

# CESM Tutorial

**NCAR Climate and Global Dynamics Laboratory**

**CESM 1.2.x and CESM1.1.x**

**CESM1.0.x and previous (see earlier tutorials)**

NCAR is sponsored by the National Science Foundation



# Outline

- **The CESM webpage**
- **Software & Hardware Requirements**
- **One-Time Setup**
- **Creating & Running a Case**
- **Getting More Help**

# CESM Web Page

<http://www2.cesm.ucar.edu>

[Home](#) [About](#) [Administration](#) [Working Groups](#) [Models](#) [Events](#) [Publications](#) [Projects](#)



*earth • modeling • climate*

Search

## 2015 CESM TUTORIAL



### CESM EXPERIMENTS

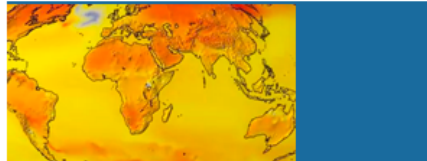


[CESM Experiments](#)

[CMIP6](#)

[IPCC Experiments](#)

### CESM RELEASES



[CESM Supported Releases](#)

[CESM Scientifically Validated Configurations](#)

[CESM Legacy Models](#)

### ANNOUNCEMENTS & EVENTS



[20th Annual CESM Workshop, 15-18 June 2015, Breckenridge, CO](#)

[CESM Tutorial, 10-14 August 2015, Boulder, CO](#)

### CESM GOVERNANCE



[SSC | Scientific Steering Committee](#)

[CAB | CESM Advisory Board](#)

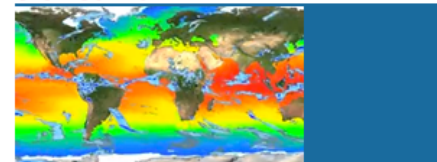
### CESM PROJECTS



[EaSM | Earth System Modeling](#)

[Climate Data Guide](#)

### CESM SUPPORT



[Bulletin Board](#)

[CESM Support Policy](#)

# CESM Web Page Models

<http://www.cesm.ucar.edu/models/current.html>

## CESM Models

Home » CESM Models » CESM Supported Releases

### CESM SUPPORTED RELEASES

You should use the most recent version of the model that is available unless you are trying to replicate previous results or create a branch run from a previous experiment. A complete list of [CESM scientifically validated configurations](#) is available for users needing to run the model in one of these configurations.

This table lists the most current supported CESM release versions.

Supported CESM Release Versions	
<a href="#">CESM1.2.z</a>	<a href="#">Release Notes</a> includes: What's New - Science, What's New - Software, Answer-Changing Features, Supported Machines, and Known Problems
<a href="#">CESM 1.1.z</a>	<a href="#">Notable Improvements</a>
<a href="#">CESM 1.0.z</a>	<a href="#">Notable Improvements</a>

### CESM MODEL VERSION NAMING CONVENTIONS

CESM X.Y.Z - CESM model release versions include three numbers separated by a dot (.) where:

- X - corresponds to the major release number indicating significant science changes.
- Y - corresponds to the addition of new infrastructure and new science capabilities for targeted components.
- Z - corresponds to release bug fixes and machine updates.

Each release includes the complete collection of component model source code, documentation, and input data. For model output data, see the [Experiments and Output Data](#) section of this website.

Users should read the [CESM Data Management & Distribution Plan](#) which documents the procedures

### CESM MODELS

- [Supported Releases](#)
- [Scientifically Validated Configurations](#)
- [CESM Development Project Policies & Terms of Use](#)
- [Acquiring the CESM Code](#)
- [CESM Support Policy](#)
- [CESM Data Management & Distribution Plan](#)
- [DiscussCESM Forums Bulletin Board](#)

### CESM LEGACY RELEASES

- [Older General/Run Info](#)

# CESM 1.2 Web Page

<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 (CAM5, CAM-CHM, WACCM)
- ▶ Climatological Data Model (CLM4)

**Land Models**

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

**Sea Ice Models**

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

**Coupler**

- ▶ CESM Coupler (CPL7)

**Ocean Models**

**Land Ice Models**

**River Models**

#### 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

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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 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@cdl.ucar.edu](mailto:cesm-help@cdl.ucar.edu). Support questions will be answered as resources are available.

#### CESM SUPPORT POLICY

CESM Support Policy - November 2012

#### CESM DATA MANAGEMENT

Release Notes



Scientific validation



Guidance on model versions



Post processing Tools



Model Documentation



← Background and Sponsors



← How to acquire the code



← Reporting problems Getting Help



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

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- ▶ Community Atmosphere Model (CAM5, CAM-OISM, WACCM)
- ▶ Climatological Data Model (cdm3)

**Land Models**

- ▶ Community Land Model (CLM4.0, CLM4.5)
- ▶ Climatological Data Model (cdm3)

**Sea Ice Models**

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

**Coupler**

- ▶ CESM Coupler (CPL7)

**Ocean Models**

- ▶ Parallel Ocean Program (POP2, POP2-86G)
- ▶ Climatological/Slab-Ocean Data Model (ocsv)

**Land Ice Models**

- ▶ Community Ice Sheet Model (Glimmer - CISM)

**River Models**

- ▶ River Transport Model (rtm)
- ▶ Climatological River Runoff Model (cror)

## EXTERNAL LIBRARY DOCUMENTATION

- [Parallel I/O Library \(PIO\)](#)
- [Model Coupling Toolkit \(MCT\)](#)
- [Earth System Modeling Framework \(ESMF\)](#)

## MODEL INPUT DATA

The input data necessary to run all supported component sets is made available from a public [Subversion input data repository](#). Note that the inputdata repository has much more data in it than you need to run CESM1.2 — **DO NOT attempt to svn checkout the whole input data repository**. The [CESM1.2 User's Guide](#) explains how to obtain the subset of input data required for your needs.

## PERFORMANCE AND LOAD BALANCING DATA

The timing table provides performance data that will continue to evolve due to changes in the model, machine hardware and input from the user community. For CESM1.2, please refer to the [CESM1.1.1 Timing Table](#).

Model Input data →

Timing and load balance →

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## 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 distribution of data associated with the CESM project.

← Data management and distribution

# Hardware/Software Requirements

- **Supported platforms**

CESM currently runs “**out of the box**” today on the following machines

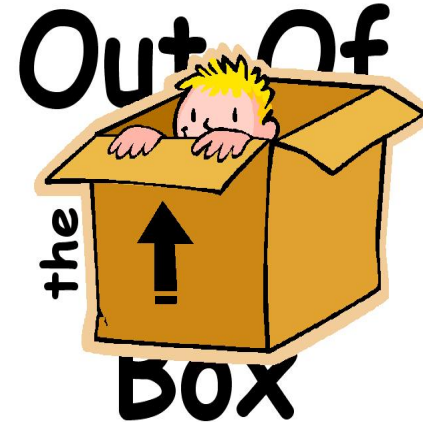
- **yellowstone** – NCAR IBM
- **edison / cori** – NERSC Cray XC
- **bluewaters** – NCSA Cray XE6
- **mira** – ANL IBM Bluegene/Q
- **pleiades** – NASA SGI ICE cluster
- and a few others

*Always review the model version release notes and DiscussCESM Forums for up-to-date machine specific issues.*

- **Running CESM on other platforms**

**Require porting + software**

- Subversion client (version 1.4.2 or greater)
- Fortran and C compilers (recommend pgi, intel, or ibm xlf compilers)
- NetCDF library (recommend netcdf4.1.3 or later)
- MPI (MPI1 is adequate, Open MPI or MPICH seem to work on Linux clusters)



*out of the box = works immediately after installation without any modification*

# Basic Work Flow

*(or how to set up and run an experiment)*

- **One-Time Setup Steps**



- (A) Registration**

- (B) Download the CESM code**

- (C) Create an Input Data Root Directory**

- (D) Porting**

- **Creating & Running a Case**

- (1) Create a New Case**

- (2) Invoke `cesm_setup`**

- (3) Build the Executable**

- (4) Run the Model and Output Data Flow**



# (A) Registration

- Go to CESM1.2 home page: <http://www.cesm.ucar.edu/models/cesm1.2/>

## CESM1.2 SERIES PUBLIC RELEASE

### ABOUT THIS RELEASE SERIES

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### DIAGNOSTIC PACKAGES AND NAMING CONVENTIONS

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

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- Machines, Resolutions, Component sets
- Model Component NameLists
- \$CASEROOT xml files

**Atmosphere Models**

- Community Atmosphere Model (CAM5, CAM-CHAM, WACM)
- Climatological Data Model (CLM)

**Land Models**

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

**Sea Ice Models**

- Community Ice Code (cice)
- Climatological Ice Model (CIM)

**Coupler**

- CESM Coupler (CPL7)

### CESM PROJECT

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### CESM SUPPORT POLICY

CESM Support Policy - November 2012

- Right hand column has a link to the registration page, click on it

Community Earth System Model

### CESM1.0 Release User Registration

Required Fields

Last Name:

First Name:

E-Mail:

Institution:

Purpose:

Valid special characters to use: period, hyphen, apostrophe, forward slash, colon, comma. No additional special characters are allowed.

(Maximum characters: 400. You have 400 characters left.)

Have you used previous versions of CCSM/CESM?  Yes  No

Publications using previous versions of CCSM/CESM:

If you have used previous versions of CCSM/CESM, please provide publications you have using the code. Valid special characters to use: period, hyphen, apostrophe, forward slash, colon, comma. No additional special characters are allowed.

(Maximum characters: 400. You have 400 characters left.)

Copyright and Terms of Use

The Community Earth System Model (CESM) was developed in cooperation with the National Science Foundation (NSF), the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), the University Corporation for Atmospheric Research (UCAR) and the National Center for Atmospheric Research (NCAR). Except for the copyrightable components listed in the copyright, CESM is public domain software. There are three party tools and libraries that are embedded and they are subject to their own copyright notices and terms.

