Using the CSIRO Mk3L climate system model
Part 2: Working with Mk3L

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1. Running Mk3L for one day

Reminder: Using Katana

- Launch Xming (`Programs > Xming > Xming`).
- Launch PuTTY (`Programs > PuTTY > PuTTY`).
- Using PuTTY, do the following:
  - Select `Connection > SSH > X11`
  - Check the `Enable X11 forwarding` box
  - Select `Session`
  - In the `Host Name` box, enter `katana.science.unsw.edu.au`
  - Click `Open`
  - Log in using your zNumber and zPass

Running Mk3L for one day

- You did this last week!
- The basic command which runs Mk3L is simply:

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

- `model` is the *executable*. This is the "model".
- `input` is the *control file*. This contains the instructions which tell the model what to do.
- `output` contains diagnostic information generated by the model.
- The above command *executes* the model, feeds it the information contained within the control file and *redirects* the diagnostic information to an output file.

Exercise 1: Running Mk3L for one day

- Change to the directory containing the test scripts:

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

- The script `qsub_test_cpl` runs the coupled model for one day.
- You ran this script last week.
- Using the `less` command, examine it carefully.
- Remember that lines beginning with # are comments.
- Look for the sections that do the following:
  - create the run directory
  - copy everything to this directory
  - run the model

Exercise 1: Running Mk3L for one day

- Create a run directory:

```
# Create a run directory if it doesn't already exist, and delete the contents
# of the directory if it does
set RUN_DIR = ../../../mk3l_tmp/
if (-e $RUN_DIR) /bin/rm $RUN_DIR/*
if (! -e $RUN_DIR) mkdir $RUN_DIR
```

- Copy the executable and the control file to the run directory:

```
# Copy the model executable to the run directory
cp ../bin/model $RUN_DIR

# Copy the control file to the run directory
cp ../control/input_cpl_1day $RUN_DIR/input
```

Exercise 1: Running Mk3L for one day

- Copy data files to the run directory:

```
# Copy the restart files to the run directory
cp ../data/atmosphere/restart/rest.start_default $RUN_DIR/rest.start
cp ../data/coupled/restart/oflux.nc_default $RUN_DIR/oflux.nc
cp ../data/ocean/restart/orest.nc_sync $RUN_DIR/orest.nc

# Copy the basic data files to the run directory
cp ../data/atmosphere/basic/* $RUN_DIR
cp ../data/ocean/basic/* $RUN_DIR

# Copy the runoff relocation data to the run directory
cp ../data/atmosphere/runoff/landrun21 $RUN_DIR

# Copy the CO2 radiative data file for 280ppm to the run directory
cp ../data/atmosphere/co2/co2_data.280ppm.18l $RUN_DIR/co2_data.18l
```

Exercise 1: Running Mk3L for one day

- Copy more data files to the run directory:

```
# Copy the flux adjustments to the run directory
cp ../data/coupled/flux_adjustments/hfcor.nc_default $RUN_DIR/hfcor.nc
cp ../data/coupled/flux_adjustments/sfcor.nc_default $RUN_DIR/sfcor.nc
cp ../data/coupled/flux_adjustments/txcor.nc_default $RUN_DIR/txcor.nc
cp ../data/coupled/flux_adjustments/tycor.nc_default $RUN_DIR/tycor.nc
cp ../data/coupled/flux_adjustments/sstcor.nc_default $RUN_DIR/sstcor.nc
cp ../data/coupled/flux_adjustments/ssscor.nc_default $RUN_DIR/ssscor.nc
cp ../data/coupled/flux_adjustments/dtm.nc_default $RUN_DIR/dtm.nc
```

- Change to the run directory and run the model:

```
# Change to the run directory
cd $RUN_DIR

# Run the model
./model < input > output
```

2. Running Mk3L for 10 years

Running Mk3L for 10 years

- This involves the same steps as running the model for one day:
  - create a run directory
  - copy everything that you need to this directory
  - run the model
- However, the model can only be run for one year at a time.
- So, in this case, we need to use a loop to run the model.

Exercise 2: Running Mk3L for 10 years

- Get the course material for this week:

```
cd
tar zxvf /srv/scratch/z3210932/week2.tar.gz
cd ~/week2
```

- The script `qsub_10years` runs the coupled model for 10 years.
- Using the `less` command, examine this script.
- How does it differ from the script which runs the model for one day?

Exercise 2: Running Mk3L for 10 years

- There's a bit more work required to set up the experiment...

```
# Set name of run
set run = 10yrs

# Set duration of run, in years
set DURATION = 10

# Set stack sizes
limit stacksize unlimited
setenv KMP_STACKSIZE 16M

# Set number of threads
setenv OMP_NUM_THREADS 4

# Set name of Mk3L core directory
set coredir = $HOME/CSIRO_Mk3L/version-1.2/core

# Set name of run directory
set rundir = /srv/scratch/$USER/$run

# Create run directory
mkdir -p $rundir
```

Exercise 2: Running Mk3L for 10 years

- ... and we need to use a loop to run the model:

```
# Run model for required number of years
while ($year <= $DURATION)

  # Convert year number to five-character string
  set yyyyy = $year
  if ($year <= 9999) set yyyyy = 0$year
  if ($year <= 999) set yyyyy = 00$year
  if ($year <= 99) set yyyyy = 000$year
  if ($year <= 9) set yyyyy = 0000$year

  # Run model for one year
  ./model < input > output.$yyyyy

  # Convert ocean model output to netCDF
  ./convert_averages fort.40 com.${run}.${yyyyy}.nc
  /bin/rm fort.40

  # Rename atmosphere model restart file
  /bin/mv rest.end rest.start

  # Increment year number
  @ year ++

end
```

Portable Batch System (PBS) options

- The script that you just examined includes the following lines:

```
#PBS -l walltime=24:00:00
#PBS -l vmem=1gb
#PBS -l nodes=1:ppn=4
```

- These request the resources needed to run the job.
- The job is expected to take up to 24 hours (`walltime`).
- The job will require up to 1 GB of memory (`vmem`).
- We want to run on one node (`nodes`) and four cores (`ppn`).
- When you design your own experiments, `walltime` is the only option that you might need to change.

