The Community Atmospheric Model (CAM)

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Outline

- CESM: workflow and compsets
- CAM standalone: running CAM4 and CAM5 physics
- Namelist changes
- Code Changes
- How to look at the results: The CAM diagnostic package
- Exercises solutions

Basic workflow to run CESM

The set of 4 commands you need to create and run a case

- ***Create a New Case***
  Go into the CESM script directory:
  cd /path/to/source/cesm1_0/scripts
  create_newcase -case ~/mycase.01 -res f19_g16 -compset B_1850 -mach mapache

  CESM grid resolution
  machine
  case name and path
  CESM compset

- **Configure the Case**
  Go into the case directory you just created (in the previous step):
  cd ~/mycase.01/
  configure –case

- **Build the Executable**
  mycase.01.mapache.build

- **Run the Model**
  mycase.01.mapache.submit

create_newcase -list

Displays complete list of resolutions, compsets and machines

RESOLUTIONS: name (shortname)

0.23x0.31_0.23x0.31 (f02_f02)

0.23x0.31_gx1v6 (f02_g16)

…

specifies the model resolutions
Format is : [atm/lnd grid]_[ocn/ice grid]

COMPSETS: name (shortname): description

A_PRESENT_DAY (A)

Description: All data model

B_2000 (B)

Description: All active components, present day

…

First letter of the compset name
indicates which components are used

MACHINES: name (description)

bluefire (NCAR IBM p6, os is AIX, 32 pes/node, batch system is LSF)

…

Compsets types

Designation	Details
A	All DATA components (used primarily for testing)
B	FULLY ACTIVE components
C	POP active with data atm, lnd(runoff), and ice
D	CICE active with data atm and ocean
E	CAM, CLM, and CICE active with data ocean (som mode)
F	CAM, CLM, and CICE (prescribed mode) active with data ocean (sstdata mode)
G	POP and CICE active with data atm and lnd(runoff)
H	POP and CICE active with data atm
I	CLM active with data atm

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H	POP and CICE active with data atm
I	CLM active with data atm

Fully coupled: This morning

CAM standalone: Now

CLM standalone: tomorrow

Scientific validation: Warning !

CESM can be run out-of-the box for a variety of compset/resolution/machine combinations but only a few combinations have undergone through a rigorous scientific climate validation

The list of scientifically validated run is displayed when running the command:
create_newcase -case ~/mycase.01 -res f19_g16 -compset B_1850 -mach mapache

```
-------------------------------------------------------------------------------
                            CESM1.0 README

For both a quick start as well as a detailed summary of creating and running
a CESM model case, see the CESM1.0 User's Guide at
http://www.cesm.ucar.edu/models/cesm1.0

IMPORTANT INFORMATION ABOUT SCIENTIFIC VALIDATION

   CESM1.0 has the flexibility to configure cases with many different
   combinations of component models, grids, and model settings, but this
   version of CESM has only been validated scientifically for the following
   fully active configurations:

      1.9x2.5_gx1v6   B_1850_CN
      1.9x2.5_gx1v6   B_1850_RAMPCO2_CN
      1.9x2.5_gx1v6   B_1850-2000_CN
```

Users should carry out their own validations prior doing scientific runs.

Validated configuration

Coupled Mode

1.9x2.5_gx1v6 B_1850_CN
1.9x2.5_gx1v6 B_1850_RAMPCO2_CN
1.9x2.5_gx1v6 B_1850-2000_CN

1.9x2.5_gx1v6 B_1850_CAM5

0.9x1.25_gx1v6 B_1850_CN
0.9x1.25_gx1v6 B_1850_RAMPCO2_CN
0.9x1.25_gx1v6 B_1850-2000_CN

0.9x1.25_gx1v6 B_1850_BGC-BPRP
0.9x1.25_gx1v6 B_1850_BGC-BDRD
0.9x1.25_gx1v6 B_1850-2000_BGC-BPRP
0.9x1.25_gx1v6 B_1850-2000_BGC-BDRD

0.9x1.25_gx1v6 B_1850_CN_CHEM
0.9x1.25_gx1v6 B_1850-2000_CN_CHEM

1.9x2.5_gx1v6 B_1850_WACCM_CN
1.9x2.5_gx1v6 B_1850-2000_WACCM_CN

T31_gx3v7 B_1850_CN

Standalone Mode

1.9x2.5_1.9x2.5 F_2000_WACCM
1.9x2.5_1.9x2.5 F_AMIP_CAM5
1.9x2.5_1.9x2.5 F_AMIP_CN
0.9x1.25_0.9x1.25 F_AMIP_CN

0.9x1.25_gx1v6 I_2000
0.9x1.25_gx1v6 I_2000_CN

T62_gx1v6 C_NORMAL_YEAR

For scientifically validated configurations, long controls runs are available on:
http://www.cesm.ucar.edu/experiments/cesm1.0

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Running CAM standalone: F cases

- **F case**: active atmosphere model (CAM) + active land model (CLM)
  + thermodynamic only sea ice model (CICE) + data ocean model (DOCN)

- **Many available F compsets**

  For instance: *F_AMIP_CN* *F_2000_CN* *F_1850*
  F_AMIP_CAM5 *F_2000_CAM5* *F_1850_CAM5*

- **Type of SSTs**

  *F_AMIP**: observed SSTs
  *F_2000**: climatological present day SSTs
  *F_1850**: climatological pre-industrial SSTs

- **CAM physics**

  CAM4 physics (default)
  CAM5 physics available (_CAM5 in compset name)

- **Resolution**

  In coupled mode: model resolution format is : [atm/lnd grid]_[ocn/ice grid]. Ex: *f09_g16*
  In CAM mode: all the components are run on CAM grid: [atm/lnd grid]_ [atm/lnd grid]: *Ex: f09_f09*

Some instructions for the lab

1. We will use the CESM code located locally on mapache, no need to checkout or download any input data.

   CESM code: /usr/projects/cesm/cesm1_0_2

2. We will run at coarse resolution (T31_T31).

   The default resolution for CAM4 is 1 degree (f09_f09) and for CAM5 2 degree (f19_f19).

   In this tutorial, we are using resolution that is NOT scientifically validated

3. Because of space issue on scratch1, the scripts are configured to put your run directories into: /scratch2/$logname/CESM (instead of /scratch1/$logname/CESM)

4. Exercises solutions are at the end of the tutorial. Try to use hints and documentation before looking at solutions.

5. Be curious (explore the CESM directories/files).

6. Have fun

Running CAM4 and CAM5 physics

The first set of exercises demonstrate how to turn on CAM4/CAM5 physics.

Model	CAM3	CAM4	CAM5
Release	**June 2004**	**April 2010**	**June 2010**
Shallow Convection	Hack (1994)	Hack (1994)	Park et al. (2009)
Deep Convection	Zhang and McFarlane (1995)	Neale et al. (2008)	Neale et al. (2008)
Microphysics	Rasch and Kristjansson (1998)	Rasch and Kristjansson (1998)	Morrison and Gettelman (2008)
Macrophysics	Rasch and Kristjansson (1998)	Rasch and Kristjansson (1998)	Park et al. (2011)
Radiation	Collins et al. (2001)	Collins et al. (2001)	Iacono et al. (2008)
Aerosols	Bulk Aerosol Model	Bulk Aerosol Model BAM	Modal Aerosol Model Ghan et al. (2011)
Dynamics	Spectral	Finite Volume	Finite Volume

Exercise 1: Running CAM4 physics

Exercise 1: Create, configure, and build an out-of-the-box set of scripts called “case01” that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM4 physics. Set the run length to 1 month. Turn off the short-term archiving.

