

CESM1.2 Tutorial: Basic Modifications

Susan Bates

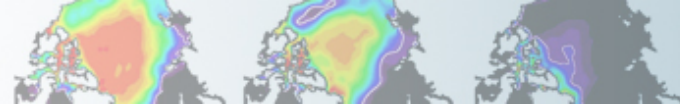
Material from: Christine A. Shields

August 9, 2016



U.S. DEPARTMENT OF
ENERGY

Office of
Science

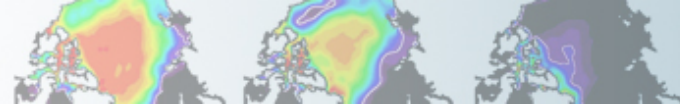


CESM1 Tutorial: Basic Modifications: **Review**

1. We will use the CESM code located locally on yellowstone, 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.
4. Please log into your assigned yellowstone (or caldera/geyser) node and do NOT compile unless you have a compile card. To make the tutorial run smoothly for all, we need to control and distribute all work evenly across yellowstone.

Tutorial Code and script base:

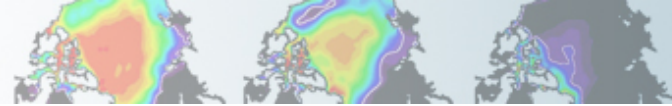
/glade/p/cesm/tutorial/cesm1_2_2.tutorial



This tutorial contains step by step instructions applicable to the current release (cesm1.2) only.

For older releases, please see past tutorials.

For information our next release, please attend to Jim Edwards presentation Wednesday at 1:05pm: “CESM2: What to expect”



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

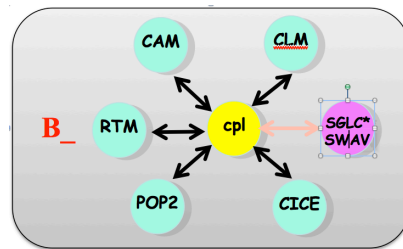
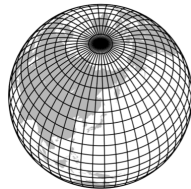
`create_newcase` requires **4 arguments**

What is the casename ?

Which resolution?

Which model configuration ?
Which set of components ?

Which machine are you running on?



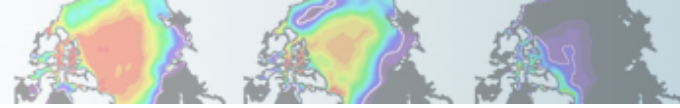
case01

T31_gx3v7

B_1850_CN

yellowstone

`create_newcase -case case01 -res T31_g37 -compset B_1850_CN -mach yellowstone`



Grid naming convention

Each model resolution can be specified by its alias, short name and long name.

Example of equivalent alias, short name and long name:

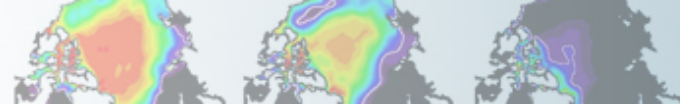
- alias: T31_g37 (atm/Ind_ocn/ice)
 - short name: T31_gx3v7
 - long name = a%T31_l%T31_oi%gx3v7_r%r05_m%gx3v7_g%null_w%null
- ↑ ↑ ↑ ↑ ↑ ↑ ↑
atm Ind ocn/ice river Ind Ind-ice wave
mask

Compset naming convention

Each model compset can be specified by its alias, short name and long name.

Example of equivalent alias, short name and long name:





- alias: B1850CN
 - short name: B_1850_CN
 - long name = 1850_CAM4_CLM40%CN_CICE_POP2_RTM_SGLC_SWAV
- ↑ ↑ ↙ ↖
Time Period Model Physics submode “S”=stub/inactive

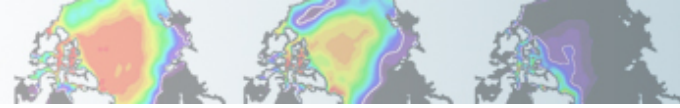


CESM1 Tutorial: Basic Modifications: **Review:** **Creating a new case**

EXERCISE.0: Log into your assigned node. (Have you copied the geyser.csh/ caldera.csh script to your home directory)? Create and configure an out-of-the-box set of scripts called “b.day2.0” on yellowstone using T31_gx3v7 and compset B_1850_CN . Build and run the model.

Explanation of steps:

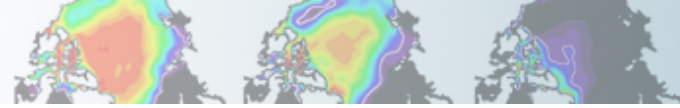
1. Change directories, (“cd”) to tutorial code base scripts directory.
2. View compset and grid choices. (hint: use –list option)
3. Create initial scripts. (We will use the same “cases” subdirectory as day1).
-  4. “cd” to your casedir.
5. Invoke cesm_setup.
-  6. Build the model.
-  7. Submit a 5-day test.
-  8. “cd” to your runtime 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 yellowstone using T31_gx3v7 and compset B_1850_CN. Build the model.