3. Your first experiment

Exercise 3: Your first experiment

- Choose one of the following experiments:

exp01	Control simulation
exp02	Mid-Holocene (6,000 years BP)
exp03	Last Glacial Maximum (21,000 years BP)
exp04	Snowball Earth
exp05	$2\times CO_2$
exp06	Water hosing

- Each experiment has already been set up for you.

Exercise 3: Your first model experiment

- For your experiment, change to the appropriate directory e.g.

```
cd ~/week2/exp01
```

- Now start your experiment e.g.

```
qsub qsub_exp01
```

- Look at the script which carries out each experiment.
- How does it differ from the control simulation (`exp01`)?
- What would you change if you wanted to run your experiment for 50 years, rather than 10 years?

4. Analysing experiments

Getting files from katana

- Mount your H drive by entering the command:

  `network`

- You will need to enter your zPass. This creates the directory:

  `~/hdrive`

- Your can copy/move files to this directory.
- The contents of this directory can be accessed in two ways:
  - from within Windows (as the H: drive)
  - online via `http://myfiles.unsw.edu.au`
- To access files online via the UNSW File System, you will need to log in using your zNumber and zPass. You will then find the contents of your H drive under `My Home Drive`.

More 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 4: More Ferret commands

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

```
cd ~/week2
```

- Load and run Ferret:

```
module load ferret
ferret
```

- Within Ferret, load some atmosphere model output:

```
yes? use stsc_exp01.nc
```

Exercise 4: More 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...
- Generate some GIF images and copy the files back to your local machine.

Even more Ferret commands

- Datasets and variable definitions:

```
use stsc_exp01.nc
use stsc_exp04.nc
let dt = tsc[d=2] - tsc[d=1]
```

- Setting up the plot window:

`set window n`	Send graphics to window `n`
`set window/size=1.0`	Resize window to `1.0` of full
`set window/aspect=0.7`	Change aspect ratio to `0.7`

Even more Ferret commands

- Plot layout:

`set viewport ll`	Lower left of window [also: `lr`, `ul`, `ur`]
`set viewport left`	Left half of window [also: `right`]
`set viewport upper`	Upper half of window [also: `lower`]

- Colour palettes:

`palette blue_darkred`	User colour palette `blue_darkred`
`spawn Fpalette '*'`	List all available palettes
`go try_palette blue_darkred`	Display palette `blue_darkred`

Even more Ferret commands

- Customising plots:

`shade/set_up/`*options* *data*	Set up a plot
ppl commands	Customise the plot using `ppl`
`ppl shade`	Generate the plot

- `fill`, `plot` and `shade` options:

`shade/levels=2d`	Use a spacing of 2 between levels
`shade/levels=2dc`	Ditto, with the levels centred around zero
`shade/hlimits=0:10:1`	Horizontal axis range and interval
`shade/vlimits=0:10:1`	Vertical axis range and interval
`shade/title="..."`	Set the plot title to ...

Even more Ferret commands

- `ppl` commands:

`ppl labset`	Sets character heights for labels
`ppl axlsze`	Sets axis label heights
`ppl shakey`	Controls the shade key
`ppl axlint`	Sets numeric label interval for axes
`ppl xfor`	Sets format of x-axis numeric labels
`ppl yfor`	Sets format of y-axis numeric labels
`ppl xlab`	Sets label of x-axis
`ppl ylab`	Sets label of y-axis

Even more Ferret commands

- Other commands:

`go margins`	Adjust the margins surrounding a plot
`go remove_logo`	Remove the Ferret logo
`go unlabel n`	Remove label `n` (`n` ≥ 4)
`go land`	Overlay continental boundaries

- Much, much, much more at:
  - `http://ferret.pmel.noaa.gov/Ferret/documentation/users-guide`

Ferret scripts

- It is not necessary to re-type Ferret commands every time you want to generate a plot.
- Instead, you can write a Ferret *script*.
- A script contains:
  - a series of Ferret commands
  - comment lines (lines beginning with `!`)
- A Ferret script can be identified by a file name ending in `.jnl`.
- To run a script, use the go command.
- For example, to run a script called `plot.jnl` you type:

```
yes? go plot
```

Exercise 5: Ferret scripts and plotting

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

```
cd ~/week2
```

- This contains three Ferret scripts.
- Load and run Ferret. Now run each script by typing e.g.

```
yes? go plot1
```

- What happens?
- Examine each script using `less`. See how the new Ferret commands that you have learnt this week are being used.

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 6: Editing Ferret scripts

- Create a copy of one of the Ferret scripts, using a command such as:

```
cp plot1.jnl new_plot.jnl
```

- Use `nano` to examine and edit this file.
- Using the three sample Ferret scripts as a starting point, try generating some of your own plots!