

Modifying Code in the CLM

Sam Levis

Terrestrial Sciences Section

CLM Tutorial 2014

Teaching Assistants: Ahmed and Quinn



U.S. DEPARTMENT OF
ENERGY

Office of
Science

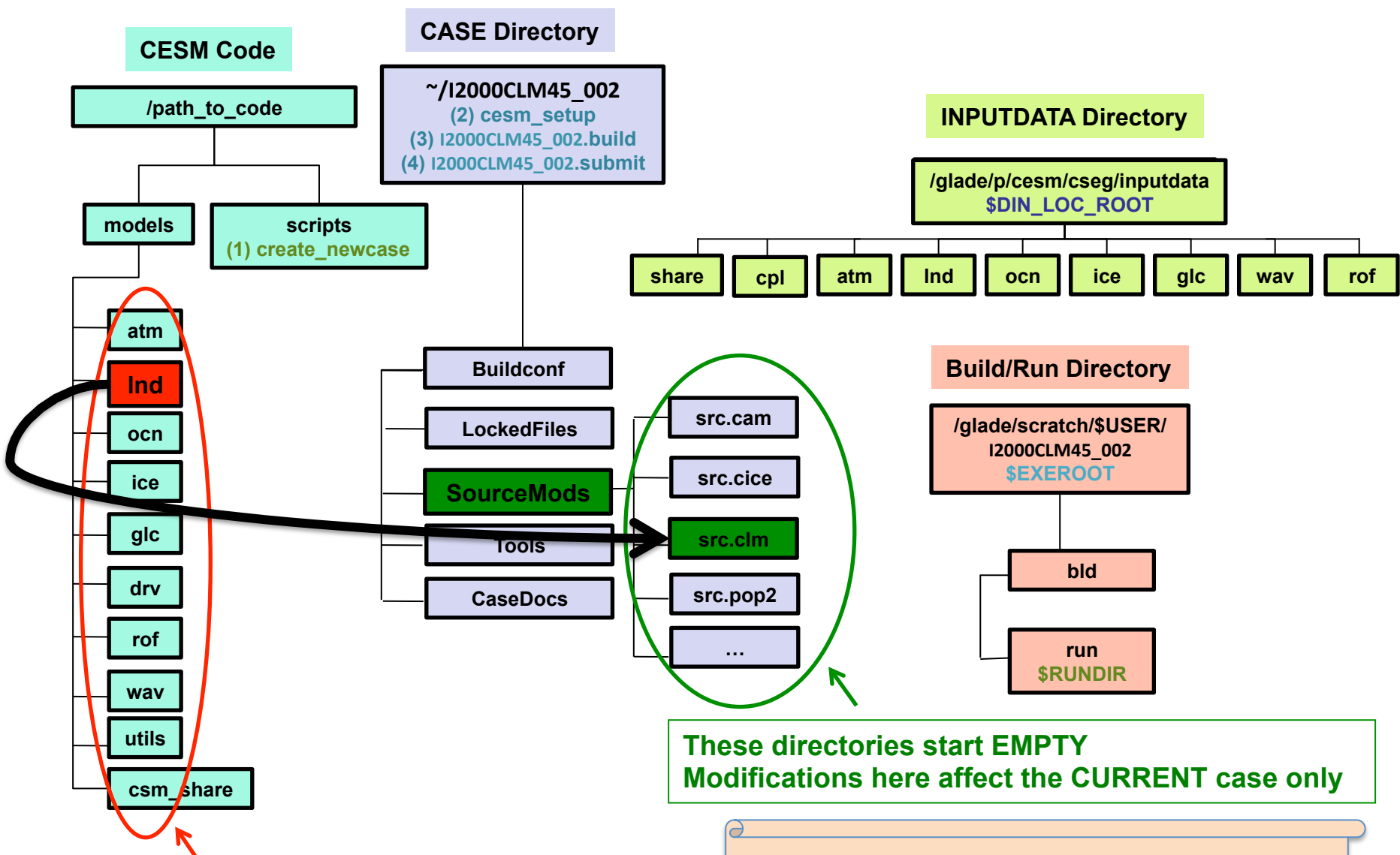
Based on Cecile Hannay's presentation at
the CESM Tutorial 2013

Why might you modify the code?

