

# Namelist and Code Modifications

**Part 1: Namelist Modifications**

**Part 2: Code Modifications**

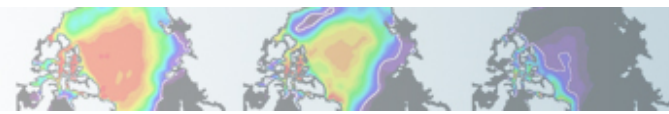
**Part 3: Quiz**

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



U.S. DEPARTMENT OF  
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## 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 namelists variables
- as an illustration, we will customize the output history files to get high frequency output



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Science

# 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_0.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
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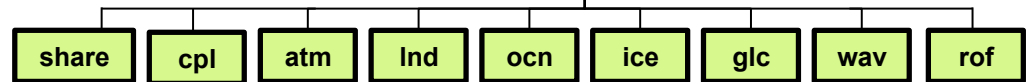
# (3) build the executable
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./case01.submit
```

# Overview of CESM directories + 4 CESM commands

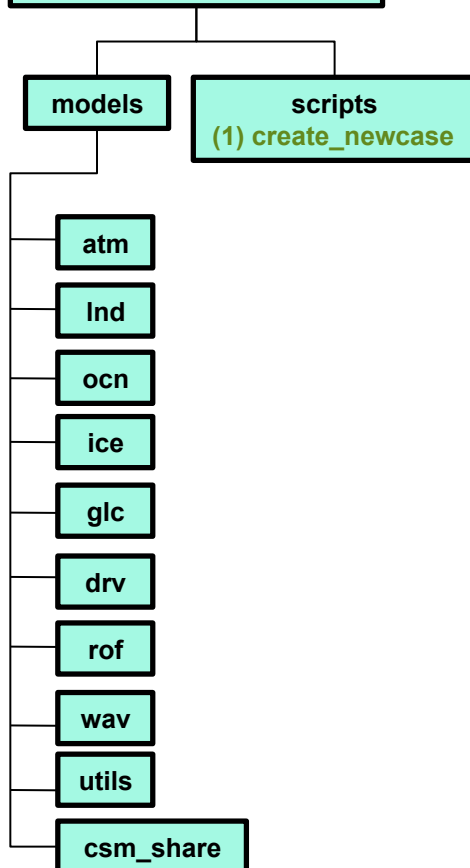
## INPUTDATA Directory

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



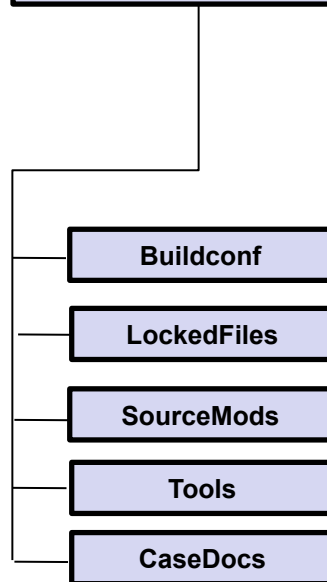
## CESM Code

`/path_to_code/cesm1_2_0`  
`$CCSMROOT`



## CASE Directory

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



## Build/Run Directory

`/glade/scratch/  
userx/ case01`  
`$EXEROOT`

```

graph TD
    A["Build/Run Directory  
/glade/scratch/  
userx/ case01  
$EXEROOT"] --> B[bld]
    A --> C["run  
$RUNDIR"]
  
```

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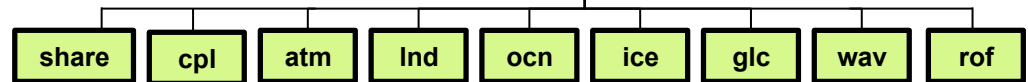
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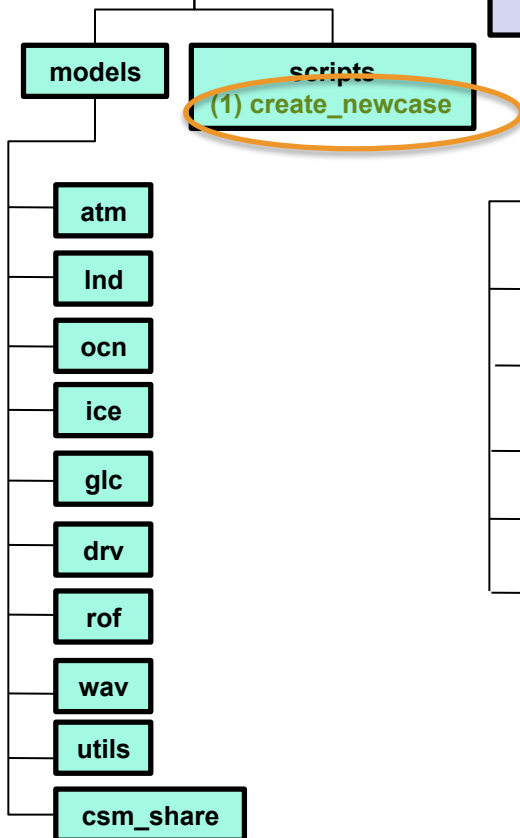
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/glade/p/cesm/cseg/inputdata  
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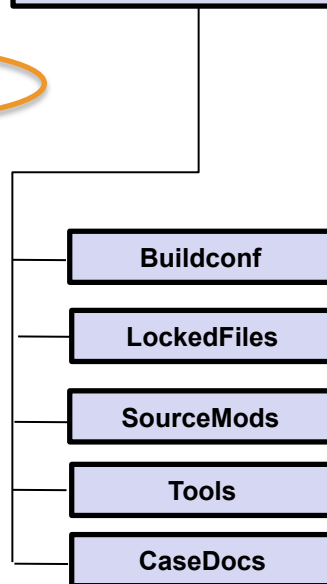
## CESM Code

/path\_to\_code/cesm1\_2\_0  
\$CCSMROOT



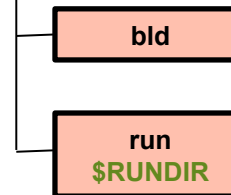
## CASE Directory

~/cases/case01  
(2) cesm\_setup  
(3) case01.build  
(4) case01.submit



## Build/Run Directory

/glade/scratch/  
userx/ case01  
\$EXERROOT