1. `cd /glade/p/cesm/tutorial/cesm1_2_2.tutorial/scripts`
2. `./create_newcase -list compsets (and -list grids)`
- ★ 3. `./create_newcase -case ~/cases/b.day2.0 -res T31_gx3v7 -mach yellowstone -compset B_1850_CN`
4. `cd ~/cases/b.day2.0`
- ★ 5. `./cesm_setup`
- ★ 6. `./b.day2.0.build`
- ★ 7. `./b.day2.0.submit`
8. `cd /glade/scratch/$LOGNAME/b.day2.0`
9. After the job completes, explore the “timing” subdirectories in both your scratch space and in your case directory. Explore the “logs” subdirectory in your case directory.



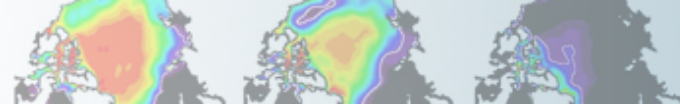
CESM1 Tutorial: Basic Modifications: **Review: Queues and Jobs**

Yellowstone

1. Submitting jobs:
Type `$CASE.submit` i.e. `b.day2.0.submit`

2. Checking jobs:
 - a. Type `bjobs` or
 - b. Type `bjobs -u all` to see everyone's jobs, or

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



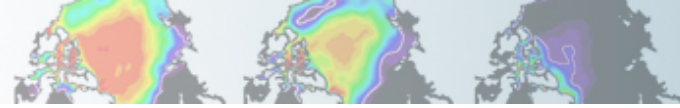
CESM1 Tutorial: Basic Modifications: **Review:** **README**

In your case directory, in addition to your scripts, you will find automatically generated documentation files.

1. **README.science_support:** refers you to the on-line documentation.
2. **README.case file:** detailed information on your compset and grid, including whether your configuration has science support.

SCIENCE_SUPPORT: NO

***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.**

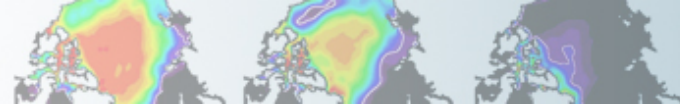


CESM1 Tutorial: Basic Modifications: **Review:** create_clone

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. Edit and DOCUMENT changes in README.case



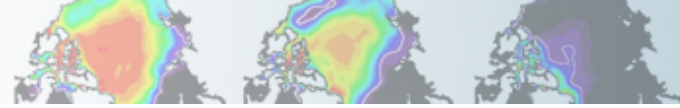
CESM1 Tutorial: Basic Modifications: **Review:** create_clone

Edit and DOCUMENT changes in README.case.

Otherwise your README.case file will look exactly like your original case and it will be much harder to backtrack your methods when troubleshooting.

CAVEATS for CREATE_CLONE: you need to use....

- 1) same model tag**
- 2) same machine**
- 3) same compset**
- 4) same resolution**
- 5) same run-type** (slide 20)



CESM1 Tutorial: Basic Modifications: Pre “cesm-setup” files

```
-rwxr-xr-x 1 shields ncar 15789 Jun 7 17:33 archive\_metadata.sh
drwxr-xr-x 2 shields ncar 16384 Jun 25 16:11 Buildconf
-rw-r--r-- 1 shields ncar 162 Jun 25 16:11 CaseStatus
-rwxr-xr-x 1 shields ncar 14495 Jun 7 17:33 cesm\_setup
-rwxr-xr-x 1 shields ncar 837 Jun 7 17:33 check\_case
-rwxr-xr-x 1 shields ncar 10126 Jun 7 17:33 check\_input\_data
-rwxr-xr-x 1 shields ncar 3672 Jun 7 17:33 create\_production\_test
-rw-r--r-- 1 shields ncar 10841 Jun 25 16:11 env\_build.xml
-rw-r--r-- 1 shields ncar 4441 Jun 25 16:11 env\_case.xml
-rw-r--r-- 1 shields ncar 6992 Jun 25 16:11 env\_mach\_pes.xml
-rwxr-xr-x 1 shields ncar 2678 Jun 25 16:11 env\_mach\_specific
-rw-r--r-- 1 shields ncar 23069 Jun 25 16:11 env\_run.xml
drwxr-xr-x 2 shields ncar 16384 Jun 25 16:11 LockedFiles
-rwxr-xr-x 1 shields ncar 2127 Jun 25 16:11 preview\_namelists
-rw-r--r-- 1 shields ncar 1630 Jun 25 16:11 README.case
-rw-r--r-- 1 shields ncar 380 Jun 25 16:11 README.science\_support
drwxr-xr-x 11 shields ncar 16384 Jun 25 16:11 SourceMods
-rwxr-xr-x 1 shields ncar 13233 Jun 25 16:11 b.day2.1.build
-rwxr-xr-x 1 shields ncar 1048 Jun 25 16:11 b.day2.1.clean\_build
-rwxrwxr-x 1 shields ncar 947 Jun 25 16:11 b.day2.1.l\_archive
-rwxr-xr-x 1 shields ncar 608 Jun 25 16:11 b.day2.1.submit
drwxr-xr-x 3 shields ncar 16384 Jun 25 16:11 Tools
-rwxr-xr-x 1 shields ncar 12569 Jun 7 17:33 xmlchange
-rwxr-xr-x 1 shields ncar 10503 Jun 7 17:33 xmlquery
```