Principles for modifying the code

Thou shalt never modify CESM root

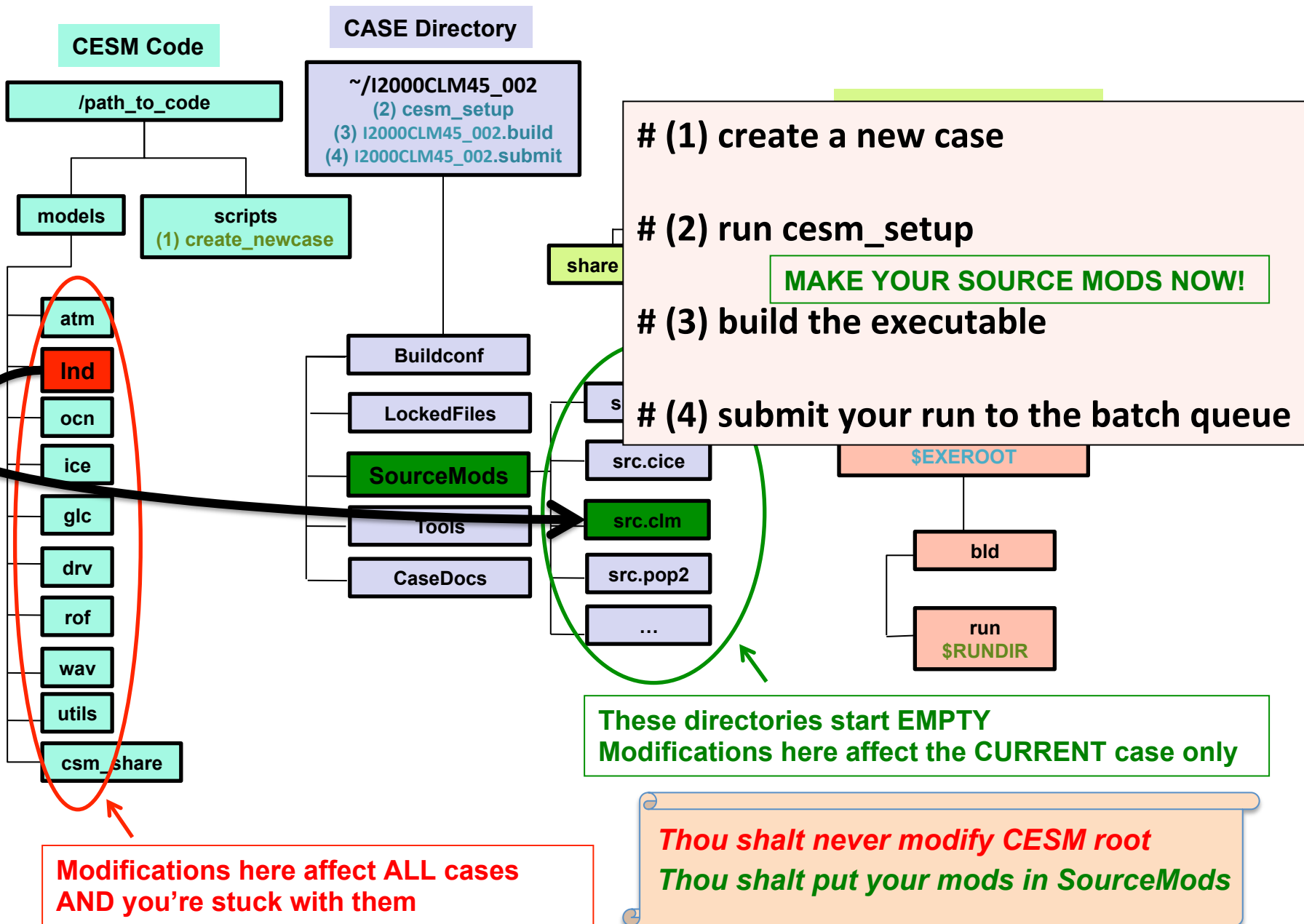
Thou shalt put your mods in SourceMods



Modifications here affect ALL cases AND you're stuck with them

These directories start EMPTY Modifications here affect the CURRENT case only

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



Steps for modifying code

- cd `/path_to_code/scripts`
- **create new case** for your planned code mods
- cd `/path_to_code/models/...`
- **Find** the fortran files (.F90) that you will modify (use grep)
- cp `/path_to_code/models/.../file.F90`
`/path_to_case/SourceMods/src.clm/.`
for the CLM to use this copy, do **NOT CHANGE** the FILENAME
- cd `/path_to_case/SourceMods/src.clm`
- **Modify** file.F90
- **Build** the executable and **Submit** the run

Exercise 1: Modify parameter zInd

We will modify the CLM parameter
zInd = roughness length for soil (m)

1) `cd /glade/p/cesm/lmwg/CLM2014_tutorial_n03_clm4_5_62/
scripts`

2) `./create_newcase -case ~/I2000CLM45_002 -res f19_g16
-compset ICLM45 -mach yellowstone`