Please read the Copyright and Terms of Use on the CESM1.0 release home page.

Agree to Terms\*  Yes  No

- Register -- you will be emailed a username and password

# Basic Work Flow

*(or how to set up and run an experiment)*

- **One-Time Setup Steps**

- (A) Registration



- (B) Download the CESM code

- (C) Create an Input Data Root Directory

- (D) Porting

- **Creating & Running a Case**

- (1) Create a New Case

- (2) Invoke `cesm_setup`

- (3) Build the Executable

- (4) Run the Model and Output Data Flow

## (B) Download the Source Code

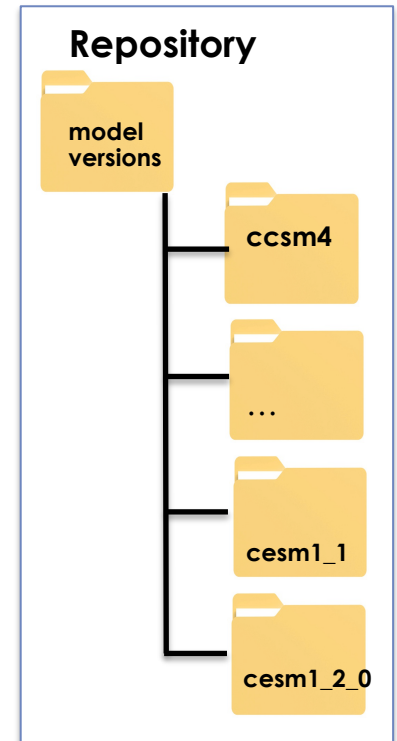
- Code and input datasets are in Subversion repositories (\*)

[https://svn-ccsm-release.cgd.ucar.edu/model\\_versions](https://svn-ccsm-release.cgd.ucar.edu/model_versions)

[https://svn-ccsm-models.cgd.ucar.edu/cesm1/release\\_tags](https://svn-ccsm-models.cgd.ucar.edu/cesm1/release_tags)

- List the versions available on the CESM repository

`svn list https://svn-ccsm-models.cgd.ucar.edu/cesm1/release_tags`



- Check out a working copy from the repository (“Download code”)

`svn co https://svn-ccsm-models.cgd.ucar.edu/cesm1/release_tags/cesm1_2_2`

(\*) You can get subversion at <http://subversion.apache.org/>

## An Important Note about Downloading the Model Code

<https://bb.cgd.ucar.edu/googlecode-repositories-are-offline-pio-source-not-found>

Affected Releases CESM1.0.z

Affected Releases CESM1.1.z

Affected Releases CESM1.2.z

Googlecode repositories are now off line and the pio and genf90 components of older CESM versions can no longer resolve.

We are very sorry for the inconvenience. Here are the changes that you need to apply. Substitute the version numbers in your version for the ones below:

In the tools/cprnc/SVN\_EXTERNAL\_DIRECTORIES change:

```
-genf90 http://parallelio.googlecode.com/svn/genf90/trunk_tags/genf90_140121  
+genf90 https://github.com/PARALLELIO/genf90/tags/genf90_140121
```

In the top level SVN\_EXTERNAL\_DIRECTORIES change:

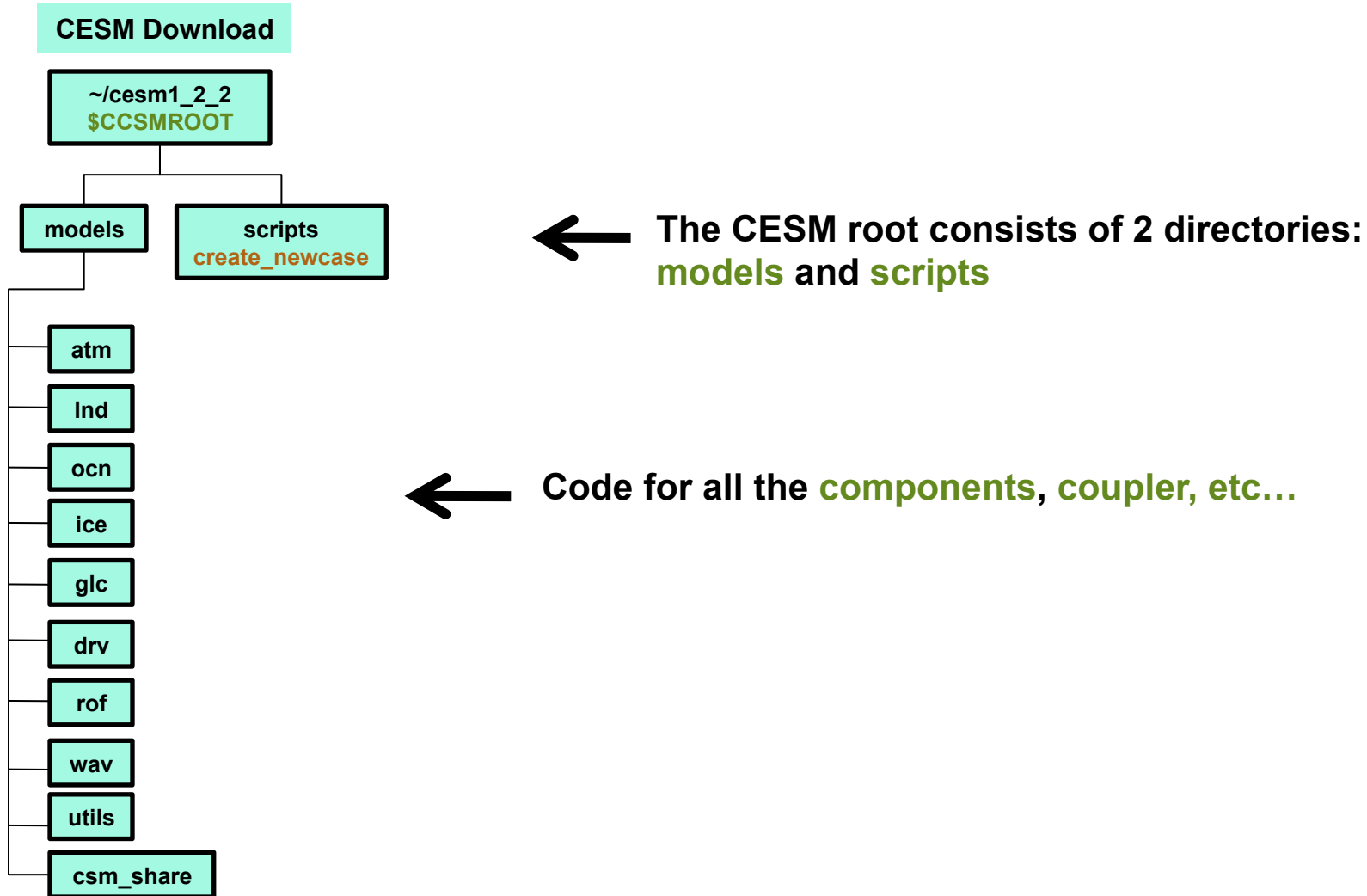
```
-models/utils/pio http://parallelio.googlecode.com/svn/trunk_tags/pio1_8_12/pio  
+models/utils/pio https://github.com/NCAR/ParallelIO.git/tags/pio1_8_12/pio
```

After each of the above changes run

```
$ svn propset svn:externals -F SVN_EXTERNAL_DIRECTORIES .
```

```
$ svn update
```

# Overview of Directories (after initial model download)



# Basic Work Flow

*(or how to set up and run an experiment)*

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- (D) Porting



- **Creating & Running a Case**

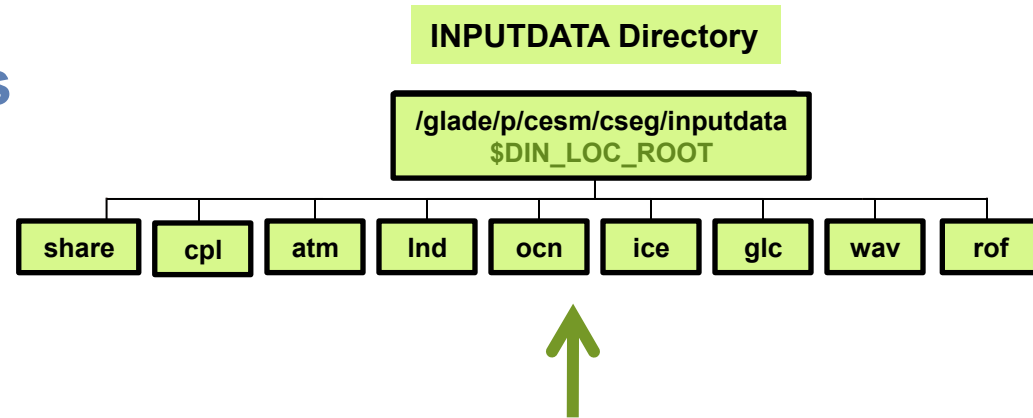
- (1) Create a New Case

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# Overview of Directories (+ inputdata directory)



Inputdata directory `$DIN_LOC_ROOT` contains all input data required to run the model

- on **supported machines** - populated inputdata already exists
- on **non-supported machines** - need to create inputdata directory root

- Ideally directory is **shared by a group of users** to save disc space

- To download input data: use the script `check_input_data`

- downloads **only** the data needed

- puts the data in the proper subdirectories

- **Do NOT download input data manually** (ie. by using `svn co`)

## CESM Download

`~/cesm1_2_2`  
`$CCSMROOT`

models

scripts

`create_newcase`

atm

lnd

ocn

ice

glc

drv

rof

wav

utils

csm\_share

# Basic Work Flow

*(or how to set up and run an experiment)*

- **One-Time Setup Steps**

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- **Creating & Running a Case**

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# (D) Porting

- On supported machines - no porting is necessary
- On new machines – porting needs to be done

Porting details are outside the scope of this tutorial

User's Guide

Porting and Validating CESM on a new platform

## CESM Models

Home » CESM Models » CESM1.2 Series Public Release

### CESM1.2 SERIES PUBLIC RELEASE

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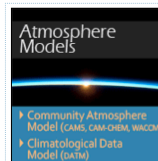
- Post Processing Utilities
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- Experiment Case Naming Conventions

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- ▶ Model Component Namelists
- ▶ \$CASEROOT.xml files



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**Coupler**

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# Work Flow: Super Quick Start

CESM can be run with a set of **4 commands**

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

```
# one time step
mkdir ~/cases

# go into scripts directory into the source code download
cd /glade/p/cesm/tutorial/cesm1_2_2.tutorial/scripts

(1) # (1) create a new case in the directory “cases” in your home directory
     ./create_newcase -case ~/cases/b.day1.0 -res T31_g37 -compset B1850CN -mach yellowstone

# go into the case you just created in the last step
cd ~/cases/b.day1.0

(2) # (2) invoke cesm_setup
     ./cesm_setup

(3) # (3) build the executable
     ./b.day1.0.build

(4) # (4) submit your run to the batch queue
     ./b.day1.0.submit
```

It is that easy !