ENV Files

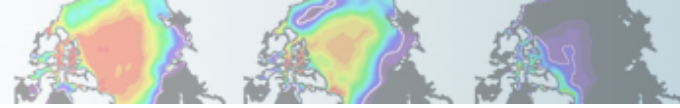
Tools

Case Scripts

Documentation

Buildconf scripts (do not modify)

SourceMods (day 4 of tutorial)



CESM1 Tutorial: Basic Modifications: Post “cesm-setup” files

```
drwxr-xr-x 2 shields ncar 16384 Jun 25 16:18 CaseDocs
-rw-r--r-- 1 shields ncar   9 Jun 25 16:18 hostfile
-rw-r--r-- 1 shields ncar  949 Jun 25 16:18 Macros
-rwxr-xr-x 1 shields ncar 10287 Jun 25 16:18 b.day0.1.run
-rw-r--r-- 1 shields ncar  115 Jun 25 16:18 user\_nl\_cam
-rw-r--r-- 1 shields ncar  367 Jun 25 16:18 user\_nl\_cice
-rw-r--r-- 1 shields ncar 1257 Jun 25 16:18 user\_nl\_clm
-rw-r--r-- 1 shields ncar 2284 Jun 25 16:18 user\_nl\_cpl
-rw-r--r-- 1 shields ncar 2949 Jun 25 16:18 user\_nl\_pop2
-rw-r--r-- 1 shields ncar  573 Jun 25 16:18 user\_nl\_rtm
```

All case modifications are applied in **env_run.xml** or **user_nl_<model>**

ENV Files

Tools

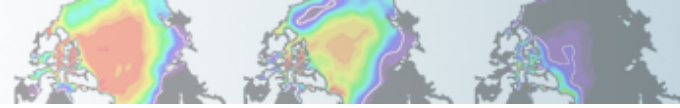
Case Scripts

Documentation

Buildconf scripts (do not modify)

SourceMods (day 4 of tutorial)

Namelist modifications



CESM1 Tutorial: Basic Modifications: **Editing Methods/Tools**

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

vi

emacs

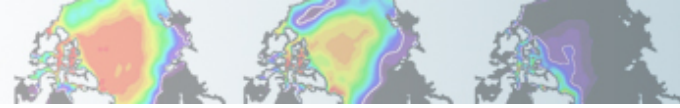
When modifying “xml” files, the user may also use the tool, **xmlchange**.

1. For help, type *xmlchange -help*
2. **Example: Single variable modification, original (long) method:**

You want to manually resubmit 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: **Editing Methods/Tools**

For help, type *xmlchange -help*

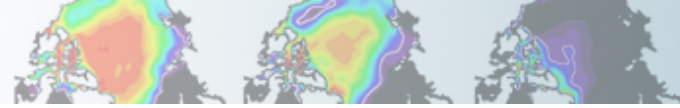
3. Example: Multiple (or list) variable modification method*:

You may want to change more than one item at a time, or to use this abbreviated “list” method for a single modification. To manually resubmit the model, plus tell the scripts to automatically do this twice more...

a. Edit `env_run.xml` via the `xmlchange` tool, type

```
./xmlchange CONTINUE_RUN=TRUE,RESUBMIT=2
```

*Note for most component namelist variables, the single modification method is necessary. (more on this later).



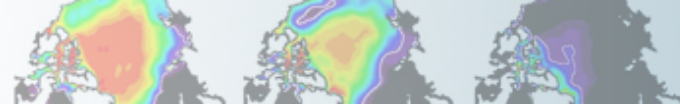
CESM1 Tutorial: Basic Modifications: Runtime variables: **env_run.xml**

Runtime variables can be changed in `env_run.xml` *at any point* during the run and control the mechanics of the run, i.e length, resubmits, and archiving.

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: Runtime variables: **env_run.xml**

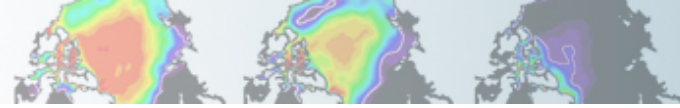
1. **RESUBMIT** → sets the number of times to resubmit the run
2. **STOP_OPTION** → nmonths, ndays, nyears or a specific date
3. **STOP_N** → sets the number of intervals (set by STOP_OPTION) to run

Question:

The special tutorial version of T31_gx3v7 CESM on yellowstone (runs on multiple nodes) simulates ~44 model years per wallclock day.

Maximum wallclock requests is 12 hours.

If you want to run 100 years, what values should be set for STOP_OPTION, STOP_N, and RESUBMIT?



CESM1 Tutorial: Basic Modifications: Runtime variables

`env_run.xml`

Question:

If you want to run 100 years, what values should be set for `STOP_OPTION`, `STOP_N`, and `RESUBMIT`?

Answer:

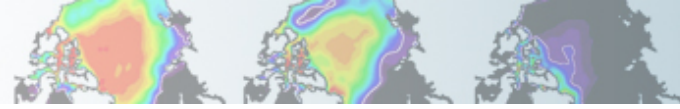
Assume 2 jobs submissions per day, (2 12-hr jobs).

Model runs 44 yrs/day, so $44/2 = 22$ model years per job submission.

If we round down to 20 model yrs/submission to give ourselves a buffer and have even numbers....

`STOP_OPTION = nyears`, `STOP_N = 20` , `RESUBMIT = 4`

Initial run of 20yrs + (4 resubmits * 20 years per job) = 100 years



CESM1 Tutorial: Basic Modifications: Runtime variables

env_run.xml

env_run.xml continued... more common runtime variables to change include

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

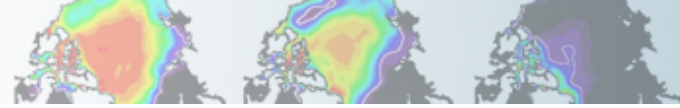
Note: if RESUBMIT is > 0 and it is an initial run (i.e. CONTINUE_RUN=FALSE), CONTINUE_RUN will automatically update to TRUE upon completion of initial run.

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

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

7. **HIST_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).

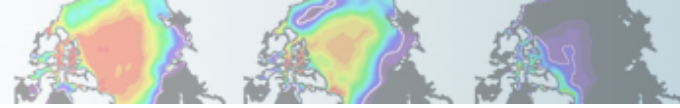
Take some time to review all other env_run.xml settings....



CESM1 Tutorial: Basic Modifications: Run-type variables: **env_run.xml**

Run-type variables define type of run (startup, hybrid) and physical controls (namelist parameters). 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. **GET_REFCASE** → default = TRUE; automatically retrieves refcase restart data; assumes refcase is on HPSS
5. **CCSM_CO2_PPM** → CO₂ value to be propagated to CAM and CLM
6. **CAM_NAMELIST_OPTS** → **CAM** namelist options that differ from default values
7. **CLM_NAMELIST_OPTS** → **CLM** namelist options that differ from default values
8. **CICE_NAMELIST_OPTS** → **CICE** namelist options that differ from default values
9. **RTM_NAMELIST_OPTS** → **RTM** namelist options that differ from default values



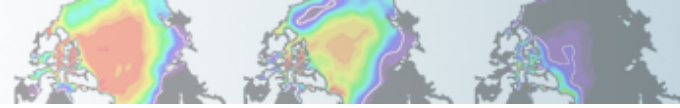
CESM1 Tutorial: Basic Modifications: Run-type variables

`env_run.xml`

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_gx3v7 cases using compset B_1850_CN (INCLUDING OUR TUTORIAL) are HYBRID runs that are initialized from the CESM1 T31x3 1850 Control.



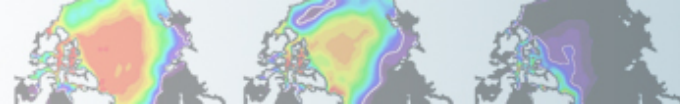
CESM1 Tutorial: Basic Modifications: Run-type variables: Branch vs Hybrid

Branch and hybrid runs are useful if you have an experiment which only slightly differs from your control, but you want to make a slight modification, add history output, or start your simulation from a CESM spun-up initial state.

Your default tutorial exercises start as a hybrid run from the CCSM4 T31_gx3v7 control 1850 simulation.

Use a hybrid run: for most applications where you do NOT need bit for bit restart. You CAN specify a new start date for your model run.

Use branch run: only for applications which require exact restart. You CANNOT specify a new start date for your model run. It will be assigned by the reference case (RUN_REFDATE).



CESM1 Tutorial: Basic Modifications: Namelist variables

Namelist variables can be changed using:

env_run.xml or

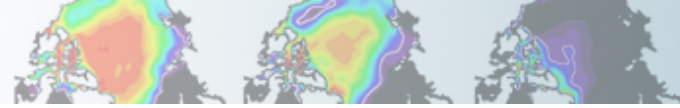
user_nl_<model> (e.g. user_nl_cam, user_nl_pop2, etc)

CAM, CLM, CICE, RTM namelist variables can be changed using both methods.

POP, CPL can be only changed using the user_nl_<model> method.

For a complete list of namelists, please see the on-line documentation for each component model.

<http://www.cesm.ucar.edu/models/cesm1.2/cesm/doc/modelnl/modelnl.html>



CESM1 Tutorial: Basic Modifications: `env_run.xml`

EXERCISE.1: Create a new fully coupled (with CN) hybrid case from 1850 conditions, but double the CO₂ values and turn on the ice runoff in the RTM 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 2 months.

1. from scripts directory, create your case scripts:

```
./create_newcase -case ~/cases/b.day2.1 -res T31_gx3v7 -mach yellowstone  
-compset B_1850_CN
```

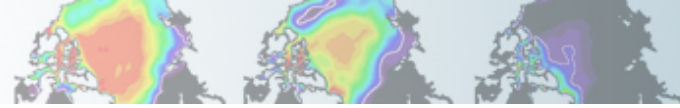
2. from case directory, change your runtime variables:

```
./xmlchange INFO_DEBUG=2,STOP_N=2,STOP_OPTION=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)



CESM1 Tutorial: Basic Modifications: `env_run.xml`

EXERCISE.1 continued:

4. Make your physics namelist changes:

a. Use the list method: `./xmlchange CCSM_CO2_PPMV=569.4`

b. Use the original method:

```
./xmlchange -file env_run.xml -id RTM_NAMELIST_OPTS -val ice_runoff=.true.
```

5. `./cesm_setup`

6. Manually update your README.case file to document your changes

7. `./b.day2.1.build`

8. Review `b.day2.1.run`:

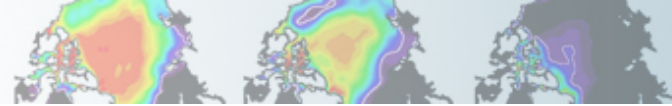
a) `#BSUB -P UESM0004` ← your project number

b) `#BSUB -q small` ← requested queue

Note this is for tutorial purposes ONLY.

9. `./b.day2.1.submit`

Review log files to familiarize yourself with standard out. Start looking at your history files. Check your CaseDocs/*_in files. Were your namelist changes applied?



CESM1 Tutorial: Basic Modifications: Ex1: Example README.case

```
create_newcase -case /glade/u/home/shields/cases/b.day2.1 -res T31_gx3v7 -mach yellowstone
-compset B_1850_CN
```

Component set: longname (shortname) (alias)

1850_CAM4_CLM40%CN_CICE_POP2_RTM_SGLC_SWAV (B_1850_CN) (B1850CN)

Component set Description:

CAM: CLM: RTM: CICE: POP2: SGLC: SWAV: pre-industrial: cam4 physics: clm4.0 physics: clm4.0 cn: prognostic cice: POP2 default:

Grid:

a%T31_l%T31_oi%gx3v7_r%r05_m%gx3v7_g%null_w%null (T31_gx3v7)

ATM_GRID = 48x96 NX_ATM=96 NY_ATM=48

LND_GRID = 48x96 NX_LND=96 NX_LND=48

ICE_GRID = gx3v7 NX_ICE=100 NX_ICE=116

OCN_GRID = gx3v7 NX_OCN=100 NX_OCN=116

ROF_GRID = r05 NX_ROF=720 NX_ROF=360

GLC_GRID = 48x96 NX_GLC=96 NX_GLC=48

WAV_GRID = null NX_WAV=0 NX_WAV=0

Grid Description:

null is no grid: T31 is Gaussian grid: gx3v7 is Greenland pole v7 3-deg grid: r05 is 1/2 degree river routing grid:

Non-Default Options:

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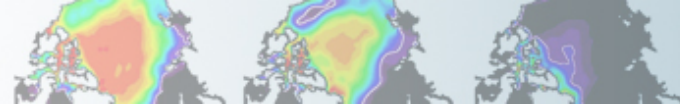
==== user modified section

```
./xmlchange INFO_DEBUG=2,STOP_N=2,STOP_OPTION=nmonths
```

```
./xmlchange -file env_run.xml -id LOGDIR -val 'glade/scratch/$CCSMUSER/logs/$CASE'
```

```
./xmlchange CCSM_CO2_PPMV=569.4
```

```
./xmlchange -file env_run.xml -id RTM_NAMELIST_OPTS -val ice_runoff=.true.
```



CESM1 Tutorial: Basic Modifications: **HOMEWORK**

Before you leave for the day:

Resubmit and continue to run Exercise 1 for 36 more months. This will run overnight in the yellowstone queues.

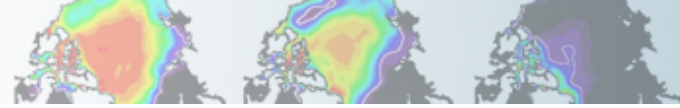
Your data will be used for the Practical Session tomorrow on *Diagnostics and Output*. Assuming your b.day2.1 exercise ran successfully in class....

In `env_run.xml`:

1. Set `CONTINUE_RUN` to `"TRUE"`
2. Keep `STOP_OPTION` set to `"nmonths"`
3. Set `STOP_N` to `"36"`
4. Set `INFO_DEBUG` to `1`
5. Comment out `"#BSUB -U CESM_WS"` line in your run script (b.day2.1.run).
(should look like `##BSUB -U CESM_WS"`)

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: Namelist variables: **user_nl_<model>**

- Not all changes can be made in env_run.xml.
- **user_nl_<model>** files appear in the case directory after ./cesm_setup has been invoked), i.e.

user_nl_cam ↔ atmosphere

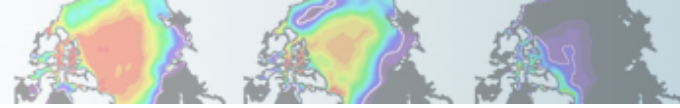
user_nl_clm ↔ land

user_nl_cice ↔ ice

user_nl_pop2 ↔ ocean

user_nl_cpl ↔ coupler (driver)

user_nl_rtm ↔ river transport



CESM1 Tutorial: Basic Modifications: Namelist tool: **preview_namelist**

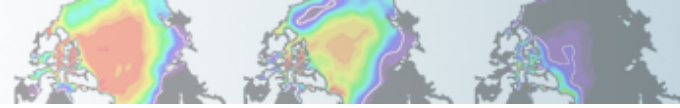
- Insert namelist syntax for desired variable change into the appropriate file. To find the proper syntax and see all default namelist values, use **preview_namelist** to create the resolved namelists the model will use at runtime in your run directory (i.e. /glade/scratch/<user>/<case>/run/). Note that `cesm_setup` automatically runs `preview_namelist` so if you have already run `./cesm_setup`, you don't need to do this again.

- In your case directory, type **`./preview_namelists`**

- cd to your run directory and view *_in files:

user_nl_cam modifies	→	atm_in
user_nl_clm modifies	→	lnd_in
user_nl_cice modifies	→	ice_in
user_nl_pop2 modifies	→	pop2_in
user_nl_cpl modifies	→	drv_in
user_nl_rtm modifies	→	rof_in

- Default namelist can also be reviewed in your CaseDocs subdirectory (found in your case directory after `cesm_setup` has been invoked).



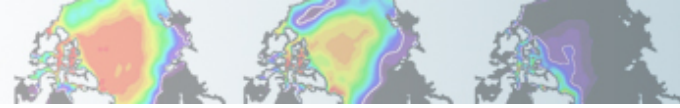
CESM1 Tutorial: Basic Modifications: Namelist tool: **preview_namelist**

Example: Decrease timestep in the ocean model by increasing `dt_count` from 12 steps per day to 23 steps per day.

1. Edit (vi or emacs) `user_nl_pop2`
2. Insert correct syntax as a new line at the end of the comment section in the form of:
namelist_var = new_namelist_value

i.e.,
`dt_count = 23`
3. Invoke *preview_namelists* again to verify change in your run directory and update the documentation `pop2_in` file in CaseDocs.

http://www.cesm.ucar.edu/models/cesm1.2/pop2/doc/faq/#nml_general_change_dt



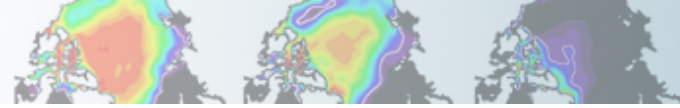
CESM1 Tutorial: Basic Modifications: **Exercise 2**

EXERCISE.2: BRANCH from the end (of the second month) in Exercise. 1 (not the end of the homework). Turn off ice runoff in the RTM (runoff) model, quadruple CO₂ and double methane. Run 1 month. Restart for 1 month. Check your resolved namelists in your run directory.

1. `./create_newcase -case ~/cases/b.day2.2 -res T31_gx3v7 -mach yellowstone -compset B_1850_CN`
2. `cd ~/cases/b.day2.2`
3. `./xmlchange RUN_TYPE=branch,RUN_REFCASE=b.day2.1,RUN_REFDATE=0001-03-01,GET_REFCASE=FALSE,STOP_OPTION=nmonths,STOP_N=1,RESUBMIT=1,CCSM_CO2_PPMV=1138.8` (no spaces between arguments).

Why do we need to set GET_REFCASE=FALSE?

Continued next page



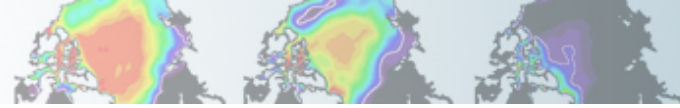
CESM1 Tutorial: Basic Modifications: **Exercise 2**

EXERCISE.2: continued

4. `./xmlchange -file env_run.xml -id CAM_NAMELIST_OPTS -val ch4vmr=1583.2e-9`
5. `./xmlchange -file env_run.xml -id RTM_NAMELIST_OPTS -val ice_runoff=.false.`

Why do we use the single `./xmlchange` method here?

6. `./cesm_setup`
7. Copy your restart files from your bday2.1 short term archive space to your bday2.2 \$RUNDIR:
`cp /glade/scratch/<user>/archive/b.day2.1/rest/0001-03-01-00000/* /glade/scratch/<user>/b.day2.2/run/.`
8. `./b.day2.2.build`
9. `./b.day2.2.submit`
10. Review queues and log files. How fast does the first month run? Was the second month resubmitted?



