CESM1 Tutorial: Basic Modifications

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CESM1 Tutorial: Basic Modifications: Review

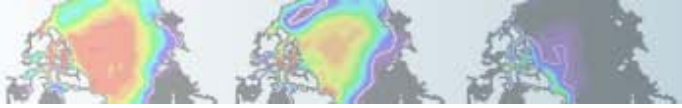
1. We will use the CESM code located locally on bluefire, no need to checkout or download any input data.

2. We will run with resolution T31_gx3v7.

3. Default scripts will **automatically** be configured for you using the code/script base prepared uniquely for this tutorial.

Tutorial Code and script base:

/glade/proj3/cseg/collections/cesm1_0_4_tutorial



The next CESM release, scheduled for November 15, 2012, will generate the namelist scripts differently.

This tutorial contains step by step instructions applicable to the current release (cesm1_0_4) only. Instructions for the new scripts will be available at the time of the release.

CESM1 Tutorial: Basic Modifications: Review: Creating a new case

EXERCISE.0: Create and configure an out-of-the-box set of scripts called "b.day2.0" on bluefire using T31_gx3v7 and compset B_1850_CN. Build the model.

Explanation of steps

1. Change directories, ("cd") to tutorial code base scripts directory.
2. View compset choices.
3. Create initial scripts.
4. "cd" to your casedir.
5. Congfiure scripts.
6. Build the model.
7. "cd" to your working directory and explore

CESM1 Tutorial: Basic Modifications: Review: Creating a new case

EXERCISE.0: Create and configure an out-of-the-box set of scripts called "b.day2.0" on bluefire using T31_gx3v7 and compset B_1850_CN. Build the model.

1. *cd /glade/proj3/cseg/collections/cesm1_0_4_tutorial/scripts*
2. *create_newcase -list*
3. *create_newcase -case ~/b.day2.0 -res T31_gx3v7 -mach bluefire -compset B_1850_CN*
4. *cd ~/b.day2.0*
5. *configure -case*
6. *b.day2.0.bluefire.build*
7. *cd /glade/scratch/$LOGNAME/b.day2.0*

We will **not** run this case, but if you want to review short term archive space, "cd" to a run completed from yesterday, i.e. /glade/scratch/$LOGNAME/archive/<mycase-from-yesterday>. Remember that the short term archive space is created **after** the initial run completion.

CESM1 Tutorial: Basic Modifications: Review: Queues and Jobs

BLUEFIRE

1. Submitting jobs:
   Type $*CASE.<mach>.submit* i.e. *b.day2.0.bluefire.submit*

2. Checking jobs:
   a. Type *bjobs* or
   b. Type *bjobs -u all* to see everyone's jobs, or
   c. Type *batchview* to see everyone's jobs in a nice format

3. Killing jobs:
   a. Find your JOBID after typing *bjobs*
   b. Type *bkill <JOBID>*

CESM1 Tutorial: Basic Modifications: Review: README

In your case directory, in addition to your scripts, you will find a README directory and a README.case file.

1. **README directory**: automatically created documentation files, please review.
2. **README.case file**: one line of text which echos your create_newcase command.

In *README.case*, we highly recommend YOU document any changes you make to the default scripts. It is YOUR paper trail and opportunity to list modifications.

CESM1 Tutorial: Basic Modifications: create_clone

1. The **create_clone** utility creates an exact copy of a previously created case.

2. The create_clone utility is very handy when the user wishes to run a slightly modified version of a previous experiment.

   a. Invoke create_clone to create an exact copy of an old case by typing the following on the command line:

   create_clone -case <new case> -clone <case to clone>

   b. Implement desired modifications before building and running . (We will learn numerous way to modify the scripts during this presentation).

   c. DOCUMENT changes in README.case.

CESM1 Tutorial: Basic Modifications: create_clone

EXERCISE.1: Clone b.day2.0 from Exercise.0, build, and run. Make no changes yet, we are simply practicing cloning a case.

