Modifying Code in the CLM

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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
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These directories start EMPTY
Modifications here affect the CURRENT case only

Modifications here affect ALL cases
AND you’re stuck with them
MAKE YOUR SOURCE MODS NOW!

# (1) create a new case
(2) cesm_setup
(3) I2000CLM45_002.build
(4) I2000CLM45_002.submit

# (2) run cesm_setup

# (3) build the executable

# (4) submit your run to the batch queue

These directories start EMPTY
Modifications here affect the CURRENT case only

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

Modifications here affect ALL cases
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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 zlnd

We will modify the CLM parameter
zlnd = 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/Lnd/clm/src/clm4_5
Exercise 1: Modify parameter zInd

4) **Find** zInd in the CLM 4.5 code:  

```
grep zInd */*
```

biogeophys/Biogeophysics1Mod.F90:

- zInd, zsno, tfrz, icol_roof, icol_sunwall, icol_shadewall, &
- z0mg(c) = zInd

biogeophys/Hydrology1Mod.F90:

- hfus, denice, zInd, rpi, spval
- frac_sno(c) = tanh(snow_depth(c)/(2.5_r8*zInd* &
- frac_sno(c) = tanh(snow_depth(c)/(2.5_r8*zInd* &
- use clm_varcon , only : zInd

main/clm_driver.F90:

- real(r8) :: zInd = 0.01_r8 !Roughness length for soil [m]
- use clm_varcon , only : zInd, istsoil, denice, denh2o, &
- frac_sno(c) = tanh( snow_depth(c) /(2.5 * zInd * fmelt) )
Exercise 1: Modify parameter zLnd


6. `cd ~/I2000CLM45_002/SourceMods/src.clm`

7. use an editor to **modify** the value of zLnd 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 zlnd=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

[...]
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

```bash
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

```bash
grep tlai */*
and see what was done to get this variable to history:
- declared in clmtype.F90 and clmtypeInitMod.F90
- 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…

```fortran
  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 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.