CESM1 Tutorial: Basic Modifications: **env_run.xml vs. user_nl_<model>**

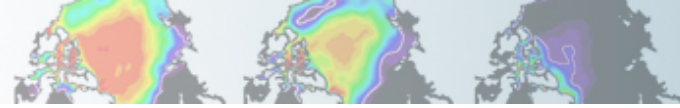
What method is best for namelist changes?

env_run.xml:

- Run_type specification (startup, hybrid, branch, continue)
- Runtime variables (stop_option, resubmits, etc.)
- Namelist changes for CAM,CLM,CICE,RTM before cesm_setup is invoked

user_nl_<model>:

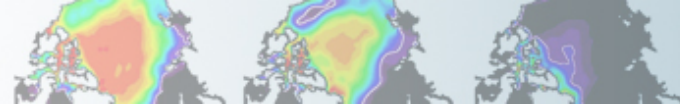
- Swapping out a default inputdata set for a home-grown dataset
- Namelist changes for POP or CPL
- Namelist changes applied to cloned scripts.



CESM1 Tutorial: Basic Modifications: `env_run.xml` vs. `user_nl_<model>`

At runtime, the scripts will automatically re-populate your resolved namelists based on `env_run` and the `user_nl_<model>` files, however, it is always good to document and check your changes BEFORE runtime.

Always check your resolved `*_in` files (run directory, i.e. `/glade/scratch`) to make sure your changes have been applied.



CESM1 Tutorial: Basic Modifications: **Time Step Changes**

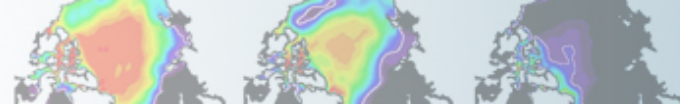
Where and When to Change Time Steps

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.

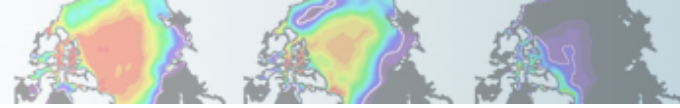
CAM/CLM: `ATM_NCPL` in `env_run.xml`.

POP: `dt_count` in POP namelist. Edit and change the `user_nl_pop` file.



CESM1 Tutorial: Basic Modifications: **Time Step Changes**

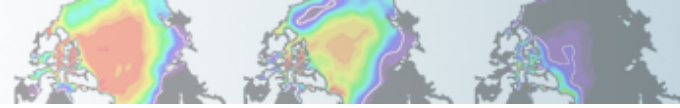
1. **ATM_NCPL** in `env_run.xml` specifies the number of **coupling intervals per day** between the atmosphere/land and the coupled system. Based on `ATM_NCPL`, the scripts will automatically compute the timestep for the atmosphere and land (`DTIME`) and populate the namelist files accordingly.
2. **CLM time step** = CAM time step; this is automatically set with the CAM timestep via `ATM_NCPL`. You cannot set this separately.
3. **RTM time step** , timestep is explicitly defined and is not relative to the CLM timestep. (Default RTM timestep is 3 hours).



CESM1 Tutorial: Basic Modifications: **More Exercises**

Exercise.3: Create new case, hybrid start, fully coupled for Pre-Industrial conditions (with CN). Quadruple the specified methane trace gas value in the atmosphere, but 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_newcase -case ~/cases/b.day2.3 -res T31_gx3v7 -mach yellowstone -compset B_1850_CN`
2. `cd ~/cases/b.day2.3`
3. `./xmlchange RESUBMIT=1`
4. `./xmlchange -file env_run.xml -id CAM_NAMELIST_OPTS -val solar_const=1359.53,ch4vmr=3166.40e-9`
5. `./cesm_setup`

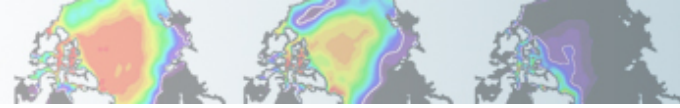


CESM1 Tutorial: Basic Modifications: **More Exercises**

Exercise.3: Continued:

6. Edit `user_nl_cpl`, after comments, add line: `orb_iyear=1600`
7. Update `README.case`
8. Optional: `./preview_namelist`
9. `./b.day2.3.build`
Check your `$RUNDIR` and review your namelist changes in `atm_in` and `drv_in`
10. Review `b.day2.3.run`:
Note `queue (small)` and `project number (UESM0004)` are for tutorial purposes **ONLY**. Normally, you will run with your own project number in the regular queue.
11. `./b.day2.3.submit`

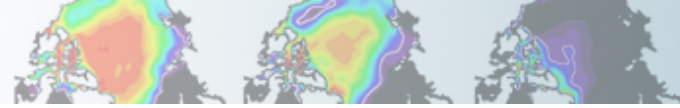
After the job completes, go to the short term archive space and explore.



CESM1 Tutorial: Basic Modifications: **More Exercises**

Exercise.4: Clone case from Exercise.3. Include all modifications from Exercise.3 except 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). Turn off the Urban parameterization in CLM. Run 5 days (default).

1. `./create_clone -case ~/cases/b.day2.4 -clone ~/cases/b.day2.3`
2. Clean up stderr and stdout that don't belong to your new case.
3. Edit `user_nl_cpl` and change the following:
 - a. Remove `orb_ityear`
 - b. Add `orb_mode = 'fixed_parameters'`
 - c. Add `orb_eccen = 0.`
 - d. Add `orb_mvlp = 0.`
 - e. Add `orb_obliq = 23.`

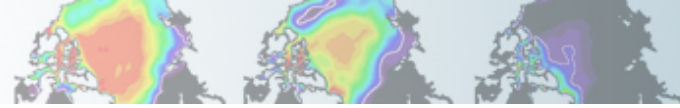


CESM1 Tutorial: Basic Modifications: **More Exercises**

Exercise.4: continued

4. Edit `user_nl_pop2` and add: `sw_absorption_type = 'jerlov'`
5. Edit `user_nl_clm` and add: `urban_hac = 'OFF'`
6. Note that in `env_run.xml`, `create_clone` has automatically set `CONTINUE_RUN` back to `FALSE`, this is an initial run.
