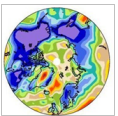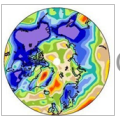# Practical Session 3: Atmospheric Model Configuration Options

Andrew Gettelman

Overview

- Monday: Running the model
- Tuesday:
  - `namelist` Control of the model
  - Diagnosing the model
- Today:
  - Different configuration options
  - Including: Single Column version of the model
  - More diagnosis
- Tomorrow:
 - Modifying the model

Control through the `namelist`

- Same code and configuration

- Do not need to recompile

- Examples (Yesterday):

  – Run with a different SST input file

  – Run different times, run lengths

  – Run with different diagnostic output fields
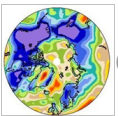
Control through `configure`

- Changes how the model is compiled
- Options require changes to code
  - Most 'automatic'
- Things commonly controlled by `configure`:
  - Compile options: threading, debugging (`-debug`)
  - Physics options: idealized (Held-Suarez), adiabatic
  - User Source code
  - Resolution and Dynamical core
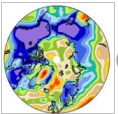
Note: `configure -h` will list all options
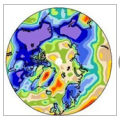
Configure command options
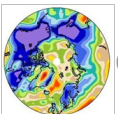
```
configure -verbose  \
        -dyn $dycore \
        -res $resolution \
        -usr_src $usr_src \
        -phys cam3_5_1 \
        -ntasks $ntasks \
        -nthreads $OMP_NUM_THREADS \
```
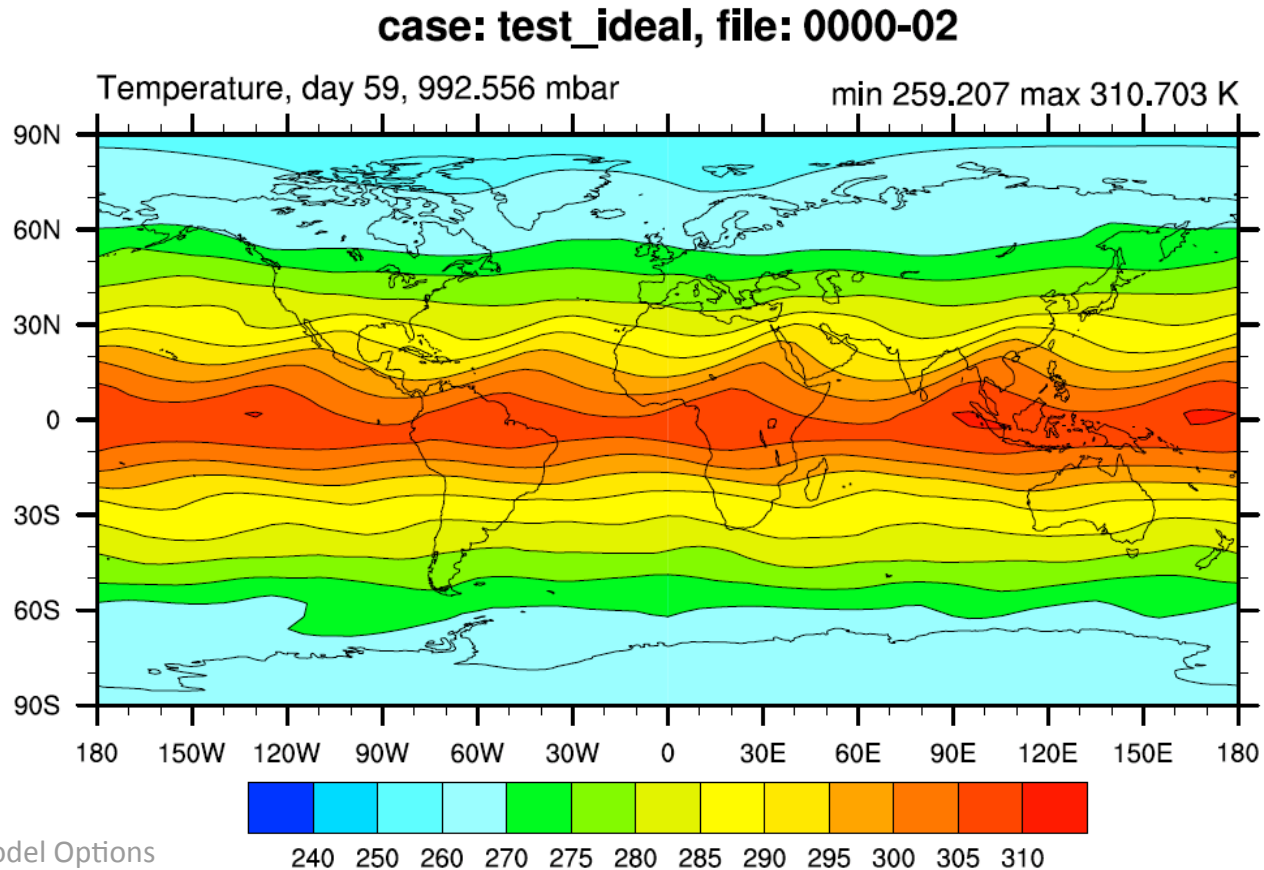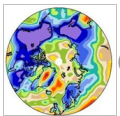
Exercise: Idealized Physics Run