# Basic Work Flow

*(or how to set up and run an experiment)*

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- (A) Registration

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- (C) Create an Input Data Root Directory

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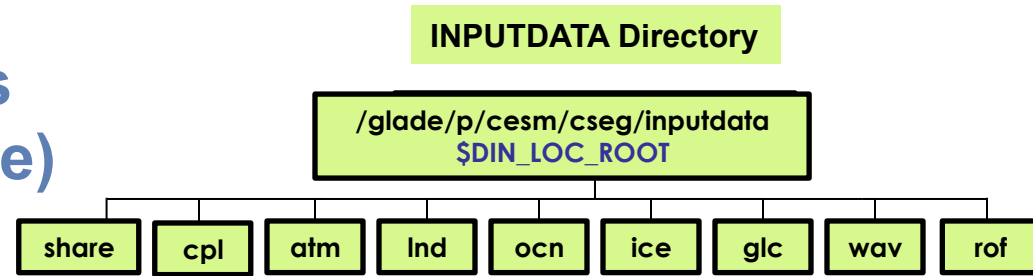
-  (1) Create a New Case

- (2) Invoke `cesm_setup`

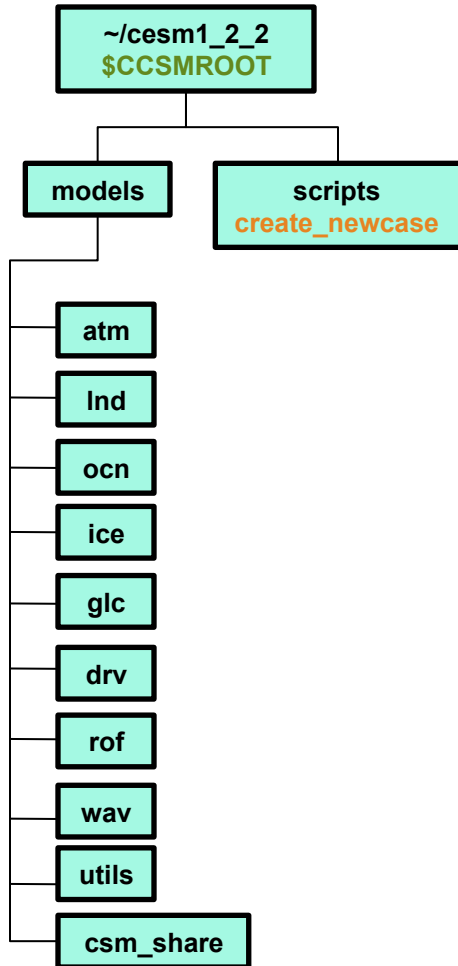
- (3) Build the Executable

- (4) Run the Model and Output Data Flow

# Overview of Directories (+ before create\_newcase)



## CESM Download



This is the **script** you need to create a new case

# Work Flow: Super Quick Start

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/b.day1.0 -res T31_g37 -compset B1850CN -mach yellowstone
```

```
# go into the case you just created in the last step
```

```
cd ~/cases/b.day1.0/
```

```
# (2) invoke cesm_setup
```

```
./cesm_setup
```

```
# (3) build the executable
```

```
./b.day1.0.build
```

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

```
./b.day1.0.submit
```

# (1) Create a new case

In the scripts directory, `create_newcase` is the tool that generates a new case.

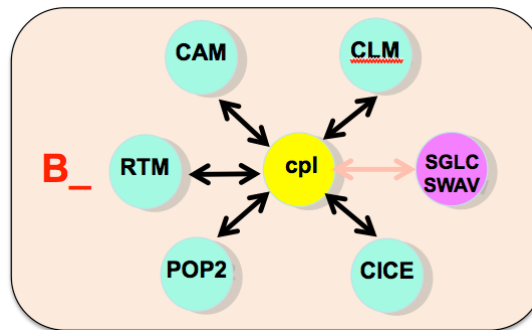
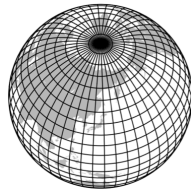
`create_newcase` requires 4 arguments

What is the casename ?

Which resolution?

Which model configuration ?  
Which set of components ?

Which machine are you running on?



# (1) create\_newcase arguments

**create\_newcase** requires 4 arguments

```
create_newcase -case ~/cases/b.day1.0 -res T31_g37 -compset B1850CN -mach yellowstone
```

# (1) create\_newcase arguments

**create\_newcase** requires 4 arguments

```
create_newcase -case ~/cases/b.day1.0 -res T31_g37 -compset B1850CN -mach yellowstone
```

What is the  
casename ?



**case** specifies the name and location of the case being created  
~/cases/b.day1.0



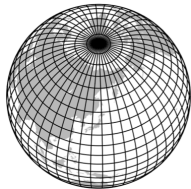


# (1) create\_newcase arguments

create\_newcase requires 4 arguments

```
create_newcase -case ~/cases/b.day1.0 -res T31_g37 -compset B1850CN -mach yellowstone
```

Which resolution?



**res** specifies the **model resolution** (or grid)

## New grid naming convention

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

Example of equivalent alias, short name and long name:

- alias: T31\_g37 (atm/Ind\_ocn/ice)
- short name: T31\_gx3v7
- long name = a%T31\_l%T31\_oi%gx3v7\_r%r05\_m%gx3v7\_g%null\_w%null

↑  
atm

↑  
Ind

↑  
ocn/ice

↑  
river

↑  
Ind  
mask

↑  
Ind-ice

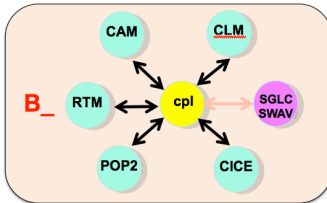
↑  
wave

# (1) create\_newcase arguments

create\_newcase requires 4 arguments

