# Using the CSIRO Mk3L climate system model Part 3: Designing and analysing experiments

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# 1. 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 1: Advanced Ferret commands

- Change to the directory containing last week's course material:

```
cd ~/week2/
```

- Load and run Ferret:

```
module load ferret
ferret
```

- Within Ferret, load the sample atmosphere model output:

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

# Exercise 1: 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 katana

- Launch PSFTP:
  - `Programs > PuTTY > PSFTP`
- Change to the H drive on your local machine:
  - `psftp> lcd h:`
- Connect to katana:
  - `psftp> open katana.science.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 2: Analyse your experiment

- Last week you ran your own experiment.
- Now analyse the output of that 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.

# 2. The control file

# 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

- 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 3: 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 that 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 $\mathrm{Wm}^{-2}$

`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

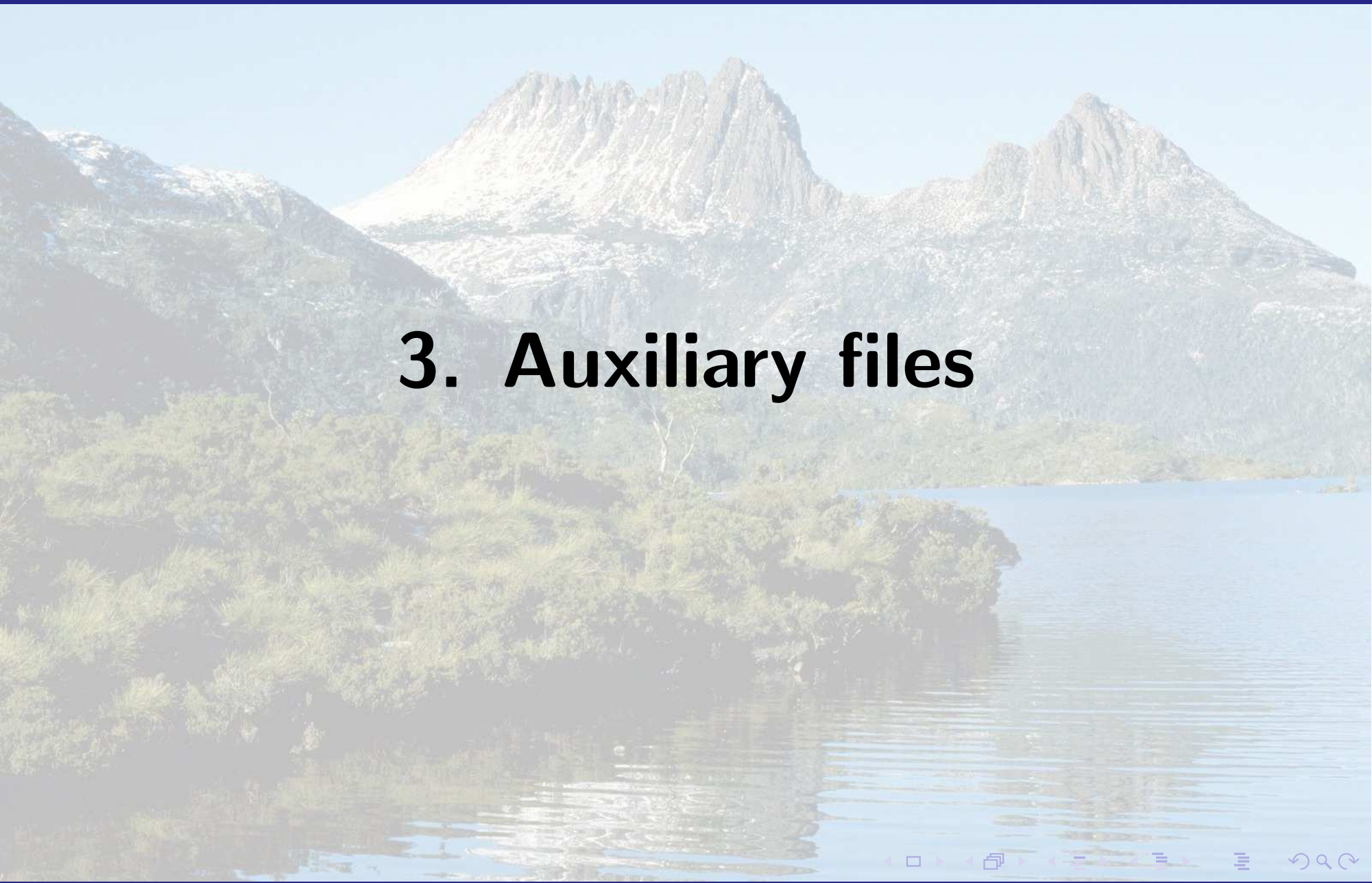
# Exercise 4: Basic `namelist` options

- 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
```



# 3. 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`

# 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
```

# 4. Design your own experiment

# Design your own experiment

- Design and run your own experiment.
- Ideas:
  - Change the epoch: simulate the past or future
  - Change the solar constant: $\pm 5\%$, $\pm 10\%$, more?
  - Change the $CO_2$ concentration: $\times \frac{1}{2}$, $\times 2$, $\times 4$?
  - Freshwater hosing: melting of the Greenland or Antarctic ice sheets
- Tips:
  - Use one of the pre-configured experiments as a basis
  - Think about how long to run the model: 50 years, 100 years?
  - Be careful to request sufficient resources using PBS
  - Unless you're feeling extremely confident, get me to check your experiments before you run them