- Run model with a changed configuration option
- In this case, idealized physics:
  - Temperature relaxation to a base state
  - Surface friction
  - Held and Suarez (1994)
 - Used for baroclinic test cases

NCL Plot Result: Idealized Physics

Zonal Wave 5 pattern

CAM Tutorial: Model Options
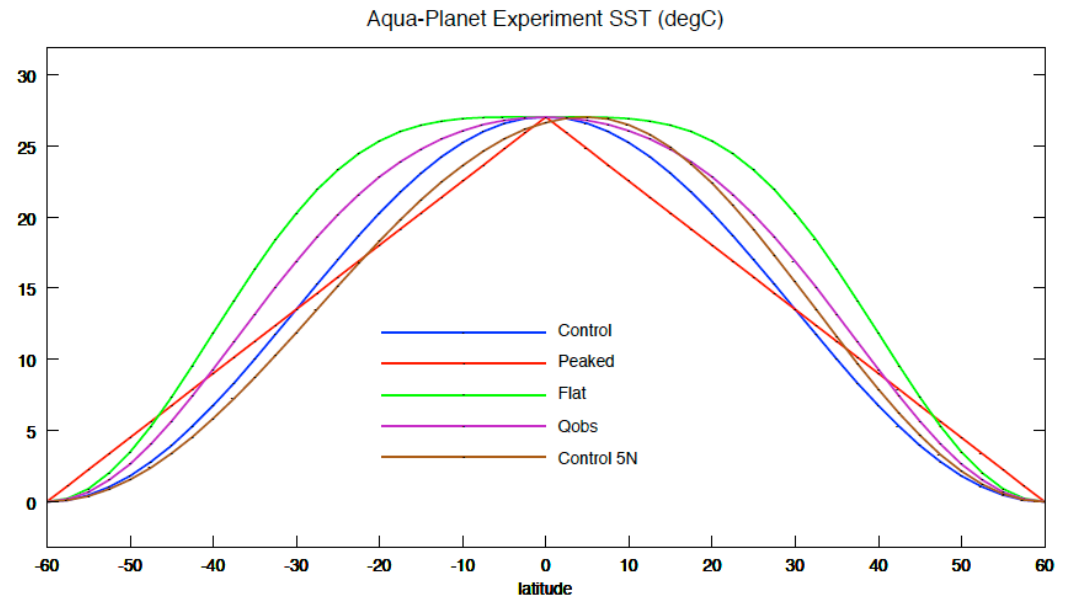
Other Common Options: Aquaplanet

- Aqua-planet mode is a common way to test GCMs and theories of the general circulation (Neale and Hoskins, 2000)

- CAM has an Aqua-planet mode
  - changes the bottom boundary: LANDFRAC = 0
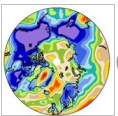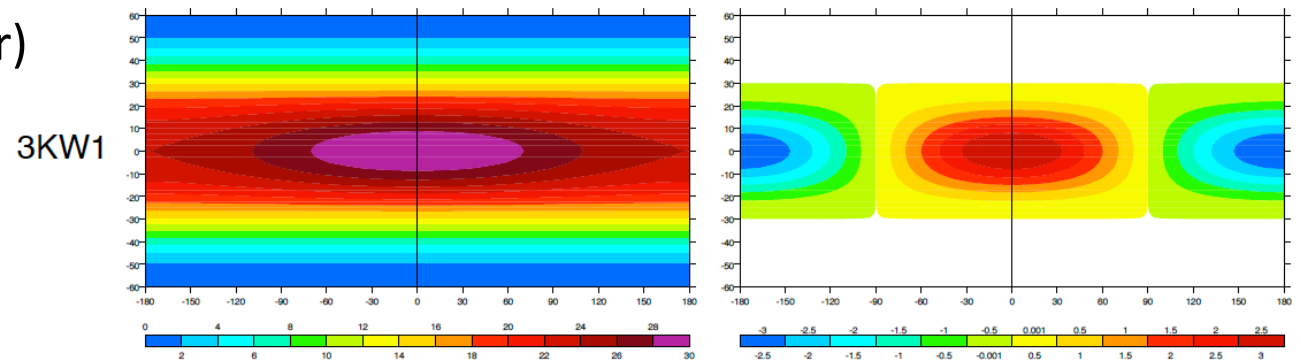 - SSTs are set in a data ocean model instead of reading in a file
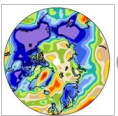
Aqua-planet SSTs

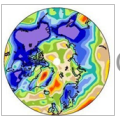## Zonal Mean:

(default is 'Control')

Zonally Asymmetric
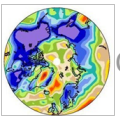
(symmetric about equator)

Aqua Planet Mode

- Aqua-planet resets SSTs and Land fraction
- Where would you think this would be?
  - `configure` option or `namelist` Option?
 - Why?

Aqua-Planet

- Actually just a name-list option

- Calls set code already in the model

  – In the 'data ocean model'

  – Sets SST (with code options)

  – Sets LANDFRAC = 0 everywhere

Visualizing Output: NCL

NCAR Command Language (NCL)

- Open source, cross platform visualization package.

- Runs using X-windows (Linux, Mac, windows)

- VERY good for model output, quick analysis and publications

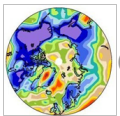- We will use some simple NCL scripts on storm for visualization
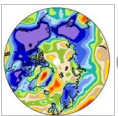
Single Column Atmosphere Model

SCAM: another configuration option

Why a single column model?