1. "cd" to tutorial code base scripts directory
2. *create_clone -case ~/b.day2.1 -clone ~/b.day2.0*
3. *cd ~/b.day2.1*
4. *configure -case*
5. Informative messages from "configure –case":

   Namelist configuration for env_case.xml and env_conf.xml has already been done...skipping
   Generating clean_build script
   Generating submit script
   Generating build script
   Generating run script
   Locking file env_mach_pes.xml
   Successfully configured the case for bluefire
   If an old build exists for this case, you might want to run the *.clean_build script before building

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CESM1 Tutorial: Basic Modifications: create_clone

EXERCISE.1 continued:

6. Run the build script, i.e. *b.day2.1.bluefire.build*
7. Review *b.day2.1.bluefire.run* file. Note special tutorial queue.
   a) *#BSUB -P 37591064*
   b) #BSUB –q workshop
   Note this is for tutorial purposes ONLY.
8. Submit the run, i.e. *b.day2.1.bluefire.submit*
9. Check the queue, *bjobs*
10. Go to /glade/scratch/$LOGNAME/*b.day2.1* and explore.
11. After the job completes, go to the short term archive space and explore.
12. After the job completes, go back to your case directory and explore the "logs" directory and the "timing" directory. How long did you job take to complete? What was the "throughput", i.e. estimated model years per actual day? Notice that your Buildconf directory exactly matches the case you "cloned". Explore the *buildnml.csh component model namelist scripts.

CESM1 Tutorial: Basic Modifications: Methods and Tools

When modifying files, the user is free to use her/his editor of choice, i.e.

vi

emacs

When modifying "xml" files, the user may also use the tool, **xmlchange.**

1. For help, type ***xmlchange*** *-help*

2. Example:

   You want to manually resubmitting an initial case that previously had a RESUBMIT value of 0, (i.e. you did not initially resubmit the run).

   Edit env_run.xml via the xmlchange tool, type

   xmlchange -file env_run.xml -id CONTINUE_RUN -val TRUE

CESM1 Tutorial: Basic Modifications: env_run.xml

These variables MAY BE CHANGED ANYTIME during a run.

Common variables to change include

1. **RESUBMIT** → sets the number of times to resubmit the run

2. **STOP_OPTION** → sets the run length time interval type, i.e. nmonths, ndays, nyears or a specific date

3. **STOP_N** → sets the number of intervals (set by STOP_OPTION) to run the model during the specified wallclock time. Wallclock time is set in your *.run file and is a measure of the actual time.

STOP_OPTION and STOP_N control the length of the run per computer job submission. A typical simulation is comprised of many job submissions. (You can only stay in the computer queue for a specified time. This queue time limit is often shorter than the desired simulation length.

CESM1 Tutorial: Basic Modifications: Example: env_run.xml

1. **RESUBMIT** → sets the number of times to resubmit the run
2. **STOP_OPTION** → nmonths, ndays, nyears or a specific date
3. **STOP_N** → sets the number of intervals (set by STOP_OPTION) to run

Question:

The special tutorial version of T31_gx3 CESM on bluefire (one node only) simulates ~20-24 model years per wallclock day.

Maximum wallclock requests is 6 hours.

If you want to run 50 years, what values should be set for STOP_OPTION, STOP_N, and RESUBMIT?

CESM1 Tutorial: Basic Modifications: Example: env_run.xml

Question:

If you want to run 50 years, what values should be set for STOP_OPTION, STOP_N, and RESUBMIT?

Answer:

Assume 4 jobs submissions per day, (4 6-hr jobs).

Model runs 21yrs/day, so 21/4 = 5.25 model years per job submission.

Round down to 5 model years/submission to be safe (machines hang).

STOP_OPTION = nyears, STOP_N = 5, RESUBMIT = 9

Initial run of 5yrs + (9 resubmits * 5 years per job) = 50 years

***Note:**

The released version of CESM1 T31_gx3 can be optimized to run ~70 model year/wall-clock day.

CESM1 Tutorial: Basic Modifications: env_run.xml

env_run.xml continued… more common variables to change include

4. **CONTINUE_RUN** → if TRUE, implies a CONTINUE run.

Note: if RESUBMIT is > 0 and it is an initial run (i.e. CONTINUE_RUN=FALSE), CONTINUE_RUN will automatically update to TRUE upon completion of initial run.

5. **INFO_DBUG** → sets level of stdout (standard out) print statements. If debugging, a higher value may be set.

6. **DOUT_S** → turns on short-term archiving (short term archiving) . DOUT_S is TRUE by default.

