Overview

Exercise 1

Namelist modification
Customize your history output

Exercise 2

Namelist + Code modification
Add a new output field to the code

Exercise 3

Change a tuning parameter

Quiz

See instructons on the tutorial webpage.
(You can complete the previous day quizzes too)

Solutions to the exercices

My own recommendation:
DON'T LOOK AT THE SOLUTIONS DURING THE LAB !!!

Exercise 1: Customizing history files

Create a case called "b1850_high_freq" using the compset B1850 at f19_g17 resolution.

Set the run length to 1 month.

In addition to the monthly history file "h0", output:
- "h1" file with instantaneous values of T, Q, U and V every 24 hour.
- "h2" file with time-average values of T, Q, U and V every 3 hour.

Set your namelist so that you output:
- a single h1 file with all the daily output for the month.
- multiple h2 files, one for every day of the month.

It means you will have:
- one h1 file with 31 timesteps and
- thirty-one h2 files with 8 timesteps each).

Hints for exercise 1

- Today JOB_QUEUE is *R7410096*

You can compile with the command:
qcmd –A UESM0007 –q R7410096 -- ./case.build

- Use namelist variables: *nhtfrq, mfilt, fincl.*
  Look at the online documentation for these variables.

- When your run is completed, go to the archive directory.

(1) Check that your archive directory contains the files:

h0 files
b1850_high_freq.cam.h0.0001-01.nc

h1 files
b1850_high_freq.cam.h1.0001-01-01-00000.nc
b1850_high_freq.cam.h1.0001-02-01-00000.nc

h2 files
b1850_high_freq.cam.h2.0001-01-01-00000.nc
…
b1850_high_freq.cam.h2.0001-01-31-00000.nc
b1850_high_freq.cam.h2.0001-02-01-00000.nc

(2) Compare the contents of the h1 and h2 files using “ncdump”.

ncdump –h b1850_high_freq.cam.h1.0001-01-01-00000.nc
ncdump –h b1850_high_freq.cam.h2.0001-01-01-00000.nc

(3) Check the number of timesteps in the h1 and the h2 files.
Look at the sizes of the files.

Exercise 2: Add an output field

Create a case called “b1850_T750” using the compset B1850 at f19_g17 resolution.

- Add an output field for the temperature at 750 mbar.
- Output daily values of T750 and T500 in the “h1” history file.
- Set the namelist to output a single h1 for the run.
- Make a 1-month run.

Hints for exercise 2

- Use T500 as a template for your changes.
  Find the subroutine containing T500 using the command *grep –r T500 **

- When the run is completed, go to your archive directory:
  - check the fields T750 and T500 are in the file h1
  - create a file with the difference between T750-T500
  - For instance, you can use ncap2
    ncap2 -s ’T750_minus_T500=T750-T500' b1850_T750.cam.h1.0001-01-01-00000.nc T750-T500.nc
  - Look at the difference with ncview.

Exercise 3: Modify a parameter, dcs

In the tuning lecture, we talked about the parameter dcs:
http://www.cesm.ucar.edu/events/tutorials/2019/files/Specialized-hannay.pdf

Create a case called "b1850_dcs" using the compset B1850 at f19_g17 resolution.

Locate the parameter Dcs and change from the default value:
micro_mg_dcs = 200.D-6
to
micro_mg_dcs = 500.D-6

Make a 1-month run.

Hint for exercise 3

- The trick is going to locate where to change micro_mg_dcs
- Compare to this run to the first run you did today: b1850_high_freq.

- You can use ncdiff and ncview to look at the difference between the 2 runs.

ncdiff /glade/scratch/$user/archive/b1850_dcs/atm/hist/b1850_dcs.cam.h0.0001-01.nc /glade/scratch/$user/archive/b1850_high_freq/atm/hist/b1850_high_freq.cam.h0.0001-01.nc diff.nc

ncview diff.nc

- How does this affect the LWCF ?

Quizzes

At the end of the practical, please go to the online course and take the quiz.
http://www.cesm.ucar.edu/events/tutorials/2019/quizzes.html

To answer the questions, you can use documentation, ask questions to others or to the helper. Indeed you are strongly encouraged to do all the above. This is the way you will use CESM in the future.

How are you graded ? You can take the quizzes as many times as you want, I only retain your highest score. But please try to understand your mistakes.

If you cannot complete the quiz by the end of the practical session, you have until August 17 to complete the quizzes. If you get a perfect score, you will get a certificate of awesomeness.

"Special prize" for those who get a perfect score before Friday morning!!!