- compare to observations (forced dynamics)

- rapid prototyping and development

- debugging easier

- specific field programs, specific observations (evaluation)

SCAM: Basic Concept

- SCAM is a single column version of CAM

- Full suite of CAM physics

- CAM Eulerian dynamics in the vertical

    – no horizontal dimension

- Advection into or out of the column is specified from an additional forcing file.
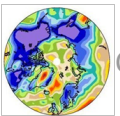
SCAM Implementation

- Runs on a PC, laptop
  - Meant to be run interactively or on a PC,
  - We are using bluefire for scripts for simplicity.
  - Practically: port this to `run-pc.csh` in scripts directory and run on a laptop
- Often run cases from field programs
  - IOP: Intensive Observation Period (=field project)
  - Today: The ARM site in Oklahoma, July 1995
  - Other runs are possible
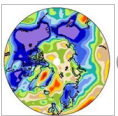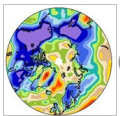
SCAM Results: Example

case: scamtest
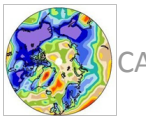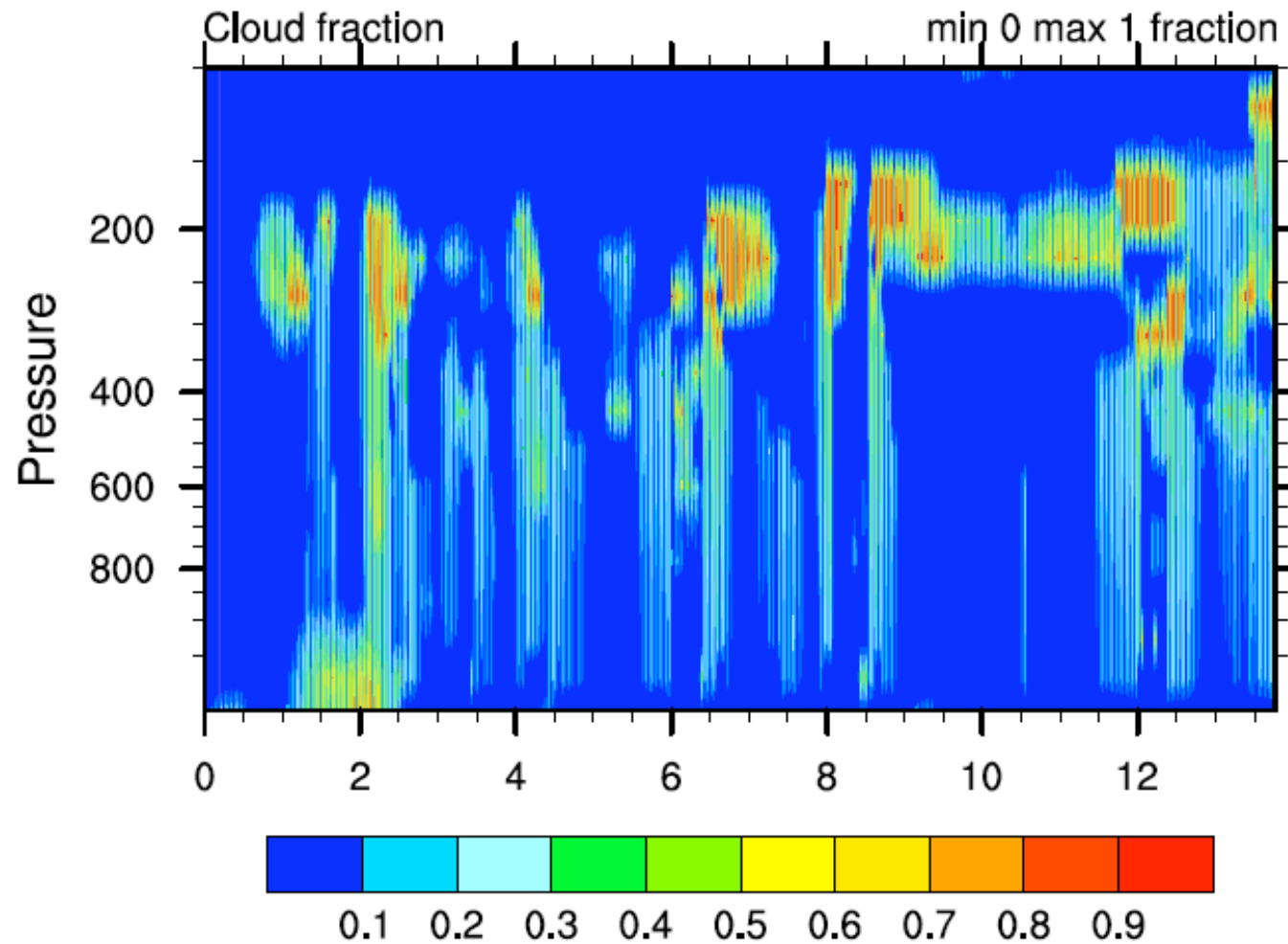
Exercises

