

Namelist and Code Modifications

Part 1: Namelist Modifications

Part 2: Code Modifications

Part 3: Quiz

Cecile Hannay, CAM Science Liaison
Atmospheric Modeling and Predictability Section
Climate and Global Dynamics Division

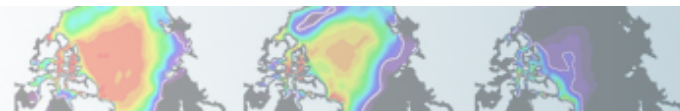


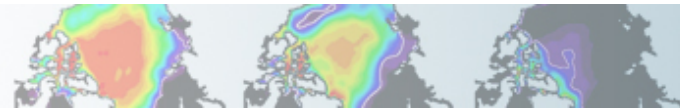
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**“I can only show you the door.
You're the one that has to walk through it”**

(The Matrix, 1999)





Part 1: Namelist Modifications

In this section, we will:

- review the “CESM flow” and how to make namelist changes,
- see where to find documentation for namelist variables
- as an illustration, we will customize the output history files to get high frequency output



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Review: The 4 commands to run CESM

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/tutorial/cesm1_2_2.tutorial/scripts

# (1) create a new case in the directory "cases" in your home directory
./create_newcase -case ~/cases/case01 -res T31_g37 -compset B_1850 -mach yellowstone

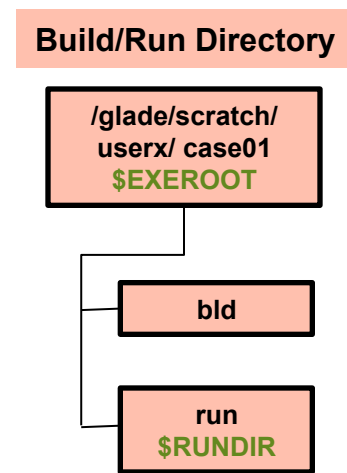
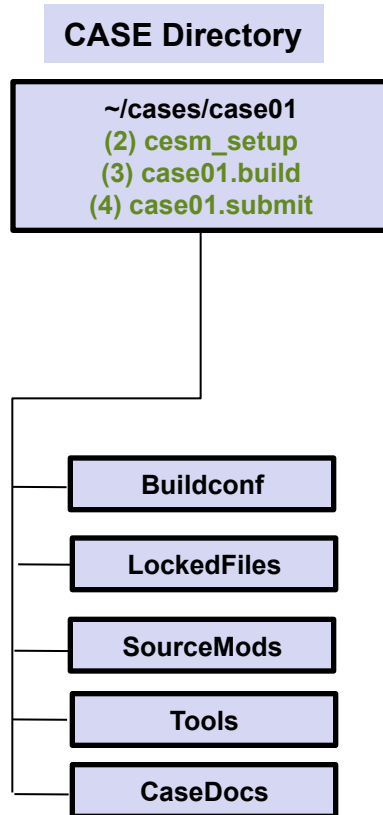
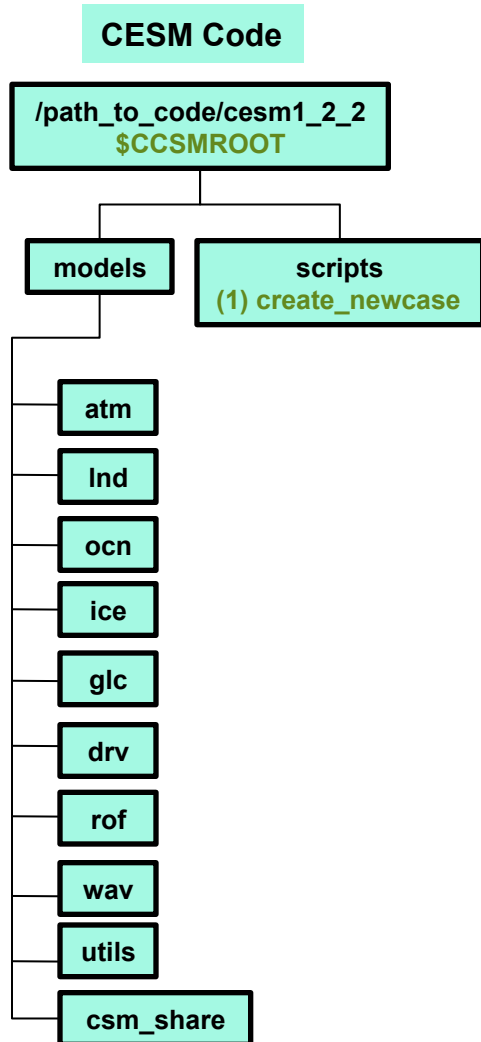
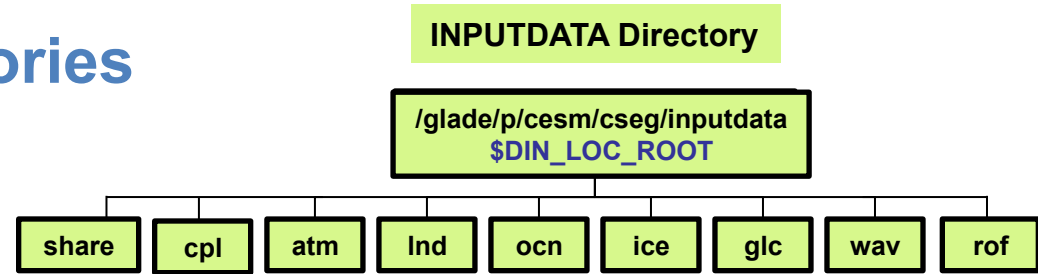
# go into the case you just created in the last step
cd ~/cases/case01/

