論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Integrated Remote Sensing and Coupled Watershed-Ocean-Vegetation Modeling for Seagrass Studies in Busuanga, Palawan, Philippines
著者(和文)	TAMONDONGAyin Modina
Author(English)	Ayin Tamondong
出典(和文)	学位:博士(学術), 学位授与機関:東京工業大学, 報告番号:甲第11855号, 授与年月日:2022年3月26日, 学位の種別:課程博士, 審査員:中村 隆志,神田 学,木内 豪,中村 恭志,髙木 泰士
Citation(English)	Degree:Doctor (Academic), Conferring organization: Tokyo Institute of Technology, Report number:甲第11855号, Conferred date:2022/3/26, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	Transdisciplinary Science and Engineering	系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of	(Philosophy)
学生氏名： Student's Name	Ayin Modina Tamondong		指導教員（主）： Academic Supervisor(main)	Takashi Nakamura	
			指導教員（副）： Academic Supervisor(sub)		

要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Seagrasses are marine flowering plants that commonly grow on soft substrata (mud, sand) in shallow coastal waters. They are one of the most unique and productive ecosystems and they are a vital natural resource. Among the ecosystem services offered by seagrasses are providing coastal protection and filtering the water. They trap sediment and excessive nutrients which improves the water quality, and they also act as a barrier to reduce current velocity. They also prevent coastal erosion and sediment resuspension by covering unstable sediments with their extensive root system. To maintain a healthy seagrass habitat, many factors are considered such as depth, sediment, and water quality, tide and water movement, and species interactions. Excessive sedimentation may cause seagrass dieback. Seagrasses are plants, so they need light to survive. Light attenuation in the water due to reduced water quality has significant impacts on the survival of seagrasses. In a study by Terrados et al. in 1998, they showed that seagrass species richness and community leaf biomass in Southeast Asia declined with increasing siltation. Seagrasses need sufficient light to thrive which is why they are influenced by disturbances that cause changes to the water and sediment quality. Siltation leads to deterioration of light and sediment conditions which results in seagrass loss. The rise in coastal developments increases the siltation deposited by rivers to the coastal environment which predicates an unclear future for seagrass meadows. There is a need to monitor the current situation of seagrasses as well as to develop predictive models to determine their possible mortality. The objective of this research is to simulate the potential seagrass growth and mortality due to sediment runoff in Busuanga, Palawan, Philippines using a coupled watershed-ocean-vegetation modeling approach. The Philippines is a hotspot for seagrasses, unfortunately, seagrasses are in decline in the region due to sedimentation caused by runoff from upland communities, overexploitation, and coastal developments due to tourism and urbanization. Studies to assess seagrass responses to anthropogenic impacts on a coastal scale in the tropical region are limited. This research addresses such limitations by including the coastal ecosystem, specifically the seagrass meadows, in the coupled modeling approach. The seagrasses in Busuanga were initially assessed using field survey, drone mapping, and satellite remote sensing. A time-series analysis of water quality parameters such as sea surface temperature, salinity, chlorophyll concentration, and sea surface level anomaly was carried out using satellite data and global models to assess the historical changes in the coastal waters of Busuanga. Based on observed field data gathered at four stations (A, B, C, D) with varying distances from the river in the study area, seagrasses beds affected by river discharges have lower percent cover and number of species than areas far from the river mouth. At stations A and B, which were nearer the river mouth, seagrass percent cover of 5.9% and 7.6% respectively were observed while at Stations C and D, 19.6% and 19.2% were recorded. Classified drone data, gathered simultaneously as the seagrass survey, also shows a similar analysis. Based on the interpolated maps from water quality data, the seagrass beds near the river mouth have higher turbidity values. The increase in turbidity in the seagrass beds occurred during ebb tide, when the water is flowing from the river into the coastal region, according to data from the sensors deployed in the field. To model the river discharges, the Soil and Water Assessment Tool or SWAT+ implemented in the QGIS platform was employed. The river outflow and sediment yield results of the SWAT simulation were used as the input river forcing in the Coupled Ocean-Atmosphere-Wave-Sediment Transport or COAWST modeling system. A three-level nested

modeling approach, called Busuanga Domain 1, 2, and 3, was utilized to increase the resolution of the simulation. The initial and boundary conditions were created from a Coral Triangle Regional model. JRA-55 data was used as atmospheric forcing while TPXO as tidal forcing. To validate the results of the Busuanga Domain 1 simulations, sea surface temperature and chlorophyll concentration were compared to existing global models (HYCOM), long-term climate data record (NOAA OISST), and satellite images (MODIS, GCOM-C). The water temperature, suspended sediment, and current velocity of the simulation results of Busuanga Domain 3 was validated using data from sensors deployed in the study area. Coupling the watershed and ocean models greatly increased the correlation of observed and simulated suspended sediment from an R2 of -0.432 to 0.640. When the presence of seagrasses was included in the simulation to complete the watershed-ocean-vegetation coupling, the current velocity and suspended sediment in the results decreased which successfully demonstrates the capability of seagrasses to act as barrier and water filter. Based on simulated data, the seagrass bed near the river outlet has higher suspended sediment concentrations which caused a decrease in seagrass above-ground biomass and plant density.