- Look at configure options

- Run an Idealized Physics Case

- Run an Aqua-planet case

- Visualization with NCVIEW, NCL

- Run the Single Column Model

- Examine Single Column Model output
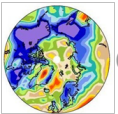
Configure command options

```
configure -verbose  \
          -dyn $dycore \
          -res $resolution \
          -usr_src $usr_src \
          -phys cam3_5_1 \
          -ntasks $ntasks \
          -nthreads $OMP_NUM_THREADS \
```
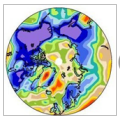
- Exercise: go to the model source code build directory and look at output of configure -h:

```
>cd /fis01/cgd/cms/andrew/camtutorial2009/
   cam_tutorial_cam3_6_48/models/atm/cam/bld
>configure -h
```

Exercise: Idealized Physics Run

- Run model with a changed configuration option

- In this case, idealized physics:
  - Held-Suarez forcing for baroclinic test cases

Exercise: Idealized Physics Run

On Bluefire, make a copy of the run script

```
cp run-ibm-tutorial.csh run-ideal.csh
```
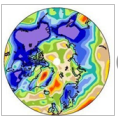
Change the case name:

```
set case = test_ideal
```

Edit the configure option:

```
-phys ideal
```

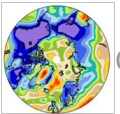Run it for 3 months

```
stop_n = 3,
```

Visualizing output: NCVIEW

Log-in to storm.

Look at /ptmp on bluefire for output

ls /gpfs/ptmp/andrew/test_ideal

ncview /gpfs/ptmp/andrew/test_ideal/
test_ideal.cam2.h0.0000-03.nc

Visualizing Output: NCL

NCAR Command Language (NCL)

- Open source, cross platform visualization package.

- Runs using X-windows (Linux, Mac, windows)

- VERY good for model output, quick analysis and publications

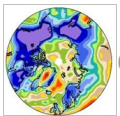- We will use some simple NCL scripts on storm for visualization
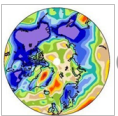
Setting up NCL

- Copy over a preference file into home directory:

  ```
  cp /fs/home/andrew/ncl/.hluresfile .
  ```

  - This makes plots look nicer (fonts)

- Add to a .bashrc / .tcshrc / .login file:

  ```
  setenv NCARG_ROOT /fs/local/apps/ncl-5.1.0
  ```
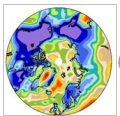
Using NCL

- Make a new directory on `storm`

  ```
  cd ~/
  mkdir ncl
  ```

Copy the script

  ```
  cd ncl
  cp /fs/home/andrew/ncl/atm_latlon.ncl .
  ```
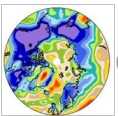
- Make a directory for output (plots)

  ```
  mkdir /ptmp/USER/ncl
  ```

NCL visualization

- ## Edit the script
  - Change case name (L23)

    ```
    case = "test_ideal"
    ```

- ## Run the script

  ```
  ncl atm_latlon.ncl
  ```

- ## Note the filename and visualize with :
  - Ghostview (`gv [filename]`)
  - Convert to PDF and transfer to a laptop:

    ```
    ps2pdf [filename]
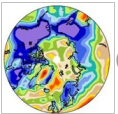    ```

    transfer pdf file to local machine using ftp

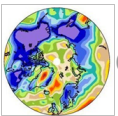# NCL Plot Result: Idealized Physics

Zonal Wave 5 pattern
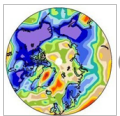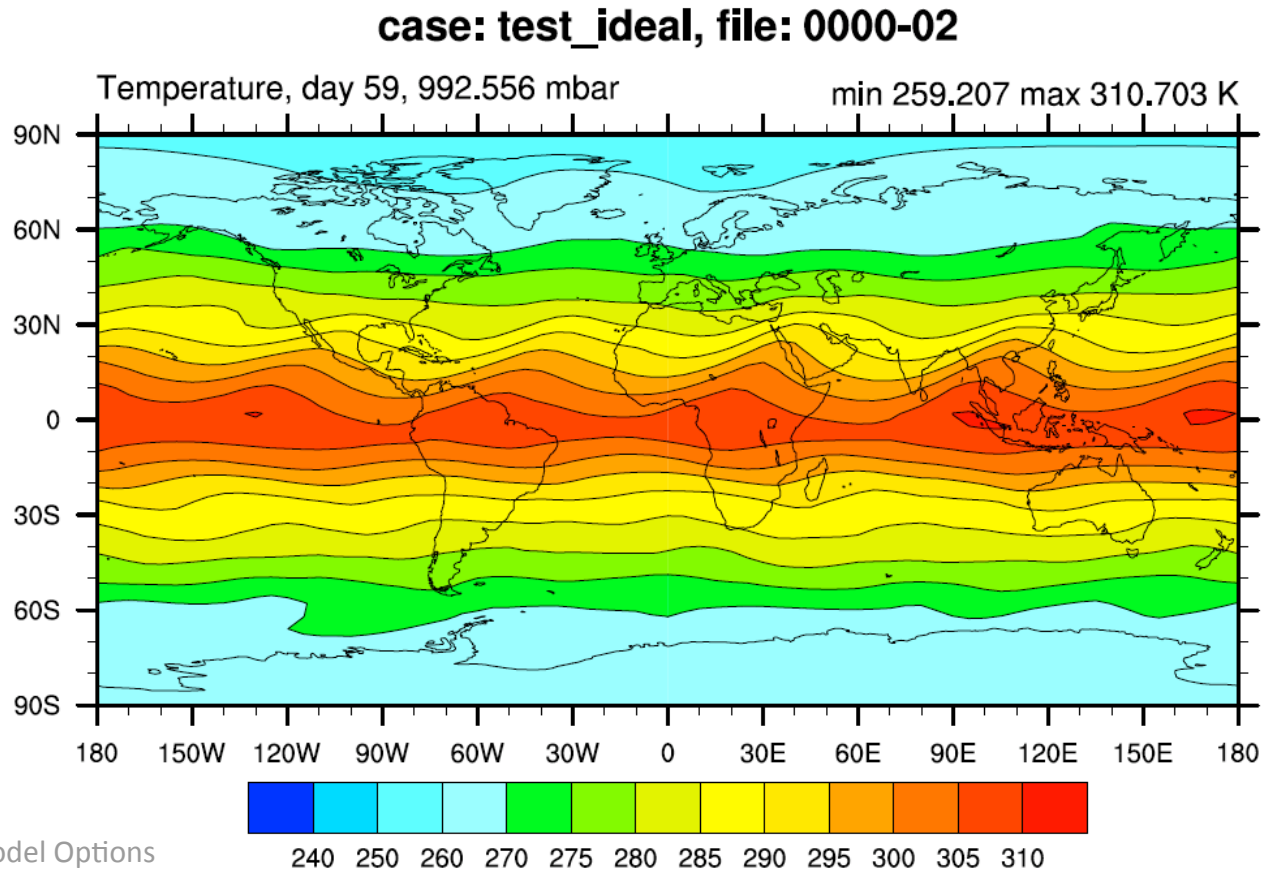
# NCL Notes