Hints:

- Use resolution: T31_T31

In CAM standalone mode, all the components are run on CAM grid

- Use compset: F_2000

Active CAM and CLM with prescribed CICE and DOCN

- Edit env_run.xml

to specify the run length (1 month)

Change the variables STOP_OPTION and STOP_N using the xmlchange command

to turn off short-term archive

Set the variable DOUT_S to FALSE using the xmlchange command

The file: env_run.xml

The variables in env_run.xml MAY BE CHANGED ANYTIME during a run.

Common variables to change include:

- *RESUBMIT* : sets the number of times to resubmit the run

- *STOP_OPTION:* sets the run length time interval, i.e. nmonths, ndays, nyears

- *STOP_N*: sets the number of intervals (set by STOP_OPTION) to run the model during the specified wallclocktime.
  Wallclocktime is set in your *.run file and is a measure of the actual time.

- CONTINUE_RUN: if TRUE, implies a CONTINUE run.
  Note: if RESUBMIT is > 0 and it is an initial run (i.e. CONTINUE_RUN=FALSE), CONTINUE_RUN will automatically update to TRUE upon completion of initial run.

- DOUT_S -> turns on short-term archiving (short term archiving) . DOUT_S is TRUE by default. Today, we will set it to false. We will cover archiving tomorrow.

xmlchange command

xmlchange is used to edit xml files:

Syntax:

xmlchange -file [name] -id [name] -val [name]

-file: The xml file to be edited.

-id: The xml variable name to be changed.

-val: The intended value of the variable associated with the -id argument.

Example;

xmlchange -file env_run.xml -id STOP_N -val 3

Note: If you want a single quotation mark ("'", also called an apostrophe) to appear in the string provided by the -val option, you must specify it as "'".

Documenting your changes

Let's introduce good practices: **Document everything you do!**

In your case directory, in addition to your scripts, you will find a file called ***README.case***.

- README.case: one line of text which echos your create_newcase command.
  create_newcase -res T31_T31 -compset F_2000 –case ~/case01 –mach mapache

- In README.case: we highly recommend YOU document any changes you make to the default scripts. It is your paper trail and opportunity to list modifications. You will thank yourself months (years) later, when you are trying to figure out what you did oh-so-long ago!

Exercise 2: Running CAM5 physics

Exercise 2: Create, configure, and build an out-of-the-box set of scripts called “case02” that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM5 physics. Set the run length to 1 month. Turn off the short-term archiving.

Compare the case directories: case01 and case02. In particular, compare the file env_conf.xml for the 2 cases

Hints:

- As in exercise 1: use resolution T31_T31 and change run length

- Use compset: F_2000_CAM5 CAM5 physics

CAM4 physics vs CAM5 physics

When the two runs are done:

output files (*.h0.*)
restart files (*.r*)

```
case01.cam2.h0.0001-01.nc
case01.cam2.r.0001-02-01-00000.nc
case01.cam2.rs.0001-02-01-00000.nc
case01.cice.r.0001-02-01-00000.nc
case01.clm2.h0.0001-01.nc
case01.clm2.r.0001-02-01-00000
case01.clm2.r.0001-02-01-00000.nc
case01.cpl.r.0001-02-01-00000.nc
case01.docn.rs1.0001-02-01-00000.bin
```

- **Compare the output files** (use *ncdump* for instance)
  - vertical resolution is different
    - CAM4: 26 levels
    - CAM5: 30 levels (4 more levels in boundary layer)
  - output variables are different

- **Compare the model cost**

  CESM produces timing files: *~/case01/timing* and *~/case02/timing*
  - CAM4: 12.6 simulated years per day
  - CAM5: 2.7 simulated years per day

  CAM5 is about *5 times* more expensive (with this number of processors)
  However: - CAM5 is scaling better on more processors (only 2 more time expensive)
  - Now: CAM5: prognostics aerosol ⇔ CAM4: prescribed aerosols
    Soon: CAM5 with prescribed aerosols will be available soon

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Changing output frequency

By default CAM output monthly mean history files. For instance, look at the case01 history file. The name structure is:

year *month*

case01.cam2.h0.0001-01.nc

casename

history file: h0
you can have up to 6 history files (h1, h2, .., h5)

The output frequency in the h0 file is controlled by the namelist variable: ***nhtfrq***
If nhtfrq=0, the file will be a monthly average
If nhtfrq>0, frequency is input as number of timesteps.
If nhtfrq<0, frequency is input as number of hours.

For instance to change the history file from monthly average to daily average, we set the namelist variable:
nhtfrq = -24

How to change a namelist variable ?

To understand how to change a namelist variable,
we need to understand when/how the namelists are created.

create_newcase: creates a case directory *~/case01* that contains the files:

env_case.xml
env_conf.xml
env_build.xml
env_run.xml
usr_cam_nl

configure –case: creates a sub-directory *~/case01/Buildconf* that contains the files

cam.buildnml.csh
cice.buildnml.csh
clm.buildnml.csh
cpl.buildnml.csh
docn.buildnml.csh
sglc.buildnml.csh

case01.$mach.build:
case01.$mach.run:

call $component.buildnml.csh to create namelists (atm_in,…) in the *run directory*

atm_in
lnd_in
ice_in
ocn_in
drv_in

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we need to understand when/how the namelists are created.

create_newcase: creates a case directory *~/case01* that contains the files:

configure –case: creates a sub-directory *~/case01/Buildconf* that contains the files

case01.$mach.build: call $component.buildnml.csh to create namelists (atm_in,…) in the *run directory*

case01.$mach.run:

There ways to change namelists

env_case.xml
env_conf.xml ←**Here**
env_build.xml
env_run.xml
usr_cam_nl ← **Here**

cam.buildnml.csh ← **Here**
cice.buildnml.csh
clm.buildnml.csh
cpl.buildnml.csh
docn.buildnml.csh
sglc.buildnml.csh

atm_in
lnd_in
ice_in
ocn_in
drv_in

Change namelists using env_conf.xml

The first way to modify a namelist variable is to edit the file env_conf.xml before configuring the model.

In env_conf.xml:

CAM_NAMELIST_OPTS: CAM namelist options that differ from default values

CLM_NAMELIST_OPTS: CLM namelist options that differ from default values

CICE_NAMELIST_OPTS: CICE namelist options for that differ from default values

For instance to change the output frequency:

xmlchange -file env_conf.xml -id CAM_NAMELIST_OPTS –val nhtfrq=-24

When you configure the model (*configure –case*), the resulting namelist variables will appear in *Buildconf/cam.buildnml.csh*

These variables CANNOT be modified once *configure -case* has been invoked without first invoking *configure –cleannamelist* or *configure –cleanall.*

Change namelists using user_nl_cam

The second way to modify a namelist variable is to create a file *user_cam_nl* that contains the modified namelist variables. Using *user_cam_nl* is very useful if you need to modify numerous namelist variables.

```
&camexp
 nhtfrq=-24
/
```

The syntax is VERY important.

```
&camexp
  insert your changes (one line per change)
/
```

The file *user_cam_nl* should be placed in your case directory before you configure the model.

