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<p>(要 旨) (Summary)</p> <p>Blue carbon ecosystems, including mangrove forests, seagrass meadows, and salt marshes, are coastal vegetation ecosystems renowned for their remarkable capacity to sequester carbon. They store a large amount of carbon, often referred to as “blue carbon”, particularly in their soil. Carbon sequestration in the soil of these ecosystems is governed by two key processes – the internal supply of organic carbon through biomass production and turnover (the “ecological process”), and trapping of particulate organic carbon hydrodynamically transported from external systems via fluvial and tidal processes (the “physical process”). However, our understanding of these processes is limited, which hampers our understanding of the dynamics of blue carbon under the impact of climate change. This thesis focuses on modeling biomass dynamics and hydrodynamics-sediment transport particularly in seagrass meadows and mangrove forests towards a better understanding of the ecological and physical processes shaping the blue carbon dynamics.</p> <p>Chapters 2–3 address a better understanding of biomass dynamics of seagrass meadows and mangrove forests. Chapter 2 presents a new seagrass growth model driven by a coupled hydrodynamic-biogeochemical model. This model is applied to a seagrass meadow in the Philippines, which has been impacted by the unregulated mariculture activities in adjacent areas. The model successfully reproduces the distribution of above-ground seagrass biomass for two co-existing species. It highlights the impact of high nutrient loads on underwater light and seagrass growth rates and a potential of recovery of seagrass meadows through mariculture regulation. In Chapter 3, a new mangrove growth model is developed and applied to a mangrove forest in Japan. This model incorporates a plant hydraulic module to consider the soil salinity control on plant water uptake and its linkage to photosynthesis and nutrient uptake. The model shows a remarkable performance in predicting the patterns in forest structures composed of two co-existing species across the soil salinity gradient. It unveils the roles of salinity and tree competition in shaping the forest structures, and identifies crucial plant traits.</p> <p>Chapters 4–6 address a better understanding of hydrodynamics-sediment transport in mangrove forests, with a specific focus on the flow-vegetation interaction of <i>Rhizophora</i> mangroves, characterized by their complicated above-ground root structures (prop root systems). Chapter 4 extensively investigates the morphological structures of the prop root systems by collecting data from</p>			

156 trees in Indonesia, the Philippines, and Japan. This research establishes an allometric relationship between root structures and stem diameter and develops an empirical model for predicting *Rhizophora* root structures, demonstrating an excellent fit with the collected data. In Chapter 5, a detailed measurement of hydrodynamics in a planted *Rhizophora* mangrove forest is presented. This includes quantifying the drag force exerted by the mangroves and estimating the drag coefficient of *Rhizophora* mangroves in the field for the first time. This research demonstrates a reasonable prediction of drag using the obtained drag coefficient and the empirical *Rhizophora* root model. Chapter 6 formulates and implements the impact of *Rhizophora* mangroves on flow in a hydrodynamic model. It incorporates the empirical *Rhizophora* root model, which enables the forest-scale simulation of hydrodynamics without rigorous measurements of root structures. The model's reasonable performance in predicting mean flow and turbulence in *Rhizophora* mangrove forests is verified using data from previous studies.

Chapters 7–8 feature two case studies applying the developed hydrodynamic model to investigate sediment transport processes in mangrove forests. In Chapter 7, the model is applied to a riverine mangrove forest in the Philippines. The results reveal that the increased hydraulic resistance of the mangrove forest significantly attenuates flow within the forest, leading to retention of sediments. When the effect of mangroves on flow is deactivated in the model, a substantial loss of sediments occurs due to soil erosion. Chapter 8 extends the model to consider the effect of mangroves on wave damping. It assesses the impact of typhoon events on sediment loss in a mangrove forest. The model demonstrate that mangroves effectively dissipate wave energy, regulating sediment loss. It also suggests that as typhoon intensity rises, sediment loss increases nonlinearly. However, the loss of mangroves has a far more significant impact on sediment erosion than an increase in typhoon intensity. These results underscore the vital role of mangrove forests in retaining sediments and thus soil organic carbon. Altogether, this thesis advances our understanding of ecological and physical processes in blue carbon ecosystems, providing a solid foundation for modeling the blue carbon dynamics under the impacts of climate change.

備考：論文要旨は、和文2000字と英文300語を1部ずつ提出するか、もしくは英文800語を1部提出してください。

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