Coupled modelling within ACCESS: status and plans

Anthony C. Hirst
CSIRO Marine and Atmospheric Research
PMB 1, Aspendale, Victoria 3195, Australia

The ACCESS goal of a comprehensive climate and earth system simulator requires the coupling of several substantial component model codes. These include initially the ocean, sea ice, atmosphere, land surface and terrestrial biosphere including terrestrial carbon cycle, and ocean biogeochemistry, with atmospheric chemistry to follow on a slightly longer time frame. To this end, the ACCESS modelling team has focussed on porting component models to the common ACCESS working environment (utilising the HPCCC SX-6 machines), on testing these components, and in commencing construction of a prototype coupled model, which will be run initially to establish technical feasibility and which will be upgraded as improvements are made to the component models. This talk reviews the status of the coupled model development, and the strategies adopted for the coupling of the component models. Results will be presented from climate simulations using the uncoupled atmospheric model.

One of the major initial objectives of the ACCESS modelling program is to contribute appropriate climate projections to the Fifth Assessment by the Intergovernmental Panel on Climate Change. The time line of model development in relation to the expected options for contribution to the Fifth Assessment will be discussed. The categories of entry postulated by the WCRP Working Group on Coupled Modelling for the Fifth Assessment report are (1) physical coupled climate models ("AOGCMs") using prescribed concentration scenarios, (2) coupled carbon cycle in AOGCM, (3) coupled chemistry in AOGCM, (4) coupled aerosols in AOGCM, (5) coupled dynamic vegetation in AOGCM. Our expectations for entry into these categories are discussed and require careful consideration of the often lengthy process of testing and balancing the coupled system.

An overarching aim of ACCESS is to make the modelling systems and model output data readily available to the broader Australian research community. The modelling systems are, in particular, required to be maintained on the APAC National Facility as well as on the HPCCC system. The model output data is envisaged to continue to be made available via enhancement of the existing TPAC data server system. Timelines for the availability of the coupled model system and output data to the broader Australian research community will be discussed.

A focus of current work involves the coupling of the ocean/sea ice model to the atmospheric model. The ocean/sea ice model is AusCOM (Australian Climate Ocean Model) consisting of an ocean component based on the MOM4 code, the TPAC sea ice model (Heil et al. 2003) and the OASIS 3.2 coupler. The atmospheric model is the UK Met Office "Unified Model" (UM), also sometimes referred to as "HadGAM" when run in climate mode. The current time line for establishment of the coupled model is:

1. July 2006 – June 2007: Port AusCOM to ACCESS working environment and test via short simulations followed by multidecadal simulations. Perform code adjustments and basic parameter testing for efficiency and to achieve first order acceptable solution. **Deliverable by June 2007** - AusCOM ocean/sea ice model with tested performance available for use on SX-6 by HPCCC users.

2. July – September 2007: Port changes made to AusCOM in (1) above to the AusCOM version on APAC, and ensure that the 'official' versions on HPCCC and APAC are compatible. **Deliverable by September 2007** - AusCOM ocean/sea ice model with tested performance available for use on APAC by university research community.

3. Nov 2006 – May 2007: Examine atmospheric UM code for technical issues associated with interfacing the UM with the coupler.

4. May – Dec 2007: Perform the technical aspects of coupling AusCOM to the UM and perform short test runs with coupled AusCOM/UM system for code checking purposes. **Deliverable by December 2007 -** Prototype physical coupled model (atmosphere/land surface/sea ice/ocean) assembled and ready for testing of physics in coupled mode.

5. 2008: Perform multi/year and multidecadal testing of the coupled model, incorporating physical and numerical improvements tested in component models into the coupled system. Determine, in consultation with the APAC user community, the appropriate time to port the coupled model to the APAC machine.

6. 2009: Finalise addition of physics options to be included in the model version for the IPCC simulations. Perform subsequent testing with the full configured system, with a major focus on achieving a non-drifting control simulation

7. 2010: Perform IPCC simulations, and process output data. **Deliverable by December 2010 –** Model output data from the IPCC simulations lodged at the designated IPCC data collection centre.

The timeline above for 2009 onwards assumes the delivery of coupled model output is required for the Fifth Assessment report by end 2010/early 2011, which is consistent with a six year gap from the IPCC AR4. The actual timelines for the Fifth Assessment report are yet to be decided, and will influence the above timeline.

An additional technical challenge with potential to impact on the above timeline involves the major upgrade of the HPCCC facility expected to occur in 2008. The details of this upgrade are still uncertain (e.g., in terms of choice of mix between vector/shared memory scalar and distributed memory) and could require significant code adaptation, nevertheless the increase in computer power expected as a result of this upgrade will be essential in the timely performance of the IPCC simulations.

Reference:

Heil, P., Roberts, J.L., Phipps, S.J., Fiedler, R.A.S. and Bindoff, N.L. 2003. Toward a high-resolution coupled ocean-sea ice model. Proceedings of the APAC Conference on Advanced Computing, Grid Applications and eResearch, 10pp.,ISBN 0-9579303-1-3.