

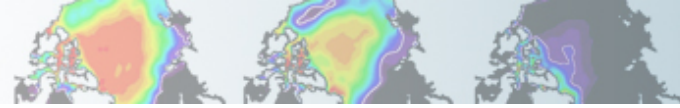
# CAM Breakout Session

## Exercises

*CESM Tutorial*

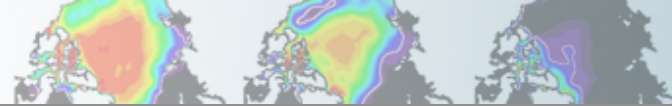
*Aug 12, 2016*

Presented by Dani Coleman  
*with contributions from Rich Neale*  
*AMP, CGD, NCAR*



# Summary

- First run the control case
- Then choose one (or more) exercises to try
  1. Turn off 'freeze-drying' approximation  
(*namelist change, Arctic*)
  2. Increase orographic height over the western US by 50%  
(*dataset change, mid-latitude*)
  - 2b. Modify sea surface temperature  
(*dataset change, tropical*)
  3. Increase the triggering threshold for deep convection just over land (*code change--simple, tropical*)
  4. Add a (fake) physics parameterization (*code change--advanced*)
- Compare your test exercise to your control



# Control Case: Atmosphere-only

To run with prescribed ocean (observed data) and prescribed sea-ice (thickness, area), use compset type F.

Compset Type	Atmosphere	Land	Ocean	Ice
F <i>(these exercises)</i>	<i>Interactive</i>	<i>Interactive</i>	Data	Thermodynamic
B <i>(previous exercises)</i>	<i>Interactive</i>	<i>Interactive</i>	<i>Interactive</i>	<i>Interactive</i>

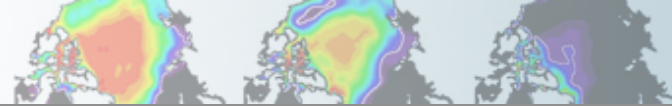
**Create a new F-case for your control (Do this now)**

```
cd /glade/p/cesm/tutorial/cesm1_2_2.tutorial/scripts
./create_newcase -case ~/cases/cesm1_2_2.cntl \
  -res T31_T31 -compset F_2000_CAM5 -mach yellowstone
```

The casename is **your choice**; this is an example of how I like to name my cases, with as much information as possible. Feel free to use the tutorial standard but start thinking about what information you want in your case names in the future.

Note the RES & COMPSET difference with the B-case we've been running (**DON'T run this command now**)

```
./create_newcase -case case01 -res T31_gx3v7 -compset B_1850_CN -mach yellowstone
```



# Control Case (continued)

- **Run length options (suggested run time of 2 months will take about 10 mins wallclock)**

```
setenv CASENAME cesm1_2_2.cntl; setenv CASEROOT ~/cases/$CASENAME
```

```
cd ~/cases/$CASENAME
```

```
./xmlchange STOP_N=2,STOP_OPTION=nmonths
```

- **Configure**

```
./cesm_setup
```

- **Build**

```
./cesm1_2_2.cntl.build
```

(Continue below; edit run files in a new window while build completes)

These c-shell short cuts will make your work easier. For bash, use `export VAR='my value'` or `export VAR=$MY_OTHER_VAR`

- **Required namelist variables (for this atm resolution to use data ice model)**

Add two variables to `$CASEROOT/user_nl_ice` with an editor (*vi* or *emacs*).

```
grid_file = '/glade/p/cesm/cseg/inputdata/share/domains/domain.ocn.48x96_gx3v7_100114.nc'
```

```
kmt_file = '/glade/p/cesm/cseg/inputdata/share/domains/domain.ocn.48x96_gx3v7_100114.nc'
```

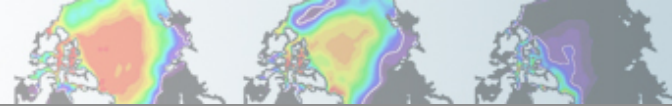
**Note that the file names are the same; do a mouse-copy 'ls' to double check the complicated names.**

**The 'single quotes' are absolutely necessary.**

**Note that, although the configuration you've been running so far does so straight 'out of the box,' that is NOT the typical scenerio. It is often necessary to make a few modifications to get exactly what you want and it is good for you to learn how to do so.**

- **The rest of the exercises are configured the same up to this point**

Do the *create\_newcase*, *cesm\_setup* and build just like this page with **new casenames** for each exercise. These slide titles are in gray boxes so you can search quickly through the document for them.



