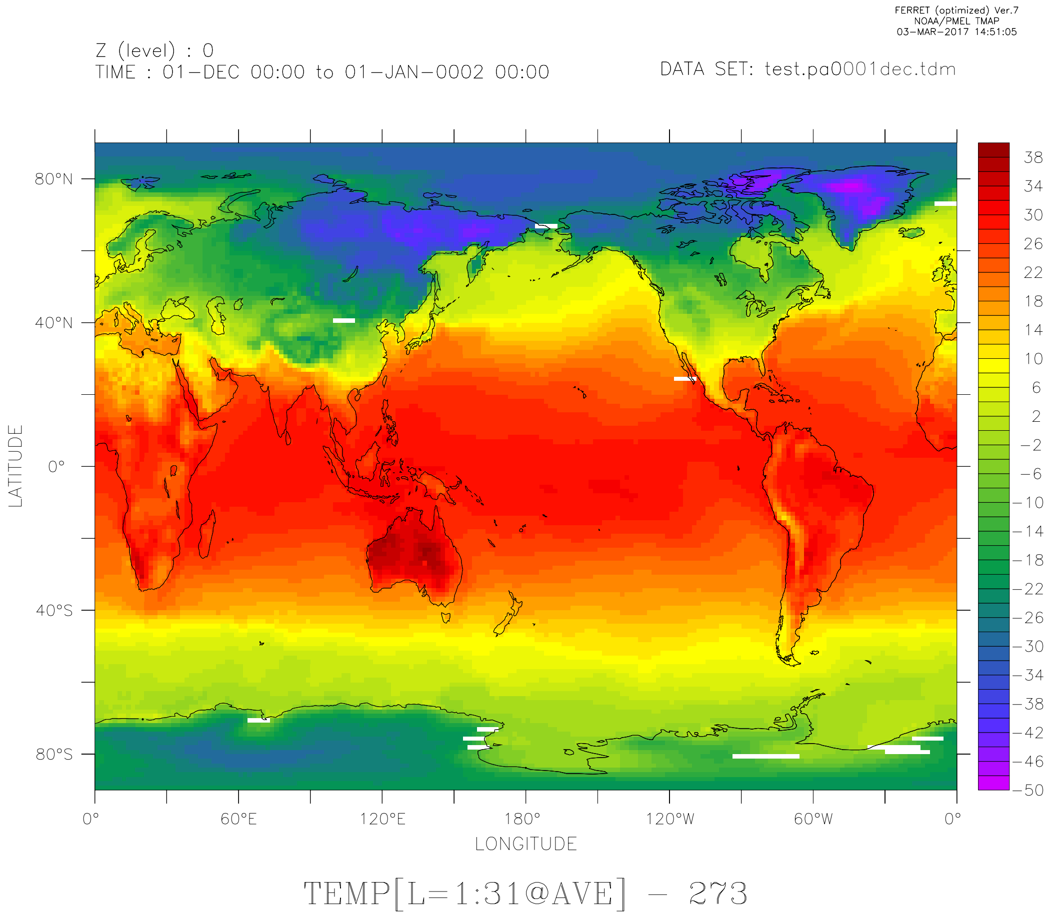
GETTING STARTED WITH ACCESS



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INTRODUCTION

Background

This document is a beginner's guide to working with the ACCESS coupled model (ACCESS-CM). It addresses these main areas:

- Getting started
- Running the model
- Model output
- Model input

It is written for a user in the p66 ACCESS project group. Further, this is not a 'dummies' guide; some basic assumptions have been made concerning the user's familiarity with computer systems.

Feedback is welcome and may be incorporated in to future versions.

Caveat emptor: Any of the links provided in this document can fail (although working at the time of writing), and many of the websites visited or linked to have some broken URL hyperlinks. Also, there is a degree of duplication across webpages and some inconsistencies.

Model outline

ACCESS-CM2 is one of a family of models which have been developed for the purposes of weather forecasting and climate change by CSIRO and partner organisations. The different model arrangements reflect the needs of various operational requirements, researchers and stakeholders. Model details of the CMIP5 coupled versions are given in Bi et al. (2013)[1] and the numerical weather prediction (NWP) versions in Puri et al. (2013)[2].

CM2 is the current (2017) version which is being prepared for CMIP6; the main sub models are the UKMO's Unified Model (UM) version 10/Global Atmosphere (GA) 7.1 for the atmosphere, Modular Ocean Model (MOM) 5.1 for the ocean, CICE 5.1 sea-ice model, CABLE 2 land surface model and biogeochemistry along with the OASIS3-MCT coupler. Further details can be found in the documentation for the individual sub-models.

NB: Acronyms are only partially dealt with in this document.

As well as being a coupled atmosphere–ocean general circulation model (AOGCM), ACCESS can function as an Earth System Model (ESM), that is one with an active carbon cycle that derives atmospheric carbon dioxide (CO_2) concentrations from given emissions, rather than prescribed CO_2 concentrations. This is referred to as ACCESS-ESM2. Working with the ESM version is not addressed here.

Document version

This guide is a work-in-progress; it will be (and need to be) updated from time to time as the ACCESS-CM2 project unfolds.

This is version 1.3, October 2017 by R. Bodman and P. Dobrohotoff.

Acknowledgments

With many thanks to Scott Wales and the accessdev help team for their assistance.

PREPARING TO RUN ACCESS

Some assumptions about who you are and your working/computing environment:

- You will need to belong to an organisation that allows access to NCI eg CSIRO, a university etc;
- Which then means you have a working institutional email address;
- And you have a quota or budget for time at NCI;
- That you have a computer with an internet connection;
- And the computer has a command line terminal eg:
    - Terminal on MacOS with XQuartz and command line tools installed;
    - Putty, Cygwin or similar XWindows compatible program on a PC;
    - Unix or Linux computer.

You need to setup an account with NCI, with a username and password:

https://my.nci.org.au/mancini/signup/0

and then join a project (for example, p66, which is the CSIRO ACCESS-CM development project).

You will also need to join the ACCESS Group:

https://my.nci.org.au/mancini/project/access/join

Once you have your NCI credentials and your ACCESS Group membership has been granted, follow the instructions at:

https://accessdev.nci.org.au/trac/wiki/GettingConnected

to complete your setup.

LOGGING IN

At this stage you should be able to connect to accessdev and raijin.

accessdev is a frontend system where you prepare ACCESS jobs and then submit them to raijin (refer https://accessdev.nci.org.au).

raijin is the name of the super-computer at NCI where ACCESS is run.

Logging in to accessdev

```
ssh -Y $USER@accessdev.nci.org.au
```

The `-Y` switch is used to allow trusted X11 forwarding.

Then you can begin to work on setting up a model run. This is explained further in the next section.

To finish `logout` or `ctrl-d`

Logging in to raijin

Similar to accessdev:

```
ssh -Y $USER@raijin.nci.org.au
```

See also https://opus.nci.org.au/display/Help/Raijin+User+Guide for more details/alternate commands for PCs etc. Also a quick guide to Linux commands at https://opus.nci.org.au/display/Help/Linux+Command+Quick+Reference+Guide

NB: Aliases and shortcuts can be created to simplify these commands, refer, e.g., the section on Configuring SSH at https://accessdev.nci.org.au/trac/wiki/Guides/SSH.

