

CESM Tutorial

NCAR Climate and Global Dynamics Laboratory

CESM 2.1.1

CESM1.2.x and previous (see earlier tutorials)

NCAR is sponsored by the National Science Foundation



Outline

- **The CESM webpage**
- **Creating & Running a Case**
- **Getting More Help**

CESM Web Page

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

Sponsored By



NCAR | **COMMUNITY EARTH SYSTEM MODEL**
UCAR | **CESM™**

ABOUT

HELP

SEARCH ...



ADMINISTRATION ▾

WORKING GROUPS ▾

MODELS ▾

EVENTS ▾

🏠 CESM Homepage

NEWS

UCAR collaboration with The Weather Company will leverage the innovative MPAS weather model

[Learn More](#)



CESM EXPERIMENTS

- Experiments Overview
- CESM2 CMIP6
- Pre-CESM2



CESM RELEASES

- Releases Overview
- Acknowledgement of NSF support in CESM
- Supported Releases
- Scientifically Validated



- Support Overview
- DiscussCESM Bulletin Board



- Projects Overview
- EaSM | Earth System Modeling

CESM 2.1.1 Web Page

<http://www.cesm.ucar.edu/models/cesm2>



NCAR | COMMUNITY EARTH SYSTEM MODEL
UCAR | CESM™

ABOUT

HELP

SEARCH ...



ADMINISTRATION ▾

WORKING GROUPS ▾

MODELS ▾

EVENTS ▾

Home / CESM Models / CESM Supported Releases / CESM2

CESM2

Current Release

The current CESM supported release is CESM 2.1.1

[Learn more](#)

[View Experiments](#)

[Download current release](#)

CESM2 QUICKLINKS

[Quick Start Guide](#)

[Downloading The Code](#)

[Scientifically Validated Configurations](#)

[Prognostic Components](#)

[CESM Software Engineering](#)

RELATED INFORMATION

[Data Management & Distribution Plan](#)

[Development Project Policies & Terms of Use](#)

[DiscussCESM Forums Bulletin Board](#)

[Publication / Acknowledgment Information](#)

[CESM2 Copyright](#)

[CESM Support Policy](#)

[CESM2 Included Packages Copyright](#)

CESM PROJECT

The CESM project is supported primarily by the National Science Foundation (NSF).

Administration of the CESM is maintained by the Climate and Global Dynamics Laboratory (CGD) at the National Center for Atmospheric Research.

About CESM2

CESM is a fully-coupled, community, global climate model that provides state-of-the-art computer simulations of the Earth's past, present, and future climate states.

- [What's New in CESM2](#)
- [CESM Naming Conventions](#)

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.

- [CESM2 Scientifically Validated Configurations *](#)

Downloading the code.

http://www.cesm.ucar.edu/models/cesm2/release_download.html



DOWNLOADING CESM2 RELEASE CODE

1. Read these instructions: [CESM2 Quickstart Guide](#)

2. Download the current release code:

```
git clone -b release-cesm2.1.1 https://github.com/ESCOMP/cesm.git
cd cesm
./manage_externals/checkout_externals
```

For downloading previous versions of CESM2, please see [Downloading CESM2](#)

3. Register for Online Help: [DiscussCESM Forums Registration](#)

4. Sign-up for E-mail Notifications: [CCSM Participants Mailman Registration](#)

CESM2 QUICKLINKS

[Quick Start Guide](#)

[Downloading The Code](#)

[Scientifically Validated Configurations](#)

[Prognostic Components](#)

[CESM Software Engineering](#)

RELATED INFORMATION

[Data Management & Distribution Plan](#)

[Development Project Policies & Terms of Use](#)

[DiscussCESM Forums Bulletin Board](#)

[Publication / Acknowledgment Information](#)

[CESM2 Copyright](#)

[CESM Support Policy](#)

[CESM2 Included Packages Copyright](#)

CESM PROJECT

The CESM project is supported primarily by the National Science Foundation (NSF).