# (2) invoke cesm_setup
./cesm_setup

# (3) build the executable
./case01.build

# (4) submit your run to the batch queue
./case01.submit
```

Overview of CESM directories + 4 CESM commands



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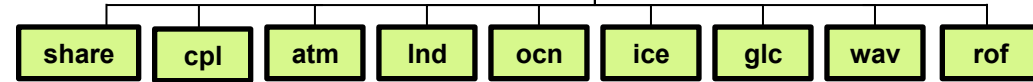
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```

Overview of CESM directories + 4 CESM commands

INPUTDATA Directory

/glade/p/cesm/cseg/inputdata
\$DIN_LOC_ROOT



CESM Code

/path_to_code/cesm1_2_2
\$CCSMROOT

models

scripts

(1) create_newcase

atm

lnd

ocn

ice

glc

drv

rof

wav

utils

csm_share

CASE Directory

~/cases/case01
(2) cesm_setup
(3) case01.build
(4) case01.submit

Buildconf

LockedFiles

SourceMods

Tools

CaseDocs

Build/Run Directory

/glade/scratch/
userx/ case01
\$EXERROOT

bld

run

\$RUNDIR

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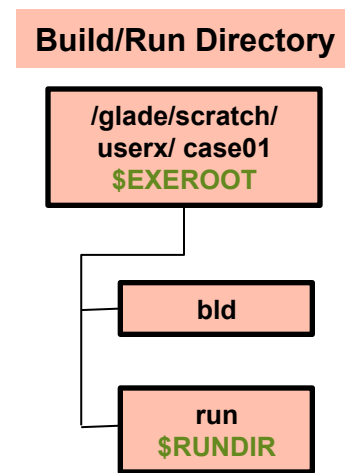
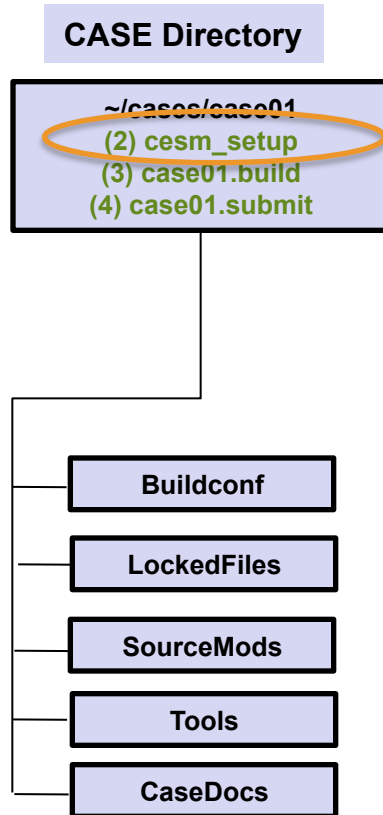
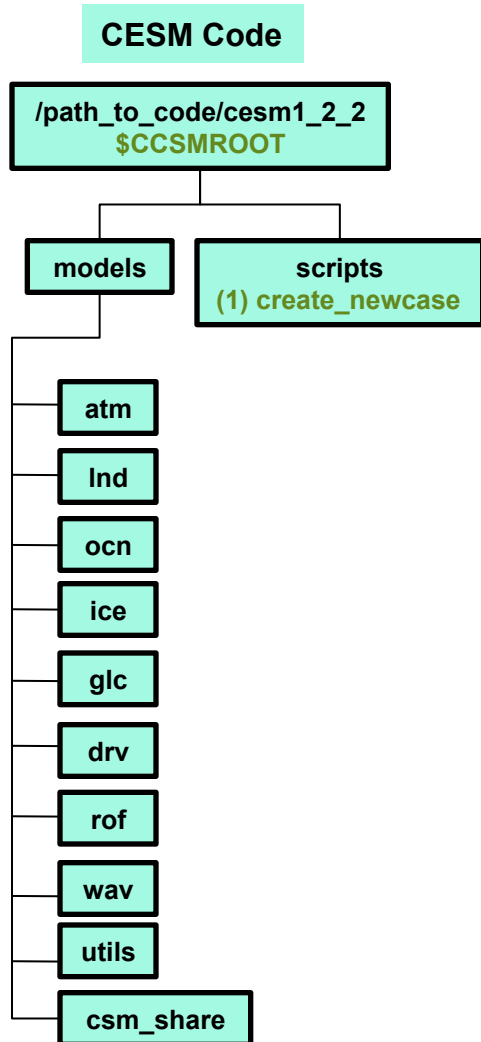
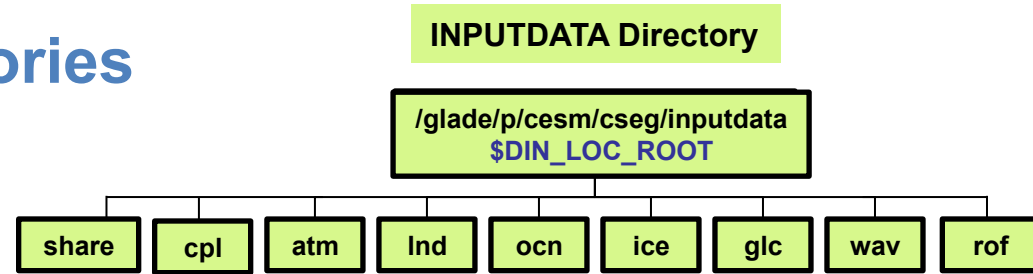
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Overview of CESM directories + 4 CESM commands



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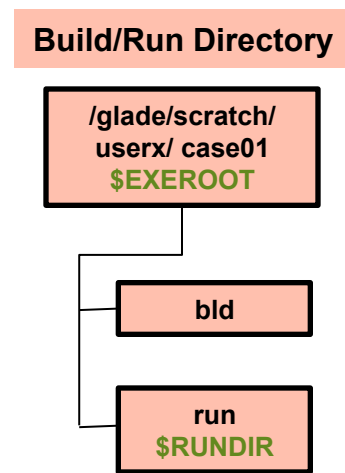
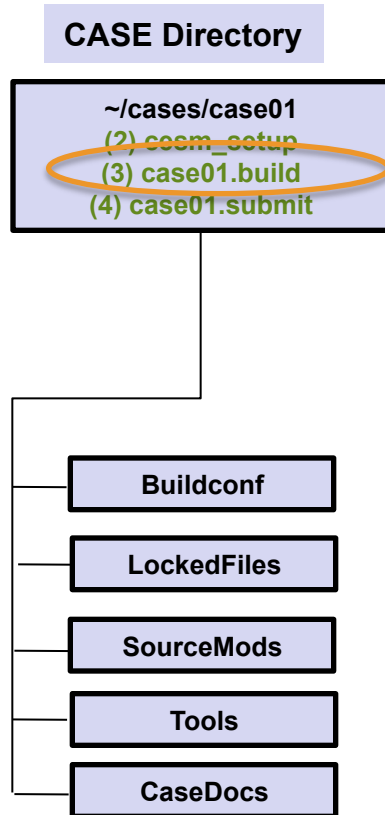
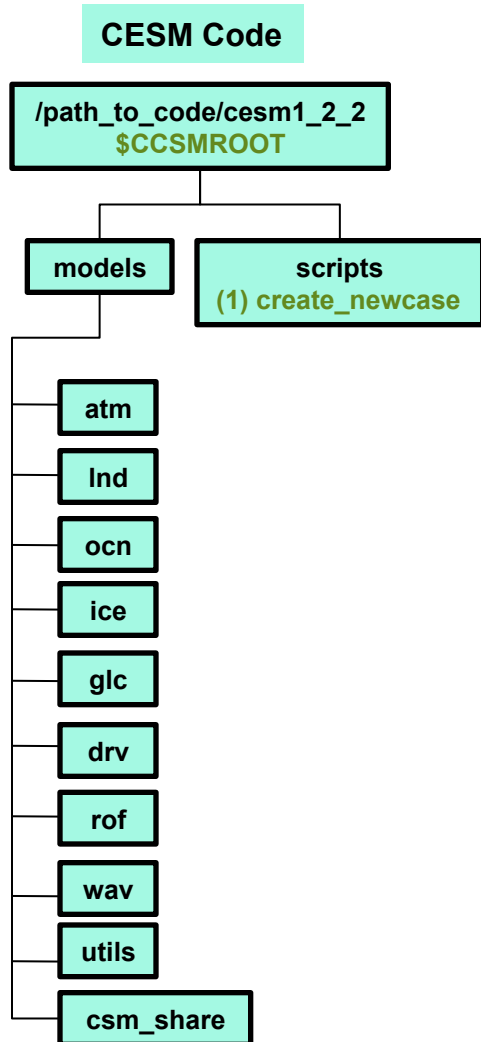
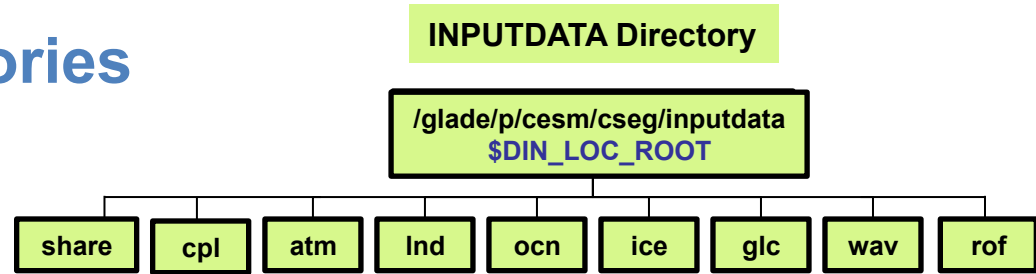
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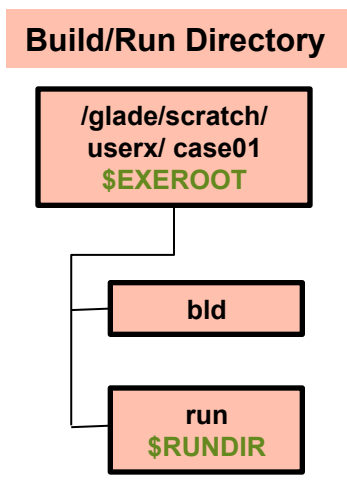
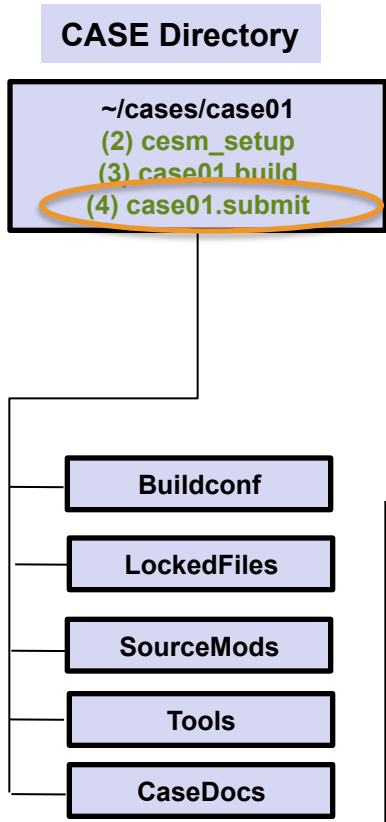
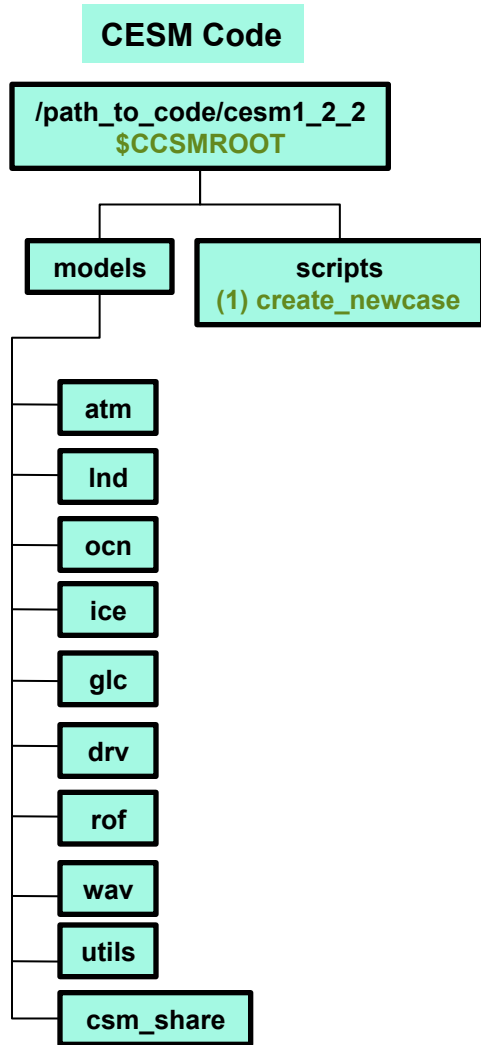
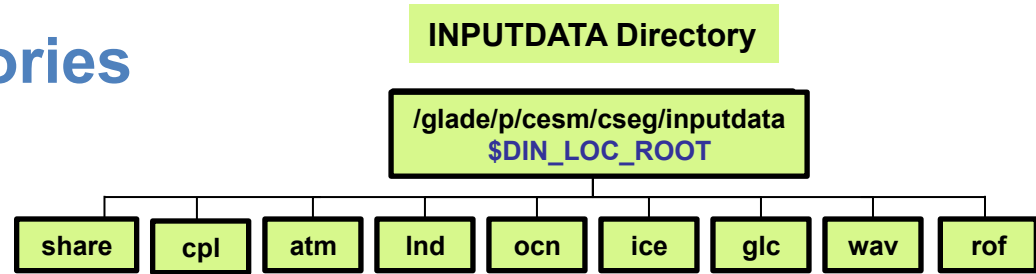
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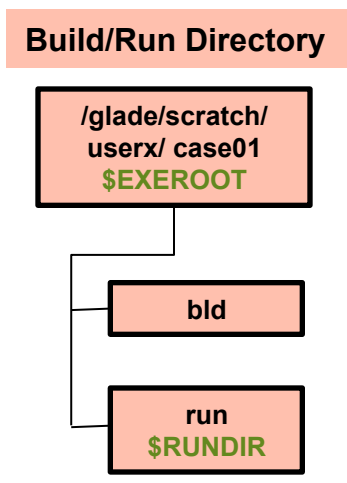
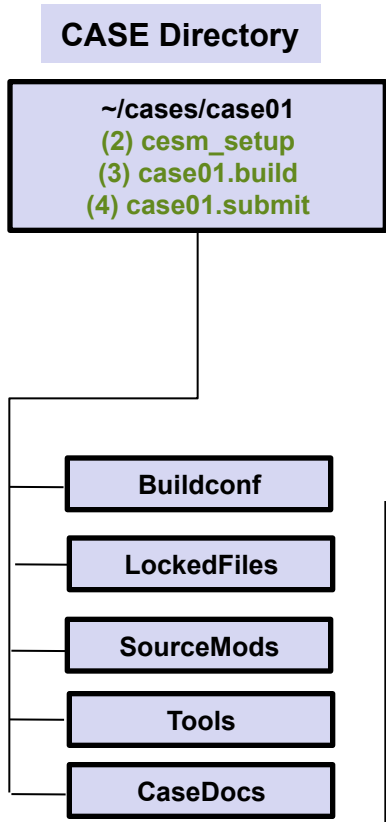
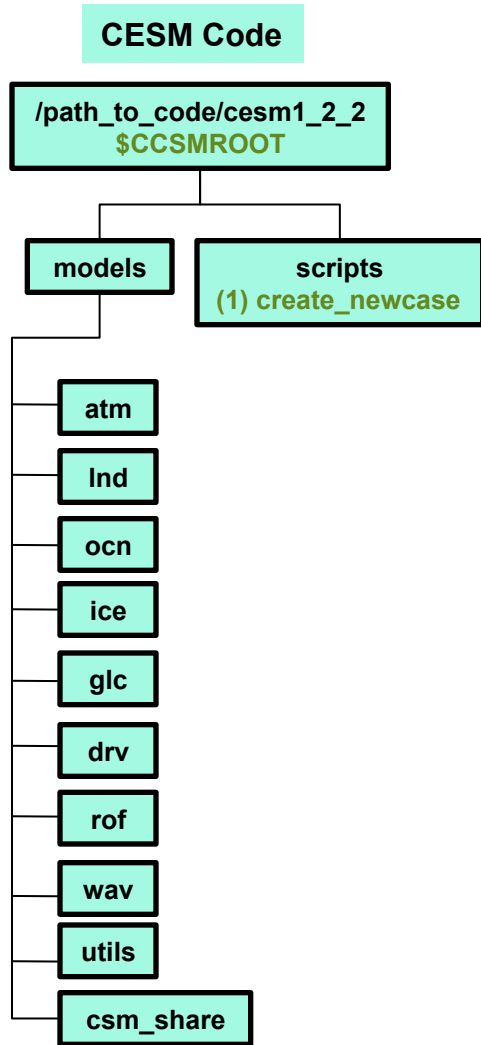
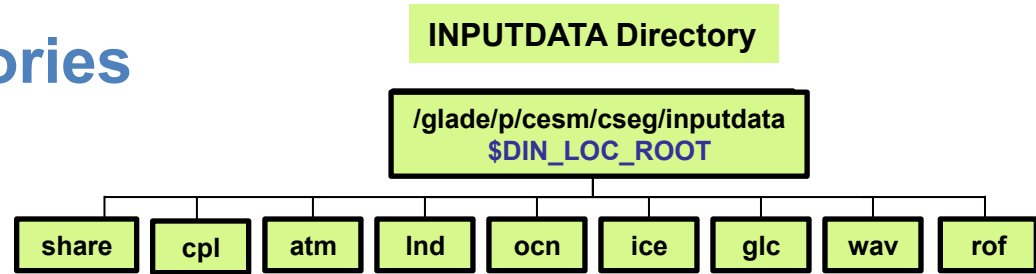
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Overview of CESM directories + 4 CESM commands



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cd ~/cases/case01/

# (2) invoke cesm_setup
./cesm_setup
    ← This is when you modify the namelists

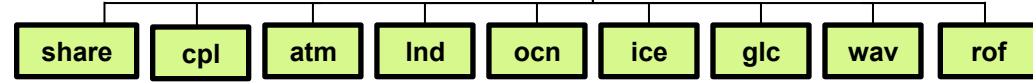
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Overview of CESM directories + namelist files

INPUTDATA Directory

/glade/p/cesm/cseg/inputdata
\$DIN_LOC_ROOT



CESM Code

/path_to_code/cesm1_2_2
\$CCSMROOT

models

scripts

(1) create_newcase

atm

lnd

ocn

ice

glc

drv

rof

wav

utils

csm_share

CASE Directory

~/cases/case01
(2) cesm_setup
(3) case01.build
(4) case01.submit
user_nl_cam
user_nl_ice
user_nl_clm
user_nl_cpl
user_nl_pop2
user_nl_rtm

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



Buildconf

LockedFiles

SourceMods

Tools

CaseDocs

atm_in
drv_flds_in
drv_in
ice_in
lnd_in
pop2_in
rof_in

CaseDocs contains **copy of the namelists** for reference only
(should not be edited)



Build/Run Directory

/glade/scratch/
userx/ case01
\$EXERROOT

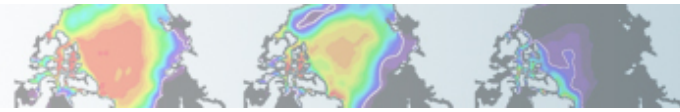
bld

run

\$RUNDIR
atm_in
drv_flds_in
drv_in
ice_in
lnd_in
pop2_in
rof_in

The build script creates **namelists** in the run directory
This is used by the model at runtime
(should not be edited)





Part 1: Namelist Modifications

In this section, we will:

- review the “CESM flow” and how to make namelist changes,
- **see where to find documentation for namelist variables**
- as an illustration, we will customize the output history files to get high frequency output



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Where to find info about namelists ?

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

The screenshot shows the CESM Models website interface. At the top, there is a search bar with 'Google Custom Search' and a 'Search' button. Below the search bar, the page title 'CESM Models' is displayed on the left, and the breadcrumb 'Home » CESM Models » CESM1.2 Series Public Release' is on the right. The main content area is divided into several sections:

- CESM1.2 SERIES PUBLIC RELEASE**
 - ABOUT THIS RELEASE SERIES**

The CESM1.2 release has numerous new key features among which are the addition of CLM4.5, new science changes to CAM5 running with the CAM-SE dynamical core, and new scripting infrastructure for the generation of component sets, grids and model testing.
 - CESM1.2 SERIES RELEASE NOTES**

Please read the [CESM1.2 Series Release Notes](#) which includes What's New - Science, What's New - Software, Answer-Changing Features, Supported Machines, and Known Problems. The new scripting infrastructure is described in detail in the [CESM1.2 User's Guide](#).
 - SCIENTIFIC VALIDATION**

Scientific validation consists of a multi-decadal model run of the given component set at the target resolution, followed by scientific review of the model output diagnostics. All scientifically supported component sets are also accompanied by diagnostic and model output data. Validated CESM1.2 model results and diagnostics will be added to the CESM1.2 website as they become available.

What version of the model should I use?
For a scientifically supported target component set and resolution, please refer to the [Scientifically Validated Configurations](#) for that target configuration. For component sets and resolutions that are not scientifically validated in any supported release (e.g. cesm1.0.5 and cesm1.1.1), CSEG strongly urges you to use the latest model release (in this case cesm1.2.0).
 - DIAGNOSTIC PACKAGES AND NAMING CONVENTIONS**
 - [Post Processing Utilities](#)
 - [Model File Naming Conventions](#)
 - [Experiment Case Naming Conventions](#)
 - MODEL DOCUMENTATION**
 - CESM1.2**
 - ▶ [User's Guide](#)
 - ▶ [Machines, Resolutions, Component sets](#)
 - ▶ [Model Component Namelists](#)
 - ▶ [\\$CASEROOT xml files](#)
 - Atmosphere Models**
 - Land Models**
 - Sea Ice Models**

On the right side of the page, there are three dark blue boxes with white text:

- CESM PROJECT**

The **Community Earth System Model (CESM)** is a fully-coupled, global climate model that provides state-of-the-art computer simulations of the Earth's past, present, and future climate states.

CESM is sponsored by the National Science Foundation (NSF) and the U.S. Department of Energy (DOE). Administration of the CESM is maintained by the Climate and Global Dynamics Division (CGD) at the National Center for Atmospheric Research (NCAR).
- MODEL SOURCE CODE**

Copyright and Terms of Use
