CLM4.5 Tutorial: Basic Modifications

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Review: The 4 commands to run CLM

Set of commands to build and run the model on a supported machine: "yellowstone"

# go into scripts directory into the source code download
cd /glade/p/cesm/lmwg/CLM2014_tutorial_n03_clm4_5_62/scripts

# (1) create a new case in the directory “cases” in your home directory
./create_newcase -case ~/I1850CLM45_001 -res f19_g16 -compset I1850CLM45 -mach yellowstone

# go into the case you just created in the last step
cd ~/I1850CLM45_001

# (2) invoke cesm_setup
./cesm_setup

# (3) build the executable
./I1850CLM45_001.build

# (4) submit your run to the batch queue
./I1850CLM45_001.submit
CLM directories & commands

**CESM Code**

- /path/to/code/directory
  - $CCSMROOT
  - models
    - atm
    - ocn
    - ice
    - glc
    - drv
    - rof
    - wav
    - utils
    - csm_share
  - scripts
    - (1) create_newcase

**CASE Directory**

- ~/I1850CLM45_001
  - (2) cesm_setup
  - (3) I1850CLM45_001.build
  - (4) I1850CLM45_001.submit

**Build/Run Directory**

- /glade/scratch/userx/I1850CLM45_001
  - $EXEROOT
    - Buildconf
    - LockedFiles
    - SourceMods
    - Tools
    - CaseDocs

- $RUNDIR
  - bld
  - run
    - $RUNDIR
CLM directories & commands

**CESM Code**

- /path/to/code/directory
  - $CCSMROOT
- models
  - atm
  - Ind
  - ocn
  - ice
  - glc
  - drv
  - rof
  - wav
  - utils
  - csm_share

**scripts**

1. create_newcase

**CASE Directory**

- ~/I1850CLM45_001
  - (2) cesm_setup
  - (3) I1850CLM45_001.build
  - (4) I1850CLM45_001.submit

**Build/Run Directory**

- /glade/scratch/userx/I1850CLM45_001
  - $EXEROOT
  - bld
  - run
  - $RUNDIR
CLM directories & commands

CESM Code

/path/to/code/directory
$CCSMROOT

models
scripts
(1) create_newcase

atm
Ind
ocn
ice
glc
drv
rof
wav
utils
csm_share

CASE Directory

~/I1850CLM45_001
(2) cesm_setup
(3) I1850CLM45_001.build
(4) I1850CLM45_001.submit

Build/Run Directory

/glade/scratch/userx/I1850CLM45_001
$EXEROOT

bld
run
$RUNDIR

Buildconf
LockedFiles
SourceMods
Tools
CaseDocs
CLM directories & commands

**CESM Code**

- /path/to/code/directory
  - $CCSMROOT
- models
- scripts
  - (1) create_newcase
- atm
- lnd
- ocn
- ice
- glc
- drv
- rof
- wav
- util
- csm_share

**CASE Directory**

- ~/I1850CLM45_001
  - (2) cesm_setup
  - (3) I1850CLM45_001.build
  - (4) I1850CLM45_001.submit

**Build/Run Directory**

- /glade/scratch/userx/I1850CLM45_001
  - $EXEROOT
  - /glade/scratch/userx/I1850CLM45_001
  - $RUNDIR
  - bld
  - run
  - $RUNDIR
CLM directories & commands

**CESM Code**

- /path/to/code/directory
- $CCSMROOT
- models
  - atm
  - lnd
  - ocn
  - ice
  - glc
  - drv
  - rof
  - wav
  - utils
  - csm_share

**scripts**

- (1) create_newcase

**CASE Directory**

- ~/I1850CLM45_001
- (2) cesm_setup
- (3) I1850CLM45_001.build
- (4) I1850CLM45_001.submit

**Build/Run Directory**

- /glade/scratch/userx/I1850CLM45_001
- $EXEROOT

- bld
- run
- $RUNDIR
Review: Queues and Jobs

Yellowstone

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

Killing jobs:
  a. Find your JOBID after typing `bjobs`
  b. Type `bkill <JOBID>`
Finding model output

