

CSEEG Update

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Brief Overview

- CCSM3.5 Status
 - Components
 - Current and proposed experiments
 - Performance
- Sequential CCSM Status
 - Results of ESMF Stage 1 Evaluation
 - Summary of ESMF Stage 2 Evaluation and future plans
- Development efforts (current and upcoming)

CCSM3.5 Status

- Physical components (Default resolution 1.9x2.5_gx1v5)
 - POP:
 - POP2 based code with increased vertical resolution (60 level) and topography changes (gx1v5)
 - Modified anisotropic horizontal viscosity, near-surface eddy flux parameterization and tidal-driven mixing parameterization
 - Operational passive tracer and ecosystem codes
 - New method for building input namelist settings
 - CICE:
 - CICE4.0 based code that adds new improved physics options and numerical/computational enhancements.
 - Includes an improved treatment of snow and ice (snow and ice albedos are now based on observation)

CCSM3.5 Status (cont)

- Physical components (cont)

- CLM:

- New surface datasets
 - Improved canopy integration scheme
 - Improved parameterizations affecting the hydrological cycle
 - New capability to run CLM on a grid that is higher resolution than the atm grid
 - Parallel RTM and dramatically improved memory scaling

- ATM:

- Modifications to the deep convection and cloud fraction parameterizations
 - New chemistry module for prognostic aerosols
 - New chemistry module for greenhouse gases and prescribed aerosols
 - Extended build-namelist utility to support use cases

CCSM3.5 Status (cont)

- **Performance (on ORNL XT4, jaguar)**
 - 40-44 years/day (1.9x2.5_gx1v5) on ~800 procs
 - 18 years/day (1x1.25_gx1v5) on ~800 procs
 - Currently CAM scaling is limited on Jaguar due to lack of OpenMp (this will be added this fall with migration to CNL, compute node linux)
- **Experiments completed**
 - Three 100 year+ 1990 (present-day) simulations already performed to tune ice albedos
 - Attempting new 1x1.25_gx1v5 simulation to examine effect of resolution on present day system
 - All experiments are now in the new run database

CCSM3.5 Status (cont)

- Experiments in progress
 - Generate CAM forcing data to spin up ocean
 - CLM run in CN mode with prognostic LAI using spun up initial data
 - CICE/DOCN7 run with SSTs and ice fraction from 1870
 - CAM run with new aerosol datasets
 - Scripts were modified substantially to have CAM generate its own namelist for IPCC 1870 scenario
 - Spin up ocean
 - Use CAM forcing data over 10 years to drive POP2/Ecosystem and CICE to run at least 100 years to get past transients
 - Perform 1870 fully coupled control run
 - CLM/CN and POP2 without ecosystem model
 - Perform 20th Century run (1870–2000) fully coupled

Sequential CCSM (cpl7)

- **Goals**

- Permit plug and play functionality (can easily swap active and data components)
- Keep full backwards compatibility with concurrent CCSM (cpl6)
- Maintain all current stand-alone component functionality
- Standardize coupling interfaces

- **Design**

- Each component needs to only have one coupling framework specific module - for example
 `atm_comp_mct.F90` or `atm_comp_ESMF.F90`
 to couple model to framework dependent top level driver
- Rest of component source code is not changed

ESMF Stage 1 Evaluation

- ESMF Stage 1 Evaluation has completed successfully!
 - All quantitative metrics met (correctness, performance, memory)
 - Qualitative survey will no longer be performed
 - ESMF version is back compatible with component code base (only one interface module component changes with use of ESMF - component version code, e.g. CAM, does not change with use of ESMF)
 - Sequential coupling scheme (based on MCT) is already in trunk of stand-alone CAM and offline CLM
- Summary of Stage 1 Results
 - Correctness: Code is round-off with respect to MCT version and all relevant CAM tests pass with ESMF coupling
 - System requirements (ESMF build): met
 - Memory (no greater than 20%): met (actually much less)
 - Performance (no greater than 5%, IBM and XT4): met

Stage 1 Performance Metrics

XT4						
Resolution	Decomp	MCT	(max)	ESMF	(max)	%
T42	64x1	218	(221)	225	(229)	3.22
T42	32x1	387	(394)	394	(398)	1.98
T42	16x1	723	(728)	724	(728)	0.18
T85	128x1	228	(228)	236	(237)	3.35
T85	64x1	407	(420)	410	(423)	0.80
T85	32x1	787	(791)	790	(807)	0.36
IBM						
Resolution	Decomp	MCT	(max)	ESMF	(max)	%
T42	16x4	208	(210)	218	(219)	5.07
T42	64x1	213	(214)	225	(231)	5.38
T42	32x1	394	(395)	409	(409)	3.80
T42	16x1	753	(758)	764	(765)	1.50
T85	32x4	232	(245)	238	(239)	2.55
T85	128x1	227	(228)	237	(251)	3.90
T85	64x1	420	(431)	436	(437)	3.74
T85	32x1	815	(817)	838	(848)	2.74

ESMF Stage 2 Evaluation

- ESMF Stage 1 code base will be migrated into the SVN sequential CCSM trunk (currently used in stand-alone CAM)
 - new component interfaces for CICE, POP2, Data models, Dead Model will be added
 - capability for ATM/OCN to run on different grids will be added
 - continued testing and upgrading of ESMF specific code base as the sequential CCSM trunk evolves will be implemented
- ESMF Stage 2 acceptance plan (for fully functional sequential ESMF compliant CCSM) has been drafted and is being reviewed
- Successful completion of Stage 2 will result in an ESMF compliant sequential CCSM as part of the CCSM4 release

Other Development efforts

- Incorporation of parallel I/O (both NetCDF and binary) across CCSM components
 - implemented in POP2, being implemented in CAM and CLM, still needs to be implemented in data models (particularly input) and CICE
- Creation of new long-term archiving utility that can be leveraged by both concurrent and sequential CCSM
 - Remove capability of component run-time long-term archiving
 - CCSM monthly history files are now being archived in yearly tar files
- Creation of more flexible and unified build for both concurrent and sequential CCSM
 - High priority item that keeps getting pushed back in the task list

Other Development Efforts (cont)

- Creation of more generic namelist generation utility that can potentially be utilized by all CCSM components
 - Currently under development
- Incorporation of GLIMMER ice sheet model into cpl6 (can only run on 1 processor currently)
 - Still in very early development stage
- POP/ROMS nested coupling effort continuing
 - Hybrid ocean component created, new communication pathway with cpl6 prototyped
- Scaling to >1000 procs on XT4 for 1x1.25_gx1v5
- Incorporation of new specification of "optional" intercomponent BGC fluxes and states