Administration of the CESM is maintained by the Climate and Global Dynamics Laboratory (CGD) at the National Center for Atmospheric

Overview of Directories (after initial model download)

CESM Download

~/cesm
\$CESMROOT

components

cime/scripts
create_newcase

aquap

cam

cice

cism

clm

mosart

pop

rtm

ww3



The CESM root contains of 2 important directories: **components** and **cime**

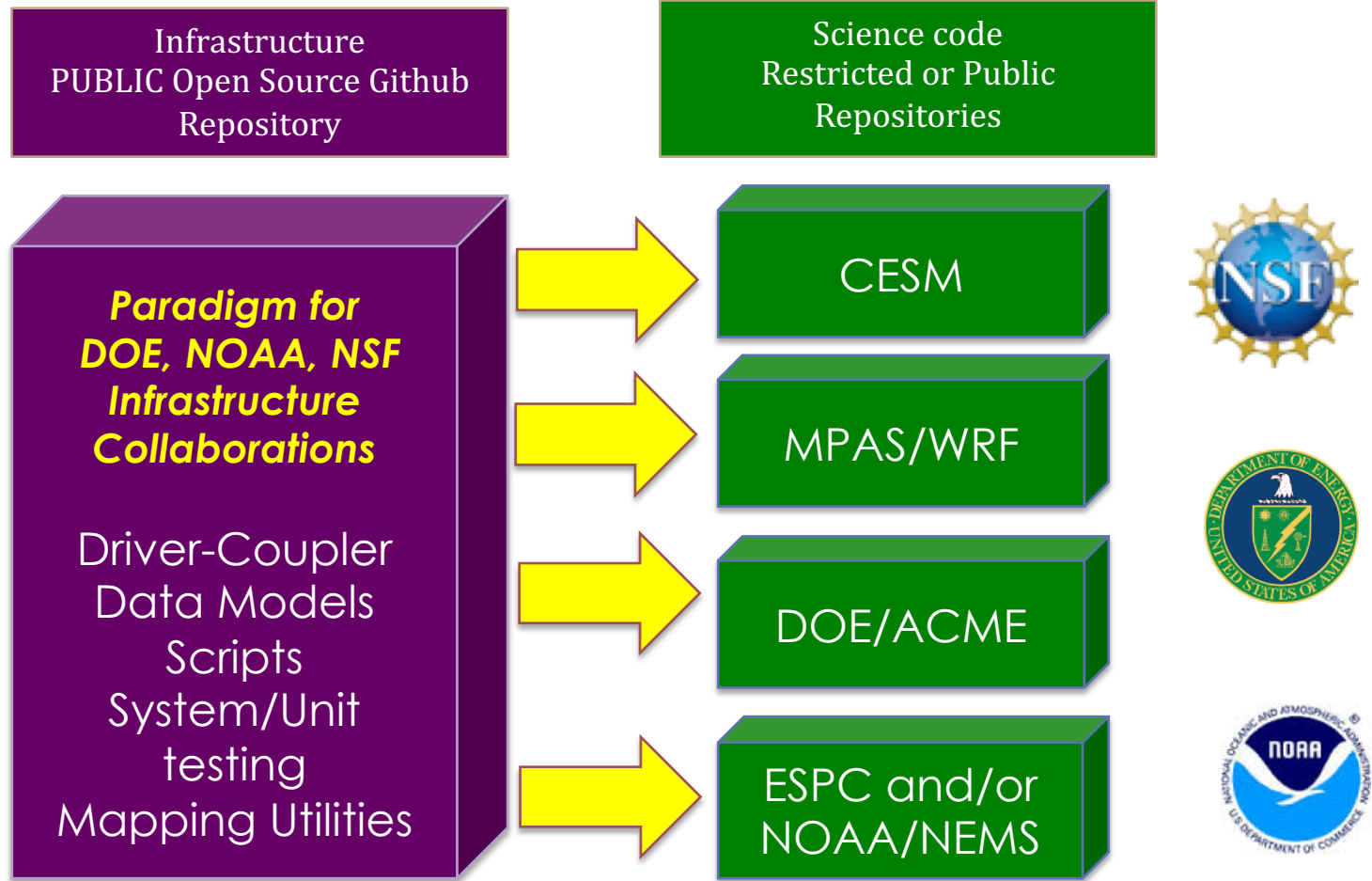


Code for all the **components**, etc...

