



2023 ACCESS Workshop Training Day

Twitter: [@ACCESS_NRI](https://twitter.com/ACCESS_NRI)

[#ACCESSCommunity23](https://twitter.com/ACCESS_NRI)

Acknowledgement of Country

We at ACCESS-NRI acknowledge the Traditional Owners of the land on which our research infrastructure and community operate across Australia and pay our respects to Elders past and present. We recognise the thousands of years of accumulated knowledge and deep connection they have with all the Earth systems we simulate.

Today we are connecting from the lands of the Ngunnawal and Ngambri people.



Training Materials



Training materials and links (slides from today will be uploaded as well)

Session 1

Working with ACCESS-CM2 from NCI's ARE

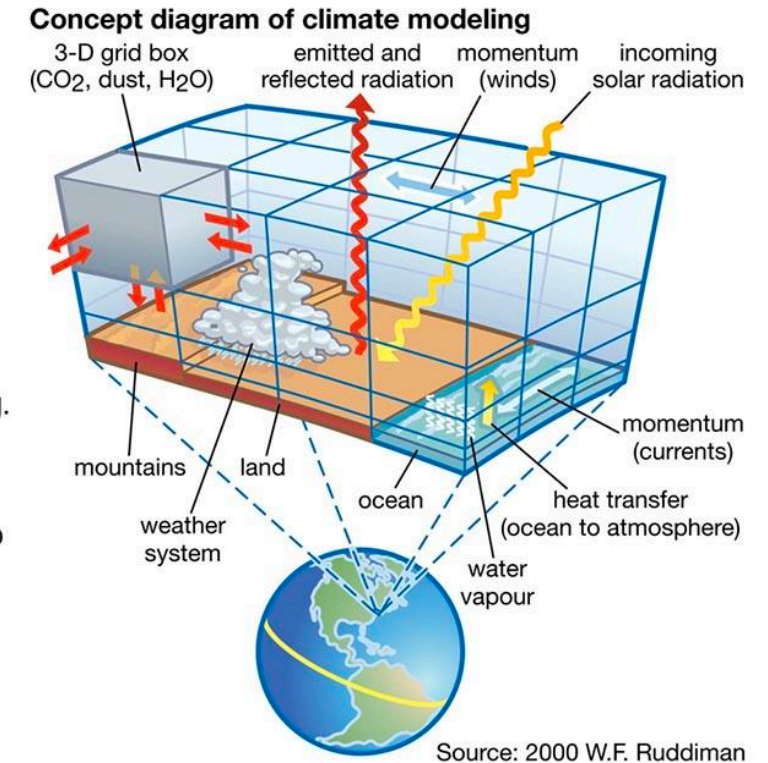
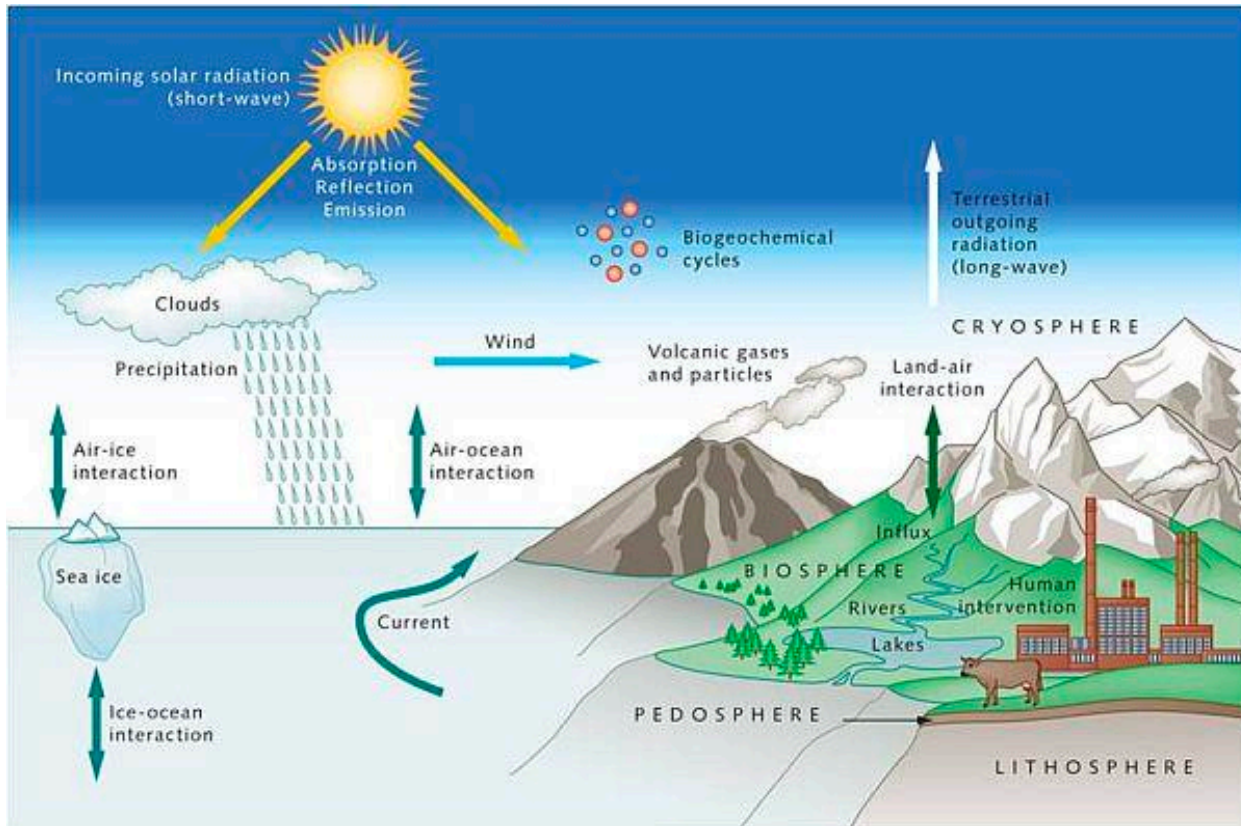
9:30 – 12:30p



ACCESS Models

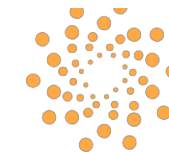


What is a climate model?



- Numerical simulation of important physical processes involving the land, atmosphere, ocean, ice, etc, of the globe.
- For scientific understanding.
- Results are given also where and when there is no monitoring.

