Rising to the Challenges of Modeling Marine Ecosystems: Acclimation, Adaptation, and Complexity

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This presentation will introduce plans for a Marine Ecosystem Modeling Research Unit within the newly established World Premier Institute - Advanced Institute for Marine Ecosystem Dynamics (WPI-AIMEC), jointly hosted by JAMSTEC and Tohoku University. This new unit will consist of a team of researchers to focus on developing and testing new models of marine ecosystems, as well as conducting related research into analyzing data and evaluating model performance.

Marine Ecosystems include great biodiversity, spanning planktonic microorganisms, macroscopic plants, bacteria, fungi and animals. Phenotypic plasticity or acclimation occurs rapidly, as various marine life forms adjust their physiology and behavior at the individual level to cope with persistent environmental fluctuations. At the same time, evolutionary adaptation occurs in a wide variety of distinct environments, and it can proceed rapidly for many fast-growing microorganisms. All the while, ocean currents and mixing processes operating at various spatio-temporal scales mix differently adapted species throughout the marine environment, where they interact and compete for resources. This makes marine ecosystems an iconic example of Complex Adaptive Systems (CAS). CAS are now widely appreciated in the physical and ecological sciences, but many challenges remain for understanding their dynamics. These challenges include understanding how marine ecosystems will respond to ongoing climate change and other environmental changes resulting from human activities.

To address these challenges, the Marine Ecosystem Modeling Research Unit will conduct research into:
(1) understanding the response and adaptive capacity of marine ecosystems to environmental change in estuarine, coastal, and open ocean settings.
(2) development and testing of equations to describe the structure and dynamics of marine ecosystems and associated biogeochemical cycles.
(3) Development of models to describe and simulate the dynamic response of marine ecosystems, their biodiversity, and interactions with the physical and chemical environment.
(4) analyzing data from laboratory experiments and ocean/field observations related to marine ecosystems and evaluating model performance by comparison to such data.

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