# Control Case (continued)

- **Check completion of build**

```
cat CaseStatus (should show 'build complete')
```

```
ls /glade/scratch/$LOGNAME/$CASENAME/bld/cesm.exe (should exist)
```

- **Submit**

```
cesm1_2_2.cntl.submit
```

- **Checking jobs**

```
bjobs
```

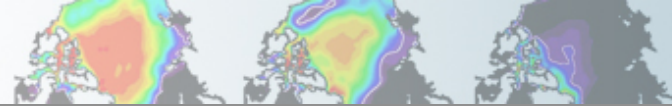
*Shows output similar to:*

JOBID	USER	STAT	QUEUE	FROM_HOST	EXEC_HOST	JOB_NAME	SUBMIT_TIME
992612	bundy	PEND	small	yslogin1-ib		*2_0_cntl	Aug 11 11:10

***This should take about 10 minutes once it is running.***

Meanwhile, continue to the following pages to **choose and set up your next exercise.**

You may want to read through the descriptions of all the exercises to find one that will both interest and challenge you. The **namelist change** is similar to the day2 practical; if you found that challenging then this is recommended, as it is the most common thing you will do with the model. The **dataset exercises** shows tools of interest for modifying netcdf files. The **code changes** are important if you'll be modifying code, and the second provides hints and tools to help you find the relevant code to change instead of just telling you what to do.



# Optional: Use a script

***You may skip this page***

***But if you are interested in using a script instead of the command line for all of this:***

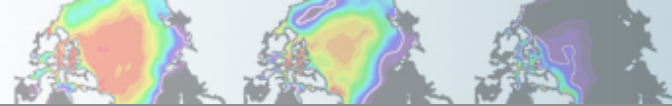
- It is possible to put most of the commands necessary to run CESM in a **shell script** instead of calling them from **the command line**
- **Advantages of a script**
  - An exact record of the commands used to make each case
  - Easy reproducibility and ability to make small changes for another case
- **Disadvantages of a script**
  - Necessary to understand a scripting language (example is in c-shell)
  - When the construction of a case requires editing or adding a file, you must have the script stop before the edit and resume afterward
- ***If you want to use scripts:*** copy the instructor's script for the control case to your directory, open it in an editor, read and understand it and make the necessary modifications to use it for your case (including changing the casename and paths)

```
cd ~/cases
```

```
cp /glade/u/home/bundy/cases/cesm1_2_2.test.csh your_casename.csh
```

This will create a case directory as specified in the script. I recommend naming the script with the casename it will create, and placing it in the directory containing all your cases.

Since this is a more advanced method, **there are no more instructions** for doing it this way. But you can compare to scripts for each exercise available in `~/bundy/my_scripts`.



# Comparing results to control case

**Once you have completed an exercise, come back to this page for a guide to a quick comparison. Again, the titles in **gray boxes** are to return to for each case.**

**You might need to load modules:** `module load ncview; module load netcdf`

- **A quick comparison of two (finished!) cases:** create an ncfile containing the diffs

```
cd /glade/scratch/$LOGNAME/archive/$CASENAME/atm/hist
```

***If you want to make it easier, use your case names in the following setenvs so you can copy and use the ncdiff lines)***

```
setenv CNTL cesm1_2_2.cntl; setenv CASE1 cesm1_2_2.nofrzdry
```

```
ncdiff $CASE1/atm/hist/$CASE1.cam.h0.0001-01.nc
```

```
    $CNTL/atm/hist/$CNTL.cam.h0.0001-01.nc
```

```
    diff_${CASE1}_${CNTL}.nc
```

