CLIM3001

Using the CSIRO Mk3L climate system model
Part 3: Configuring Mk3L

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Overview

- Input files
- The control file
- Auxiliary files
- Design your own experiment - Part 1
- Analysing experiments
- Advanced configuration
- Design your own experiment - Part 2

Input files

Reminder: Input files

- The model requires three types of input files:

control file	configures the model for a particular simulation
restart file(s)	initialise(s) the model at the *start* of a simulation
auxiliary files	provide the boundary conditions *during* a simulation

- The model may be configured for a particular scenario by modifying one or more of these files
- See Chapters 4 and 5 of the Users Guide for further information

The control file

The control file

- To run the model, you use a command such as:

```
./model < input > output
```

- The file `input` is the *control file*
- This file contains a number of `namelist` groups
- The parameters contained within these groups specify:
  - the duration of a simulation
  - the physical configuration of the model
  - which model variables are to be saved

namelist groups

- A `namelist` group looks like this:

```
&control
  lcouple=T
  locean=F
  mstep=20
  nsstop=0
  ndstop=1
  lastmonth=0
  months=0
  nrad=6
&end
```

`nano`

- `nano` is a simple Linux text editor
- To edit a file, enter the command:

```
nano <file>
```

- Some basic `nano` commands are:

`Ctrl-G`	Get Help
`Ctrl-O`	Write (Save)
`Ctrl-X`	Exit

Exercise 1: `nano`

- Change to the directory containing the test scripts:

```
cd ~/CSIRO_Mk3L/version-1.2/core/control/
```

- Create a copy of one of the control files, using a command such as:

```
cp input_cpl_1day input_copy
```

- Use `nano` to examine and edit this file.

Basic `namelist` options

`locean, lcouple`

These parameters determine the mode in which the model is to run:

`locean=T`	Stand-alone ocean mode (this overrides `lcouple`)
`locean=F, lcouple=F`	Stand-alone atmosphere mode
`locean=F, lcouple=T`	Coupled mode

Basic `namelist` options

`nsstop, ndstop, lastmonth, months`

For the coupled model and stand-alone atmosphere model, these determine the duration of the simulation:

`nsstop`	Stop after `nsstop` timesteps
`ndstop`	Stop after `ndstop` days
`lastmonth`	Stop at the end of calendar month `lastmonth` (1=January, 2=February, ..., 12=December)
`months`	Stop after `months` months

The first of these to have a non-zero value is the one which takes effect

Basic `namelist` options

`iocmn, iocyr`

For the stand-alone ocean model, these determine the duration of the simulation:

`iocmn` < 12	Stop after `iocmn` months
`iocmn` $= 12$	Stop after `iocyr` years

Basic `namelist` options

`bpyear, csolar`

- `bpyear` specifies the epoch, in years before present (where the "present" is the year 1950 CE)
- `csolar` specifies the solar constant, in $\mathrm{W m^{-2}}$

`runtype`

- `runtype` specifies the name of the experiment

Atmosphere model output: monthly

- This is controlled by the parameter `statsflag`:

`statsflag=T`	Save monthly-mean statistics
`statsflag=F`	Don't save this data

- The parameters in the group `statvars` control which variables are to be saved - see Section 4.2.3 of the Users Guide

Atmosphere model output: "daily"

- This is controlled by the parameters `savehist` and `hist_interval`:

`savehist=T`	Save "daily" statistics
`hist_interval=1440`	Save these statistics every 1440 minutes

- It's possible to save statistics at two different frequencies - see Section 4.2.2 of the Users Guide
- The parameters in the group `histvars` control which variables are to be saved - see Section 4.2.4 of the Users Guide

Ocean model output

- The ocean model saves monthly-mean statistics only
- This is controlled by the parameters in the group `osave` e.g.

`save_temp=T`	Save the potential temperature
`save_sal=T`	Save the salinity
`save_over=T`	Save the meridional overturning streamfunctions

- See Table 4.11 of the Users Guide

Exercise 2: Basic `namelist` options

- Look at the control files in the following directories:

```
~/CSIRO_Mk3L/version-1.2/core/control/
~/week2/exp0?/
```

- Find the following parameters, and see how the values differ:

```
locean, lcouple
nsstop, ndstop, lastmonth, months
iocmn, iocyr
bpyear, csolar
runtype
```

Auxiliary files

Changing the atmospheric CO_2 concentration

- The CO_2 transmission coefficients are read from an auxiliary file
- These files are generated by the utility `radint`
- To compile and initialise this utility, change to the following directory:

```
cd ~/CSIRO_Mk3L/version-1.2/pre/co2/
```

- Now enter the commands:

```
make
./pset -n 18
```

Changing the atmospheric CO_2 concentration

- To generate the auxiliary file for an atmospheric CO_2 concentration of `<concentration>` ppm, enter the command:

```
./radint -c <concentration>
```

- For example, for a CO_2 concentration of 280 ppm:

```
./radint -c 280
```

- This generates a file called `co2_data`, which you should rename

Applying freshwater hosing

- To apply freshwater hosing, use these `namelist` parameters:

`hosing_flag`	If `T`, apply freshwater hosing
`hosing_rate`	The freshwater hosing rate (Sv)

- You must also supply the auxiliary file `hosemask`
- A sample auxiliary file is provided with the model:

```
~/CSIRO_Mk3L/version-1.2/core/data/atmosphere/hosing/hosemask
```

Design your own experiment

Part 1

Design your own experiment - Part 1

- Design your own experiment.
- Run the coupled model for six months on 4 cores.