When you configure the model (*configure –case*), the resulting namelist variables will appear in *Buildconf/cam.buildnml.csh*

These variables CANNOT be modified once *configure -case* has been invoked without first invoking *configure –cleannamelist* or *configure –cleanall.*

Change namelists using cam.buildnml.csh

The third way to modify a namelist variable is to edit: *Buildconf/cam.buildnml.csh*

Useful if you forgot to include something.

This is done after configuring the model.

You need to include your changes in the appropriate *namelist group*:

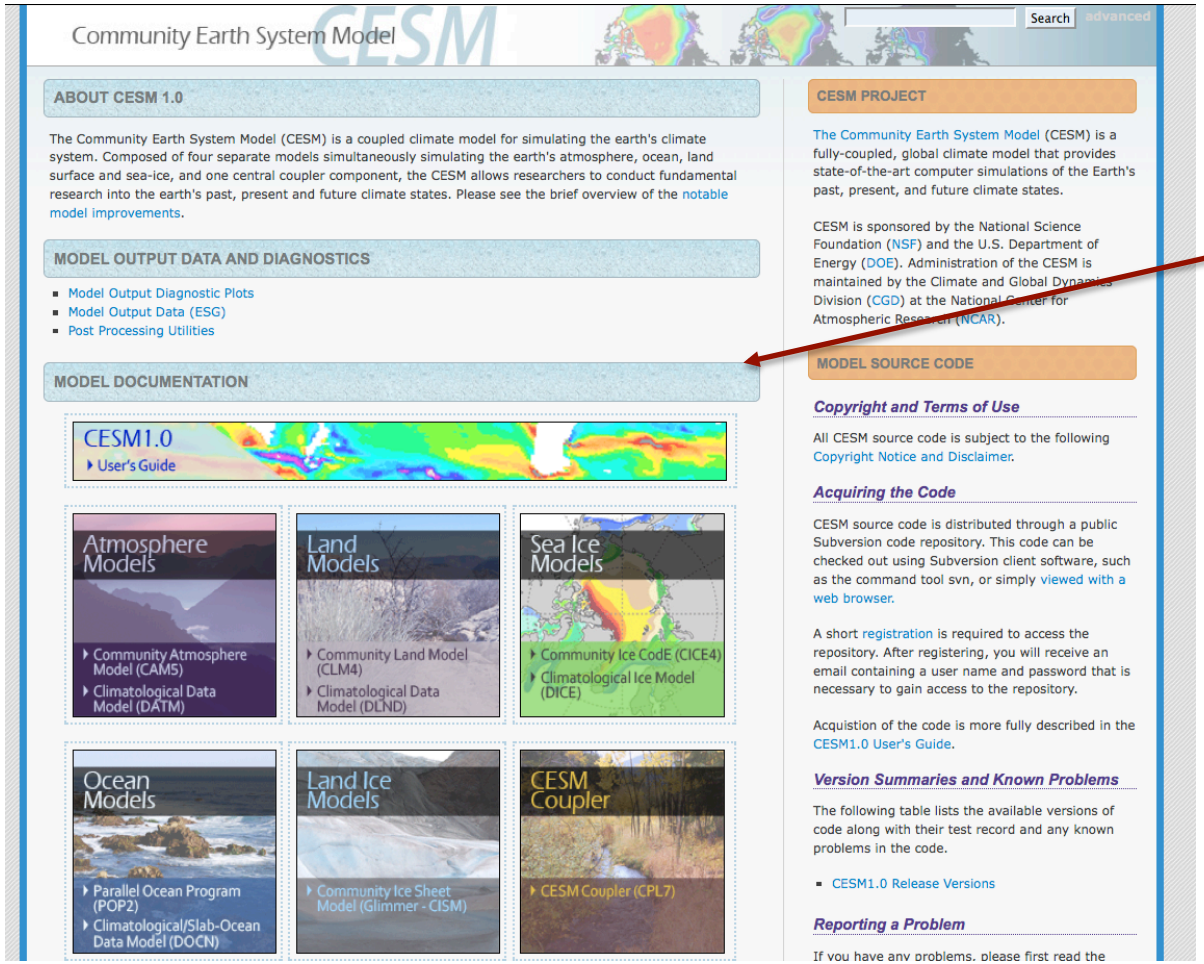
Ex: *nhtfrq* is in *cam_inparm*

If you issue the commands:
configure –cleannamelist
or
configure -cleanall
all your changes are gone !!!

```
#! /bin/csh -f

#*****************************************************************#
#                    WARNING:                                     #
# - CAM and CLM namelist variable dtime must have same values     #
# - If the user changes any input datasets - be sure to give it a #
#   unique filename. Do not duplicate any existing input files    #
#*****************************************************************#

set exedir = $RUNDIR; cd $exedir

cat >! atm_in << EOF
&aerodep_flx_nl
 aerodep_flx_datapath = '$DIN_LOC_ROOT/atm/cam/chem/trop_mozart_aero/
aero'
 aerodep_flx_file = 'aerosoldep_monthly_1849-2006_1.9x2.5_c090803.nc'
 aerodep_flx_type = 'CYCLICAL'
 aerodep_flx_ymd = 20000101
/
&cam_inparm
 nhtfrq = -24        <= Include your changes here
 absems_data = '$DIN_LOC_ROOT/atm/cam/rad/
abs_ems_factors_fastvx.c030508.nc'
 bnd_topo = '$DIN_LOC_ROOT/atm/cam/topo/USGS-gtopo30_48x96_c050520.nc'
 cam_branch_file = ' '
 dtime  = 1800
 ncdata = '$DIN_LOC_ROOT/atm/cam/inic/gaus/
cami_0000-01-01_48x96_L26_c091218.nc'
 phys_loadbalance = 2
/
&chem_surfvals_nl
 ch4vmr = 1760.0e-9
 co2vmr = 367.0e-6
 f11vmr = 653.45e-12
 f12vmr = 535.0e-12
 n2ovmr = 316.0e-9
/
```

Where to find the namelist documentation ?

CESM website: http://www.cesm.ucar.edu/models/cesm1.0/



Model documentation for each component of CESM

CAM namelist documentation ?

http://www.cesm.ucar.edu/models/cesm1.0/cam/

CESM | Administration | Working Groups | Models | Events | News | Publications

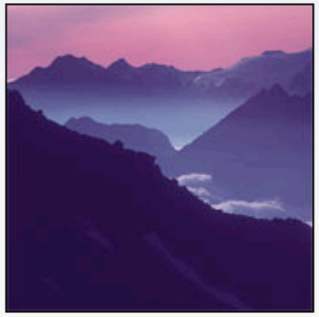
Community Earth System Model

Search advanced

CESM1.0: CAM DOCUMENTATION

Introduction

Version 5.0 of the Community Atmosphere Model (CAM) is the latest in a series of global atmosphere models developed primarily at the National Center for Atmospheric Research (NCAR). CAM5.0 includes significant enhancement to the represntation of atmopsheric processes resulting a a number of notable improvements. CAM4.0 is also available in the CESM1.0 release. Development of the model was led by the Atmosphere Model Working Group (AMWG).