```

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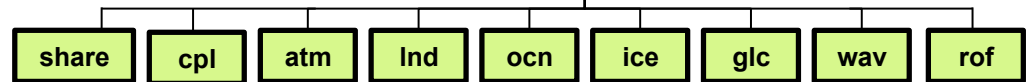
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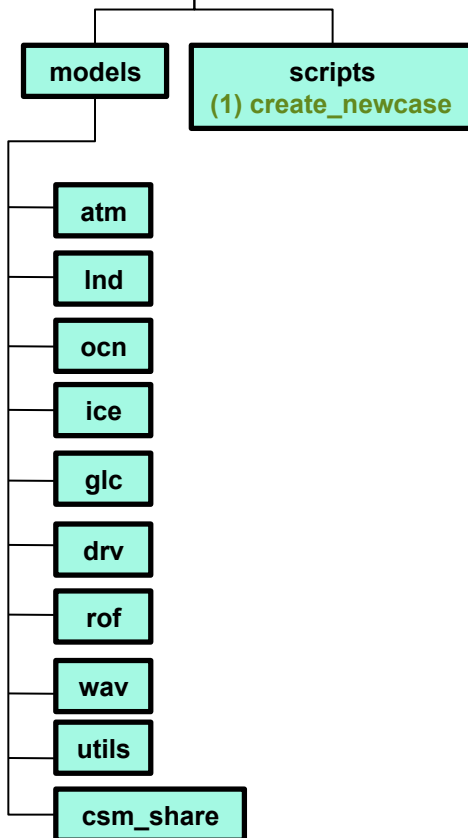
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`/glade/p/cesm/cseg/inputdata`  
`$DIN_LOC_ROOT`



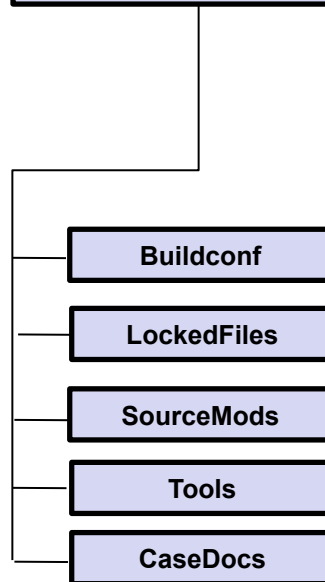
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## CASE Directory

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## Build/Run Directory

`/glade/scratch/  
userx/ case01`  
`$EXERROOT`

```

graph TD
    A["Build/Run Directory  
/glade/scratch/  
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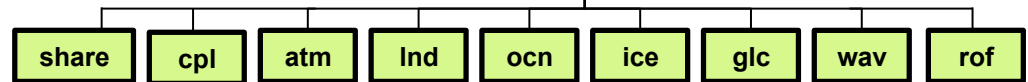
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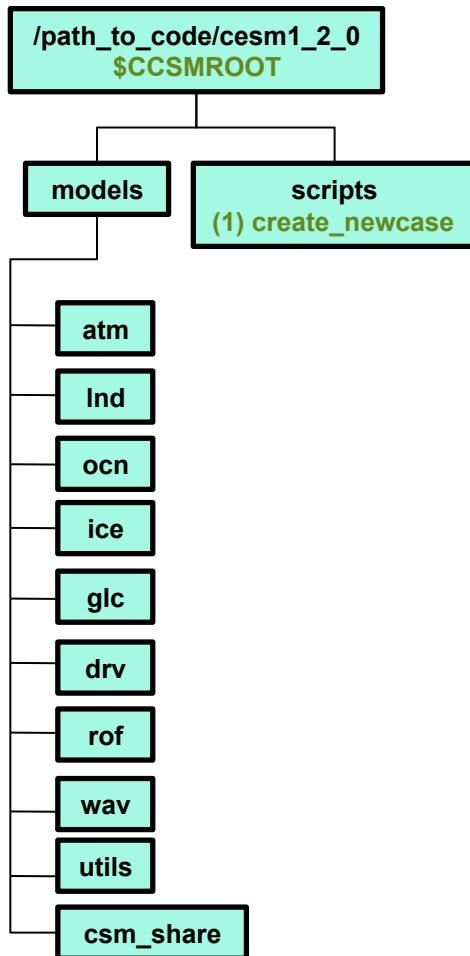
# Overview of CESM directories + 4 CESM commands

## INPUTDATA Directory

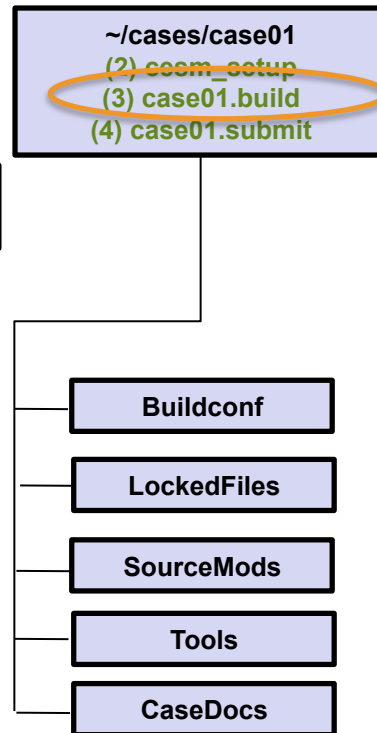
/glade/p/cesm/cseg/inputdata  
\$DIN\_LOC\_ROOT



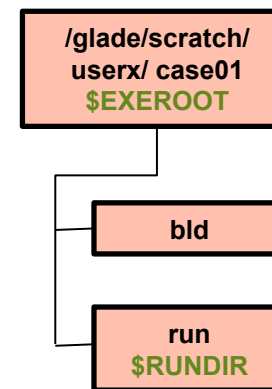
## CESM Code



## CASE Directory



## Build/Run Directory