All CESM source code is subject to the following [Copyright Notice and Disclaimer](#).

Acquiring the Release Code
The source code for CESM releases is distributed through a public Subversion code repository. This code can be checked out using Subversion client software, such as the command tool svn, or simply [view the latest version with a web browser](#).

A short [registration](#) is required to access the repository. After registering, you will receive an email containing a user name and password that is necessary to gain access to the repository.

Acquisition of the code is more fully described in the most recent version of the [CESM1.2 User's Guide](#).
- REPORTING A PROBLEM**

If you have any problems, please first read the User's Guide including the sections on FAQs and Use Cases. Please also refer to the [CESM](#)

Information about namelist variables

Where to find info about namelists ?

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

CESM Models

Home » CESM Models » CESM1.2 Series Public Release

CESM1.2 MODEL COMPONENT NAMELISTS

CREATE_NEWCASE FILES (SUPPORTED MACHINES, GRIDS, COMPSETS)

- Available Machines ([config_machines.xml](#))
- Available Grids ([config_grid.xml](#))
- Available Component Sets ([config_compsets.xml](#))

\$CASEROOT XML FILES

- [env_case.xml](#)
- [env_mach_pes.xml](#)
- [env_build.xml](#)
- [env_run.xml](#)

DRIVER NAMELIST DEFINITIONS

- [DRV Namelists](#)

PROGNOSTIC COMPONENTS NAMELIST DEFINITIONS

- [CAM5.3 Namelists](#)
- [CLM4.0 Namelists](#)
- [CLM4.5 Namelists](#)
- [RTM Namelists](#)
- [CICE Namelists](#)
- [POP2 Namelists](#)
- [CISM Namelists](#)

DATA COMPONENTS NAMELIST DEFINITIONS

- [DATM Namelists](#)
- [DLND Namelists](#)
- [DROF Namelists](#)
- [DICE Namelists](#)
- [DOCN Namelists](#)

Information about namelist variables

Please also refer to the [CESM](#)

CESM Models

CESM1.2 SERIES PUBLIC RELEASE

ABOUT THIS RELEASE SERIES

The CESM1.2 release has numerous new key features among which science changes to CAM5 running with the CAM-SE dynamical core for the generation of component sets, grids and model testing.

CESM1.2 SERIES RELEASE NOTES

Please read the [CESM1.2 Series Release Notes](#) which includes New Software, Answer-Changing Features, Supported Machines, and infrastructure is described in detail in the [CESM1.2 User's Guide](#).

SCIENTIFIC VALIDATION

Scientific validation consists of a multi-decadal model run of the resolution, followed by scientific review of the model output diagnostics. Component sets are also accompanied by diagnostic and model results and diagnostics will be added to the CESM1.2 website.

What version of the model should I use?

For a scientifically supported target component set and resolution, see the [Validated Configurations](#) for that target configuration. For component sets not scientifically validated in any supported release (e.g. cesm1.0), we urge you to use the latest model release (in this case cesm1.2.0).

DIAGNOSTIC PACKAGES AND NAMING CONVENTIONS

- [Post Processing Utilities](#)
- [Model File Naming Conventions](#)
- [Experiment Case Naming Conventions](#)

MODEL DOCUMENTATION

- [CESM1.2 User's Guide](#)
- [Machines, Resolutions, Component sets](#)
- [Model Component Namelists](#)
- [\\$CASEROOT xml files](#)

Atmosphere Models

Land Models

Where to find info about namelists ?

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

The image shows a screenshot of the CESM Models website. On the left, there is a navigation menu with sections: CESM1.2 SERIES PUBLIC RELEASE, ABOUT THIS RELEASE SERIES, CESM1.2 SERIES RELEASE NOTES, SCIENTIFIC VALIDATION, What version of the model should I use?, DIAGNOSTIC PACKAGES AND NAMING CONVENTIONS, and MODEL DOCUMENTATION. The main content area is titled 'CESM1.2 MODEL COMPONENTS' and lists various categories: CREATE_NEWCASE FILES (SUPPORTED MACHINES), \$CASEROOT XML FILES, DRIVER NAMELIST DEFINITIONS, PROGNOSTIC COMPONENTS NAMELIST DEFINITIONS, and DATA COMPONENTS NAMELIST DEFINITIONS. An orange arrow points from the 'CAM5.3 Namelists' link in the 'PROGNOSTIC COMPONENTS NAMELIST DEFINITIONS' section to a search interface on the right. The search interface is titled 'Search or Browse CAM Component Model Namelist Variables' and includes a search box, radio buttons for 'AND' and 'OR', and a 'Show All Variable Names' button. Below the search interface, there are three tables of variables, each with a cyan header: 'CAM: VOC Emissions', 'CAM: Species - Aerosol - Prescribed (CAM3 version)', and 'CAM: Chemistry - CAM-CHEM and WACCM'. Each table has columns for 'Namelist Variable', 'Type', and 'Group'. A text box on the right side of the search interface says 'Search or browse variables names'.

CESM Models

CESM1.2 SERIES PUBLIC RELEASE

ABOUT THIS RELEASE SERIES

The CESM1.2 release has numerous new key features among which science changes to CAM5 running with the CAM-SE dynamical core for the generation of component sets, grids and model testing.

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SCIENTIFIC VALIDATION

Scientific validation consists of a multi-decadal model run of the resolution, followed by scientific review of the model output. Diagnostic component sets are also accompanied by diagnostic and model results and diagnostics will be added to the CESM1.2 website.

What version of the model should I use?

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DIAGNOSTIC PACKAGES AND NAMING CONVENTIONS

- Post Processing Utilities
- Model File Naming Conventions
- Experiment Case Naming Conventions

MODEL DOCUMENTATION

CESM1.2

- User's Guide
- Machines, Resolutions, Component sets
- Model Component Namelists
- \$CASEROOT xml files

Atmosphere Models | Land Models

CESM Models

CESM1.2 MODEL COMPONENTS

CREATE_NEWCASE FILES (SUPPORTED MACHINES)

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- Available Component Sets ([config_components.xml](#))

\$CASEROOT XML FILES

- [env_case.xml](#)
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- [env_run.xml](#)

DRIVER NAMELIST DEFINITIONS

- DRV Namelists

PROGNOSTIC COMPONENTS NAMELIST DEFINITIONS

- [CAM5.3 Namelists](#)
- CLM4.0 Namelists
- CLM4.5 Namelists
- RTM Namelists
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- CISM Namelists

DATA COMPONENTS NAMELIST DEFINITIONS

- DATM Namelists
- DLND Namelists
- DROF Namelists
