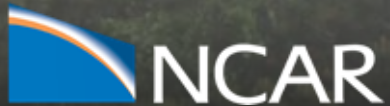


Wednesday Lab: Customizing, Debugging, and Modifying CESM

Cécile Hannay

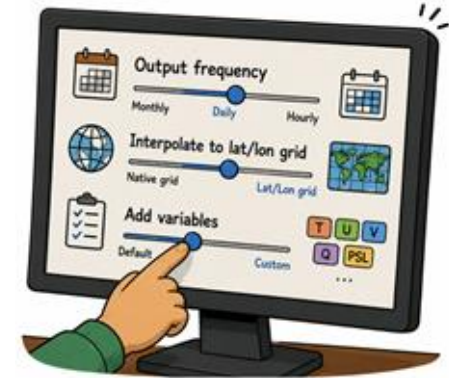


CESM tutorial, July 8, 2026



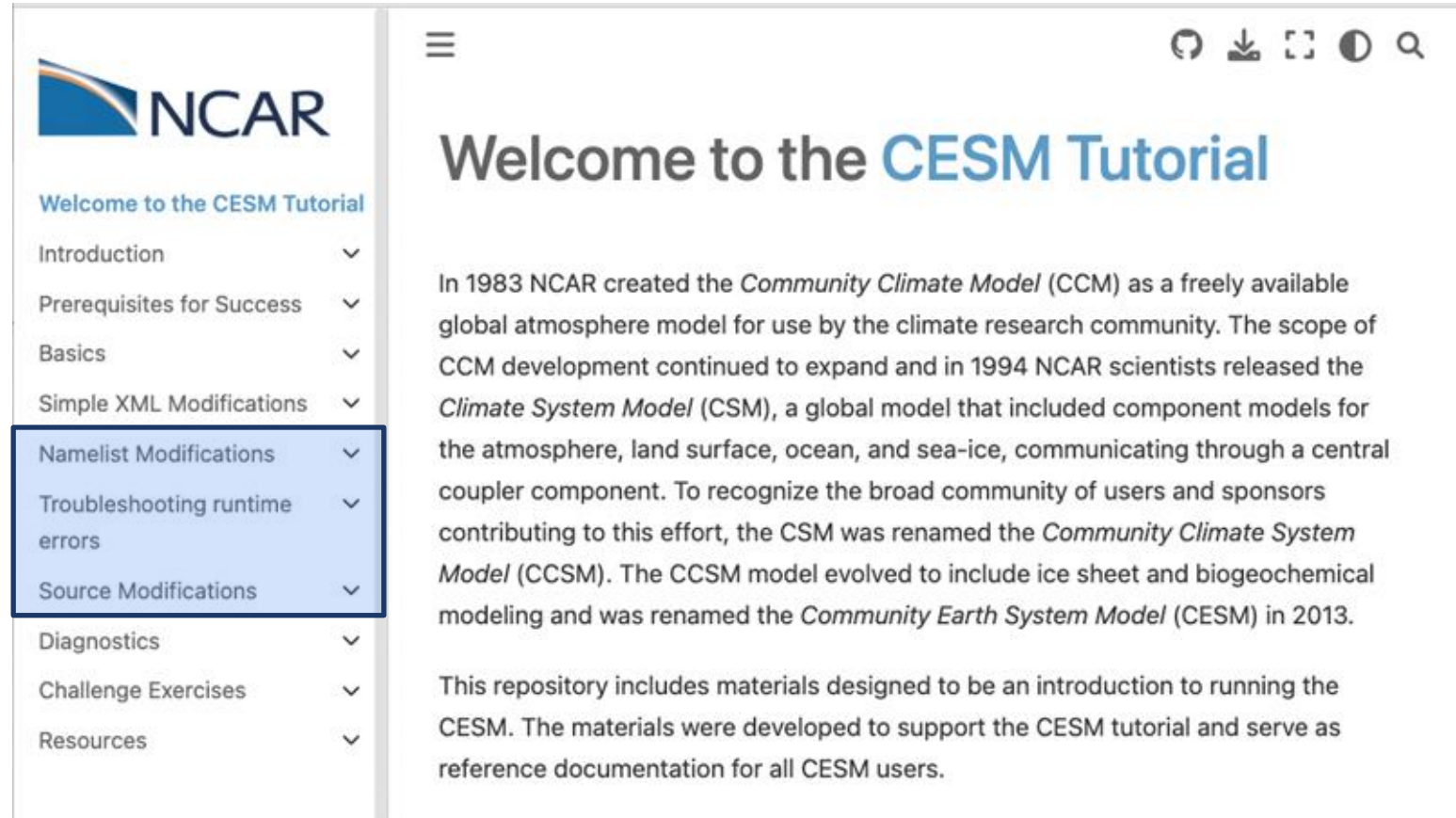
Today you'll learn three skills every CESM user needs