```

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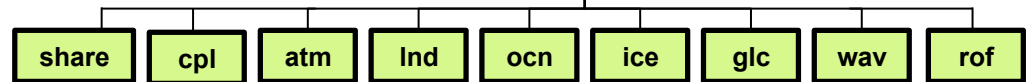
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./case01.submit
  
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# Overview of CESM directories + 4 CESM commands

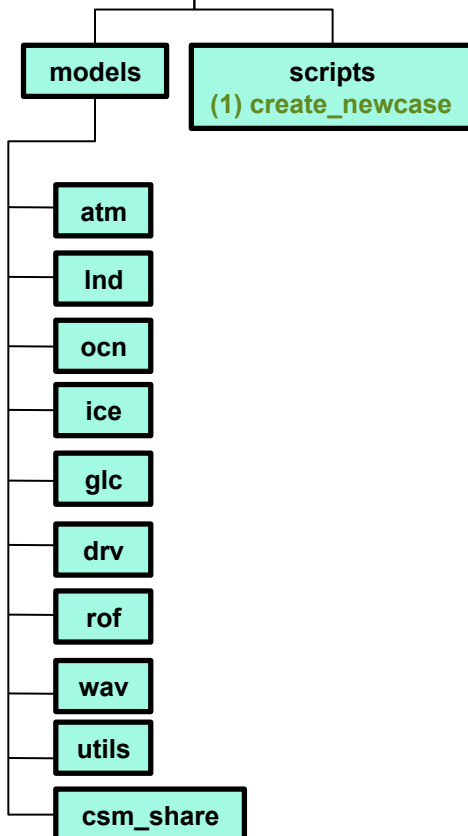
## INPUTDATA Directory

/glade/p/cesm/cseg/inputdata  
\$DIN\_LOC\_ROOT



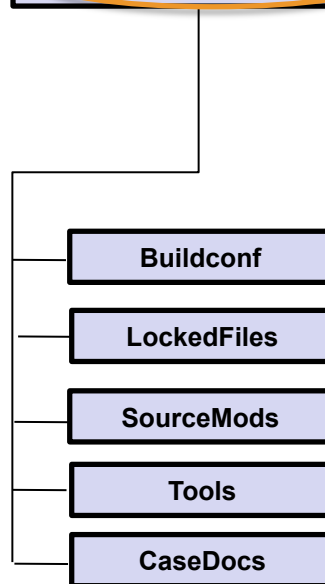
## CESM Code

/path\_to\_code/cesm1\_2\_0  
\$CCSMROOT



## CASE Directory

~/cases/case01  
(2) cesm\_setup  
(3) case01\_build  
(4) case01.submit



## Build/Run Directory

/glade/scratch/  
userx/ case01  
\$EXEROOT

bld

run  
\$RUNDIR

```

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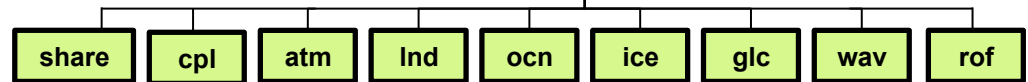
# (4) submit your run to the batch queue
./case01.submit
  
```



# Overview of CESM directories + 4 CESM commands

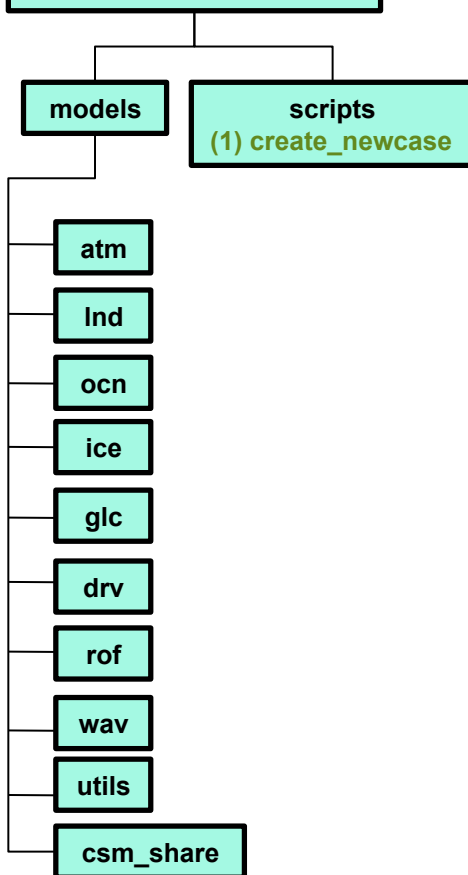
## INPUTDATA Directory

/glade/p/cesm/cseg/inputdata  
\$DIN\_LOC\_ROOT



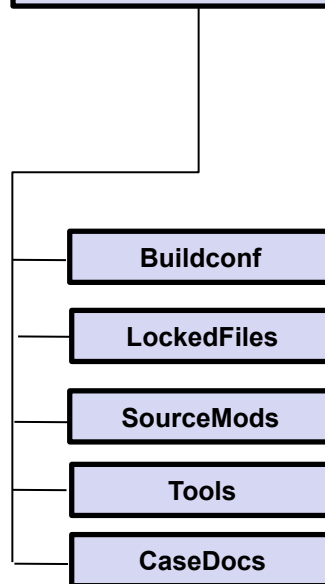
## CESM Code

/path\_to\_code/cesm1\_2\_0  
\$CCSMROOT



## CASE Directory

~/cases/case01  
(2) cesm\_setup  
(3) case01.build  
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## Build/Run Directory