Some commands to try out:

```
hostname
```

```
nci_account

module list

module avail
```

To finish `logout` or `ctrl-d`

The status of a running job can be checked using:

```
nqstat
```

This is a script that shows jobs just for the p66 group, not all of the jobs running on raijin.

To check space:

```
lquota
```

On accessdev, enter UKMO password at the start of a session if appropriate. It is needed for copying a suite and making any changes that affect the UM and its repository (since this password expires after 12 hours):

```
mosrs-auth
```

ROSIE, ROSE AND CYLC

What are these?

ACCESS-CM is a set of sub-models (eg, UM, MON, CICE, CABLE and OASIS) with a raft of model parameters and data plus computer related information that need to be packaged together in order to run. Such a package is called a 'suite'. Typically, an existing suite is copied and then edited as needed for a particular run.

The suite resides in a directory created in the user's accessdev cylc-run directory for this purpose eg:

```
~/cylc-run/u-ai147
```

where `u-ai147` is an example of a test suite name (in this case, an ACCESS CM2-GA7.0 N96 UM10.3 + 1 degree MOM5 present day climate simulation test experiment). Note that each suite directory gets copied over to raijin when it is submitted as a job to a raijin queue.

There are two ways of editing a suite, approaches that can be used individually or in conjunction, whichever the user finds most useful or easier. One is to use the Rose GUI (graphical user interface), the other is to use a text editor.

Rose

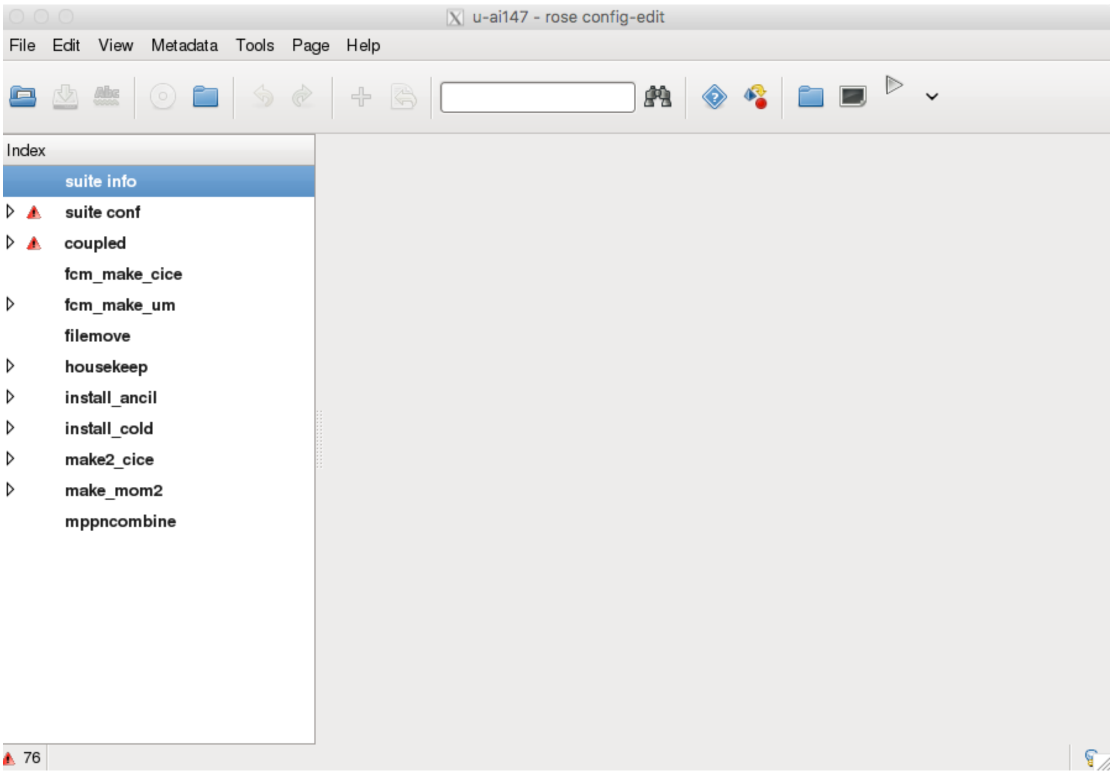
This is a program that starts a GUI to edit a rose suite; effectively a configuration editor.

It is run from your suite directory on accessdev, eg:

```
cd roses/u-ai147

rose edit &
```

which will create a dialog box similar to the one shown below (the & is optional; it just keeps the terminal prompt active and runs the GUI as a separate process).



Alternatively, the files

```
rose-suite.conf

rose-suite.info

suite.rc
```

can be edited directly using a text editor. There are also files related to building the model, compiling the programs and so forth, aspects that are not addressed here.

For more details refer to:

http://metomi.github.io/rose/doc/rose.html

CYLC

Pronounced 'silk', cylc is a job scheduler that deals with specifications for how the job will be run and the time steps of each sub-model. Documentation for this can be found at:

http://cylc.github.io/cylc/documentation.html

It provides important capabilities for monitoring jobs, particularly for dealing with jobs that have failed during processing but can be re-started from a previous timestep rather than starting all over again from the beginning.

ROSIE

Rosie is a script with a set of high level options to work with rose, handling suite storage and discovery. Commands include, eg.:

```
rosie copy

rosie go

rosie create
```

Refer also to the documentation at http://metomi.github.io/rose/doc/rose.html as well as http://metomi.github.io/rose/doc/rose-rug-rosie-go.html

RUNNING ACCESS-CM

This section provides a short introduction to running the model, monitoring, debugging, managing runs (shutdown, viewing status, tidying up), and managing output.

Working with suites

Typically, the suite you will be working with is derived from an existing suite, which is then modified as needed. Only a rudimentary introduction is provided here. It is likely that someone else from the project will provide an initial or test suite to begin with.

When a new suite is created with `rosie create`, a new name is generated within the repository system. This is populated with some descriptive information about the suite along with all the initial configuration details, much of which is generated automatically for you.

Suites can be 'checked out' to create a local version of a suite, and there are commands to delete copies of rose suites.

```
rosie checkout
```

Editing of a suite enables the specifications for a particular model run to be established in preparation for running the simulation.