```
create_newcase -case ~/cases/b.day1.0 -res T31_g37 -compset B1850CN -mach yellowstone
```

Which component set ?



**compset** specifies the “component set”

Component set specifies component models, forcing scenarios and physics options for those models

## New compset naming convention

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

Example of equivalent alias, short name and long name:

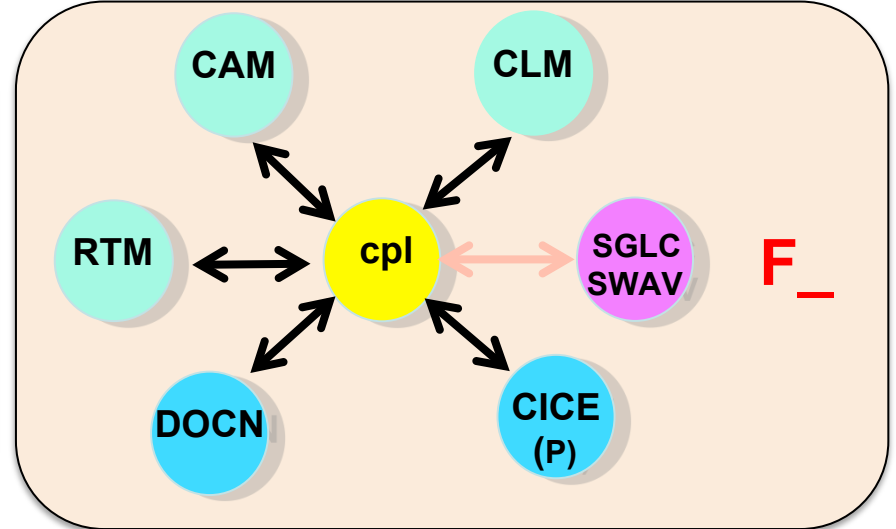
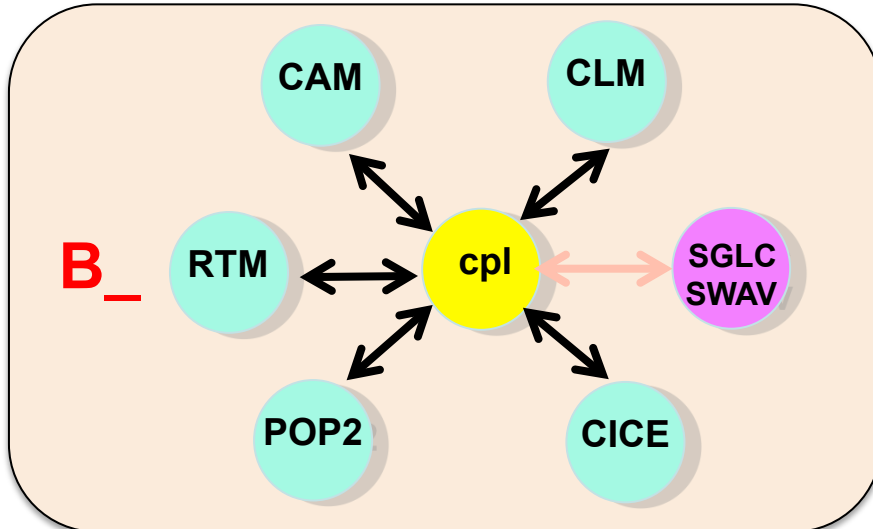
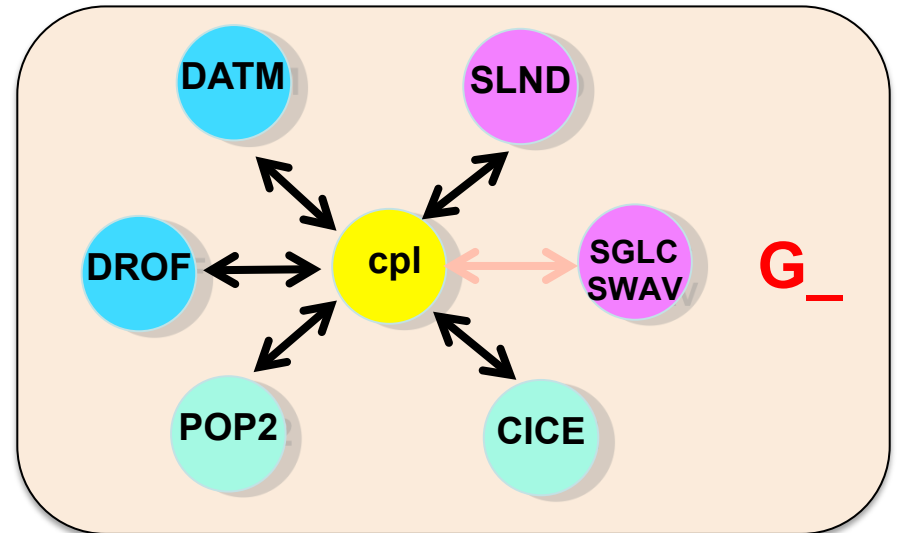
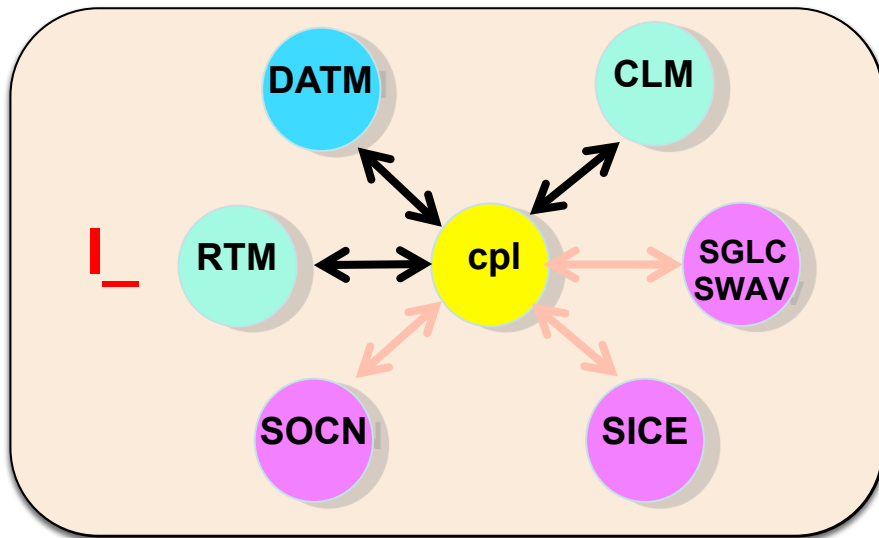
- alias: B1850CN
- short name: B\_1850\_CN
- long name = 1850\_CAM4\_CLM40%CN\_CICE\_POP2\_RTM\_SGLC\_SWAV

↑            ↑            ↑            ↑            ↑            ↑            ↑            ↑  
time        atm            Ind            ice        ocn        river        Ind-ice    wave

# More on CESM component sets

Plug and play of components with different component models

Color code: active data stub



# (1) create\_newcase arguments

`create_newcase` requires 4 arguments

```
create_newcase -case ~/cases/b.day1.0 -res T31_g37 -compset B1850CN -mach yellowstone
```

Which machine  
are you running on?



**mach** specifies the **machine** that will be used.

“supported” machines tested regularly, eg. yellowstone, edison, mira, bluewaters

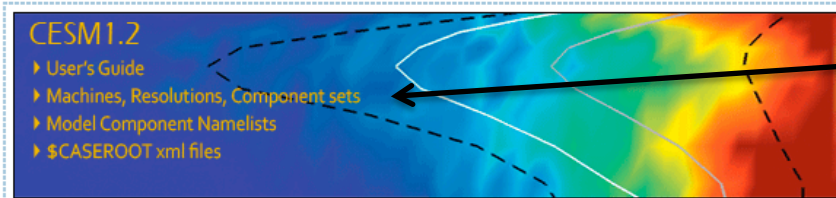
# Valid Values for res, compset, and mach

Command line to list all the valid choices for grids, compsets and machines

`./create_newcase -list <type>`

with type can be [compsets, grids, machines]

## MODEL DOCUMENTATION

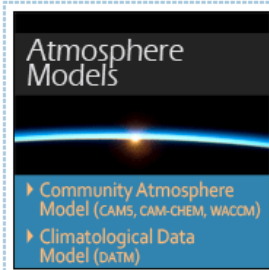


**CESM1.2**

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

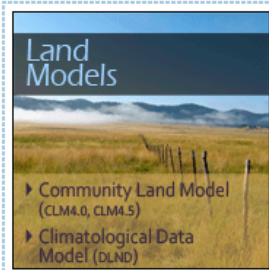
List of valid values is also available from the CESM website

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



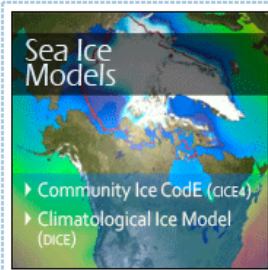
**Atmosphere Models**

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



**Land Models**

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



**Sea Ice Models**

- ▶ Community Ice Code (CICE4)
- ▶ Climatological Ice Model (OICE)

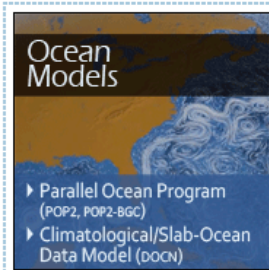
List of scientifically validated component sets and resolutions are available from the CESM website

<https://www.cesm.ucar.edu/models/scientifically-supported.html>



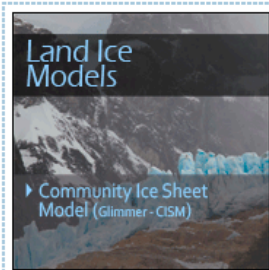
**Coupler**

- ▶ CESM Coupler (CPL7)



**Ocean Models**

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



**Land Ice Models**

- ▶ Community Ice Sheet Model (Climmer - CISM)



**River Models**

- ▶ River Transport Model (RTM)
- ▶ Climatological River Runoff Model (PROF)

# About create\_newcase

**./create\_newcase -help** lists all the available options

**Most often only four options are used: case, compset, res, and mach**

```
cd ../cesm1_2_2.tutorial/scripts/  
./create_newcase -help
```

## SYNOPSIS

```
create_newcase [options]
```

## OPTIONS

User supplied values are denoted in angle brackets (<>). Any value that contains white-space must be quoted. Long option names may be supplied with either single or double leading dashes. A consequence of this is that single letter options may NOT be bundled.

-case <name>	Specifies the case name (required).
-compset <name>	Specify a CESM compset (required).
-res <name>	Specify a CESM grid resolution (required).
-mach <name>	Specify a CESM machine (required).
-compiler <name>	Specify a compiler for the target machine (optional) default: default compiler for the target machine
-mpilib <name>	Specify a mpi library for the target machine (optional) default: default mpi library for the target machine allowed: openmpi, mpich, ibm, mpi-serial, etc
-mach_dir <path>	Specify the locations of the Machines directory (optional). default: /glade/p/cesm/cseg/collections/cesm1_2_0_beta08/scripts/ccsm_utils/Machines
-pecount <name>	Value of S,M,L,X1,X2 (optional). default: M, partially redundant with confopts _P
-pes_file <name>	Full pathname of pes file to use (will overwrite default settings) (optional). See sample_pes_file.xml for an example.
-user_compset	Long name for new user compset file to use (optional) This assumes that all of the compset settings in the long name have been defined.
-grid_file <name>	Full pathname of grid file to use (optional) See sample_grid_file.xml for an example.
-help [or -h]	Note that compset components must support the new grid. Print usage to STDOUT (optional).
-list <type>	Only list valid values, type can be [compsets, grids, machines] (optional).

**required arguments**

...

# Result of running create\_newcase

```
./create_newcase -case ~/cases/b.day1.0 -res T31_g37 \  
-compset B1850CN -mach yellowstone
```

```
-----  
For a list of potential issues in the current tag, please point your web browser to:  
https://svn-ccsm-models.cgd.ucar.edu/cesm1/known\_problems/  
-----
```

```
grid longname is T31_g37  
Component set: longname (shortname) (alias)  
  1850_CAM4_CLM40%CN_CICE_POP2_RTM_SGLC_SWAV (B_1850_CN) (B1850CN)  
Component set Description:  
  CAM: CLM: RTM: CICE: POP2: SGLC: SWAV: pre-industrial: cam4 physics: clm4.0  
physics: clm4.0 cn specified phenology: prognostic cice: POP2 default:  
Grid:  
  a%T31_l%T31_oi%gx3v7_r%r05_m%gx3v7_g%null_w%null (T31_gx3v7)  
  ATM_GRID = 48x96 NX_ATM=96 NY_ATM=48  
  LND_GRID = 48x96 NX_LND=96 NX_LND=48  
  ...
```

```
Non-Default Options:  
  ATM_NCPL: 48  
  BUDGETS: TRUE  
  CAM_CONFIG_OPTS: -phys cam4  
  ...
```