/glade/scratch/  
userx/ case01  
\$EXERROOT

```

graph TD
    A["Build/Run Directory  
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# go into the case you just created in the last step
cd ~/cases/case01/

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

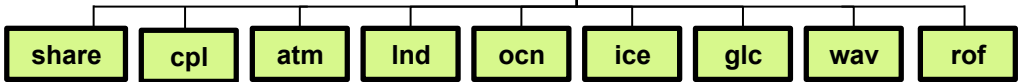
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# (4) submit your run to the batch queue
./case01.submit
  
```

# Overview of CESM directories + namelist files

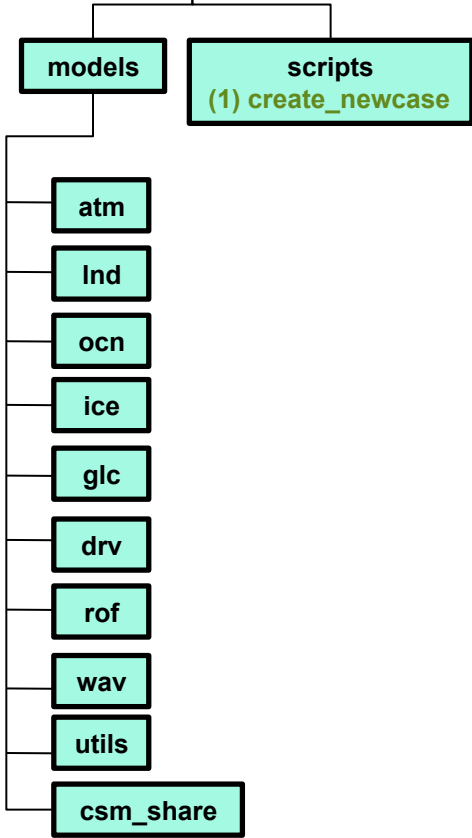
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## CESM Code

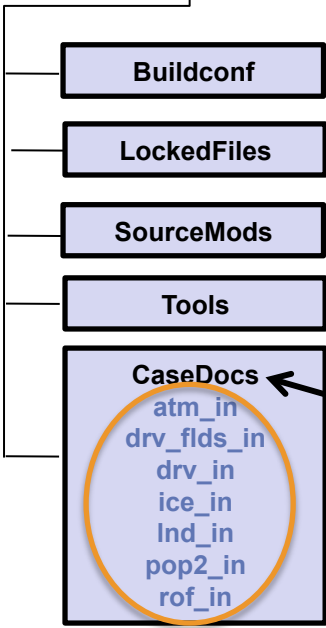
/path\_to\_code/cesm1\_2\_0  
\$CCSMROOT



## 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

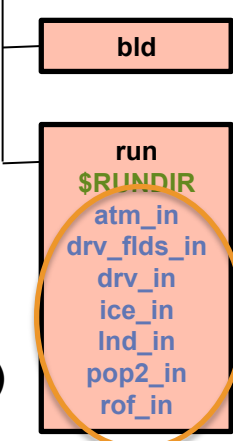
cesm\_setup creates namelist modification files user\_nl\_XXX this is where you modify your namelists



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

## Build/Run Directory

/glade/scratch/userx/case01  
\$EXERROOT



The build script creates namelists in the run directory

# Where to find info about namelists ?

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

The screenshot shows the CESM Models website with a search bar at the top right. The main navigation bar includes 'CESM Models' and 'Home » CESM Models » CESM1.2 Series Public Release'. The page is titled 'CESM1.2 SERIES PUBLIC RELEASE' and contains several sections: '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 'MODEL DOCUMENTATION' section features a navigation menu with 'Model Component Namelists' highlighted. Below this menu is a map of the United States with a red arrow pointing to the 'Model Component Namelists' link. At the bottom, there are three thumbnails for 'Atmosphere Models', 'Land Models', and 'Sea Ice Models'. On the right side of the page, there are three informational boxes: 'CESM PROJECT', 'MODEL SOURCE CODE', and 'REPORTING A PROBLEM'. The 'MODEL SOURCE CODE' box contains a sub-section 'Acquiring the Release Code' which states that a registration is required to access the repository and that an email containing a user name and password is necessary for access.

**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

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

### 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/>

The image shows a screenshot of the CESM Models website. The main page is titled "CESM Models" and features a navigation menu. A prominent orange arrow points from the "Model Component Namelists" link in the left sidebar to the "PROGNOSTIC COMPONENTS NAMELIST DEFINITIONS" section on the right. A callout box with the text "Information about namelist variables" is positioned over the "CAM5.3 Namelists" link in this section.

**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 What's 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 model at the target 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 web site.