Source: <https://www.climatechangeinaustralia.gov.au/en/learning-support/climate-models/theory-and-physics/>

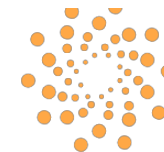
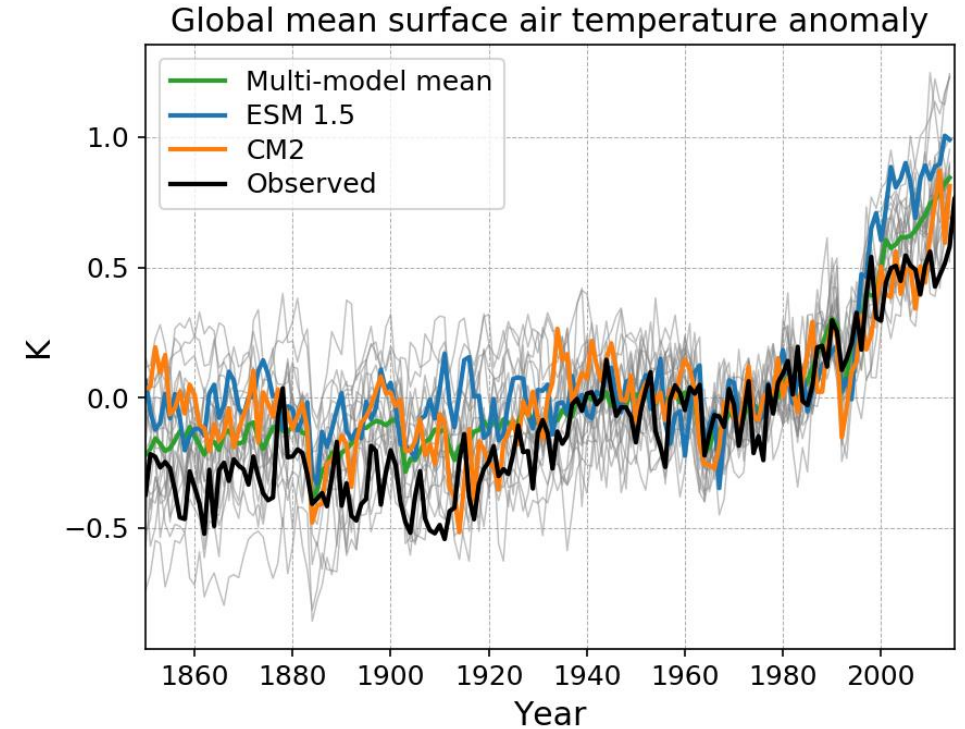


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Climate model uses

- Seasonal and decadal prediction
- Climate projection & detection/attribution
- Research into climate processes
- Compared to Numerical Weather Prediction (NWP)
 - Boundary conditions and forcing are more important
 - Atmospheric initial state is less important
 - Slow physical processes are more important

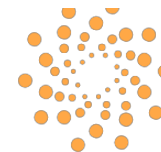


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Earth System Models

- Traditional climate models include atmosphere, ocean, land, sea-ice
- Earth System Models add
 - Carbon and other biogeochemical cycles
 - Dynamic vegetation
 - Atmospheric chemistry and ozone photochemistry
 - Dynamic ice sheets
- Allows extra feedbacks and also more interesting experiment design



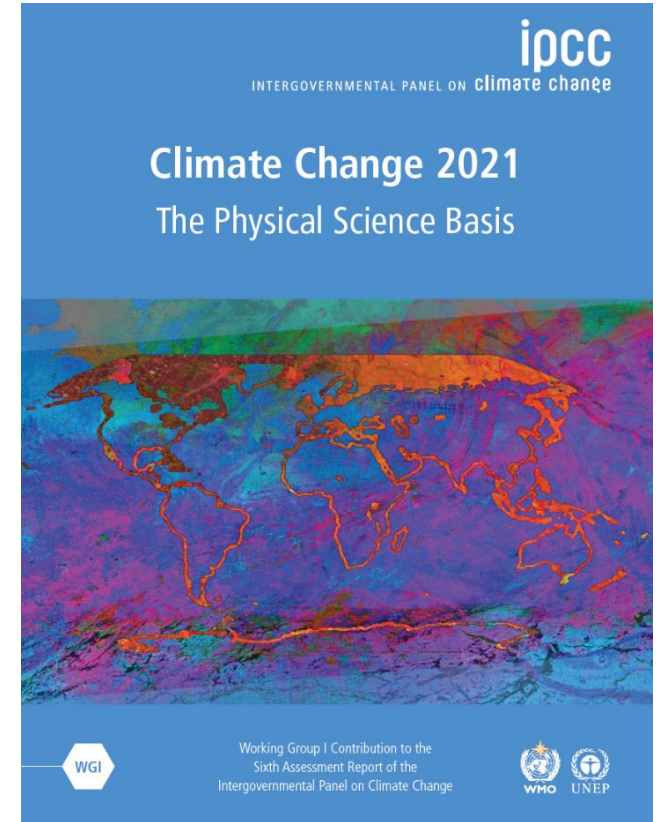
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Coupled Model Intercomparison Project (CMIP6)

- Overseen by World Climate Research Programme's (WCRP) Working Group on Coupled Modelling (WGCM)
- Coordinated model experiments to address 3 broad questions
 - How does the Earth system respond to forcing?
 - What are the origins and consequences of systematic model biases?
 - How can we assess future climate changes given internal climate variability, predictability, and uncertainties in scenarios?

Modelling basis of the IPCC 6th Assessment (AR6) WG1 report



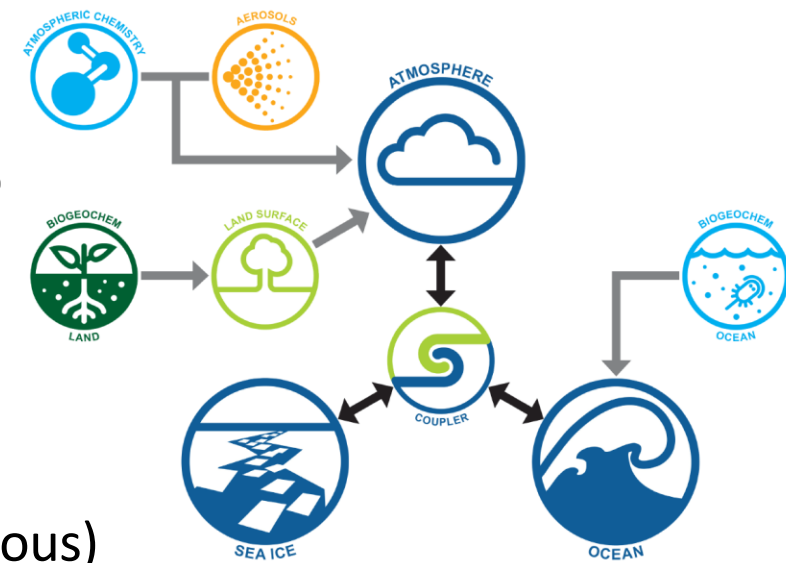
ACCESS configurations for CMIP6

- ACCESS-ESM 1.5

- Includes **carbon cycle** (CABLE and WOMBAT)
- CABLE land surface with CASA-CNP (nitrogen and phosphorous)
- Older atmosphere from CMIP5 (ACCESS 1.3, UM vn7.3), MOM5, CICE4
- Less expensive to run