- **Customize a simulation (Namelist Modifications)**
- **Diagnose a failed run (Troubleshooting model errors)**
- **Modify the model code (Code Modifications)**



Which sections of the website are we covering?

- **Namelist Modifications**
- **Troubleshooting model errors**
- **Code Modifications**



<https://ncar.github.io/CESM-Tutorial/README.html>

**“I can only show you the door.
You're the one that has to walk through it”**

(The Matrix, 1999)



I can explain CESM for hours, but real learning happens when **YOU** run the model yourself.

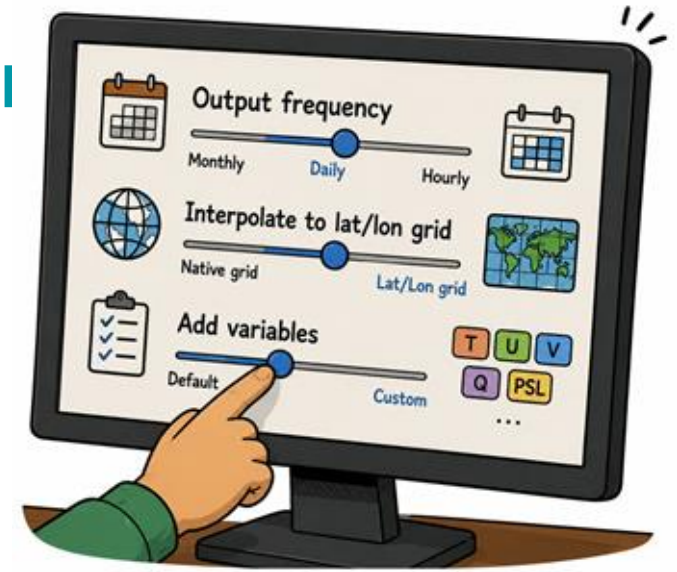
You learn by running experiments, asking questions, making mistakes, fixing them, and trying again. Every failed run teaches you something.

These practicals are the beginning of that journey.

Customize a simulation (Namelist Modification)

Imagine you're running CESM and realize:

- *I need daily output instead of monthly.*
- *I want to output additional history variables.*
- *I want to interpolate CAM history files on a regular latitude–longitude grid.*
- *...and many more.*



Where do I make these changes?

→ **Namelists.**

Namelist Modifications

- What are namelists? How to modify them?

Namelist Modifications

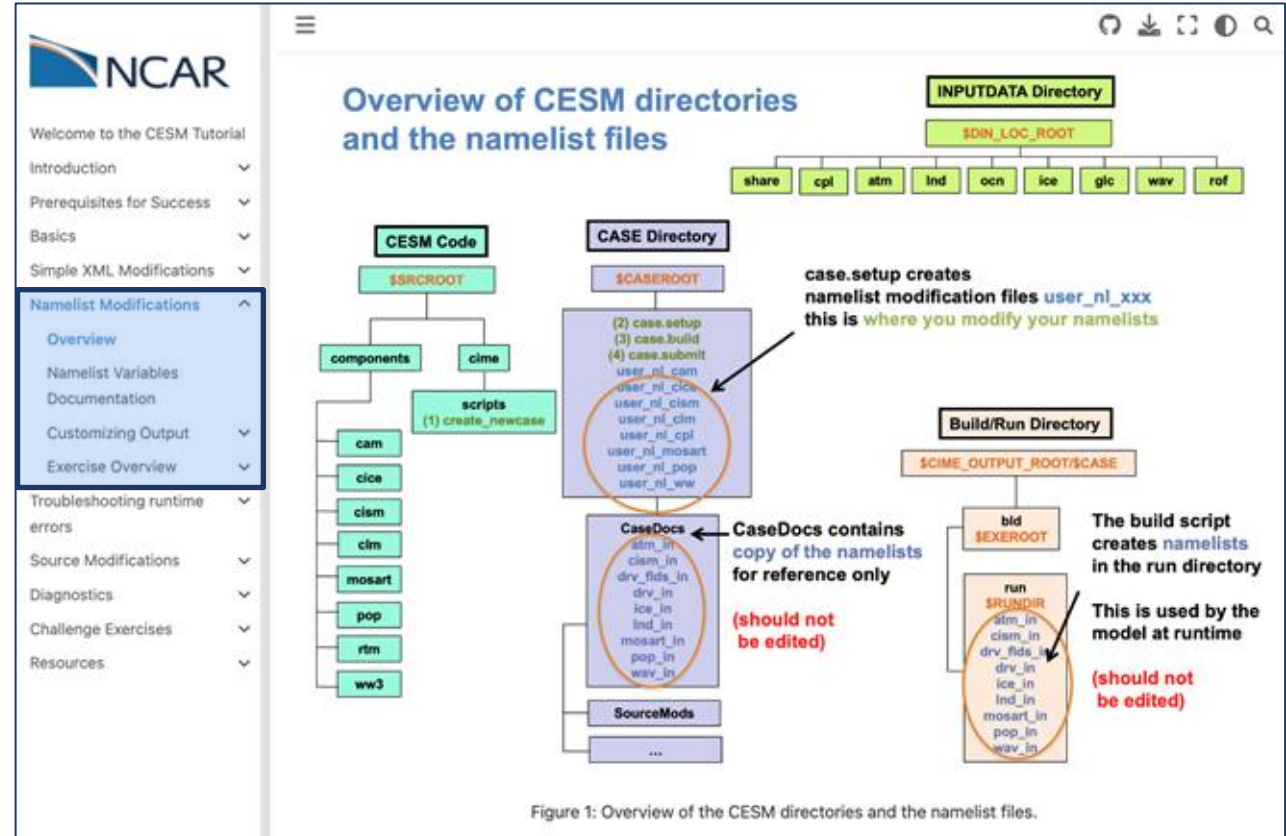
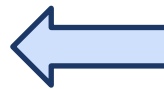
Overview

Namelist Variables

Documentation

Customizing Output

Exercise Overview



Go step by step into the chapter:
Namelist Modifications

Troubleshooting runtime errors

Yesterday everything worked.

But today...

```
ERROR  
Segmentation fault  
Model abort
```



Now what?

Where do you even begin?

Today you'll learn how to diagnose runtime errors instead of guessing.

Troubleshooting runtime errors

- My run crashed. Where/how can I find information about the crash?

Troubleshooting runtime errors

The log files

Adding debugging info

Exercise Overview



Go step by step into the chapter:
Troubleshooting runtime errors

NCAR

Welcome to the CESM Tutorial

- Introduction
- Prerequisites for Success
- Basics
- Simple XML Modifications
- Namelist Modifications
- Troubleshooting runtime errors**
 - The log files**
 - Adding debugging info
 - Exercise Overview
- Source Modifications
- Diagnostics
- Challenge Exercises
- Resources

The log files

The log files are files in the format `$model.log.*`

- When the model is running, it produces the log files in the **run directory**: `RUNDIR`.
- When the run completes successfully, the model moves the log files into the **archive** directory: `DOOUT_S_ROOT`
- When the model fails, the log files remains in the run directory `RUNDIR`

Overview of CESM directories and Log files

INPUTDATA Directory

- share
- cpl
- atm
- ind
- ocn
- ice
- glc
- wav
- rot

CESM Code

- srcroot
- components
 - cam
 - sice
 - clim
 - mosart
 - pop
 - rim
 - wr3
- time
 - scripts
 - (1) create_hirescase

CASE Directory

- caseroot
- ~Ncases/case01
 - (1) ccesm_setup
 - (2) ccesm_build
 - (3) ccesm_run

Build/Run Directory

- SCHEME_OUTPUT_ROOTCASE
- bid
 - SEXDIR
 - run
 - SEXDIR
 - *.log*

Archive Directory

- DOOUT_S_ROOT
- atm
- ...
- ind
- logs
- ...
- rest

Logs files:

- In RUNDIR while it is running
- moved to CASE/logs when run completes

QUICK TIPS

If the model crashes the log files will stay in the run directory RUNDIR

Source Modifications

Sooner or later you'll realize

"CESM **almost** does what I want..."