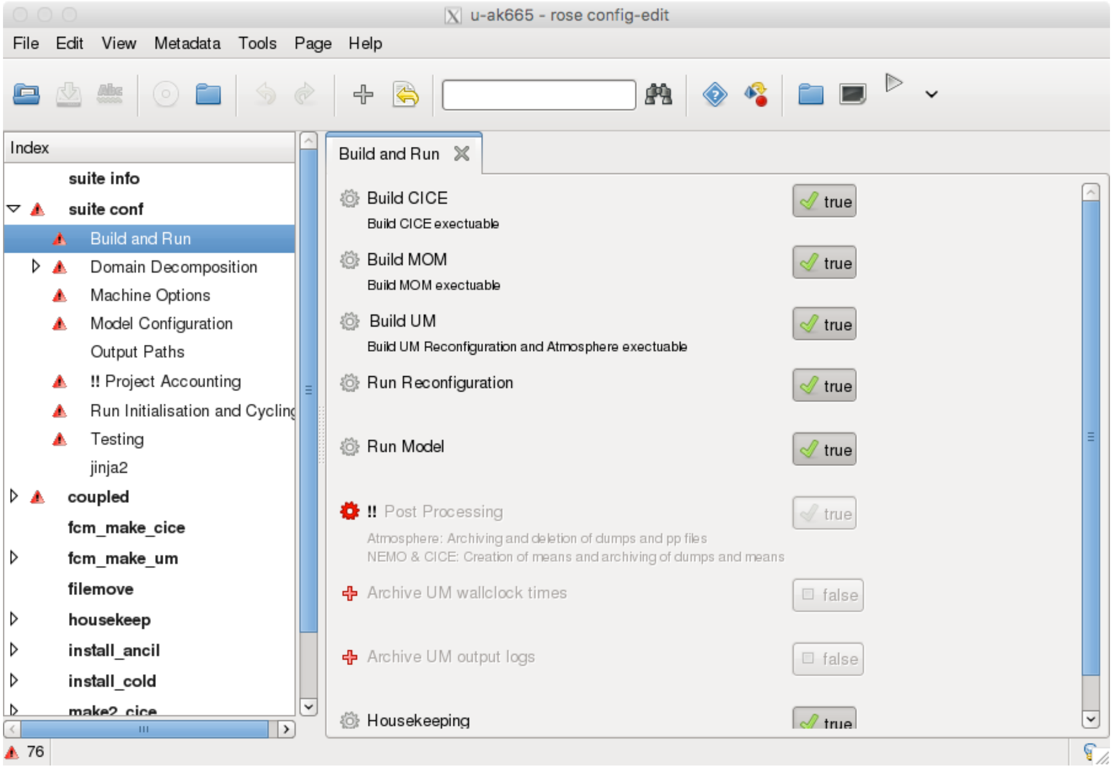
Important run-time features

Prior to submitting a suite to raijin, it is worth double checking some of the settings. Start the rose GUI from the roses suite directory, eg:

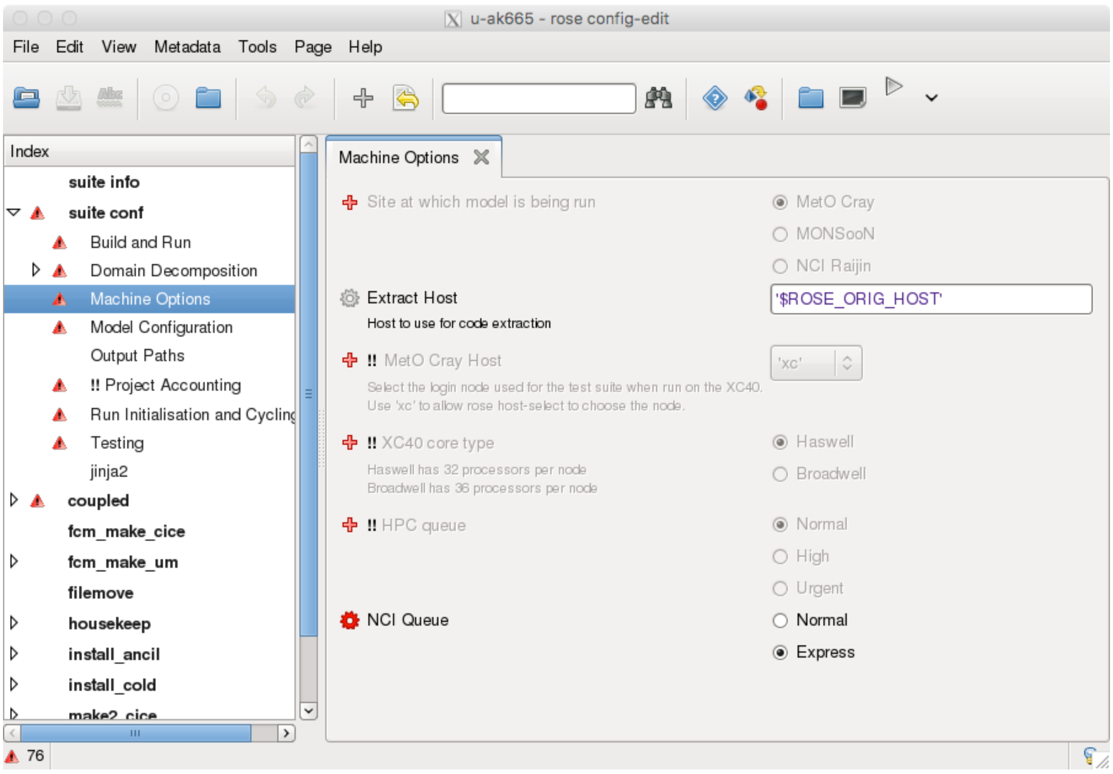
```
cd roses/u-ai147

rose edit
```

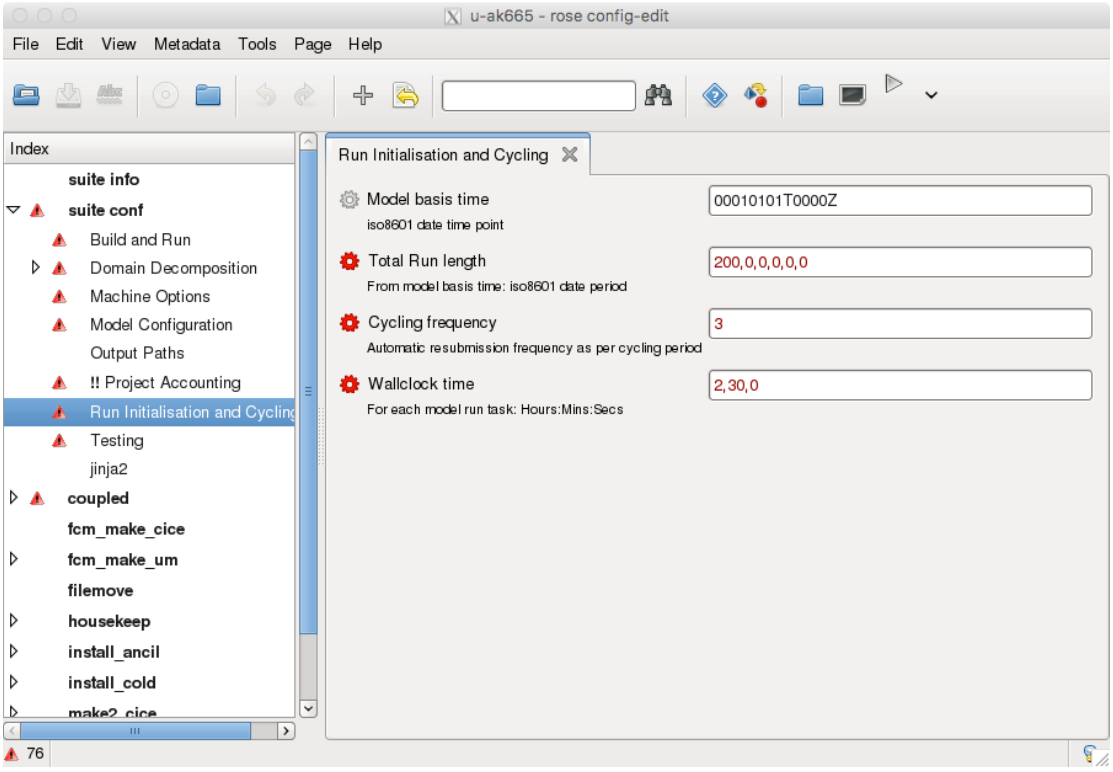
Under suite conf, Build and Run, check that the Build CICE, Build MOM, Build UM, Run Reconfiguration and Run Model are all set to true (assuming this is a fresh run), as per this screenshot:



Check that the NCI queue is correctly set, normal or express, as in this illustration:



Check the timespan to be simulated, cycling frequency and wall clock time:



Submitting a suite

Change to the roses suite directory e.g., `~/roses/u-ai147` (if not already there).

A suite can then be initiated using the rose command:

```
rose suite-run
```

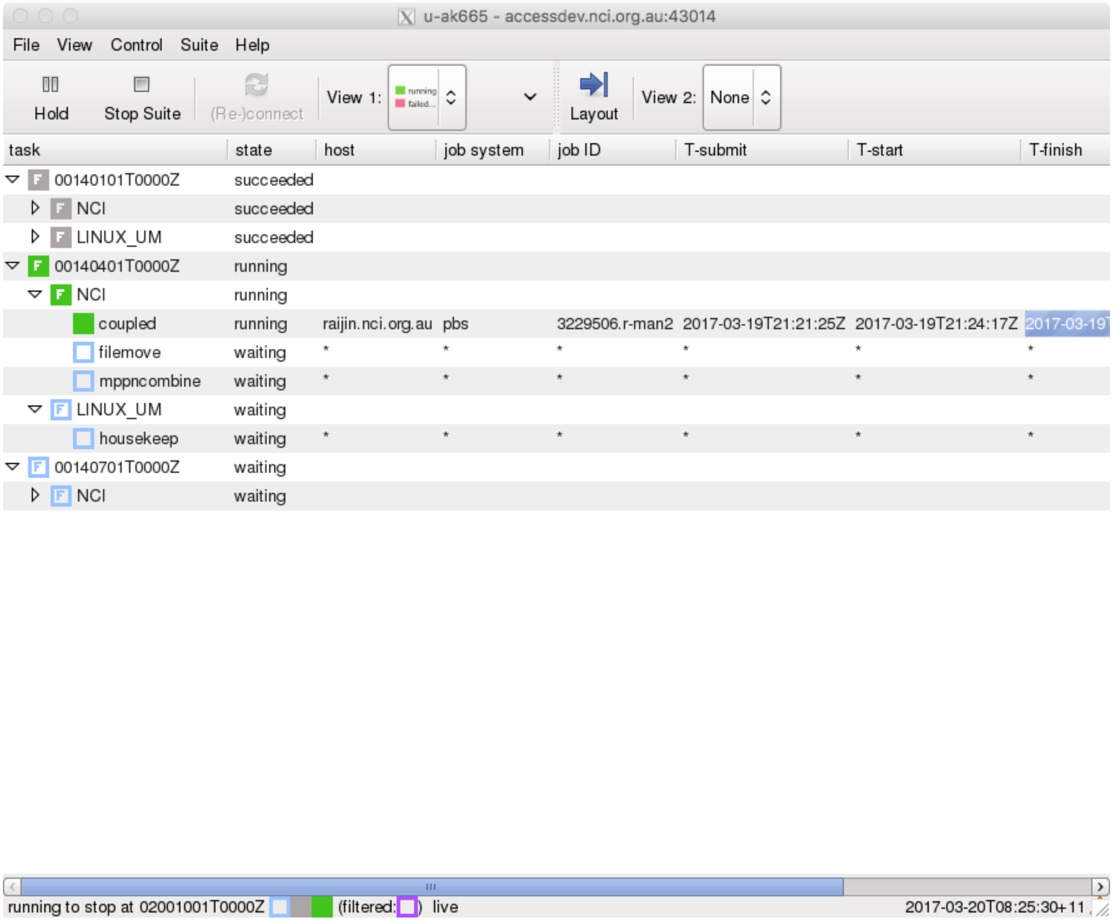
This will generate a GUI that shows the suite being processed. This GUI can also be accessed at a later stage by the command `rose suite-gcontrol` or more generally:

```
rose suite-gcontrol [OPTIONS] --name=SUITE-NAME [--EXTRA-ARGS …]
```

For further information, refer:

http://metomi.github.io/rose/doc/rose-command.html#rose-suite-gcontrol

An illustrative screenshot of a working model run:



Job status, Job history

The status of a running job on raijin can be checked using:

```
nqstat
```

Alternative commands are also provided from the `rose suite-run` command output, e.g.:

```
[INFO] To view suite daemon contact information:
[INFO]  $ cylc get-suite-contact u-ak665
[INFO]
[INFO] Other ways to see if the suite is still running:
[INFO]  $ cylc scan -n '\bu-ak665\b' accessdev.nci.org.au
[INFO]  $ cylc ping -v --host=accessdev.nci.org.au u-ak665
[INFO]  $ ssh accessdev.nci.org.au "pgrep -a -P 1 -fu $USER
'cylc-r.* \bu-ak665\b'"
```

In general, `rose suite-gcontrol` will provide an overview of the status of a suite whilst it is running. Any technical problems with the job will then show up, such as compiler or file permission issues. These will have to be resolved in order to successfully complete the model simulation.

Model output can be checked whilst the job is running to confirm that the model is behaving sensibly. Output from a model run is discussed further in the next section.

NCI also provide a web based interface to check on the history of your jobs:

https://usersupport.nci.org.au/report/job_history

NB: This is not the model output, just the job history.

Stopping a job

Should the need arise, a job can be killed. From the suite directory:

```
rose suite-shutdown
```

Otherwise append the name switch, e.g.:

```
rose suite-shutdown --name=u-ai147
```

(ref: http://metomi.github.io/rose/doc/rose-rug-suite-control.html#rose-suite-shutdown)

MODEL OUTPUT

Assuming the model runs without problems, then a series of files are generated and saved that contain the model output. Some of these are NetCDF files, some are UKMO UM format (for which there are tools available to assist with looking at the data as well as converting some or all of the fields to NetCDF format).

The model results are stored to a raijin directory called `short`, initially in, for example:

```
/short/$PROJECT/$USER/cylc-run/u-ai147/share/data/History_Data/
```

where $PROJECT is the project you are working on and $USER is your NCI username.

This output is then automatically moved to another folder, also on `short`, called `archive`, e.g.:

```
/short/$PROJECT/$USER/archive/ai147/history
```

Note that storage on `short` is intended as short-term storage (NB: this is not backed up). For longer-term, backed-up storage, output needs to be transferred to a different location (refer to local technical support for further information).