**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](#)

**CESM Models**

**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**

Atmosphere Models | Land Models

Please also refer to the [CESM](#)

# Where to find info about namelists ?

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The image shows a screenshot of the CESM Models website. On the left, there is a navigation menu with sections like '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 'MODEL DOCUMENTATION' section includes links for 'User's Guide', 'Machines, Resolutions, Component sets', 'Model Component Namelists', and '\$CASEROOT xml files'. Below this are thumbnails for 'Atmosphere Models' and 'Land Models'. 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 '\$CASEROOT XML FILES' section to a search interface on the right. The search interface is titled 'Search or Browse CAM Component Model Namelist Variables' and contains a search box, radio buttons for 'AND' and 'OR', and a 'Show All' button. Below the search interface are three tables of namelist variables, each with a header row for 'Namelist Variable', 'Type', and 'Group'. The tables are categorized by 'CAM: VOC Emissions', 'CAM: Species - Aerosol - Prescribed (CAM3 version)', and 'CAM: Chemistry - CAM-CHEM and WACCM'.

## 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

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#### DIAGNOSTIC PACKAGES AND NAMING CONVENTIONS

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

#### MODEL DOCUMENTATION

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

## CESM1.2 MODEL COMPONENTS

### CREATE\_NEWCASE FILES (SUPPORTED MACHINES)

- [Available Machines \(config\\_machines.xml\)](#)
- [Available Grids \(config\\_grid.xml\)](#)
- [Available Component Sets \(config\\_component\\_sets.xml\)](#)

### \$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

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- [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  Show All Variable Names

AND  OR (separate search terms with spaces)

Also search help text

Show All

### Search or browse variables names

#### CAM: VOC Emissions

Namelist Variable	Type	Group
▶ <a href="#">megan_factors_file</a>	char*256	megan_emis_nl
▶ <a href="#">megan_mapped_emisfctra</a>	logical	megan_emis_nl
▶ <a href="#">megan_specifier</a>	char*1024(100)	megan_emis_nl

#### CAM: Species - Aerosol - Prescribed (CAM3 version)

Namelist Variable	Type	Group
▶ <a href="#">bndtvaer</a>	char*256	cam3_aero_data_nl
▶ <a href="#">cam3_aero_data_on</a>	logical	cam3_aero_data_nl

#### CAM: Chemistry - CAM-CHEM and WACCM

Namelist Variable	Type	Group
▶ <a href="#">aer_drydep_list</a>	char*16(1000)	chem_inparm
▶ <a href="#">aer_wetdep_list</a>	char*16(1000)	chem_inparm
▶ <a href="#">aerodep_fix_cycle_yr</a>	integer	aerodep_fix_nl
▶ <a href="#">aerodep_fix_datapath</a>	char*256	aerodep_fix_nl
▶ <a href="#">aerodep_fix_file</a>	char*256	aerodep_fix_nl
▶ <a href="#">aerodep_fix_filelist</a>	char*256	aerodep_fix_nl
▶ <a href="#">aerodep_fix_fixed_tod</a>	integer	aerodep_fix_nl
▶ <a href="#">aerodep_fix_fixed_ynd</a>	integer	aerodep_fix_nl
▶ <a href="#">aerodep_fix_rmfile</a>	logical	aerodep_fix_nl
▶ <a href="#">aerodep_fix_specifier</a>	char*32(22)	aerodep_fix_nl
▶ <a href="#">aerodep_fix_type</a>	char*32	aerodep_fix_nl
▶ <a href="#">aircraft_specifier</a>	char*256(100)	aircraft_emit_nl

# Where to find info about namelists ?

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

## 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



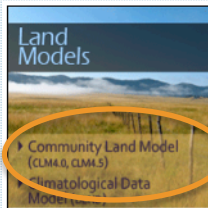
**Atmosphere Models**

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



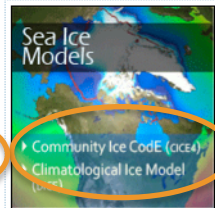
**Land Models**

- ▶ Community Land Model (CLM4.0, CLM4.5)
- ▶ Climatological Data Model (ccsm)



**Sea Ice Models**

- ▶ Community Ice Code (cice4)
- ▶ Climatological Ice Model (cism)



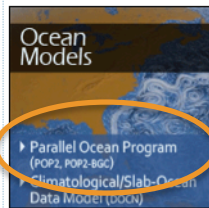
**Coupler**

- ▶ CESM Coupler (CPL7)



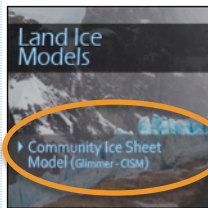
**Ocean Models**

- ▶ Parallel Ocean Program (POP2, POP2-89c)
- ▶ Climatological/Slab-Ocean Data Model (ccsm)



**Land Ice Models**

- ▶ Community Ice Sheet Model (Glimmer - CISM)



**River Models**

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



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

# 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.

nhtfrq

- 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) &gt; 0</code>, frequency is specified as number of timesteps. If <code>nhtfrq(i) &lt; 0</code>, frequency is specified as number of hours.</p> <p>Default: 0,-24,-24,-24,-24,-24</p>	integer(6)	cam_inparm

How to set it

daily average: `nhtfrq=-24`

type

Namelist group



# 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](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'  
nhtfrq = 0, -3
```

Notice that it is equivalent to:

```
fincl2 = 'T:I','Q:I','U:I','V:I','OMEGA:I'  
nhtfrq(1) = 0  
nhtfrq(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](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

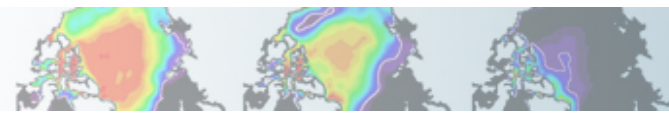
**tavg\_file\_freq\_opt** = 'nmonth'

**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**



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

# 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 leading to his "escape" from the Matrix 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*