7. **AVGHIST_OPTION** → coupler history file specification. Note: All other model components specify history file information within the model component namelists! (More on namelists in a few slides).

Take some time to review all other env_run.xml settings….

CESM1 Tutorial: Basic Modifications: env_conf.xml

The env_conf.xml file configures the model namelist scripts.

These variables CANNOT be modified once configure -case has been invoked without first invoking configure -cleannamelist.

For a complete list of variables that can be specified via the env_conf.xml file, please review your env_conf.xml file as well as on-line documentation for each component model. (example, CAM4 namelist variables are defined at: http://www.cesm.ucar.edu/cgi-bin/eaton/namelist/nldef2html-pub).

CAM, CLM, CICE namelist variables that differ from the default values can be specified via the env_conf.xml file.

However, POP namelist variables that differ from default values may be modified **after** the configure command. Use your line editor of choice (i.e., vi, emacs).

CESM1 Tutorial: Basic Modifications: env_conf.xml

Sample variables specified in this file include:

1. **RUN_TYPE** → startup, hybrid, branch
2. **RUN_REFCASE** → if branch/hybrid, case name you are starting from
3. **RUN_REFDATE** → if " " , date stamp of reference case you are starting from

4. **CCSM_CO2_PPM** → CO_2 value to be propagated to CAM and CLM

5. **CAM_NAMELIST_OPTS** → **CAM** namelist options that differ from default values
6. **CLM_NAMELIST_OPTS** → **CLM** namelist options that differ from default values
7. **CICE_NAMELIST_OPTS** → **CICE** namelist options for that differ from default values

CESM1 Tutorial: Basic Modifications: run_types

CESM has four "types" of runs:

STARTUP: All model components are initialized from basic default initial conditions.

HYBRID:
- The atmosphere and land are initialized from initial condition files generated by a user-specified CESM simulation.
- The ocean and ice are initialized from restart files generated by a user-specified CESM simulation.
- Initial conditions and restart files use the same reference case and reference date.

BRANCH: All model components are initialized from restart files generated by a user-specified CESM simulation.

CONTINUE: Continuation runs for all run types.

Default T31_gx3 cases using compset B_1850_CN (INCLUDING OUR TUTORIAL) are HYBRID runs that are initialized from the CESM1 T31x3 1850 Control.

CESM1 Tutorial: Basic Modifications: env_conf.xml

EXERCISE.2: Create a new fully coupled (with CN) hybrid case from 1850 conditions, but double the CO_2 values and turn on the ice runoff in the land model. Increase the amount of standard out produced by the model and change the default location for the log files to a directory on /glade/scratch. Run 1 month.

1. from scripts directory
   create_newcase -case ~/b.day2.2 -res T31_gx3v7 - mach bluefire -compset B_1850_CN
2. from case directory
   xmlchange -file env_run.xml -id INFO_DBUG -val 2
   xmlchange -file env_run.xml -id STOP_N -val 1
   xmlchange -file env_run.xml -id STOP_OPTION -val nmonths
3. *vi* (or *emacs*) *env_run.xml* to change LOGDIR to */glade/scratch/$CCSMUSER/logs/$CASE* , ***or***
   xmlchange -file env_run.xml -id LOGDIR -val '/glade/scratch/$CCSMUSER/logs/$CASE'
   (note that single quotes prevent evaluation of environment variables)

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CESM1 Tutorial: Basic Modifications: env_conf.xml

EXERCISE.2 continued:

4. *xmlchange -file env_conf.xml -id CCSM_CO2_PPMV -val 569.4*
   xmlchange -file env_conf.xml -id CLM_NAMELIST_OPTS -val ice_runoff=.true.
5. *configure -case*
6. Manually update your README.case file to reflect changes
7. *b.day2.2.bluefire.build*
8. Review *b.day2.2.bluefire.run*:
   a) *#BSUB -P 37591064*
   b) #BSUB –q workshop
   Note this is for tutorial purposes ONLY.
9. *b.day2.2.bluefire.submit*

Review your Buildconf/*.buildnml.csh files to verify changes. Review log files to familiarize yourself with standard out. Start looking at your history files.

CESM1 Tutorial: Basic Modifications: HOMEWORK

Before you leave for the day:

Resubmit and continue to run Exercise 2 for 26 months. This will run overnight in the Bluefire queues.