Documentation

CAM5

- Users Guide [html (single page)] [html (multipage)] [pdf]
- Search Namelist Variables
- Scientific description (*coming soon*) [ps] [pdf]

CAM4

- Users Guide [html (single page)] [html (multipage)] [pdf]
- Search Namelist Variables
- Scientific description [ps] [pdf]

Search Namelist Variables

CAM namelist documentation ?

Search or Browse CAM Namelist Variables

This page contains the complete list of namelist variables available in CAM-4.0. They are grouped by categories designed to aid browsing. Clicking on the name of a variable will display descriptive information. If search terms are entered in the text box below, the list will be condensed to contain only matched variables.

Search Variable Names | Show All Variable Names

AND OR (separate search terms with spaces)

Also search help text

Search Variables Names or Show All Variables Names

Control - Driver

Namelist Variable	Type	Group
aqua_planet	logical	seq_infodata_inparm
atm_adiabatic	logical	seq_infodata_inparm
atm_ideal_phys	logical	seq_infodata_inparm
atm_logfile	char*256	camexp
atm_logfile_diro	char*256	camexp
atm_ntasks	integer	ccsm_pes
atm_nthreads	integer	ccsm_pes
atm_pestride	integer	ccsm_pes
atm_rootpe	integer	ccsm_pes
bfbflag	logical	seq_infodata_inparm
brnch_retain_casename	logical	seq_infodata_inparm
budget_ann	integer	seq_infodata_inparm
budget_daily	integer	seq_infodata_inparm
budget_inst	integer	seq_infodata_inparm
budget_ltann	integer	seq_infodata_inparm
budget_ltend	integer	seq_infodata_inparm
budget_month	integer	seq_infodata_inparm
case_desc	char*256	seq_infodata_inparm

CAM namelist documentation ?

Search or Browse CAM Namelist Variables

This page contains the complete list of namelist variables available in CAM-5.0. They are grouped by categories designed to aid browsing. Clicking on the name of a variable will display descriptive information. If search terms are entered in the text box below, the list will be condensed to contain only matched variables.

nhtfrq [Search Variable Names] [Show All Variable Names]

AND OR (separate search terms with spaces)

Also search help text

Found 2 standard names matching query: nhtfrq

Search for nhtfrq

History and Initial Conditions Output

Namelist Variable	Type	Group
nhtfrq Array of write frequencies for each history file series. If nhtfrq(1) = 0, the file will be a monthly average. Only the first file series may be a monthly average. If nhtfrq(i) > 0, frequency is specified as number of timesteps. If nhtfrq(i) < 0, frequency is specified as number of hours. Default: 0,-24,-24,-24,-24,-24	integer(6)	cam_inparm

How to set it

type

Namelist group

Some useful namelist variables

Common namelist variables to change include:

- *NHTFRQ*: sets the output frequency
- *FINCL:* add variables to the history file
- *MFILT*: maximum number of time samples written to a history file

Namelist variables: nhtfrq, mfilt

The default history file from CAM is a monthly average.

We can change the output frequency with the namelist variable ***nhtfrq***

If nhtfrq=0, the file will be a monthly average
If nhtfrq>0, frequency is input as number of timesteps.

If nhtfrq<0, frequency is input as number of hours.

For instance to change the history file from monthly average to daily average, we set the namelist variable:
nhtfrq = -24

To control the number of timestep in the history file, we can use the variable ***mfilt***
For instance, to specify that we want one time sample on each history file, we set the namelist variable:

mfilt = 1

Namelist variables: fincl

You can output up to 6 history files: **“h0”, “h1”, …, “h5”.**

The file “h0” contains the default variables (in the code: “call add_default”). This includes the variables necessary for the AMWG package.

For the files “h1” to “h5”, the user has to specify the variables to output.

We can use the namelist variables ***fincl1, fincl2,.., fincl6*** to control the list of fields in the history files: **h0** **h1** **h5**

The added fields must be in Master Field List (= fields that can be written to the history files).

Using a ":" following a field gives the **averaging flag** for the output field. Valid flags are: I for instantaneous, A for average, M for minimum, and X for maximum.

Example of customizing history files

For instance, on the top of the monthly history file “h0”, if we want to output a file “h1” with instantaneous values of T, Q, U, V and OMEGA every 3 hour, we can use:

fincl2 = 'T:I','Q:I','U:I','V:I’,‘OMEGA:I’
nhtfrq = 0, -3

Notice that it is equivalent to:

fincl2 = 'T:I','Q:I','U:I','V:I’, ‘OMEGA:I’
nhtfrq(1) = 0
nhtfrq(2) = -3

NB: If you plan to run the AMWG diagnostic package, it is recommended to leave the “h0” file untouched and to add extra history files.

Exercise 3-5: Change in namelist

Exercise 3: Create, configure, and build an out-of-the-box set of scripts called “case03” that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM4 physics. Set the run length to 15 days. Output daily averages using the variable CAM_NAMELIST_OPTS in env_conf.xml.

Turn off the short-term archiving.

(Hint: Use namelist variables: *nhtfrq*)

Exercise 4: Create, configure, and build an out-of-the-box set of scripts called “case04” that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM4 physics. Set the run length to 1 month. Make namelist variables changes by creating a file: user_nl_cam

On the top of the monthly history file “h0”, output “h1” file with 3-hourly values of T, Q, U and V.

` Turn off the short-term archiving.
(Hint: Use namelist variables: *nhtfrq, fincl*)

Exercise 3-5: Change in namelist

Exercise 5: Create, configure, and build an out-of-the-box set of scripts called “case05” that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM4 physics. Set the run length to 1 month.

On the top of the monthly history file “h0”, output:

- “h1” file with instantaneous values of T, Q, U and V every 3 hour.
- “h2” file with time-average values of T, Q, U and V every 24 hour.

Write one h1 file for every day of the month and write a single h2.

Make your namelist variables changes by creating a file: user_nl_cam

Turn off the short-term archiving.

(Hint: Use namelist variables: *nhtfrq, mfilt, fincl*)

Outline

- CESM: workflow and compsets
- CAM standalone: running CAM4 and CAM 5 physics
- Namelist changes
- Code Changes
- How to look at the results: The CAM diagnostic package
- Exercises solutions

Principles for modifying the code

This section gives an overview of simple code modifications

Never modify the CESM root itself. Your modifications to the code should go into: ***SourceMods***

SourceMods contains subdirectories for each component:

- *src.cam* → because we are looking at CAM, this is where we put our mods
- *src.cice*
- *src.clm*
- *src.docn*
- *src.drv*
- *src.sglc*
- *src.share*

Modifying a subroutine

- **Steps to modify the code**:
  - Find the subroutine you want to modify
  - Copy this subroutine in SourceMods
  - Make your modifications
  - Compile and run the model

Example: Modify a parameter, Dcs

Let's modify a parameter in the CAM physics
Dcs = autoconversion size threshold for cloud ice to snow

1. Find the subroutine you want.

Go in the CESM code and look for Dcs (for instance, you can use: *grep -r Dcs **)

Dcs is in the subroutine *cldwat2m_micro.F90*

2. Copy this subroutine in SourceMods

Go your case directory and copy *cldwat2m_micro.F90* into *SourceMods/src.cam*

3. Make your modifications

Edit the value of Dcs in *SourceMods/src.cam/cldwat2m_micro.F90*

4. Compile and run the model

Exercise 6: Make a source modification

Exercise 6: Create, configure, and build an out-of-the-box set of scripts called “case06” that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM5 physics and modify the value of Dcs from 325 to 300 microns. Set the run length to 3 days. Turn off the short-term archiving.