Solutions to the exercises

At the request of previous year students, I am providing the solutions to the exercises.

My own recommendation:
DON'T LOOK AT THE SOLUTIONS DURING THE LAB !!!

I believe:
- You will only learn if you try the exercises by yourself.
- You will only learn if you do mistakes.
- Copy/paste will teach you little, indeed.
- Your best bet is to try, do mistakes, ask your neighbor, interact with each others, look at the documentation, try to understand what is wrong...
- But this is my own opinion, and at the end of the day, do what is best for you.

Go to the next page at your own risk 😉

If you are sure you want to look at the solutions, click on the button below...

Solution to exercise 1

Point to the prebuilt code (These instructions are for tcsh shell. If you use another shell, modify accordingly)
setenv CESM_BLD_TEMPLATE
/glade/p/cesm/tutorial/templates/cesm2.1.1_b1850/bld

Create a new case
cd /glade/p/cesm/tutorial/cesm2.1.1_tutorial/cime/scripts
./create_newcase --case ~/cases/b1850_high_freq --compset B1850 --res f19_g17

Case setup
cd ~/cases/b1850_high_freq
./case.setup

Edit the user_nl_cam and add the lines:
nhtfrq = 0, -24, -3
mfilt = 1, 31, 8
fincl2 = 'T:I','Q:I','U:I','V:I'
fincl3 = 'T','Q','U','V'

Change run length
./xmlchange STOP_N=1,STOP_OPTION=nmonths

Build and submit
qcmd –A UESM0007 –q R7410096 -- ./case.build
./case.submit

When your run is completed

(1) Check that your archive directory:
cd /glade/scratch/$user/archive/b1850_high_freq/atm/hist
ls

(2) Compare the contents of the h1 and h2 files using “ncdump”.
Look at the variables attributes. What is the difference between the 2 files ?

(3) Check the number of timesteps in the h1 and the h2 files.

h1 => 31 timestep. In the netcdf file, time = UNLIMITED ; // (31 currently)
h2 => 8 timesteps. In the netcdf file, time = UNLIMITED ; // (8 currently)

Check size of the files
du –ks –h /glade/scratch/$user/archive/b1850_high_freq/atm/hist/*

234M b1850_high_freq.cam.h0.0001-01.nc

210M b1850_high_freq.cam.h1.0001-01-01-00000.nc
7.0M b1850_high_freq.cam.h1.0001-02-01-00000.nc

55M b1850_high_freq.cam.h2.0001-01-01-00000.nc
55M b1850_high_freq.cam.h2.0001-01-02-00000.nc
...
55M b1850_high_freq.cam.h2.0001-01-31-00000.nc
7.0M b1850_high_freq.cam.h2.0001-02-01-00000.nc

Solution to exercise 2

Point to the prebuilt code (These instructions are for tcsh shell. If you use another shell, modify accordingly)
setenv CESM_BLD_TEMPLATE /glade/p/cesm/tutorial/templates/cesm2.1.1_b1850/bld

Create a new case
cd /glade/p/cesm/tutorial/cesm2.1.1_tutorial/cime/scripts
./create_newcase --case ~/cases/b1850_T750 --compset B1850 --res f19_g17

Case setup
cd ~/cases/b1850_T750
./case.setup

Locate the file where T500 is computed and copy it SourceMods/sc
cp /glade/p/cesm/tutorial/cesm2.1.1_tutorial/components/cam/src/physics/cam/cam_diagnostics.F90 SourceMods/src.cam

Edit the file SourceMods/src.cam/cam_diagnostics.F90 and add the lines:
```
   !++ add a variable for T750
  call addfld ('T750',       horiz_only,  'A', 'K','Temperature at 750 mbar pressure surface')
  !++ add a variable for T750
    if (hist_fld_active('T750')) then
      call vertinterp(ncol, pcols, pver, state%pmid, 75000._r8, state%t, p_surf, &
         extrapolate='T', ps=state%ps, phis=state%phis)
      call outfld('T750    ', p_surf, pcols, lchnk )
    end if
```

Edit the user_nl_cam and add the lines:
```
 nhtfrq = 0, -24
 mfilt = 1, 31
 fincl2 = 'T750', 'T500'
```

Change run length
./xmlchange STOP_N=1,STOP_OPTION=nmonths

Build and submit
qcmd –A UESM0007 –q R7410096 -- ./case.build
./case.submit

When the run is completed,

- check the field T750 and T500 are in the file h1

cd /glade/scratch/$user/archive/b1850_T750/atm/hist/
ncdump -h b1850_T750.cam.h1.0001-01-01-00000.nc