- There is lots in the NCL script, and lots that can be changed:
  - `field` (L24)
  - `level_index` (L56)

- More NCL scripts soon. More info on NCL at:

  http://www.ncl.ucar.edu

  NCAR Teaches courses on NCL too.

# Other Common Options: Aquaplanet

- Aqua-planet mode is a common way to test GCMs and theories of the general circulation (Neale and Hoskins, 2000)
- CAM has an Aqua-planet mode
  - changes the bottom boundary: LANDFRAC = 0
  - SSTs are set in a data ocean model instead of reading in a file
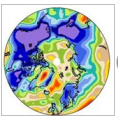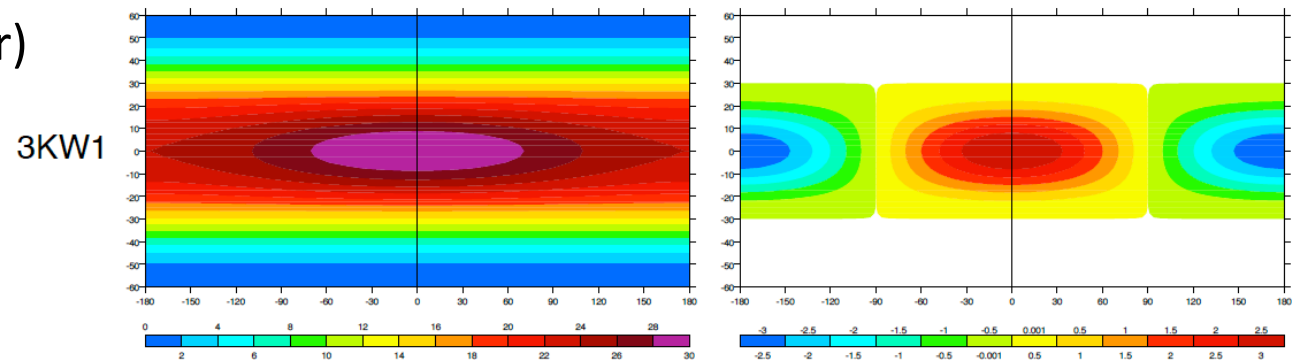- Actually a namelist option

# Aqua-planet SSTs

## Zonal Mean:

(default is 'Control')



Aqua-Planet Experiment SST (degC)

## Zonally Asymmetric

(symmetric about equator)



3KW1
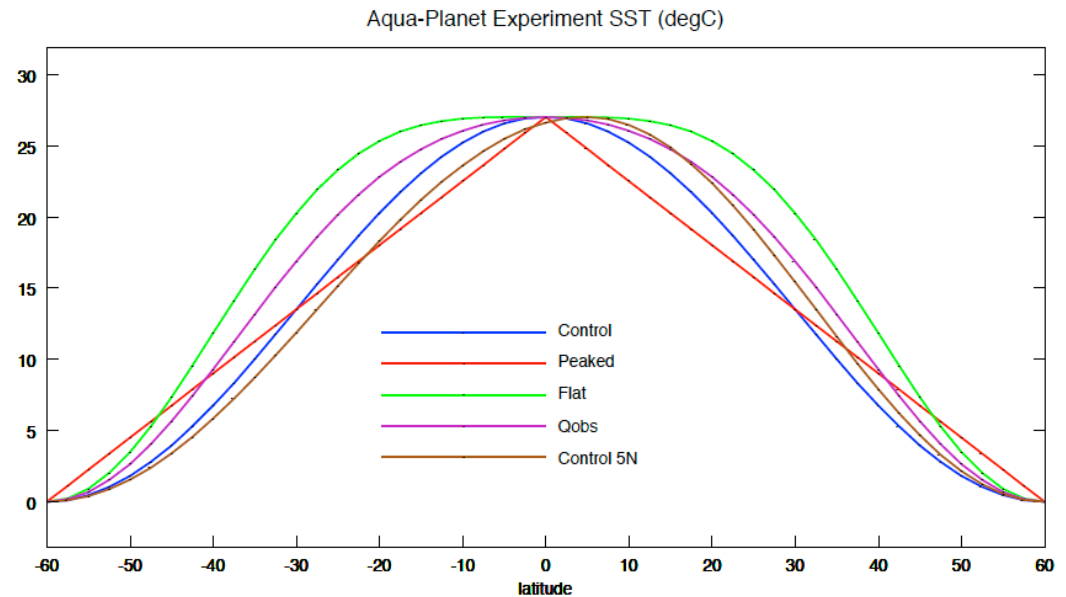
# Exercise: Aqua-planet Run
# Namelist option