Outline

- CESM: workflow and compsets
- CAM standalone: running CAM4 and CAM 5 physics
- Namelist changes
- Code Changes
- How to look at the results: The CAM diagnostic package
- Exercises solutions

The AMWG diagnostics package

Post processing tool to plot the atmospheric diagnostics for CAM or CESM

The AMWG diagnostics package produces over 600 plots and tables from the default CESM or CAM monthly means and displays the plots/tables on a webpage (you can also produce plots in ps format).

The AMWG diagnostics package can be used:

- to compare two CCSM (CAM) model simulations
- for comparing a model simulation to the observational and reanalysis data.

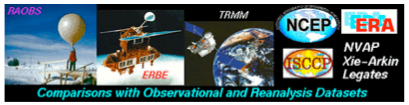
To run the AMWG diagnostics package, you must have on your computer:

- NCL (The NCAR Command Language)
- the netcdf operators (NCO)
- utility "convert" to convert the postscript plots to an image format suitable for the webpages (png,gif,jpg). Convert is part of the ImageMagick package.

The AMWG package

AMWG Diagnostics Package

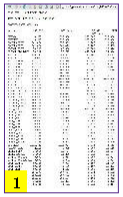
b40_1850_2d_b16c5cn_147jp



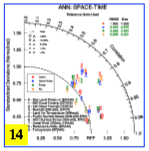
Plots Created
Fri Apr 15 11:38:32 EDT 2011

Set Description

1 Tables of ANN, DJF, JJA, global and regional means and RMSE.
2 Line plots of annual implied northward transports.
3 Line plots of DJF, JJA and ANN zonal means
4 Vertical contour plots of DJF, JJA and ANN zonal means
4a Vertical (XZ) contour plots of DJF, JJA and ANN meridional means
5 Horizontal contour plots of DJF, JJA and ANN means
6 Horizontal vector plots of DJF, JJA and ANN means
7 Polar contour and vector plots of DJF, JJA and ANN means
8 Annual cycle contour plots of zonal means
9 Horizontal contour plots of DJF-JJA differences
10 Annual cycle line plots of global means
11 Pacific annual cycle, Scatter plot plots
12 Vertical profile plots from 17 selected stations
13 ISCCP cloud simulator plots
14 Taylor Diagram plots
15 Annual Cycle at Select Stations plots

