Summary of GFDL ocean climate modeling activities: 2005-2007

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Major activities occupying GFDL ocean climate modelers during the past year include the following.

A/ MOM4p1 development: This code includes major upgrades to the MOM-code subsequent to the May2005 release of MOM4.0d. Included in MOM4p1 are

- multiple Eulerian (i.e. not isopycnal) vertical coordinates
- new tracer advection schemes
- updated open boundary conditions
- new physical parameterizations
- wrapper for the General Ocean Turbulence Model (GOTM)
- updated tracer options, including a prognostic ecosystem model
- enhance grid specification features (while still supporting older grid files)
- enhanced FMS infrastructure
- updated documentation and test cases
- new diagnostic features

This code is presently being used for global climate modeling in the one-degree and one-quarter degree class of models. It is a candidate for the next ocean code for use in GFDL's AR5 IPCC coupled climate model. A focused development cycle for the AR5 climate model begins at GFDL during the secondhalf of 2007. It is expected that this development will mature sometime in 2009.

B/ GOLD: The Hallberg Isopycnal Model (HIM) has been reformulated into the Generalized Ocean Layer Dynamics (GOLD), with primary development by Bob Hallberg and Alistair Adcroft. This code has updated algorithms for pressure gradient calculation, time splitting, and physical parameterizations. It has been configured as the ocean component in the GFDL CM2 coupled climate model. Its performance for coupled modelling will be assessed in parallel to the MOM4p1 development.

C/ GFDL ocean scientists continue to play a leading role in the CLIVAR Climate Process Teams (CPTs) on ocean mixing (gravity currents and eddy/mixed layers), which have entered their 5th and final year (ending 2008).

D/ GFDL climate modelers continue to push forward with the analysis of various climate related simulations using the AR4 coupled climate model. Such studies have emphasized work on climate variability, change, as well as impacts of climate on hurricanes.

E/ GFDL has moved forward with a coupled model assimilation project for use in ENSO forecasting as well as decadal prediction.

F/ GFDL earth system model development for AR5 IPCC assessment focuses mostly on extending the capabilities of the physical climate models to incorporate biogeochemical cycles on land, atmosphere, and ocean. Given the added cost of many new tracers and physical/chemical processes, this work is primarily being considered within the same physical ocean model configuration used for AR4 (i.e., one degree class ocean model). In addition to enhanced features for biogeochemical processes, the atmospheric component will see a refined vertical and horizontal resolution organized on a cubed sphere grid, along with the addition of many new physical and chemical processes. The decision to focus primarily on the atmosphere for enhanced resolution and physics is based on noting that the largest uncertainty in global climate models remains in the atmosphere.

A second development is ongoing within the ocean, to develop a one-quarter degree ocean component for studies focused on assessing the role of ocean eddies in global climate. This work involves the MOM4p1 ocean component, along with a refined resolution atmospheric model. The introduction of biogeochemical cycles is likely to remain too expensive for this ocean component, thus motivating a focus on physical processes in this model.