7. Update your `README.case` file. Document your changes
8. `./cesm_setup`

Because you cloned this case you already had your `user_nl_<model>` file in your case directory, but you have changed them and therefore need to invoke `cesm_setup` or `preview_namelist` to update your CaseDocs, create the resolved namelists in your run directory, and create your runscript.



CESM1 Tutorial: Basic Modifications: **More Exercises**

Exercise.4: continued

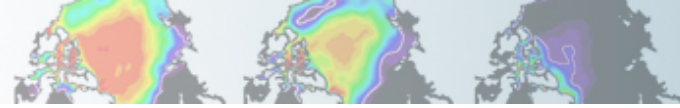
9. `./b.day2.4.build`

10. `./b.day2.4.submit`

11. 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? To use ncview, you will need to type “module load ncview” on your command line.

12. Compare b.day2.4 history data to b.day2.3 history data. (ncdiff). To use ncdiff, you will need to type “module load nco” on your command line.

13. Optional: Resubmit Exercise.3 and Exercise.4 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.5: On your own...

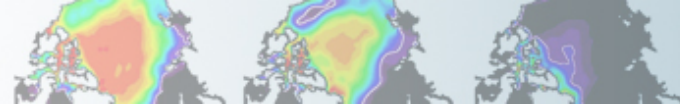
Do a “startup” run. Change the atm/Ind timestep to 900 seconds. (Default value is 1800 seconds with ATM_NCPL=48). Run 1 month. Be sure all time steps are compatible. Be sure to update your README.case file to keep track of your changes. Review logs to verify time step changes.

Exercise.6: On your own...

Branch start using Exercise.5 restart files. Include all Exercise 5 modifications. Reduce the snow albedoes over sea ice in CICE by half. Run 1 month.

Know what you are changing. Look up information on namelist variables in the documentation. (<http://www.cesm.ucar.edu/models/cesm1.2/cice/doc/index.html>).

Be sure to update your README.case file to keep track of your changes. The model will run regardless of whether or not you remember to include all of your changes. Check your resolved/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 files are actually used at runtime?

./cesm_setup (or *./preview_namelists*) \longrightarrow \$RUNDIR/atm_in
\$RUNDIR/lnd_in
\$RUNDIR/pop2_in
\$RUNDIR/ice_in
\$RUNDIR/drv_in

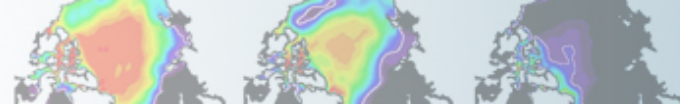
Bottom Line: User modifications should be implemented in the *env_run.xml* or the *user_nl_<model>* files.

What files are for documentation purposes?

Buildconf/*.input_data_list

CaseDocs, CaseStatus, LockedFiles, README.*

Note: Buildconf/*conf directories are created after *cesm_setup*. The user does NOT need to touch these files.



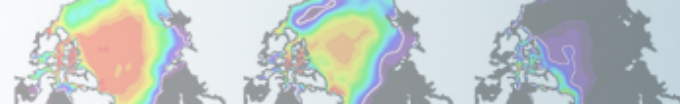
CESM1 Tutorial: Basic Modifications: **Run Scripts**

Review run script: *b.day2.x.run*

Common BSUB command to change:

#BSUB -q small	queue type*
#BSUB -o cesm.stdout.%J	machine standard out
#BSUB -e cesm.stderr.%J	machine standard error
#BSUB -J b.day2.x	job name
#BSUB -W 2:00	wallclock time requested
#BSUB -P UESM0004	project number

Note: Maximum allowable wall clock time per job submission varies from machine to machine and queue to queue. Yellowstone (NCAR's IBM) regular queue is 12 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

rof.log.yyddmm-nnnnnn.gz

cesm.log.yyddmm-nnnnnn.gz

Model runtime standard output

\$RUNDIR/*

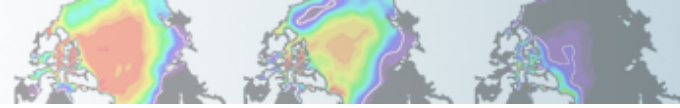
\$LOGDIR/*

Files are gzipped after model completion.

Restore by typing *gunzip <logfile>*.

yyddmm = year, month, day

nnnnnn = time id stamp



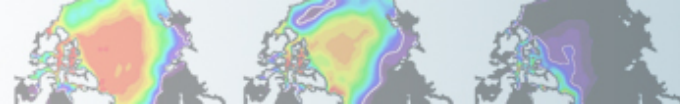
CESM1 Tutorial: Basic Modifications: **Other Tips**

CHECK your resolved namelists!

- Before you submit your job, 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 env_run.xml and user_nl_<model> files.
- 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

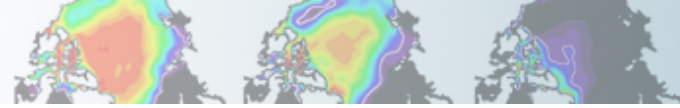
- Check your log files to make sure there are no hidden problems and to verify the model is running smoothly and as you expect. The log files may also help you verify your modifications were included in your run.

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 for CESM1.2 can be found at: <http://www.cesm.ucar.edu/models/cesm1.2/timing/>



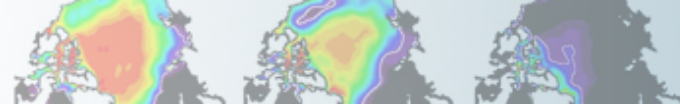
CESM1 Tutorial: Basic Modifications: **HELP!**

Finding Help...

1. Documentation:

<http://www.cesm.ucar.edu/models/cesm1.2/>

2. DiscussCESM: <http://bb.cgd.ucar.edu>



CESM1 Tutorial: Basic Modifications

Have Fun!!!