On Bluefire, make a copy of the run script

```
cp run-ibm-tutorial.csh run-aqua.csh
```
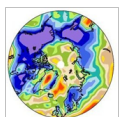
Change the case name:

```
set case = test01_aqua
```

Add the namelist option:

```
aqua_planet = .true.,
```

Run it for 3 months

```
stop_n = 3,
```

NCL visualization

- Edit the NCL script again
  - Change case name (L23)

    `case = "test01_aqua"`
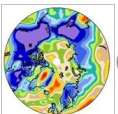
- Run the script

  `>ncl atm_latlon.ncl`

- Note the filename and visualize with :
  - Ghostview (`gv [filename]`)
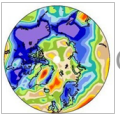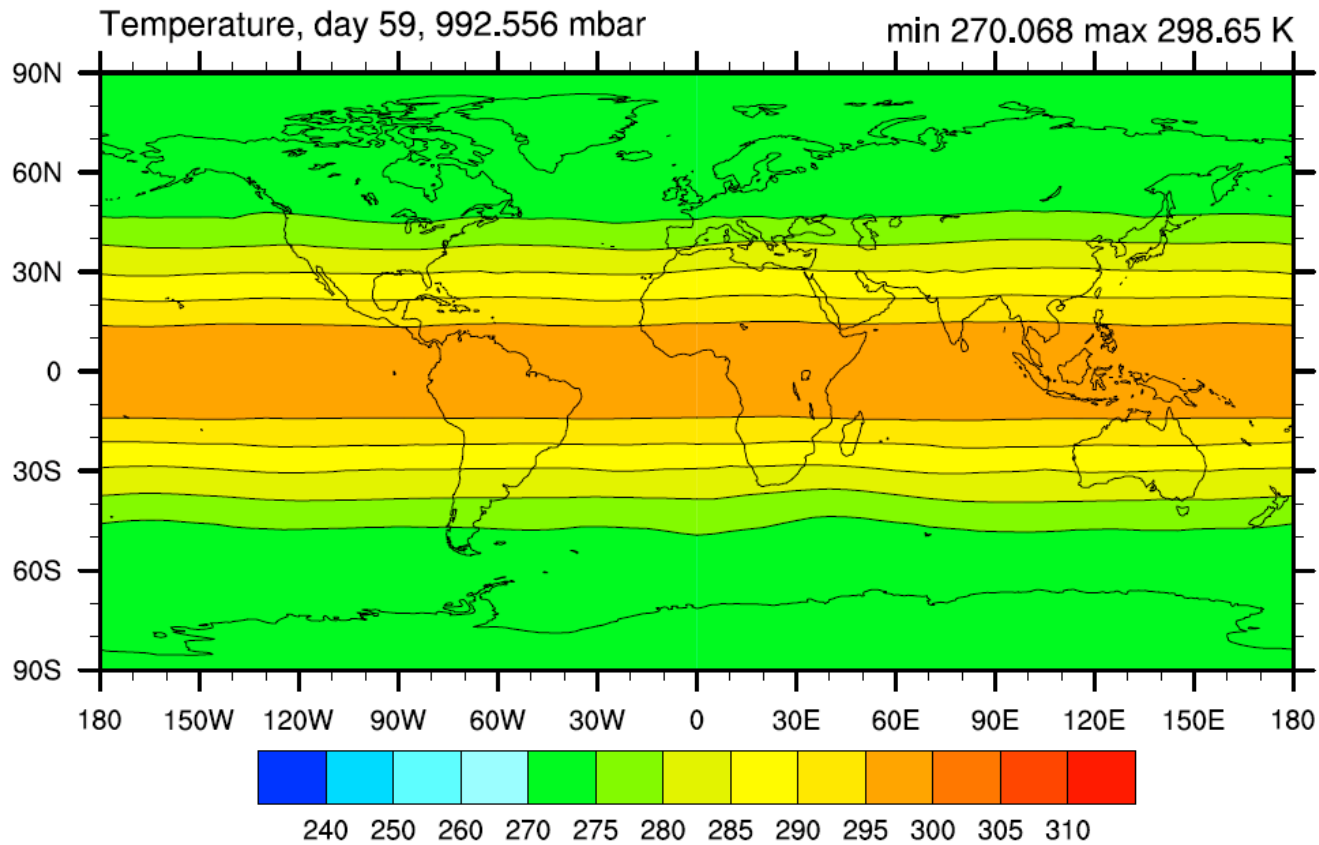 - Convert to PDF and transfer to a laptop:

    `ps2pdf [filename]`

    transfer pdf file to local machine using ftp

Aqua-planet result

case: test_aqua, file: 0000-02

Temperature, day 59, 992.556 mbar — min 270.068 max 298.65 K

Standard Test Case Result

Note Differences…

case: test, file: 0000-02

Temperature, day 59, 992.556 mbar   min 228.861 max 308.255 K
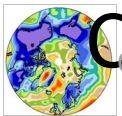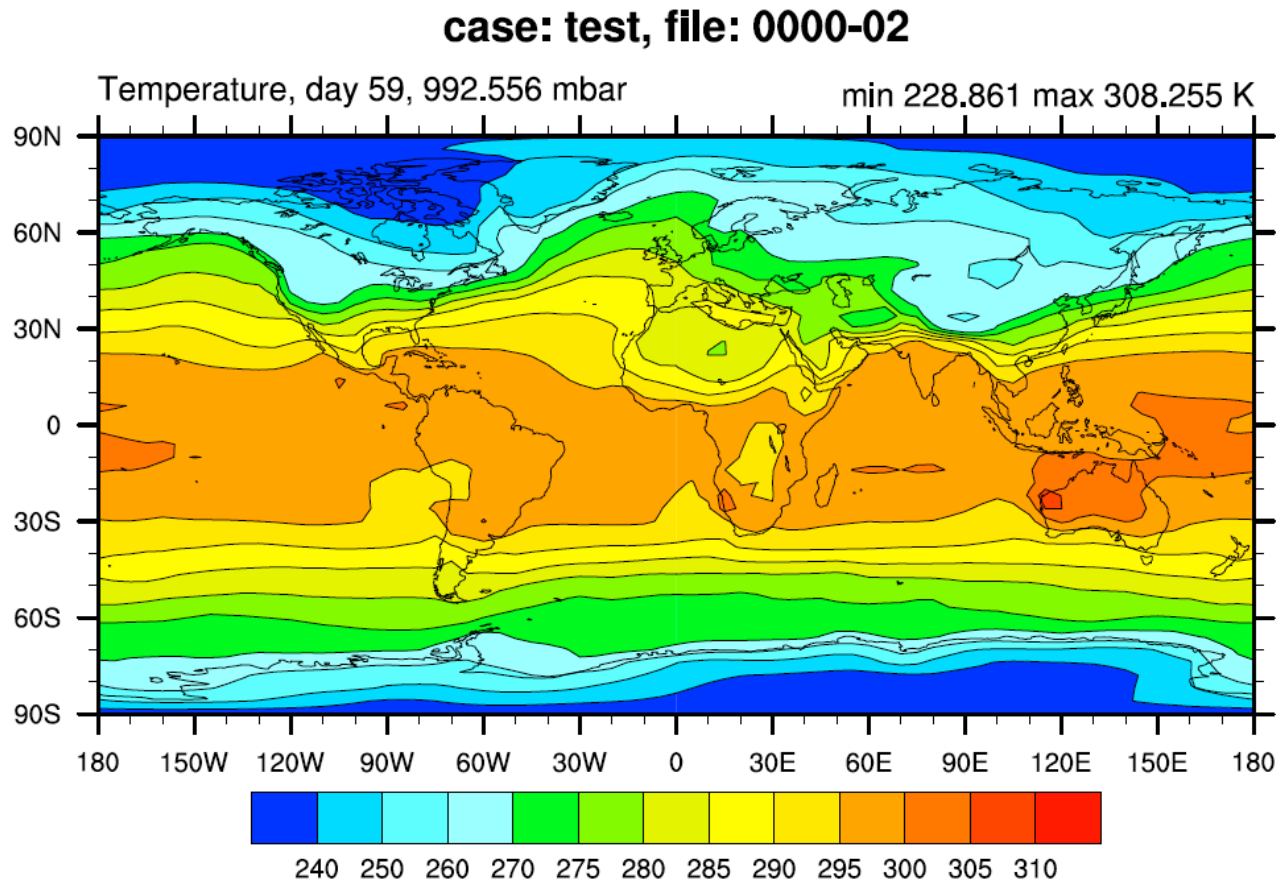
Can you make one of these too? (`case= 'test01'`)

Next Exercise: Running SCAM

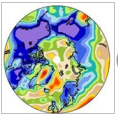- Single task, not threaded
- Configure options:

```
–scam
dycore = eul, resolution = 64x128
```

  also: remove threading

- Namelist options:

```
single_column = .true.,
```

  +Several important run-time options for each case

SCAM Script

- Copy `run-scam-tutorial.csh` on bluefire

  `cp /blhome/andrew/tutorial/run-scam-tutorial.csh .`
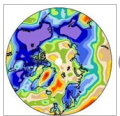
- Look at script

- Look at differences from other script

  `diff run-scam-tutorial.csh run-ibm-tutorial.csh`
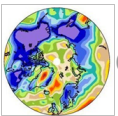
- Edit Script

  – change case name if desired (L68)

- Run:

  `>bsub –U 37591047#6 < run-scam-tutorial.csh`

SCAM Script Differences

- ## Configure Differences
  - – 'scam', dycore, no threading (nospmd, nosmp)

- ## Namelist differences related to IOP file
  - – `single_column = .true.`
  - – Time controls and stepping specific to IOP file
  - – Most information can be read off the IOP file itself
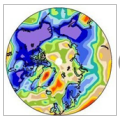
  `ncdump –h /ptmp/andrew/tutorial/scam/arm95_4scam.nc`

SCAM output

- First: look at output file (bluefire or storm)

```
cd /ptmp/USER/scam_CASE

ncdump —h scam_CASE.cam2.h0.1995-07-18-19800.nc
```