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

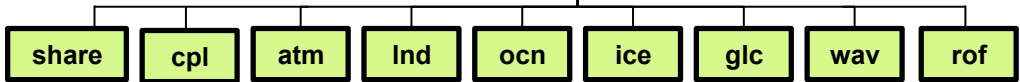


# Principles for modifying the code

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

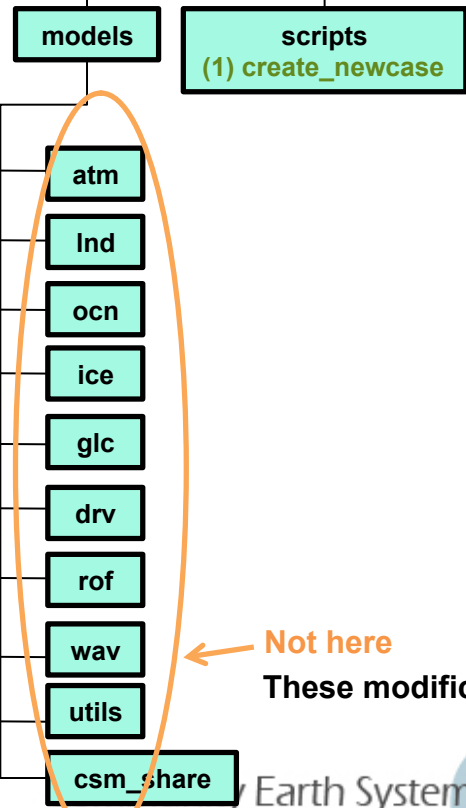
## INPUTDATA Directory

/glade/p/cesm/cseg/inputdata  
 \$DIN\_LOC\_ROOT



## CESM Code

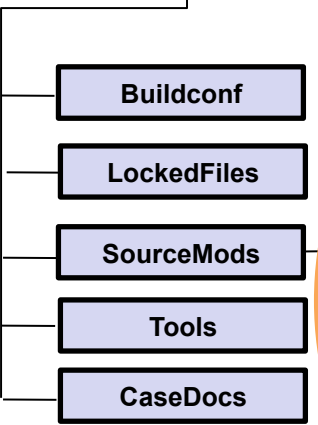
/path\_to\_code/cesm1\_2\_0  
 \$CCSMROOT



Not here  
 These modifications affect all the cases

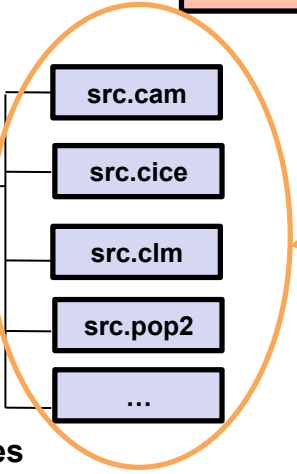
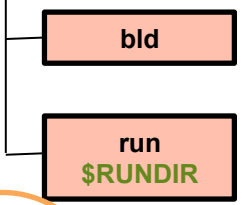
## CASE Directory

~/cases/case01  
 (2) cesm\_setup  
 (3) case01.build  
 (4) case01.submit



## Build/Run Directory

/glade/scratch/  
 userx/ case01  
 \$EXERROOT



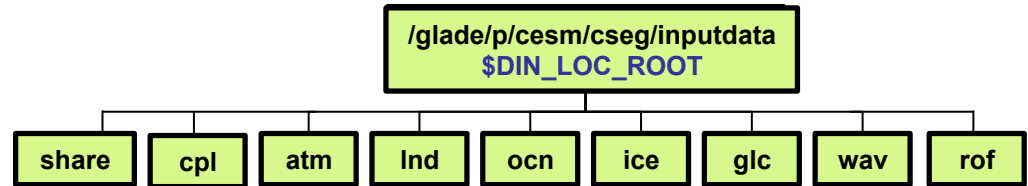
This is where you put your modifications  
 These modifications only affect the current case