Your data will be used for the Practical Session tomorrow on *Diagnostics and Output*. Assuming your b.day2.2 exercise ran successfully in class….

In env_run.xml:

1. Set *CONTINUE_RUN* to *"TRUE"*
2. Set *STOP_OPTION* to *"nmonths"*
3. Set *STOP _N* to *"26"*
4. Set *INFO_DBUG* to *1*

In *b.day2.2.bluefire.run:*

1. Set *#BSUB -W 4:00*

Try to get as many exercises in this presentation completed in class *BEFORE* you go back and set up this continue run.

Note: The reserved nodes are for day-time use only. Overnight jobs can either be run in the workshop queue or regular queue.

CESM1 Tutorial: Basic Modifications: env_conf.xml

More about branch runs….

A branch run is useful if you have an experiment which only slightly differs from your control, but you want to initialize with the spun-up basic state of your control. We can do this by initializing the model with restart files from each component model taken from the end of the control.

Example: You are running a present day control and have completed 200 years of steady-state (i.e. unchanging) forcing. You want to run a $2xCO_2$ experiment off the end of your control. You accomplish this by creating a new case, configuring your model to run as a **BRANCH** case, and specifying the **reference case name** (your control) and **reference case date** (the end date of your control) in your env_conf.xml file ***before*** you issue the configure command. You would also change your CCSM_CO2_PPMV value in env_conf.xml to the desired value *before* configuring.

CESM1 Tutorial: Basic Modifications: env_conf.xml

EXERCISE.3: On your own…. (no step by step instructions).

Repeat Exercise 2, except **BRANCH** from the end of Exercise.2. Turn off ice runoff in the land model and quadruple CO_2. Run 1 month. Restart for 1 month.

Question: You can't use create_clone from Exercise 2 to create your initial scripts. Why?

Hints: For BRANCH run:

1. You will need to edit env_conf.xml for branch run specifications, etc.
2. You you will need to manually copy your restart and rpointer files from the Exercise 2 short-term archive directory into your Exercise 3 run directory.

Review: Difference (unix command "diff") Exercise.2 and Exercise.3 buildnml scripts to review differences in namelist scripts for startup cases compared to branch cases.

CESM1 Tutorial: Basic Modifications: Post configure changes

WARNING!!!!

The safest way to modify your scripts is via the env_conf.xml file **before** you configure.

If you must change your buildnml scripts after issuing the configure command, be sure you understand exactly what you are doing and how it will impact the model.

It is very easy to create an incompatibility in the scripts. (You should not assume the model will crash. It may run, just give you wrong answers).

CESM1 Tutorial: Basic Modifications: Post configure changes

Examples of **what can be changed** after the configure command has been issued:

- Swap out a default inputdata set for a home-grown dataset
- Namelist changes for POP or CPL
- Namelist changes that you forgot to include in env_conf.xml before configuring.
- Namelist changes from buildnml scripts created when cloning another case.

  Note: after cloning a case, if you want to cleanup your namelists, invoke the configure –cleannamelist command. Otherwise, edit the buildnml scripts by hand.

Examples of **what canNOT be changed** after the configure command has been issued:

- RUN_TYPE specifications

CESM1 Tutorial: Basic Modifications: Time Step Changes

Where and When to Change Time Steps

Examples of Pre and Post configure changes

When the model crashes due to large, temporary instabilities, one method to overcome the problem is to change the time step.

This is typically done in either the atmosphere or ocean components.

CAM: dtime, in CAM namelist. Change in env_conf.xml pre or post configure.

POP: dt_count in POP namelist. Edit pop.buildnml.csh post configure.

GOTCHAS?

CESM1 Tutorial: Basic Modifications: Time Step Changes

GOTCHAS

Examples of why we need to know what we are doing!

1. **CLM time step** = CAM time step, dtime must be changed in CLM namelist as well

2. **RTM time step** (in lnd.buildnml.csh) must be compatible with the CLM time step. The river runoff model (embedded within CLM) requires the number of rtm time steps per 3 hours be specified. Therefore, if dtime changes, so must rtm_nsteps.

3. **ATM_NCPL** in env_conf.xml specifies the number of coupling intervals per day between the atmosphere and the coupled system. The atmosphere and land are coupled every time step. If the CAM time step is changed, ATM_NCPL must be updated to reflect the new number of coupling intervals per day.