```
The PE layout for this case match these options:
```

```
GRID = a%T31.+oi%gx3  
CCSM_LCOMPSET = CAM.+CLM.+CICE.+POP  
MACH = yellowstone  
Creating /glade/u/home/hannay/cases/b.day1.0  
Created /glade/u/home/hannay/cases/b.day1.0/env_case.xml  
Created /glade/u/home/hannay/cases/b.day1.0/env_mach_pes.xml  
Created /glade/u/home/hannay/cases/b.day1.0/env_build.xml  
Created /glade/u/home/hannay/cases/b.day1.0/env_run.xml  
Locking file /glade/u/home/hannay/cases/b.day1.0/env_case.xml  
Successfully created the case for yellowstone
```

```
Locking file ~/cases/b.day1.0/env_case.xml  
Successfully created the case for yellowstone
```

compset info

grid info

non default  
options

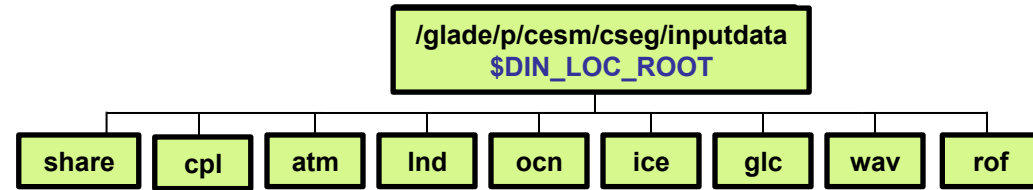
case location

Success!

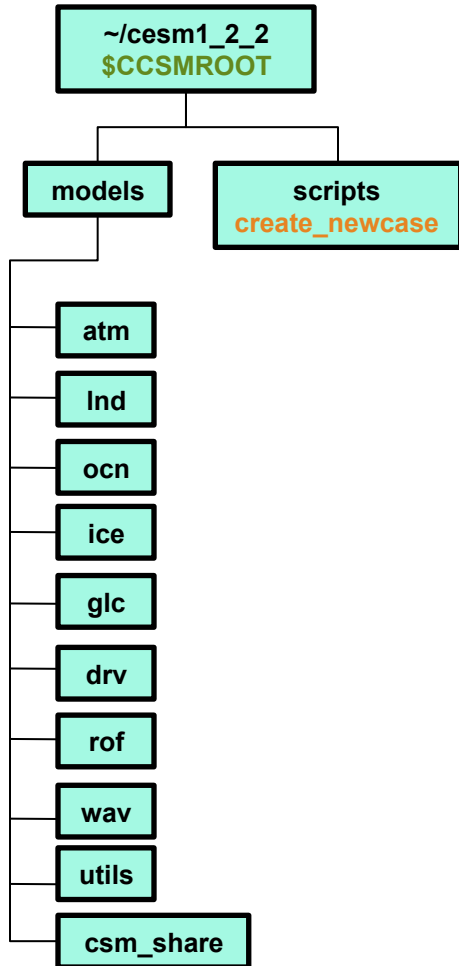


# Overview of Directories (after create\_newcase)

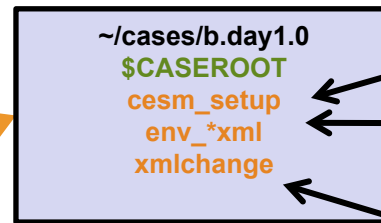
## INPUTDATA Directory



## CESM Download



## CASE Directory



`create_newcase` creates case directory that contains:

`cesm_setup`: script used in the next step

files with xml variables used by CESM scripts

script to edit `env_*.xml` files

subdirectory for case specific code modifications



# About env\_\*.xml files

- env\_\*.xml contains variables used by scripts -- some can be changed by the user
  - env\_case.xml: set by create\_newcase and cannot be modified
  - env\_mach\_pes.xml : specifies layout of components
  - env\_build.xml: specifies build information
  - env\_run.xml : sets run time information (such as length of run, frequency of restarts, ...)  
**User interacts with this file most frequently**

- Here's a snippet of the env\_run.xml file

```
<!--"sets the run length in conjunction with STOP_N and STOP_DATE, valid values: none,never,nst  
eps,nstep,nseconds,nsecond,nminutes,nminute,nhours,nhour,ndays,nday,nmonths,nmonth,nyears,nyea  
r,date,ifdays0,end (char) " -->  
<entry id="STOP_OPTION" value="ndays" />  
  
<!--"sets the run length in conjunction with STOP_OPTION and STOP_DATE (integer) " -->  
<entry id="STOP_N" value="5" />
```

“id” - variable name

“value” – variable value

**CESM will run for 5 days**

- To modify a variable in an xml file – use **xmlchange**  
**xmlchange STOP\_N=20**

# Basic Work Flow

*(or how to set up and run an experiment)*

- **One-Time Setup Steps**

- (A) Registration

- (B) Download the CESM code

- (C) Create an Input Data Root Directory

- (D) Porting

- **Creating & Running a Case**

- (1) Create a New Case



- (2) Invoke `cesm_setup`

- (3) Build the Executable

- (4) Run the Model and Output Data Flow

# Work Flow: Super Quick Start

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/b.day1.0 -res T31_g37 -compset B1850CN -mach yellowstone
```

```
# go into the case you just created in the last step
```

```
cd ~/cases/b.day1.0/
```

```
# (2) invoke cesm_setup
```

```
./cesm_setup
```

```
# (3) build the executable
```

```
./b.day1.0.build
```

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

```
./b.day1.0.submit
```

# About cesm\_setup

```
./cesm_setup -help
```

## SYNOPSIS

```
Creates Macros file for target machine if it does not exist  
Creates user_nl_xxx files for target components  
(and number of instances) if they do not exist  
Creates batch run script (case.run) for target machine
```

## USAGE

```
cesm_setup [options]
```

## OPTIONS

```
-help [or -h]          Print usage to STDOUT.  
  
-clean                 Removes the batch run script for target machines  
                        Macros and user_nl_xxx files are never removed  
                        by cesm_setup - you must remove them manually
```

# Calling cesm\_setup

- `cd ~/cases/b.day1.0`
- `./cesm_setup`

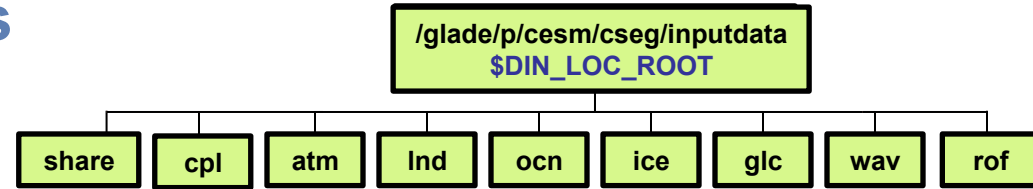
```
Creating Macros file for yellowstone
/glade/p/cesm/cseg/tutorial/cesm1_2_2.tutorial/scripts/ccsm_utils/Machines/
config_compilers.xml intel yellowstone
Creating batch script b.day1.0.run
Locking file env_mach_pes.xml
Creating user_nl_xxx files for components and cpl
Running preview_namelist script
  infile is /glade/u/home/hannay/cases/b.day1.0/Buildconf/cplconf/
cesm_namelist
CAM writing dry deposition namelist to drv_flds_in
CAM writing namelist to atm_in
CLM configure done.
CLM adding use_case 1850_control defaults for var sim_year with val 1850
CLM adding use_case 1850_control defaults for var sim_year_range with val
constant
CLM adding use_case 1850_control defaults for var use_case_desc with val
Conditions to simulate 1850 land-use
CICE configure done.
POP2 build-namelist: ocn_grid is gx1v6
POP2 build-namelist: ocn_tracer_modules are iage
See ./CaseDoc for component namelists
If an old case build already exists, might want to run b.day1.0.clean_build
before building
```

Diagram illustrating the steps of the `cesm_setup` process:

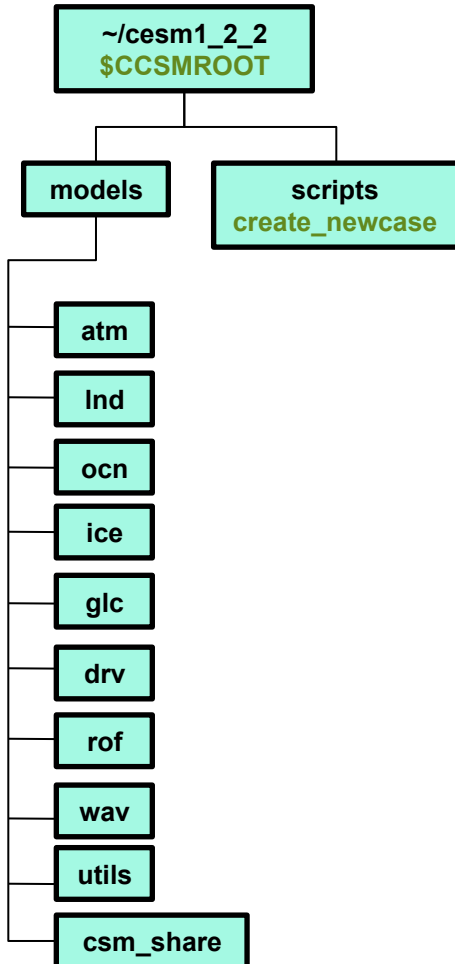
- Create Macros**: Points to the line `Creating Macros file for yellowstone`.
- Create run script**: Points to the line `Creating batch script b.day1.0.run`.
- Create user\_nl\_xxx**: Points to the line `Creating user_nl_xxx files for components and cpl`.