Directory:
/glade/scratch/{userXX}/archive/I850CLM45_001/Ind/hist

Change this to your user name
Finding model output

Directory:
/glade/scratch/{userXX}/archive/I850CLM45_001/Ind/hist

Files (use "ls" to list them):
I1850CLM45_001.h0.0001-12.nc

Case Name  Time  Output Type  File Type
           (history) (netCDF)
3 Types of Basic Modifications

1. Component Sets

2. ENV files (env_[command])

3. Namelist files (user_nl_[model])
3 Types of Basic Modifications

1. Component Sets
   Set up a simulation for 2000

2. ENV files (env_[command])

3. Namelist files (user_nll_[model])
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?**

YourCaseName: `~`/I1850CLM45_001

Resolution: f19_g16 (2-degree)

Model Configuration: I1850CLM45 (I = CLM only, 1850)

Machine: yellowstone

Command:
```
./create_newcase --case ~I1850CLM45_001 --res f19_g16 --compset I1850CLM45 --mach yellowstone
```
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?

YourCaseName: `f19_g16` (2-degree)

Model Configuration: `I1850CLM45` (I = CLM only, 1850)

Machine: `yellowstone`

Command:
```
./create_newcase -case ~/I1850CLM45_001 -res f19_g16 -compset I1850CLM45 -mach yellowstone
```
Changing Simulation Components

**Compset**, or component set:
predefined options for running the model

Use compset to change the type of simulation
Changing compsets lets you run different experiments

**Component options:**
- Year (1850, 2000, transient, etc.)
- Data atmosphere (Qian, CRUNCEP, CPLHIST3HrWx)
- Model options (SP [satellite phenology], BGC [biogeochemistry])
- RCP scenarios
Changing compsets lets you run different experiments

Component options:
• Year (1850, 2000, transient, etc.)
• Data atmosphere (Qian, CRUNCEP, CPLHIST3HrWx)
• Model options (SP [satellite phenology], BGC [biogeochemistry])
• RCP scenarios

Examples of simulations using different compsets:
• Stabilize ("spin up") a biogeochemistry (includes N & C cycles) simulation for 1850
• Run a transient historical simulation from 1850-2000 based on the 1850 spin up
• Run a transient future simulation from 2000 through 2100 using RCP8.5
• Run a “time slice” simulation for 2000
Where to find a list of compsets:

http://www.cesm.ucar.edu/models/cesm1.2/clm/scripts/ccsm_utils/Case.template/config_compsets.xml

- Website lists ALL compsets for CESM. CLM only = “I” compsets

In CESM scripts directory, can run:
./create_newcase –list compsets

Tip: Add “ | more” at the end of the command line, then use the spacebar to scroll through the options
Exercise 1: Create & build simulation for 2000

`create_newcase` requires 4 arguments

What is the casename? f19_g16 (2-degree)

Which resolution? ICLM45 (I = CLM only, 2000)

Which model configuration? Which set of components? yellowstone

Which machine are you running on?

YourCaseName

./create_newcase -case ~/I2000CLM45_001 -res f19_g16 -compset ICLM45 -mach yellowstone
Exercise 1: Create & build simulation for 2000

# go into scripts directory into the source code download
cd /glade/p/cesm/lmwg/CLM2014_tutorial_n03_clm4_5_62/scripts

# (1) create a new case in the directory “cases” in your home directory
./create_newcase -case ~/I2000CLM45_001 -res f19_g16 -compset ICLM45 -mach yellowstone

