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
The current CESM supported release is CESM 2.1.1

Learn more | View Experiments | Download current release

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

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.
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
   ./manageExternals/checkoutExternals

   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
Overview of Directories
(after initial model download)

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)

Infrastructure
PUBLIC Open Source Github Repository

Paradigm for DOE, NOAA, NSF Infrastructure Collaborations
Driver-Coupler
Data Models
Scripts
System/Unit testing
Mapping Utilities

Science code
Restricted or Public Repositories

- CESM
- MPAS/WRF
- DOE/ACME
- ESPC and/or NOAA/NEMS

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)
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
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

goto 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

cmd -- ./case.build

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

It is that easy!
Overview of Directories
(+ before create_newcase)

INPUTDATA Directory
/glade/p/cesm/cseg/inputdata
$DIN_LOC_ROOT

share
cpl
atm
Ind
ocn
ice
glc
wav
rof

CESM Download

/~cesm2
$CESMROOT

components

cime/scripts
create_newcase

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

```bash
# 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?
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_oicuxv7_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

```
<entry id="STOP_OPTION" value="ndays"/>
<entry id="STOP_N" value="5"/>
```

“id” - variable name
“value” – variable value

- To modify a variable in an xml file – use **xmlchange**

  `.xmlchange STOP_N=20`
Overview of Directories (when the job completes) (archiving data)

1. Move timing and log files into case directory
2. Leave in $rundir what is needed to continue the run
3. Move history and log files to short-term archive

CESM Download
~/cesm2 $CESMROOT

Components
aquap
cam
cice
cism
clm
mosart
pop

CASE Directory
b.day1.0
case.setup
case.build
case.submit
user_nl_xxx

Buildconf
CaseDocs
Tools
SourceMods
Timing
Logs

Build/Run Directory
/glade/scratch/use rx/ b.day1.0 $EXEROOT

Build/Run Directory
bld
run $RUNDIR

Short Term Archive
/glade/scratch/userx/archive/b.day1.0 $DOUT_S_ROOT

Short Term Archive
atm
Ind
ocn
ice
glc
rof
cpl
wav
lib
rest

INPUTDATA Directory
/glade/p/cesm/cseg/inputdata
$DIN_LOC_ROOT

INPUTDATA Directory
share
cpl
atm
Ind
ocn
ice
glc
wav
rof

Short Term Archive
atm
Ind
ocn
ice
glc
cpl
rof
cpl
wav
lib
rest

Short Term Archive
logs
hist
More Information/Getting Help

CESM Bulletin Board: http://bb.cgd.ucar.edu/
1. 1850 fully-coupled (B1850) control with biogeochemistry.
2. 20th 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. 20th century fully-coupled (BHIST) with biogeochemistry and evolving ice sheets.
4. 1850 standalone CAM (F1850) control without biogeochemistry.
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)