The `history` folder contains four folders with data for each of the sub-models: `atm`, `cpl`, `ice`, `ocn`.

The `atm` contains output from the UM, and is in the UKMO's format, while `ice` and `ocn` contain NetCDF files. `cpl` may or may not have anything in it.

The `atm` files are, for example, daily and monthly mean results (frequency and contents are set by the rose suite). The contents of these can be examined with, for example, `xconv`, a utility program (on raijin, path `/projects/access/bin/xconv;` an alias can be created to make this easier to use from the user's current working directory).

UM atm results

Or how to use `xconv` (some assistance from your local technical support may be needed to get this working from your raijin directory).

Output from the UM is in a particular format that can be viewed with `xconv` and manipulated in various ways, including conversion to NetCDF. Documentation for this program can be found at:

http://cms.ncas.ac.uk/documents/xconv/

Outputs from the UM are specified using the STASHmaster file, which is linked to a particular UM version. Variables are selected and specified as part of the suite configuration. As such, this can be achieved through the Rose GUI. Some files may be output daily, monthly, some quarterly and some are accumulative and some mean fields, all depending on the variable and the specifications set-up for that variable.

There are also a range of other options for looking at and extracting information from the output files such as NetCDF utilities, Python utilities, Ferret and Matlab.

Locate the data on raijin, e.g.:

```
cd /short/$PROJECT/$USER/cylc-run/u-
ai147/share/data/History_Data
```

This is used while the job is running. Otherwise, eg.:

```
cd /short/$PROJECT/$USER/archive/ai147/history/
```

which holds model output for each of the sub-models.

Select a file to examine, e.g., from the `atm` directory:

```
xconv ai147a.pa0001jan
```

which starts the `xconv` GUI.

There are (for this example) 10 classes or groups of files, labelled pa, pb etc, each of which contains output for a group of variables. An example of the contents follows for the ai147 suite (each screen shot is from an `xconv` GUI listing), but the file contents will vary depending on how particular suites were organised. The grouping of these variables relates to their time frequency and level dimensions. A few selected variables are highlighted along with preliminary comments as being key model evaluation variables (tas, pr, psl, clt and ua). See also Appendix A.

NB: This is only an introduction to the topic of UM model output and is NOT a definitive guide to variables and their meaning as there is a degree of overlap and lack of clarity around some of these details. It is anticipated that this will be verified over time with the help of feedback from others.

pa files contain:

0	:	192	144	1	31	LARGE SCALE RAINFALL RATE	KG/M2/S
1	:	192	144	1	31	CONVECTIVE RAINFALL RATE	KG/M2/S
2	:	192	144	1	31	TOTAL PRECIPITATION RATE	KG/M2/S
3	:	192	144	52	31	UPDRAUGHT MASS FLUX (Pa/s)	
4	:	192	144	52	31	U INCREMENT MS-2 (P GRID)	
5	:	192	144	52	31	V INCREMENT MS-2 (P GRID)	
6	:	192	144	1	31	SHALLOW CONVECTION INDICATOR	
7	:	192	144	1	31	MID LEVEL CONVECTION INDICATOR	
8	:	192	144	1	31	SOIL MOISTURE CONTENT	
9	:	360	180	1	31	RIVER WATER STORAGE	KG
10	:	192	145	2	31	U COMPNT OF WIND ON P LEV/UV GRID	
11	:	192	145	2	31	V COMPNT OF WIND ON P LEV/UV GRID	
12	:	192	145	2	31	HEAVYSIDE FN ON P LEV/UV GRID	
13	:	192	144	1	31	SURFACE TEMPERATURE AFTER TIMESTEP	
14	:	192	144	1	31	FRAC OF SEA ICE IN SEA AFTER TSTEP	
15	:	192	144	1	31	SEA ICE DEPTH (MEAN OVER ICE)	M

SURFACE TEMPERATURE AFTER TIMESTEP is STASH output 'm01s00i024' with TDAYM time_name, where s00 and i024 refer to section and item numbers that can be viewed and selected or unselected with the rose GUI. Similar output is included in pj files and pm (mean) files for different time_names. Here, it is the daily mean surface temperature for each day of the month (with this suite running on the Gregorian calendar), output for each month of each year of the model simulation at the model global grid box resolution (1.875 by 1.25 degrees). This appears to be the 'skin' temperature. TDAYM is a time mean, daily at model timesteps, at regular intervals.

Another variable is used for the near-surface air temperature, the 1.5m air temperature. This is taken as corresponding to tas, the CMIP variable name for near_surface_air_temperature.

TOTAL PRECIPITATION RATE – daily time mean field for total precipitation (column) for each grid box.

U INCREMENT MS-2 (P GRID) – daily time mean field on 52 hybrid height levels.

U COMPNT OF WIND ON P LEV/UV GRID – daily time mean field on two pressure height levels, 850 mbar and 200 mbar.

pb files contain:

0	: 192	145	1	91	THETA ON PV=+/-2 SURFACE
1	: 192	144	1	91	PRESSURE AT MEAN SEA LEVEL
2	: 192	145	1	91	U COMPNT OF WIND ON P LEV/UV GRID
3	: 192	145	1	91	V COMPNT OF WIND ON P LEV/UV GRID
4	: 192	145	17	91	GEOPOTENTIAL HEIGHT ON P LEV/UV GRID
5	: 192	145	7	91	HEAVYSIDE FN ON P LEV/UV GRID

PRESSURE AT MEAN SEA LEVEL – daily time mean field for each day for three months of each grouped timestep (i.e., the cycling frequency, 3 months in this example).

U COMPNT OF WIND ON P LEV/UV GRID – daily time mean field at 500 mbar for three months of each grouped timestep (3 months).

pc files contain:

0	: 192	145	1	364	10 METRE WIND SPEED ON B GRID
1	: 192	144	1	364	GEOPOTENTIAL HEIGHT ON P LEV/P GRID
2	: 192	144	1	364	PRESSURE AT MEAN SEA LEVEL
3	: 192	145	6	364	U COMPNT OF WIND ON P LEV/UV GRID
4	: 192	145	6	364	V COMPNT OF WIND ON P LEV/UV GRID
5	: 192	145	6	364	W COMPNT OF WIND ON P LEV/UV GRID
6	: 192	145	6	364	TEMPERATURE ON P LEV/UV GRID
7	: 192	145	6	364	SPECIFIC HUMIDITY ON P LEV/UV GRID
8	: 192	145	6	364	HEAVYSIDE FN ON P LEV/UV GRID
9	: 192	145	1	364	Stash code = 30455
10	: 192	145	1	364	Stash code = 30456
11	: 192	145	6	364	Stash code = 30457
12	: 192	145	6	364	Stash code = 30458

PRESSURE AT MEAN SEA LEVEL - on global grid four times per day for three months (e.g., counts of 360, 364 or 368).