3) `cd /glade/p/cesm/lmwg/CLM2014_tutorial_n03_clm4_5_62/
models/Ind/clm/src/clm4_5`

Exercise 1: Modify parameter zlnd

4) Find zlnd in the CLM 4.5 code: *grep zlnd */**

```
biogeophys/Biogeophysics1Mod.F90: zlnd, z sno, tfrz, icol_roof, icol_sunwall, icol_shadewall, &  
biogeophys/Biogeophysics1Mod.F90: z0mg(c) = zlnd  
biogeophys/Hydrology1Mod.F90: hfus,denice, zlnd,rpi,spval  
biogeophys/Hydrology1Mod.F90: frac_sno(c) = tanh(snow_depth(c)/(2.5_r8*zlnd* &  
biogeophys/Hydrology1Mod.F90: frac_sno(c) = tanh(snow_depth(c)/(2.5_r8*zlnd* &  
main/clm_driver.F90: use clm_varcon , only : zlnd  
main/clm_varcon.F90: real(r8) :: zlnd = 0.01_r8 !Roughness length for soil [m]  
main/initSurfAlbMod.F90: use clm_varcon , only : zlnd, istsoil, denice, denh2o, &  
main/initSurfAlbMod.F90: frac_sno(c) = tanh( snow_depth(c) /(2.5 * zlnd * fmelt) )
```


Exercise 1: Modify parameter zInd

5. `cp /glade/p/cesm/lmwg/CLM2014_tutorial_n03_clm4_5_62/models/Ind/clm/src/clm4_5/main/clm_varcon.F90
~/I2000CLM45_002/SourceMods/src.clm/.`
6. `cd ~/I2000CLM45_002/SourceMods/src.clm`
7. use an editor to **modify** the value of zInd from 0.01 to 0.02 in `SourceMods/src.clm/clm_varcon.F90`
8. build new executable
9. use an editor to change env_run in order to...
10. submit a 1-month run

Exercise 1: Modify parameter zInd

Check your solution:

Compare clm history files from this case (I2000CLM45_002) vs. the earlier case where everything but zInd was the same

Does the output look different?

Use **ncdiff** & **ncview** to see differences between the runs

```
ncdiff /glade/scratch/$user/archive/I2000CLM45_002/Ind/hist/I2000CLM45_002.clm2.h0.0001-01.nc  
/glade/scratch/$user/archive/I2000CLM45_001/Ind/hist/I2000CLM45_001.clm2.h0.0001-01.nc dif.nc
```

```
ncview dif.nc &
```

Does changing zInd affect the fraction of ground covered by snow?

What else?

Exercise 2: Getting a compilation error

- **Repeat** Exercise 1 but set zInd=xyz
- **What happens when you build?** 😞
- **Follow** directions in the error message as if you didn't know why you got this error (cheat sheet on next slide)
- **Correct** the mistake and build again
- **Does the error go away?**

Exercise 2: Getting a compilation error

```
[...]  
Wed Feb 12 17:49:24 MST 2014 /glade/scratch/slevis/I2000CLM45_002/bld/Ind.bldlog.140212-174911  
ERROR: clm.buildexe.csh failed, see /glade/scratch/slevis/I2000CLM45_002/bld/Ind.bldlog.140212-174911  
ERROR: cat /glade/scratch/slevis/I2000CLM45_002/bld/Ind.bldlog.140212-174911
```

...so open /glade/scratch/\$USER/I2000CLM45_002/bld/Ind.bldlog.140212-174911 with an editor & find the error:

```
/glade/u/home/slevis/I2000CLM45_002/SourceMods/src.clm/clm_varcon.F90(83): error #6592: This symbol must be a  
defined parameter, an enumerator, or an argument of an inquiry function that evaluates to a compile-time constant.  
[XYZ]
```

```
real(r8) :: zInd = xyz      !Roughness length for soil [m]  
-----^
```

```
/glade/u/home/slevis/I2000CLM45_002/SourceMods/src.clm/clm_varcon.F90(83): error #6973: This is not a valid  
initialization expression. [XYZ]
```

```
real(r8) :: zInd = xyz      !Roughness length for soil [m]  
-----^
```

```
/glade/u/home/slevis/I2000CLM45_002/SourceMods/src.clm/clm_varcon.F90(83): error #6404: This name does not  
have a type, and must have an explicit type. [XYZ]
```

```
real(r8) :: zInd = xyz      !Roughness length for soil [m]  
-----^
```

```
compilation aborted for /glade/u/home/slevis/I2000CLM45_002/SourceMods/src.clm/clm_varcon.F90 (code 1)  
gmake: *** [clm_varcon.o] Error 1
```

another common error message...

pointing to the wrong finidat

For more elaborate mods...