Maybe you want to

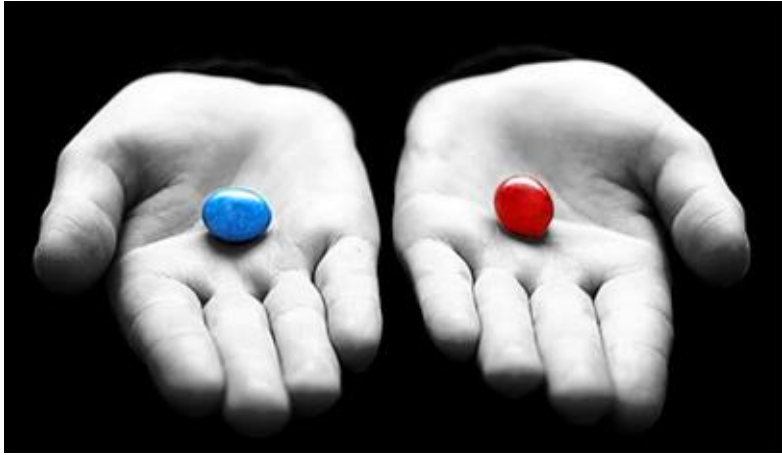
- output a variable that CESM doesn't currently output
- change a parameter
- test a new scientific idea

At that point, namelists aren't enough.

You need to modify the source code.



Source Modifications: Warming



Your choice: The **Red** Pill or the **Blue** Pill

The Matrix (1999): Neo, the main character is offered the choice between a red pill and a blue pill.

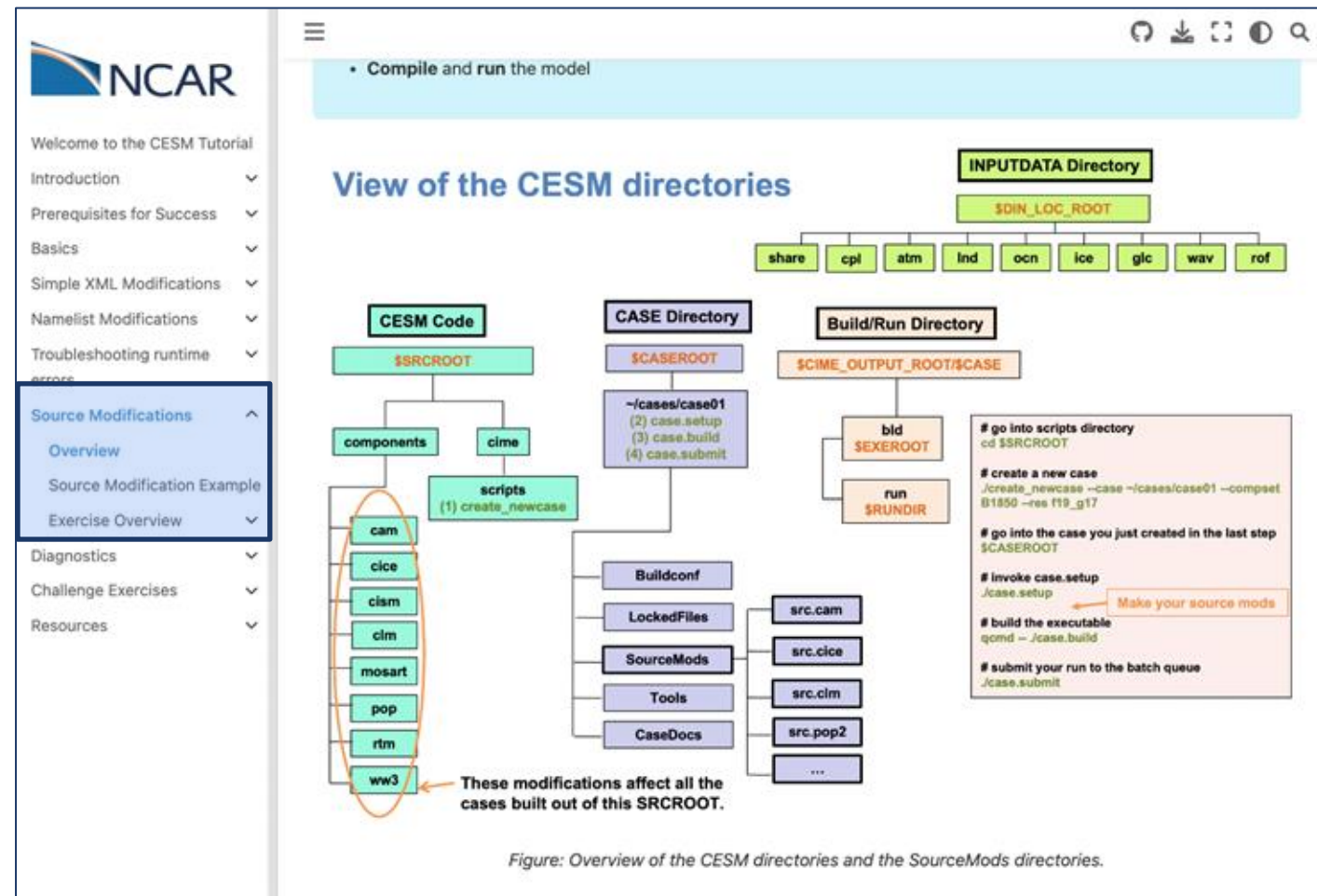
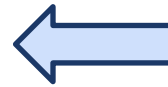
- The **blue pill** would allow him to remain in the Matrix (a fictional computer-generated world)
- The **red pill** would lead to his "escape" from the Matrix into the real world and embracing the sometimes painful truth of reality.

