

Development of EcoPARI, a GUI-based tool for conducting hydrodynamic-ecosystem simulations

*Tetsunori Inoue¹, Yoshitaka Matsuzai¹, Masaya Kubota¹, Hiroki Matsumoto¹, Tomoyuki Sato¹

1. Port and Airport Research Institute

Numerical simulation models are worth using in understanding various phenomena in enclosed water bodies. However, in general, considerable skill is required to use the models and they are not easily accessible to a beginner. In this study, a numerical simulation tools using a GUI for pre- and post-processing have been developed so that even novice users can conduct numerical simulations. First, there are four tools for the preparation stage. EcoPARI-Pre is a tool that extracts the necessary parts of various pre-prepared data for individual simulation and creates a boundary condition file according to a format as model input. The tool also allows modifications to be made to existing data as required by the operator. EcoPARI-Boundary condition is a tool that creates boundary condition files for atmospheric, river, and open boundaries from AMeDAS and JMA GPV data, etc. EcoPARI-Parser is a tool for editing existing initial condition files, allowing users to create their own initial conditions. EcoPARI- Remesher is a tool for rational mesh partitioning, that is, the tool merges meshes, if the quantities of interest are similar in neighbouring.

Numerical simulation execution model is EcoPARI-Simulator. This model is mainly aimed at simulating fluid dynamics-ecosystems in closed water bodies and consists of three models: fluid dynamics, pelagic, and benthic ecosystems. Non-hydrostatic model can be selected, particle tracking calculations are possible, and BCM is used for nesting. The ecosystem model has distinctive features such as modelling of detritus food chains, bivalves, and fish.

As a post-processing stage, three tools are available: EcoPARI-Post Web is a tool that reads the output results directly from the computer and visualises the results via a web browser. EcoPARI-Post Stand-alone is a tool that displays the output results in two dimensions on the user's PC. EcoPARI-Reaction is a tool that calculates and displays not only scalar quantities (stock) but also reaction rates (flow) in an ecosystem model.

A system for routine 11-day short-term forecast calculations has also been built by combining EcoPARI-Boundary condition and EcoPARI-Simulator, and a tool called EcoPARI-Post Mobile has been created to display these results on a smartphone.

Another sub-system is the data assimilation tool (EcoPARI-Data Assimilation), which is used to create accurate initial conditions. This can also be used in parameter tuning. Another parameter tuning tool, EcoPARI-Genetic Algorithm, has also been created for parameter tuning based on genetic algorithms based on comparisons between observed data and calculated results.

In summary, a series of the systems have been developed to easily and accurately perform fluid dynamics and ecosystem simulations in closed water bodies. Although the system has not been used extensively at this stage, it is intended that it will be used and improved by many users in the future.

Keywords: GUI, Numerical models, hydrodynamics, ecosystems, enclosed water area