## Development of Three-Dimensional Hydrodynamic and Ecosystem Numerical Model for Ago Bay

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Ago Bay is a small semi-enclosed coastal sea of Japan. It locates in the center of Honshu island and faced to the Pacific Ocean. The deeply indented, rias-type, coastline of the bay protects the intrusion of ocean waves and it provides an adequate place for the pearl culture. The culture began about a century ago and has prospered until now. Recently, the deterioration of the sediment began to be serious. The COD value of the sediment in the bay head has been increasing for 30 years and already exceeded the pollution limit defined by a regulation. Since the sludgy sediment brings about the oxygen depleted water and degrades the water quality in summer, it gives bad effect to the pearl culture. The cause of deterioration is unclear although the pollution load from land area as well as those from the pearl culture is suspected. In such a situation, Mie Prefecture, who is the local government, started the research project for investigation of the mechanism of deterioration process of the sediment and for developing the purification technologies.

Our research team has a role to clarify the characteristic of the flow, the water quality and the sediment quality of Ago Bay, and to draw the picture of material circulation. For this purpose, we decided to develop our original numerical models suited for the analysis of Ago Bay. The models under development are three kinds, a three-dimensional hydrodynamic model, a water quality model, and a sedimentation model. All of the models are based on the finite difference method. It is the special feature of the hydrodynamic model that the grid system conforms to the sea surface and moves with it. The vertical grid interval shrinks towards the sea surface. This aims at improvement of computational accuracy of salinity which has a large vertical gradient near the sea surface. According to the analysis already done, the river plume which spreads on a sea surface was clearly captured, and density stratification in summer season was reproduced quite accurately. Since the nutrient from land area is conveyed by the river plume, it is also expected to improve the accuracy of water quality calculation.

The water quality model includes dynamics of plankton and nutrient, and the physiological characteristic of a pearl oyster. 19 compartments are taken into the model, which allows the competition between a diatom and a dinoflagellate. The conservation of carbon, nitrogen and phosphorus, are carefully implemented in the model so that the computational results can be utilized in the investigation of material circulation. The sedimentation model, whose detail is described in another paper, has also 19 compartments and is taking into consideration the material circulation of carbon, nitrogen, phosphate, iron, manganese, sulfur, and oxygen. It is the target of our research to couple the water quality and the sedimentation model, and to perform analysis which reproduces the phenomenon as correctly as possible.

For the purpose to obtain basic data of the numerical models, oceanographic observations and experiments for the sediment, have been conducted over two years and a half. Moreover, the biological experiment for developing the physiological model of a pearl oyster has been carried out. The water quality data measured by the environmental monitoring system since September 2003, which is reported in another paper, has also created a big database. All of these will be utilized to complete the Ago Bay model.

In addition, a short term prediction of the water quality is planned in the project. The real time observation data of the environmental monitoring system is utilized and is read into the numerical models with use of data assimilation technique. This will be tried after the completion of numerical models.

The detail description of the numerical models, calculation results and comparison with observation data will be provided in the full manuscript. The present study is a part of the Ago Bay Environmental Restoration Project under the program of Japan Science and Technology Agency.

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