Use ncview to browse variables in this file that contains only the diffs

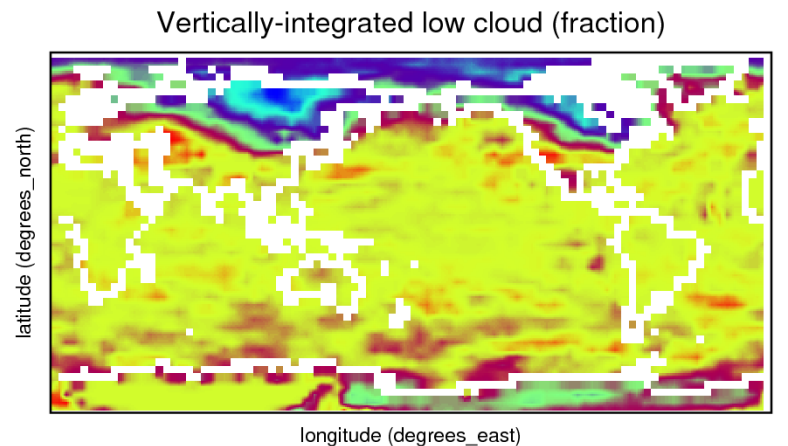
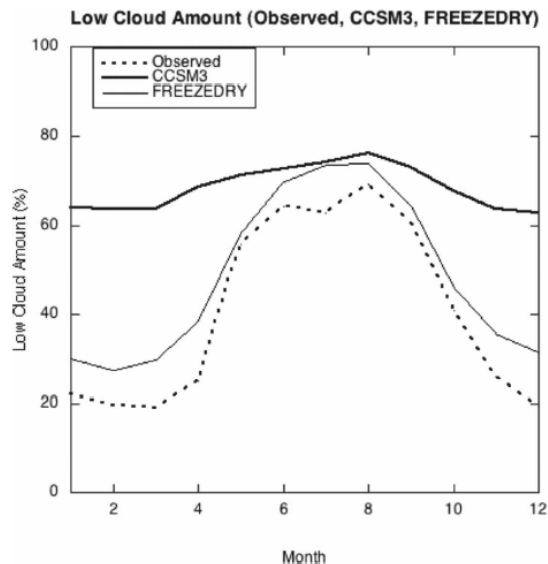
```
ncview diff_${CASE1}_${CNTL}.nc
```

- **Use ncl scripts from the diagnostics tutorial to compare single fields**
- Run the AMWG mean diagnostics for a more comprehensive comparison (not time to do this today, needs at least 14 months of data)
- **Is two months enough model run time to see changes? To see meaningful changes? Is T31 good enough resolution to start with?**

# Exercise 1: *Namelist Change*

*(a review from previous day)*

- ACTION:** Switch off an approximation that reduces the cloud fraction in very dry atmospheric conditions (Vavrus and Walliser, 2008), which improved results from CCSM3.



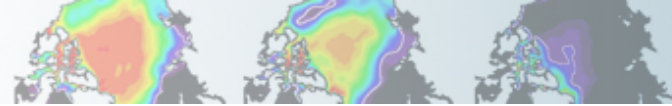
```
if (cldfrc_freeze_dry) then
  f = f x max(0.15, min(1.0, q/0.003))
endif
```

Recall from day2: for a complete list of namelist, please see the on-line documentation for each component model.

CAM4: <http://www.cesm.ucar.edu/cgi-bin/eaton/namelist/nldef2html-pub>

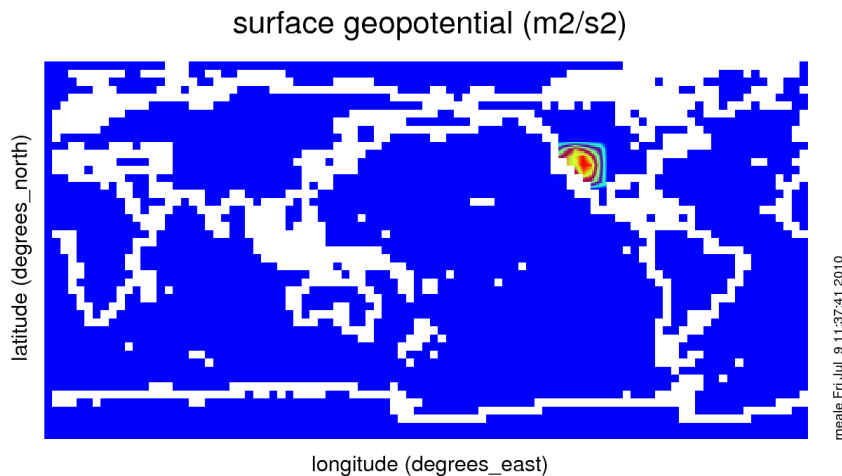
CAM5: [http://www.cesm.ucar.edu/cgi-bin/eaton/namelist/nldef2html-cam5\\_2](http://www.cesm.ucar.edu/cgi-bin/eaton/namelist/nldef2html-cam5_2)





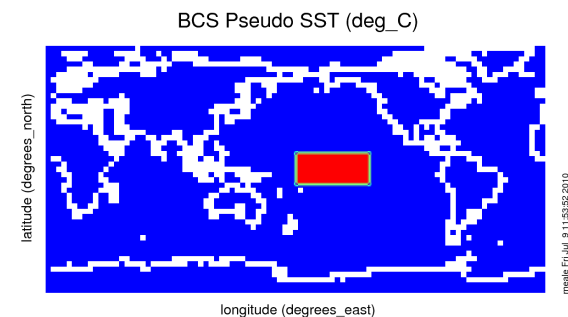
## Exercise 2: Dataset change

- Change input boundary datasets (orography) by increasing surface geopotential height by 50% in the western USA