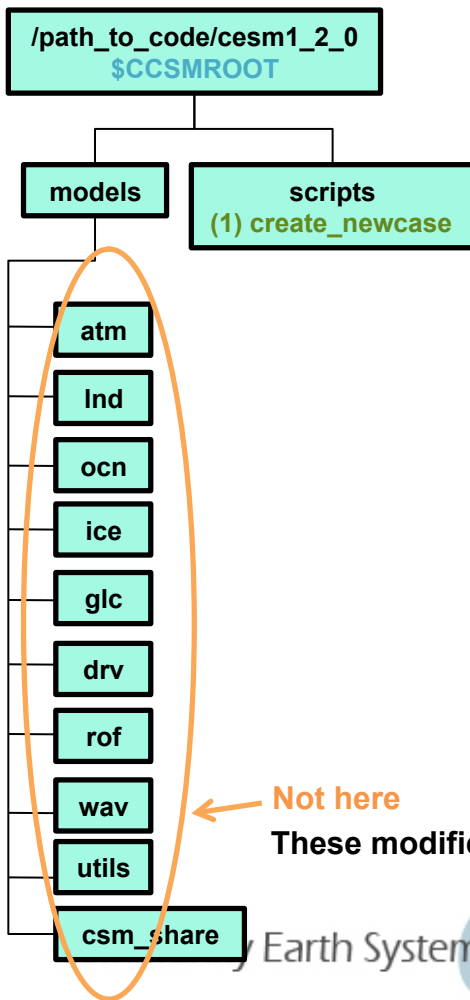
# Principles for modifying the code

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

## INPUTDATA Directory



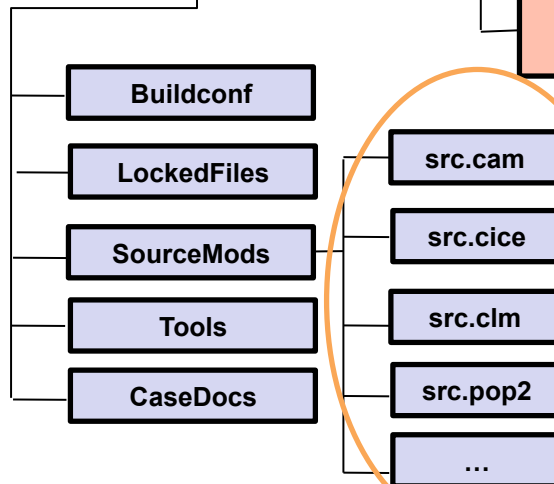
## CESM Code



## CASE Directory

```

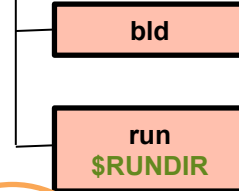
    ~/cases/case01
    (2) cesm_setup
    (3) case01.build
    (4) case01.submit
  
```



## Build/Run Directory

```

    /glade/scratch/
    userx/ case01
    $EXERROOT
  
```



```

    # go into scripts directory
    cd /glade/p/cesm/tutorial/cesm1_2_0.tutorial/scripts

    # (1) create a new case
    ./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
  
```

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/$user/archive/b.day4.002/Ind/hist/b.day4.002.clm2.h0.0001-01.nc /glade/scratch/$user/archive/b.day4.001/Ind/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)