There is no going back !!

Source Modifications

- For instance, let's add a variable into CAM

Source Modifications	^
Overview	
Source Modification Example	
Exercise Overview	▼



Go step by step into the chapter:
Source Modifications

Today's goal

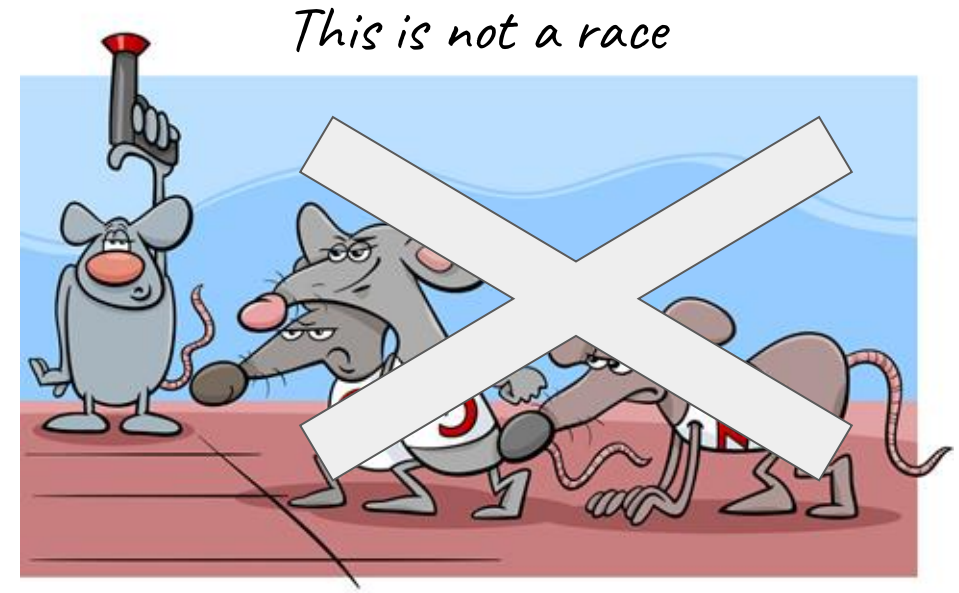
By the end of today you should be comfortable

- ✓ modifying namelists**
- ✓ reading log files and diagnosing runtime errors**
- ✓ making simple source-code changes**

These are the skills you'll use every time you work with CESM.