The file should contain:

float T500(time, lat, lon) ;
T500:units = "K" ;
T500:long_name = "Temperature at 500 mbar pressure surface" ;
T500:cell_methods = "time: mean" ;
float T750(time, lat, lon) ;
T750:units = "K" ;
T750:long_name = "Temperature at 750 mbar pressure surface" ;
T750:cell_methods = "time: mean" ;

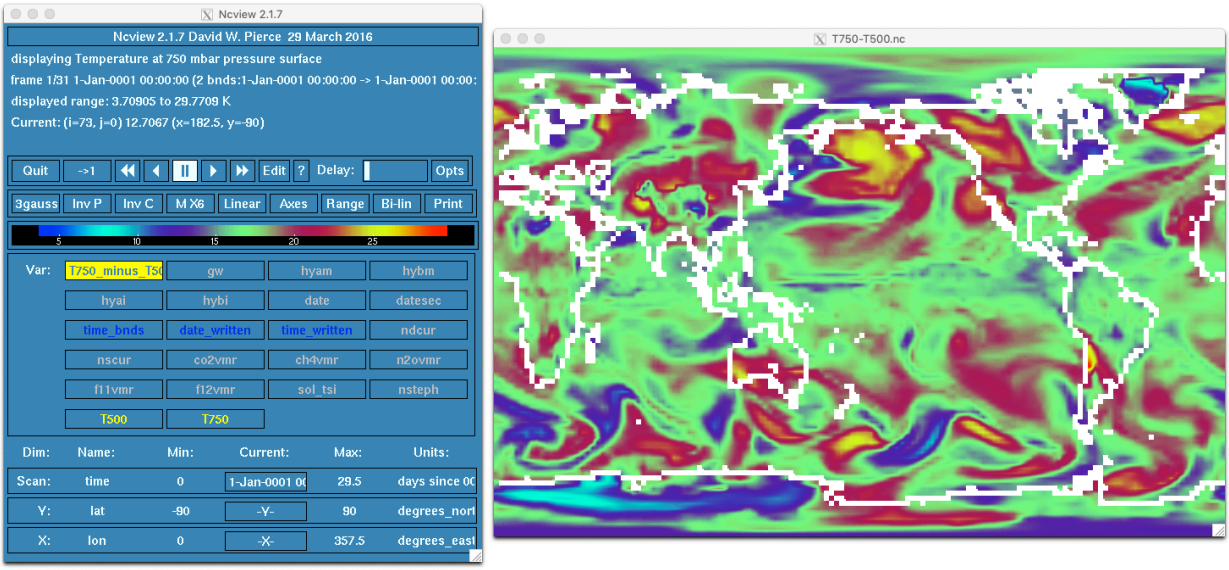
create a file with the difference between T750-T500
cd /glade/scratch/$user/archive/b1850_T750/atm/hist/
ncap2 -s 'T750_minus_T500=T750-T500' b1850_T750.cam.h1.0001-01-01-00000.nc T750-T500.nc

look at the difference between T750-T500 with ncview.
cd /glade/scratch/$user/archive/b1850_T750/atm/hist/

Use ncview to look at the difference

ncview T750-T500.nc

The field 'T750_minus_T500' looks like:



Solution to exercise 3

Point to the prebuilt code (These instructions are for tcsh shell. If you use another shell, modify accordingly)
setenv CESM_BLD_TEMPLATE
/glade/p/cesm/tutorial/templates/cesm2.1.1_b1850/bld

Create a new case
cd /glade/p/cesm/tutorial/cesm2.1.1_tutorial/cime/scripts
./create_newcase --case ~/cases/b1850_dcs --compset B1850 --res f19_g17

Case setup
cd ~/cases/b1850_dcs
./case.setup

Edit user_nl_cam and add the line
micro_mg_dcs = 500.D-6

The default value is:
micro_mg_dcs = 200.D-6

Change run length
./xmlchange STOP_N=1,STOP_OPTION=nmonths

Build and submit
qcmd –A UESM0007 –q R7410096 -- ./case.build
./case.submit

When the run is completed, compare to the first run: b1850_high_freq. Create a file with the difference between LWCF between b1850_dcs and b1850_high_freq.