Range of surface geopotential: 0 to 31521.7 m<sup>2</sup>/s<sup>2</sup>

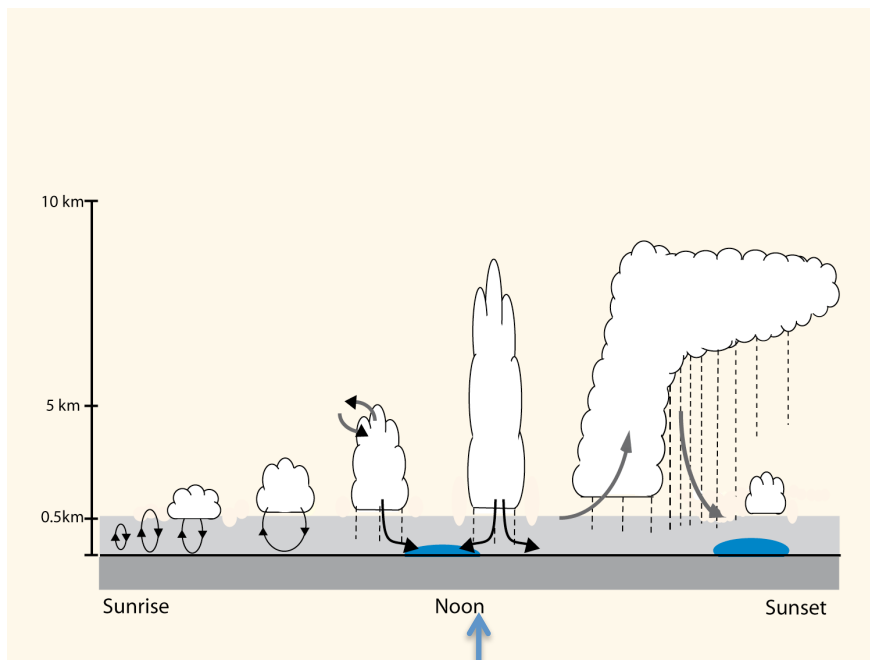
See alternative case 2b to add a Sea Surface Temperature (SST) anomaly instead



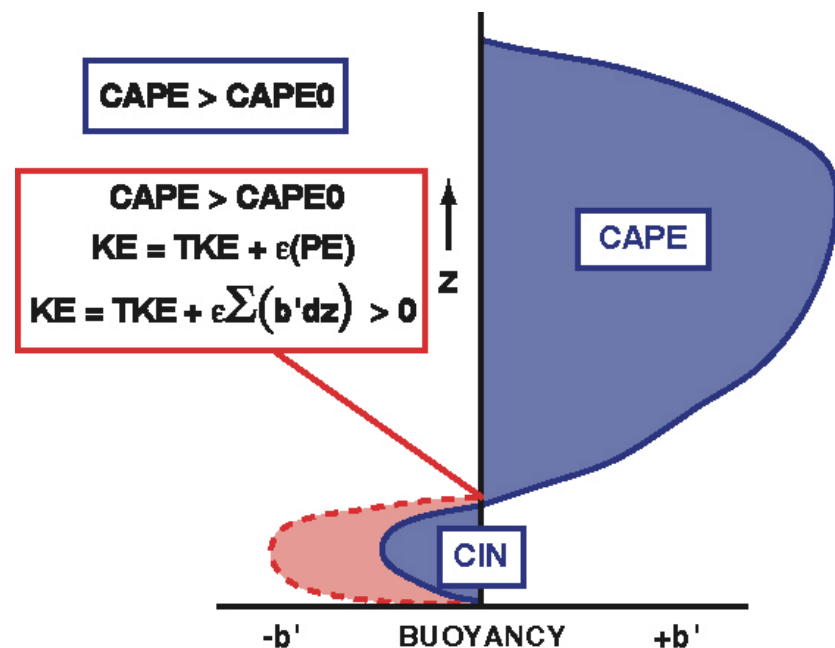
Range of BCS Pseudo SST: 0 to 1 deg\_C

# Exercise 3: *Code Change CAPE*

- Examine the mean effects of delaying the initiation of convection by increasing the minimum required convective available potential energy (CAPE) to initiate convection over land;



Models peak around noon  
Too early



# Exercise 4 *Code Change*

## *Add a parameterization*

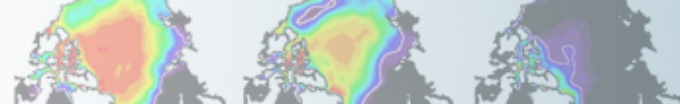
***Exercise 4 is a more general, free-form exercise to prepare you to do major modifications or replace an existing parameterization.***

This exercise will provide guidance if you want to **add a parameterization** to CAM, including these topics:

- a) The requirements for a parameterization and interface
- b) Finding source code (reading documentation, browsing and smart searching)
- c) A 'stub' parameterization to add to CAM (the subroutines & calls without content code)
- d) References to CAM physics code details

First: **Create, setup and build a new case** following the control case instructions (slides 3-4) but with a unique name, eg. *cesm1\_2\_2.param*

We will re-build after modifying the source code, meanwhile using some files created by the build to navigate through the source code.