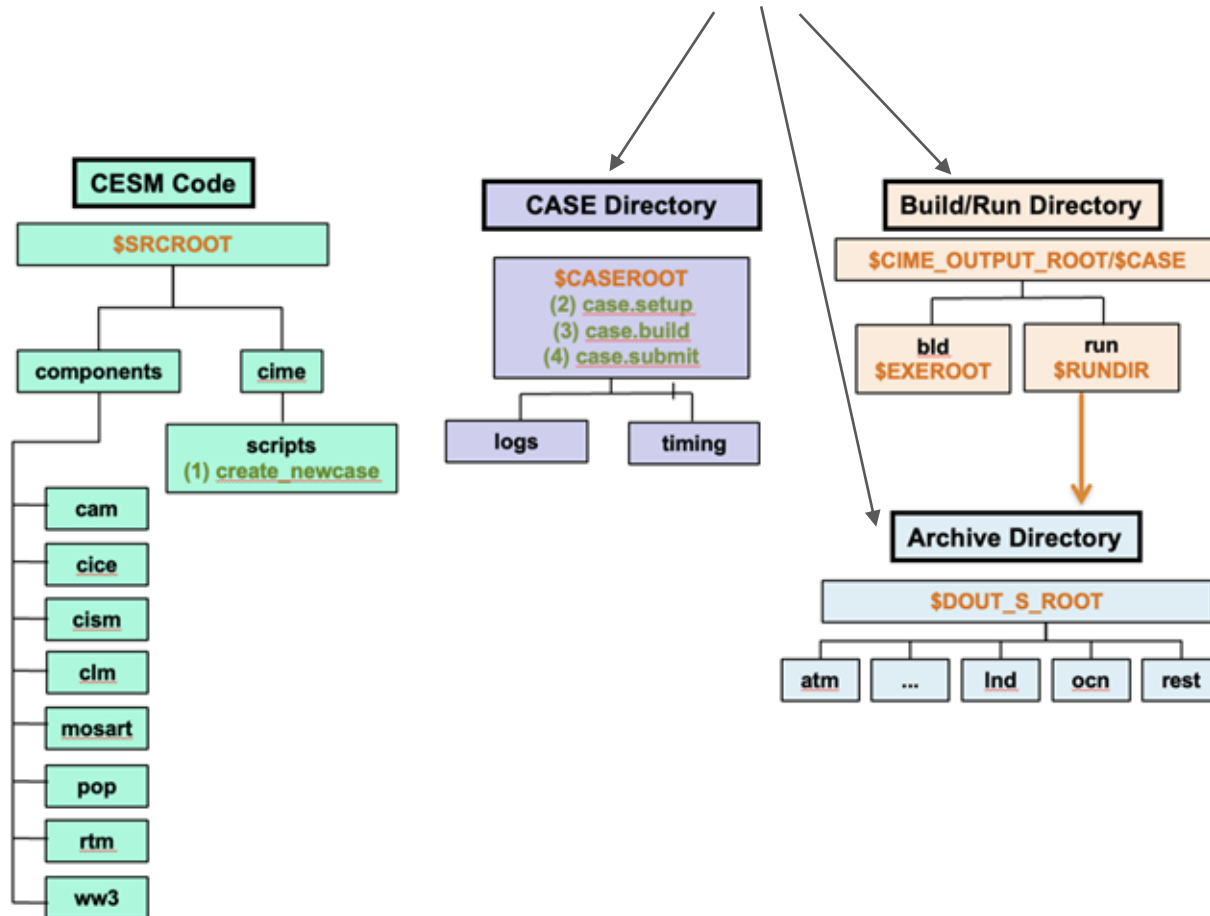
FAQs

- I have not finish Monday's exercise.
What should I do?
- I already completed all of these chapters.
What should I do?



FAQs

- Everything is called ‘**b1850.basics**’. I am a bit confused.



For the current tutorial on Derecho, the paths are:

- `$SRCROOT = /glade/u/home/$USER/code/my_cesm_code`
- `$CASEROOT = /glade/u/home/$USER/cases/$CASE`
- `$EXEROOT = /glade/derecho/scratch/$USER/$CASE/bld`
- `$RUNDIR = /glade/derecho/scratch/$USER/$CASE/run`
- `$DOUT_S_ROOT = /glade/derecho/scratch/$USER/archive/$CASE`

Questions ?



Courtesy: Kolya Dols

The CESM row ?