# go into the case you just created in the last step
cd ~/I2000CLM45_001

# (2) invoke cesm_setup
./cesm_setup

# (3) build the executable
./I2000CLM45_001.build

Stop Here

# (4) submit your run to the batch queue
./I2000CLM45_001.submit
3 Types of Basic Modifications

1. Component Sets

2. ENV files (env_[command].xml)
   Changing the length of the run

3. Namelist files (user_nl_[model])
Review: The 4 commands to run CLM

Set of commands to build and run the model on a supported machine: "yellowstone"

```plaintext
# go into scripts directory into the source code download
cd /glade/p/cesm/lmwg/CLM2014_tutorial_n03_clm4_5_62/scripts

# (1) create a new case in the directory “cases” in your home directory
./create_newcase -case ~/I2000CLM45_001 -res f19_g16 -compset ICLM45 -mach yellowstone

# go into the case you just created in the last step
cd ~/I2000CLM45_001

# (2) invoke cesm_setup
./cesm_setup

# (3) build the executable
./I2000CLM45_001.build

# (4) submit your run to the batch queue
./I2000CLM45_001.submit

Change the run length BEFORE submitting
```
ENV files

Example 2. Simulations for a different length of time

Two steps to change run length:

1) Modify `env_run.xml` to set desired simulated length

2) Modify `I2000CLM45_001.run` to tell computer how much computer time is needed to complete the simulation (Wall Clock Time)

When modifying files, use an editor of your choice

Examples:

   emacs
   nedit
   vi
xmlchange command

Use when modifying “xml” files (e.g. env_run.xml)

1. Benefit: Won’t let you mess up the syntax!
2. For help, type ./xmlchange –help
3. Use “./xmlquery list” to list all variables and their values in all the .xml files

Example: editing env_run.xml via the xmlchange tool

./xmlchange {variable to be changed}={value to change to}

* We won’t use xml commands right now, but you will during the next section.
1) Modify `env_run.xml` to set desired simulated length

In a text editor*, open `env_run.xml`

* If you don’t have a preferred editor, `emacs` is more user friendly. Type “`emacs env_run.xml`” (or “`emacs anyfilename`”)

CASE Directory

```
~/I2000CLM45_001
  (2) cesm_setup
  (3) I2000CLM45_001.build
  (4) I2000CLM45_001.submit
```

- Buildconf
- LockedFiles
- SourceMods
- Tools
- CaseDocs
<entry id="RUNDIR" value="/glade/scratch/$CCSMUSER/$CASE/run" />

<entry id="CCSM_REPO\_TAG" value="" />

<entry id="CASE\_STR" value="UNSET" />

<entry id="RUN\_TYPE" value="startup" />

<entry id="RUN\_STARTDATE" value="0001-01-01" />

<entry id="START\_TOD" value="0" />

<entry id="RUN\_REFCASE" value="cose.\_std" />

<entry id="RUN\_REF\_DATE" value="0001-01-01" />

<entry id="RUN\_REF\_TT" value="00000" />

<entry id="BRANCH\_RET\_CAS\_NAME" value="FALSE" />

<entry id="GET\_REF\_CASE" value="FALSE" />

<entry id="STOP\_OPTION" value="nyears" />

<entry id="STOP\_OPTION" value="20" />

<entry id="STOP\_DATE" value="-999" />
Runtime variables can be changed in env_run.xml at any point during the run and control the mechanics of the run (length, resubmits, and archiving).

Common variables to change include

1. **STOP_OPTION** → sets the run time interval type, i.e. nmonths, ndays, nyears

2. **STOP_N** → sets the number of intervals to run the model during the specified wallclock* time.
   * Wallclock time is set in your YourCaseName.run file and is a measure of the actual time.

3. **RESUBMIT** → sets the number of times to resubmit the run
Exercise 2: Run simulation for 5 years (Part 1)

1. **STOP_OPTION** → change to “nyears”

2. **STOP_N** → change to “5”

3. **RESUBMIT** → sets the number of times to resubmit the run
   
   To use resubmit, can set “STOP_N” to 1, then set RESUBMIT to “4”.  
   ** This will run 5 different simulations for 1 year each **
Run Scripts: Wall clock time

2) Modify `I2000CLM45_001.run` to tell computer how much computer time is needed to complete the simulation (Wall Clock Time)