- ACCESS-CM2

- Physical model only – **no carbon cycle**
- New atmospheric model with more sophisticated chemistry/aerosol/cloud interactions
- UM vn10.6+ (GA7.1 configuration), MOM5, CICE5
- Same as HadGEM3-GC3.1 atmosphere but with CABLE replacing JULES

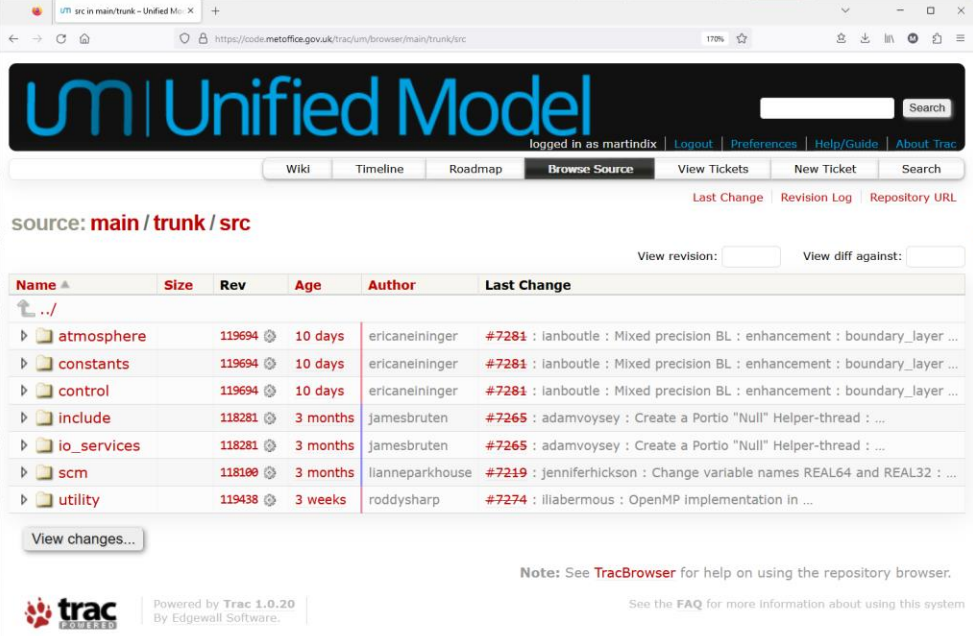


ACCESS development plans

- ACCESS ESM3 for CMIP7?
 - GC5 atmosphere
 - Updated CABLE
 - POP-LUC (dynamic vegetation)
 - BLAZE (fire)
 - ACCESS-OM3 (MOM6, CICE6, WW3)
 - NUOPC coupler?
- Improved reproducibility, archiving, post-processing and evaluation
 - NRI release and model evaluation teams
- Fast model like ACCESS-ESM1.5 is still important

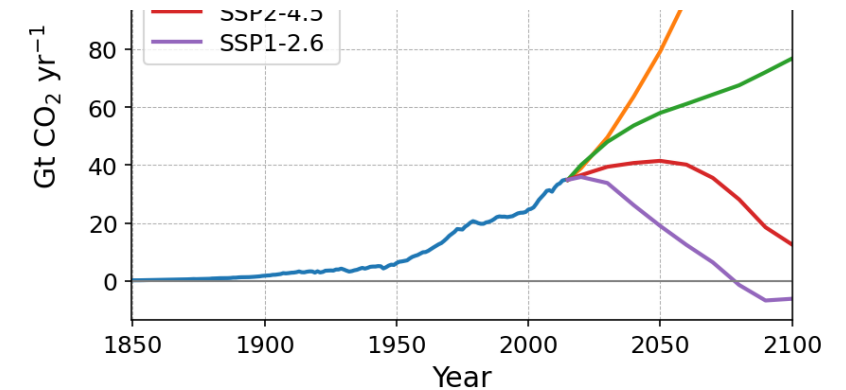
A climate model experiment

- Component model code
 - Links to executables or repositories for builds
 - Code and library versions
- Model science and diagnostic options
 - E.g. fortran namelists
- Initial state
 - Previous model run, reanalyses
- Forcing
 - Historically changing emissions
- Compute options
 - Decomposition, coupling, task dependencies and cycling



The screenshot shows the Trac repository browser for the Unified Model. The page title is "Unified Model" and the current view is "source: main / trunk / src". A table lists the contents of the directory:

Name	Size	Rev	Age	Author	Last Change
./					
atmosphere		119694	10 days	ericaneining	#7281: ianboutle: Mixed precision BL: enhancement: boundary_layer ...
constants		119694	10 days	ericaneining	#7281: ianboutle: Mixed precision BL: enhancement: boundary_layer ...
control		119694	10 days	ericaneining	#7281: ianboutle: Mixed precision BL: enhancement: boundary_layer ...
include		118281	3 months	jamesbruten	#7265: adamvoyssey: Create a Portio "Null" Helper-thread: ...
io_services		118281	3 months	jamesbruten	#7265: adamvoyssey: Create a Portio "Null" Helper-thread: ...
scm		118100	3 months	lianneparkhouse	#7219: jenniferhickson: Change variable names REAL64 and REAL32: ...
utility		119438	3 weeks	roddysharp	#7274: illiberous: OpenMP implementation in ...



Managing a climate model experiment

- For reproducibility all details of an experiment should be in a repository
- ACCESS-OM2 and ESM1.5 use payu
- The UM, ACCESS-CM2, Aus2200, ACCESS-S, BOM NWP suites use rose/cylc
 - Climate suites are relatively simple but NWP suites make have hundreds of tasks per cycle
- A rose/cylc suite is a directory in the MOSRS roses repository