You can use ncdiff and ncview to look at the difference between the 2 runs.

cd /glade/scratch/$user/archive/b1850_dcs
ncdiff
/glade/scratch/$user/archive/b1850_dcs/atm/hist/b1850_dcs.cam.h0.0001-01.nc

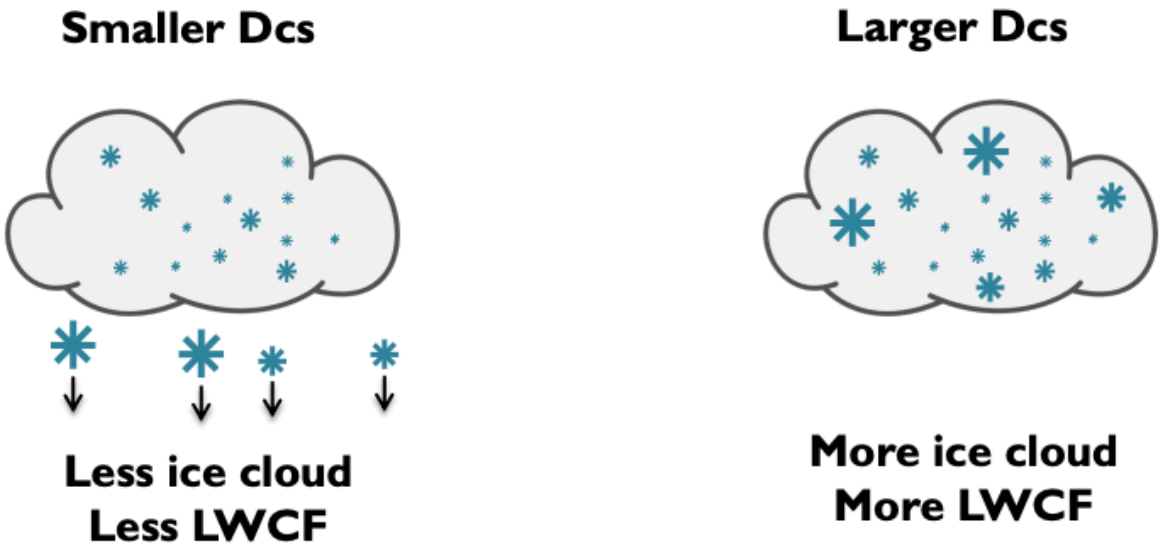
/glade/scratch/$user/archive/b1850_high_freq/atm/hist/b1850_high_freq.cam.h0.0001-01.nc diff.nc

Use ncview to look at the file you created.

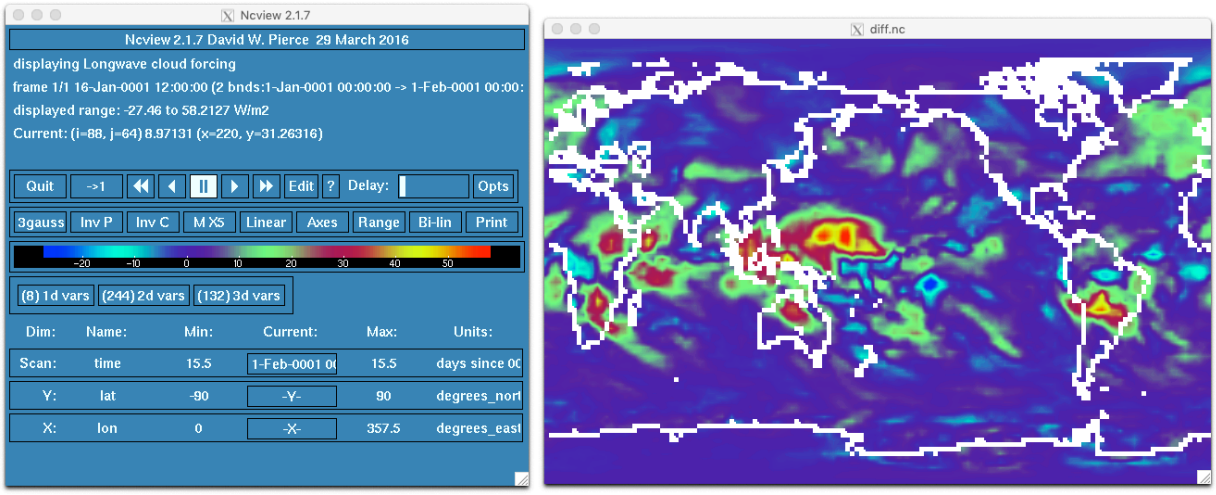
ncview diff.nc

How does this affect the LWCF ?

Dcs = Threshold diameter to convert cloud ice particles to snow



We increased Dcs from 200 microns to 500 microns. We should have more ice cloud and the LWCF should be larger.



We can see that the change in Dcs affects the tropics where LWCF is large

However, 1-month run is too short to look at robust statistics.