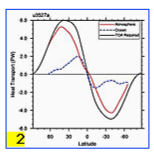


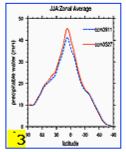
TABLES

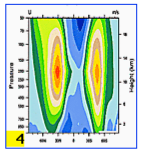


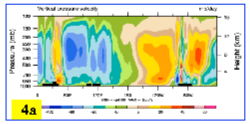
METRICS

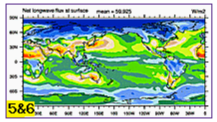
Click on Plot Type

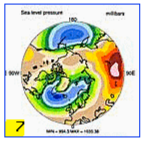


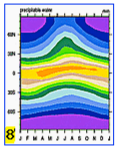


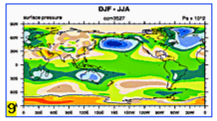


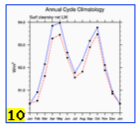


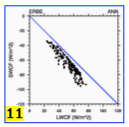


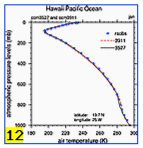


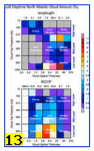


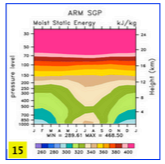






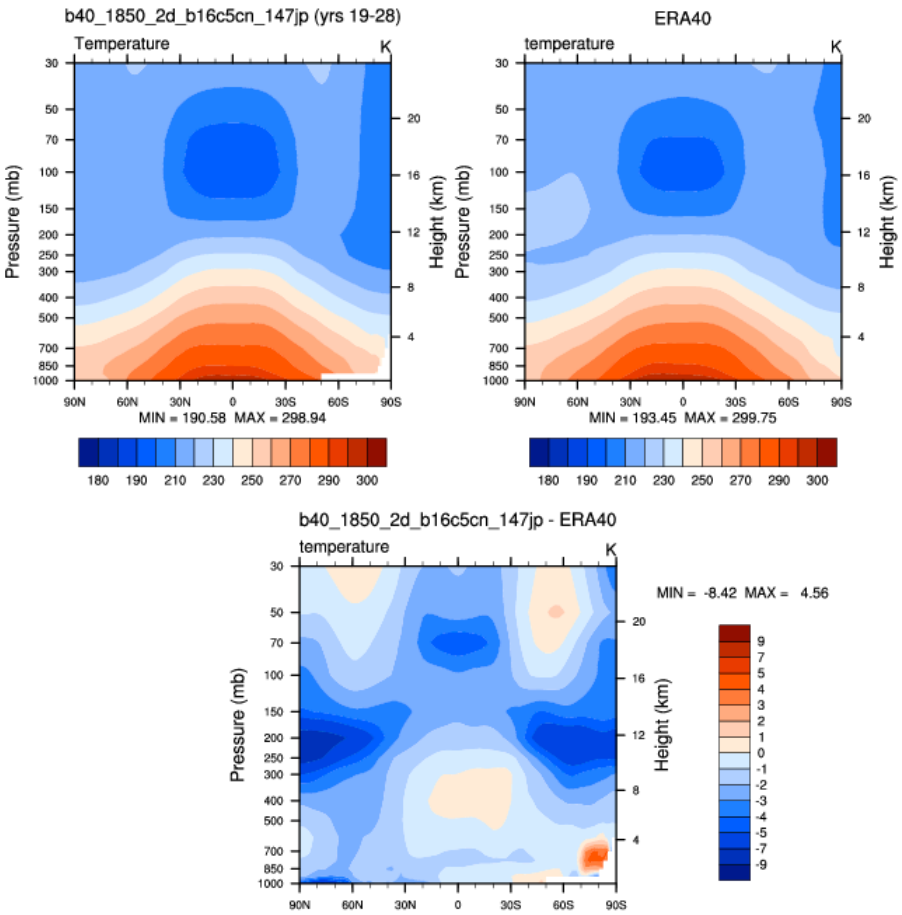




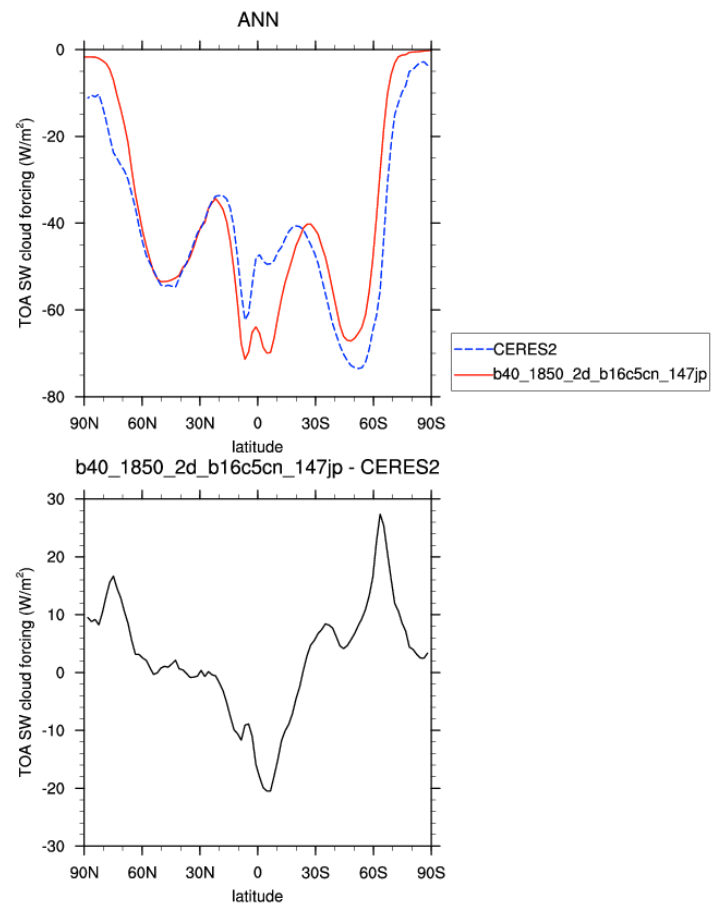


Zonal means

Temperature versus ERA40

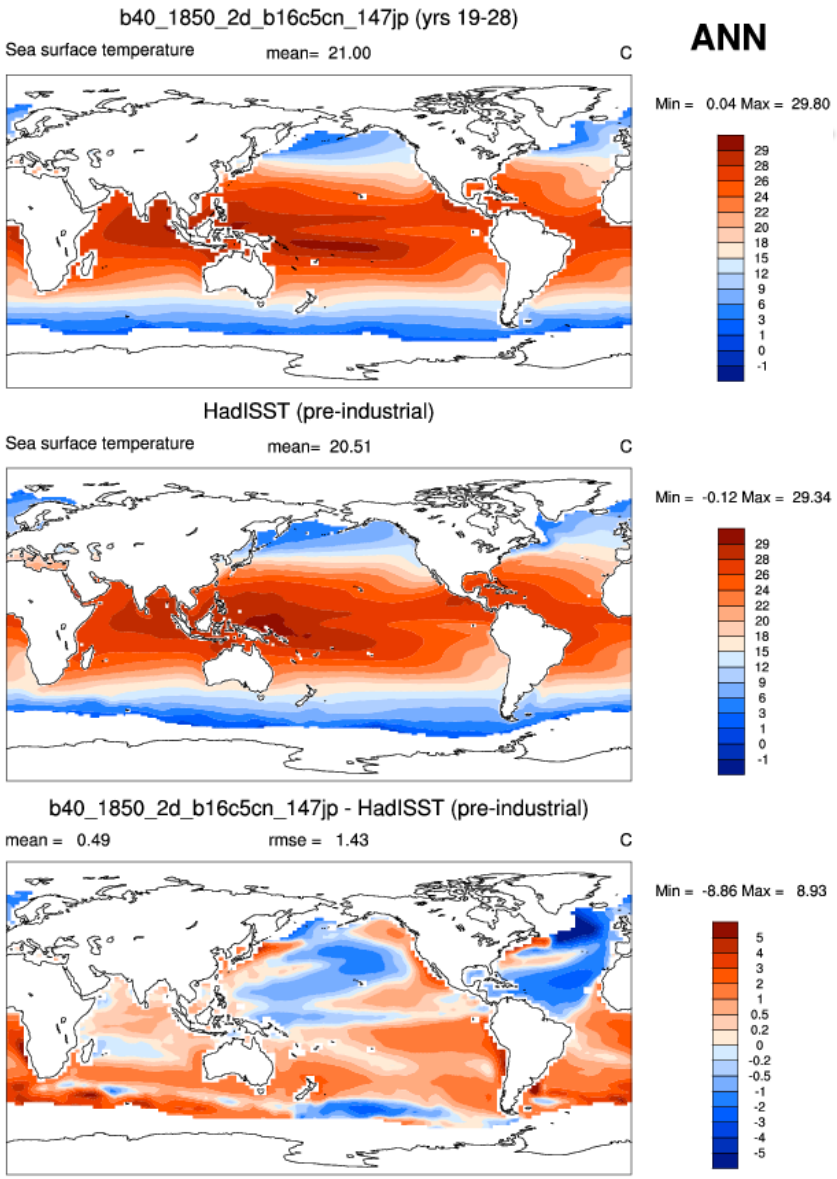


Shortwave cloud forcing versus CERES



Lat/Lon plots

Sea Surface Temperatures compared to observations



Where to dowload the code

http://www.cgd.ucar.edu/amp/amwg/diagnostics/

Menu

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What's new ?

Where to find the code ?

Support ?

Mailing list

Possible problems/Known Bugs

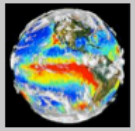
Links

CAM4 webpage

CCSM4 webpage

CCSM4 post processing

The CCSM Atmospheric Model Working Group Diagnostic Package



Diagnostics of Climatological Monthly Means

The AMWG diagnostics package produces over 600 postscript plots and tables in a variety of formats from CCSM (CAM) monthly netcdf files. Climatological means for DJF, JJA, and ANN are used. The diagnostics package can be used to compare two CCSM (CAM) model simulations or for comparing a model simulation to the observational and reanalysis data. Model output on gaussian or fixed grids can be used.

Included in the package are HTML files which provide the infrastructure for a basic website for the display of all your plots and tables. The c-shell script has a switch for creating webpages automatically. When this is used the end result of running the script is a tar file of all the plots in gif, jpg or png format and the needed html files organized in the proper subdirectories. The user can then untar this file in a directory of their choosing and create a link to it.

Examples of the webpages created by the diagnostics package

- Model fields compared with observational data plots
- Comparison of two different models plots