Cylc

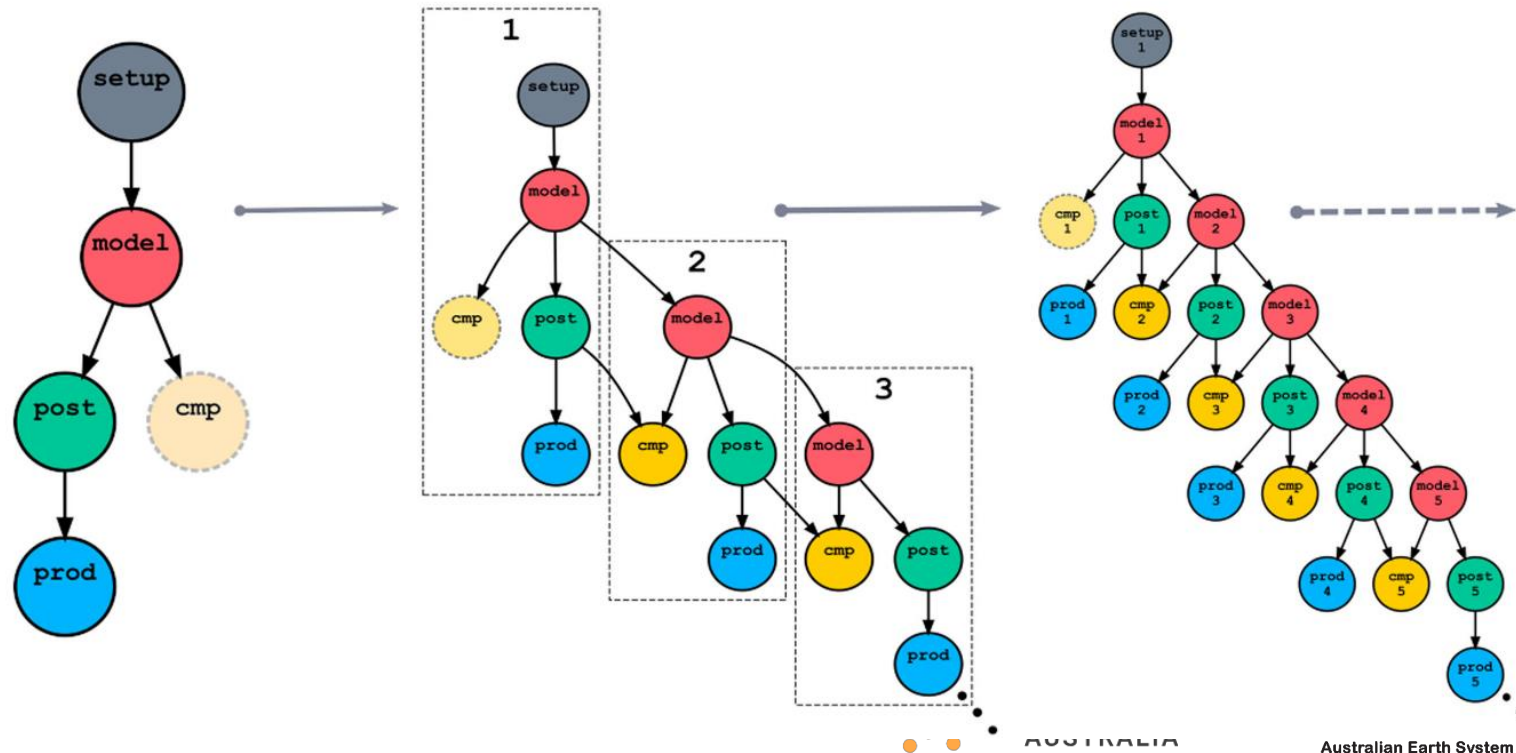
- Cylc is a workflow engine that automatically executes tasks according to schedules and dependencies.

- <https://cylc.github.io/>
- <https://cylc.github.io/cy>

- Developed by NIWA general

- We're currently using

- Python 3
- Web based GUI
- Cylc 7 suites should run



Rose

- Rose is a toolkit for writing, editing and running application configurations
<http://metomi.github.io/rose/doc/html/index.html>
- Developed by Met Office for the UM but in principle is more general
- Adds a GUI and metadata to fortran namelists

Modelling environment at NCI

- Model runs on NCI peak system gadi
 - Typical configuration ACCESS CM2 ~800 cores
- Shared data in ~access, /g/data/access
 - E.g. ancillary files, initial conditions, pre-built libraries
- **accessdev will be retired**
- Launch suites from ARE or gadi login nodes
- New persistent sessions for long running suites



Exercise: Running ACCESS from ARE

- Checkout and launch a simple suite
- Suite input and output files

Details of exercises

<https://github.com/ACCESS-NRI/workshop-training-2023>



Simple example suite u-cz168

- `module use /g/data/hr22/modulefiles`
- `module load cylc7`
- `mosrs-auth`
- `rosie co u-cz168`
 - creates a copy of the suite in `~/roses/u-cz168`
- Alternately if you don't have a MOSRS account
 - `mkdir -p $HOME/roses`
 - `cp -r /g/data/access/nri_training/u-cz168 $HOME/roses`
- `cd ~/roses/u-cmz168`
- `rose suite-run`

A running suite

The screenshot shows a Linux desktop environment with a window titled "u-cz168 - gadi-cpu-bdw-0021.gadi.nci.org.au:1887". This window displays a table of tasks and their states:

task	state	host	job system	job ID	T-submit	T-start	T-finish	dT-mean
19820101	submitted							
BUILD	submitted							
install_ancil	submitted	localhost	pbs	93315350.gadi-pbs	05:15:26Z	*	*	*
recon	waiting	*	*	*	*	*	*	*
fix_cable_dump	waiting	*	*	*	*	*	*	*
atmos	waiting	*	*	*	*	*	*	*
POSTPROC	waiting							

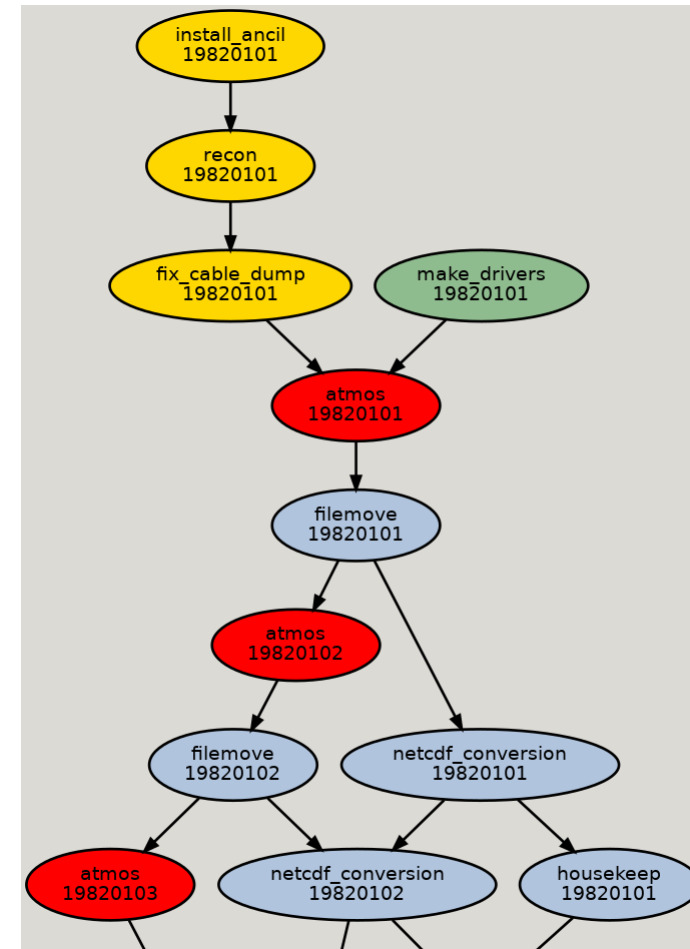
Below the table, a status bar shows "running to stop at 19820105 (filtered: live) 2023-08-23T15:30+10:00".