# Overview of Directories (after cesm\_setup)

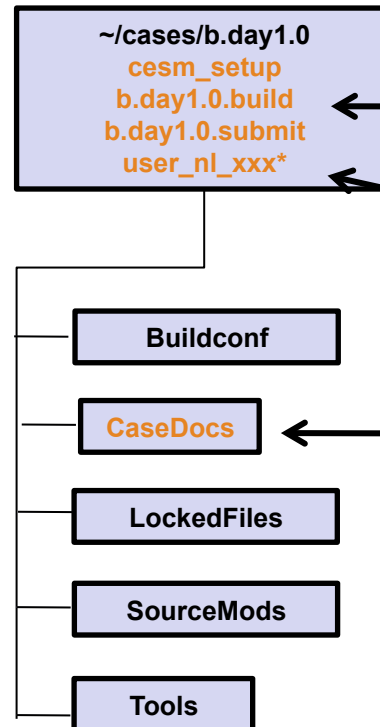
## INPUTDATA Directory



## CESM Download



## CASE Directory



**cesm\_setup creates:**

**case scripts** (to build, run and archive)

**namelist modification files** `user_nl_***`  
this is where you modify **your** namelists

**CaseDocs:** contains **copy of the namelists**  
This is for reference only and files in this directory **SHOULD NOT BE EDITED.**

# Basic Work Flow

*(or how to set up and run an experiment)*

- **One-Time Setup Steps**

- (A) Registration

- (B) Download the CESM code

- (C) Create an Input Data Root Directory

- (D) Porting

- **Creating & Running a Case**

- (1) Create a New Case

- (2) Invoke `cesm_setup`

- (3) Build the Executable

- (4) Run the Model and Output Data Flow



# Work Flow: Super Quick Start

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/b.day1.0 -res T31_g37 -compset B1850CN -mach yellowstone

# go into the case you just created in the last step
cd ~/cases/b.day1.0/

# (2) invoke cesm_setup
./cesm_setup

# (3) build the executable
./b.day1.0.build

# (4) submit your run to the batch queue
./b.day1.0.submit
```



# Build the Model

- **Modifications before build**
  - Change env\_build.xml values *before* running \*.build
  - Introduce any modified source code in SourceMods/ before building
- To completely rebuild, run \*.clean\_build first
- **The \*.build script**
  - Checks for missing input data
  - Builds the individual component libraries and model executable
- **If any inputdata is missing,**
  - Build aborts, but provides a list of missing files
  - Run ./check\_input\_data –export to acquire missing data
  - This will use svn to put required data in the inputdata directory
  - Then re-run build script

# Running the .build Script

- Checks for missing input data
- Aborts if any input data is missing
- Builds the component model libraries and executable by running the **\*.buildexe.csh** scripts for each component

```
./b.day1.0.build
```

```
-----  
CESM BUILDNML SCRIPT STARTING
```

```
- To prestage restarts, untar a restart.tar file into /glade/scratch/hannay/b.day1.0/run  
infile is /glade/u/home/hannay/cases/b.day1.0/Buildconf/cplconf/cesm_namelist
```

```
. . .
```

```
CESM BUILDNML SCRIPT HAS FINISHED SUCCESSFULLY  
-----
```

```
CESM PRESTAGE SCRIPT STARTING
```

```
- Case input data directory, DIN_LOC_ROOT, is /glade/p/cesm/cseg//inputdata  
- Checking the existence of input datasets in DIN_LOC_ROOT
```

```
CESM PRESTAGE SCRIPT HAS FINISHED SUCCESSFULLY  
-----
```

```
CESM BUILDEXE SCRIPT STARTING
```

```
COMPILER is intel
```

```
- Build Libraries: mct gptl pio csm_share
```

```
Tue Jun 11 19:13:41 MDT 2013 /glade/scratch/hannay/b.day1.0/bld/mct/mct.bldlog.130611-191330
```

```
. . .
```

```
- Locking file env_build.xml
```

```
CESM BUILDEXE SCRIPT HAS FINISHED SUCCESSFULLY  
-----
```

Namelist creation

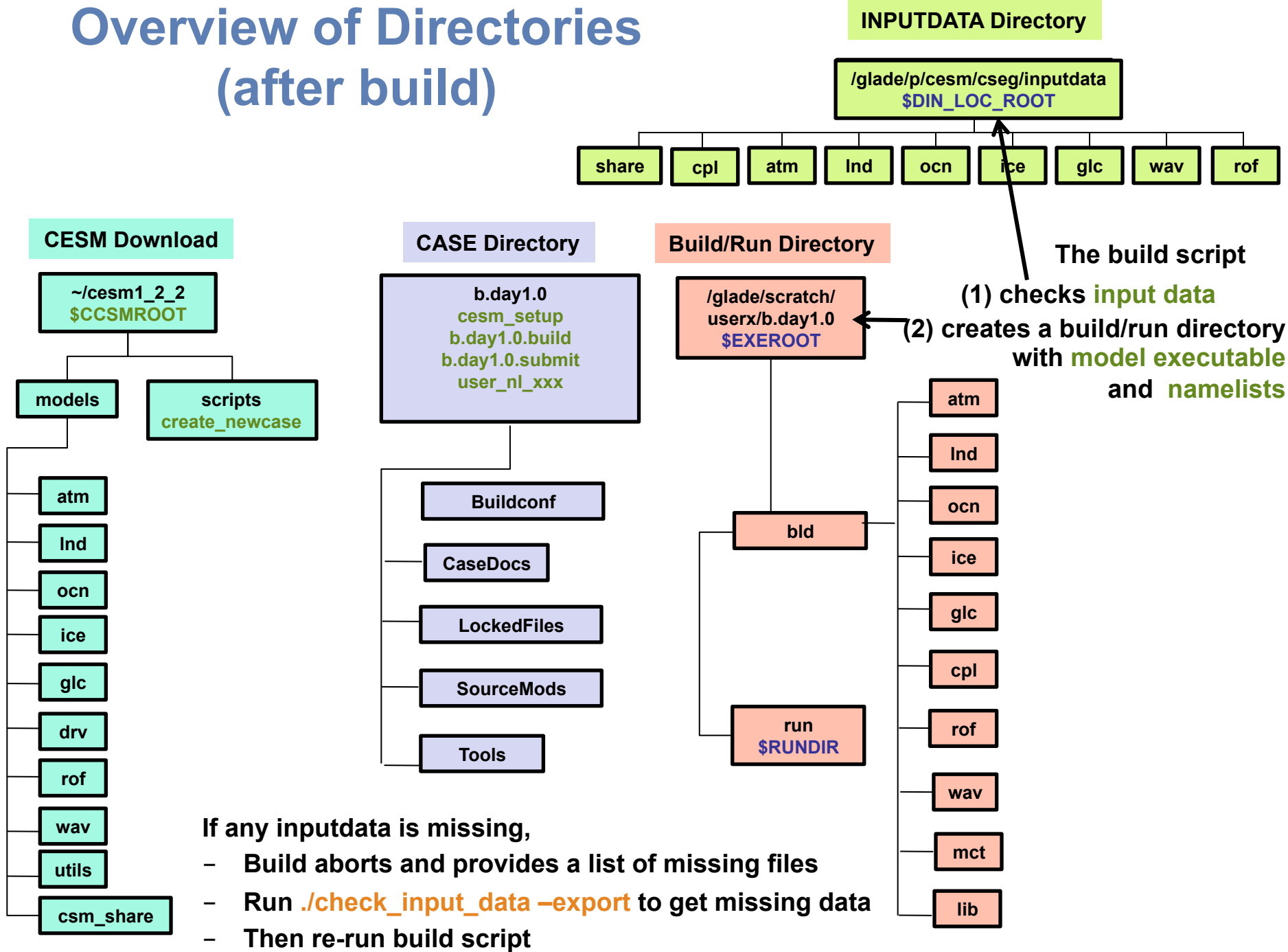
Inputdata verification  
and prestage

Model Build

Success



# Overview of Directories (after build)



If any inputdata is missing,

- Build aborts and provides a list of missing files
- Run `./check_input_data -export` to get missing data
- Then re-run build script

# Basic Work Flow

*(or how to set up and run an experiment)*

- **One-Time Setup Steps**
  - (A) Registration and Download
  - (B) Create an Input Data Root Directory
  - (C) Porting
- **Creating & Running a Case**
  - (1) Create a New Case
  - (2) Invoke `cesm_setup`
  - (3) Build the Executable
  - (4) Run the Model and Output Data Flow



# Work Flow: Super Quick Start

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/b.day1.0 -res T31_g37 -compset B1850CN -mach yellowstone

# go into the case you just created in the last step
cd ~/cases/b.day1.0/

# (2) invoke cesm_setup
./cesm_setup

# (3) build the executable
./b.day1.0.build

# (4) submit your run to the batch queue
./b.day1.0.submit
```

## (4) Running the Model

### When you submit your jobs

```
~/cases/b.day1.0>b.day1.0.submit  
check_case OK  
Job <959733> is submitted to queue <regular>
```

### Use “bjobs” to check if job is running

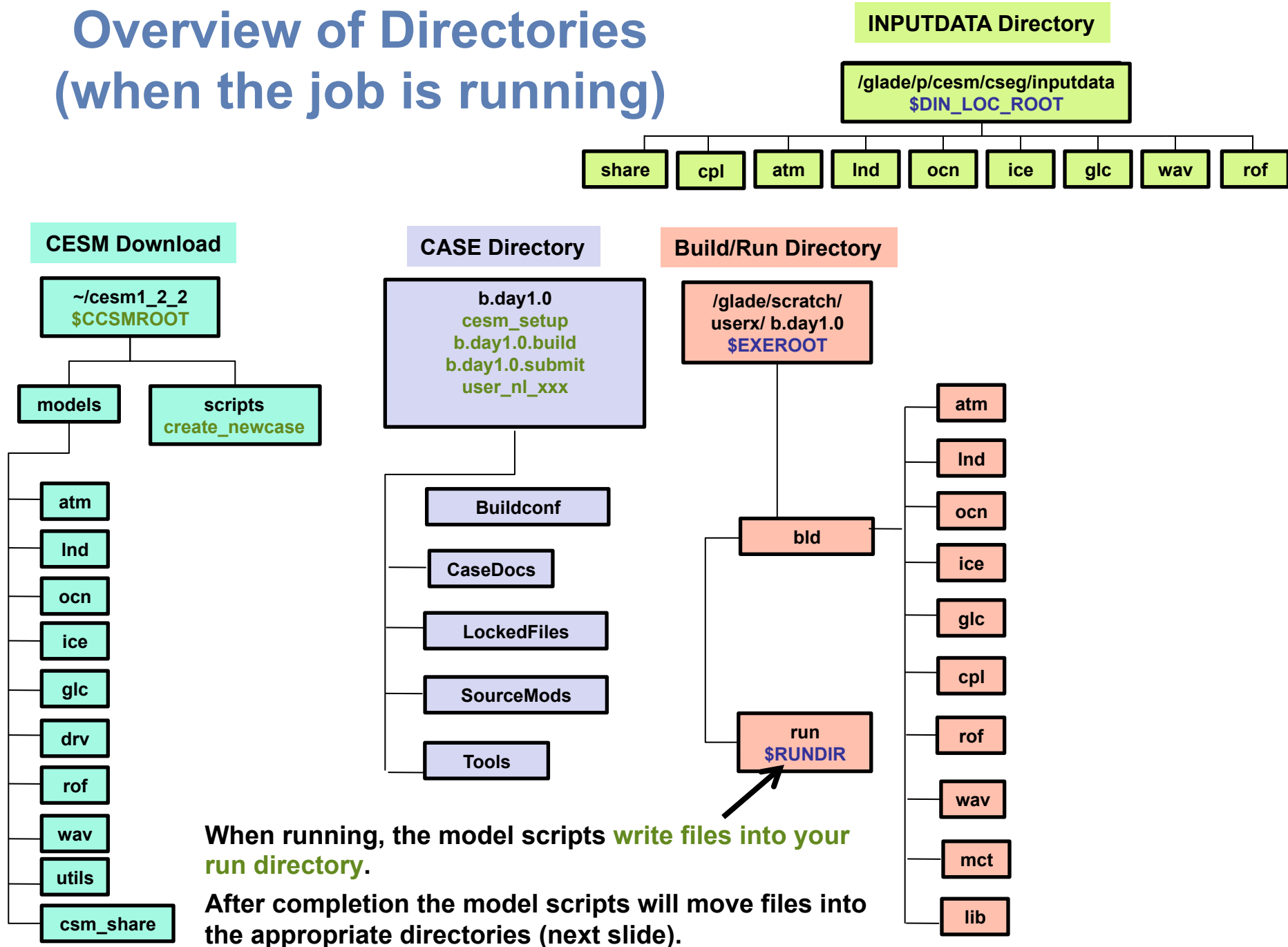
```
~/cases/b.day1.0>bjobs  
JOBID  USER  STAT  QUEUE  FROM_HOST  EXEC_HOST  JOB_NAME  SUBMIT_TIME  
960463  userx  PEND  regular  yslogin3-ib  yslogin3-ib  b.day1.0  Jun 17 08:34
```

Your job is waiting in the queue

```
~/cases/b.day1.0>bjobs  
JOBID  USER  STAT  QUEUE  FROM_HOST  EXEC_HOST  JOB_NAME  SUBMIT_TIME  
960463  userx  RUN   regular  yslogin3-ib  15*ys0702-i  b.day1.0  Jun 17 08:34  
15*ys1872-ib  
15*ys1906-ib  
15*ys1907-ib  
15*ys1908-ib  
15*ys1918-ib  
15*ys2055-ib  
15*ys2057-ib  
15*ys2058-ib  
15*ys2130-ib  
15*ys2131-ib  
15*ys2132-ib  
15*ys2216-ib  
15*ys2218-ib
```

Your job is running

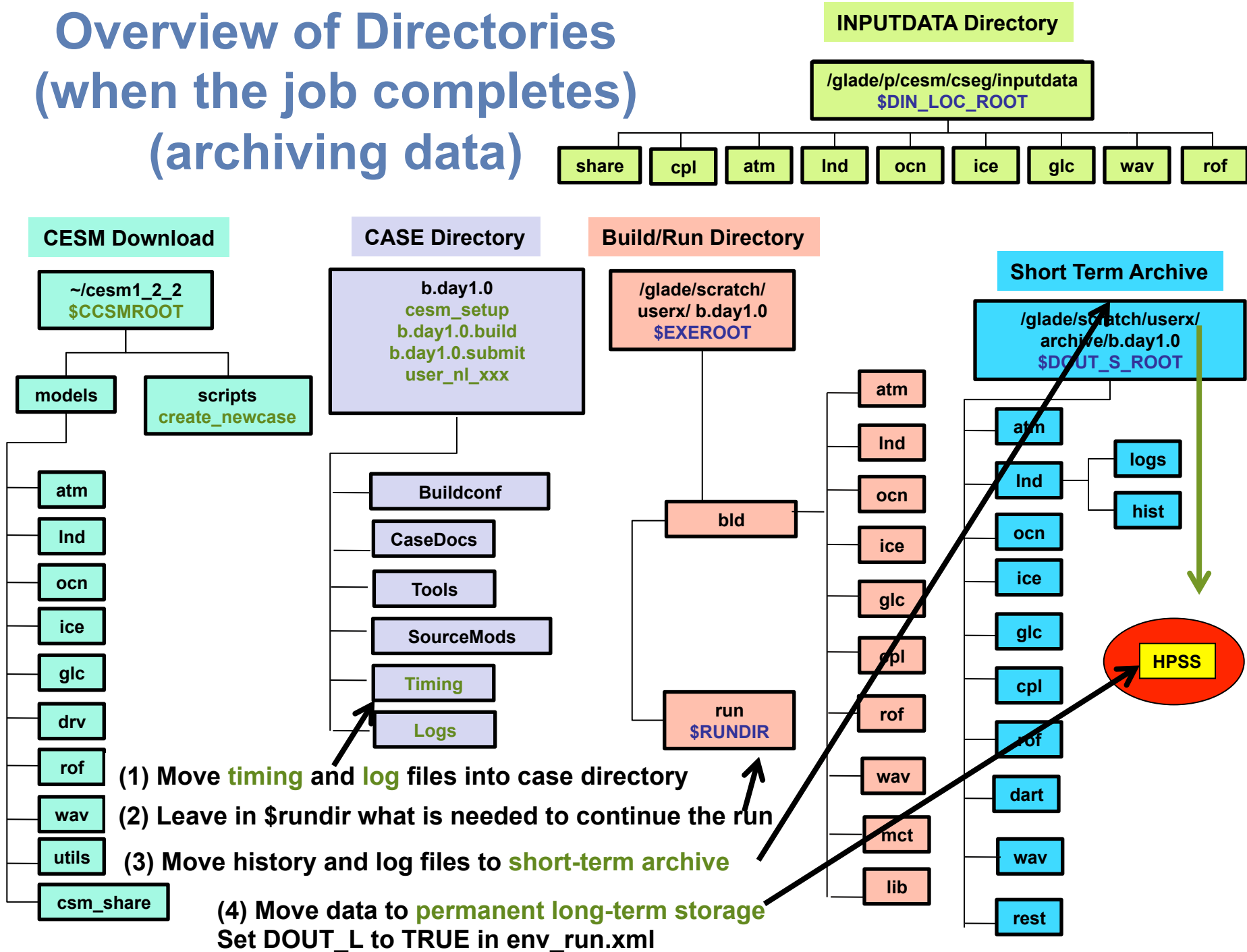
# Overview of Directories (when the job is running)



When running, the model scripts **write files into your run directory**.

After completion the model scripts will move files into the appropriate directories (next slide).

# Overview of Directories (when the job completes) (archiving data)





# Expert feature: create\_clone

- The “create\_clone” tool copies an existing case to make a new copy.
- Things that are copied:
  - Most (not all) env\_\*.xml settings.
  - user\_nl\_\*\*\* files
  - Macros
  - SourceMods
  - Batch system files
  - README.case
- Not copied:
  - Logs
  - Timing files
- Invocation (from scripts directory):
  - `./create_clone -clone ~/cases/b.day1.0 -case ~/cases/b.day1.2`

# Best practices for copying cases

- **Using “cp -R” does not work!**
- **When using create\_clone, make sure that your changes will be minor:**
  - **Same version of the code!**
  - **Same grid**
  - **Same compset**
  - **Namelist/SourceMods changes not too complex.**
- **Document changes in your case directory so that they are easy to track: README.case is a great place.**
- **If your changes are more complex, if you use multiple code versions, or if you have to create a great many cases at once, consider writing your own script to set up your cases.**

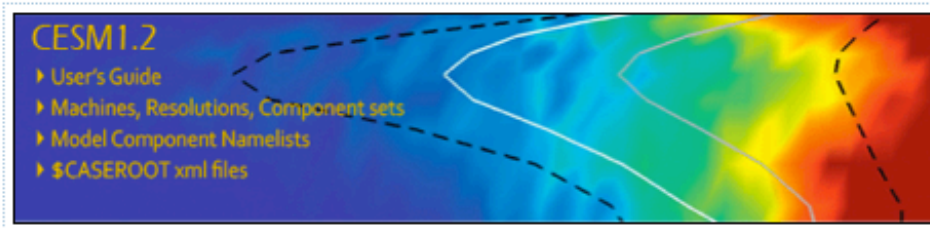
# More Information/Getting Help

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

## MODEL DOCUMENTATION


**CESM1.2**

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



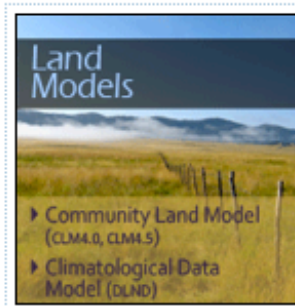
**Atmosphere Models**

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



**Land Models**

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



**Sea Ice Models**

- ▶ Community Ice Code (ICE4)
- ▶ Climatological Ice Model (OICE)



