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

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

- Compile command reminder

You can compile with the command:
qcmd -- ./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 ?

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 helper, interact with each other's, 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 😉

Solution to exercise 1

Create a new case
cd /glade/p/cesm/tutorial/cesm2.1_tutorial2022/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

Change job queue and account number (if needed after 5pm)
./xmlchange JOB_QUEUE=regular,PROJECT=UESM0011

Build and submit
qcmd -- ./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 ?

The file with the instantaneous output (h1) have no cell_methods attribute while the average output (h2) has a attribute: cell_methods = "time: mean" ;

For instance for the field Q.

In: b1850_high_freq.cam.h1.0001-01-01-00000.nc
float Q(time, lev, lat, lon) ;
        Q:mdims = 1 ;
        Q:units = "kg/kg" ;
        Q:mixing_ratio = "wet" ;
        Q:long_name = "Specific humidity" ;

In: b1850_high_freq.cam.h2.0001-01-01-00000.nc
float Q(time, lev, lat, lon) ;
        Q:mdims = 1 ;
        Q:units = "kg/kg" ;
        Q:mixing_ratio = "wet" ;
        Q:long_name = "Specific humidity" ;
        Q:cell_methods = "time: mean" ;

(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

Create a new case
cd /glade/p/cesm/tutorial/cesm2.1_tutorial2022/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_tutorial2022/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

Change job queue and account number (if needed after 5pm)
./xmlchange JOB_QUEUE=regular,PROJECT=UESM0011

Build and submit
```
qcmd -- ./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
```
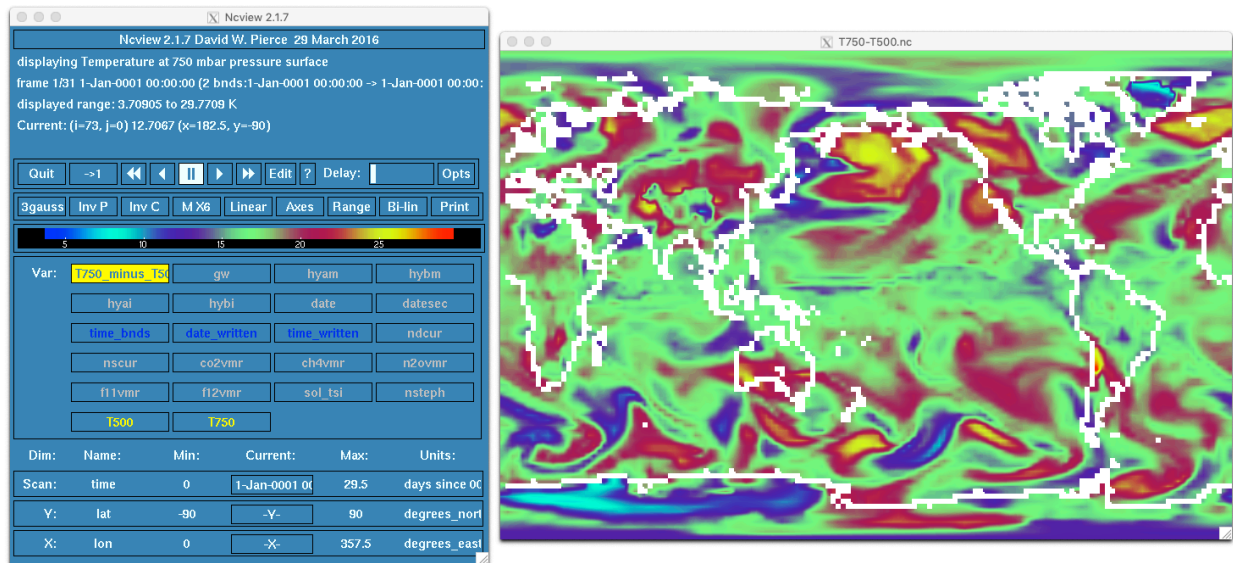

look at the difference between T750-T500 with ncview.
```
cd /glade/scratch/$user/archive/b1850_T750/atm/hist/
```

Use ncview to look at the difference

ncview T750-T500.nc

The field 'T750_minus_T500' looks like:

Solution to exercise 3

\# Create a new case
cd /glade/p/cesm/tutorial/cesm2.1_tutorial2022/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

\# Change job queue and account number (if needed after 5pm)
./xmlchange JOB_QUEUE=regular,PROJECT=UESM0011