Last modified: Apr 9 2010 by hannay@ucar.edu

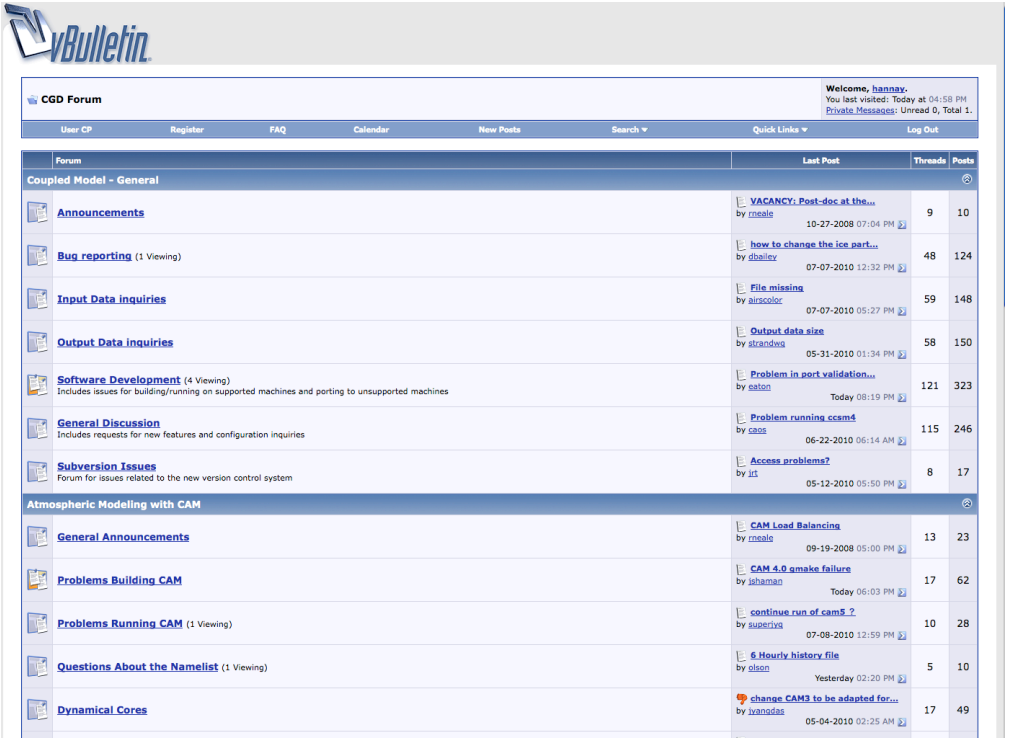
Outline

- CESM: workflow and compsets
- CAM standalone: running CAM4 and CAM 5 physics
- Namelist changes
- Code Changes
- How to look at the results: The CAM diagnostic package
- Where to find help
- Exercises solutions

Where to find help ?

Documentation:
http://www.cesm.ucar.edu/models/cesm1.0/

CESM bulletin board:
http://bb.cgd.ucar.edu/



The NCAR Command Language (NCL)

NCAR Command Language

NCL is an interpreted language designed specifically for scientific data analysis and visualization.

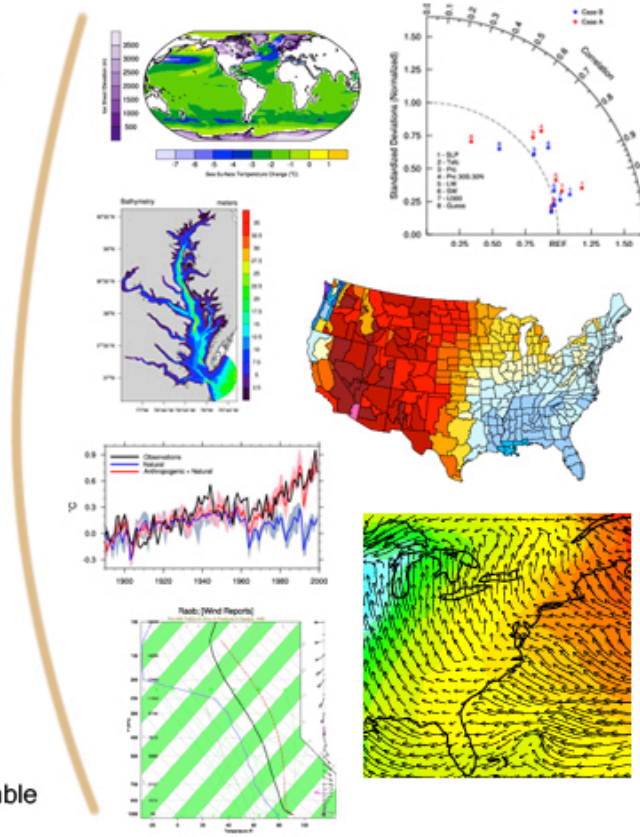
Portable, robust and free, NCL is available as binaries or open source

Supports netCDF3/4, GRIB1/2, HDF-SDS, HDF4-EOS, binary, shapefiles, and ascii files

Numerous analysis functions are built-in

High quality graphics are easily created and customized with hundreds of graphic resources

Many example scripts and their corresponding graphics are available



http://www.ncl.ucar.edu/

Outline

- CESM: workflow and compsets
- CAM standalone: running CAM4 and CAM 5 physics
- Namelist changes
- Code Changes
- How to look at the results: The CAM diagnostic package
- Exercises solutions

Exercise 1: Solutions

Exercise 1: Create, configure, and build an out-of-the-box set of scripts called “case01” that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM4 physics. Set the run length to 1 month. Turn off the short-term archiving.

Solution:

1. Go the the scripts directory and create a new case in your home directory

```
cd /usr/projects/cesm/cesm1_0_2/scripts
./create_newcase –res T31_T31 –compset F_2000 –case ~/case01 –mach mapache
```

2. Go to the case directory and configure the model

```
cd ~/case01
./configure –case
```

3. Examine the variables STOP_OPTION and STOP_N in the file env_run.xml. These are used to set the run length.

```
<!--"sets the run length with STOP_N and STOP_DATE, valid values:
none,never,nsteps,nstep,nseconds,nsecond,nminutes,nminute,nhours,nhour,ndays,nday,nmonths,nmonth,nyears,n
year,date,ifdays0,end (char) " -->
<entry id="STOP_OPTION"   value="ndays"  />
<!--"sets the run length with STOP_OPTION and STOP_DATE (integer) " -->
<entry id="STOP_N"   value="5"  />
```

Exercise 1: Solutions

4. Edit the variable STOP_N

./xmlchange -file env_run.xml -id STOP_N –val 1

./xmlchange -file env_run.xml -id STOP_OPTION –val nmonths

5. Examine the variables STOP_N and STOP_OPTION in the file env_run.xml.

```
<!--"sets the run length with STOP_N and STOP_DATE, valid values:
 none,never,nsteps,nstep,nseconds,nsecond,nminutes,nminute,nhours,nhour,ndays,nday,nmonths,nmonth,nyears,n
 year,date,ifdays0,end (char) " -->
<entry id="STOP_OPTION"   value="nmonths"  />

<!--"sets the run length with STOP_OPTION and STOP_DATE (integer) " -->
 <entry id="STOP_N"   value="3"  />
```

6. Turn off the short-term archiving

./xmlchange -file env_run.xml –id DOUT_S –val FALSE

7. Build the model

./case01.mapache.build

It will take a while. While the model is building, you can explore your case directory: ~/case01

8. Submit your job

./case01.mapache.submit

Exercise 2: Solutions

Exercise 2: Create, configure, and build an out-of-the-box set of scripts called “case02” that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM5 physics. Set the run length to 1 month. Turn off the short-term archiving.