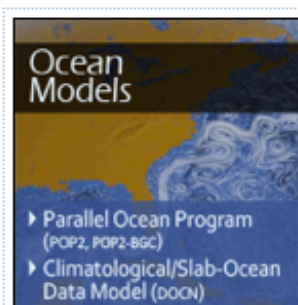
**Coupler**

- ▶ CESM Coupler (CPL7)



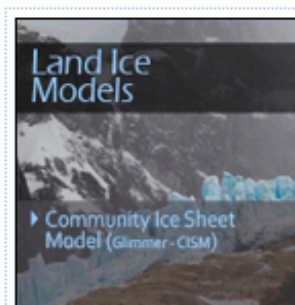
**Ocean Models**

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



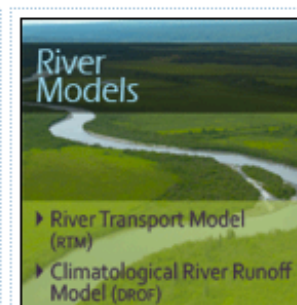
**Land Ice Models**

- ▶ Community Ice Sheet Model (Glimmer - CISM)



**River Models**

- ▶ River Transport Model (RTM)
- ▶ Climatological River Runoff Model (PROF)



# More Information/Getting Help

CESM Bulletin Board: <http://bb.cgd.ucar.edu/>

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NCAR UCAR **DiscussCESM** COMMUNITY Earth System MODEL










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## FORUMS

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**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	29	61	Invitation to participate in CESM integrated data search survey by aliceb June 15, 2015 - 6:14pm
 Bug reporting Community Bug Reporting	194	625	CCSM3 run error by janezhang8587@... July 21, 2015 - 3:03am
 Climate Variability Diagnostics Package inquiries	2	20	Sign of PDO by asphilli June 9, 2014 - 10:40am
 General Discussion Includes requests for new features and configuration inquiries	434	1479	CLM4 Irrigation Modification by mdfowler@... July 29, 2015 - 9:11am
 GIT Issues This forum is for the discussion of git issues in the CIME repository	3	16	svn external for a given git tag by andre May 6, 2015 - 4:04pm
 Input Data inquiries	207	555	map_fv0.9x1.25_to_T85_aave_110411.nc by aliceb July 30, 2015 - 11:43am
 Known Issues Posted and Moderated by CSEG only Subforums: ocean/POP2 (3), atmosphere/CAM (23), atmosphere/WACCM (12), Component Sets (COMPSETS) (5), Coupler (3), Dead and Stub Models (0), Grids (1), ice/CICE (1), land/CLM (13), land-ice/CISM (1), Machines/scripts (27), mapping (0), Utilities (1)	0	0	n/a
 Model Intercomparison Project (MIP) inquiries CESM MIP simulations, including CMIP5	14	47	Notice to the Community: ESGF Nodes Going Offline by strandwg June 21, 2015 - 10:36am
 New Feature Requests	1	2	user_nl feature request by jedwards August 14, 2014 - 4:18pm

# More Information/Getting Help

CESM tutorial: <http://www.cesm.ucar.edu/events/tutorials/>

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COMMUNITY EARTH SYSTEM MODEL

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## CESM Tutorials

### UPCOMING CESM TUTORIALS

**2014 CLM TUTORIAL**  
18 - 21 February 2014, National Center for Atmospheric Research, Mesa Lab, Boulder, CO [[tutorial home](#)] [[announcement](#)]

**2014 CESM TUTORIAL**  
11 - 5 August 2014, National Center for Atmospheric Research, Mesa Lab, Boulder, CO [[tutorial home](#)] [[announcement](#)]

### PAST CESM TUTORIALS

**2013 COMMUNITY EARTH SYSTEM MODELING TUTORIAL**  
12 - 16 August 2013, National Center for Atmospheric Research, Boulder, CO [[tutorial home](#)] [[announcement](#)] [[tutorial agenda](#)] [[tutorial coursework](#)]

**2012 COMMUNITY EARTH SYSTEM MODELING TUTORIAL**  
30 July - 03 August 2012, National Center for Atmospheric Research, Boulder, CO [[tutorial home](#)] [[announcement](#)]

**2011 COMMUNITY EARTH SYSTEM MODELING TUTORIAL**  
1 - 5 August 2011, National Center for Atmospheric Research, Boulder, CO [[tutorial home](#)] [[agenda](#)] [[participants](#)]

**2010 COMMUNITY EARTH SYSTEM MODELING TUTORIAL**  
12-16 July 2010, National Center for Atmospheric Research, Boulder, CO [[agenda](#)] [[announcement](#)] [[course materials](#)]

### 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).

### CESM ADMINISTRATION

- SSC
- CAB
- Governance

# Thank You!

The UCAR Mission is:

To advance understanding of weather, climate, atmospheric composition and processes;  
To provide facility support to the wider community; and,  
To apply the results to benefit society.

NCAR is sponsored by the National Science Foundation



# Day 1 Exercise 0

- This afternoon we will simply be introducing you to the system and running for the first time.
- Log in to yellowstone, geyser or caldera depending on the instructions on your compile card and follow these steps.

**Step 1:** From your tutorial machine window prompt, type the first command from your compile card. This creates a login session on yellowstone.

If your compile card is **blue** and says “Yellowstone” at the top then congratulations! You are done logging in and have successfully completed this first exercise.

---

If your compile card is **yellow** or **green** and says “Geyser Login” or “Caldera Login” at the top then you need to type one additional command – but just for today!

**Step 2 (one time only – this step is not on your compile card):**

```
#cp /glade/p/cesm/tutorial/login_scripts/*.csh .
```

**Step 3:**

Type in the last command on your compile card

```
#!/caldera.csh calderaXX
```

-- or --

```
#!/geyser.csh geyserXX
```

# Day 1 Exercise 1

- This afternoon we will simply be introducing you to the system and running for the first time.
- Log in to yellowstone, geyser or caldera and run the following steps.
- Do the build step only if you have a compile card.

```
# One time step
```

```
mkdir ~/cases
```

```
# 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/b.day1.0 -res T31_g37 -compset B1850CN -mach yellowstone
```

```
# go into the case you just created in the last step
```

```
cd ~/cases/b.day1.0
```

```
# (2) invoke cesm_setup
```

```
./cesm_setup
```

```
# (3) build the executable
```

```
./b.day1.0.build
```

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

```
./b.day1.0.submit
```



# Day 1 Exercises 2-3

**# Exercise 1: Check on your case and resubmit when it is complete.**

**bjobs**

**cat cesm.stdout.\***

**# Changing options like STOP\_N and STOP\_OPTION would increase run length.**

**./xmlchange CONTINUE\_RUN=TRUE**

**./b.day1.0.submit**

**# Note that if you make a mistake, you can kill the job using its ID number.**

**# bkill <job\_id>**

**# Exercise 2: create\_clone**

**# Go back to the scripts directory**

**cd /glade/p/cesm/tutorial/cesm1\_2\_2.tutorial/scripts**

**# Make a clone of the case**

**./create\_clone -clone ~/cases/b.day1.0 -case ~/cases/b.day1.2**

**# Take a look in the create\_clone directory.**

**# What is the value of CONTINUE\_RUN in the new directory (this is in env\_run.xml)?**

**# What does README.case look like?**

**# What other files are copied over?**

# Notes for this tutorial

- There are a few things we will do this week that are different from running normally on yellowstone.
  - We will be using code in “/glade/p/cesm/tutorials” this week. Normally, you will use a version of the code in “/glade/p/cesm/collections”, or check out your own version. *The tutorial code refers to a special account key that will not work in the future!*
  - Some of you will be building on caldera or geyser today. Normally, you would build on the yellowstone login nodes and run on the batch nodes, and use caldera or geyser only for data postprocessing and analysis.
- Some general tips:
  - We will use short case directory names today, but in the future you may want to use longer names so that cases are easier to find. Typically, case names should include the compset, grid, and possibly a short name for the experiment.
  - While CESM is building, you can open a second terminal window and log in to yellowstone again. This allows you to look around or do other things while waiting for a job to complete.

# Further exercises

- **Some suggestions if you finish early today:**
  - **Look through the attached exercises from Adam Phillips to get a preview of this Wednesday's topics.**
  - **Look through the user's guide and other information online. Try to get a feel for what information you would need to look up to set up your own cases.**
  - **Try using the “ncview” command on one of the history files in your run directory. This is a simple but useful tool for taking a quick look at output.**
  - **Take a quick look at the NCO utilities for manipulating netCDF files:**
  - **<http://nco.sourceforge.net/nco.html>**

# Day 1 Auxiliary Exercises

In Wednesday's lab session you will be learning how to run the various diagnostic packages. You will also learn about the types of tools that are commonly used on model output. Here are some exercises that you can do to prepare yourself for Wednesday's lab session.

- Go to the CESM1 Large Ensemble Community Project page:  
<http://www2.cesm.ucar.edu/models/experiments/LENS/>  
After reading the project overview click on the “Diagnostics” link. Take a look at the available experiments and look at diagnostics output from the atmosphere, sea ice, land, and ocean diagnostics packages. Become familiar with the types of calculations the packages do.
- See <http://www2.cesm.ucar.edu/working-groups/cvcwg/cvdp> The **Climate Variability Diagnostics Package (CVDP)** is different from the other diagnostics packages in that it is usually run over an entire simulation and can be run on numerous simulations (*CESM and non-CESM data*) at once. The CVDP calculates the major modes of variability, trends, and provides a quantifiable metric table. Look at the website example comparisons.
- Go to <http://climatedataguide.ucar.edu> and explore the site. The **Climate Data Guide** contains information on over 150 different datasets, provides inter-dataset comparisons, and has dataset pros and cons evaluated by expert dataset users.
- The programming language **NCL** is used extensively within the CESM project. You will have the opportunity to run several NCL scripts on Wednesday. Take a look at the NCL Examples page to get an idea of the types of plots NCL can create:  
<http://www.ncl.ucar.edu/Applications/>