- Be a good programmer (...right!?)

OR (safer bet)

- Use existing code as a template

BONUS EXERCISE

Add a new variable to history
using existing code as a template

- ncview or ncdump a history file to see variables already written to history
- grep the CLM code for one of these variables
- copy code to SourceMods
- copy the relevant lines of code and modify

BONUS EXERCISE

- Example of variable already written to history: TLAI

`grep TLAI */*` gives

`main/histFldsMod.F90: call hist_addfld1d (fname='TLAI', units='none', &`

`so open histFldsMod.F90` with an editor and `look for TLAI:`

```
call hist_addfld1d (fname='TLAI', units='none', &  
    avgflag='A', long_name='total projected leaf area index', &  
    ptr_pft=pps%tlai))
```

Ah! So...

⇒ TLAI was the “field name”

⇒ tlai is the variable name

`grep tlai */*` and see what was done to get this variable to history:

- declared in `clmtype.F90` and `clmtypeInitMod.F90` and
- listed in `histFldsMod.F90` at the very least

BONUS EXERCISE

- copy relevant files to SourceMods
- copy relevant lines of code and modify

- - -

- some variables not in history because...

```
call hist_addfld2d (fname='ALBGRD', units='proportion', type2d='numrad', &  
    avgflag='A', long_name='ground albedo (direct)', &  
    ptr_col=cps%albgrd, default='inactive')
```

What to do?

- In SourceMods: remove “, default='inactive'” in histFldsMod.F90
- Build new executable
- Submit the run

Where to find help ?

The screenshot shows the CESM Models website with a navigation bar at the top containing 'CESM Models' and 'Home » CESM Models » CESM1.2 Series Public Release'. The main content area is titled 'CESM1.2 SERIES PUBLIC RELEASE' and includes sections for '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 grid of links for various model components: CESM1.2 (User's Guide, Machines, Resolutions, Component sets, Model Component Name lists, \$CASEROOT xml files), Atmosphere Models (Community Atmosphere Model, Climatological Data Model), Land Models (Community Land Model, Climatological Data Model), Sea Ice Models (Community Ice Code, Climatological Ice Model), Coupler (CESM Coupler), Ocean Models (Parallel Ocean Program, Climatological/Slab-Ocean Data Model), Land Ice Models (Community Ice Sheet Model), and River Models (River Transport Model, Climatological River Runoff Model). On the right side, there are additional sections: 'CESM PROJECT' (describing the Community Earth System Model), 'MODEL SOURCE CODE Copyright and Terms of Use' (providing information on source code access and registration), and 'REPORTING A PROBLEM' (instructions for users to report issues).

The CESM webpage is a gold mine for **model documentation**

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

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

Home » CESM Models » CESM1.2 Series Public Release

CESM Models

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-OSM, wacm)
- Climatological Data Model (cdcm)

Land Models

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

Sea Ice Models

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

Coupler

- CESM Coupler (CPL7)

Ocean Models

- Parallel Ocean Program (POP2, POP3)
- Climatological/Slab-Ocean Data Model (csdm)

Land Ice Models

- Community Ice Sheet Model (cismm, cism)

River Models

- River Transport Model (rtm)
- Climatological River Runoff Model (crrm)

CESM PROJECT

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

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

MODEL SOURCE CODE

Copyright and Terms of Use

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

Acquiring the Release Code

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

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

Acquisition of the code is made 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@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 Data Distribution Plan](#) documents the procedures for the storage and

About FAQ Contact Us

NCAR DiscussCESM COMMUNITY Earth System MODEL

FORUMS REGISTER LOGIN

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	19	46	CESM1.1.2 Release Announcement by aliceb July 30, 2013 - 11:07am
Bug reporting	120	335	Error in executing CESM 1.2.0 T85_gx1v6 compset B_2000 by yllouc@... 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 fyke@... August 5, 2013 - 2:43pm
Tools	4	15	-grid_file equivalent for CESM1.3 (user_grid_file)? by erik July 25, 2013 - 9:52pm
Software Development	188	563	CESM 1.0.4 run failed when initializing lnd component by jedwards 1 day 19 hours ago
General Discussion	209	546	basic example by jedwards August 6, 2013 - 2:59pm
Subversion Issues	11	24	CESM4 on yellowstone by jedwards August 5, 2013 - 11:44am
Tutorials	5	13	Basic B_1850 Compilation by strey2@... June 4, 2013 - 9:10am