Using a text editor, open `I2000CLM45_001.run`
Run Scripts: Wall clock time

Review run script:  \texttt{i2000CLM45\_001.run}

Common BSUB command to change:

\begin{itemize}
  \item \texttt{#BSUB -q regular} queue type (also: economy, premium, etc.)
  \item \texttt{#BSUB -o cesm.stdout.%J} machine standard out
  \item \texttt{#BSUB -e cesm.stderr.%J} machine standard error
  \item \texttt{#BSUB -J ICLM200045\_001} job name
  \item \texttt{#BSUB -W 2:00} wallclock time requested*
  \item \texttt{#BSUB -P UCGD0001} project number
\end{itemize}

*Note: Maximum allowable wall clock time on Yellowstone is 12 hours. Submissions requesting under an hour typically have shorter wait times in the queue.
Exercise 2: Run for different length of time

# go into scripts directory into the source code download
cd /glade/p/cesm/lmwg/CLM2014_tutorial_n03_clm4_5_62/scripts

# (1) create a new case in the directory “cases” in your home directory
./create_newcase -case ~/I2000CLM45_001 -res f19_g16 -compset ICLM45 -mach yellowstone

# go into the case you just created in the last step
cd ~/I2000CLM45_001

# (2) invoke cesm_setup
./cesm_setup

# (3) build the executable
./I2000CLM45_001.build

After modifying env_run.xml and I2000CLM45_001.run, START HERE

# (4) submit your run to the batch queue
./I2000CLM45_001.submit
3 Types of Basic Modifications

1. Component Sets

2. ENV files (env_[command])

3. Namelist files (user_nl_[model])
   * Going back to I1850CLM45_001 case, changing data record frequency
Review: The 4 commands to run CLM

Set of commands to build and run the model on a supported machine: ”yellowstone”

# go into scripts directory into the source code download
cd /glade/p/cesm/lmwg/CLM2014_tutorial_n03_clm4_5_62/scripts

# (1) create a new case in the directory “cases” in your home directory
./create_newcase -case ~/I1850CLM45_001-res f19_g16 -compset I1850CLM45 -mach yellowstone

# go into the case you just created in the last step
cd ~/I1850CLM45_001
# (2) invoke cesm_setup
./cesm_setup

# (3) build the executable
./I1850CLM45_001.build

# (4) submit your run to the batch queue
./I1850CLM45_001.submit
CLM directories & commands

**CESM Code**

```
/path_to_code/CodeDir
$CCSMROOT
```

- models
- scripts
  1. create_newcase

**CASE Directory**

```
~/I1850CLM45_001
```

- (2) cesm_setup
- user_nl_datm
- user_nl_cice
- user_nl_clm
- user_nl_cpl
- user_nl_pop2
- user_nl_rtm

- (3) I1850CLM45_001.build
- (4) I1850CLM45_001.submit

**Build/Run Directory**

```
/glade/scratch/userx/I1850CLM45_001
```

- run
  1. $RUNDIR
  2. atm_in
  3. drv_flds_in
  4. drv_in
  5. ice_in
  6. Ind_in
  7. pop2_in
  8. rof_in

- bld
  - Source Mods
  - Tools
  - Case Docs
    - atm_in
    - drv_flds_in
    - drv_in
    - ice_in
    - Ind_in
    - pop2_in
    - rof_in
CLM directories & commands

**CASE Directory**

```
~/.I1859CLM45_001
(2) cesm_setup
   user_nl_datm
   user_nl_cice
   user_nl_clm
   user_nl_cpl
   user_nl_pop2
   user_nl_rtm
(3) I1850CLM45_001.build
(4) I1850CLM45_001.submit
```

cesm_setup creates namelist modification files *user_nl_***xxx*** this is where you modify your namelists

**Build/Run Directory**

```
/glade/scratch/userx/I1850CLM45_001
$EXEROOT
```

- **bld**
- **run** $RUNDIR
- **atm**
- **drv**
- **glc**
- **ice**
- **ind**
- **lnd**
- **pop2**
- **rof**
- **wav**
- **utils**
- **csm_share**
CLM directories & commands

