

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

TROSELJ, Josko^{1*} ; YAMASHIKI, Yosuke² ; TAKARA, Kaoru³

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

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.

Acknowledgements

Dr. Shinichiro Kida, executive supervisor, JAMSTEC
Dr. Keiko Takahashi, MSSG program director, JAMSTEC
Monbukagakusho (MEXT) scholarship, GCOE-HSE program

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

PRATAMA, Mochamad adhiraga^{1*} ; YAMASHIKI, Yosuke² ; YONEDA, Minoru¹

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

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

KIMURA, Naoko^{1*}

¹GSGES, Kyoto University

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

TERAMOTO, Tomoko¹ ; YAMASHIKI, Yosuke^{2*} ; TAKARA, Kaoru³

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

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