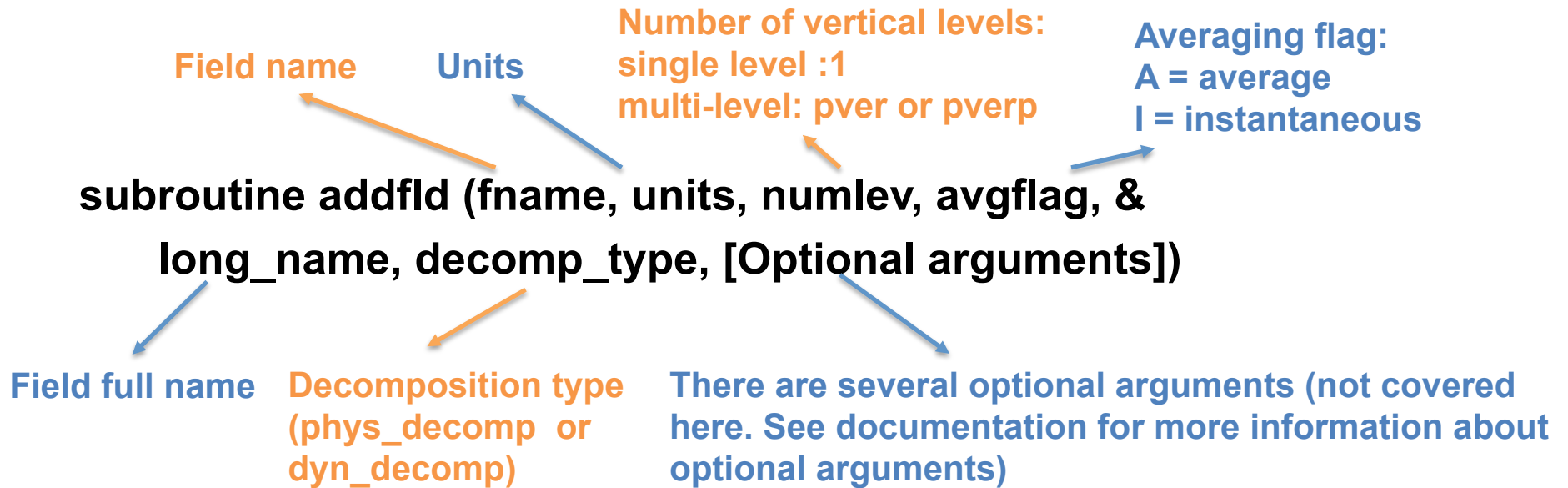
*call outfld('T750', ... )*

→ Collect values for this field and write to history file



# Syntax: addfld

**addfld = Add a field to master field list**



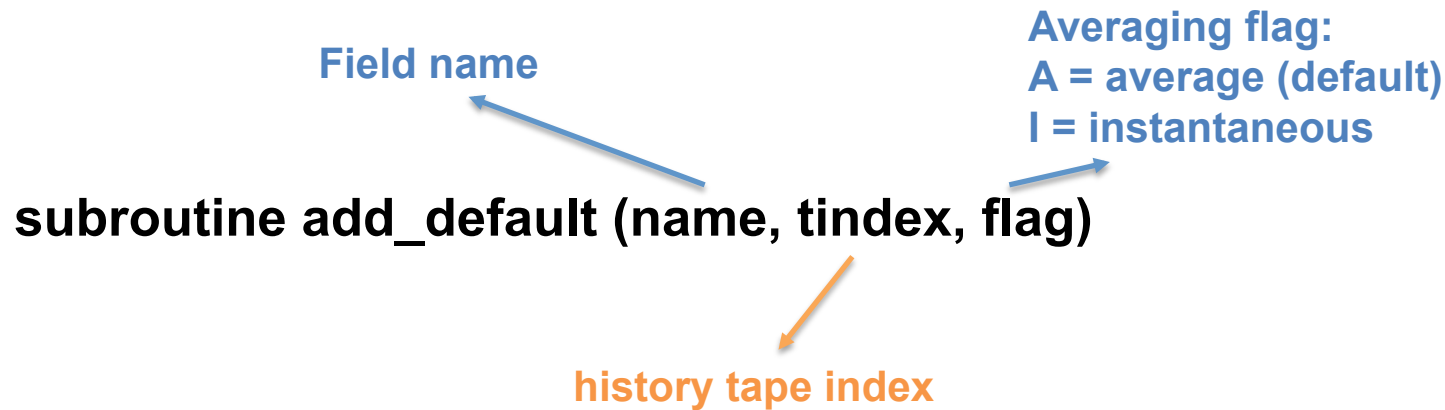
**Example:**

*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**



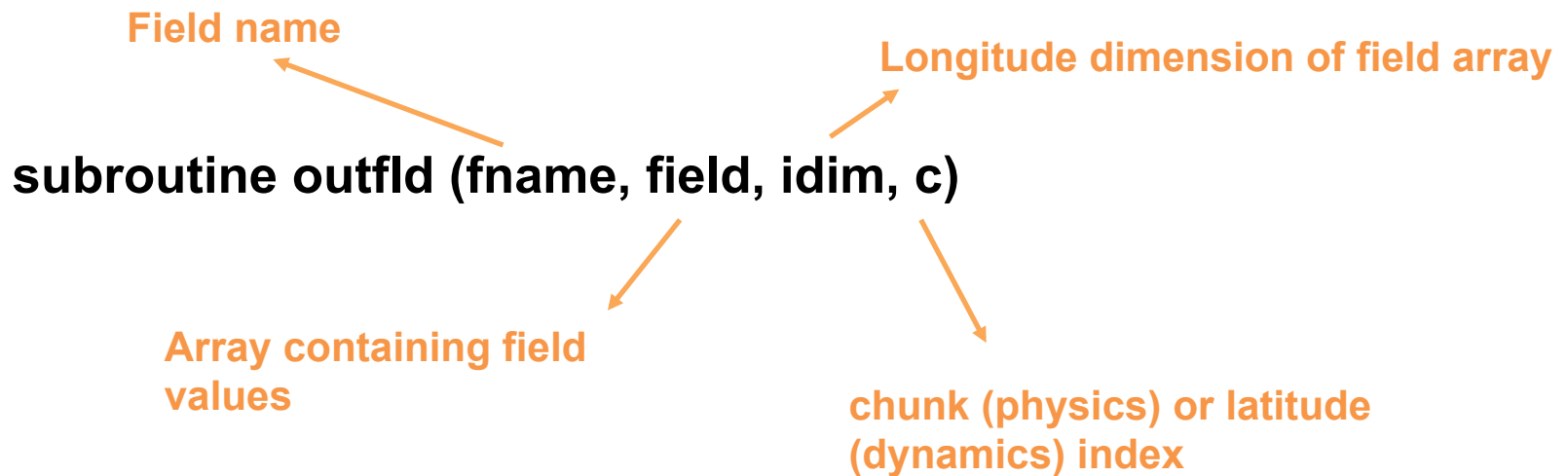
**Example:**

```
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/>

The screenshot shows the CESM Models website with the following 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
      - SCASEROOT xml files
    - Atmosphere Models**
      - Community Atmosphere Model (CAM, cam, cam2, cam3, cam5)
      - Climatological Data Model (ccsm)
    - Land Models**
      - Community Land Model (CLM4, CLM4.5)
      - Climatological Data Model (ccsm)
    - Sea Ice Models**
      - Community Ice CoE (cice)
      - Climatological Ice Model (cice)
    - Coupler**
      - CESM Coupler (CPL7)
    - Ocean Models**
      - Parallel Ocean Program (POP2, POP2.860)
      - Climatological Slab-Ocean Data Model (ccsm)
    - Land Ice Models**
      - Community Ice Sheet Model (cism)
    - River Models**
      - River Transport Model (rtm)
      - Climatological River Runoff Model (ccsm)
- 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, or operation as environment 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 User 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 release update. If questions or problems still exist, then please send an email to cesm-help@cgd.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 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 Namelists
  - \$CASEROOT xml files
- Atmosphere Models**
  - Community Atmosphere Model (CAM, cam, csm4, wcam)
  - Climatological Data Model (cdm)
- Land Models**
  - Community Land Model (CLM4.5, CLM4.5)
  - Climatological Data Model (cdm)
- Sea Ice Models**
  - Community Ice CoE (cice)
  - Climatological Ice Model (cice)
- Coupler**
  - CESM Coupler (CPL7)
- Ocean Models**
  - Parallel Ocean Program (POP, POP2, POP3)
  - Climatological Slab-Ocean Data Model (csom)
- Land Ice Models**
  - Community Ice Sheet Model (cism) - cism
- River Models**
  - River Transport Model (rtm)
  - Climatological River Runoff Model (crrm)

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

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**NCAR** DiscussCESM **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	CESM1.2 Release Announcement by aliceb July 30, 2013 - 11:07am	
Bug reporting	120	335	Error in executing CESM 1.2.0 T85_gx1v6 compset B_2000 by yll_ouc@... 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 SNOTTOPL and TG in CLM history output (CLM4.0)? by fyeke@... 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	Includes issues for building/running on supported machines and porting to unsupported machines	188	563	CESM 1.0.4 run failed when initializing lnd component by jedwards 1 day 19 hours ago
General Discussion	Includes requests for new features and configuration inquiries	209	546	basic example by jedwards August 6, 2013 - 2:59pm
Subversion Issues	Forum for issues related to the new version control system	11	24	CCSM4 on yellowstone by jedwards August 5, 2013 - 11:44am
Tutorials	For discussion regarding the web based modeling 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.**



# 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)**

