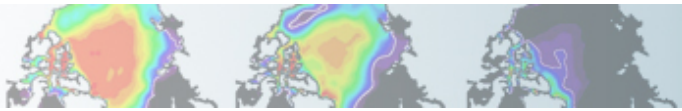


Namelist and Code Modifications

Part 1: Namelist Modifications

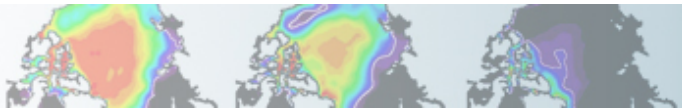
Part 2: Code Modifications

Part 3: Exercises and Quiz

Cecile Hannay, CAM Science Liaison
Atmospheric Modeling and Predictability Section
Climate and Global Dynamics Division

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

(The Matrix, 1999)



Part 1: Namelist Modifications

In this section, we will:

- review the "CESM flow" and how to make namelist changes,

- see where to find documentation for namelist variables

- as an illustration, we will customize the output history files to get high frequency output

Review: The 4 commands to run CESM

Set of commands to build and run the model on ”cheyenne”

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# if you use tcsh shell
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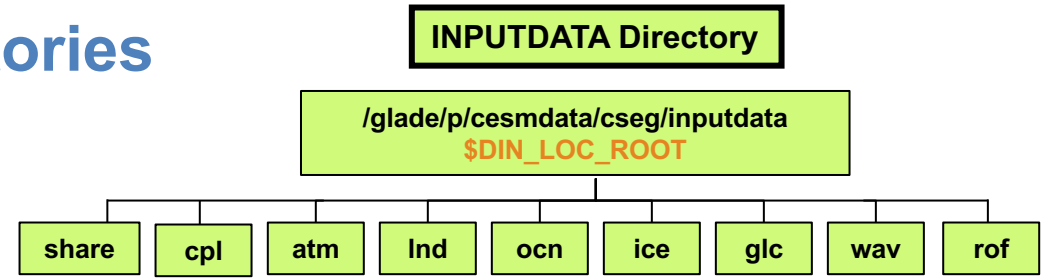
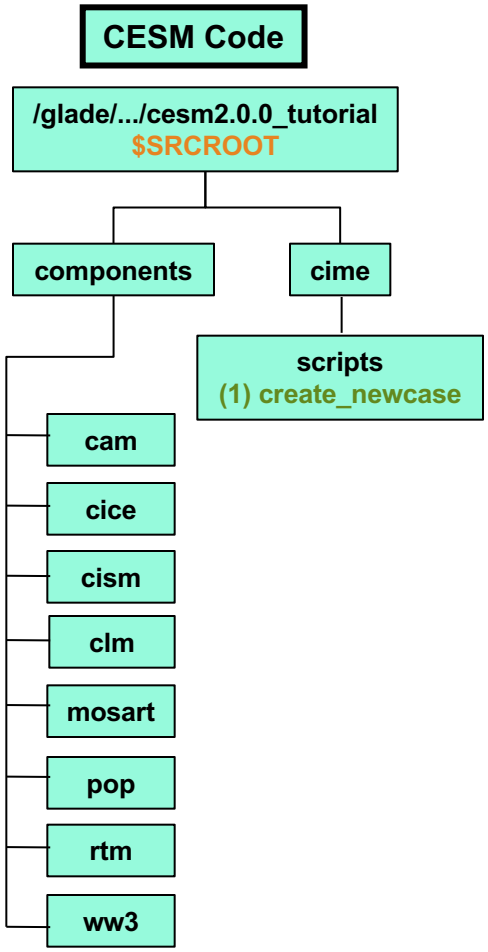
For tutorial only

“qcmd” is for Cheyenne only

Overview of CESM directories before create_newcase



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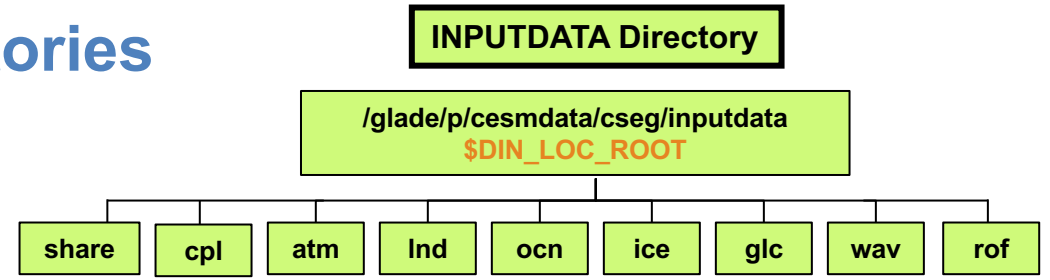

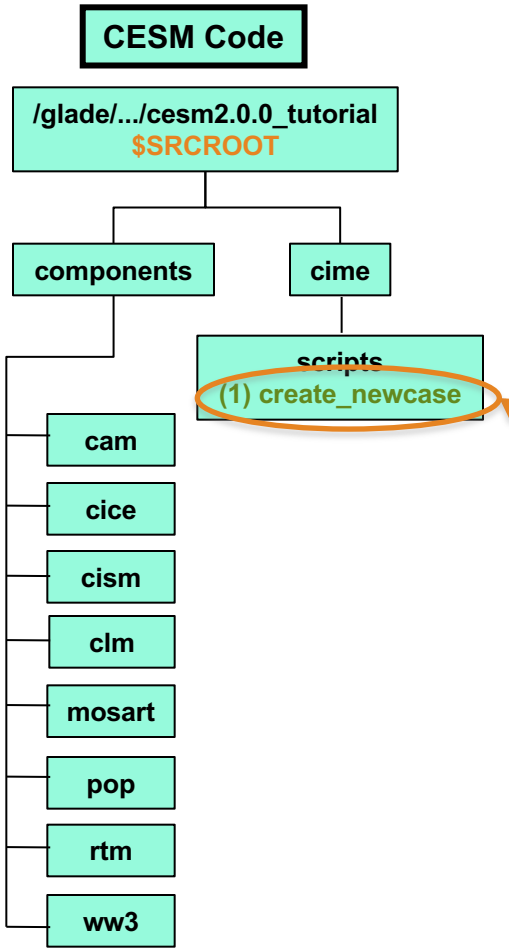


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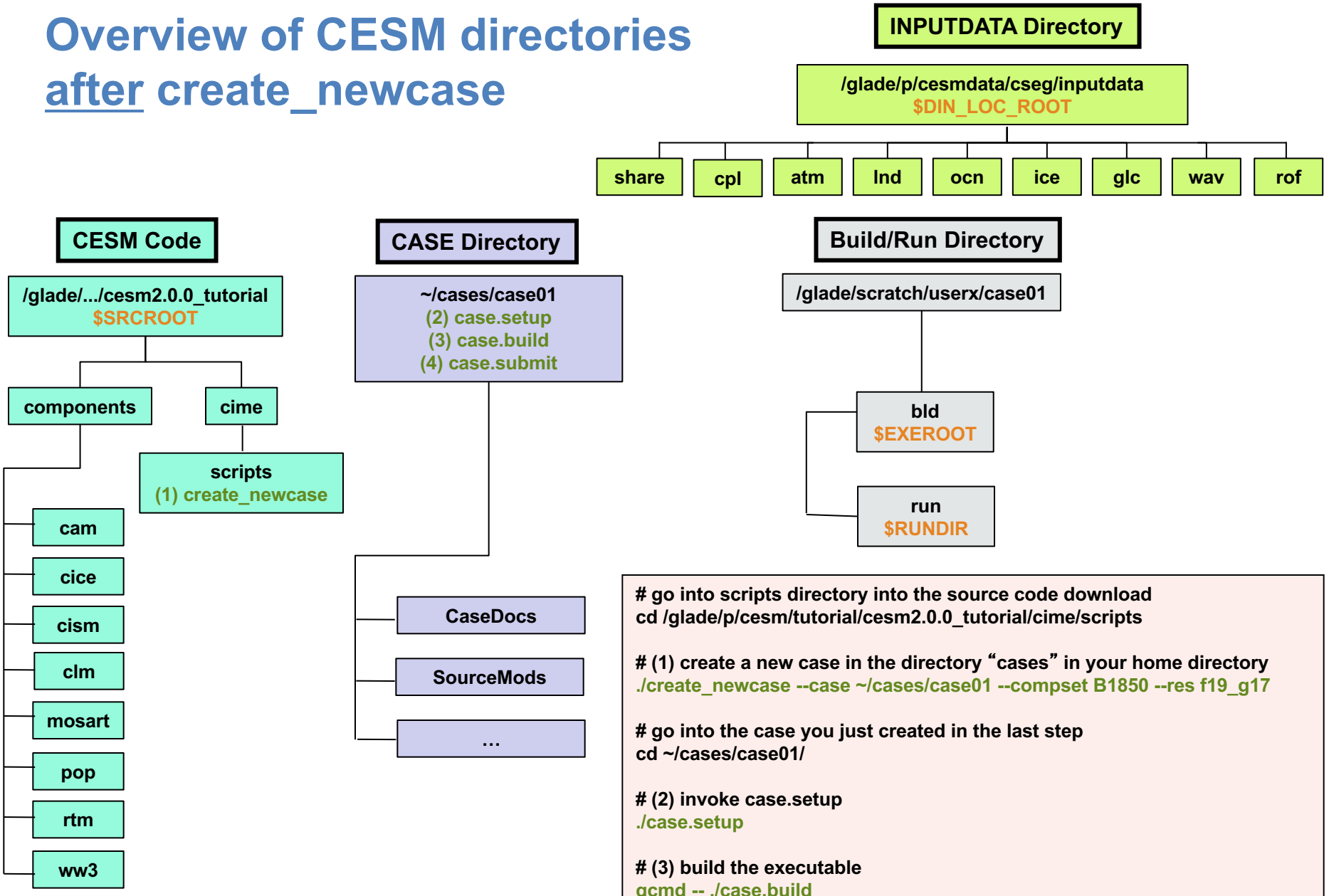


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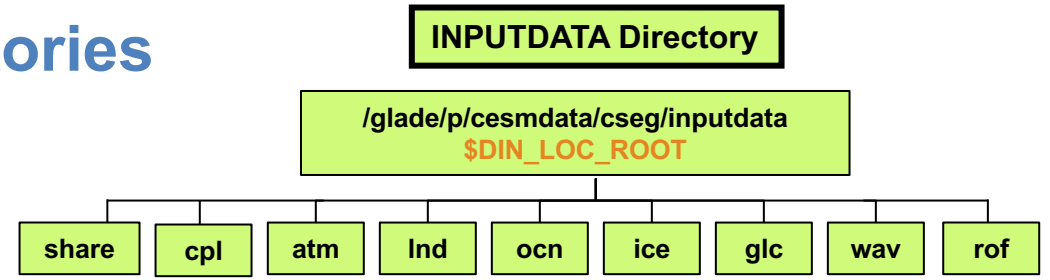

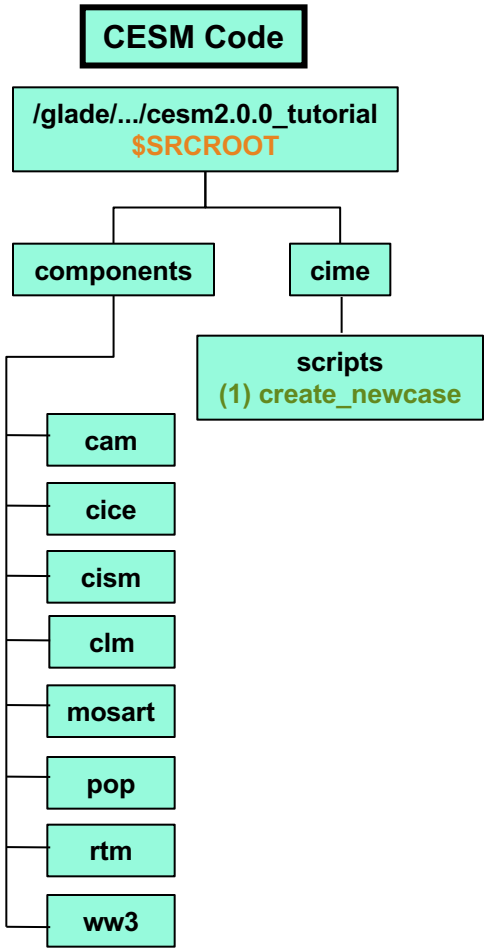

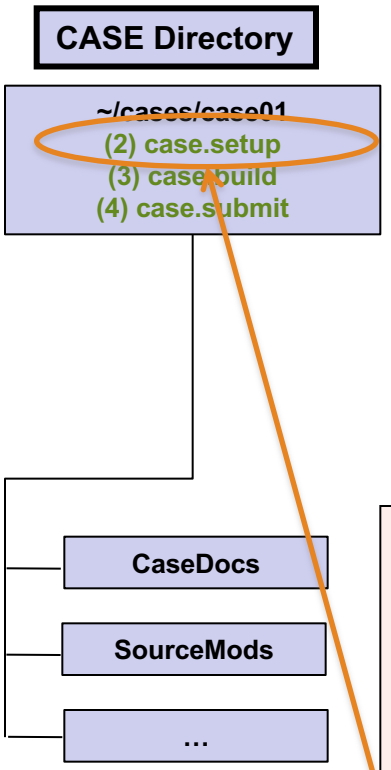

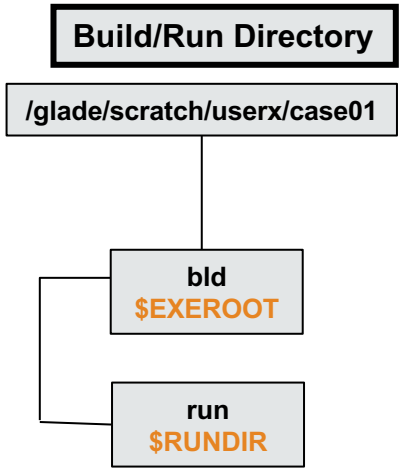


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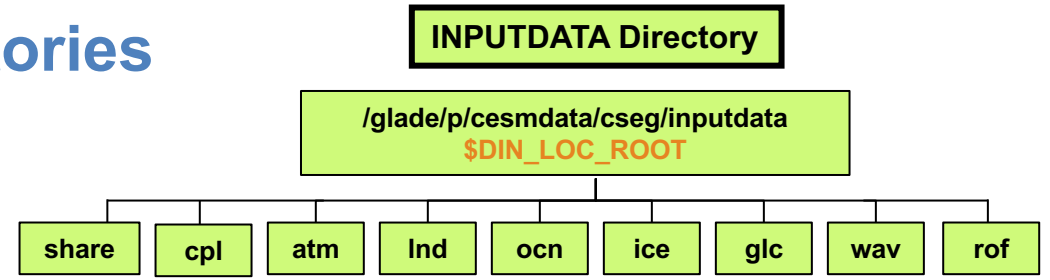

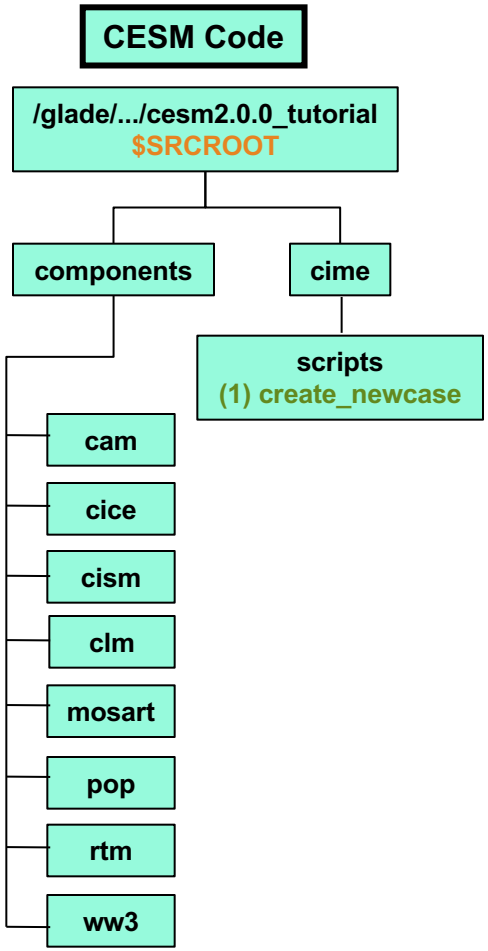

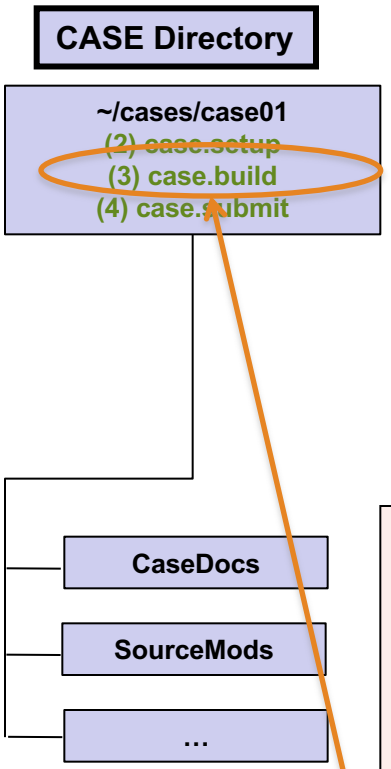

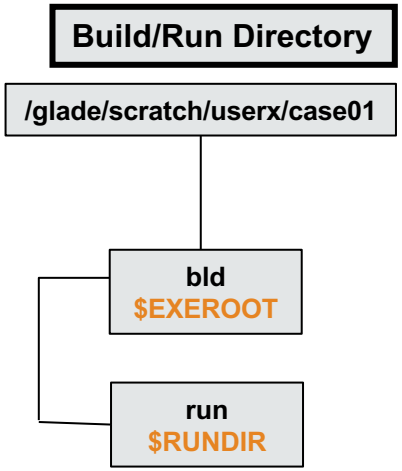


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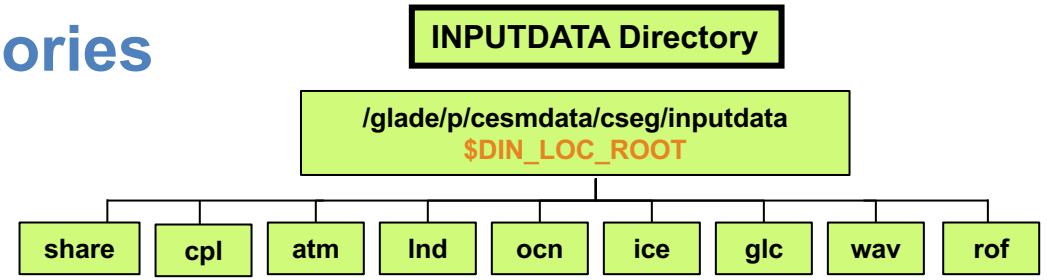

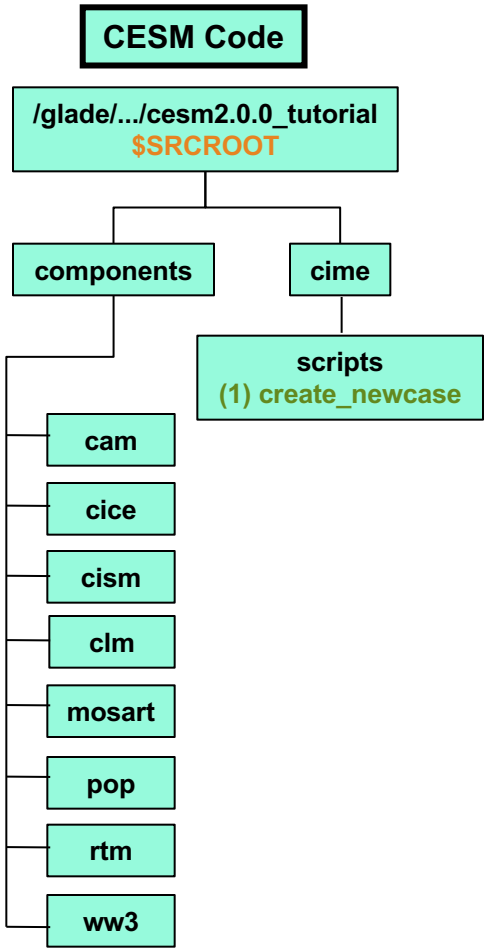

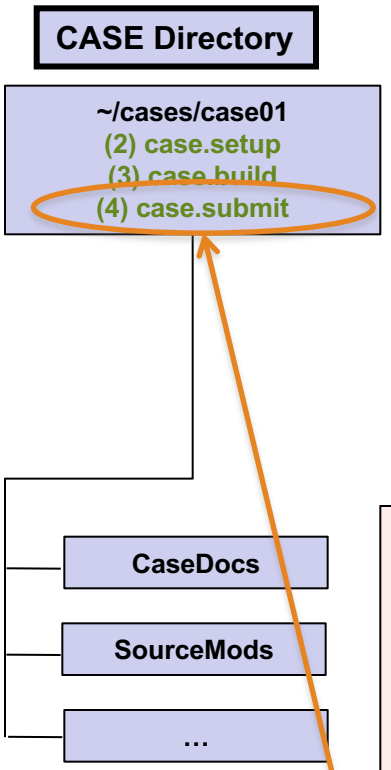

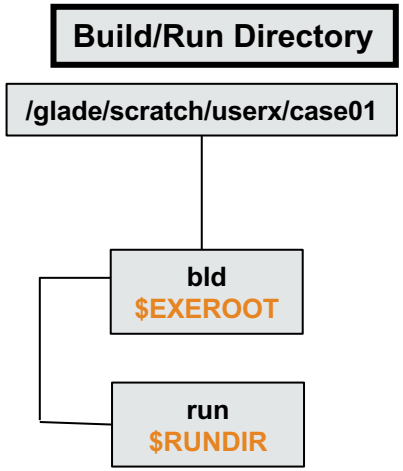


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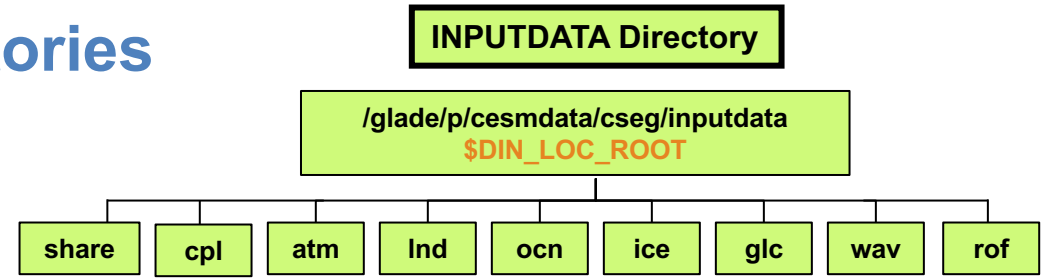

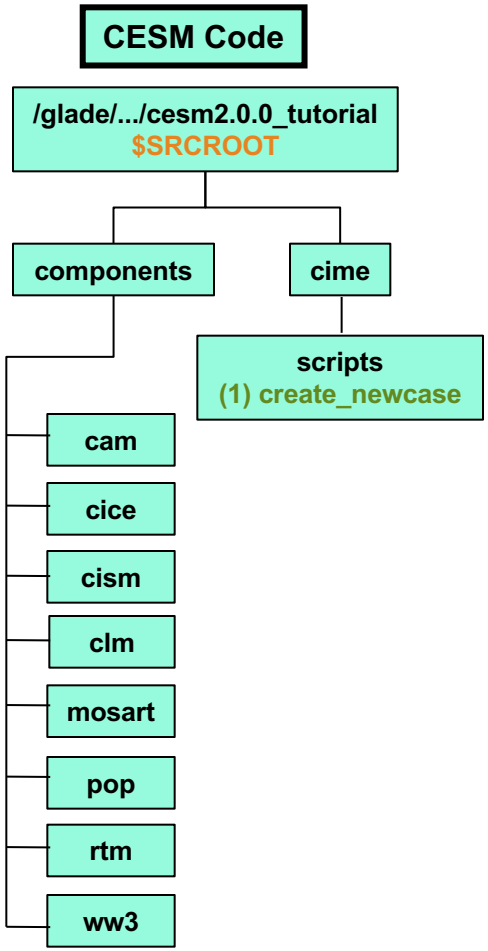

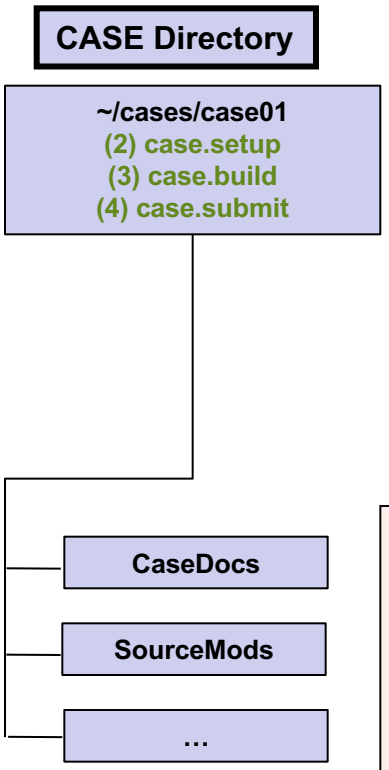

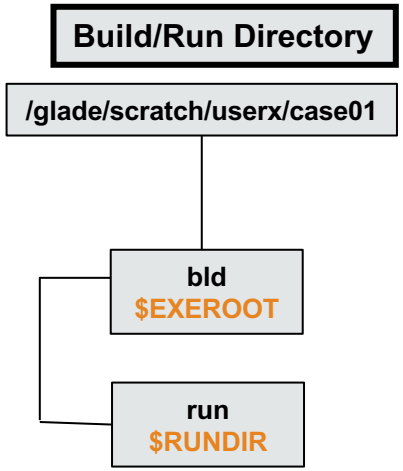


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This is when you can modify the namelists

Overview of CESM directories + 4 CESM commands

INPUTDATA Directory

/glade/p/cesmdata/cseg/inputdata
$DIN_LOC_ROOT

share | cpl | atm | lnd | ocn | ice | glc | wav | rof

CESM Code

/glade/.../cesm2.0.0_tutorial
$SRCROOT

components | cime

cam
cice
cism
clm
mosart
pop
rtm
ww3

scripts
(1) create_newcase

CASE Directory

~/cases/case01
(2) case.setup
(3) case.build
(4) case.submit
user_nl_cam
user_nl_cice
user_nl_cism
user_nl_clm
user_nl_cpl
user_nl_mosart
user_nl_pop
user_nl_ww

case.setup creates namelist modification files user_nl_xxx
this is where you modify your namelists

CaseDocs
atm_in
cism_in
drv_flds_in
drv_in
ice_in
lnd_in
mosart_in
pop_in
wav_in

CaseDocs contains copy of the namelists for reference only

(should not be edited)

SourceMods

...

Build/Run Directory

/glade/scratch/userx/case01

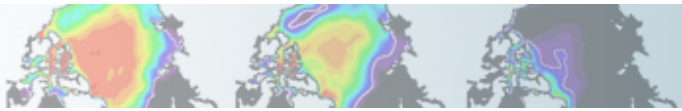
bld
$EXEROOT

run
$RUNDIR
atm_in
cism_in
drv_flds_in
drv_in
ice_in
lnd_in
mosart_in
pop_in
wav_in

The build script creates namelists in the run directory

This is used by the model at runtime

(should not be edited)



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- review the "CESM flow" and how to make namelist changes,

- see where to find documentation for namelist variables

- as an illustration, we will customize the output history files to get high frequency output

Where to find info about namelists ?

http://www.cesm.ucar.edu/models/cesm2.0/

In "Prognostic Components" or in "Components Configuration Settings", you can find information about namelist variables in:
"Component Fortran Namelist settings"

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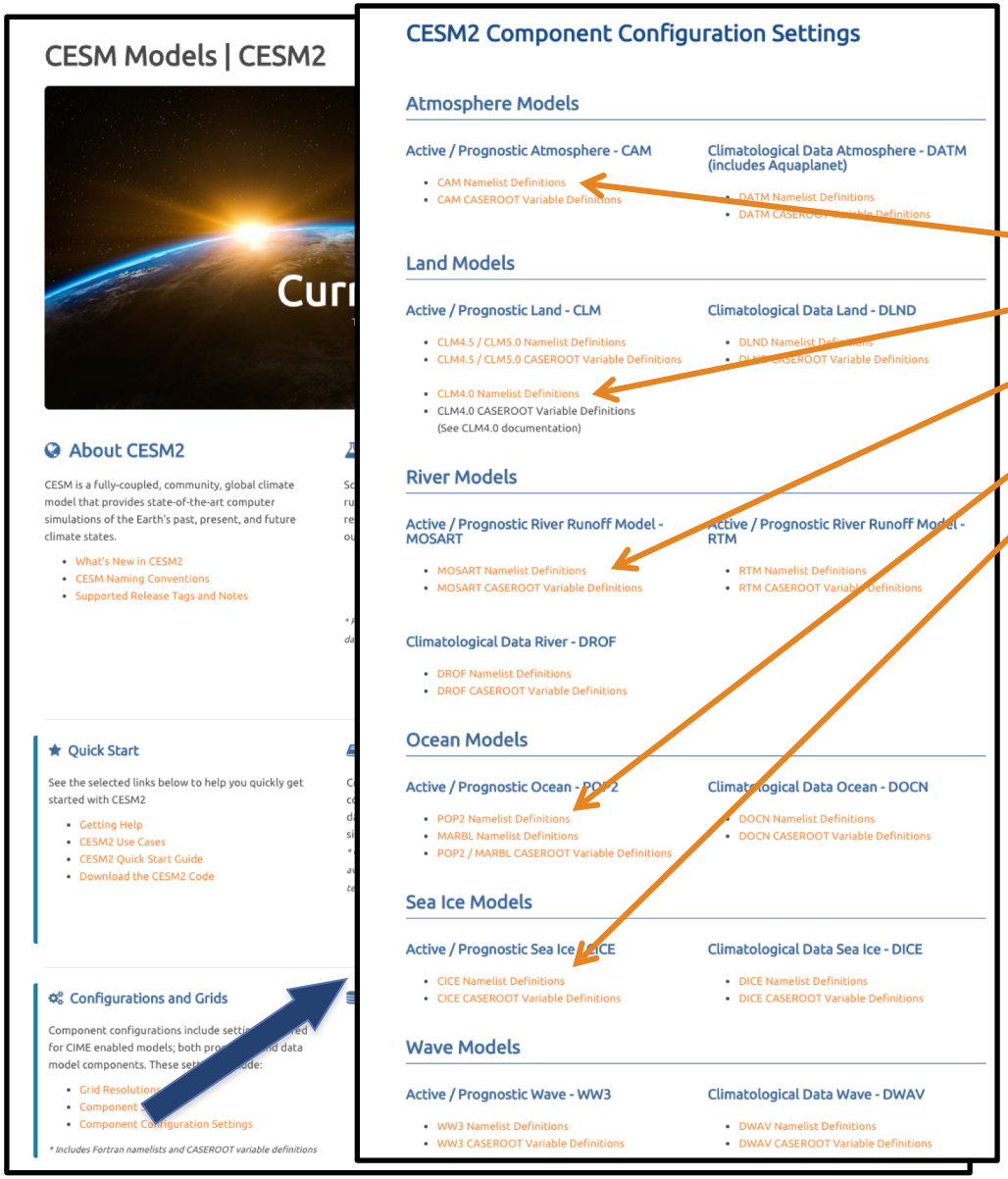

Namelist definitions for every component

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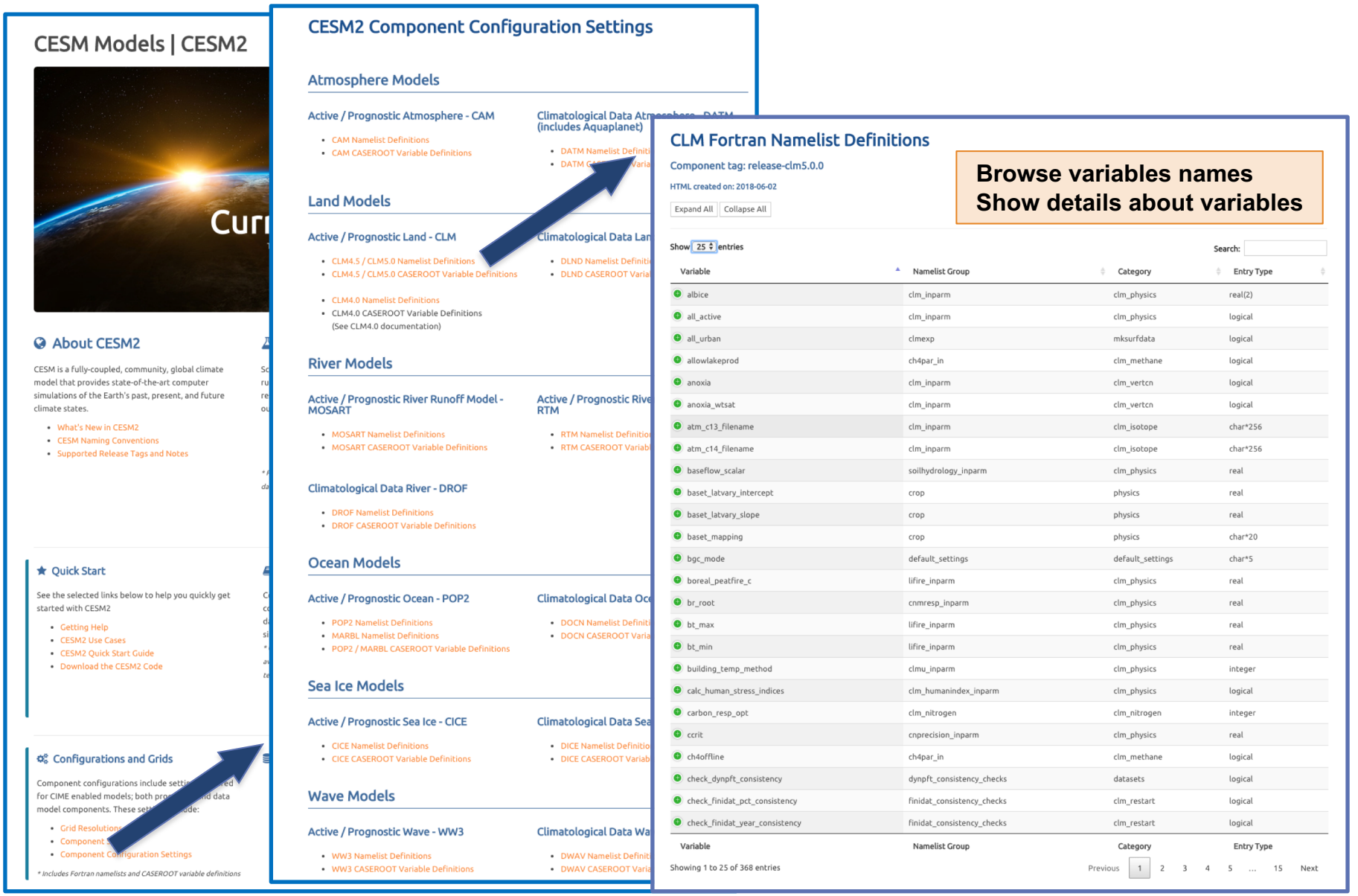

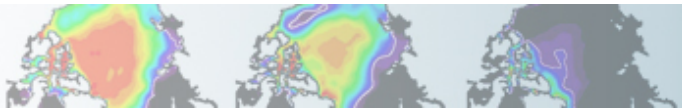

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Let's change the output frequency in CAM**

By default, CESM outputs monthly average history files but you can output at other frequency.

For instance: to change the output frequency of a CAM history file from monthly average to daily average,
we use the namelist variable: *nhtfrq=-24*

***** In this tutorial, examples will be coming from the atmospheric. Concepts are transferable to other model components.***

Customizing CAM history files

In this section, we will cover:

- **how to change the output frequency**
- **how to output extra variables**
- **how to output extra history files**
- **how to control the number of time samples written to a history file**

This can be achieved with 3 namelist variables:

- ***nhtfrq*: sets the output frequency**
- ***fincl*: add variables to the history file**
- ***mfilt*: maximum number of time samples written to a history file**

Customizing CAM history files: nhtfrq, mfilt

The default history file from CAM is a monthly average.

We can change the output frequency with the namelist variable *nhtfrq*

If nhtfrq=0, the file will be a monthly average
If nhtfrq>0, frequency is input as number of timesteps.

If nhtfrq<0, frequency is input as number of hours.

For instance to change the history file from monthly average to daily average, we set the namelist variable:
nhtfrq = -24

To control the number of timesteps in the history file, we can use the variable *mfilt*
For instance, to specify that we want one time sample on each history file, we set the namelist variable:

mfilt = 1

Customizing CAM history files: fincl

You can output up to 6 history files: "h0", "h1", …, "h5".

The file "h0" contains the default variables (in the code: "call add_default"). This includes the variables necessary for the AMWG package.

For the files "h1" to "h5", the user has to specify the variables to output.

To control the list of fields in the history files we can use the namelist variables

h0	*h1*	…	*h5*
fincl1	*fincl2*	…	*fincl6*

For instance, the line:

fincl1 = 'PRECT'

is used to add the field 'PRECT' to the file "h0"

Customizing CAM history files: fincl

Using a ":" following a field gives the averaging flag for the output field.

Valid flags are:
I for instantaneous,
A for average,
M for minimum,
X for maximum.

For instance, the line:

fincl1 = 'PRECT:M'

is used to add the minimum of 'PREC' to the file "h0"

Example of customizing history files

For instance, in addition to the monthly history file "h0", we want to output a file "h1" with instantaneous values of T, Q, U, V and OMEGA every 3 hour. We can use:

fincl2 = 'T:I','Q:I','U:I','V:I', 'OMEGA:I'
nhtfrq = 0, -3

Notice that it is equivalent to:

fincl2 = 'T:I','Q:I','U:I','V:I', 'OMEGA:I'
nhtfrq(1) = 0
nhtfrq(2) = -3

NB: If you plan to run the AMWG diagnostic package, it is recommended to leave the "h0" file untouched and to add extra history files.

Outputting high frequency data in other components

Here is a few variables to control output frequency of land, ice and ocean

CLM

hist_nhtfrq: output frequency of the history file

hist_mfilt: number of samples on each history file

hist_fincl: adding variables and auxiliary history files

Example

user_nl_clm to output 4 extra history files with daily, six-hourly, hourly, and every time-step values of TG and TV (leaving the primary history files as monthly):

hist_fincl2 = 'TG', 'TV'

hist_fincl3 = 'TG', 'TV'

hist_fincl4 = 'TG', 'TV'

hist_fincl5 = 'TG', 'TV'

hist_nhtfrq = 0, -24, -6, -1, 1

http://www.cesm.ucar.edu/models/cesm2.0/namelists/clm_nml.html

Outputting high frequency data in other components

CICE

histfreq: Frequency of output written to history files ('1', 'm', 'd', 'y', …)

histfreq_n: Frequency history data is written to history files

hist_avg: if false => instantaneous values

if true => time-averages

Example

user_nl_cice to output an extra history file with daily values (leaving the primary history file as monthly):

histfreq = 'm','d','x','x','x'

histfreq_n = 1,1,1,1,1

See: http://www.cesm.ucar.edu/models/cesm2.0/namelists/cice_nml.html

Outputting high frequency data in other components

POP2

tavg_freq = frequency at which the model fields are written

tavg_freq_opt = units of time for 'tavg_freq' ('nmonth', 'nhour', 'once',…)

tavg_file_freq = frequency at which the model files are written

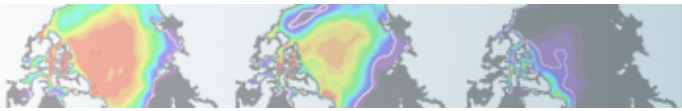
tavg_file_freq_opt = units of time for 'tavg_file_freq' ('nmonth', 'nhour', …)

http://www.cesm.ucar.edu/models/cesm2.0/namelists/pop2_nml.html

For instance, to output a timeseries of daily averages bundled into a monthly file:

```
tavg_freq_opt = 'nday'
tavg_freq = 1
tavg_file_freq_opt = 'nmonth'
tavg_file_freq = 1
```

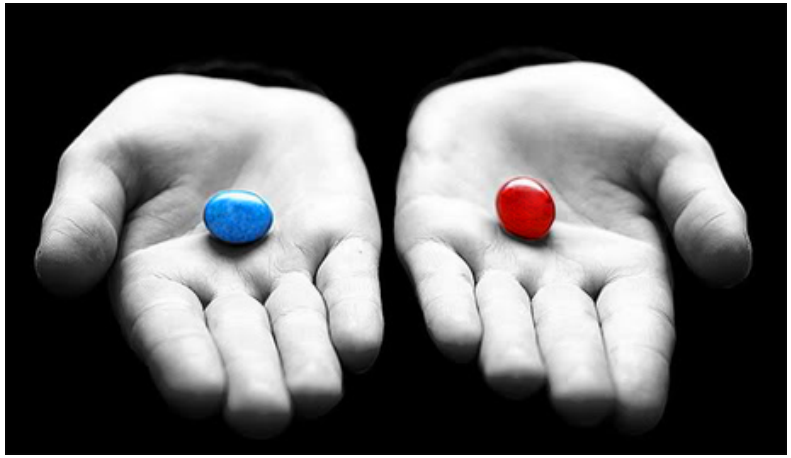
Changing tavg_nml variables is non standard
Do not modify these variables directly in user_nl_pop2
Use the workaround explained in user_nl_pop2



Part 2: Code Modification

In this section, we will learn how to do simple code modifications such adding a new variable

Your choice: The Red Pill or the Blue Pill



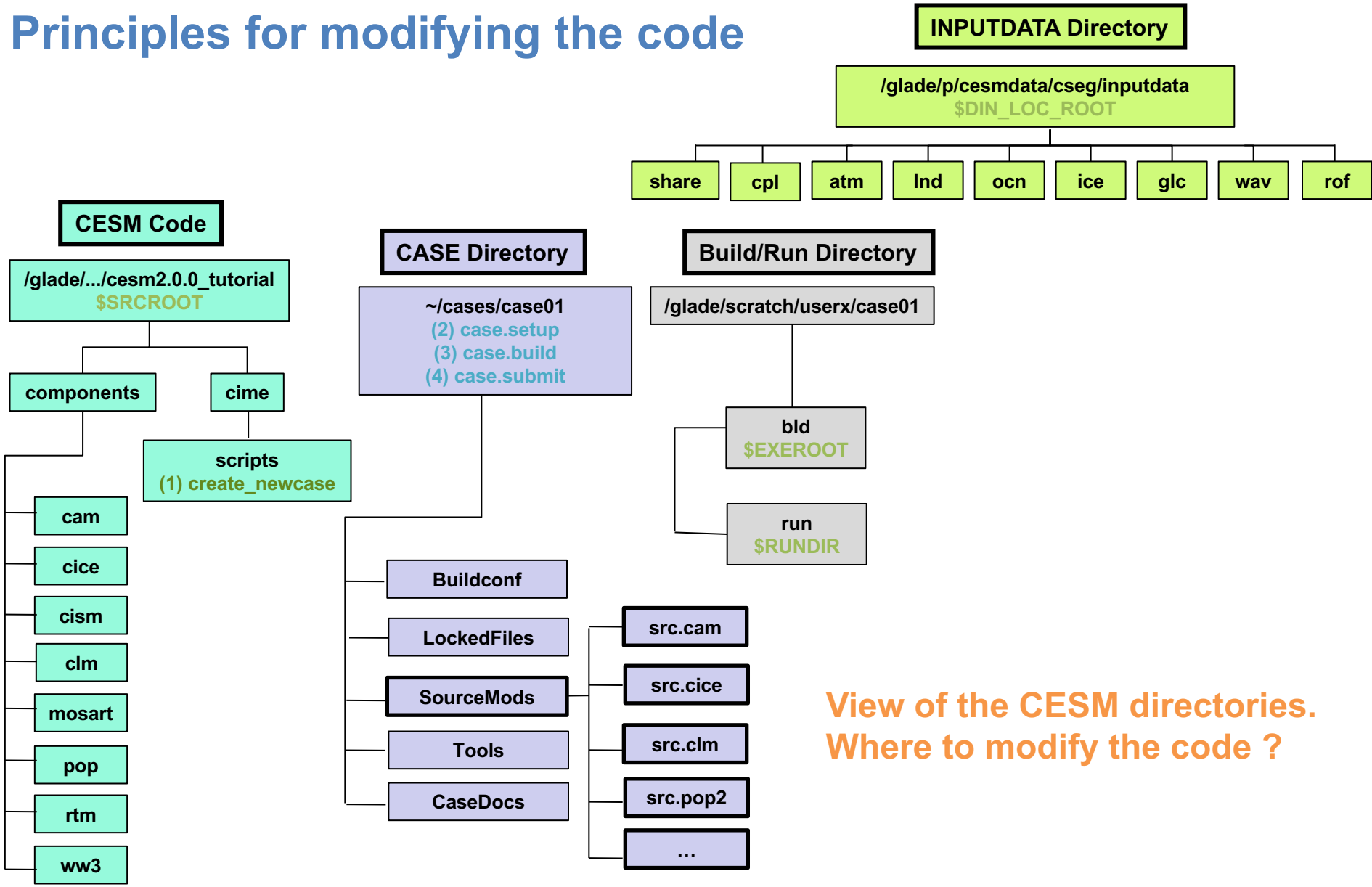
The Matrix (1999): Neo, the **main character is offered the choice between a red pill and a blue pill.**

-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.

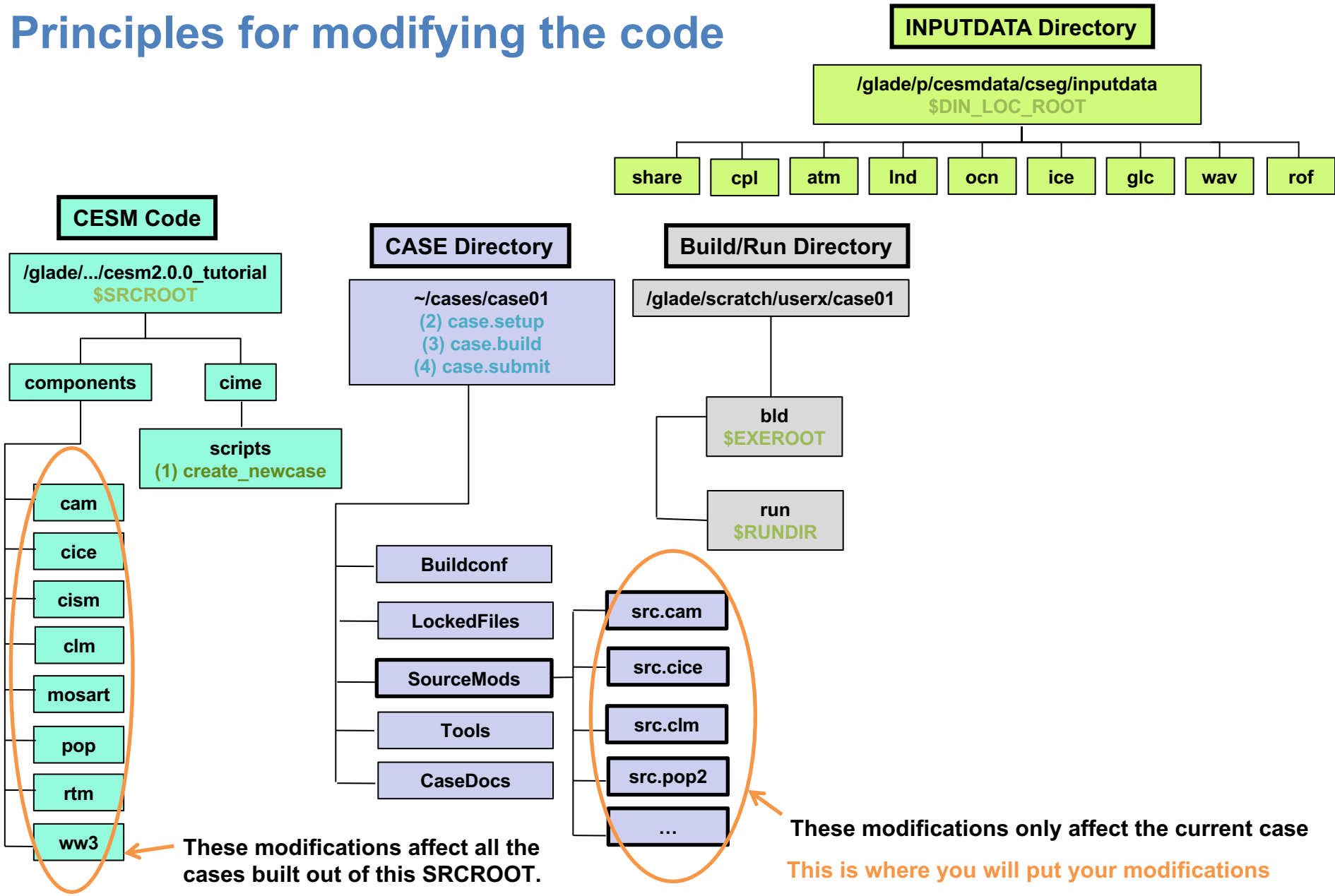
Courtesy: Andrew Gettelman

Principles for modifying the code

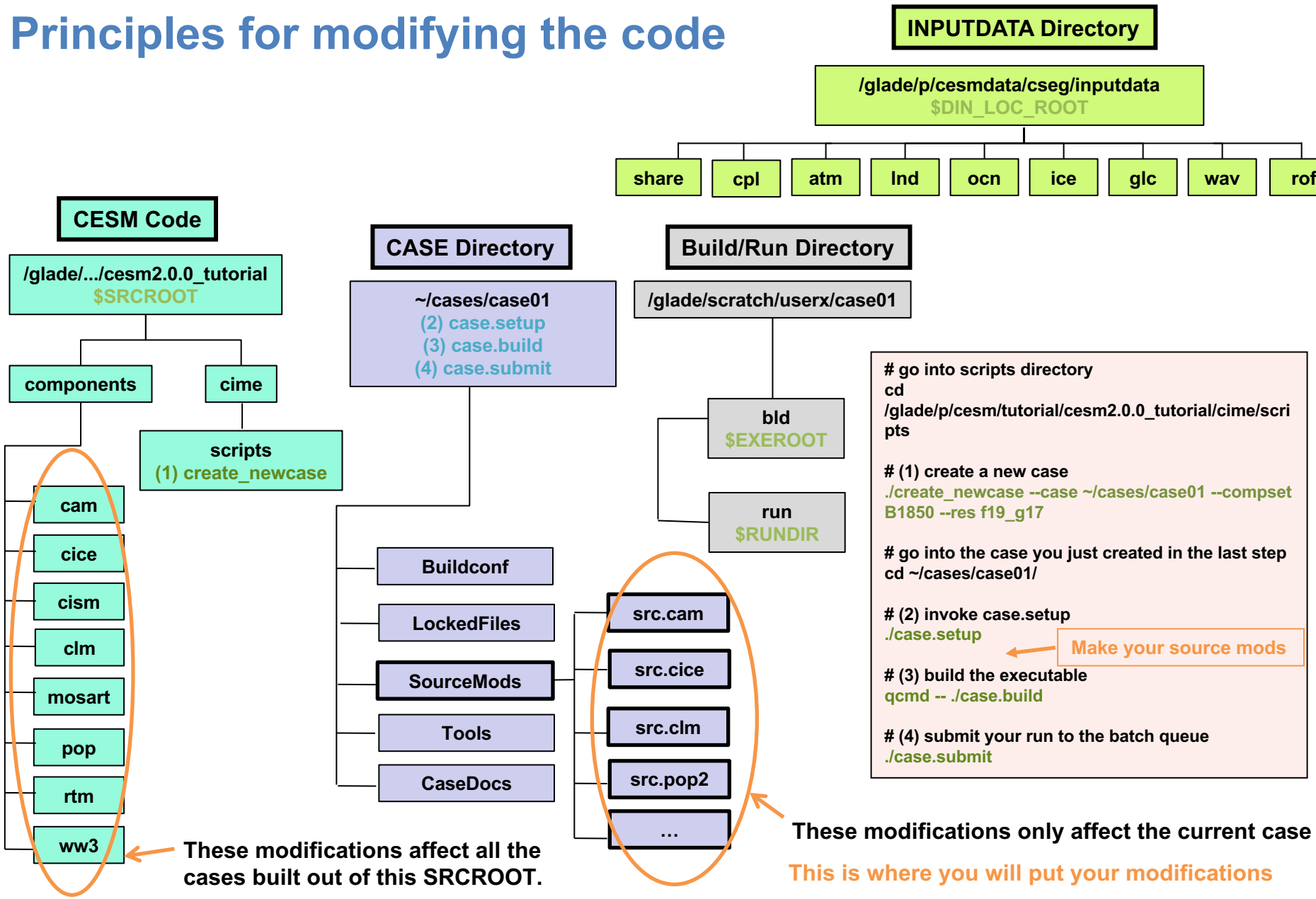


View of the CESM directories.
Where to modify the code ?

Principles for modifying the code



Principles for modifying the code



Modifying a subroutine

Steps to modify the code:

- **Find the subroutine you want to modify**

- **Copy this subroutine in SourceMods**

- **Make your mods**

- **Compile and run the model**

Output an extra variable

- **One common thing you may want to do is to add code to output a new variable**

- **For instance, CAM has a field to output the temperature at 500 mbar (T500) but not at 750mb.**
Let's add a field to output the temperature at 750 mbar (T750)

This can be done by a succession of calls:

call addfld ('T750', …) → **Add a field to master field list**

call add_default ('T750',…) → **Add this field to "h0" by default (optional)**

call outfld('T750', …) → **Collect values for this field and write to history file**

Syntax: addfld

addfld = Add a field to master field list

Field name

Units

Number of vertical levels:
single level :1
multi-level: pver or pverp

Averaging flag:
A = average
I = instantaneous

```
subroutine addfld (fname, units, numlev, avgflag, &
     long_name, decomp_type, [Optional arguments])
```

Field full name

Decomposition type (phys_decomp or dyn_decomp)

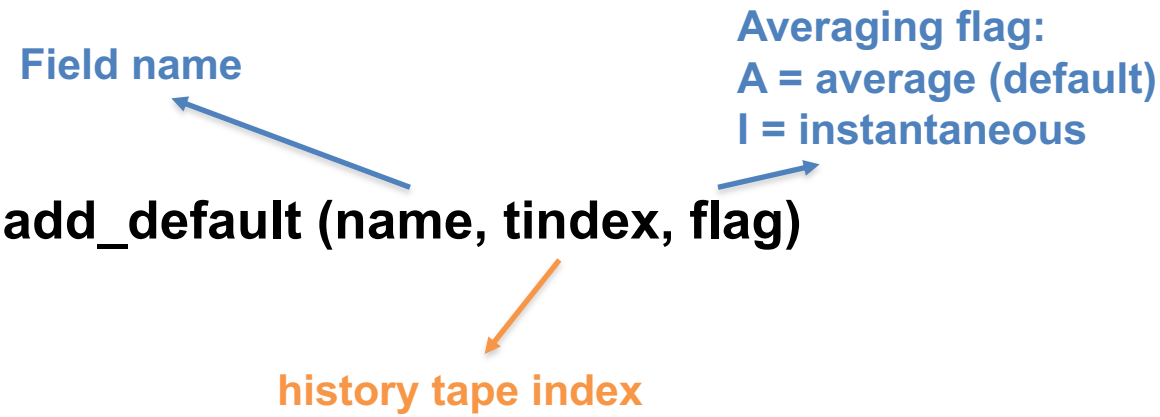
There are several optional arguments (not covered here. See documentation for more information about optional arguments)

Example:

```
call addfld ('T500',’K',1,'A','Temperature at 500 mbar pressure surface', phys_decomp)
```


Syntax: add_default

add_default = Add a field to the list of default fields on history file

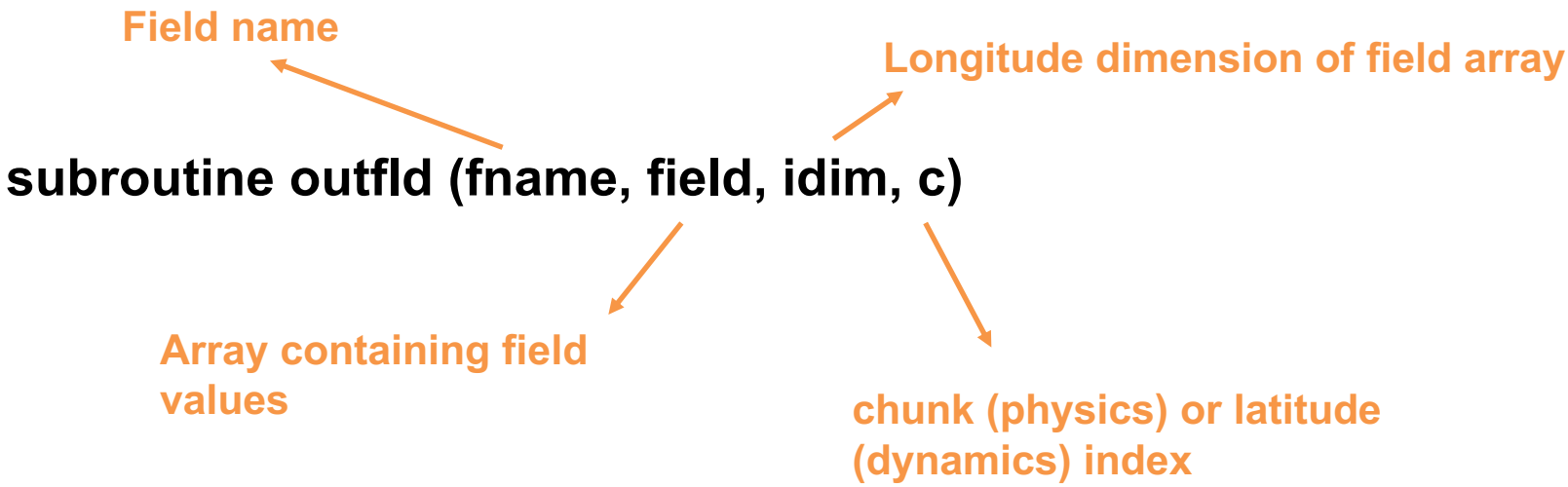


Example:

call add_default ('CLOUD ', 1, ' ')

Syntax: outfld

outfld = accumulate (or take min, max, etc. as appropriate) input field into its history buffer for appropriate tapes

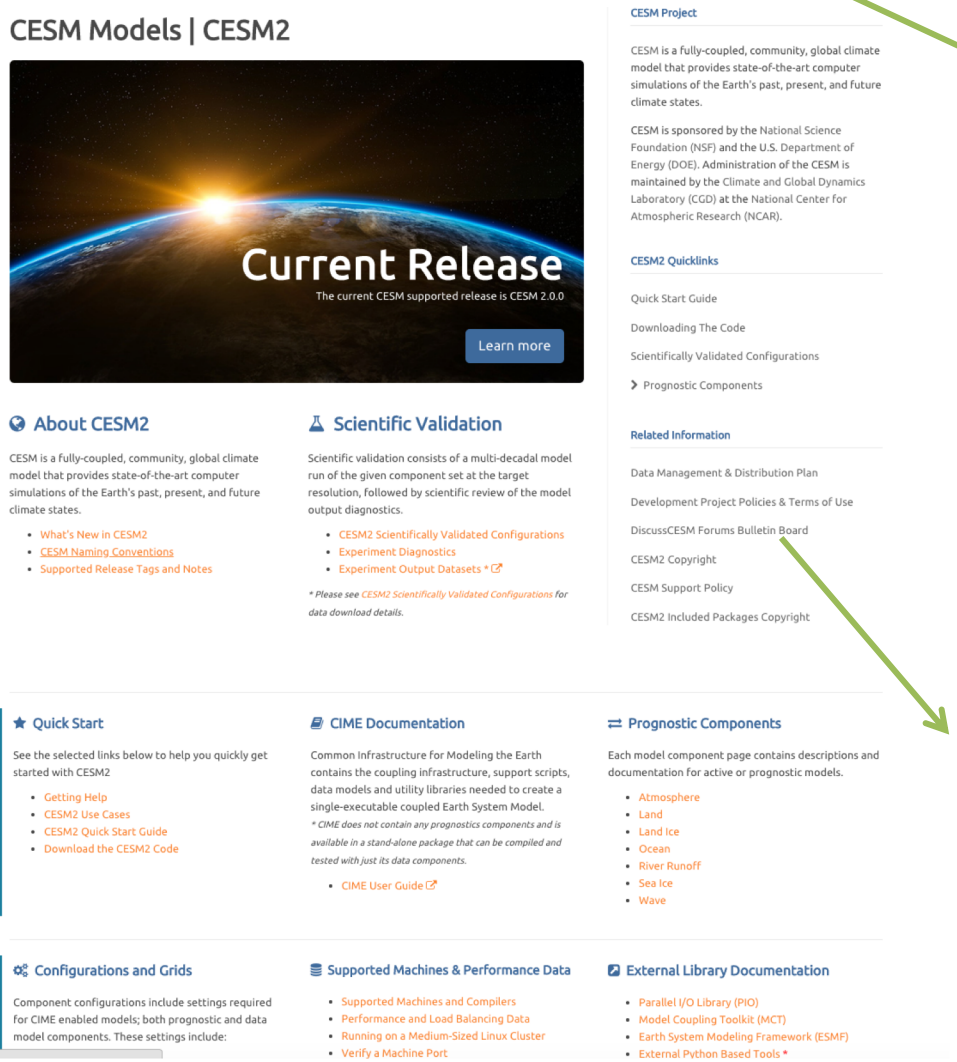


Example:

call outfld('CLOUD', cld, pcols, lchnk)

Where to find help ?

http://www.cesm.ucar.edu/models/cesm2.0/



CESM Models | CESM2

Current Release

The current CESM supported release is CESM 2.0.0

Learn more

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
- Supported Release Tags and Notes

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
- Experiment Diagnostics
- Experiment Output Datasets *

* Please see CESM2 Scientifically Validated Configurations for data download details.

CESM Project

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.

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 Laboratory (CGD) at the National Center for Atmospheric Research (NCAR).

CESM2 Quicklinks

Quick Start Guide

Downloading The Code

Scientifically Validated Configurations

Prognostic Components

Related Information

Data Management & Distribution Plan

Development Project Policies & Terms of Use

DiscussCESM Forums Bulletin Board

CESM2 Copyright

CESM Support Policy

CESM2 Included Packages Copyright

Quick Start

See the selected links below to help you quickly get started with CESM2

- Getting Help
- CESM2 Use Cases
- CESM2 Quick Start Guide
- Download the CESM2 Code

CIME Documentation

Common Infrastructure for Modeling the Earth contains the coupling infrastructure, support scripts, data models and utility libraries needed to create a single-executable coupled Earth System Model.

* CIME does not contain any prognostics components and is available in a stand-alone package that can be compiled and tested with just its data components.

- CIME User Guide

Prognostic Components

Each model component page contains descriptions and documentation for active or prognostic models.

- Atmosphere
- Land
- Land Ice
- Ocean
- River Runoff
- Sea Ice
- Wave

Configurations and Grids

Component configurations include settings required for CIME enabled models; both prognostic and data model components. These settings include:

Supported Machines & Performance Data

- Supported Machines and Compilers
- Performance and Load Balancing Data
- Running on a Medium-Sized Linux Cluster
- Verify a Machine Port

External Library Documentation

- Parallel I/O Library (PIO)
- Model Coupling Toolkit (MCT)
- Earth System Modeling Framework (ESMF)
- External Python Based Tools *

CESM webpage is a gold mine for model documentation

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