Coupled Climate Modeling with a Fine Resolution CCSM

(an oceanography perspective)

Why, What, When, Where, How, Who?

Why?

- We strive to make our models represent the real world. The real ocean is full of eddies.
- More accurate science:
  - A coarse resolution ocean model with an accurate parameterization of transient eddy processes will never produce the correct climate for the correct reasons because the fine scales of the time-mean flow will still be inaccurate.
- More precise science:
  - Many applications in climate prediction and impact assessment require information on scales finer than we currently resolve (e.g. coastal upwelling systems)
- New science:
  - Emergence of completely new modes of coupled low-frequency variability when both the ocean and atmosphere are capable of generating turbulence through flow instabilities.
  - Emergence of strong air-sea coupling at ocean frontal scales

What?

- Should we have as a goal a fully-coupled version of CCSM with an eddy resolving ocean component and other components (active and data models) with commensurate resolution?

When? Where?

- At least three projects have already undertaken fully coupled integrations of CCSM with 0.1˚ eddy-resolving ocean component:

- CRIEPI:
  - T85 CAM3 (~12 years)
- LLNL GC:
  - 0.5˚ and 0.25˚ FV CAM3.5 (13-15 years, ongoing?)
- PetaApps:
  - 0.5˚ FV CAM3.5 (25 years, ongoing)

How, Who?

- Computing resources are precious, but we have been relatively successful in getting them.
- Human resources are sub-critical in each of the individual efforts. Each of the previous efforts have been limited by:
  - Lack of full representation of CCSM component working groups
  - Incomplete software implementation and testing
- We must better coordinate our efforts to eliminate duplication of effort, coordinate development, and leverage resources

A Way Forward?

- Software engineering effort to stand up fully tested and performance optimized “out-of-the-box” high-resolution CCSM4
  - Estimated 2 to 4 CSEG man-months
- Identify a science focus that will attract participation from the breadth of CCSM working groups

Discussion Points

- Is there sufficiently broad interest to make the SE investment?
- What are the science questions to be addressed?
- What is the target resolution?
  - Should we consider an intermediate step (eddy-permitting)?
- Through what avenues should we seek computational resources?
- What support tools need to be modified or created?