- DICE Namelists
- DOCN Namelists

Search or Browse CAM Component Model Namelist Variables

This page contains the complete list of CAM namelist variables. They are grouped by categories designed to aid browsing. Clicking on the name of a variable will display descriptive information. If search terms are entered in the text box below, the list will be condensed to contain only matched variables.

Search Variable Names

AND OR (separate search terms with spaces)

Also search help text

CAM: VOC Emissions

Namelist Variable	Type	Group
megan_factors_file	char*256	megan_emis_nl
megan_mapped_emisfctrs	logical	megan_emis_nl
megan_specifier	char*1024(100)	megan_emis_nl

CAM: Species - Aerosol - Prescribed (CAM3 version)

Namelist Variable	Type	Group
bndtvaer	char*256	cam3_aero_data_nl
cam3_aero_data_on	logical	cam3_aero_data_nl

CAM: Chemistry - CAM-CHEM and WACCM

Namelist Variable	Type	Group
aer_drydep_list	char*16(1000)	chem_inparm
aer_wetdep_list	char*16(1000)	chem_inparm
aerodep_flx_cycle_yr	integer	aerodep_fix_nl
aerodep_flx_datapath	char*256	aerodep_fix_nl
aerodep_flx_file	char*256	aerodep_fix_nl
aerodep_flx_filelist	char*256	aerodep_fix_nl
aerodep_flx_fixed_tod	integer	aerodep_fix_nl
aerodep_flx_fixed_ymd	integer	aerodep_fix_nl
aerodep_flx_rmfile	logical	aerodep_fix_nl
aerodep_flx_specifier	char*32(22)	aerodep_fix_nl
aerodep_flx_type	char*32	aerodep_fix_nl
aircraft_specifier	char*256(100)	aircraft_emit_nl

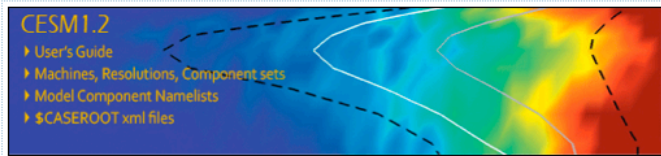
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DIAGNOSTIC PACKAGES AND NAMING CONVENTIONS

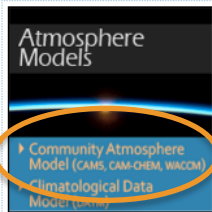
- Post Processing Utilities
- Model File Naming Conventions
- Experiment Case Naming Conventions

MODEL DOCUMENTATION



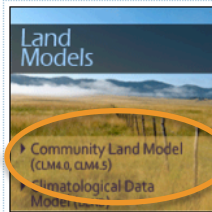
CESM 1.2

- ▶ User's Guide
- ▶ Machines, Resolutions, Component sets
- ▶ Model Component Namelists
- ▶ \$CASEROOT xml files



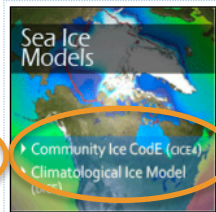
Atmosphere Models

- ▶ Community Atmosphere Model (CAM5, CAM-CHEM, WACCM)
- ▶ Climatological Data Model (ccsm)



Land Models

- ▶ Community Land Model (CLM4.0, CLM5.0)
- ▶ Climatological Data Model (ccsm)



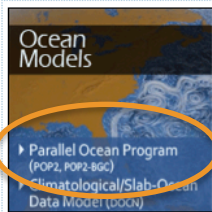
Sea Ice Models

- ▶ Community Ice CodE (ICE4)
- ▶ Climatological Ice Model (ccsm)



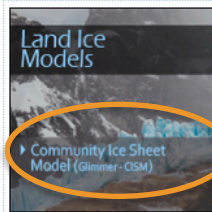
Coupler

- ▶ CESM Coupler (CPL7)



Ocean Models

- ▶ Parallel Ocean Program (POP2, POP2-BGC)
- ▶ Climatological/Slab-Ocean Data Model (ccsm)



Land Ice Models

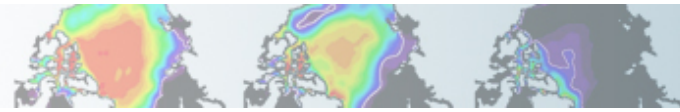
- ▶ Community Ice Sheet Model (Glimmer - CISM)



River Models

- ▶ River Transport Model (RTM)
- ▶ Climatological River P Model (ccsm)

Useful information about namelist variables can also be found in the user guide of each component



Part 1: Namelist Modifications

In this section, we will:

- review the “CESM flow” and how to make namelist changes,
- see where to find documentation for namelist variables
- as an illustration, we will customize the output history files to get high frequency output



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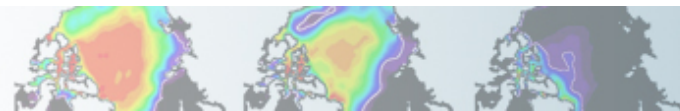
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Let's change the output frequency in CAM**

By default, CESM outputs **monthly average** history files.

To change the output frequency of a CAM history file from **monthly average** to **daily average**, we use the namelist variable: ***nhtfrq=-24***

***** In this tutorial, most examples will be coming from the atmospheric and land model. Concepts are transferable to other model components.***



Search CAM namelist documentation

Search or Browse CAM Component Model Namelist Variables

This page contains the complete list of CAM namelist variables. They are grouped by categories designed to aid browsing. Clicking on the name of a variable will display descriptive information. If search terms are entered in the text box below, the list will be condensed to contain only matched variables.

- AND OR (separate search terms with spaces)
 Also search help text

Found 1 standard names matching query: nhtfrq

Search for nhtfrq

CAM: History and Initial Conditions Output

Namelist Variable	Type	Group
<p>▼ nhtfrq</p> <p>Array of write frequencies for each history file series. If <code>nhtfrq(1) = 0</code>, the file will be a monthly average. Only the first file series may be a monthly average. If <code>nhtfrq(i) > 0</code>, frequency is specified as number of timesteps. If <code>nhtfrq(i) < 0</code>, frequency is specified as number of hours.</p> <p>Default: 0, -24, -24, -24, -24, -24</p>	integer(6) ↑ type	cam_inparm ↑ Namelist group

How to set it

daily average: `nhtfrq=-24`

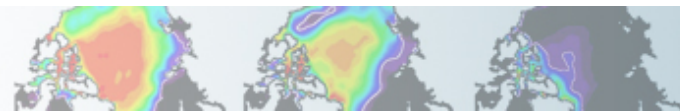
Customizing CAM history files

In this section, we will cover:

- how to change the **output frequency**
- how to output **extra variables**
- how to output **extra history files**
- how to control the **number of time samples** written to a history file

This can be achieved with 3 namelist variables:

- ***nhtfrq***: sets the output frequency
- ***fincl***: add variables to the history file
- ***mfilt***: maximum number of time samples written to a history file



Customizing CAM history files: *nhtfrq*, *mfilt*

The **default** history file from CAM is a **monthly average**.

We can change the output frequency with the namelist variable *nhtfrq*

If *nhtfrq*=0, the file will be a **monthly** average

If *nhtfrq*>0, frequency is input as number of **timesteps**.

If *nhtfrq*<0, frequency is input as number of **hours**.

For instance to change the history file from **monthly** average to **daily** average, we set the namelist variable:

nhtfrq = -24

To control the **number of timesteps** in the history file, we can use the variable *mfilt*

For instance, to specify that we want one time sample on each history file, we set the namelist variable:

mfilt = 1

Customizing CAM history files: fincl

You can output up to 6 history files: “h0”, “h1”, ..., “h5”.

The file “h0” contains the default variables (in the code: “call add_default”). This includes the variables necessary for the *AMWG package*.

For the files “h1” to “h5”, the user has to specify the variables to output.

To control the list of fields in the history files we can use the namelist variables

h0 *h1* ... *h5*
fincl1 *fincl2* ... *fincl6*

For instance, the line:

```
fincl1 = 'PRECT'
```

is used to add the field 'PRECT' to the file “h0”

The added fields must be in **Master Field List** (= fields that can be written to the history files).

http://www.cesm.ucar.edu/models/cesm1.2/cam/docs/ug5_3/ug.html#model_out

Customizing CAM history files: fincl

Using a ":" following a field gives the **averaging flag** for the output field.

Valid flags are:

I for instantaneous,

A for average,

M for minimum,

X for maximum.

For instance, the line:

fincl1 = 'PRECT:M'

is used to add the minimum of 'PRECT' to the file "h0"

Example of customizing history files

For instance, in addition to the monthly history file “h0”, we want to output a file “h1” with instantaneous values of T, Q, U, V and OMEGA every 3 hour. We can use:

```
fincl2 = 'T:I','Q:I','U:I','V:I', 'OMEGA:I'  
nhtrfq = 0, -3
```

Notice that it is equivalent to:

```
fincl2 = 'T:I','Q:I','U:I','V:I', 'OMEGA:I'  
nhtrfq(1) = 0  
nhtrfq(2) = -3
```

NB: If you plan to run the AMWG diagnostic package, it is recommended to leave the “h0” file untouched and to add extra history files.

Exercise 1: Customizing history files



Create a case called “b.day4.001” using the compset B_1850_CN at T31_g37 resolution. Set the run length to 1 month.

In addition to the monthly history file “h0”, output:

- “h1” file with instantaneous values of T, Q, U and V every 3 hour.
- “h2” file with time-average values of T, Q, U and V every 24 hour.

Write one h1 file and one h2 file for every day of the month.

(Hint: - Use namelist variables: *nhtfrq*, *mfilt*, *fincl*. Look at the online documentation for these variables)

Exercise 1: Check your solution



When your run is completed,

(1) check that your archive directory contains the files:

b.day4.001.cam.h0.0001-01.nc

b.day4.001.cam.h1.0001-01-01-00000.nc

b.day4.001.cam.h2.0001-01-01-00000.nc

b.day4.001.cam.h1.0001-01-02-00000.nc

b.day4.001.cam.h2.0001-01-02-00000.nc

...

b.day4.001.cam.h1.0001-01-31-00000.nc

...

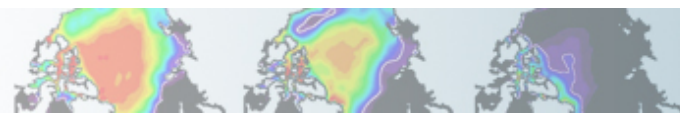
b.day4.001.cam.h2.0001-01-31-00000.nc

(2) Compare the contents of the h1 and h2 files using “ncdump”.

```
ncdump -h b.day4.001.cam.h1.0001-01-01-00000.nc
```

```
ncdump -h b.day4.001.cam.h2.0001-01-01-00000.nc
```

Look at the variables attributes. What is the difference between the 2 files ?



Outputting high frequency data in other components

Here is a few variables to control output frequency of **land**, **ice** and **ocean**

CLM

hist_nhtfrq: output frequency of the history file

hist_mfilt: number of samples on each history file

hist_fincl: adding variables and auxiliary history files

Example

user_nl_clm to output 4 extra history files with daily, six-hourly, hourly, and every time-step values of TG and TV (leaving the primary history files as monthly):

hist_fincl2 = 'TG', 'TV'

hist_fincl3 = 'TG', 'TV'

hist_fincl4 = 'TG', 'TV'

hist_fincl5 = 'TG', 'TV'

hist_nhtfrq = 0, -24, -6, -1, 1

<http://www.cesm.ucar.edu/models/cesm1.2/clm/models/Ind/clm/doc/UsersGuide/book1.html>

Outputting high frequency data in other components

CICE

histfreq: Frequency of output written to history files ('m', 'w', 'd', 'y', ...)

histfreq_n: Frequency history data is written to history files

hist_avg: if false => instantaneous values
if true => time-averages

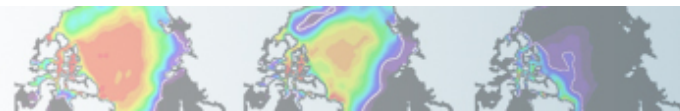
Example

user_nl_cice to output an extra history file with daily values (leaving the primary history file as monthly):