# References

## *Learn more about coding in CAM*

- CAM reference manual

[http://www.cesm.ucar.edu/models/cesm1.2/cam/docs/rm5\\_3/](http://www.cesm.ucar.edu/models/cesm1.2/cam/docs/rm5_3/)

It provides details of how the CAM routines are called, the data structures (state, ptend), the array dimensions (chunks and columns), and descriptions of subcolumns and radiative constituents.

- CAM coding standards

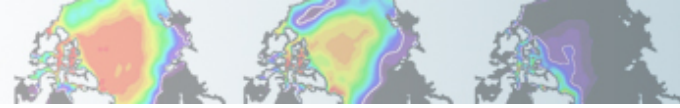
<https://wiki.ucar.edu/display/ccsm/Draft+of+Coding+Standards+for+CAM>

- Unit testing

<http://www.cesm.ucar.edu/events/ws.2014/Presentations/SEWG/santos.pdf>

- Physics interface design

<http://www.cesm.ucar.edu/models/atm-cam/docs/phys-interface/>



## References

### *Stand-alone , Single-Column CAM*

- Users who are developing CAM might be interested in using the stand-alone CAM configure/run instead of dealing with the entire CESM structure

```
models/atm/cam/bld/run-yellowstone.csh (among others)
```

- Single-column CAM is a good tool for developing physics parameterizations

- no dynamics
- runs with field-experiment data

```
models/atm/cam/bld/run-scaml.csh
```

# References

## *CESM bulletin board*

NCAR UCAR **DiscussCESM** COMMUNITY Earth System MODEL

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#### CESM - General

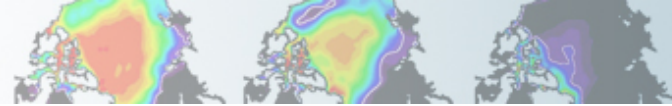
The Community Earth System Model (CESM) is a fully coupled, global climate model that provides state-of-the-art computer simulations of the Earth's past, present, and future climate states.

Forum	Topics	Posts	Last post
Announcements	15	39	CESM1_0_5 issues by jedwards March 20, 2013 - 2:14pm
Bug reporting	103	287	problem with... by dbailey February 20, 2013 -

#### Atmospheric Modeling with CAM

The Community Atmosphere Model (CAM) is the atmosphere model component of the CESM. Information about running CAM as the atmospheric component of the CESM is found in the CESM release documentation. For information on CAM microphysics, visit the CAM Microphysics Development Group. Please see the Whole Atmosphere Community Climate Model Forum and the Climate Chemistry Forum for topic discussions specific to these capabilities of CAM.

Forum	Topics	Posts	Last post
			What is the



# Answers

## Basic commands for all cases (using my casename cesm1\_2\_2.cntl)

```
cd /glade/p/cesm/tutorial/cesm1_2_2.tutorial/scripts
./create_newcase -case ~/cases/cesm1_2_2.cntl -mach yellowstone -res T31_T31 -compset F_2000_CAM5

cd ~/cases/cesm1_2_2.cntl
./cesm_setup
./cesm1_2_2.cntl.build >& ! out.build

./xmlchange -file env_run.xml -id STOP_N -val 2
./xmlchange -file env_run.xml -id STOP_OPTION -val nmonths

echo "grid_file = '/glade/p/cesm/cseg//inputdata/share/domains/domain.ocn.48x96_gx3v7_100114.nc'" >>&user_nl_cice
echo "kmt_file = '/glade/p/cesm/cseg//inputdata/share/domains/domain.ocn.48x96_gx3v7_100114.nc'" >>&user_nl_cice
```

## Make any dataset changes or code changes here.

```
./cesm1_2_2.cntl.submit
```

## Likely run-time errors

- No hist files in archive directory and only 5 days in rundir ->**stop\_n , stop\_option not changed**
- Run quit with an error relating to ice model grid (or no description)-> **forget to set grid\_file, kmt\_file in user\_nl\_cice**

## Exercise 4 errors

May need to delete /glade/scratch/\$USER/\$CASENAME/bld/atm/\* to get it to work, especially if there were previous build errors