Where is the coupler???

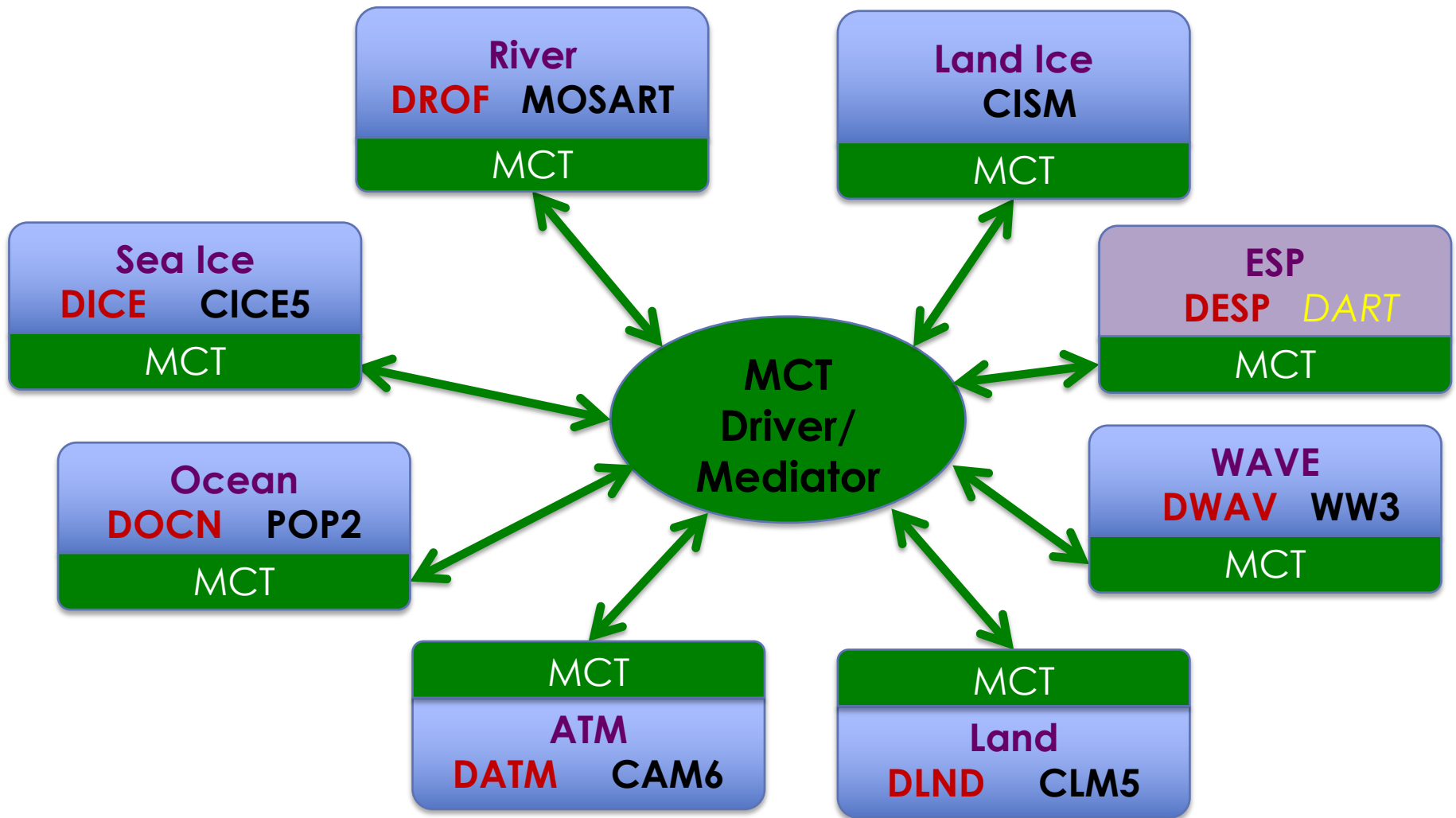
Coupling Infrastructure for Modeling Earth (CIME)