**CESM Code**
- `/path_to_code/CodeDir`
- `$CCSMROOT`

**models**
- `atm`
- `Ind`
- `ocn`
- `ice`
- `glc`
- `drv`
- `rof`
- `wav`
- `utils`
- `csm_share`

**scripts**
1. `create_newcase`

**CASE Directory**
- `~/.I1850CLM45_001`
- `user_nl_xxx`
- `user_nl_cice`
- `user_nl_clm`
- `user_nl_pop2`
- `user_nl_rtm`

**Build/Run Directory**
- `/glade/scratch/userx/`
- `$EXEROOT`
- `bld`
- `run`

**Buildconf**
- `atm_in`
- `drv_flds_in`
- `drv_in`
- `ice_in`
- `Ind_in`
- `pop2_in`
- `rof_in`

**LockedFiles**

**SourceMods**

**Tools**

**CaseDocs**

The build script creates namelists in the run directory.

cesm_setup creates namelist modification files `user_nl_xxx` this is where you modify your namelists.
CLM directories & commands

CASE Directory

~'/I1850CLM45_001
(2) cesm_setup
  user_nl_datm
  user_nl_cice
  user_nl_clm
  user_nl_cpl
  user_nl_pop2
  user_nl_rtm
(3) I1850CLM45_001.build
(4) I1850CLM45_001.submit

cesm_setup creates namelist modification files user_nl_xxx
this is where you modify your namelists

Build/Run Directory

/glade/scratch/userx/
'I1850CLM45_001
$EXEROOT

run
$RUNDIR
atm_in
drv_in
ice_in
lnd_in
pop2_in
rof_in

The build script creates namelists in the run directory

CaseDocs contains copy of the namelists for reference only
(should not be edited)
• Not all changes can be made in env_run.xml.

• `user_nl_<model> files appear in the case directory after ./cesm_setup is invoked:

  - `user_nl_datm` ← atmosphere (atm_in)
  - `user_nl_clm` ← land (lnd_in)
  - `user_nl_cice` ← ice (ice_in)
  - `user_nl_pop2` ← ocean (pop2_in)
  - `user_nl_cpl` ← coupler (driver; drv_in)
  - `user_nl_rtm` ← river transport (rof_in)
Modifying Namelists

- Compsets set up namelists

- `user_nl_clm` modifies `Ind_in` namelist file

  Important: Don’t modify the namelist file directly. Use `user_nl_clm`. 
Modifying Namelists

- Compsets set up namelists
- `user_nl_clm` modifies `ind_in` namelist file
  Important: Don’t modify the namelist file directly. Use `user_nl_clm`.

- Website for CLM namelist variables:

** Some namelist variables can also be changed in `env_run.xml` file
Looking at Namelist Files

Option 1

• cd into your case directory, then CaseDocs
  • (~/I1850CLM45_001/CaseDocs)

• Open Ind_in with text editor

Option 2

• cd into your run directory
  • (glade/scratch/I1850CLM45_001/run)

• Open Ind_in with text editor
albice = 0.60, 0.40
co2_ppmv = 367.0
co2_type = 'constant'
create_crop_landunit = .false.
dtime = 1800
fatmlndfrc = '/glade/p/cesmda/cseg/inputdata/share/domains/domain.lnd.fv1.9x2.5_gxv6.090206.nc'
fin_dat = '
fsnowaging = '/glade/p/cesmda/cseg/inputdata/lnd/clm2/snicardata/snicar_drdt_bst_fit_60_c070416.nc'
fsnowoptics = '/glade/p/cesmda/cseg/inputdata/lnd/clm2/snicardata/snical_optics_5bnd_c090915.nc'
surdat = '/glade/p/cesmda/cseg/inputdata/lnd/clm2/surfdata_map/surfdata_1.9x2.5_simyr2000_c130927.nc'
maxpatch_gmc = 0
maxpatch_pft = 17
more_vertlayers = .false.
nsegspc = 20
paramfile = '/glade/p/cesmda/cseg/inputdata/lnd/clm2/paramdata/clm_params.c130821.nc'
uurban_hac = 'ON'
uurban_traffic = .false.
use_century_decomp = .false.
use_cn = .false.
use_crop = .false.
use_lch4 = .false.
use_nitrif_denitrif = .false.
use_vertoilc = .false.

