134 and Cs-137 in surface soil in Fukushima Prefecture. All of the samples indicate Cs-134/Cs-137 ratio is about 1.0 so that radiocesium in surface waters transported to all of the stations. The radioactivity of Cs-137 decreases at each monitoring station during May-September except for the downstream of Abukuma River. In this study, we will describe the spatial and temporal variations in of Cs-134 and Cs-137 in the river systems in addition with the December data, and discuss with the factors controlling the variations of radiocesium in river watershed environments.

Keywords: Cs-137, river water, migration, Fukushima NPP accident

Interannual chlorophyll variability in the Northeastern Tropical Pacific Ocean: An eddy-resolving ocean model study

SASAI, Yoshikazu^{1*}, Hideharu Sasaki¹

¹Japan Agency for Marine-Earth Science and Technology

An eddy-resolving coupled physical-biological ocean model has been employed to investigate the seasonal and interannual variability of the chlorophyll in the northeastern tropical Pacific during 2000-2007. The seasonal variability of the surface chlorophyll concentration in the model agrees well with satellite ocean color data, except for the equatorial region. High chlorophyll levels off the Gulf of Tehuantepec, Papagayo, and Panama in winter and in the Costa Rica Dome in summer are well reproduced. Production in these areas is controlled by the supply of nitrate rich-waters through vertical mixing and coastal and open ocean upwelling. The variability of the thermocline depth is strongly connected to the seasonal variability of surface chlorophyll. El Nino Southern Ocean (ENSO) variability has a marked effect on the marine ecosystem. The model reproduces the variability of chlorophyll corresponding to the observed ENSO variability. During cold SST anomaly phases (2000, 2001 and 2007), the chlorophyll concentration is considerably higher than other years (2002-2006). Chlorophyll variance is largest off the Gulf of Papagayo and over the Costa Rica Dome where the changes to chlorophyll levels are related to changes in the supply of nitrate rich-waters through vertical mixing and upwelling.

Keywords: Marine ecosystem, Northeastern Tropical Pacific, ENSO, High-resolution ocean model

Observation of atmospheric radioactivity in Tsukuba-Impacts on aerosol and deposition by the Fukushima nuclear accident

IGARASHI, Yasuhito^{1*}

¹Atmospheric Environment & Applied Meteorology Resarch Department, Meteorological Research Institute

At the Meteorological Research Institute, Japan (MRI), in order to clarify the actual condition and its control factors for temporal concentration change of anthropogenic radionuclides in the atmosphere as well as in the ocean, observations have been continued for the long-lived radionuclides, which could have environmental and health impacts, over the long period of 50 years or more from the 1950s, triggered by the Bikini incident. Especially, long-term observation record of monthly depositions of anthropogenic radionuclides (⁹⁰Sr and ¹³⁷Cs) becomes the world-longest, and will cover full 55 years in March, 2012 since April, 1957.

The large-scale nuclear test in the atmosphere conducted by the U.S. and the former Soviet Union during the late 1950s to the early 1960s, nuclear tests by China during the early 1970s to the early 1980s and the Chernobyl accident in 1986 have been recorded clearly with which level the anthropogenic radionuclides emitted being affected onto the atmospheric environment over our country.

The accident of Fukushima Daiichi Nuclear Power Plant of the Tokyo Electric Power Corporation, which occurred by the hit of great earthquake in March 11, 2011, newly emitted and added abundant radioactive material, which is a few tenth of those from the Chernobyl accident, to the atmospheric environment. By this large-scale contamination, atmospheric environments over Japan, especially the eastern Japan, had a substantial influence with a massive amount of the anthropogenic radionuclides. At the MRI, atmospheric sampling and analysis of the radioactivity in the sample were continued before and after the accident. In this lecture, the impacts by the Fukushima accident is addressed about which were documented in our long-term time series data of the atmospheric radioactivity.

Keywords: Anthropogenic radioactivity, Atmospheric samples, the Fukushima accident, Atmospheric deposition

Transport simulations of Cs137 from the shelf to open ocean around Fukushima

MIYAZAWA, Yasumasa^{1*}, Yukio Masumoto¹, Sergey M. Varlamov¹, Toru Miyama¹, Masayuki Takigawa¹, Makio Honda¹, Toshiro Saino¹

¹JAMSTEC

We have conducted simulations of the Cs137 oceanic dispersion process from March to May 2011, focusing on transport processes from the shelf to open ocean and source information. Dispersion due to direct emission was limited near the coast for the period from March to the beginning of April, and extended to open ocean in the middle of April. Atmospheric deposition was dominant for oceanic dispersion for the period from March to the beginning of April. Estimation of the source information using the observation data could be considerably influenced by simulated ocean currents and error specification of urgent monitoring data. Comparatively large direct emission amount estimated as compared to other models suggests more transport of Cs137 from the shelf to open ocean simulated by JCOPE-T than by the other models

Keywords: Cs137, Fukushima, oceanic dispersion, simulation, observation

Modeling the oceanic flow field for investigating the dispersion of radioactive water along Fukushima coast

KIDA, Shinichiro^{1*}, CHOI, YOUNGJIN¹, TAKAHASHI, Keiko¹

¹Earth Simulator Center, JAMSTEC

A numerical model is developed at the Earth Simulator Center, JAMSTEC, to investigate the dispersion of radioactive water released to the coast waters of Fukushima. This model is based on a three-dimensional particle random-walk model for simulating the dispersion of radioactive water and an ocean general circulation model for simulating the background oceanic flow field. While we were successful at modeling the dispersion of radionuclides similar to that observed, we also find the spatial variability in the oceanic flow field quite sensitive to model settings. Qualitatively, we find the radionuclides to be trapped mostly along the coast. However, differences in surface wind stress and heat flux products as well as maximum model depth gave different results. We will suggest that the differences in the development of coastal currents, meso-scale open oceanic eddy, and surface mixing to be the primary causes of the differences.

Keywords: ocean modeling, coastal currents, meso-scale eddies

Cooling Processes in the Southeastern Tropical Indian Ocean during the Initiation Period of the 2006 IOD

MATSUBARA, Kosuke¹, MASUMOTO, Yukio^{2*}

¹Graduate School of Science, University of Tokyo, ²Japan Agency for Marine-Earth Science and Technology

Subsurface temperature variability in the southeastern tropical Indian Ocean associated with the 2006 Indian Ocean Dipole (IOD) event and a possible mechanism responsible for cooling of the upper-ocean during a generation period of the IOD are investigated using satellite data, atmospheric reanalysis data, and results from a high-resolution ocean general circulation model (OFES). We conducted a heat budget analysis, focusing on the evolution for the 2006 IOD event, which was the largest positive IOD during the 2000s and the first event of the three consecutive positive IODs in 2006/07/08.

OFES reproduced the 2006 IOD event realistically in terms of time evolution of the subsurface temperature in the eastern tropical Indian Ocean. During May to July 2006, prior to the emergence of the surface IOD signals, several equatorial upwelling Kelvin waves are excited in the central Indian Ocean by zonal wind stress anomalies. These Kelvin waves penetrate into the coastal regions along the Sumatra and Java Islands, and generate subsurface negative temperature anomalies through a vertical advection term in the heat budget analysis. It turns out that the vertical advection term is dominated by a term associated with an advection of mean vertical temperature gradient by an anomalous vertical velocity. These subsurface cooling processes associated with the intraseasonal Kelvin waves seem to be important for the onset of the sea surface temperature anomaly off the coast of Sumatra and Java Islands in 2006.

Keywords: Indian Ocean Dipole, Upper ocean heat budget