(new python-based CESM infrastructure)

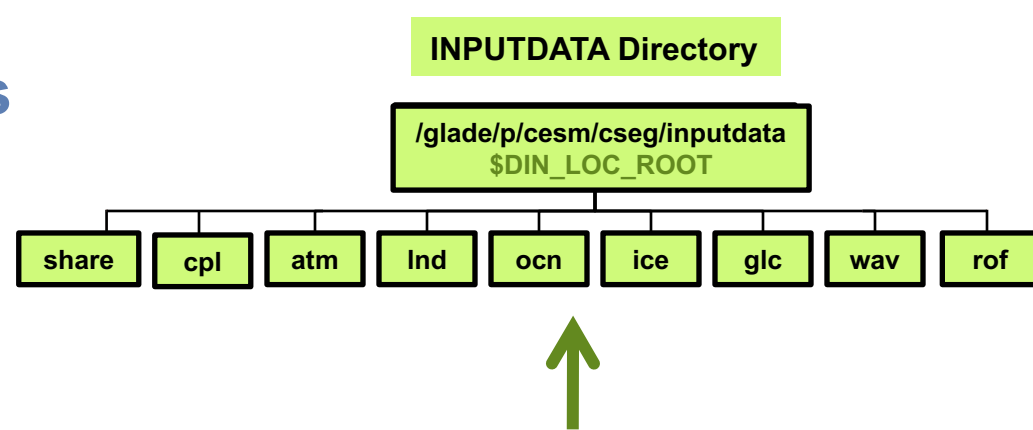


addresses needs of multiple efforts

Current CESM Coupling – data components permit flexible activation/deactivation of feedbacks



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

`~/cesm2`
`$CESMROOT`

components

`cime/scripts`
`create_newcase`

aquap

cam

cice

cism

clm

mosart

pop

rtm

ww3

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

The screenshot shows a web browser displaying the CIME 5.6 documentation page for porting on a new platform. The page is titled "6. Porting and validating CIME on a new platform" and is part of the "Case Control System Part 1: Basic Usage" section. The page content includes a "Table Of Contents" on the left, a "Previous topic" link, a "Next topic" link, and a "This Page" section. The main content area is divided into two sections: "6.1. Required libraries/packages" and "6.2. An MPI example".

6.1. Required libraries/packages

The machine needs to have:

- a functioning MPI environment (unless you plan to run on a single core with the CIME mpi-serial library).
- build tools gmake and cmake,
- a netcdf library version 4.3 or newer built with the same compiler you will use for CIME.

A pnetcdf library is optional.

If you are using MPI, make sure you can run a basic MPI parallel program on your machine before you attempt a CIME port. You can use this MPI example to check.

6.2. An MPI example

It is usually very helpful to assure that you can run a basic mpi parallel program on your machine prior to attempting a CIME port. Understanding how to compile and run the program fhello_world_mpi.F90 shown here could potentially save many hours of frustration.

```
program fhello_world_mpi.F90
  use mpi
  implicit none
  integer ( kind = 4 ) error
  integer ( kind = 4 ) id
  integer p
  character(len=MPI_MAX_PROCESSOR_NAME) :: name
  integer clen
  integer, allocatable :: mype(:)
  real ( kind = 8 ) wtime

  call MPI_Init ( error )
  call MPI_Comm_size ( MPI_COMM_WORLD, p, error )
  call MPI_Comm_rank ( MPI_COMM_WORLD, id, error )
  if ( id == 0 ) then
    wtime = MPI_Wtime ( )

    write ( *, '(a)' ) ' '
    write ( *, '(a)' ) 'HELLO_MPI - Master process:'
    write ( *, '(a)' ) 'FORTRAN90/MPI version'
    write ( *, '(a)' ) ' '
    write ( *, '(a)' ) ' An MPI test program.'
    write ( *, '(a)' ) ' '
    write ( *, '(a,i8)' ) ' The number of processes is ', p
    write ( *, '(a)' ) ' '
  end if
  ! MPI_GET_PROCESSOR_NAME(NAME, CLEN, ERROR)
```