&ndepdyn_nml

&popd_streams

&light_streams

&clm_hydrology1_inparm

&clm_soilhydrology_inparm

#! lnd_in:: Comment:
#! This namelist was created using the following command-line:
#! ymd = 00010101 / -use_case 2000_control -res 1.9x2.5 -clm_start_type default -l_ncpl 48 -lndfrac /glade/p/cesmda/cseg/inputdata/share/domains/domain.lnd.fv1.9x2.5_gxv6.090206.nc -glc nec 0 -co2_ppmv 367.0 -co2_type constant -config /glade/p/work/dll/testcases/CLM2014Tutorial_20yr2000SP_n02_clm4_5_57/Buildconf/clmconf/config_cache.xml -bgc sp
#! For help on options use: /glade/p/cesmda/lmgw/CLM2014_tutorial_n02_clm4_5_57/models/lnd/clm/bld/CLM build-namelist -help

~
Different compsets will change the status of some of these things.
Example Modification: user_nl_clm
Changing the frequency of model output

**hist_mfilt**: Number of samples within a file

- Default is 1
- Setting value to 12 would put 12 records into a single file

* Both hist_mfilt & hist_nhtfrq must be integers
Example Modification: user_nl_clm
Changing the frequency of model output

**hist_mfilt**: Number of samples within a file
- Default is 1
- Setting value to 12 would put 12 records into a single file

**hist_nhtfrq**: Frequency that data are recorded and written to a file
- **Default**: 0 means that output is recorded every month (monthly averages)
- **Positive Values**: Number of model timesteps (half-hourly) for output record
  - ex: 48 means output is recorded every day (daily averages)
- **Negative Values**: Absolute value in hours for output record
  - ex: -1 means output is recorded hourly; -24 means output is recorded daily

* Both hist_mfilt & hist_nhtfrq must be integers
Example Modification: user.nl_clm
Changing the frequency of model output

Daily output with a years worth of daily records in a file:
\[ \text{hist_mfilt} = 365 \]
\[ \text{hist_nhtfrq} = -24 \]

Monthly output with each month written to a separate file (default, as in I2000CLM45_001 case):
\[ \text{hist_mfilt} = 1 \]
\[ \text{hist_nhtfrq} = 0 \]
For this tutorial, we changed the default data record setting to daily in the I1850CLM45 compset.

Example 3: Modify `user_nl_clm` to get monthly output, 1 file per month in I1850CLM45_001
Run I1850CLM45_001 for 5 years

1. Change user_nl_clm to record monthly output
   - Rebuild the case: I1850CLM45_001.build

2. Change variables in env_run.xml

3. Change wall clock time in I1850CLM45_001.run

4. Rerun the simulation
   - I1850CLM45_001.submit
Review: The 4 commands to run CLM

Set of commands to build and run the model on a supported machine: "yellowstone"

```
# go into scripts directory into the source code download
cd /glade/p/cesm/lmwg/CLM2014_tutorial_n03_clm4_5_62/scripts

# (1) create a new case in the directory “cases” in your home directory
./create_newcase -case ~/I1850CLM45_001 -res f19_g16 -compset I1850CLM45 -mach yellowstone

# go into the case you just created in the last step
cd ~/I1850CLM45_001

# (2) invoke cesm_setup
./cesm_setup

After modifying namelists, START HERE

# (3) build the executable
./I1850CLM45_001.build

# (4) submit your run to the batch queue
./I1850CLM45_001.submit
```
Now **YOU** know how to run the model!

Use these **3 basic modifications** to run a variety of simulations.

1. Component Sets
2. ENV files (env_[command])
3. Namelist files (user_nll_[model])
Documenting Your Changes: README files

In your case directory, 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 resolution, 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.
For additional information on running & configuring CLM, see CLM User’s Guide: