CLM5.0 Tutorial: Changing Model Setup

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Outline

Lecture/Intro

- Review Practical 1
- Why change model setup?

Practical

- **Checkout a Local Branch on Git**
- **Changing Model Setup**
    1) Component sets
    2) Namelist files
    3) Parameter changes
- **Data Analysis with Jupyter Notebook**

Review Practical 1: Create & run an out-of-the-box simulation

First, a one-time step to create a directory to store your experiment cases:

```
mkdir ~/clm_tutorial_cases
```

Then, navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line:

```
./create_newcase --case ~/clm_tutorial_cases/I1850CLM50_001 --res f19_g17 --compset I1850Clm50Sp
```

(2) invoke case.setup

Then, navigate to your case directory:

```
cd ~/clm_tutorial_cases/I1850CLM50_001
```

Type this command line:

```
./case.setup
```

(3) build the executable

Type this command line:

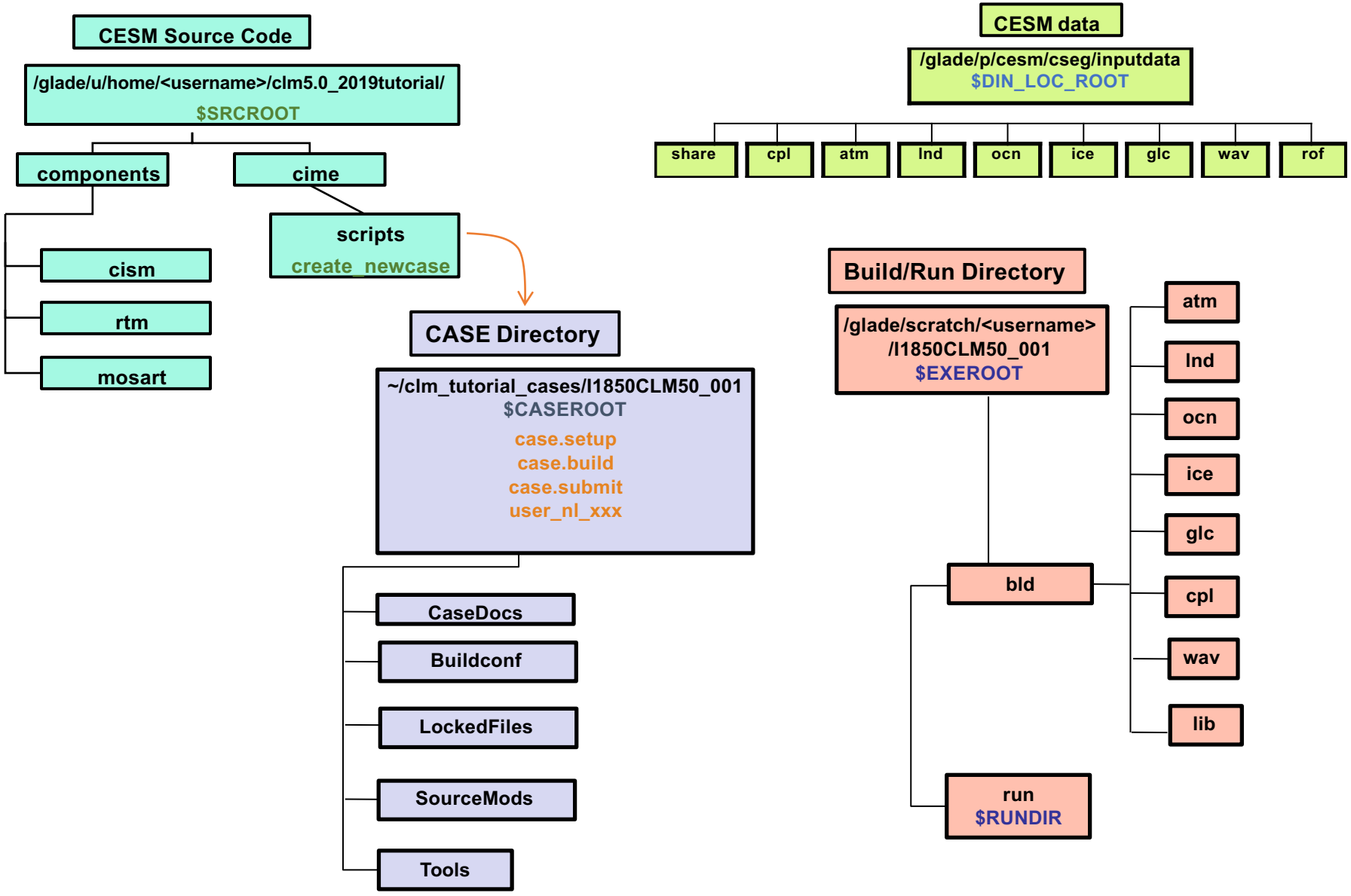
```
qcmd -- ./case.build
```

(4) submit your run to the batch queue

Type this command line:

```
./case.submit
```

Review CLM Directory Structure



Review: Queues and Jobs

On Cheyenne

Checking jobs:

a. Type *qstat <username>*

Killing jobs:

a. Use *qstat* to find your <JOBID>

b. Type *qdel <JOBID>*

Why change model setup?

- Investigate differences between preindustrial and present-day climates
  - ***Change the compset*** *to use year 2000 forcing data instead of 1850*
- Study changes happening over higher frequency time periods
  - ***Change the output frequency*** *to save daily data instead of monthly averages*
- Calculate sensitivity of a parameter representing land surface processes
  - ***Change the parameter value*** *for a specified process*

3 Types of Basic Modifications

1. Component Sets
2. Namelist files
3. Parameter changes

Changing the Component Set (Compset)

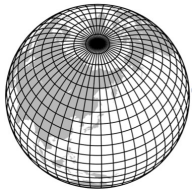
In the scripts directory, `create_newcase` generates a new case.

`create_newcase` requires 3 arguments

What is the casename ?

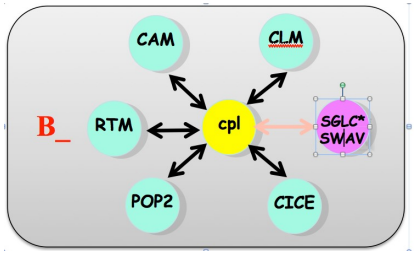
`--case`

Which resolution?



`--res`

Which model configuration ?
Which set of components ?



`--compset`

Changing compsets lets you run different experiments

Some component options:

- Year (1850, 2000, transient, etc.)
- Data atmosphere (GSWP3, CRUNCEP, CPLHIST3HrWx)
- Model options (SP [satellite phenology], BGC [biogeochemistry], FATES*)
- RCP scenarios

SP means that the phenology is prescribed based on remote sensing data. **BGC/FATES** means that the phenology is prognostic based on model-calculated climatology. **FATES** also includes size structure with disturbance and competition.

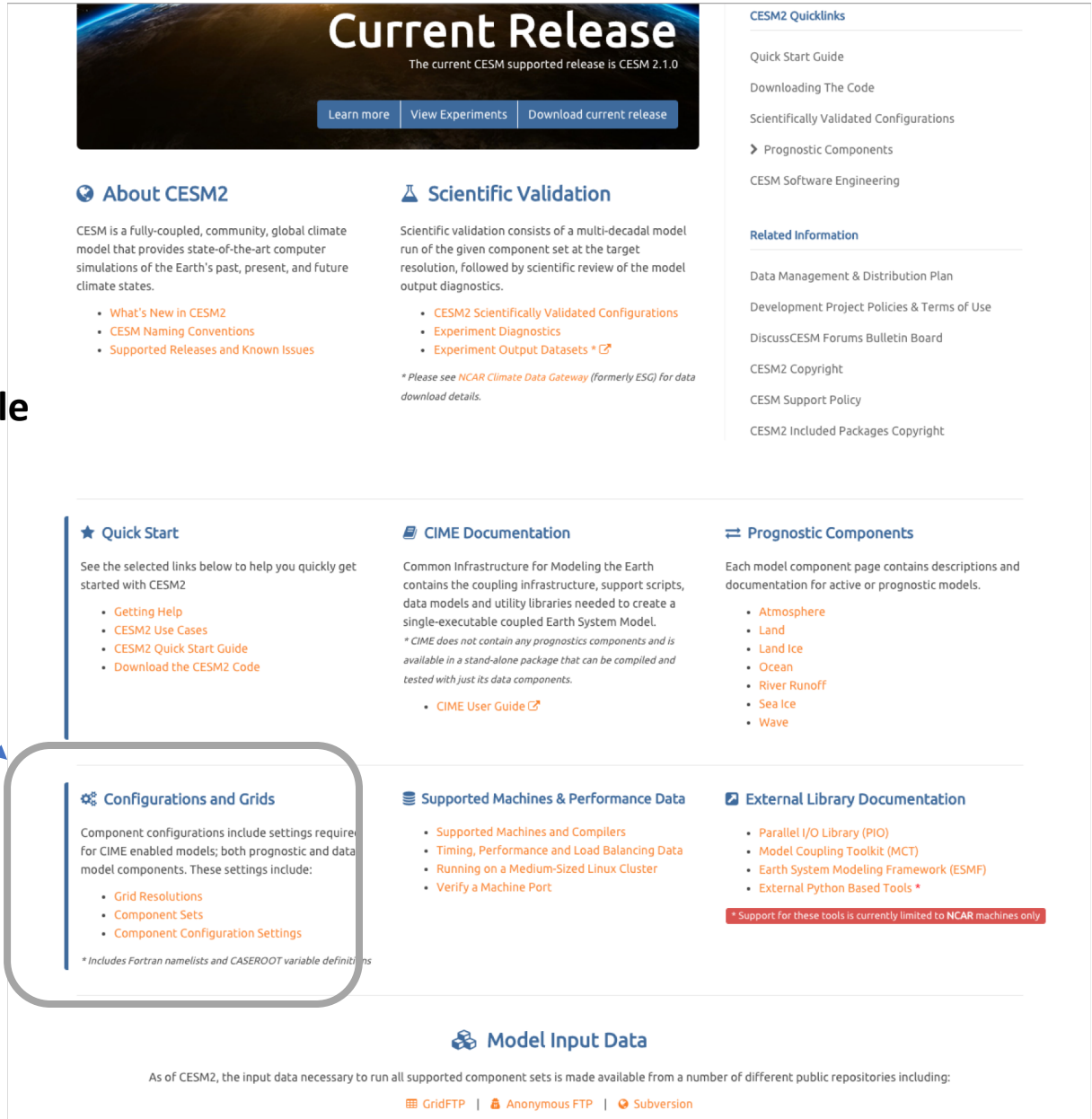
**FATES (Functionally Assembled Terrestrial Ecosystem Simulator) model option must also be specified with a namelist parameter: use_fates=.true.*

CESM 2.0 Web Page

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

List of component sets are available on the CESM website

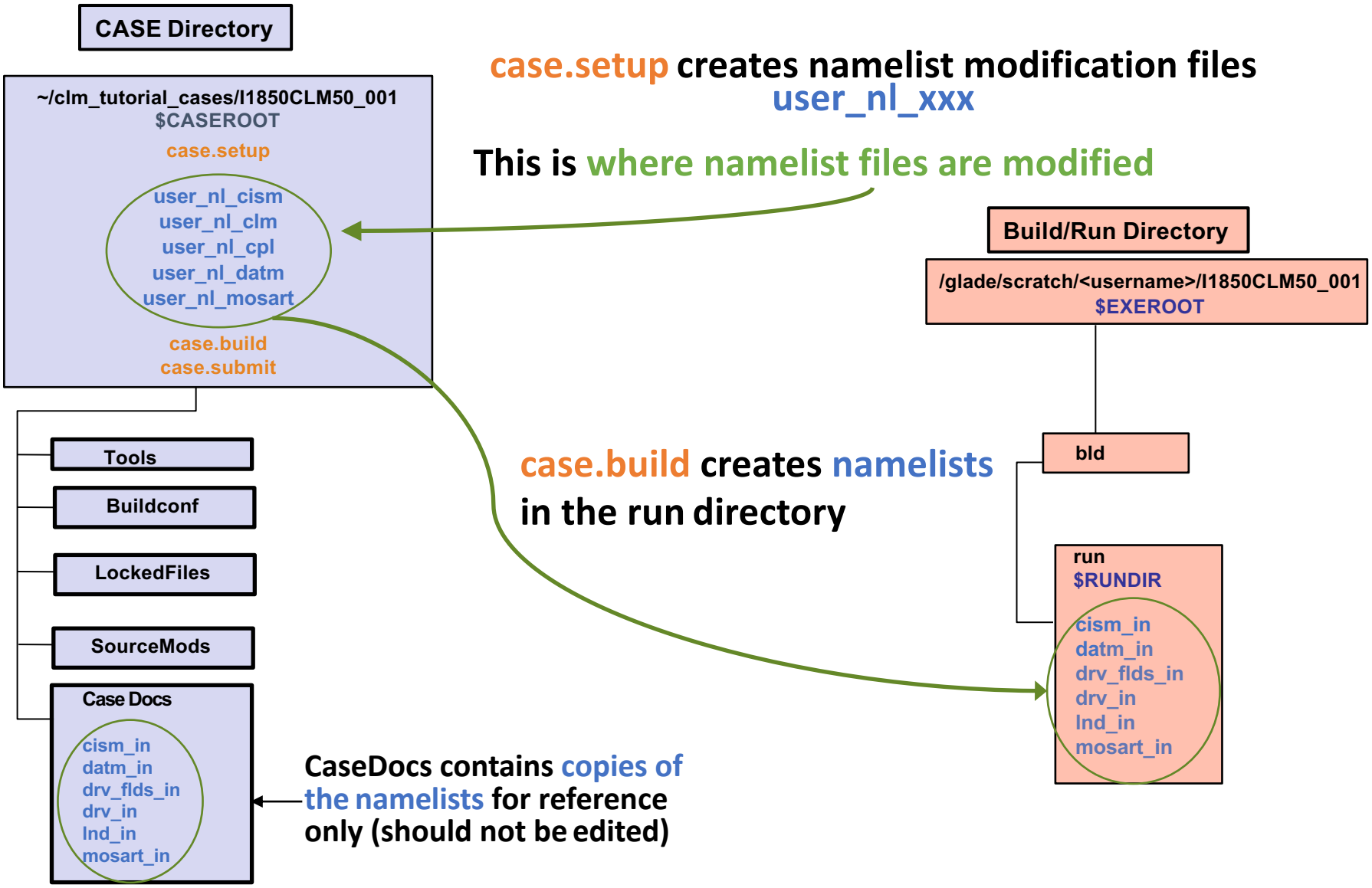
Component sets website:
http://www.cesm.ucar.edu/models/cesm2/config/compsets.html



3 Types of Basic Modifications

1. Component Sets
2. Namelist files
3. Parameter changes

Namelists in CLM Directory Structure



Modifying Namelist files

- Compset choice sets up initial namelists
- user_nl_clm modifies namelist file lnd_in

Important: Don't modify the namelist file (lnd_in) directly.
Make changes in user_nl_clm.

- Website for CLM5.0 namelist variables:

http://www.cesm.ucar.edu/models/cesm2/settings/current/clm5_0_nml.html

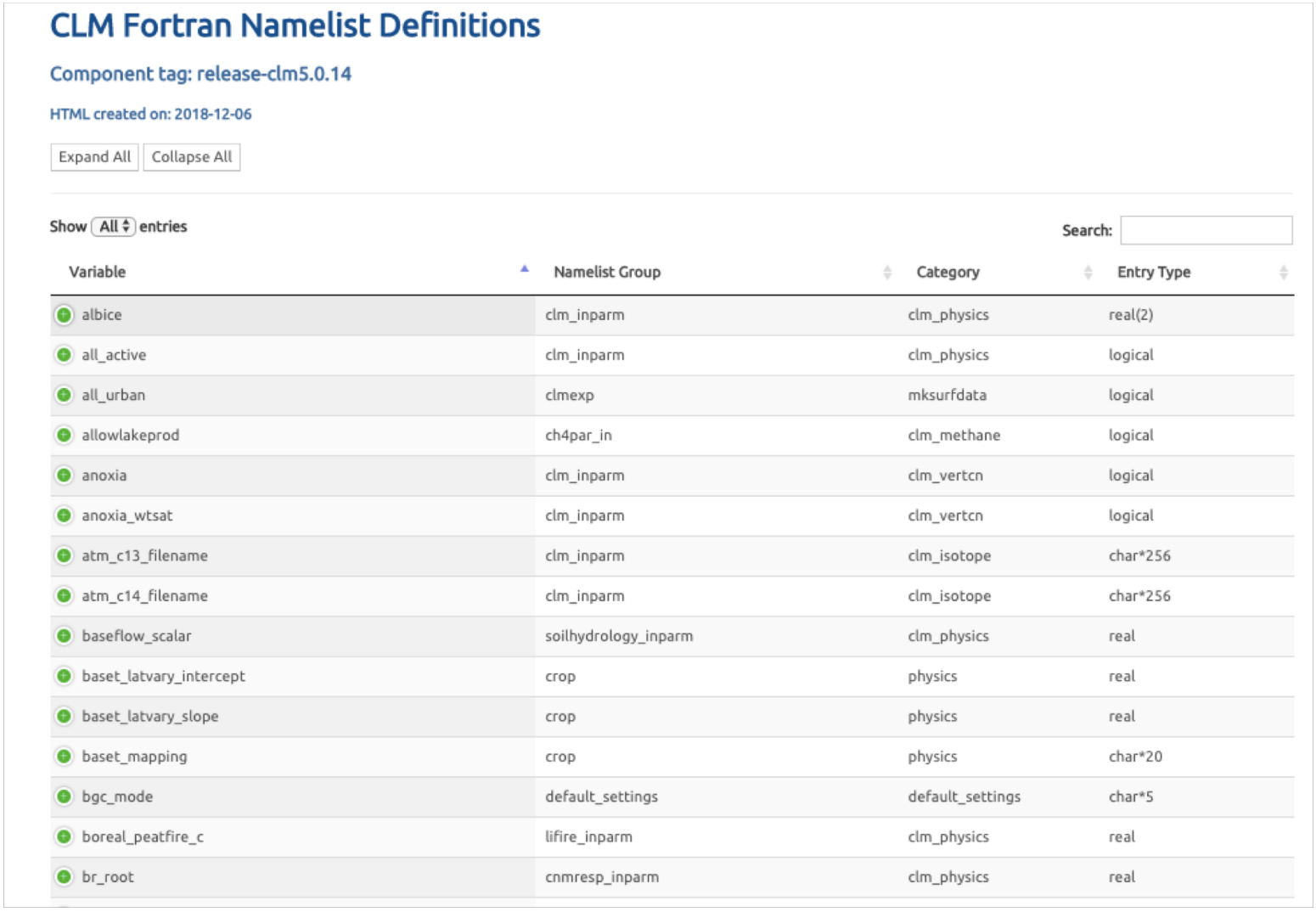
** Some namelist variables can also be changed in env_run.xml file

CESM 2.0 Web Page

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

Website for CLM5.0 namelist variables:

http://www.cesm.ucar.edu/models/cesm2/settings/current/clm5_0_nml.html



CLM Fortran Namelist Definitions

Component tag: release-clm5.0.14

HTML created on: 2018-12-06

Expand All | Collapse All

Show All entries Search:

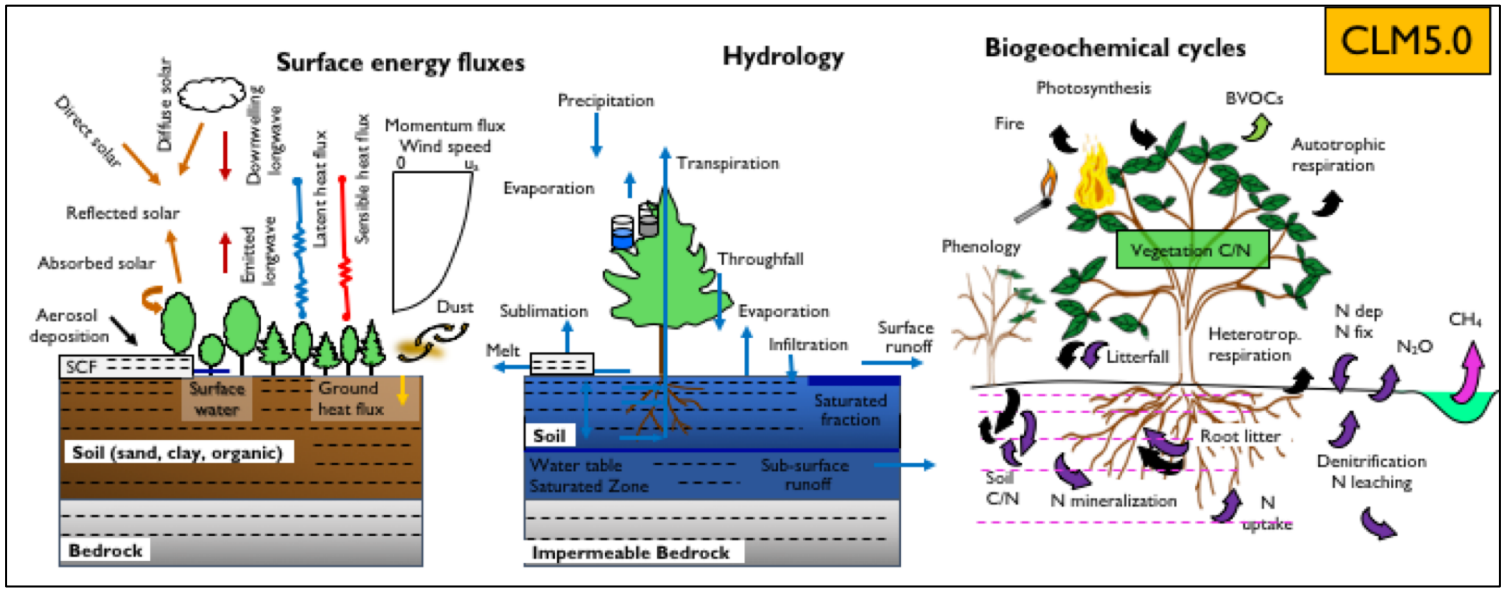
Variable	Namelist Group	Category	Entry Type
albice	clm_inparm	clm_physics	real(2)
all_active	clm_inparm	clm_physics	logical
all_urban	clmexp	mksurfdata	logical
allowlakeprod	ch4par_in	clm_methane	logical
anoxia	clm_inparm	clm_vertcn	logical
anoxia_wtsat	clm_inparm	clm_vertcn	logical
atm_c13_filename	clm_inparm	clm_isotope	char*256
atm_c14_filename	clm_inparm	clm_isotope	char*256
baseflow_scalar	soilhydrology_inparm	clm_physics	real
baset_latvary_intercept	crop	physics	real
baset_latvary_slope	crop	physics	real
baset_mapping	crop	physics	char*20
bgc_mode	default_settings	default_settings	char*5
boreal_peatfire_c	lifire_inparm	clm_physics	real
br_root	cnmresp_inparm	clm_physics	real

3 Types of Basic Modifications

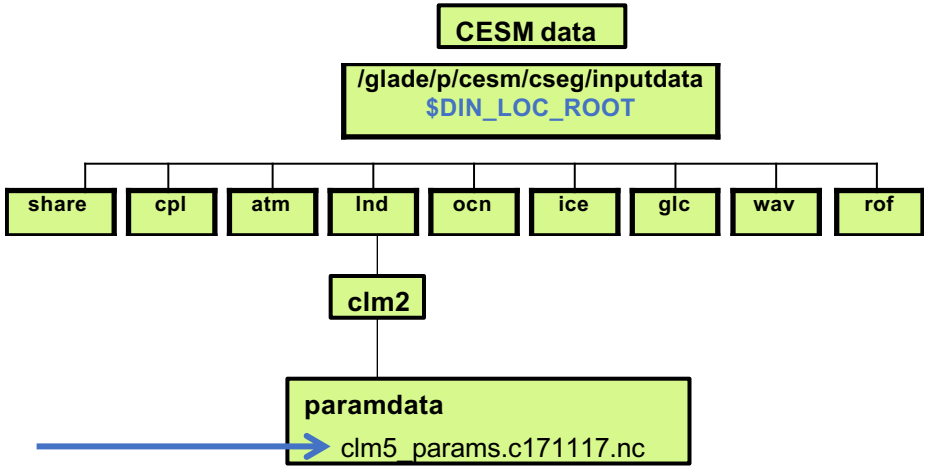
1. Component Sets
2. Namelist files
3. Parameter changes

Parameter changes

- Parameters exist to represent physical processes in the model
- To test sensitivity and quantify uncertainties, we can try out different parameter values
- We'll be looking at PFT-dependent parameters, which live in their own netcdf file. (Other parameters are set using the namelist.)



Parameters in CLM Directory Structure



The default parameter file lives in this directory.

In the practical, you will copy this file and modify it to change a parameter value.

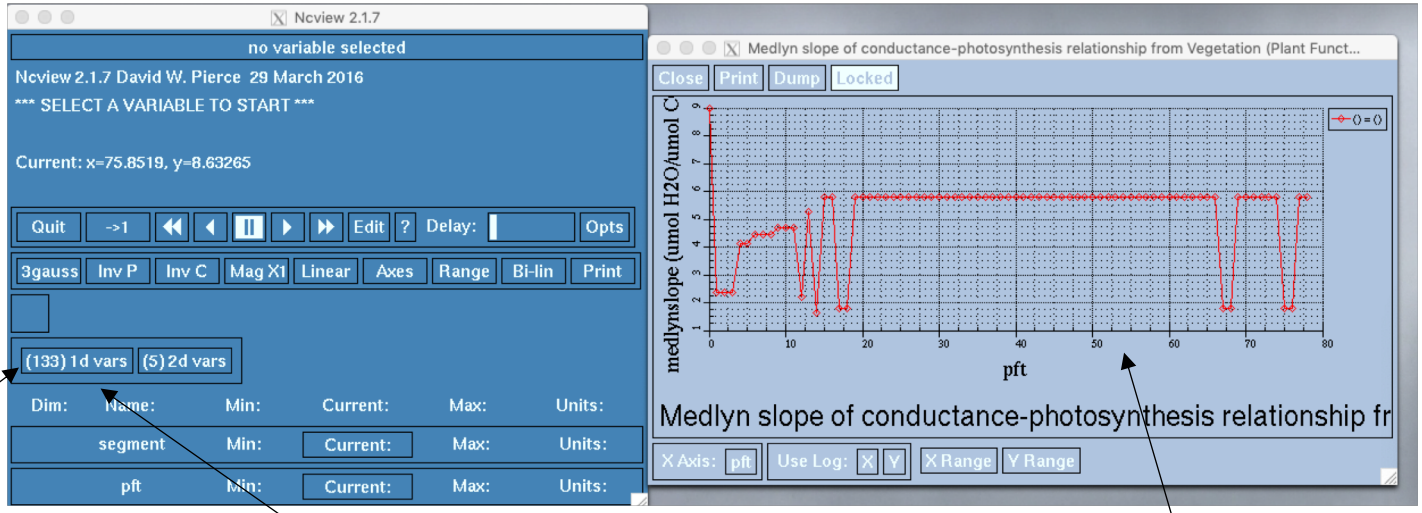
Structure of parameter file

Navigate to parameter data directory:

```
cd /glade/p/cesm/cseg/inputdata/lnd/clm2/paramdata
```

Use ncview to look at parameter file:

```
ncview clm5_params.c171117.nc
```



Click on 1d or 2d vars to get a list of PFT-dependent parameters

Select “medlynslope” from the 1d list to look at the different values of this parameter for each PFT

ncview will plot the different values of medlynslope

Today's Practical:
3 Types of Basic Modifications

1. Change Component Set

2. Modify Namelist file

3. Change a Parameter

Questions?

Start Practical Here

Use git to checkout a local branch

Navigate into your clm code directory

```
cd ~/clm5.0_2019tutorial
```

Check your branch. *What branch are you on now?*

```
git branch -v
```

Create local branch

```
git checkout -b <username_tutorial>
```

Check again. *Are you on the new branch?*

```
git branch -v
```

- This is your “active branch” and all work should be done in this branch.

Today's Exercises:
3 Types of Basic Modifications

1. Change Component Set
   Create and build simulation for year 2000

2. Modify Namelist file

3. Change a Parameter

Exercise 2.1: Change Compset
Create and build simulation for year 2000

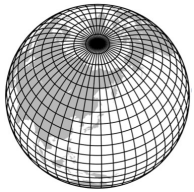
Exercise 2.1: Change Compset
Create and build simulation for year 2000

`create_newcase` **requires 3 arguments**

What is the casename ?

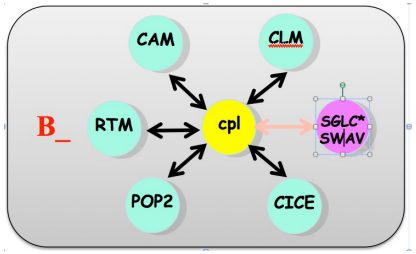
`--case`

Which resolution?



`--res`

Which model configuration ? Which set of components ?



`--compset`

Now we'll change the compset

CLM component sets:

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

```
./query_config -h
```

This will show a help message with information and options for the command

List compsets specific to clm:

```
./query_config --compsets clm
```

TO DO: Identify and copy name of component set for year 2000 with GSWP3 atmosphere using CLM5 and Satellite Phenology

CLM component sets:

List compsets specific to clm:

```
./query_config --compsets clm
```

Compset Alias:

Short name for component set

CLM only = “I” Alias compsets

Compset Long Name:

- Year
- Data atmosphere (GSWP3, CRUNCEP, etc.)
- Model options (SP [satellite phenology], BGC [biogeochemistry])

```
cime/scripts> ./query_config --compsets clm

Active component: clm
        ----------------------------------------
        Compset Alias: Compset Long Name
        ----------------------------------------
   I1PtClm50SpGs         : 2000_DATM%1PT_CLM50%SP_SICE_SOCN_MOSART_SGLC_SWAV
   I1PtClm45SpGs         : 2000_DATM%1PT_CLM45%SP_SICE_SOCN_RTM_SGLC_SWAV
   I2000Clm50Sp          : 2000_DATM%GSWP3v1_CLM50%SP_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   I2000Clm50BgcCru      : 2000_DATM%CRUv7_CLM50%BGC_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   I2000Clm50BgcCropRtm  : 2000_DATM%GSWP3v1_CLM50%BGC-CROP_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   I2000Clm50BgcCrop     : 2000_DATM%GSWP3v1_CLM50%BGC-CROP_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   I2000Clm50Cn          : 2000_DATM%GSWP3v1_CLM50%CN_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   I1850Clm50Sp          : 1850_DATM%GSWP3v1_CLM50%SP_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   I1850Clm50SpCru       : 1850_DATM%CRUv7_CLM50%SP_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   I1850Clm50BgcCrop     : 1850_DATM%GSWP3v1_CLM50%BGC-CROP_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   I1850Clm50BgcCropCru  : 1850_DATM%CRUv7_CLM50%BGC-CROP_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   I2000Clm50SpGs        : 2000_DATM%GSWP3v1_CLM50%SP_SICE_SOCN_MOSART_SGLC_SWAV
   I2000Clm50BgcCropGs   : 2000_DATM%GSWP3v1_CLM50%BGC-CROP_SICE_SOCN_MOSART_SGLC_SWAV
   I2000Clm50BgcCruGs    : 2000_DATM%CRUv7_CLM50%BGC_SICE_SOCN_MOSART_SGLC_SWAV
   I2000Clm50SpRtmFl     : 2000_DATM%GSWP3v1_CLM50%SP_SICE_SOCN_RTM%FLOOD_CISM2%NOEVOLVE_SWAV
   I2000Clm50Fates       : 2000_DATM%GSWP3v1_CLM50%FATES_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   I2000Clm50FatesCruGs  : 2000_DATM%CRUv7_CLM50%FATES_SICE_SOCN_MOSART_SGLC_SWAV
   I2000Clm50FatesGs     : 2000_DATM%GSWP3v1_CLM50%FATES_SICE_SOCN_MOSART_SGLC_SWAV
   I1850Clm50Bgc         : 1850_DATM%GSWP3v1_CLM50%BGC_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   IHistClm50BgcCrop     : HIST_DATM%GSWP3v1_CLM50%BGC-CROP_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   IHistClm50Bgc         : HIST_DATM%GSWP3v1_CLM50%BGC_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   IHistClm50BgcQianGs   : HIST_DATM%QIA_CLM50%BGC_SICE_SOCN_MOSART_SGLC_SWAV
   IHistClm50BgcCropGs   : HIST_DATM%GSWP3v1_CLM50%BGC-CROP_SICE_SOCN_MOSART_SGLC_SWAV
   I2000Clm50BgcDvCrop   : 2000_DATM%GSWP3v1_CLM50%BGCDV-CROP_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   I2000Clm50BgcDvCropQianGs : 2000_DATM%QIA_CLM50%BGCDV-CROP_SICE_SOCN_MOSART_SGLC_SWAV
   I1850Clm50BgcSpinup   : 1850_DATM%CPLHIST_CLM50%BGC_SICE_SOCN_MOSART_CISM2%NOEVOLVE_SWAV
   I1850Clm45BgcCrop     : 1850_DATM%GSWP3v1_CLM45%BGC-CROP_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   I1850Clm45BgcCruGs    : 1850_DATM%CRUv7_CLM45%BGC_SICE_SOCN_RTM_SGLC_SWAV
   IHistClm45BgcCrop     : HIST_DATM%GSWP3v1_CLM45%BGC-CROP_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   IHistClm45BgcCropQianGs : HIST_DATM%QIA_CLM45%BGC-CROP_SICE_SOCN_RTM_SGLC_SWAV
   I2000Clm45Sp          : 2000_DATM%GSWP3v1_CLM45%SP_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   I2000Clm45BgcCrop     : 2000_DATM%GSWP3v1_CLM45%BGC-CROP_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   I2000Clm45Fates       : 2000_DATM%GSWP3v1_CLM45%FATES_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   I2000Clm45FatesGs     : 2000_DATM%GSWP3v1_CLM45%FATES_SICE_SOCN_RTM_SGLC_SWAV
   I1850Clm45Cn          : 1850_DATM%GSWP3v1_CLM45%CN_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   I1850Clm45Bgc         : 1850_DATM%GSWP3v1_CLM45%BGC_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   I1850Clm45BgcGs       : 1850_DATM%GSWP3v1_CLM45%BGC_SICE_SOCN_RTM_SGLC_SWAV
   I1850Clm45BgcCru      : 1850_DATM%CRUv7_CLM45%BGC_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   IHistClm45Bgc         : HIST_DATM%GSWP3v1_CLM45%BGC_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   I2000Clm50Vic         : 2000_DATM%GSWP3v1_CLM50%SP-VIC_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   I2000Clm45VicCru      : 2000_DATM%CRUv7_CLM45%SP-VIC_SICE_SOCN_RTM_CISM2%NOEVOLVE_SWAV
   I1850Clm50SpG         : 1850_DATM%GSWP3v1_CLM50%SP_SICE_SOCN_MOSART_CISM2%EVOLVE_SWAV
   IHistClm50SpG         : HIST_DATM%GSWP3v1_CLM50%SP_SICE_SOCN_MOSART_CISM2%EVOLVE_SWAV
   I1850Clm50BgcCropG    : 1850_DATM%GSWP3v1_CLM50%BGC-CROP_SICE_SOCN_MOSART_CISM2%EVOLVE_SWAV
   IHistClm50BgcCropG    : HIST_DATM%GSWP3v1_CLM50%BGC-CROP_SICE_SOCN_MOSART_CISM2%EVOLVE_SWAV
   I2000Clm40SpCruGs     : 2000_DATM%CRUv7_CLM40%SP_SICE_SOCN_RTM_SGLC_SWAV
   I1850Clm40SpCruGs     : 1850_DATM%CRUv7_CLM40%SP_SICE_SOCN_RTM_SGLC_SWAV
   I1850Clm40CnGswGs     : 1850_DATM%GSWP3v1_CLM40%CN_SICE_SOCN_RTM_SGLC_SWAV
   IHistClm40SpCruGs     : HIST_DATM%CRUv7_CLM40%SP_SICE_SOCN_RTM_SGLC_SWAV
cime/scripts>
```

Exercise 2.1: Change Compset
Create and build simulation for year 2000

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line

```
./create_newcase --case ~/clm_tutorial_cases/I2000CLM50_001 --res f19_g17 --compset I2000Clm50Sp --project UCGD0004
```

(2) invoke case.setup

NOTE: you can use compset ***<alias>*** *or* ***<long name>*** *here*

---

(3) build the executable

(4) submit your run to the batch queue

Exercise 2.1: Change Compset
Create and build simulation for year 2000

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line

```
./create_newcase --case ~/clm_tutorial_cases/I2000CLM50_001 --res f19_g17 --compset I2000Clm50Sp --project UCGD0004
```

(2) invoke case.setup

Navigate to the case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_001
```

Type this command line

```
./case.setup
```

(3) build the executable

Type this command line:

```
qcmd -q R4231039 -- ./case.build
```

Type this command line:

```
./xmlchange STOP_OPTION=nyears
./xmlchange JOB_WALLCLOCK_TIME=1:00:00
./xmlchange PROJECT=UCGD0004
```

After step 3, update to run for 5 years, reduce wall clock time, and specify Project code

(4) submit your run to the batch queue

Exercise 2.1: Change Compset
Create and build simulation for year 2000

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line

```
./create_newcase --case ~/clm_tutorial_cases/I2000CLM50_001 --res f19_g17 --compset I2000Clm50Sp --project UCGD0004
```

(2) invoke case.setup

Navigate to the case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_001
```

Type this command line

```
./case.setup
```

(3) build the executable

Type this command line:

```
qcmd -q R4231039 -- ./case.build
```

Type this command line:

```
./xmlquery STOP_OPTION
./xmlquery STOP_N
```


Confirm you are running for 5 years, then submit case

(4) submit your run to the batch queue

Type this command line:

```
./case.submit
```

Today's Exercises:
3 Types of Basic Modifications

1. Change Component Set

2. Modify Namelist file

   Changing data record frequency with a new case

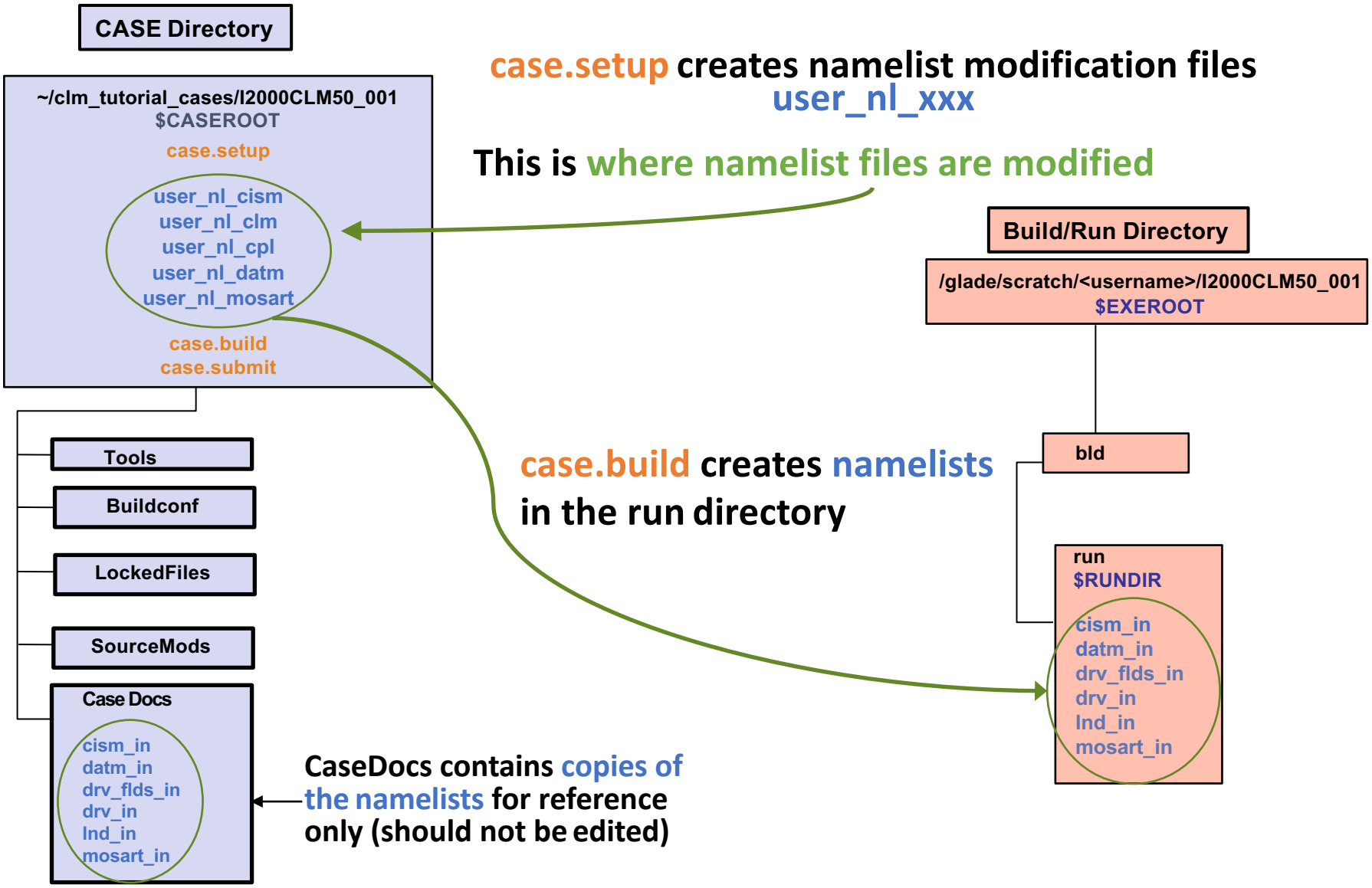
3. Change a Parameter

Modifying Namelist files

- Not all changes can be made with `./xmlchange`
- Additional changes made using namelist files: user_nl_<model>
- user_nl_<model> files created in the case directory after ./case.setup

user_nl_cism	⟷	ice (cism_in)
user_nl_datm	⟷	atmosphere (datm_in)
user_nl_clm	⟷	land (lnd_in)
user_nl_cpl	⟷	coupler (driver; drv_in)
user_nl_mosart	⟷	river transport (mosart_in)

Namelists in CLM Directory Structure



Looking at Namelist Files

Note: These files tell the input datasets and model options that your simulation is set up to use.
Do not change these xxx_in files directly. *If changes are necessary, modify the* ***user_nl_xxx*** *files.*

Open and view the lnd_in file using one of these options

Option 1

- *navigate to the CaseDocs directory inside you case directory*

```
cd ~/clm_tutorial_cases/I2000CLM50_001/CaseDocs
```

- *Open lnd_in with text editor of your choice (VI, emacs, etc)*

```
emacs lnd_in
```

Option 2

- *navigate to the run directory*

```
cd /glade/scratch/$USER/I2000CLM50_001/run
```

- *Open lnd_in with text editor of your choice (VI, emacs, etc)*

```
emacs lnd_in
```

Reminder: ***Do not change these files directly.*** *If changes are necessary, modify the* ***user_nl_xxx*** *files.*

Beginning of the lnd_in file

```
&clm_inparm
 albice = 0.50,0.30
 co2_ppmv = 367.0
 co2_type = 'constant'
 create_crop_landunit = .true.
 dtime = 1800
 fatmlndfrc = '/glade/p/cesmdata/cseg/inputdata/share/domains/domain.lnd.fv1.9x2.5_gx1v7.170518.nc'
 finidat = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/initdata_map/clmi.I2000Clm50BgcCrop.2011-01-01.1.9x2.5_gx1v7_gl4_simyr2000_c180715.nc'
 fsnowaging = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/snicardata/snicar_drdt_bst_fit_60_c070416.nc'
 fsnowoptics = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/snicardata/snicar_optics_5bnd_c090915.nc'
 fsurdat = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/surfdata_map/surfdata_1.9x2.5_16pfts_Irrig_CMIP6_simyr2000_c170824.nc'
 glc_do_dynglacier = .true.
 glc_snow_persistence_max_days = 0
 h2osno_max = 10000.0
 int_snow_max = 2000.
 irrigate = .true.
 maxpatch_glcmec = 10
 maxpatch_pft = 17
 n_melt_glcmec = 10.0d00
 nlevsno = 12
 nsegspc = 35
 paramfile = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/paramdata/clm5_params.c171117.nc'
 run_zero_weight_urban = .false.
 soil_layerstruct = '20SL_8.5m'
 spinup_state = 0
 use_bedrock = .true.
 use_century_decomp = .false.
 use_cn = .false.
 use_crop = .false.
 use_dynroot = .false.
 use_fates = .false.
 use_fertilizer = .false.
 use_fun = .false.
 use_grainproduct = .false.
 use_hydrstress = .true.
 use_init_interp = .true.
 use_lai_streams = .false.
 use_lch4 = .false.
 use_luna = .true.
 use_nitrif_denitrif = .false.
 use_vertsoilc = .false.
/
&ndepdyn_nml
/
&popd_streams
/
&urbantv_streams
 stream_fldfilename_urbantv = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/urbandata/CLM50_tbuildmax_Oleson_2016_0.9x1.25_simyr1849-2106_c160923.nc'
 stream_year_first_urbantv = 2000
 stream_year_last_urbantv = 2000
 urbantvmapalgo = 'nn'
/
```

Beginning of the lnd_in file

```
&clm_inparm
 albice = 0.50,0.30
 co2_ppmv = 367.0
 co2_type = 'constant'
 create_crop_landunit = .true.
 dtime = 1800
 fatmlndfrc = '/glade/p/cesmdata/cseg/inputdata/share/domains/domain.lnd.fv1.9x2.5_gx1v7.170518.nc'
 finidat = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/initdata_map/clmi.I2000Clm50BgcCrop.2011-01-01.1.9x2.5_gx1v7_gl4_simyr2000_c180715.nc'
 fsnowaging = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/snicardata/snicar_drdt_bst_fit_60_c070416.nc'
 fsnowoptics = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/snicardata/snicar_optics_5bnd_c090915.nc'
 fsurdat = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/surfdata_map/surfdata_1.9x2.5_16pfts_Irrig_CMIP6_simyr2000_c170824.nc'
 glc_do_dynglacier = .true.
 glc_snow_persistence_max_days = 0
 h2osno_max = 10000.0
 int_snow_max = 2000.
 irrigate = .true.
 maxpatch_glcmec = 10
 maxpatch_pft = 17
 n_melt_glcmec = 10.0d00
 nlevsno = 12
 nsegspc = 35
 paramfile = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/paramdata/clm5_params.c171117.nc'
 run_zero_weight_urban = .false.
 soil_layerstruct = '20SL_8.5m'
 spinup_state = 0
 use_bedrock = .true.
 use_century_decomp = .false.
 use_cn = .false.
 use_crop = .false.
 use_dynroot = .false.
 use_fates = .false.
 use_fertilizer = .false.
 use_fun = .false.
 use_grainproduct = .false.
 use_hydrstress = .true.
 use_init_interp = .true.
 use_lai_streams = .false.
 use_lch4 = .false.
 use_luna = .true.
 use_nitrif_denitrif = .false.
 use_vertsoilc = .false.
/
&ndepdyn_nml
/
&popd_streams
/
&urbantv_streams
 stream_fldfilename_urbantv = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/urbandata/CLM50_tbuildmax_Oleson_2016_0.9x1.25_simyr1849-2106_c160923.nc'
 stream_year_first_urbantv = 2000
 stream_year_last_urbantv = 2000
 urbantvmapalgo = 'nn'
/
```

[CO_2]

File with initial conditions

File with surface dataset

Different component sets will change the status of some of these things.

Exercise 2.2: Modify Namelist
Changing data record frequency with a new case

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line

```
./create_newcase --case ~/clm_tutorial_cases/I2000CLM50_002 --res f19_g17 --compset I2000Clm50Sp --project UCGD0004
```

(2) invoke case.setup

Create a new case for exercise 2.2

(3) build the executable

(4) submit your run to the batch queue

Exercise 2.2: Modify Namelist
Changing data record frequency with a new case

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line

```
./create_newcase --case ~/clm_tutorial_cases/I2000CLM50_002 --res f19_g17 --compset I2000Clm50Sp --project UCGD0004
```

(2) invoke case.setup

Navigate to the case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_002
```

Type this command line

```
./case.setup
```

(3) build the executable

Type this command line:

```
qcmd -q R4231039 -- ./case.build
```

Type this command line:

```
./xmlchange STOP_OPTION=nyears
./xmlchange STOP_N=2
./xmlchange JOB_WALLCLOCK_TIME=1:00:00
./xmlchange PROJECT=UCGD0004
```

After step 3, update to run for 2 years, reduce wall clock time, and specify Project code

---

(4) submit your run to the batch queue

Exercise 2.2: Modify Namelist
Changing data record frequency with a new case

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line

```
./create_newcase --case ~/clm_tutorial_cases/I2000CLM50_002 --res f19_g17 --compset I2000Clm50Sp --project UCGD0004
```

(2) invoke case.setup

Navigate to the case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_002
```

Type this command line

```
./case.setup
```

(3) build the executable

Type this command line:

```
qcmd -q R4231039 -- ./case.build
```

← After xmlchanges, modify the namelist before submit

---

(4) submit your run to the batch queue

Example Modification: user_nl_clm

Changing the frequency of model output

hist_mfilt: Number of samples within a file

Default is 1

Setting value to 12 would put 12 records into a single file

Example Modification: user_nl_clm

Changing the frequency of model output

hist_mfilt: Number of samples within a file

Default is 1

Setting value to 12 would put 12 records into a single file

hist_nhtfrq: Frequency that data are recorded and written to a file

Default is 0; means that output is recorded every month (monthly averages)

Positive Values represent number of model timesteps (half--hourly) for output record

Ex: 48 means output is recorded every day (daily averages)

Negative Values represent absolute value in hours for output record

Ex: -1 means output is recorded hourly; -24 means output is recorded daily

* Both hist_mfilt & hist_nhtfrq must be integers

What values of hist_mfilt and hist_nhtfrq will produce:

- Daily output?

  AND

- 1 year of output in each history file?

TO DO: Identify the values needed for these two namelist settings in order to update user_nl_clm.