The "Mate Terminal" window shows the following output:

```
[INFO] The Cylc Suite Engine [7.9.7]
[INFO] Copyright (C) 2008-2019 NIWA
[INFO] & British Crown (Met Office) & Contributors.
[INFO] This program comes with ABSOLUTELY NO WARRANTY;
[INFO] see 'cylc warranty'. It is free software, you
[INFO] are welcome to redistribute it under certain
[INFO] *** listening on https://gadi-cpu-bdw-0021.gadi.nci.org.au:1887/ ***
[INFO] To view suite server program contact information:
[INFO] $ cylc get-suite-contact u-cz168
[INFO] Other ways to see if the suite is still running:
[INFO] $ cylc scan -n 'u-cz168' gadi-cpu-bdw-0021.gadi.nci.org.au
[INFO] $ cylc ping -v --host=gadi-cpu-bdw-0021.gadi.nci.org.au u-cz168
[INFO] $ ps -opid,args 3594244 # on gadi-cpu-bdw-0021.gadi.nci.org.au
[INFO] gadi-cpu-bdw-0021:~/roses/u-cz168%
```

u-cz168 example suite

- ACCESS-CM2 AMIP style suite
 - n48 rather than n96 resolution
 - Runs in daily rather than 6 monthly chunks
 - Uses a prebuilt model executable

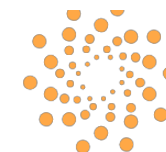


Suite output

```
gadi-cpu-bdw-0003:~% ls -l ~/cylc-run/u-cz168/
total 44
drwxr-x--- 7 mrd599 p66 4096 Aug 29 09:51 app
lrwxrwxrwx 1 mrd599 tm70 6 Aug 30 07:20 cylc-suite.db -> log/db
lrwxrwxrwx 1 mrd599 tm70 20 Aug 31 07:37 log -> log.20230830T213739Z
drwxr-s--- 6 mrd599 tm70 4096 Aug 31 07:49 log.20230830T213739Z
drwxr-x--- 2 mrd599 p66 4096 Aug 20 09:45 meta
-rw-r----- 1 mrd599 tm70 772 Aug 30 07:20 rose-suite.info
drwxr-s--- 6 mrd599 tm70 4096 Aug 31 07:37 share
-rw-r----- 1 mrd599 tm70 11676 Aug 31 07:31 suite.rc
-rw-r--r-- 1 mrd599 tm70 7394 Aug 31 07:37 suite.rc.processed
drwxr-s--- 3 mrd599 tm70 4096 Aug 31 07:37 work
gadi-cpu-bdw-0003:~% ls -l ~/cylc-run/u-cz168/log/job/19820101/
total 28
drwxr-sr-x 3 mrd599 tm70 4096 Aug 31 07:43 atmos
drwxr-sr-x 3 mrd599 tm70 4096 Aug 31 07:47 filemove
drwxr-sr-x 3 mrd599 tm70 4096 Aug 31 07:43 fix_cable_dump
drwxr-sr-x 3 mrd599 tm70 4096 Aug 31 07:48 housekeep
drwxr-sr-x 3 mrd599 tm70 4096 Aug 31 07:37 install_ancil
drwxr-sr-x 3 mrd599 tm70 4096 Aug 31 07:47 netcdf_conversion
drwxr-sr-x 3 mrd599 tm70 4096 Aug 31 07:37 recon
gadi-cpu-bdw-0003:~% ls -l ~/cylc-run/u-cz168/log/job/19820101/atmos/NN/
total 944
-rwxr-xr-x 1 mrd599 tm70 4170 Aug 31 07:43 job
-rw-r--r-- 1 mrd599 tm70 150 Aug 31 07:44 job-activity.log
-rw----- 1 mrd599 tm70 11167 Aug 31 07:46 job.err
-rw----- 1 mrd599 tm70 935703 Aug 31 07:48 job.out
-rw-r--r-- 1 mrd599 tm70 246 Aug 31 07:47 job.status
gadi-cpu-bdw-0003:~%
```

Files that persist for whole run, e.g. builds

Time stamped directories for each cycle where tasks actually run



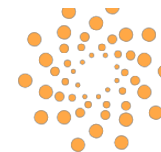
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u-cz168 suite structure

```
|— app
|   |— fcm_make_um
|   |   |— file
|   |   |   └─ fcm-make.cfg
|   |   └─ rose-app.conf
|   |— housekeep
|   |   └─ rose-app.conf
|   |— install_ancil
|   |   └─ rose-app.conf
|   |— netcdf_conversion
|   |   |— meta
|   |   |   └─ rose-meta.conf
|   |   └─ rose-app.conf
```

```
|— um
|   |— file
|   |   └─ STASHmaster_A
|   |— opt
|   |   |— rose-app-daily.conf
|   |   └─ rose-app-n48.conf
|   └─ rose-app.conf
|— meta
|   └─ rose-meta.conf
|— rose-suite.conf
|— rose-suite.info
|— suite.rc
```




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RAL suite structure: u-cy385

```
|— Jinja2Filters
|— app
|— bin
|— etc
|— lib
|— meta
|— opt
|— rose-suite.conf
|— rose-suite.info
|— site
|— suite-graph
|— suite-macros.rc
|— suite-runtime
|— suite-setup.rc
|— suite-setup_dir
|— suite.rc
|— README
|— afw-hp-intel
|— ecmwf-cray-xc40
|— icm-pwr7-xlf
|— icm-xc40-cce
|— kma-cray-xc40
|— mo1b-cray-xc40
|— mo1c-cray-xc40
|— moexz-cray-xc50
|— monsoon-cray-xc40
|— mss-cray-xc30
|— ncas-cray-xc30
|— nci-gadi
|— ncmr-cray-xc40
|— niwa-ibm-pwr6
```



Model output (ACCESS-CM2 style)

```
ARE + v
gadi-cpu-bdw-0003:~% tree /scratch/$PROJECT/$USER/archive/cz168
/scratch/tm70/mrd599/archive/cz168
├── history
│   └── atm
│       ├── cz168a.pd19820101
│       └── netCDF
│           └── cz168a.pd19820101.nc
└── restart
    └── atm
        ├── cz168.xhist-19820101
        └── cz168a.da19820102_00

5 directories, 4 files
gadi-cpu-bdw-0003:~% |
```

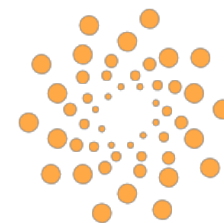
```
module use /g/data/hh5/public/modules
module load conda/analysis3

ncdump -c
/scratch/$PROJECT/$USER/archive/cz168/histo
ry/atm/netCDF/cz168a.pd19820101.nc

python
/g/data/access/nri_training/simple_plot.py
/scratch/$PROJECT/$USER/archive/cz168/histo
ry/atm/netCDF/cz168a.pd19820101.nc
fld_s03i236
```