\# Build and submit
qcmd -- ./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.h
0.0001-01.nc   diff.nc
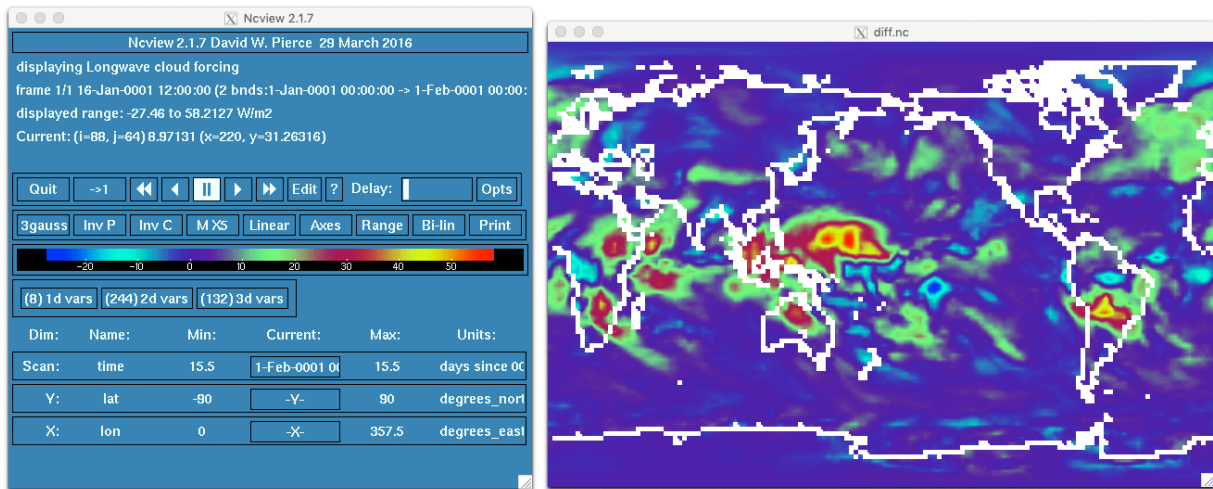
Use ncview to look at the file you created.

ncview diff.nc

How does this affect the LWCF ?

Dcs = Threshold diameter to convert cloud ice particles to snow

Smaller Dcs   **Larger Dcs**

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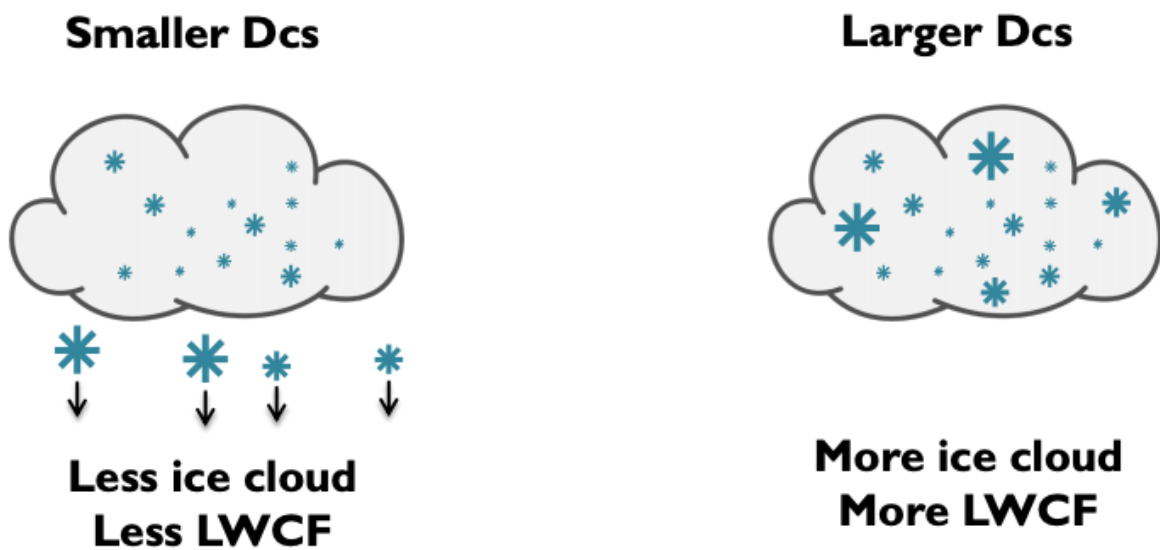
We increased Dcs from 200 microns to 500 microns. We should have more ice cloud and the LWCF should be larger.

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.