

# Numerical Simulation Model for Quantitative Management of Mariculture

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A numerical model is developed for mariculture management, which consists of four parts: (1) current simulation model which calculates tidal and wind induced currents, (2) COD diffusion model which calculates spatial distribution of COD using simulated current, (3) DO diffusion model which calculates spatial distribution of dissolved oxygen, and (4) accumulation model which calculates distribution of deposits from mariculture of fish.

Our model is capable of (1) calculating the detailed spatial distribution of COD and DO by dividing the bay area into many grid points, (2) taking into consideration the effects of feed and fish in each raft, and the loading of COD from rivers.

Using this model, we can assess the influence of the location or the area of the mariculture rafts on the ecological and/or environmental system. It is also of practical use in order to obtain a better distribution of rafts in bay areas, or to calculate the basic data for the renewal of licenses.

Application is made to Mikame Bay in Ehime Pref., west part of Japan, as a case study.

## Model Conception

The schematic view of the model is shown in Fig.1 and the ecological parts of the model is shown in Fig.2. Tidal, wind induced and/or density currents are calculated using three dimensional primitive equations and equation of state. The spatial concentrations of COD and DO are calculated using diffusion equation based upon the calculated currents. Loading of COD from land and/or mariculture and open boundary condition are also included. All biological parameters are collected or observed as the actual case study of the bay and fish. For example, the consumption of oxygen by yellowtail respiration is represented as follows;

$$R = 0.34 \times 1.059^{(T-20)} \times W^{0.82}$$

where T is water temperature and W is weight of a yellowtail.

## SIMULATION RESULTS - Case study at Mikame Bay -

A horizontal distribution of mariculture preserve is shown in Fig.3. Yellow tails are mainly bred in this bay and monthly mean number of fish, body weight, amount of feed, river loading and also horizontal distribution of COD, DO, water temperature and salinity are collected by fisheries experimental station.

And based on these data, we calculated COD and DO distributions at different levels and also accumulated organic matter.

Fig.1 : Schematic view of the model

