Metos3D

model

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1 Model interface

Metos3D can be coupled to every (biogeochemical) model that conforms to the following interface:

```
subroutine metos3dbgc(n, ny, m, nb, nd, dt, q, t, y, u, b, d)
    integer :: n            ! tracer count
    integer :: ny           ! layer count
    integer :: m            ! parameter count
    integer :: nb           ! boundary condition count
    integer :: nd           ! domain condition count
    real*8  :: dt           ! ocean time step
    real*8  :: q(nz, n)     ! bgc model output
    real*8  :: t            ! point in time
    real*8  :: y(nz, n)     ! bgc model input
    real*8  :: u(m)         ! parameters
    real*8  :: b(nb)        ! boundary conditions
    real*8  :: d(nz, nd)    ! domain conditions
end subroutine
```

The interface decouples biogeochemical models and driver routines (ocean circulation, forcing, geometry) programmatically. It gives you the possibility to provide a free number of tracers, parameters, boundary and domain conditions. It suits well an optimization as well as an Automatic Differentiation (AD) context.

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2 BGC Models

Every model archive contains an `option` directory. You can find a test option file therein. Use it as a starting point for your own work.

2.1 `I-Cs`

The Iodine (I) and Caesium (Cs) model was implemented to the predict the Caesium distribution after the Fukushima accident.

2.1.1 Equations

The model equations describe the radioactive decay of the I^{131} and Cs^{137} isotops named y_1 and y_2, respectively. The decay depends on the half-life. The tracers do not react with each other. The equations read:

$$q_1(y_1, y_2) = \log(0.5)\, 360.0/8.02070\, y_1$$
$$q_2(y_1, y_2) = \log(0.5)\, 1.0/30.17\, y_2$$

2.2 MITgcm-PO4-DOP

The `MITgcm-PO4-DOP` model is an *original* implementation of a biogeochemical model that is used for the MIT General Circulation Model [cf. 2, MITgcm] biogeochemistry tutorial and described in detail in [1]. The model comprises five biogeochemical variables, namely dissolved inorganic carbon (DIC), alkalinity (ALK), phosphate (PO4), dissolved organic phosphorous (DOP) and oxygen (O2). In fact, just PO4 and DOP are used here since the concentrations of DIC, ALK and O2 are derived from those two.

References

[1] Stephanie Dutkiewicz, Andrei P. Sokolov, Jeffery Scott, and Peter H. Stone. A three-dimensional ocean-seaice-carbon cycle model and its coupling to a two-dimensional atmospheric model: Uses in climate change studies. Technical Report 122, MIT Joint Program on the Science and Policy of Global Change, 2005.

[2] J. Marshall, A. Adcroft, C. Hill, L. Perelman, and C. Heisey. A finite-volume, incompressible navier stokes model for studies of the ocean on parallel computers. *Journal of Geophysical Research*, 102:5753–5766, 1997.