Model Entry form

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| ***General Information*** | |
| Acronym of the model: | AED |
| Full name of the model: | Aquatic Ecodynamics Modelling Library |
| Model components: | ☐Hydrodynamics  ☒Chemistry  ☒Biology |
| Supported platforms: | Windows ☒  Mac ☒  Linux ☒ |
| Programming languages: | Fortran 90 |
| Still maintained: | ☒ Yes, by AED Research Group, University of Australia ☐ No |
| Most recent version | 2.4.0rc5 |
| ***Model Structure and Spatial Domain*** | |
| ☐ Needs compilation ☒ Executables are available | |
| ☒ 0D ☐ 1D ☐ 2D (horizontal) ☐ 2D (vertical) ☐ 3D | |
| ☐ Flexible grid ☐ Fixed grid Other: | |
| ☒ Mass balance included ☐ Catchment model | |
| ***Model Description*** | |
| Model Objective: | Simulation of aquatic ecosystem dynamics.  Provision of a flexible model structure |
| Specific application:  *(Please include example(s))* | * Analysis of oxygen depletion in an estuary (Bruce et al. 2014) * Selective withdrawal to manage oxygen concentration in a reservoir (Weber et al. 2017) * Analysis of hypolimnetic anoxia Snortheim et al. 2017) |
| Background knowledge needed to run model: | * Understanding of biological and chemical processes in the water body * some programing language to handle input/output files, e.g., R, Python or Matlab |
| Basic procedures:  (*Describe the procedure step-by-step*) | Note: the developer’s website provides extensive information on the model setup. The general procedure is:   1. Optional: Run one of the example simulations 2. Decide on a hydrodynamic model (e.g., GLM, Tuflow) and set-up that model 3. Prepare the input files for the model (e.g., inflow concentration of oxygen and nutrients; .csv file with inflow data) 4. Set the simulation settings (configuration which modules to include, set initial conditions, set module parameters specific to the study site); which files to include depends on the hydrodynamic driver and on the chosen modules (e.g. "aed\_phyto\_pars.nml" for the phytoplankton-specific parameters), you will always need to configure the “aed2.nml” text file 5. Prepare the validation data (e.g., measurements of oxygen, nutrient and chlorophyll concentrations in the water body) 6. Split input and monitoring data into two periods in time 7. Run the model (e.g., “glm.exe”) for the first period. 8. Compare model results and observations (start with oxygen, then the nutrients and then the biological variables) and calibrate model parameters (e.g., nutrient release from the sediment, mineralisation rates, oxygen demand, growth parameters, etc.). 9. Use the second period to validate the model, i.e. compare observations and model results without further calibrating the model and calculate the model fit. 10. Optional: Use your model set-up to run scenarios. |
| *Here you can add a more detailed description of the model here (up to 250 words)*:  AED is an open source library of ecodynamics modules. This setup makes the model structure very flexible and allows for testing of different model formulations and algorithms. Some of the modules depend on each other and have to be run together.  AED can be coupled to different hydrodynamic drivers. It has been coupled to GLM (1D), TUFLOW-FV (2D/3D finite volume) and Telemac (1/2/3D flexible mesh). | |
| Link to website(s) and/or manual: | <http://aed.see.uwa.edu.au/research/models/AED/overview.html>  <http://aed.see.uwa.edu.au/research/models/AED/setup.html> |
| ***Model Characteristics*** | |
| Input variables: | *Obligatory*:  External load and inflow:   * DO (or assume saturation) * TP, knowledge of how to fractionate that, DOP * TN, full fractionation * Si * POC, DOC * If available and relevant: carbon of different phytoplankton groups   In Lake/water body:   * chlorophyll (+ if available: phytoplankton counts = or an idea of main groups/species and succesion), * phosphorus (TP, PO4, DOP) concentrations * nitrogen (TN, NO3, NH4, DON) concentrations * silicate (Si) concentration (only if limiting) * oxygen concentration |
| *Optional*: |
| Input file format: | ASCII ☒  .netcdf ☐  .csv ☒  .xls ☐  Other, namely: |
| Output variables: | dependent on the configuration:  tracers, dissolved oxygen, carbon (dissolved inorganic carbon, methane), nitrogen (nitrate, ammonium, nitrous oxide), phosphorus (phosphate), silica, suspended solids, organic matter (dissolved and particulate carbon, nitrogen, phosphorus), phytoplankton, zooplankton |
| Output file format | ASCII ☐  .netcdf ☒  .csv ☒  .xls ☐  Other, namely: |
| Biogeochemical model components:  (*Which nutrients, phytoplankton, zooplankton, etc., including number of different groups*) | carbon (dissolved inorganic carbon, methane), nitrogen (nitrate, ammonium, nitrous oxide), phosphorus (phosphate), silica, suspended solids, organic matter (dissolved and particulate carbon, nitrogen, phosphorus), phytoplankton (up to seven groups), zooplankton (up to three groups) |
| Model structure/mathematical framework (e.g., ODE, PDE, empirical model,...) | ODE |
| Temporal resolution:  (*minimal and maximal)* | depends on hydrodynamic driver |
| Minimal spatial resolution: | NA |