Analysing your experiments

Advanced Ferret commands

`cancel mode logo`	Turns off the Ferret logo
`fill/title="My title"`	Specifies a plot title
`fill/lev=1d`	Use a spacing of 1.0 between contour levels
`fill/lev=1dc`	Use a spacing of 1.0 and centre around zero
`contour/over`	Overlay contours
`contour/over/nolab`	Overlay contours without adding a label
`go land`	Overlay continental boundaries
`frame/file=file.gif`	Save the image to the file `file.gif`

- Much, much, much more at:

`http://ferret.pmel.noaa.gov/Ferret/documentation/users-guide`

Exercise 3: Advanced Ferret commands

- Load and run Ferret:

```
module load ferret
ferret
```

- Within Ferret, load the sample atmosphere model output:

```
yes? use stsc_spi62.nc
```

Exercise 3: Advanced Ferret commands

- Type the following commands:

```
yes? cancel mode logo
yes? fill/title="Screen temperature (K)" tsc[k=@ave,l=@ave]
yes? go land
yes? frame/file=temperature.gif
```

- Now try generating some different plots...

Getting files from tensor

- Launch PSFTP:
  - `Programs > PuTTY > PSFTP`
- Change to the H drive on your local machine:
  - `psftp> lcd h:`
- Connect to tensor:
  - `psftp> open tensor.maths.unsw.edu.au`
- Log in using your zNumber and zPass
- Change to the appropriate directory on tensor e.g.
  - `psftp> cd ~/week2`
- Get the file you want e.g.
  - `psftp> get temperature.gif`

Exercise 4: Analyse your experiment

- Now that you know what you did last week, analyse the output of your experiment.
- Did it work?
- Use Ferret to plot the output of the model.
- Generate some GIF images and copy the files back to your local machine.

Advanced configuration

Summary: Basic configuration

- What we've covered so far:
  - How to configure the model via the control file
  - How to change the atmospheric CO_2 concentration by generating a new auxiliary file
  - How to apply freshwater hosing
- This enables you to vary:
  - the epoch
  - the solar constant
  - the atmospheric CO_2 concentration
  - the freshwater flux into the ocean
  - which model statistics are saved

Advanced configuration

- There are three other ways of configuring aspects of the model:
  - Modify the other auxiliary files
  - Modify the restart file(s)
  - Modify the source code

Auxiliary files: atmosphere model

- Bottom boundary conditions:
  - Sea surface temperatures (`ssta.nc`)
  - Ocean currents (`ocuv.nc`)
  - Topography (`psrk.nc`)
  - Albedo (`albedo.nc`)
  - Vegetation and soil types (`sib*.nc`)
- Radiative boundary conditions:
  - CO_2 transmission coefficients (`co2_datafile`)
  - Ozone mixing ratios (`amip2o3.dat`)

Auxiliary files: ocean model

- Upper boundary conditions:
  - Sea surface temperatures (`sst.nc`)
  - Sea surface salinities (`sss.nc`)
  - Surface wind stresses (`stress.nc`)
- Bottom boundary conditions:
  - Bathymetry (`orest.nc` - restart file)

Auxiliary files: coupled model

- Bottom boundary conditions:
  - Topography (`psrk.nc`, `landrun21`)
  - Bathymetry (`orest.nc`)
  - Albedo (`albedo.nc`)
  - Vegetation and soil types (`sib*.nc`)
- Radiative boundary conditions:
  - CO_2 transmission coefficients (`co2_datafile`)
  - Ozone mixing ratios (`amip2o3.dat`)
- Freshwater hosing (`hosemask`)
- Flux adjustments (`dtm.nc`, `*cor.nc`)

Examples of advanced configuration

- Applying anomalies within the atmosphere and ocean models:
  - modify the SSTs, SSSs, currents, wind stresses
- Applying anomalies within the coupled model:
  - modify the flux adjustments
- Configuring the model for a different era:
  - modify the topography and bathymetry
  - modify the albedo, and the vegetation and soil types
  - modify the epoch, solar constant, CO_2 transmission coefficients, ozone mixing ratios
  - issues with restart files, spin-up procedures and flux adjustments

Design your own experiment

Part 2

Design your own experiment - Part 2

- Analyse the output of your experiment.
- Did it work? If not, why not?
- Use Ferret to plot the output of the model.
- If it worked, now run it for 10 years (or longer!).
- If it didn't work, try again.