Exercises with the example suite

1. Changing run length
2. Changing a model physics option
3. Troubleshooting



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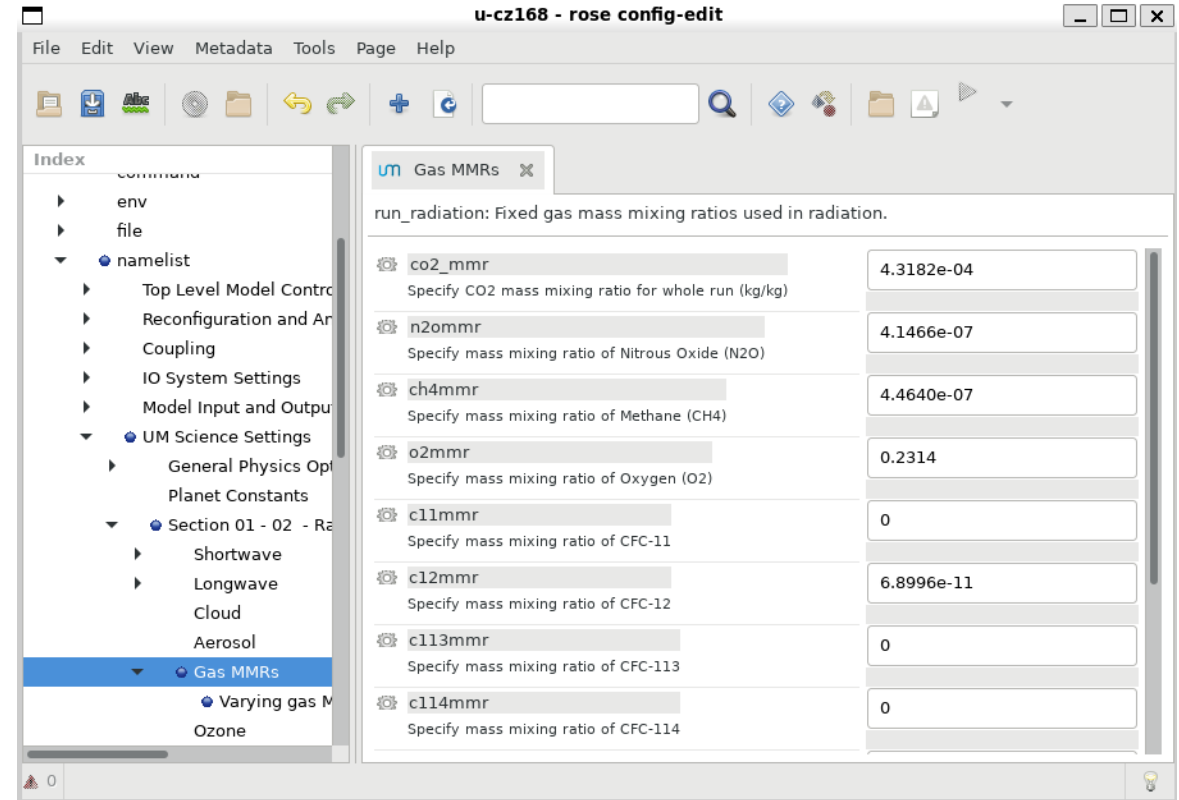
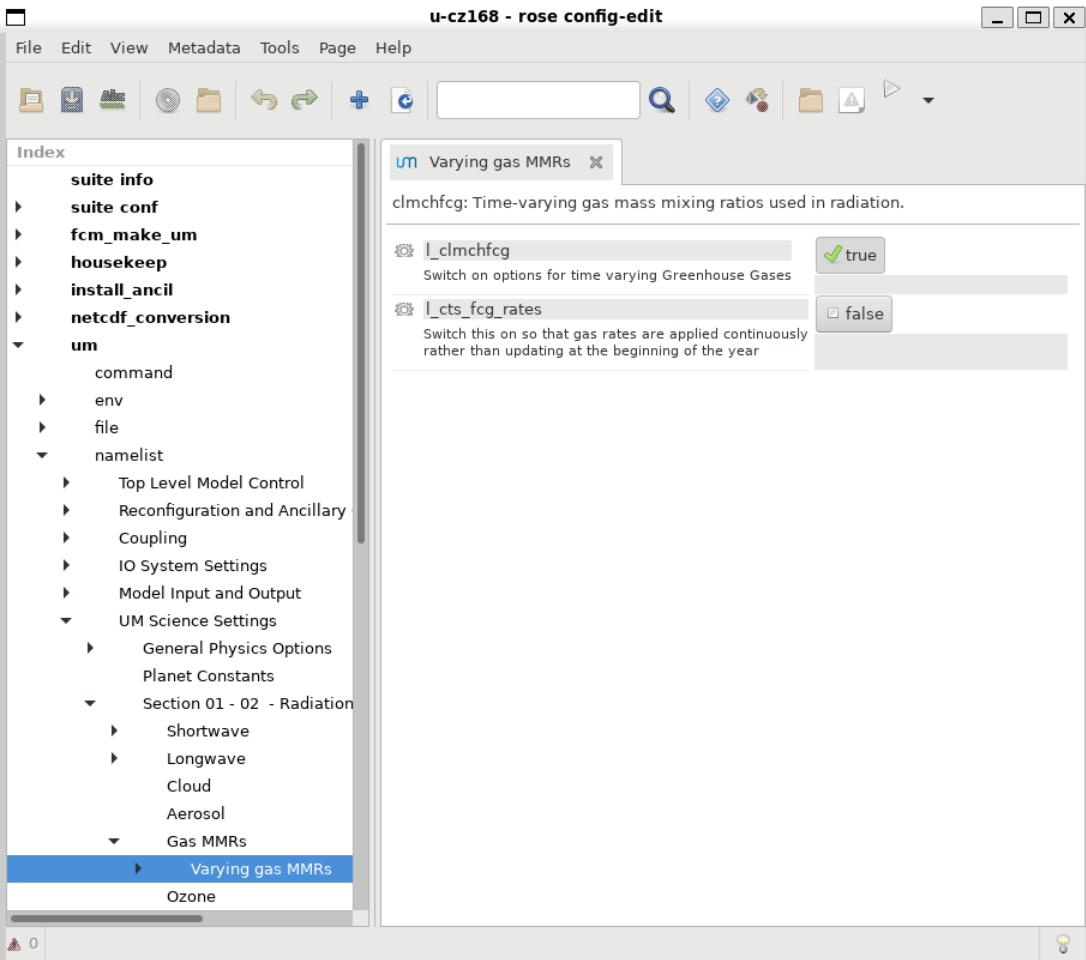
1: Change the model run length

The screenshot shows the 'u-cz168 - rose config-edit' window. The left sidebar lists configuration categories: suite info, suite conf, Build and Run, Domain Decomposition, Machine and Runtime Options, Model Configuration, Output Paths, Run Initialisation and Cycling (selected), jinja2, fcm_make_um, housekeep, install_ancil, netcdf_conversion, and um. The main panel displays the 'Run Initialisation and Cycling' configuration with the following values:

Parameter	Value
Input dump location	/g/data/access/access-cm2/cmip6
Model basis time	19820101
Total Run length	P2D
Cycling frequency	P1D
Wallclock time	PT10M

```
~/roses/u-cz168% svn diff
Index: rose-suite.conf
=====
--- rose-suite.conf
(revision
265552=====
+++ rose-suite.conf
(working copy)
@@ -22,6 +22,6 @@
 RUN=true
 RUNID=true
 !!RUNID_USR=' '
 -RUNLEN='P1D'
 +RUNLEN='P2D'
 UM_OPT_KEYS='daily'
 USE_STD_EXEC=true
```

2: Changing a model physics option (CO₂)



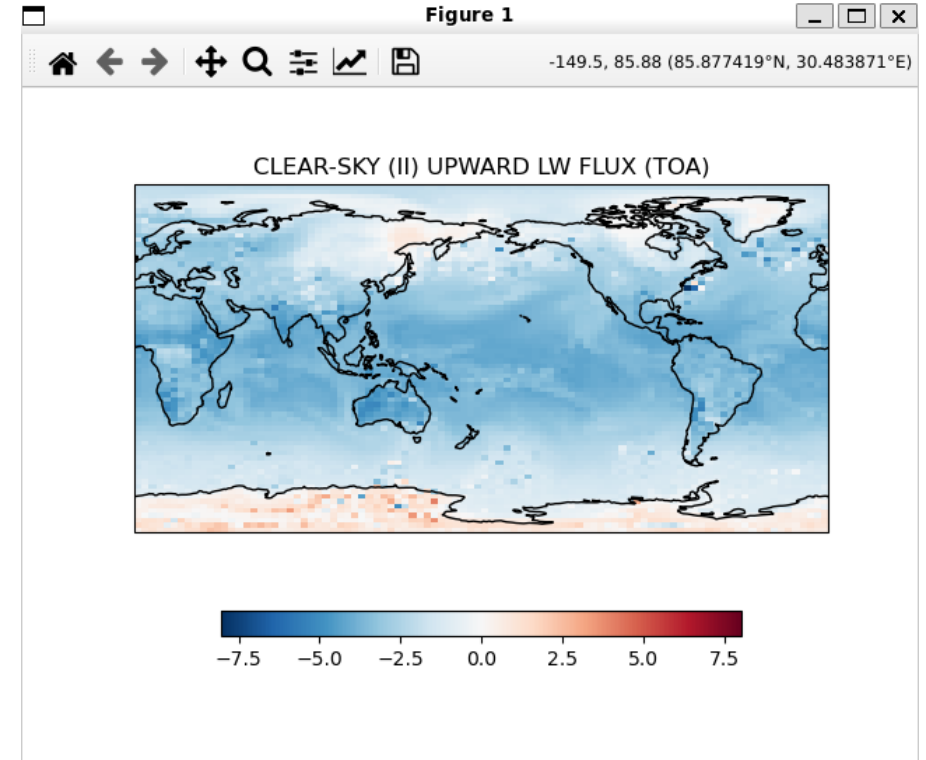
Changed results

```
% module use
/g/data/hh5/public/modules

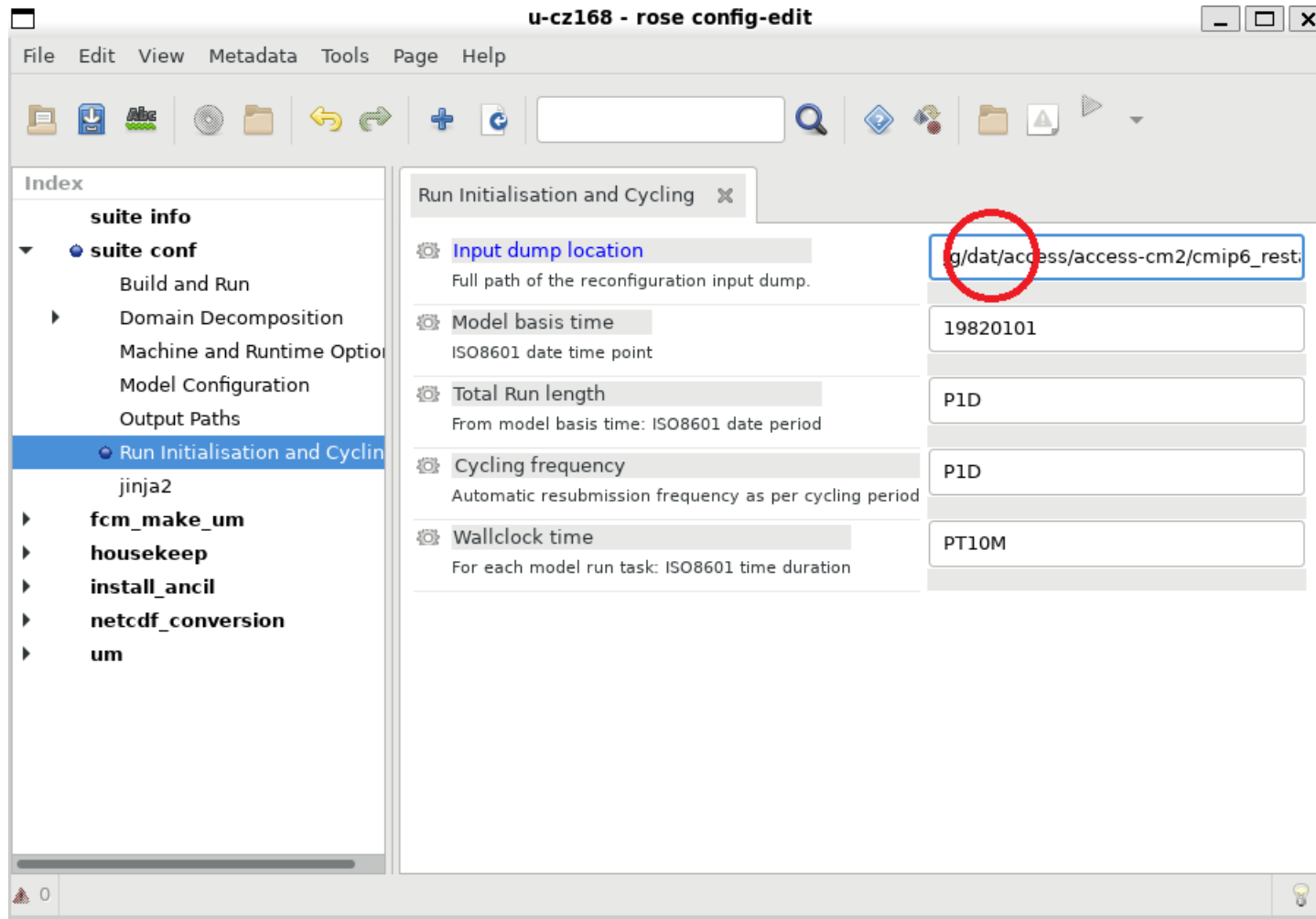
% module load conda/analysis3

% cdo sub
/scratch/$PROJECT/$USER/archive/cz168/
history/atm/netCDF/cz168a.pd19820101.n
c
/g/data/access/nri_training/archive/cz
168/history/atm/netCDF/cz168a.pd198201
01.nc diff.nc

% python
/g/data/access/nri_training/simple_plo
t.py diff.nc fld_s02i206
```