CESM1 Tutorial: Basic Modifications: More Exercises

Exercise.4: Clone case from Exercise.1. Quadruple the specified methane trace gas value in the atmosphere, decrease the solar constant by 0.1%, and set the orbital parameters to 1600. (Note: this is an exercise and does not represent any historical period). Run 5 days (default). Resubmit for another 5 days. What happens to *CONTINUE_RUN* in env_run.xml after completion of the initial 5day run (assuming you set RESUBMIT = 1) ?

1. *create_clone -case ~/b.day2.4 -clone ~/b.day2.1*
2. Clean up log and timing files that don't belong to your new case
3. Clean namelists from b.day2.1 by invoking *configure -cleannamelist*
4. *xmlchange -file env_run.xml -id RESUBMIT -val 1*
5. *xmlchange -file env_run.xml -id ORBITAL_YEAR -val 1600*
6. *xmlchange -file env_conf.xml -id CAM_NAMELIST_OPTS -val solar_const=1359.53,ch4vmr=3166.44e-9*

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CESM1 Tutorial: Basic Modifications: More Exercises

Exercise.4: Continued:

7. *configure –case*
8. Update README.case
9. *b.day2.4.bluefire.build*
10. Review *b.day2.4.bluefire.run*:
    a) *#BSUB -P 37591064*
    b) #BSUB –q workshop
    Note this is for tutorial purposes ONLY.
11. *b.day2.4.bluefire.submit*

CESM1 Tutorial: Basic Modifications: More Exercises

Exercise.5: Clone case from Exercise.4. Include all modifications from Exercise.4. Instead of specifying orbital year, assign individual parameters (eccentricity=0, obliquity=23., and precession=0.) Include new modification to use a different short wave absorption parameterization in POP called "jerlov". (The default sw absorption parameterization is geography-specific and called "chlorophyll". "Jerlov" is typically used for paleoclimate simulations where the geography is different from present day). Run 5 days (default).

1. *create_clone -case ~/b.day2.5 -clone ~/b.day2.4*
2. Clean up log and timing files that don't belong to your new case.
3. Keep namelists from previous run because we are keeping all of the modifications. We will adjust orbital parameters in the resolved cpl.buildnml.csh file.
4. Edit Buildconf/cpl.buildnml.csh and change the following:
   a. Remove *orb_iyear* and *orb_iyear_align*
   b. Change *orb_mode* to *'fixed_parameters'*

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CESM1 Tutorial: Basic Modifications: More Exercises

Exercise.5: continued

c. Add the following lines:

orb_eccen = 0.

orb_obliq = 23.

orb_mvelp = 0.

5. Edit Buildconf/pop2.buildnml.csh and change

sw_absorption_type = 'jerlov'

6. Edit env_run.xml, change *CONTINUE_RUN* back to *FALSE*, this is an initial run. Note: you cloned the scripts from b.day2.4 which automatically updated this parameter to TRUE upon its resubmission in Exercise 4.

7. *configure -case* (even though namelist are edited by hand, you still need to invoke the configure commands to create your build, run, and archive scripts).

8. Update README.case

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CESM1 Tutorial: Basic Modifications: More Exercises

Exercise.5: continued

9. *b.day.2.5.bluefire.build*

10. Edit *b.day2.5.bluefire.run* and add the following to *#BSUB* lines:

    a) *#BSUB -P 37591064*

    b) #BSUB –q workshop

    Note this is for tutorial purposes ONLY.

11. *b.day2.5.bluefire.submit*

12. Go over all log files and timing files. If you want, you can start to look at the history output. Only the atm/ocn will have daily output to view. (ncview). Where is the short term history output located?

13. Compare b.day2.5 history data to b.day2.4 history data. (ncdiff).

14. Optional: Resubmit Exercise.4 and Exercise.5 for 1 month to obtain monthly history files for all model components. What will you need to change?

CESM1 Tutorial: Basic Modifications: More Exercises

Exercise.6: On your own…

Do a "startup" run. Change the atm/lnd timestep to 1200 seconds. (Default value is 1800). Run 1 month. Be sure all time steps are compatible. Be sure to update your README.case file to keep track of your changes. Review logs to verify time step changes.