- What is different?
    – Latitudes and Longitudes
- Now, let's look at the run using NCL
    – over to storm

CAM Tutorial: Model Options

Visualizing SCAM

- Copy the NCL script (on storm)

  `cp /fs/home/andrew/diag/scam_latheight.ncl ~/ncl`

- Edit the script

  – Change case name (L23)

  `case = "scam_test"`
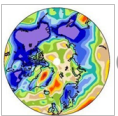
- Run the script

  `>ncl scam_latheight.ncl`

- Note the filename and visualize with :

  – Ghostview (`gv [filename]`)
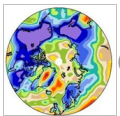
  – Convert to PDF and transfer to a laptop:
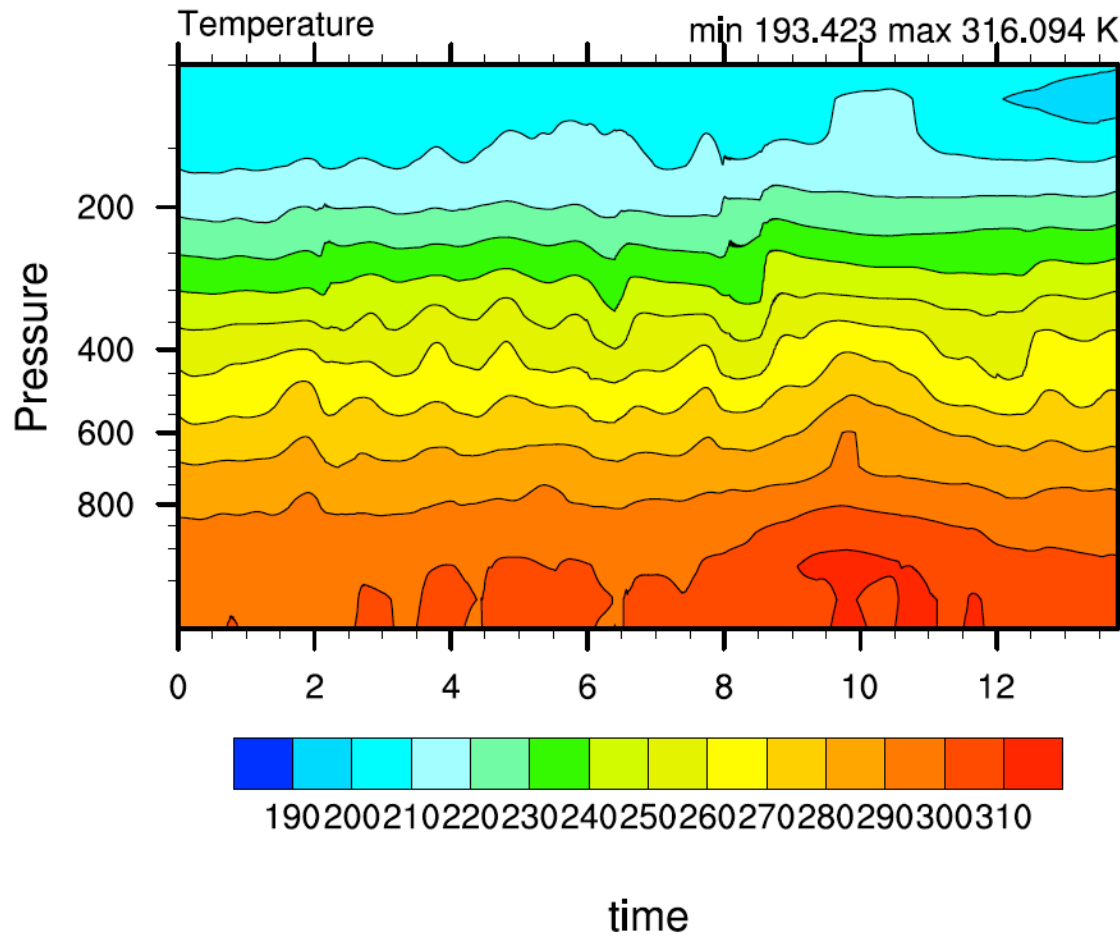
  `ps2pdf [filename]`

  transfer pdf file to local machine using ftp

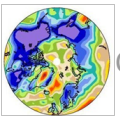CAM Tutorial: Model Options

SCAM Temperature "curtain"

case: scamtest

Temperature   min 193.423 max 316.094 K
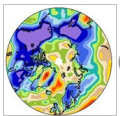
time

Further SCAM Visualization

- Can also play with other fields:

  - `field` (L24)

- Tomorrow, we will use this tool to explore other physics options and changes to the code.

Advanced SCAM: Different IOPs

- Change the IOP Case:

- Look at other cases in:

    bluefire: /ptmp/andrew/tutorial/scam

- Pick one

    – ARM = Oklahoma, GATE & TOGA tropics)

- Look at the file with ncdump –c

    ncdump –c /ptmp/andrew/tutorial/scam/gate_4scam.nc

- Need to get out all the needed SCAM Parameters

Advanced SCAM: Different IOPs

- Copy the SCAM Script to a new case

- Modify: SCAM Specific inputs for the IOP

  (these are OLD settings: find new ones in IOP File)

```
set iopfile = '/ptmp/andrew/tutorial/scam/
   arm95_4scam.nc'
set lat = 36.61
set lon = 262.51
set dtime = 1200
set basedate  = 19950718
set basesecs  = 19800
set stop_n    = 1261
```