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

- ```
one time step
mkdir ~/cases

go into scripts directory into the source code download
cd /glade/p/cesm/tutorial/cesm2.1.1_tutorial/cime/scripts

(1) # (1) create a new case in the directory "cases" in your home directory
 ./create_newcase --case ~/cases/b.day1.0 --res f09_g17 --compset B1850

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

(2) # (2) invoke case.setup
 ./case.setup

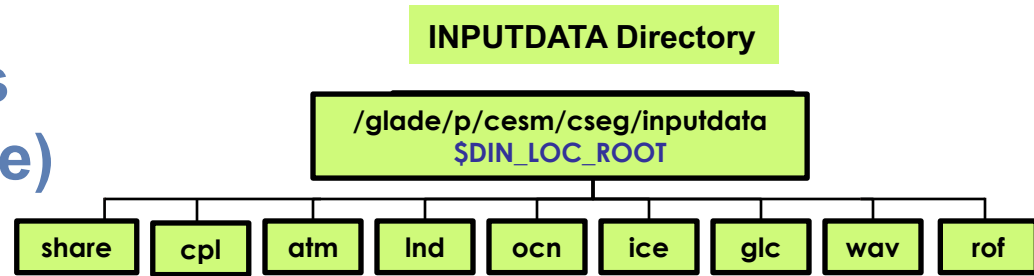
(3) # (3) build the executable
 qcmd -- ./case.build

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

It is that easy !



# Overview of Directories (+ before create\_newcase)



## CESM Download

`~/cesm2`  
`$CESMROOT`

components

cime/scripts

`create_newcase`

aquap

cam

cice

cism

clm

mosart

pop

rtm

ww3



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

```
go into scripts directory into the source code download
cd /glade/p/cesm/tutorial/cesm2.1.1_tutorial/cime/scripts
```

```
(1) create a new case in the directory "cases" in your home directory
./create_newcase --case ~/cases/b.day1.0 --res f09_g17 --compset B1850
```

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

```
(2) invoke case.setup
./case.setup
```

```
(3) build the executable
qcmd -- ./case.build
```

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

# (1) Create a new case

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

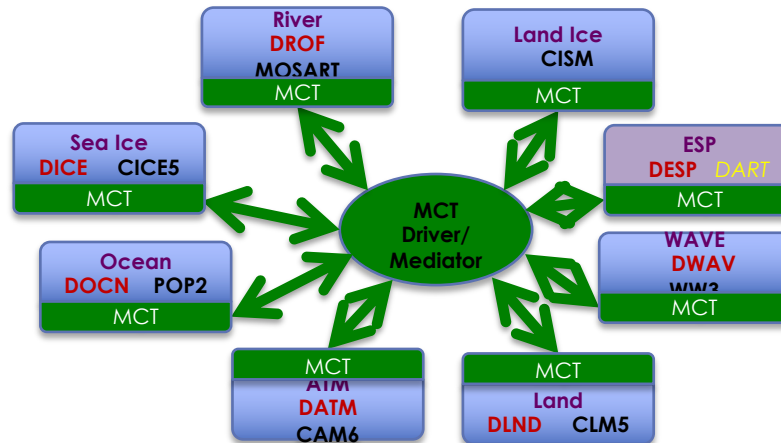
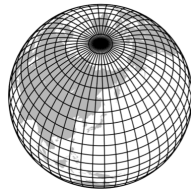
`create_newcase` requires 3 arguments

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 3 arguments