Solution:

1. Go the the scripts directory and create a new case in your home directory
   cd /usr/projects/cesm/cesm1_0_2/scripts
   ./create_newcase –res T31_T31 –compset F_2000_CAM5 –case ~/case02 –mach mapache

2. Go to the case directory and configure the model
   cd ~/case02
   ./configure –case

3. Edit the variable STOP_N and STOP_OPTION and turn off the short-term archiving
   ./xmlchange -file env_run.xml -id STOP_N –val 1
   ./xmlchange -file env_run.xml -id STOP_OPTION –val nmonths
   ./xmlchange -file env_run.xml –id DOUT_S –val FALSE

4. Build the model
   ./case02.mapache.build

5. Submit your job
   ./case02.mapache.submit

Exercise 2: Solutions

6. Compare the case directories: case01 and case02. In particular, compare the file env_conf.xml for the 2 cases

diff ~/case01/env_conf.xml ~/case02/env_conf.xml

7. Compare the output files:

ncdump -h case01.cam2.h0.0001-01.nc => 26 vertical levels

ncdump -h case02.cam2.h0.0001-01.nc => 30 vertical levels

8. Compare the timings

Timings are in:

*~/case01/timing/ccsm_timing.case01.**

*~/case02/timing/ccsm_timing.case02.**

Exercise 3: Solutions

Exercise 3: Create, configure, and build an out-of-the-box set of scripts called "case03" that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM4 physics. Set the run length to 15 days. Output daily averages using the variable CAM_NAMELIST_OPTS in env_conf.xml. Turn off the archiving.

Solution:

1. Go the the scripts directory and create a new case in your home directory
   cd /usr/projects/cesm/cesm1_0_2/scripts
   ./create_newcase –res T31_T31 –compset F_2000 –case ~/case03 –mach mapache

2. Go to the case directory and edit the file env_conf.xml to add the namelist parameter: *nhtfrq=-24*
   cd ~/case03
   ./xmlchange -file env_conf.xml -id CAM_NAMELIST_OPTS –val nhtfrq=-24

2. Go to the case directory and configure the model
   ./configure –case

3. Edit the variable STOP_N and turn off the short-term archiving
   ./xmlchange -file env_run.xml -id STOP_N –val 15
   ./xmlchange -file env_run.xml –id DOUT_S –val FALSE

4. Build the model
   ./case03.mapache.build

Exercise 3: Solutions

5. Submit your job

   ./case03.mapache.submit

6. Go the run directory:

   ncdump –h case03.cam2.h0.0001-01-01-00000.nc

```
netcdf case03.cam2.h0.0001-01-01-00000 {
dimensions:
        lat = 48 ;
        lon = 96 ;
        lev = 26 ;
        ilev = 27 ;
        isccp_prs = 7 ;
        isccp_tau = 7 ;
        isccp_prstau = 49 ;
        time = UNLIMITED ; // (16 currently)      => 16 timesteps
        tbnd = 2 ;
        chars = 8 ;
variables:
```

Exercise 4: Solutions

Exercise 4: Create, configure, and build an out-of-the-box set of scripts called “case04” that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM4 physics. Set the run length to 1 month. Make namelist variables changes by creating a file: user_nl_cam

On the top of the monthly history file “h0”, output “h1” file with 3-hourly values of T, Q, U and V.

Turn off the short-term archiving.

Solution:

1. Go the the scripts directory and create a new case in your home directory

```
cd /usr/projects/cesm/cesm1_0_2/scripts
./create_newcase –res T31_T31 –compset F_2000 –case ~/case04 –mach mapache
```

2. Go to the case directory

```
cd ~/case04
```

Create a file ‘user_nl_cam’ (emacs or vi) with the content:

```
&camexp
  fincl2='T', 'Q', 'U', 'V'
  nhtfrq=0,-3
/
```

3. Go to the case directory and configure the model

```
./configure –case
```

Exercise 4: Solutions

4. Edit the variable STOP_N and STOP_OPTION and turn off the short-term archiving

```
./xmlchange -file env_run.xml -id STOP_N –val 1
./xmlchange -file env_run.xml -id STOP_OPTION –val nmonths
./xmlchange -file env_run.xml –id DOUT_S –val FALSE
```

5. Build the model

```
./case04.mapache.build
```

6. Submit your job

```
./case04.mapache.submit
```

7. Look at the output files

```
case04.cam2.h0.0001-01.nc      case04.cam2.h1.0001-01-01-00000.nc
case04.cam2.h1.0001-01-04-64800.nc
case04.cam2.h1.0001-01-08-43200.nc
case04.cam2.h1.0001-01-12-21600.nc
case04.cam2.h1.0001-01-16-00000.nc
case04.cam2.h1.0001-01-19-64800.nc
case04.cam2.h1.0001-01-23-43200.nc
case04.cam2.h1.0001-01-27-21600.nc
case04.cam2.h1.0001-01-31-00000.nc
```

Exercise 5: Solutions

Exercise 5: Create, configure, and build an out-of-the-box set of scripts called “case05” that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM4 physics. Set the run length to 1 month. Turn off the short-term archiving.

On the top of the monthly history file “h0”, output:

- “h1” file with instantaneous values of T, Q, U and V every 3 hour.
- “h2” file with time-average values of T, Q, U and V every 24 hour.

Write one h1 file for every day of the month and write a single h2.

Make your namelist variables changes by creating a file: user_nl_cam

Solution:

1. Go the the scripts directory and create a new case in your home directory

```
cd /usr/projects/cesm/cesm1_0_2/scripts
./create_newcase –res T31_T31 –compset F_2000 –case ~/case05 –mach mapache
```

2. Go to the case directory

```
cd ~/case05
```

Create a file ‘user_nl_cam’ (emacs or vi) with the content:

```
&camexp
  fincl2='T':I, 'Q:I', 'U:I', 'V:I'
  fincl3='T', 'Q', 'U', 'V'
  nhtfrq=0,-3,-24
  mfilt=1,8,31
/
```

Exercise 5: Solutions

3. Go to the case directory and configure the model

   ./configure –case

4. Edit the variable STOP_N and STOP_OPTION and turn off the short-term archiving

   ./xmlchange -file env_run.xml -id STOP_N –val 1

   ./xmlchange -file env_run.xml -id STOP_OPTION –val nmonths

   ./xmlchange -file env_run.xml –id DOUT_S –val FALSE

5. Build the model

   ./case05.mapache.build

6. Submit your job

   ./case05.mapache.submit

Exercise 6: Solutions

Exercise 6: Create, configure, and build an out-of-the-box set of scripts called “case06” that runs CAM standalone forced with climatological present-day SSTs at T31 resolution. Use the CAM5 physics and modify the value of Dcs from 325 to 300 microns. Output daily averages and set the run length to 3 days. Turn off the short-term archiving.

Solution:

1. Go the the scripts directory and create a new case in your home directory

   cd /usr/projects/cesm/cesm1_0_2/scripts

   ./create_newcase –res T31_T31 –compset F_2000_CAM5 –case ~/case06 –mach mapache

2. Go to the case directory and edit the file env_conf.xml to add the namelist parameter: *nhtfrq=-24*

   cd ~/case06

   ./xmlchange -file env_conf.xml -id CAM_NAMELIST_OPTS –val nhtfrq=-24

3. Go to the case directory and configure the model

   ./configure –case

4. Edit the variable STOP_N and turn off the short-term archiving

   ./xmlchange -file env_run.xml -id STOP_N –val 3

   ./xmlchange -file env_run.xml –id DOUT_S –val FALSE

Exercise 6: Solutions

6. Copy the file cldwat2m.F90 into your SourceMods directory and edit the value of Dcs

   cp /usr/projects/cesm/cesm1_0_2/models/atm/cam/src/physics/cam/cldwat2m_micro.F90 SourceMods/src.cam/

   edit SourceMods/src.cam//cldwat2m_micro.F90 to change value of Dcs

7. Build the model

   ./case06.mapache.build

8. Submit your job

   ./case06.mapache.submit