3: Troubleshooting: Missing input dump



Change to something that doesn't exist and rerun

Restarting after fix

The image shows a web-based configuration editor window titled "u-cz168 - rose config-edit". The interface includes a menu bar (File, Edit, View, Metadata, Tools, Page, Help) and a toolbar with various icons. A red circle highlights a play button icon in the toolbar. Below the toolbar is a sidebar with a tree view under "Index" containing "suite info" and "suite conf". The "suite conf" section is expanded, showing options like "Build and Run", "Domain Decomposition", "Machine and Runtime C", "Model Configuration", "Output Paths", "Run Initialisation and C", "jinja2", "fcm_make_um", "housekeep", "install_ancil", "netcdf_conversion", and "um". The "Run Initialisation and C" option is selected. An error dialog box titled "rose suite-run" is overlaid on the editor. The dialog contains a red error icon and the following text: "SuiteStillRunningError: Suite 'u-cz168' appears to be running: Contact info from: '/home/599/mrd599/cylc-run/u-cz168/.service/contact' CYLC_SUITE_HOST=gadi-cpu-bdw-0005.gadi.nci.org.au CYLC_SUITE_OWNER=mrd599 CYLC_SUITE_PORT=1864 CYLC_SUITE_PROCESS=876803 /g/data/hr22/apps/cylc7/bin/python -s /g/data/hr22/apps/cylc7/cylc_7.9.7/bin/cylc-run u-cz168 Try 'cylc stop 'u-cz168'' first?". At the bottom of the dialog is a "Show log" button and an "OK" button.

u-cz168 - rose config-edit

File Edit View Metadata Tools Page Help

Run Initialisation and Cycling

Index

- suite info
- suite conf
 - Build and Run
 - Domain Decomposition
 - Machine and Runtime C
 - Model Configuration
 - Output Paths
 - Run Initialisation and C
 - jinja2
 - fcm_make_um
 - housekeep
 - install_ancil
 - netcdf_conversion
 - um

rose suite-run

SuiteStillRunningError: Suite "u-cz168" appears to be running:
Contact info from: "/home/599/mrd599/cylc-run/u-cz168/.service/contact"
CYLC_SUITE_HOST=gadi-cpu-bdw-0005.gadi.nci.org.au
CYLC_SUITE_OWNER=mrd599
CYLC_SUITE_PORT=1864
CYLC_SUITE_PROCESS=876803 /g/data/hr22/apps/cylc7/bin/python -s /g/data/hr22/apps/cylc7/cylc_7.9.7/bin/cylc-run u-cz168
Try "cylc stop 'u-cz168'" first?

Show log

OK

Restarting with reload

The image shows two overlapping windows from a Cylc workflow environment. The background window is 'u-cz168 - rose config-edit', displaying configuration options for 'Run Initialisation and Cycling'. The foreground window is 'u-cz168 - gadi-cpu-bdw-0005.gadi.nci.org.au:1864', showing a task list with a 'recon' task in a failed state. A terminal window in the foreground shows the command 'rose suite-run --reload'.

task	state	host	job system	job ID	T-submit	T-start
19820101	failed					
BUILD	succeeded					
install_ancil	succeeded	localhost	background	876857	2023-08-29T23:21:28Z	*
recon	failed	localhost	pbs	93870312.gadi-pbs	2023-08-29T23:21:32Z	2023-08-29
fix_c	Task: recon.19820101			*	*	*
atmc	Browse task URL			*	*	*
POST	View Job Logs (Viewer)					
	View Job Log (Editor)					
	prereq's & outputs					
	run "cylc show"					
	Trigger (run now)					
	Trigger (edit run)					
	Poll					

```
rose suite-run --reload
```

Fix the suite
% rose suite-run --reload
% cylc trigger u-cz168 19820101/recon

Restarted success

u-cz168 - gadi-cpu-bdw-0005.gadi.nci.org.au:1864

File View Control Suite Help

Hold Stop Suite Connect Now View 1: Layout View 2: None

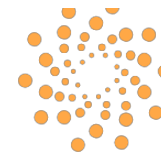
task	state	host	job system	job ID	T
19820101	submitted				
BUILD	succeeded				
install_ancil	succeeded	localhost	background	876857	20
recon	succeeded	localhost	pbs	93870846.gadi-pbs	20
fix_cable_dump	succeeded	localhost	background	881166	20
atmos	submitted	localhost	pbs	93870891.gadi-pbs	20
POSTPROC	waiting				

running to stop at 19820101 (filtered:) live 2023-08-30T09:42:18+10:00

```
% ls -l ~/cylc-run/u-cz168/log/job/19820101/recon/  
total 8  
drwxr-sr-x 2 mrd599 tm70 4096 Aug 30 09:22 01  
drwxr-sr-x 2 mrd599 tm70 4096 Aug 30 09:41 02  
lrwxrwxrwx 1 mrd599 tm70      2 Aug 30 09:40 NN -> 02
```

Running climate suites

- Simulations of hundreds of years may take several months
- Needs a long running cylc server
 - Yue will present on persistent services and web services tomorrow
 - Not quite ready for general use yet
- Monitoring simulations to check whether they're behaving sensibly
 - New package being developed
- Archiving and post-processing
 - Intake catalog (afternoon session)
 - Working on streamlining "CMORization" of data



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ACCESS
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Interactive monitoring & diagnostic analyses of live ACCESS models.



Model Live Diagnostics: A Python framework to monitor, visualise and evaluate currently running ACCESS models on Gadi.

Mike Tetley @ ACCESS-NRI

- Interactively monitor and visualise all available variables from currently running ACCESS models on Australian NCI supercomputer Gadi
- Evaluate live model progress against existing reference ACCESS models from the ACCESS-NRI Intake catalog
- Integration of diagnostic metrics and ESMValTool recipes currently in development

Transition from accessdev

- Rose/cylc environment now managed by NCI
- Whole cylc-run directory now on scratch, not just work and share
- Need gdata/hr22+gdata/ki32 storage directives
- Use localhost rather than gadi as compute host
 - ***no ssh configuration required!***
 - Required for persistent sessions with long running suites
 - Complications with the mirror step in a 2 step fcm_make. Still looking at best work-around
- Cylc 8 is now available
 - Many suites work in compatibility mode
 - Migration guide to come

Support



ACCESS-Hive Forum
<https://forum.access-hive.org.au/>



NCI Helpdesk
help@nci.org.au

Training Survey