```
create_newcase --case ~/cases/b.day1.0 --res f09_g17 --compset B1850
```

# (1) create\_newcase arguments

create\_newcase requires 3 arguments

```
create_newcase --case ~/cases/b.day1.0 --res f09_g17 --compset B1850
```

What is the  
casename ?



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



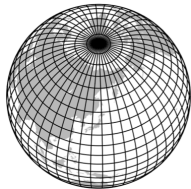


# (1) create\_newcase arguments

create\_newcase requires 3 arguments

```
create_newcase --case ~/cases/b.day1.0 --res f09_g17 --compset B1850
```

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: f09\_g17 (atm/Ind\_ocn/ice)
- short name: f09\_g17
- long name =

a%0.9x1.25\_l%0.9x1.25\_oi%gx1v7\_r%r05\_g%gland4\_w%ww3a\_m%gx1v7

↑  
atm

↑  
Ind

↑  
ocn/ice

↑  
river

↑  
Ind-ice

↑  
wave

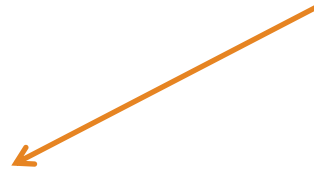
↑  
land-ocean mask

# (1) create\_newcase arguments

create\_newcase requires 3 arguments

```
create_newcase --case ~/cases/b.day1.0 --res f09_g17 --compset B1850
```

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: B1850
  - long name =  
1850\_CAM60\_CLM50%BGC\_CICE\_POP2%ECO\_MOSART\_CISM2%NOEVOLVE\_WW3\_BGC%BDRD
- ↑   ↑   ↑   ↑   ↑   ↑   ↑   ↑   ↑
- time atm   Ind   ice   ocn   river   Ind-ice   wave   BGC scenario

# About env\_\*.xml files

- env\_\*.xml contains variables used by scripts -- some can be changed by the user
  - env\_archive.xml: short-term archiving
  - env\_batch.xml: contains batch job information like project, wallclock time, etc.
  - env\_build.xml: specifies build information
  - env\_case.xml: set by create\_newcase and cannot be modified
  - env\_mach\_pes.xml : specifies layout of components
  - env\_mach\_specific.xml: compiler, other machine 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" />
```