Exercise.7: On your own…

Branch from Exercise.6. Include all Exercise 6 modifications. Also, double the CO_2 and N_2O values and change orbital parameters to match what was used in Exercise 5. Remember that CO_2 needs to be consistent across model components. Run 1 month. Hint: Some things can be modified via env_conf.xml and others post configure. Be sure to update your README.case file to keep track of your changes. The model will run regardless of whether or not your remember to include all of your changes. Check your buildnml scripts and the processed namelist files ($RUNDIR/<model>_in files) to make sure all changes are included. If you like, resubmit and continue the run for 1 more month.

CESM1 Tutorial: Basic Modifications: Bottom Line

What user-modified "configured" files are actually used at runtime?

Buildconf/cam.buildnml.csh → $RUNDIR/atm_in

Buildconf/clm.buildnml.csh → $RUNDIR/lnd_in

Buildconf/pop2.buildnml.csh → $RUNDIR/pop2_in

Buildconf/cice.buildnml.csh → $RUNDIR/ice_in

Buildconf/cpl.buildnml.csh → $RUNDIR/drv_in

Bottom Line: User modifications should be implemented in the *.buildnml.csh files.

What files are for documentation purposes?

Buildconf/*.input_data_list, Buildconf/pop2doc

CaseDocs, CaseStatus, LockedFiles, README.case

Note: Buildconf/camconf, Buildconf/clmconf, and Buildconf/ciceconf are used when creating the *.buildnml.csh files. The user does NOT need to touch these files.

CESM1 Tutorial: Basic Modifications: Run Scripts

Review run script: ***mycase.bluefire.run***

Common BSUB command to change:

#BSUB -q **workshop**	queue type*
#BSUB -o poe.stdout.%J	machine standard out
#BSUB -e poe.stderr.%J	machine standard error
#BSUB -J b.day2.t	job name
#BSUB -W 0:50	wallclock time requested
#BSUB -P **37591064**	**project number**

*bluefire queues for non-tutorial work are: premium, regular, economy, standby, share)

Note: Maximum allowable wall clock time per job submission varies from machine to machine. Bluefire (NCAR's IBM) is 6 hours. Submissions requesting under an hour typically have shorter wait times in the queue.

CESM1 Tutorial: Basic Modifications: Log Files

Log Files:

During model execution:
After model completion:

atm.log.yyddmm-nnnnnn.gz
lnd.log.yyddmm-nnnnnn.gz
ocn.log.yyddmm-nnnnnn.gz
ice.log.yyddmm-nnnnnn.gz
cpl.log.yyddmm-nnnnnn.gz
ccsm.log.yyddmm-nnnnnn.gz

Model runtime standard output

$RUNDIR/*
$LOGDIR/*

Files are gzipped after model completion.
Restore by typing *gunzip <logfile>.*

yyddmm = year, month, day
nnnnnn = time id stamp

CESM1 Tutorial: Basic Modifications: Other Tips

CHECK your processed namelists!

- After the model builds, it is always good to double check your $RUNDIR/<model>_in namelist files. These are the files the model will actually use at runtime and are based on your *.buildnml.csh files. If there is an error in *.buildnml.csh, it will show up in *_in.
- Also, it is always good to verify that the model is using what you think it is using!

DOCUMENT everything you do!

- A paper trail of your procedures and thoughts is good scientific practice. The README.case file is the perfect place to write notes. You will thank yourself months (years) later, when you are trying to figure out what you did oh-so-long ago!

CESM1 Tutorial: Basic Modifications: Post Run Tips

Check logs

- Check your log files to make sure there are no hidden problems and to verify the model is running smoothly and as you expect. The log files may also help you verify your modifications were included in your run.

Check output

- Check your history files. It is a good idea to run a small test sample of your experiment before launching your full production run. For example, if you want to run a 500 year control with various modifications, first run 10 years. Check the history output files and verify the model is running as you designed before continuing with the full 500 years. It is always best to find errors early, rather than later, in the run.

Check timings

- Check your timings. After model completion, a timing subdirectory will be placed in your scripts directory. Check the timings after several job completions to verify that the model is running efficiently and as expected. Double check your timings with the CESM default timings for your specific model resolution and machine. Default timings can be found at: http://www.cesm.ucar.edu/models/cesm1.0/timing/

CESM1 Tutorial: Basic Modifications

Have Fun!!!