U COMPNT OF WIND ON P LEV/UV GRID - on global grid four times per day for three months on 6 pressure levels (925, 850, 700, 500, 300, and 200 mbar).

pd files contain:

0	:	192	144	1	30	NET DOWN SURFACE SW FLUX: SW TS ONLY
1	:	192	144	1	30	NET DN SW RAD FLUX:OPEN SEA:SEA MEAN
2	:	192	144	1	30	CLEAR-SKY (II) DOWN SURFACE SW FLUX
3	:	192	144	1	30	CLEAR-SKY (II) UP SURFACE SW FLUX
4	:	192	144	1	30	TOTAL DOWNWARD SURFACE SW FLUX
5	:	192	144	1	30	NET DN SW O SEA FLX BLW 690NM:SEA MN
6	:	192	144	1	30	NET DOWN SURFACE LW RAD FLUX
7	:	192	144	1	30	NET DN LW RAD FLUX:OPEN SEA:SEA MEAN
8	:	192	144	1	30	TOTAL CLOUD AMOUNT IN LW RADIATION
9	:	192	144	1	30	DOWNWARD LW RAD FLUX: SURFACE
10	:	192	144	1	30	CLEAR-SKY (II) DOWN SURFACE LW FLUX
11	:	192	144	1	30	SURFACE HEAT FLUX W/M2
12	:	192	145	1	30	10 METRE WIND U-COMP B GRID
13	:	192	145	1	30	10 METRE WIND V-COMP B GRID
14	:	192	145	1	30	10 METRE WIND SPEED ON B GRID
15	:	192	144	1	30	SFC SH FLX FROM OPEN SEA:SEA MN W/M2
16	:	192	144	1	30	SURFACE LATENT HEAT FLUX W/M2
17	:	192	144	1	30	TEMPERATURE AT 1.5M
18	:	192	144	1	30	TEMPERATURE AT 1.5M
19	:	192	144	1	30	TEMPERATURE AT 1.5M
20	:	192	144	1	30	SPECIFIC HUMIDITY AT 1.5M
21	:	192	144	1	30	RELATIVE HUMIDITY AT 1.5M
22	:	192	144	9	30	CANOPY EVAPORATION ON TILES
23	:	192	144	1	30	EVAP FROM SOIL SURF : RATE KG/M2/S
24	:	192	144	1	30	EVAP FROM CANOPY : RATE KG/M2/S
25	:	192	144	1	30	TURBULENT MIXING HT AFTER B.LAYER m
26	:	192	144	1	30	STABLE BL INDICATOR
27	:	192	144	1	30	WELL_MIXED BL INDICATOR
28	:	192	144	1	30	DECOUPLED SC. OVER CU. INDICATOR
29	:	192	144	1	30	CUMULUS-CAPPED BL INDICATOR
30	:	192	144	1	30	TOA OUTGOING LW RAD AFTER B.LAYER
31	:	192	145	1	30	Stash code = 3365
32	:	192	145	1	30	Stash code = 3366
33	:	192	145	1	30	Stash code = 3367
34	:	192	145	1	30	Stash code = 3367
35	:	192	144	1	30	MID LEVEL CONVECTION INDICATOR
36	:	192	144	1	30	SNOW MASS AFTER HYDROLOGY KG/M2
37	:	192	144	1	30	CANOPY WATER CONTENT
38	:	192	144	4	30	SOIL MOISTURE CONTENT IN A LAYER
39	:	192	144	1	30	PRESSURE AT MEAN SEA LEVEL
40	:	192	144	52	30	PRESSURE AT RHO LEVELS AFTER TS
41	:	192	144	52	30	PRESSURE AT THETA LEVELS AFTER TS

This set includes daily mean fields for radiation fluxes, 10 m wind speeds, 1.5 m temperatures and humidity etc., for the number of days in the month (Gregorian calendar).

pe files contain:

0	:	192	144	1	30	SURFACE TOTAL MOISTURE FLUX KG/M2/S
1	:	192	145	17	30	U COMPNT OF WIND ON P LEV/UV GRID
2	:	192	145	17	30	V COMPNT OF WIND ON P LEV/UV GRID
3	:	192	145	17	30	TEMPERATURE ON P LEV/UV GRID
4	:	192	145	17	30	SPECIFIC HUMIDITY ON P LEV/UV GRID
5	:	192	145	17	30	OMEGA ON P LEV/UV GRID
6	:	192	145	17	30	UQ ON P LEV/UV GRID
7	:	192	145	17	30	VQ ON P LEV/UV GRID
8	:	192	145	17	30	QOM ON P LEV/UV GRID
9	:	192	145	17	30	HEAVYSIDE FN ON P LEV/UV GRID

U COMPNT OF WIND ON P LEV/UV GRID, with 17 pressure levels (1000 through to 10 mbar) on global grid, daily mean fields.

pf files contain:

0	:	192	144	1	91	INCOMING SW RAD FLUX (TOA): ALL TSS
1	:	192	144	1	91	OUTGOING SW RAD FLUX (TOA)
2	:	192	144	1	91	CLEAR-SKY (II) UPWARD SW FLUX (TOA)
3	:	192	144	1	91	CLEAR-SKY (II) UPWARD LW FLUX (TOA)
4	:	192	144	1	91	Stash code = 2330
5	:	192	144	1	91	Stash code = 2331
6	:	192	144	1	91	Stash code = 2333
7	:	192	144	1	91	Stash code = 2334
8	:	192	144	1	91	TOA OUTGOING LW RAD AFTER B.LAYER
9	:	192	144	1	91	SNOW AMOUNT OVER LAND AFT TSTP KG/M2
10	:	192	144	1	91	FRAC OF SEA ICE IN SEA AFTER TSTEP

pg files contain:

0	: 192	144	63	3	EASTWARD FLUX - SPECTRAL PSEUDOMOM.
1	: 192	145	63	3	SOUTHWARD FLUX - SPECTRAL PSEUDOMOM.
2	: 192	144	63	3	WESTWARD FLUX - SPECTRAL PSEUDOMOM.
3	: 192	145	63	3	NORTHWARD FLUX - SPECTRAL PSEUDOMOM.
4	: 192	144	63	3	EASTWARD FORCE FROM SPECTRAL GW
5	: 192	145	63	3	NORTHWARD FORCE FROM SPECTRAL GW
6	: 1	145	36	3	E. FLUX SPECTRAL PSEUDOMOM. P LEVS
7	: 1	145	36	3	W. FLUX SPECTRAL PSEUDOMOM. P LEVS
8	: 1	145	36	3	EAST. FORCE FROM SPECTRAL GW P LEVS
9	: 192	144	85	3	U-ACCEL FROM SATURATED STRESS
10	: 192	145	85	3	V-ACCEL FROM SATURATED STRESS
11	: 192	144	85	3	X COMPONENT OF GW SATURATION STRESS
12	: 192	145	85	3	Y COMPONENT OF GW SATURATION STRESS
13	: 1	145	36	3	X COMPT OF GRAV. WAVE STRESS P LEVS
14	: 1	145	36	3	U-ACCEL FROM SATURATED STRESS P LEVS
15	: 1	145	36	3	U COMPNT OF WIND ON P LEV/UV GRID
16	: 1	145	36	3	V COMPNT OF WIND ON P LEV/UV GRID
17	: 1	145	36	3	W COMPNT OF WIND ON P LEV/UV GRID
18	: 1	145	36	3	TEMPERATURE ON P LEV/UV GRID
19	: 1	145	36	3	SPECIFIC HUMIDITY ON P LEV/UV GRID
20	: 1	145	36	3	HEAVYSIDE FN ON P LEV/UV GRID
21	: 1	145	36	3	RESIDUAL MN MERID. CIRC. VSTARBAR
22	: 1	145	36	3	RESIDUAL MN MERID. CIRC. WSTARBAR
23	: 1	145	36	3	ELIASSEN-PALM FLUX (MERID. COMPNT)
24	: 1	145	36	3	ELIASSEN-PALM FLUX (VERT. COMPNT)
25	: 1	145	36	3	DIVERGENCE OF ELIASSEN-PALM FLUX
26	: 1	145	36	3	MERIDIONAL HEAT FLUX
27	: 1	145	36	3	MERIDIONAL MOMENTUM FLUX
28	: 192	144	85	3	U COMPNT OF WIND AFTER TIMESTEP
29	: 192	145	85	3	V COMPNT OF WIND AFTER TIMESTEP
30	: 192	144	85	3	AGE OF AIR IN SECONDS

U COMPNT OF WIND AFTER TIMESTEP maps to CMIP field ua, eastward_wind. It is from the domain DALLRH, time_domain T6HMONM, index 9cf8eaf6. DALLRH is for a variable derived on model rho levels (Charney-Phillips Grid) and provides for the modelled 85 atmospheric levels (hybrid height) for each of the land and sea grid points. T6HMONM is a time mean, in this case monthly time intervals sampled every 6 hours and output every month, i.e., a monthly mean field, not daily.

The U COMPNT OF WIND ON P LEV/UV GRID is arranged differently from the other instances, being zonal bands on 36 pressure levels (1000 through 0.3 mbar) and is a monthly mean field (hence 3 sets of values) rather than daily.

NB: Although the xy axes are listed as, e.g., 192 by 145 or 192 x 144, they do not necessarily have the same origin and, instead, have slightly different start points, such as 0 or 0.9375, -90 or -89.275 (i.e., grid box edges or grid box centers).

ph files contain: Empty in this example (i.e., no output called for by this particular suite configuration).

pi files contain:

0	:	360	180	1	2	RIVER WATER STORAGE KG
1	:	192	144	1	1	FRACTION OF LAND
2	:	192	144	1	1	SNOW MASS AFTER HYDROLOGY KG/M2
3	:	192	144	1	1	CANOPY WATER CONTENT
4	:	192	144	4	1	SOIL MOISTURE CONTENT IN A LAYER
5	:	192	144	1	1	TOTAL KE PER UA WITH W RHO GRID
6	:	192	144	1	1	column integral cvT per unit area
7	:	192	144	1	1	column integral gr per unit area
8	:	192	144	1	1	LAND MASK (No halo) (LAND=TRUE)
9	:	192	144	1	1	OROGRAPHY (/STRAT LOWER BC)

pj files contain:

0	:	192	144	1	91	TEMPERATURE AT 1.5M
1	:	192	144	1	91	TEMPERATURE AT 1.5M
2	:	192	144	1	91	TEMPERATURE AT 1.5M
3	:	192	144	1	91	TOA OUTGOING LW RAD AFTER B.LAYER
4	:	192	144	1	91	TOTAL PRECIPITATION RATE KG/M2/S
5	:	192	145	3	91	U COMPNT OF WIND ON P LEV/UV GRID
6	:	192	145	3	91	V COMPNT OF WIND ON P LEV/UV GRID
7	:	192	144	1	91	SURFACE TEMPERATURE AFTER TIMESTEP

SURFACE TEMPERATURE AFTER TIMESTEP here is STASH output 'm01sooi024' with TDAYM time_name, but with 3-month grouped timesteps rather than single months, and data is daily mean field at 12-noon.

pk files contain:

0	:	192	144	1	240	TOTAL PRECIPITATION RATE KG/M2/S

A single variable, TOTAL PRECIPITATION RATE, UM grid box resolution 192 by 144 (1.875 long. by 1.25 lat.) single value per grid box (total column precipitation) for 240 values (0.125 day time mean field, or mean taken 8 times per day) for a 30-day month in this example, or 248 values for a 31-day month.

pm files contain:

251 outputs at monthly intervals for mean fields, where the period over which the means are calculated is set in the model configuration. Details of the settings and calculation approach for mean fields is covered in the UM documentation paper C05 "Control of Means Calculations".

psl matches to SURFACE PRESSURE AFTER TIMESTEP, is a UPMEAN field, that is, a monthly mean field, so a single value for each grid box for each month (item 19).

pr is a UPMEAN field that matches to TOTAL PRECIPITATION RATE (item 179).

clt is a UPMEAN field (item 16), BULK CLOUD FRACTION IN EACH LAYER, with 85 levels (hybrid height).

ua (item 220), U COMPNT OF WIND ON P LEV/UV GRID.

UPMEAN is a dump store with climate mean set by the STASH usage profile caeb5f17.

ocn results

Only a very brief outline of the ocean model results is provided here.

Output comprises 3 classes of NetCDF files, daily, monthly and scalar (plus a fourth for ocean biogeochemistry from WOMBAT for the CABLE configuration).

daily files contain:

```
0   : 360   300   0   31   Conservative temperature
1   : 360   300   0   31   effective sea level (eta_t + patm/(rho0*g)) on T cells
2   : 0     0     0   31   Start time for average period
3   : 0     0     0   31   End time for average period
4   : 0     0     0   31   Length of average period
5   : 2     0     0   31   time axis boundaries
```

monthly files contain:

124 variables, including temperature and salinity data.

scalar files contain:

32 values for ocean scalar variables at the end of each month (test suite output has zeroes for all of these?).

ice results

Only an extremely brief outline of the sea-ice model results is provided here.

Two types of NetCDF files, year-month numbered and year-month-day, are output, where day is 10, 20 or 30.

year-month numbered files containing 110 variables.

year-month-day numbered files with 55 variables.

MODEL INPUT

A number of files need to made available to ACCESS to create the working environment for the particular simulation run. Some introductory comments are provided in this section; more detailed information will require delving in to the documentation associated with each component as well as related websites; refer Appendix B for some of these links.

UM Science Settings

Managed as part of the suite configuration, the UM science settings are high level settings that control such things as which planet is being modelled, orbital parameters etc., the carbon cycle options (e.g., fixed concentrations or interactive carbon cycle), settings related to GHGs and other radiative forcing components and so on.

Land Surface Scheme Settings

The model configuration also has a section for JULES, the land surface scheme or, alternatively for CABLE. In the longer-term it is expected that these modules will be interchangeable modules, but this is not currently the case.

CICE and MOM settings

Not discussed here.

Initialisation files

There are a number of files used to start the model (unless it's a full spin-up run), e.g.:

- a2i.nc
- i2a.nc
- o2i.nc
- monthly.sstsss.nc
- ocean_temp_salt.res.nc

These are the files given under the heading install_cold in the rose suite and are located in the directory $CPL_RUNDIR.

Ancillary files

There is also a rose configuration section install_ancil, which has the path, for example, $ROSE_DATA/etc, with the file um_ancils_gl. This file is a script that provides links to multiple data files, with data for a variety of model inputs including land-sea mask, orography, ozone and aerosol information, land-surface albedo and emissions related to atmospheric chemistry plus others.

APPENDIX A – MODEL OUTPUT

Mapping UM fields to CF fields

The variables output from the UM are named according to the UKMO's own naming conventions; these names are not the same as the CMIP CF field names. Mapping model output to meet the CMIP requirements is a major exercise, addressed through the Climate Model Output Rewrite (CMOR) process (http://helene.llnl.gov/cmor).

This appendix maps selected atmospheric variables, from CMIP CF names to the UM diagnostic output variables, but is still under development.

Table 1: Key atmospheric variables

VARIABLE NAME	CF STANDARD NAME / CF LONG NAME	UM NAME
tas	air temperature Near-Surface Air Temperature	
t500	temperature at 500 hPa. (from ta)	
u500	zonal wind at 500 hPa (from ua)	
r500	relative humidity at 500 hPa (from hur)	
psl	air_pressure_at_sea_level Sea Level Pressure (not, in general, the same as surface pressure)	
rsds	surface_downwelling_shortwave_flux_in_air Surface Downwelling Shortwave Radiation	

VARIABLE NAME	CF STANDARD NAME/ CF LONG NAME	UM NAME
rlut	toa_outgoing_longwave_flux TOA Outgoing Longwave Radiation	
rsut	toa_outgoing_shortwave_flux TOA Outgoing Shortwave Radiation	
crf	cloud radiative forcing at TOA - the difference between the RF for clear-sky and all-sky conditions. A derived field, see text.	
prw	atmosphere_water_vapor_content Water Vapor Path (vertically integrated through the atmospheric column)	
pr	precipitation_flux Precipitation (at surface; includes both liquid and solid phases from all types of clouds (both large-scale and convective)	
evspsbl	water_evaporation_flux Evaporation	
clt	cloud_area_fraction Total Cloud Fraction (for the whole atmospheric column, as seen from the surface or the top of the atmosphere. Includes both large-scale and convective cloud.)	

Following details from CMIP5 CMOR table (https://github.com/PCMDI/cmip5-cmor-tables) for selected atmospheric variables:

ts - surface temperature, meaning skin temperature, or SST for open ocean.

tas – near-surface air temperature (2m air temperature) tasmin - Daily Minimum Near-Surface Air Temperature (monthly mean of the daily-minimum near-surface air temperature).

tasmax - Daily Maximum Near-Surface Air Temperature (monthly mean of the daily-maximum near-surface air temperature).

ps - surface_air_pressure, Surface Air Pressure, not, in general, the same as mean sea-level pressure.

pr – precipitation_flux, Precipitation, at surface; includes both liquid and solid phases from all types of clouds (both large-scale and convective).

uas - eastward_wind, Eastward Near-Surface Wind.

vas - northward_wind, Northward Near-Surface Wind

sfcWind - wind_speed, Near-Surface Wind Speed. This is the mean of the speed, not the speed computed from the mean u and v components of wind.

hurs - relative_humidity, Near-Surface Relative Humidity. This is the relative humidity with respect to liquid water for T> 0 C, and with respect to ice for T<0 C.

huss - specific_humidity, Near-Surface Specific Humidity.

evspsbl - water_evaporation_flux, Evaporation. At surface; flux of water into the atmosphere due to conversion of both liquid and solid phases to vapor (from underlying surface and vegetation).

rlds - surface_downwelling_longwave_flux_in_air, Surface Downwelling Longwave Radiation.

rlus - surface_upwelling_longwave_flux_in_air, Surface Upwelling Longwave Radiation.

rsus - surface_upwelling_shortwave_flux_in_air, Surface Upwelling Shortwave Radiation.

rsdt - toa_incoming_shortwave_flux, TOA Incident Shortwave Radiation (at the top of the atmosphere).

rlutcs – toa_outgoing_longwave_flux_assuming_clear_sky, TOA Outgoing Clear-Sky Longwave Radiation.

rsutcs - toa_outgoing_shortwave_flux_assuming_clear_sky, TOA Outgoing Clear-Sky Shortwave Radiation

ta - air_temperature, Air Temperature. Dimensions: longitude, latitude, plevs, time.

ua - eastward_wind, Eastward Wind. Dimensions: longitude, latitude, plevs, time.

va - northward_wind, Northward Wind. Dimensions: longitude, latitude, plevs, time.

hus - specific_humidity, Specific Humidity. Dimensions: longitude, latitude, plevs, time.

hur - relative_humidity, Relative Humidity. Dimensions: longitude, latitude, plevs, time.

crf – derived from toa energy balance, difference between all-sky and clear-sky toa outgoing LW and SW radiation (To Be Confirmed):

crf = (rlut + rsut) – (rlutcs +rsutcs)

Reference information:

https://github.com/PCMDI/cmip5-cmor-tables/blob/master/Tables/CMIP5_Amon

APPENDIX B - USER GUIDES, WIKIS ETC

A collection of links to additional resources.

Getting started:

http://nci.org.au/user-support/training/training-exercises/starting-nci/

http://climate-cms.unsw.wikispaces.net/Introduction+to+UMUI

https://code.metoffice.gov.uk/doc/um/latest/um-training/index.html

Accessdev

https://accessdev.nci.org.au/trac

https://accessdev.nci.org.au/trac/wiki/GettingConnected

https://accessdev.nci.org.au/trac/wiki/access

https://accessdev.nci.org.au/trac/wiki/access/AccessModelExperimentLibrary

https://accessdev.nci.org.au/trac/wiki/access/UserGuides

NCI useful links

http://nci.org.au/user-support/getting-help/help-resources/

MetOffice account setup

https://code.metoffice.gov.uk/auth/UI/Login?goto=https%3A%2F%2Fcode.metoffice.gov.uk%2Ftrac%2Fhome&realm=mo-realm-1&gx_charset=UTF-8

https://code.metoffice.gov.uk/trac/home/wiki/FAQ

Rose User Guide

http://metomi.github.io/rose/doc/rose-rug-brief-tour.html

CYLC Guide

http://cylc.github.io/cylc/documentation.html

FMC User Guide

http://metomi.github.io/fcm/doc/user_guide/introduction.html

UM documentation

http://cms.ncas.ac.uk/wiki/Docs/MetOfficeDocs

http://climate-cms.unsw.wikispaces.net/Unified+Model

https://code.metoffice.gov.uk/doc/um/vn10.6/umdp.html (password required).

STASH tutorial, http://www.ukca.ac.uk/wiki/index.php/UKCA_%26_UMUI_Tutorial_3

MOM

http://www.mom-ocean.org/web/docs/project/user_guide

CICE

http://oceans11.lanl.gov/trac/CICE

OASIS Coupler

https://verc.enes.org/oasis

REFERENCES

[1] Bi, D., et al., (2013a) The ACCESS coupled model: description, control climate and evaluation, AMOJ, 63, 41-64.

[2] Puri, K., et al., (2013) Implementation of the initial ACCESS numerical weather prediction system, AMOJ, 63, 265–284.