To: CE, PFJL, RT, PJH
From: CE, PFJL, PJH
Date: December 17, 2002 – 6:18 pm
Re: Minutes of Meeting of November 21, 2002

Agenda

(1) Review minutes of previous meeting
(2) Reports on similar efforts in computational community
(3) Biological models, functional forms and parameterizations
(4) Physical adaptivity
(5) Physical/Biological Code separation and issues (e.g. load balancing)

Attendees

CE, PFJL, RT, PJH

Summary

(1) Review minutes of previous meeting
  (a) PL suggested and it was agreed that a finally agreed upon copy of the minutes of every meeting be forwarded to the PIs.
  (b) The minutes of the previous meeting were reviewed.

(2) Reports on similar efforts carried out elsewhere:
  (a) The ERSEM extensive ecosystem model was mentioned by PL. A copy of the ERSEM technical report was shown and given to all.
  (b) MEAD was mentioned by CE as a similar type of Grid ensemble processing for Earth Sciences at NCSA.
  (c) IOM by Bennett *et al.*'s team was discussed as another ITR project which intends to build a general inverse/data assimilation system.
  (d) PL mentioned a project out of JPL/NASA by Yi Chao called "OurOcean" (`http://OurOcean.jpl.nasa.gov`) that has similarities with Poseidon. CE would try and locate information online. CE mentioned that Grid technologies are already in use at NASA (with the Information Power Grid - IPG).

(3-4) A comprehensive discussion ensued on the subjects of:
  (a) Biological models, functional forms and parameterizations.
    (i) RT distributed a draft of his detailed exposition of various biological model structures.
    (ii) It was suggested that the best way to introduce the multiple functional forms in the code would be to use function pointers with function assignment at the beginning of every time step to keep things clean.
  (b) Physical adaptivity.
    (i) A main source of adaptivity arises from changing the parameters and functional forms (e.g. Shapiro filter, Pacanowski/Philander, etc.) that are used to parameterize eddy viscosities/diffusivities in the flow equations.

(ii) A second source of adaptivity involves the boundary layers: e.g. the upper boundary layer and the parameterization of the turbulent transfer of the atmospheric surface forcings to the ocean's interior.
   (c) Automatic Error Metrics were again mentioned as the means to automate the adaptivity.

(5) Efficient ways to split the physical from the biological solver.
   (a) A description of the basic biological advection-diffusion equation was given by PL; velocity, temperature and salinity data are needed to be sent from the physical solver. In some cases, diffusivity terms/coefficients may also need to be transferred: e.g. for load balancing (reduce the computing load of a complex biological model) or for facility (coupling with a different physical model). The biological code should allow for either case (no-transfer/transfer) by simply including/not-including a call to a subroutine that computes these diffusivity terms. An optimal scheme for communicating these variables to the biological solver needs to be determined.
   (b) Load imbalance problems are bound to arise from the split. They can be partially offset by introducing different time step sizes for the two solvers. PL suggested that with this separation, the biogeochemical time-stepping scheme can in fact be independent from that of the physics, and in light of nonlinearities, Runge-Kutta, predictor-corrector, etc. should be investigated. Suites of pre-packaged solvers exist. CE mentioned that a study of the accuracy effects of such a time decoupling would need to be done at some point. Tolerance on load imbalances should be investigated.
   (c) Issues with the use of different grids for the two models were discussed. In the case of the same grid, regarding the vertical velocity, the code can either exchange vertical flux velocities or true vertical velocities. In the case of a different grid, vertical velocities can be derived from a mass balance equation (assuming primitive equation physics). In the light of the euphotic zone, possible sub-surface maxima, benthic layers, etc., PL suggested that allowing for a different grid is likely the way to go. Simplest first step is to allow for different biological vertical sigma-levels, but keep same horizontal grid.
   (d) PL suggested that an internal software for the management of distributed runs could be useful. Based on the time taken for the execution of current runs, such management software could determine internally what is the likely ideal distribution for future runs. CE added that there should be a database of model run speeds per machine.

Action Items

(1) **ARR** should ask the Harvard group's ONR manager for feedback on the DURIP proposal.

(2) **PJH** to tell WGL that the latest Sun compilers (Sun ONE Studio 7) should be installed at Harvard.

(3) **RT** will borrow suggested books from the library. He will also start interacting more often with CE/PJH/PL for software development.

(4) **PL** will give papers for iterative SVD and links to library manuals to CE. He will also furnish example data files for ESSE. The target is to allow for parallel (shared memory at least) and iterative SVD.

(5) **CE** will visit and install Sun's Clustertools at Harvard.

(6) **CE** will figure out a (preferably elegant) way to implement function pointers in Fortran ASAP.

(7) **CE** will bring to the Harvard team copies of the vortex extraction/identification literature.

(8) **PJH** will send the MIT team the scripts used by Harvard researchers to produce gifs and Postscript dumps of the NCAR graphics output. MIT researchers and PL/PJH should meet to discuss visualization projects. In particular, brief on new work by Pang *et al.* using ESSE outputs.

(9) **PJH** will send the MIT team 2 domain nesting test.