```
histfreq = 'm','d','x','x','x'
```

```
histfreq_n = 1,1,1,1,1
```

See: http://www.cesm.ucar.edu/models/cesm1.2/cice/doc/node8.html#table:setup_nml



Outputting high frequency data in other components

POP2

tavg_freq = frequency at which the model fields are written

tavg_freq_opt = units of time for 'tavg_freq' ('nmonth', 'nhour', 'once', ...)

tavg_file_freq = frequency at which the model files are written

tavg_file_freq_opt = units of time for 'tavg_file_freq' ('nmonth', 'nhour', ...)

See: <http://www.cesm.ucar.edu/models/cesm1.2/pop2/doc/users/node77.html>

For instance, to output a timeseries of daily averages bundled into a monthly file:

tavg_freq_opt = 'nday'

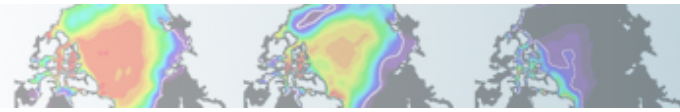
tavg_freq = 1

tavg_file_freq_opt = 'nmonth'

tavg_file_freq = 1



Changing tavg_nml variables is non standard
Do not modify these variables directly in user_nl_pop2
Use the workaround explained in user_nl_pop2



Part 2: Code Modification

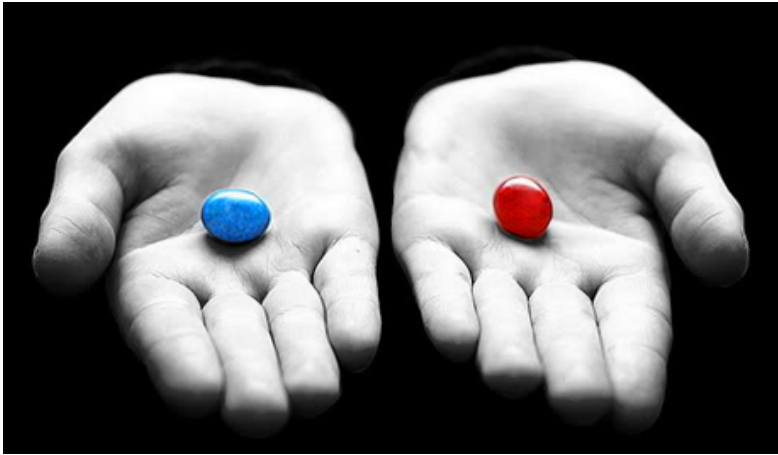
In this section, we will learn how to do simple code modifications such changing a parameter in the code or adding a new variable



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Your choice: The Red Pill or the Blue Pill



The Matrix (1999): Neo, the main character is offered the choice between a red pill and a blue pill.

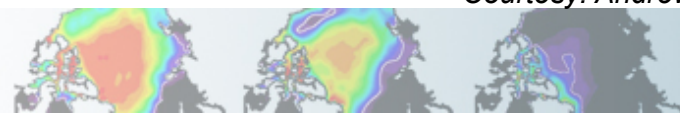
-The **blue pill** would allow him to remain in the Matrix (a fictional computer-generated world)



-The **red pill** would lead to his "escape" from the Matrix into the real world and embracing the sometimes painful truth of reality.



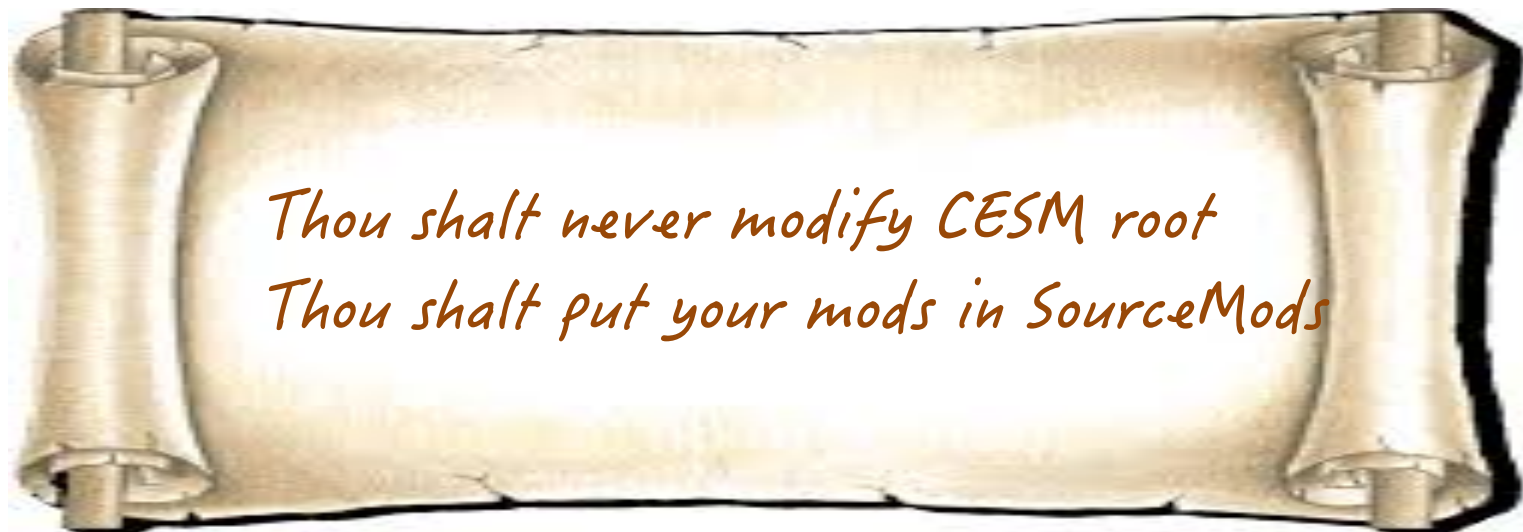
Courtesy: Andrew Gettelman



Principles for modifying the code

Never modify the CESM root itself.

Your modifications to the code should go into: *SourceMods*

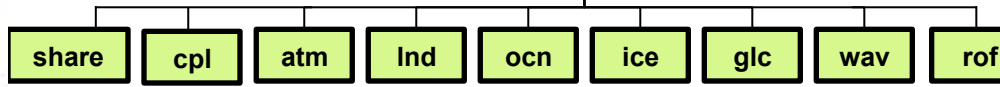


Principles for modifying the code

*Thou shalt never modify CESM root
Thou shalt put your mods in SourceMods*

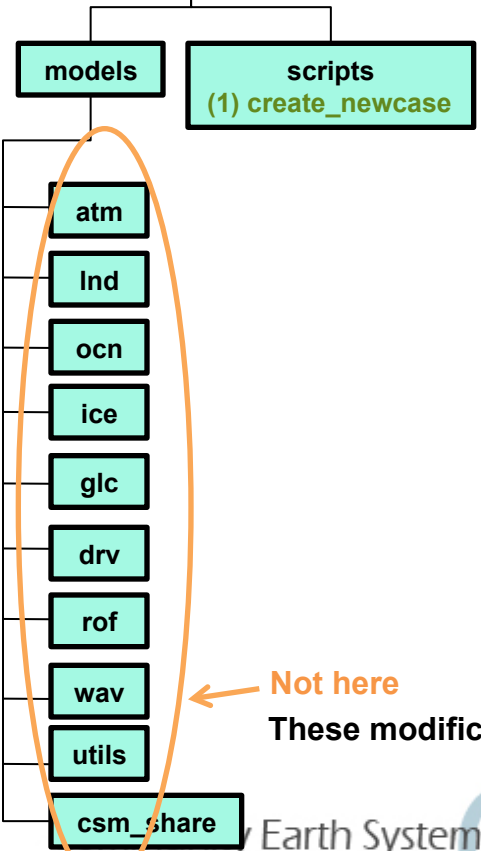
INPUTDATA Directory

/glade/p/cesm/cseg/inputdata
\$DIN_LOC_ROOT



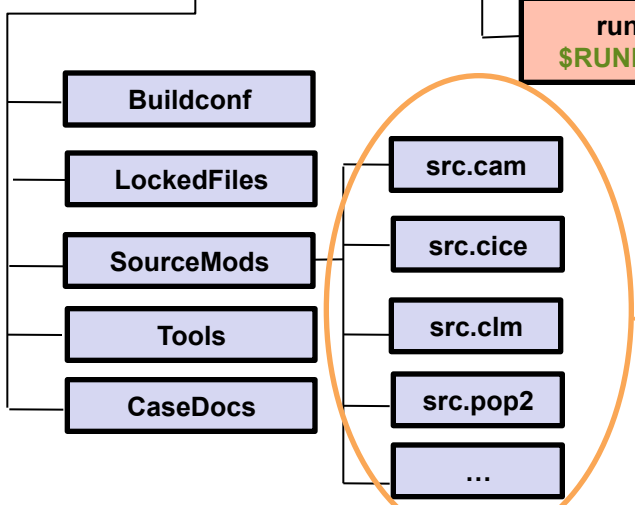
CESM Code

/path_to_code/cesm1_2_2
\$CCSMROOT



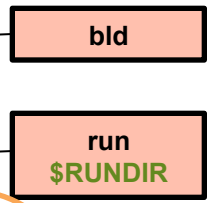
CASE Directory

~/cases/case01
(2) cesm_setup
(3) case01.build
(4) case01.submit



Build/Run Directory

/glade/scratch/
userx/ case01
\$EXERROOT



This is where you put your modifications
These modifications only affect the current case

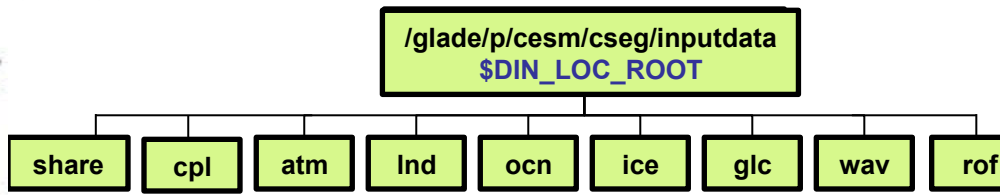
Not here
These modifications affect all the cases



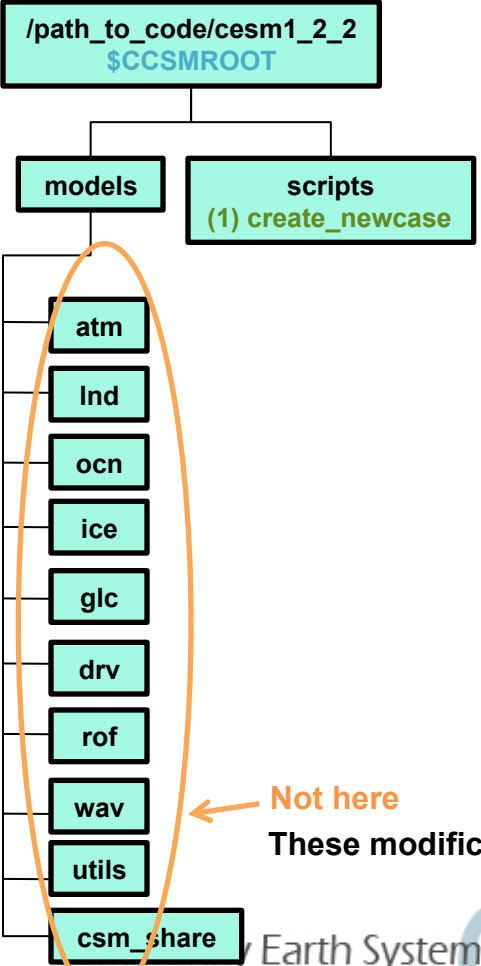
Principles for modifying the code

*Thou shalt never modify CESM root
Thou shalt put your mods in SourceMods*

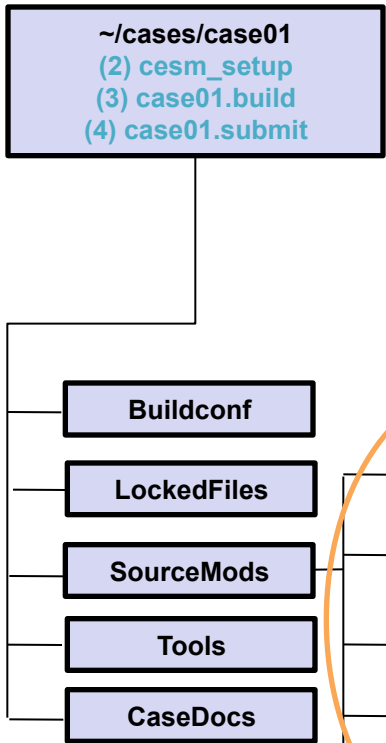
INPUTDATA Directory



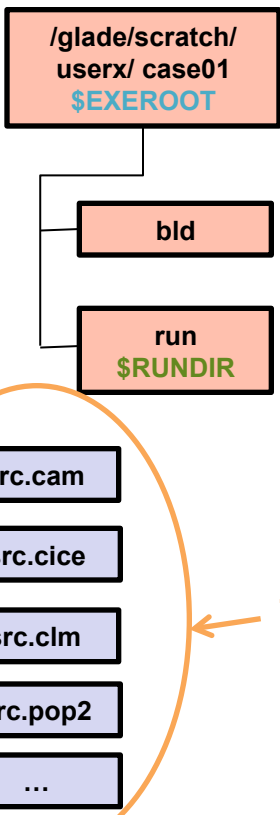
CESM Code



CASE Directory



Build/Run Directory