| Variables needing calibration: | typical: sediment and water column oxygen demand, nutrient release rates from the sediment, nutrient mineralization rates, growth parameters (maximum rate, nutrient uptake and storage, light-dependency, temperature-dependency) |
| Has successfully been used in:  (*e.g. Climate change scenarios, lake management support, etc. Please provide a reference*) | |
| ☒ Climate Change Scenario | Snortheim et al. 2017 |
| ☐ Shallow Lake/Reservoir |  |
| ☐ Deep Lake/Reservoir |  |
| ☐ Oligotrophic Water |  |
| ☐ Mesotrophic Water |  |
| ☐ Eutrophic Water |  |
| ☐ Ocean |  |
| ☒ Management Support | Weber et al. 2017 |
| ☐ ... |  |
| Countries in which the model has been applied | Australia, Germany, USA |
| Which Institutes have applied the model | University of Western Australia;  Helmholtz Center for Environmental Research;  Center for Limnology, University of Wisconsin;  Virginia Tech |
| Has coding for: | |
| ☐ Ice dynamics ☐ Sediment heat flux  ☒ Sediment dynamics ☐ ...  ☐ Internal waves ☐ ... | |
| ***Accessibility*** | |
| ☒ Open-Source ☒ Open-to-Use ☐ Licensed | |
| ☒ Prompt-based ☐ GUI | |
| ☒ Test cases available | |
| Available tools for pre- and post-processing: |  |
| Support:  (*Community forum, mailing list, “help”-manual, contact, etc.)* | Online Manual:  <http://aed.see.uwa.edu.au/research/models/AED/setup.html>  Community forum:  <https://groups.google.com/forum/#!categories/aquaticmodelling/aed> |
| Can be coupled to the following models: | GLM, TUFLOW-FV, Telemac, any other model via FABM |
| How can someone get access to this model:  (*Please provide a URL or contact person*) | Executables on develop website:  <http://aed.see.uwa.edu.au/research/models/AED/download.html>  Source Code on github:  <https://github.com/AquaticEcoDynamics/libaed2> |
| ***Miscellaneous*** | |
| *Comments (things not covered by the form):* | |
| *Useful tricks and hints for other users (on handling input files, running the model, numerics,...):*  Do not start off too complicated and only include those modules that are absolutely necessary. For example, rather simulate three phytoplankton groups than seven. | |
| Links (*Please add links to the model’s developer’s website and the model’s resources, like forums, manuals, support, contact,...*):  <http://aed.see.uwa.edu.au/research/models/AED/download.html>  <https://groups.google.com/forum/#!forum/aquaticmodelling> | |
| *Reference list (Please add several references in which the model has been applied*):  Weber, M., Rinke, K., Hipsey, M.R. and Boehrer, B., 2017. Optimizing withdrawal from drinking water reservoirs to reduce downstream temperature pollution and reservoir hypoxia. Journal of Environmental Management, 197, pp.96-105.  Snortheim, C.A., Hanson, P.C., McMahon, K.D., Read, J.S., Carey, C.C. and Dugan, H.A., 2017. Meteorological drivers of hypolimnetic anoxia in a eutrophic, north temperate lake. Ecological Modelling, 343, pp.39-53.  Adiyanti, S., Eyre, B.D., Maher, D.T., Santos, I., Golsby-Smith, L., Mangion, P. and Hipsey, M.R., 2016. Stable isotopes reduce parameter uncertainty of an estuarine carbon cycling model. Environmental Modelling & Software, 79, pp.233-255.  Bruce, L.C., P.L.M. Cook and M.R. Hipsey (2015) A model of oxygen and nitrogen biogeochemical response to hydrodynamic regimes in the Yarra River estuary. In: Weber, T., McPhee, M.J. and Anderssen, R.S. (eds) MODSIM2015, 21st International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2015, pp. 524–530. ISBN: 978-0-9872143-5-5  Paraska, D.W., L.C. Bruce, G. Shiell and M.R. Hipsey (2015) Predicting critical thresholds of aquaculture waste loading to coastal sediment. In: Weber, T., McPhee, M.J. and Anderssen, R.S. (eds) MODSIM2015, 21st International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2015, pp. 536–542. ISBN: 978-0-9872143-5-5  Bruce, L.C., Cook, P.L.M., Teakle, I. and Hipsey, M.R., 2014. Hydrodynamic controls on oxygen dynamics in a riverine salt-wedge estuary, the Yarra River estuary, Australia. Hydrology & Earth System Sciences, 18: 1397 - 1411  Hipsey, M.R., Bruce, L.C. and Kilminster, K., 2013. A 3D hydrodynamic-biogeochemical model for assessing artificial oxygenation in a riverine salt-wedge estuary. MODSIM2013 - 20th International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2013, Adelaide, Australia.  Li, Y. and Hipsey, M.R., 2013. The importance of model structural complexity when simulating aquatic food webs. MODSIM2013 - 20th International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2013, Adelaide, Australia.  Bruce, L.C., Cook, P.L.M. and Hipsey, M.R., 2011. Using a 3D hydrodynamic-biogeochemical model to compare estuarine nitrogen assimilation efficiency under anoxic and oxic conditions. In: Chan, F., Marinova, D. and Anderssen, R.S. (eds) MODSIM2011, 19th International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2011, pp. 3691-3697. ISBN: 978-0-9872143-1-7. | |
| Form was updated (YYYY-MM-DD) | 2018-10-23 |

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| Please tick this box if we can acknowledge your contribution on the wiki. Your name would be placed on the "List of Contributors" tab of the wiki. | ☑ |