

The Earth Science Box Modeling Toolkit (ESBMTK)

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Box modeling is a versatile tool to explore earth systems processes, ranging from transient changes in the marine carbonate system to the long-term evolution of biogeochemical cycles. The Earth Science Box Modeling Toolkit is a python based toolkit that allows for the rapid creation and deployment of box models. It abstracts typical modeling tasks, e.g., air-sea gas exchange, weathering, seafloor carbonate precipitation/dissolution, kinetic isotope fractionation, seawater properties etc., to python classes. Class instances can then simply be combined to build a model. While there is no graphical interface, this approach significantly reduces coding complexity and model development time. The model structure is then parsed and translated into an equation system that is passed to ode solver libraries like ODEPACK. Separating model description from numerical implementation results in well-documented model code, and combines the computational efficiency of state-of-the-art numerical libraries with the ease of use of python. A 12-box model with air-sea gas exchange, tracers for carbon isotopes, and water column carbonate chemistry requires about 1 CPU second to calculate the model evolution over a time period of 10 million years.