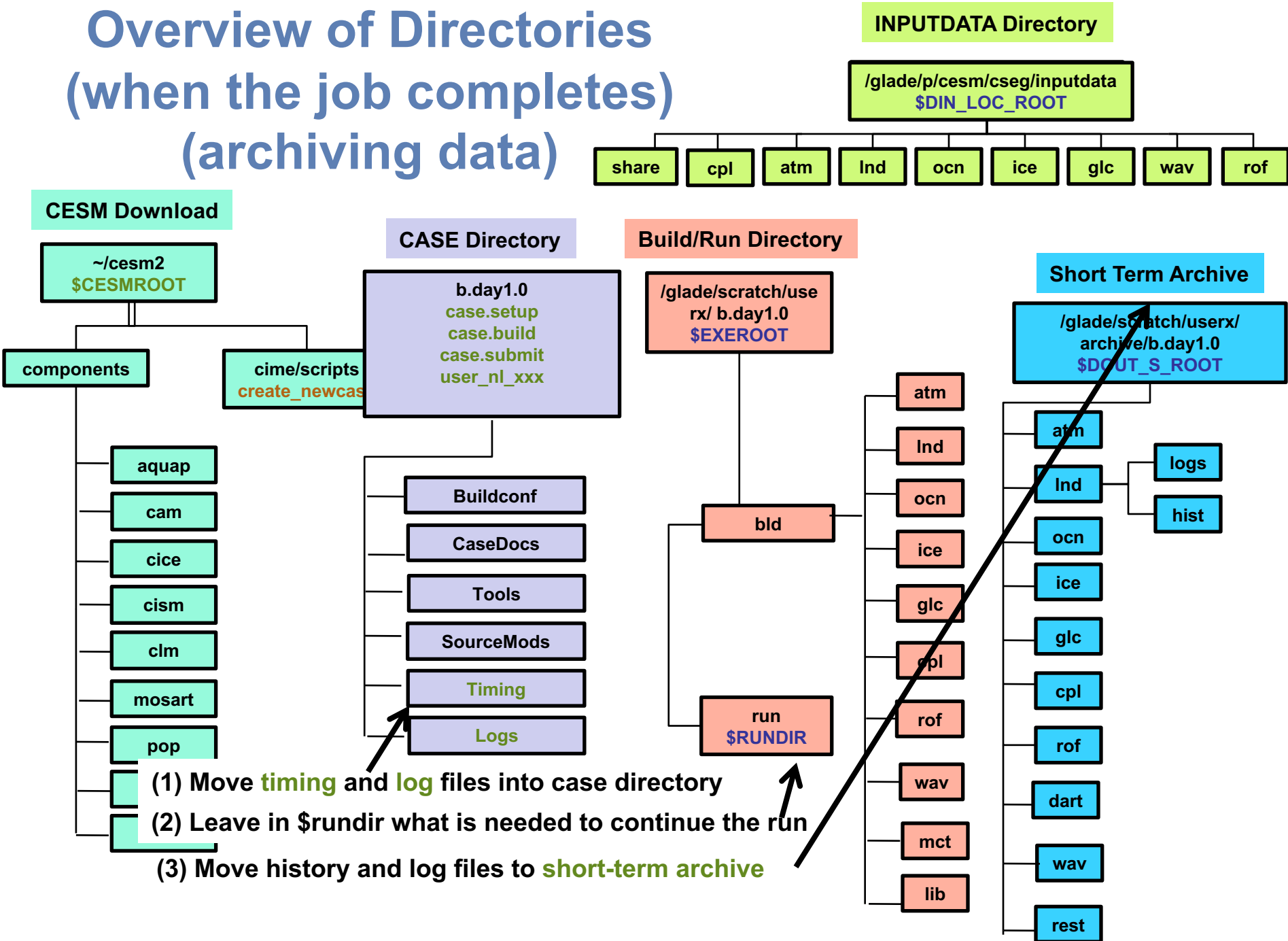
“id” - variable name

“value” – variable value

**CESM will run for 5 days**

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

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



# More Information/Getting Help

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

About FAQ Contact Us

NCAR UCAR DiscussCESM COMMUNITY Earth System MODEL

FORUMS REGISTER LOGIN Search

Home » Forums

## 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	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



# CESM Compsets and Grids

1850\_CAM60\_CLM50%BGC-CROP\_  
CICE\_POP2%ECO\_MOSART\_  
CISM2%NOEVOLVE\_WW3\_BGC%BDRD

1. 1850 fully-coupled (B1850) control with biogeochemistry.
2. 20<sup>th</sup> century fully-coupled (BHIST) with biogeochemistry and evolving ice sheets.
3. 1850 fully-coupled (BW1850) control with WACCM atmosphere and no biogeochemistry.
4. 1850 standalone CAM (F1850) control without biogeochemistry.

2000\_CAM60%WCSC\_CLM50%BGC-CROP\_  
CICE%PRES\_DOCN%DOM\_MOSART\_  
CISM2%NOEVOLVE\_SWAV

1. 1850 fully-coupled (B1850) control with biogeochemistry.
2. 20<sup>th</sup> century fully-coupled (BHIST) with biogeochemistry and evolving ice sheets.
3. 2000 standalone CAM (FWsc2000) control with WACCM atmosphere, specified chemistry.
4. 1850 standalone CAM (F1850) control without biogeochemistry.



a%0.9x1.25\_l%0.9x1.25\_oi%gx1v7\_  
r%r05\_g%gland4\_w%ww3a\_m%gx1v7

1. 1.9x2.25\_gx1v7 (f19\_g17)
2. 0.9x1.25\_gx1v7 (f09\_g17)
3. T62\_gx3v7 (T62\_g37)
4. ne120np4\_tx0.1v2 (ne120\_t12)