Exercise 2.2: Modify Namelist
Changing data record frequency with a new case

Navigate to the Case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_002
```

Open user_nl_clm with text editor of your choice (VI, emacs, etc)

```
emacs user_nl_clm
```

Add this text to the bottom of the file:

```
hist_mfilt=365
hist_nhtfrq=-24
```

These changes will produce daily output with each year written to a separate file.

This changes the default settings, as used in the I1850 and I2000_001 case, from monthly output with each month written to a separate file.

Exercise 2.2: Modify Namelist
Changing data record frequency with a new case

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line

```
./create_newcase --case ~/clm_tutorial_cases/I2000CLM50_002 --res f19_g17 --compset I2000Clm50Sp --project UCGD0004
```

(2) invoke case.setup

Navigate to the case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_002
```

Type this command line

```
./case.setup
```

(3) build the executable

Type this command line:

```
qcmd -q R4210171 -- ./case.build
```

After modifying namelist, submit the case:

(4) submit your run to the batch queue

Type this command line:

```
./case.submit
```

***Note**: The case.submit script will automatically update and check the namelists. If you want to update and check your namelists before submitting, you can also run ./preview_namelists from your case directory.*

Today's Exercises:
3 Types of Basic Modifications

1. Change Component Set

2. Modify Namelist file

3. Change a Parameter

   Altering medlynslope to change stomatal conductance

Medlynslope parameter

This parameter represents the slope of the stomatal conductance – photosynthesis relationship

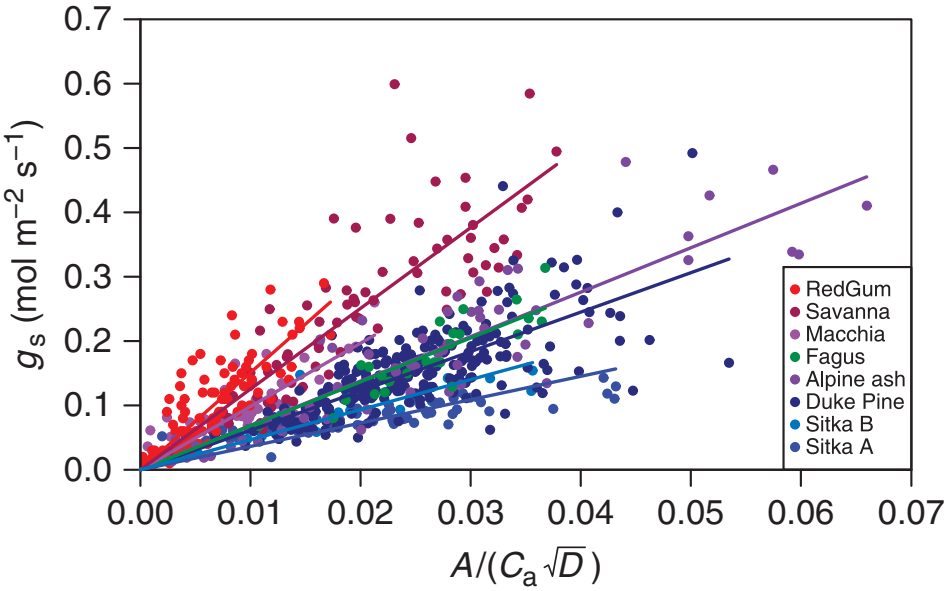
From the CLM5 Documentation:

$$g_s = g_o + 1.6\left(1 + \frac{g_1}{\sqrt{D}}\right)\frac{A_n}{c_s/P_{atm}}$$

stomatal conductance

medlynslope

photosynthesis



Medlyn et al. (2011)

Exercise 2.3: Update a Parameter

Altering medlynslope to change stomatal conductance

Exercise 2.3: Update a Parameter

Altering medlynslope to change stomatal conductance

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line

```
./create_newcase --case ~/clm_tutorial_cases/I2000CLM50_003 --res f19_g17 --compset I2000Clm50Sp --project UCGD0004
```

(2) invoke case.setup

Create a new case for exercise 2.3

(3) build the executable

(4) submit your run to the batch queue

Exercise 2.3: Update a parameter
Set up and build new case to run for 5 years

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line

```
./create_newcase --case ~/clm_tutorial_cases/I2000CLM50_003 --res f19_g17 --compset I2000Clm50Sp --project UCGD0004
```

(2) invoke case.setup

Navigate to the case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_003
```

Type this command line

```
./case.setup
```

(3) build the executable

Type this command line:

```
qcmd -q R4231039 -- ./case.build
```

Type this command line:

```
./xmlchange STOP_OPTION=nyears
./xmlchange JOB_WALLCLOCK_TIME=1:00:00
./xmlchange PROJECT=UCGD0004
```

After step 3, update to run for 5 years, reduce wall clock time, and specify Project code

(4) submit your run to the batch queue

Exercise 2.3: Update a Parameter

Altering medlynslope to change stomatal conductance

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line

```
./create_newcase --case ~/clm_tutorial_cases/I2000CLM50_003 --res f19_g17 --compset I2000Clm50Sp --project UCGD0004
```

(2) invoke case.setup

Navigate to the case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_003
```

Type this command line

```
./case.setup
```

(3) build the executable

Type this command line:

```
qcmd -q R4231039 -- ./case.build
```

After xmlchanges, update the parameter file before you submit

---

(4) submit your run to the batch queue

Exercise 2.3: Update a Parameter

Altering medlynslope to change stomatal conductance

Navigate to the CaseDocs inside your Case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_003/CaseDocs
```

*Open **lnd_in** with text editor of your choice (VI, emacs, etc)*

```
emacs lnd_in
```

*In **lnd_in** find path for **paramfile** and copy this file to your case directory*

```
cp <paramfile> ~/clm_tutorial_cases/I2000CLM50_003/.
cd ~/clm_tutorial_cases/I2000CLM50_003
```

Next: We'll present 2 options for modifying this file, but ask that everyone follow option 1 for this exercise

Exercise 2.3: Update a Parameter

Altering medlynslope to change stomatal conductance

Option 1: netCDF Operators

Load the NCO operators

```
module load nco
```

Modify copy of parameter file using netCDF Operators or NCO (http://nco.sourceforge.net/)

```
ncap2 -s "medlynslope=medlynslope*0.9" clm5_params.c171117.nc <new_param_file_name>
```

The parameter we want to change is called “medlynslope”

We will decrease all the values of this parameter by 10%

Create a new file name for this modified file (include .nc file extension, for example `new_file.nc`)

Exercise 2.3: Update a Parameter

Altering medlynslope to change stomatal conductance

Option 1: netCDF Operators

Load the NCO operators

```
module load nco
```

Modify copy of parameter file using netCDF Operators or NCO (http://nco.sourceforge.net/)

```
ncap2 -s "medlynslope=medlynslope*0.9" clm5_params.c171117.nc <new_param_file_name>
```

*Then, set new path for **paramfile** in user_nl_clm*

Navigate to the Case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_003
```

Open user_nl_clm with text editor of your choice (VI, emacs, etc)

```
emacs user_nl_clm
```

Add this text to the bottom of user_nl_clm (filling in brackets as appropriate):

```
paramfile = '/glade/u/home/$USER/clm_tutorial_cases/I2000CLM50_003/<new_param_file_name>'
```

Exercise 2.3: Update a Parameter

Altering medlynslope to change stomatal conductance

Option 2: ncdump and ncgen

Navigate to the CaseDocs inside your Case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_003/CaseDocs
```

*Open **lnd_in** with text editor of your choice (VI, emacs, etc)*

```
emacs lnd_in
```

*In **lnd_in** find path for **paramfile** and copy file to your case directory*

```
cp <paramfile> ~/clm_tutorial_cases/I2000CLM50_003/.
cd ~/clm_tutorial_cases/I2000CLM50_003
```

Create a cdl file and open with a text editor
Then, update "medlynslope" by replacing with a new value

```
ncdump clm5_params.c171117.nc > clm5_temp.cdl
emacs clm5_temp.cdl
```

Reminder: you are not making changes here, you made these modifications with Option 1.

***NOTE:** For updating a whole set of PFT parameter values, such as this, using NCO commands are less error prone. ncdump and ncgen are useful for smaller changes. We present the syntax here, but **you do not need to modify these by hand**, since you did this in option 1 with an NCO command.*

Exercise 2.3: Update a Parameter

Altering medlynslope to change stomatal conductance

Option 2: ncdump and ncgen

Navigate to the CaseDocs inside your Case directory

```
cd ~/clm_tutorial_cases/I2000CLM50_003/CaseDocs
```

*Open **lnd_in** with text editor of your choice (VI, emacs, etc)*

```
emacs lnd_in
```

*In **lnd_in** find path for **paramfile** and copy file to your case directory*

```
cp <paramfile> ~/clm_tutorial_cases/I2000CLM50_003/.
cd ~/clm_tutorial_cases/I2000CLM50_003
```

Create a cdl file and open with a text editor
Then, update "medlynslope" by replacing with a new value

```
ncdump clm5_params.c171117.nc > clm5_temp.cdl
emacs clm5_temp.cdl
```

Create a new nc file from your edited cdl file

```
ncgen -o clm5_medlynless10.nc clm5_temp.cdl
```

*Set new path for **paramfile** in user_nl_clm*
Add this text to the bottom of the file:

```
paramfile = '/glade/u/home/$USER/clm_tutorial_cases/I2000CLM50_003/clm5_medlynless10.nc'
```

Reminder: you are not making changes here, you made these modifications with Option 1.

Exercise 2.3: Update a Parameter

Altering medlynslope to change stomatal conductance

Navigate to the scripts directory in the source code directory:

```
cd /glade/u/home/$USER/clm5.0_2019tutorial/cime/scripts
```

(1) create a new case

Type this command line

```
./create_newcase --case ~/clm_tutorial_cases/I2000CLM50_003 --res f19_g17 --compset I2000Clm50Sp --project UCGD0004
```

(2) invoke case.setup

Navigate to the case directory

```
cd ~/I2000CLM50_003
```

Type this command line

```
./case.setup
```

(3) build the executable

Type this command line:

```
qcmd -q R4231039 -- ./case.build
```

After updating parameter file submit the case

---

(4) submit your run to the batch queue

Type this command line:

```
./case.submit
```

Outline

Lecture/Intro

- Review Practical 1
- Why change model setup?

Practical

- **Checkout a Local Branch on Git**
- **Changing Model Setup**
    1) Component sets
    2) Namelist files
    3) Parameter changes
- **Data Analysis with Jupyter Notebook**

Basic Analysis using Jupyter Lab

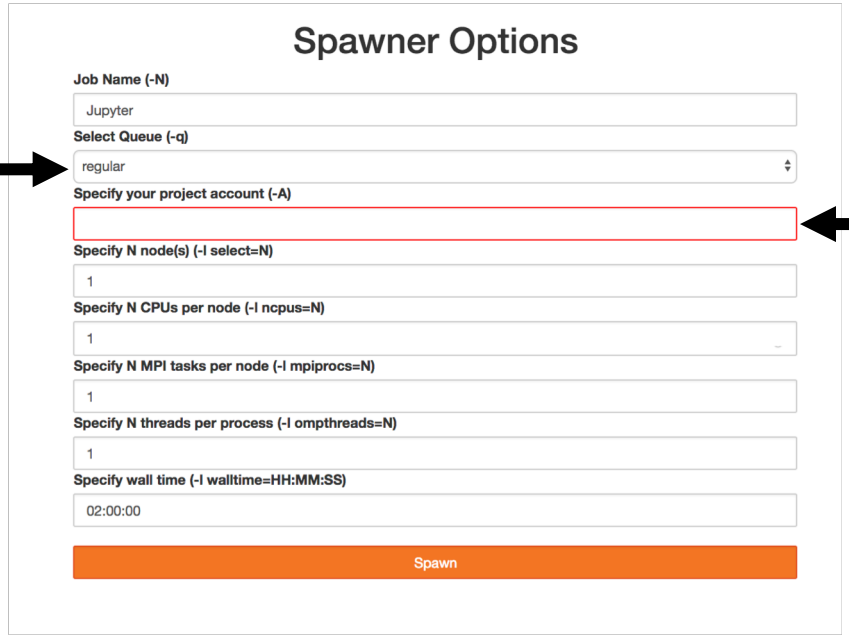
Using a web browser, navigate to this website:

http://jupyterhub.ucar.edu/ch

Log into the website using your cheyenne log in credentials: your username and yubikey (as the password).

This will navigate to a webpage with "Spawner Options". You'll need to enter ***today's Reservation number*** *and the* ***JupyterHub project number*** *and then click "Spawn"*

Enter today's Reservation number here: R4231039



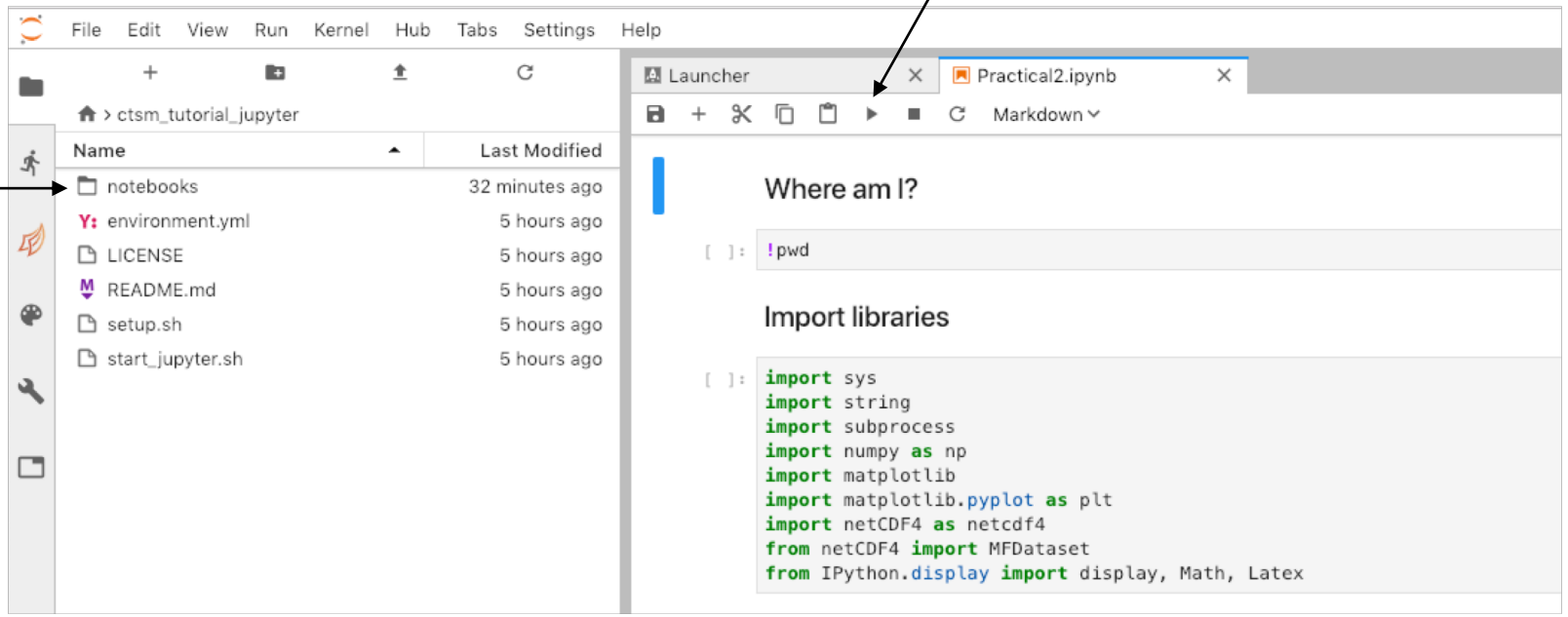
Enter Project number here: UCGD0004

Basic Analysis using Jupyter Lab

This will take you a new page that will allow you to explore the CLM output using code we developed in Jupyter Lab. On the left, navigate to the "notebooks" directory, and then ***click on "Practical2".*** *This will bring up the lab, with sections of code and comments on the left. Run through the exercises here. You can use the ▶ on the navigation bar or use the keyboard commands "shift" + "return" to run each cell.*

This button runs a block of code and advances to the next cell

Navigate to the "notebooks" folder to find ***Practical2.ipynb***



Jupyter Notebook Data Analysis

Using the Jupyter notebook, you will analyze CLM output from all three exercises. (Don't worry if your simulations haven't finished, we provide the output for you.)

- Exercise 2.1
  - Look at the difference between this simulation with year 2000 compset, and Day 1 practical simulation with year 1850 compset.
- Exercise 2.2
  - Look at a timeseries of daily output from this simulation compared to a timeseries of monthly output from Exercise 2.1.
- Exercise 2.3
  - Look at the difference between this simulation with medlynslope decrease, and the simulation from Exercise 2.1 with the default parameter value.

Now YOU know how to run and modify CLM!

Use these 3 basic modifications to run a variety of simulations.

1. Component Sets
2. Namelist files
3. Parameter changes

Congratulations on learning these new skills! Tomorrow, you will learn about tracking bugs and coding best practices.

Documenting Your Changes: README files

In your case directory, you will find automatically generated documentation files.

README.case file: detailed information on your compset and resolution, including whether your configuration has science support.

Best Practice: In the *README.case file*, we highly recommend YOU document any changes you make to the default scripts. It is YOUR paper trail and opportunity to list modifications.

Bonus Exercises: Test Your Knowledge

1) Set up a 2-degree CLM5.0-BGC simulation for 2000 and run for 1 month with daily history files.

2) Set up a 2-degree CLM5.0-BGC historical simulation and run for 5 years with monthly history files

3) Set up a 1-degree CLM5.0-BGC 1850 simulation and run for 1 year with monthly history files