```

# go into scripts directory
cd /glade/p/cesm/tutorial/cesm1_2_2.tutorial/scripts

# (1) create a new case
./create_newcase -case ~/cases/case01 -res T31_g37
-compsset B_1850 -mach yellowstone

# go into the case you just created in the last step
cd ~/cases/case01/

# (2) invoke cesm_setup
./cesm_setup

# (3) build the executable
./case01.build

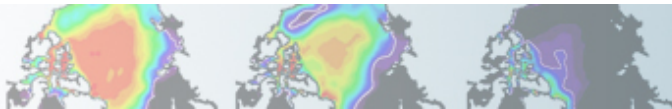
# (4) submit your run to the batch queue
./case01.submit
  
```

Make your source mods

This is where you put your modifications

These modifications only affect the current case

Not here
These modifications affect all the cases



Modifying a subroutine

Steps to modify the code:

- Find the subroutine you want to modify
- Copy this subroutine in SourceMods
- Make your mods
- Compile and run the model

Example: Modify a parameter, zlnd

Let's modify a **tuning parameter** in the CLM code
zlnd = roughness length for soil (m)

“tuning parameter”

- *parameter weakly constrained by observation*
- *can be adjusted to achieve agreement with observations*

1. Find the subroutine you want.

Go in the CESM code and look for zlnd (for instance, you can use: `grep -r zlnd *`)

zlnd is in the subroutine `clm_varcon.F90`

2. Copy this subroutine in SourceMods

Go your case directory and copy `clm_varcon.F90` into `SourceMods/src.clm`

3. Make your modifications

Edit the value of zlnd in `SourceMods/src.clm/clm_varcon.F90`

4. Compile and run the model

Exercise 2: Modify a parameter, zInd



Create a case called “b.day4.002” using the compset B_1850_CN at T31_g37 resolution. Change the value of zInd (roughness length for soil) to zInd = 0.02_r8 and make a 1-month run.

Hint: Locate your subroutine using `grep -r zInd *`

The compset B_1850_CN is using ‘clm4_0’ and not ‘clm4_5’

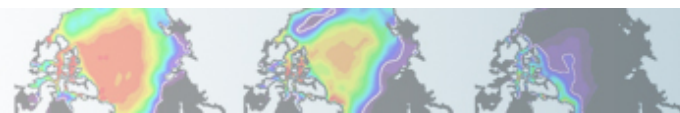
Check your solution:

Compare the land file for “b.day4.001” and “b.day4.002” and make sure that the 2 runs are different.

You can use `ncdiff` to look at the difference between the 2 runs.

```
ncdiff /glade/scratch/$user/archive/b.day4.002/ln/hist/b.day4.002.clm2.h0.0001-01.nc /glade/scratch/$user/archive/b.day4.001/ln/hist/b.day4.001.clm2.h0.0001-01.nc diff.nc
```

How does it affect the fraction of ground covered by snow ?



Output an extra variable

- One common thing you may want to do is to **add code to output a new variable**
- For instance, CAM has a field to output the temperature at 500 mbar (T500) but not at 750mb. Let's add a field to output the temperature at 750 mbar (T750)

This can be done by a succession of calls:

call addfld (' T750', ...)

→ Add a field to master field list

call add_default (' T750',...)

→ Add this field to "h0" by default (optional)

call outfld(' T750', ...)

→ Collect values for this field and write to history file

Syntax: addfld

addfld = Add a field to master field list

Field name

Units

Number of vertical levels:
single level :1
multi-level: pver or pverp

Averaging flag:
A = average
I = instantaneous

**subroutine addfld (fname, units, numlev, avgflag, &
long_name, decomp_type, [Optional arguments])**

Field full name

Decomposition type
(phys_decomp or
dyn_decomp)

There are several optional arguments (not covered here. See documentation for more information about optional arguments)

Example:

call addfld ('T500', 'K', 1, 'A', 'Temperature at 500 mbar pressure surface', phys_decomp)

Syntax: add_default

add_default = Add a field to the list of default fields on history file

Field name

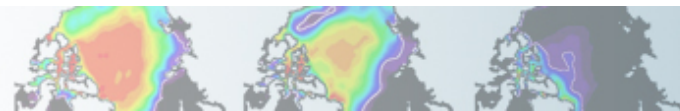
Averaging flag:
A = average (default)
I = instantaneous

```
subroutine add_default (name, tindex, flag)
```

history tape index

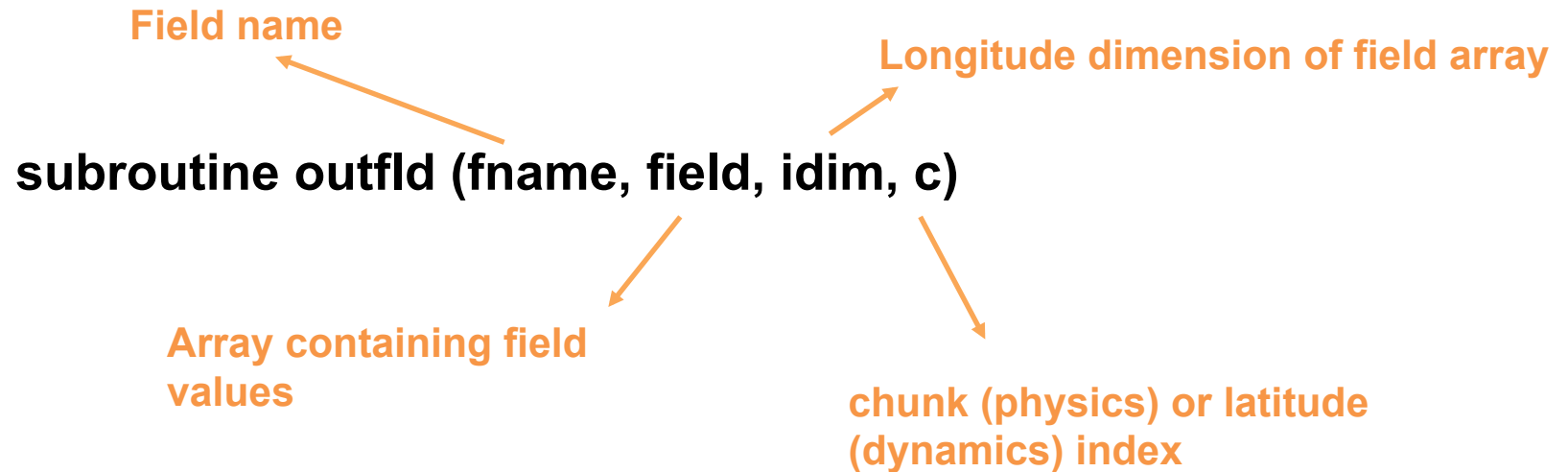
Example:

```
call add_default ('CLOUD ', 1, '')
```



Syntax: outfld

outfld = accumulate (or take min, max, etc. as appropriate) input field into its history buffer for appropriate tapes



Example:

call outfld('CLOUD', cld, pcols, lchnk)



Exercise 3: Add an output field

Create a case called “b.day4.003” using the compset B_1850_CN at T31_g37 resolution. Add an output field for the temperature at 750 mbar. Output daily values of T750 and T500 in the “h1” history file. Make a 1-month run.

Hint:

- Use T500 as a template for your changes.
- Find the subroutine containing T500 using `grep -r T500 *`

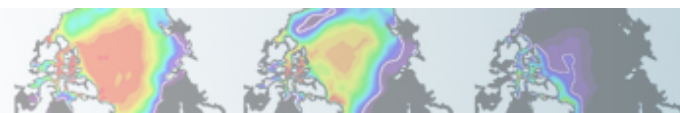
Check your solution

When the run is completed,

- check the field T750 and T500 are in the file h1
- create a file with the difference between T750-T500 (*)
- look at the difference with `ncview`.

(*) For instance, you can use `ncap2`

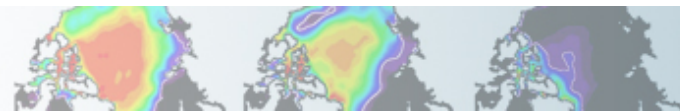
```
ncap2 -s 'T750_minus_T500=T750-T500' b.day4.003.cam.h1.0001-01-01-00000.nc T750-T500.nc
```



Exercise Overview



- **Exercise 1: Namelist modification**
Customize your history output
- **Exercise 2: Code modification**
Change a tuning parameter
- **Exercise 3: Namelist + Code modification**
Add a new output field to the code



Where to find help ?

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

CESM Models Home » CESM Models » CESM1.2 Series Public Release

CESM1.2 SERIES PUBLIC RELEASE

ABOUT THIS RELEASE SERIES

The CESM1.2 release has numerous new key features among which are the addition of CLM4.5, new science changes to CAM5 running with the CAM-SE dynamical core, and new scripting infrastructure for the generation of component sets, grids and model testing.

CESM1.2 SERIES RELEASE NOTES

Please read the [CESM1.2 Series Release Notes](#) which includes What's New - Science, What's New - Software, Answer-Changing Features, Supported Machines, and Known Problems. The new scripting infrastructure is described in detail in the [CESM1.2 User's Guide](#).

SCIENTIFIC VALIDATION

Scientific validation consists of a multi-decadal model run of the given component set at the target resolution, followed by scientific review of the model output diagnostics. All scientifically supported component sets are also accompanied by diagnostic and model output data. Validated CESM1.2 model results and diagnostics will be added to the CESM1.2 website as they become available.

What version of the model should I use?

For a scientifically supported target component set and resolution, please refer to the [Scientifically Validated Configurations](#) for that target configuration. For component sets and resolutions that are not scientifically validated in any supported release (e.g. cesm1.0.5 and cesm1.1.1), CSEG strongly urges you to use the latest model release (in this case cesm1.2.0).

DIAGNOSTIC PACKAGES AND NAMING CONVENTIONS

- Post Processing Utilities
- Model File Naming Conventions
- Experiment Case Naming Conventions

MODEL DOCUMENTATION

- CESM1.2**
 - User's Guide
 - Machines, Resolutions, Component sets
 - Model Component NameLists
 - \$CASEROOT vml files
- Atmosphere Models**
 - Community Atmosphere Model (CAM, CAM3, CAM3.0, CAM5)
 - Climatological Data Model (CDM)
- Land Models**
 - Community Land Model (CLM, CLM3)
 - Climatological Data Model (CDM)
- Sea Ice Models**
 - Community Ice Code (CICE)
 - Climatological Ice Model (CIM)
- Coupler**
 - CESM Coupler (CPL)
- Ocean Models**
 - Parallel Ocean Program (POP, POP2, POP3)
 - Climatological/Slab-Ocean Data Model (COSM)
- Land Ice Models**
 - Community Ice Sheet Model (CISM, CISM3)
- River Models**
 - River Transport Model (RTM)
 - Climatological River Runoff Model (CRRM)

CESM PROJECT

The Community Earth System Model (CESM) is a fully-coupled, global climate model that provides state-of-the-art computer simulations of the Earth's past, present, and future climate states.

CESM is sponsored by the National Science Foundation (NSF) and the U.S. Department of Energy (DOE). Administration of the CESM is maintained by the climate and Global Dynamics Division (CGD) at the National Center for Atmospheric Research (NCAR).

MODEL SOURCE CODE

Copyright and Terms of Use

All CESM source code is subject to the following [Copyright Notice and Disclaimer](#).

Acquiring the Release Code

The source code for CESM releases is distributed through a public Subversion code repository. This code can be checked out using Subversion client software, such as TortoiseSVN, or simply view the latest version with a web browser.

A short registration is required to access the repository. After registering, you will receive an email containing a user name and password that is necessary to gain access to the repository.

Acquisition of the code is more fully described in the most recent version of the [CESM1.2 User's Guide](#).

REPORTING A PROBLEM

If you have any problems, please first read the User's Guide including the sections on FAQs and Use Cases. Please also refer to the [CESM Bulletin Board](#), which is a place to facilitate communication within the CESM community. Finally, please also refer to the [Release Notes](#) entries that are provided with every release and release update. If questions or problems still exist, then please send an email to cesm-help@cd.ucar.edu. Support questions will be answered as resources are available.

CESM SUPPORT POLICY

CESM Support Policy - November 2012

CESM DATA MANAGEMENT & DISTRIBUTION PLAN

The Community Earth System Model (CESM) Data Management and Data Distribution Plan documents the procedures for the storage and

CESM webpage is a gold mine for model documentation

If you cannot find an answer in the model documentation, post your question on the CESM Bulletin Board

Where to find help ?

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

CESM Models Home » CESM Models » CESM1.2 Series Public Release

CESM1.2 SERIES PUBLIC RELEASE

ABOUT THIS RELEASE SERIES

The CESM1.2 release has numerous new key features among which are the addition of CLM4.5, new science changes to CAM5 running with the CAM-SE dynamical core, and new scripting infrastructure for the generation of component sets, grids and model testing.

CESM1.2 SERIES RELEASE NOTES

Please read the [CESM1.2 Series Release Notes](#) which includes What's New - Science, What's New - Software, Answer-Changing Features, Supported Machines, and Known Problems. The new scripting infrastructure is described in detail in the [CESM1.2 User's Guide](#).

SCIENTIFIC VALIDATION

Scientific validation consists of a multi-decadal model run of the given component set at the target resolution, followed by scientific review of the model output diagnostics. All scientifically supported component sets are also accompanied by diagnostic and model output data. Validated CESM1.2 model results and diagnostics will be added to the CESM1.2 website as they become available.

What version of the model should I use?

For a scientifically supported target component set and resolution, please refer to the [Scientifically Validated Configurations](#) for that target configuration. For component sets and resolutions that are not scientifically validated in any supported release (e.g. cesm1.0.5 and cesm1.1.1), CSEG strongly urges you to use the latest model release (in this case cesm1.2.0).

DIAGNOSTIC PACKAGES AND NAMING CONVENTIONS

- Post Processing Utilities
- Model File Naming Conventions
- Experiment Case Naming Conventions

MODEL DOCUMENTATION

- CESM1.2**
 - User's Guide
 - Machines, Resolutions, Component sets
 - Model Component Nomenclature
 - \$CASEROOT vml files
- Atmosphere Models**
 - Community Atmosphere Model (CAM, cam, cam2, cam3)
 - Climatological Data Model (cdm)
- Land Models**
 - Community Land Model (CLM4, clm4)
 - Climatological Data Model (cdm)
- Sea Ice Models**
 - Community Ice Code (cice)
 - Climatological Ice Model (cic)
- Coupler**
 - CESM Coupler (CPL)
- Ocean Models**
 - Parallel Ocean Program (pop, pop2, pop3)
 - Climatological/Slab-Ocean Data Model (coso)
- Land Ice Models**
 - Community Ice Sheet Model (cism, cism2)
- River Models**
 - River Transport Model (rtm)
 - Climatological River Runoff Model (crrm)

CESM PROJECT

The Community Earth System Model (CESM) is a fully-coupled, global climate model that provides state-of-the-art computer simulations of the Earth's past, present, and future climate states.

CESM is sponsored by the National Science Foundation (NSF) and the U.S. Department of Energy (DOE). Administration of the CESM is maintained by the climate and Global Dynamics Division (CGD) at the National Center for Atmospheric Research (NCAR).

MODEL SOURCE CODE

Copyright and Terms of Use

All CESM source code is subject to the following [Copyright Notice and Disclaimer](#).

Acquiring the Release Code

The source code for CESM releases is distributed through a public Subversion code repository. This code can be checked out using Subversion client software, such as the command tool svn, or simply view the [latest version with a web browser](#).

A short [registration](#) is required to access the repository. After registering, you will receive an email containing a user name and password that is necessary to gain access to the repository.

Acquisition of the code is more fully described in the most recent version of the [CESM1.2 User's Guide](#).

REPORTING A PROBLEM

If you have any problem, please first read the User's Guide including the sections on FAQs and Use Cases. Please also refer to the [CESM Bulletin Board](#), which is in place to facilitate communication within the CESM community. Finally, please also refer to the [Release Notes](#) entries that are provided with every release and update. If questions or problems still exist, then please send an email to cesm-help@cd.ucar.edu. Support questions will be answered as resources are available.

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The **CESM Bulletin Board** is a forum to ask your questions and to facilitate communication within the CESM community

About FAQ Contact Us

COMMUNITY Earth System MODEL

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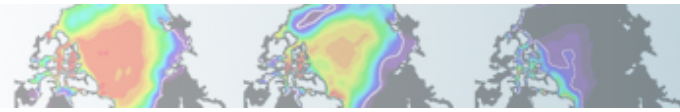
FORUMS

View Forums Active topics Unanswered topics

CESM - General

The Community Earth System Model (CESM) is a fully coupled, global climate model that provides state-of-the-art computer simulations of the Earth's past, present, and future climate states.

Forum	Topics	Posts	Last post
Announcements	19	46	CESM1.1.2 Release Announcement by aliceb July 30, 2013 - 11:07am
Bug reporting	120	335	Error in executing CESM 1.2.0 TBS_gx1v6 compset B_2000 by yliouc@... August 6, 2013 - 2:16am
Input Data inquiries	113	269	F_2000 compset SST data by torbenmlr@... 20 hours 22 min ago
Output Data inquiries	89	210	Difference between SNOTTOPFL and TG in CLM history output (CLM4.0)? by fyke@... August 5, 2013 - 2:43pm
Tools	4	15	-grid_file equivalent for CESM1.3 (-user_grid_file)? by erik July 25, 2013 - 9:52pm
Software Development	188	563	CESM 1.0.4 run failed when initializing Ind component by jedwards 1 day 19 hours ago
General Discussion	209	546	basic example by jedwards August 6, 2013 - 2:59pm
Subversion Issues	11	24	CESM4 on yellowstone by jedwards August 5, 2013 - 11:44am
Tutorials	5	13	Basic B_1850 Compilation by sstrey2@... June 4, 2013 - 9:10am



Part 3: Quiz

During the lab, you will receive a quiz with 6 questions about what you have learned during the practicals this week.

One quiz per person. Please write your name, email and institution at the top of the page.

To answer the questions, you can use documentation, ask questions to others.

If you cannot complete the quiz by the end of the day, you can return it on Friday.



U.S. DEPARTMENT OF
ENERGY

Office of
Science

Reminder: Rules for compiling



During the tutorial (this week only)

Yellowstone can only handle a certain number compilations at the same time. If too many students compile at the same time, the machine will hang. Compilation time will increase from 10 minutes to 2+ hours.

We have determined how many compilations the machine can handle. This is the reason of the “compile cards”.

**Please don't compile if you don't have a compile card.
In a team of two, only one person can compile at a time.
Please respect the rule (if you don't you penalize not only yourself but everybody in the room and all the yellowstone users over the country)**