
# 2023 ACCESS Workshop Training Day

**Twitter: @ACCESS_NRI** **#ACCESSCommunity23**

# 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.*

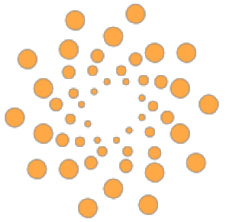
# Training Materials

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



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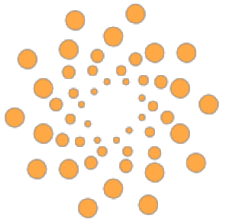
# ACCESS Models



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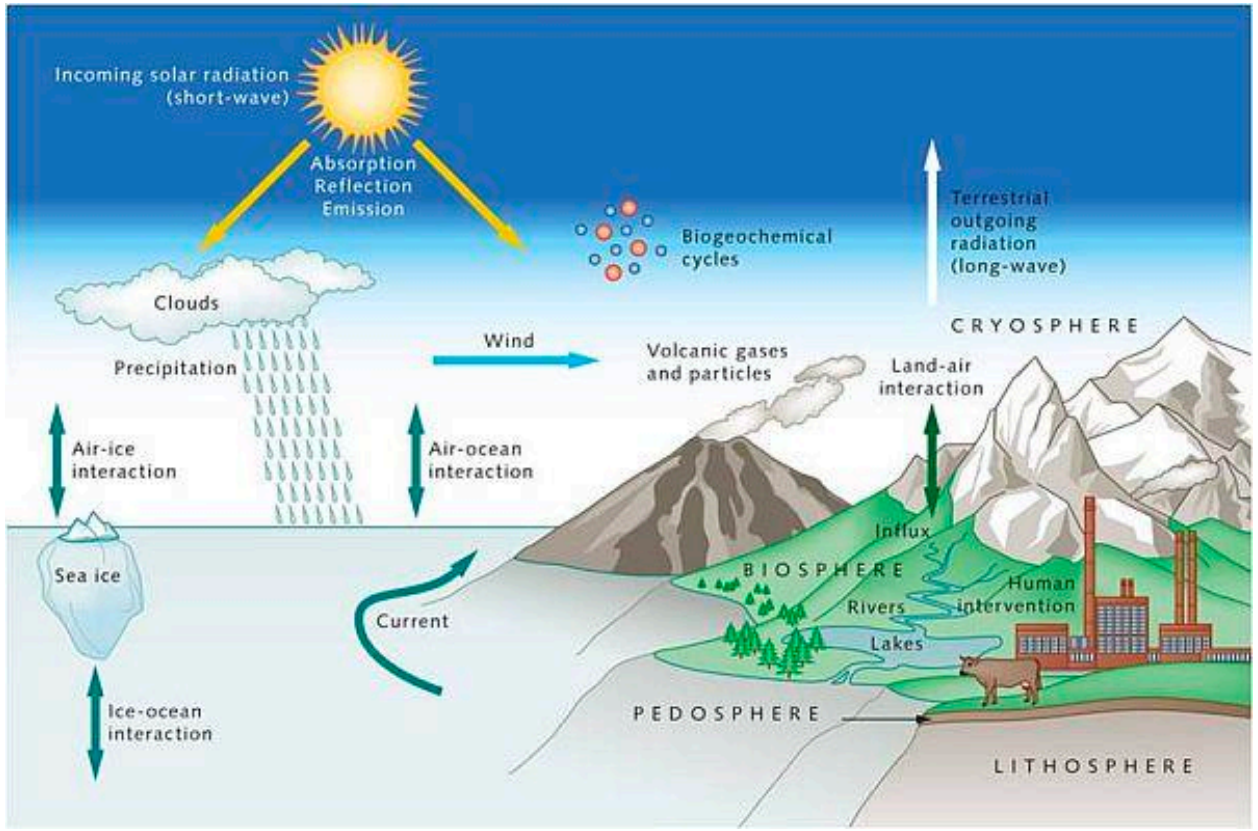
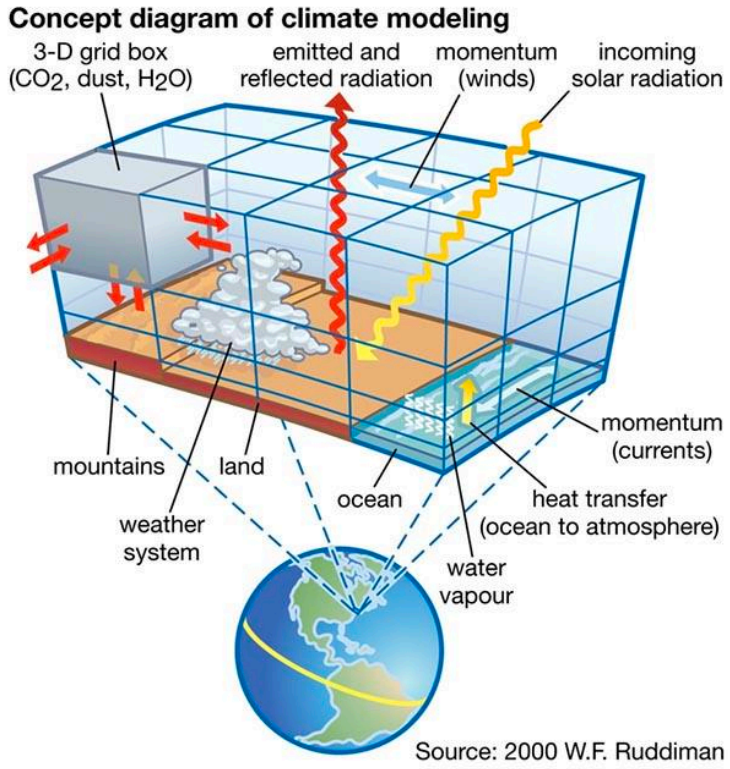
# What is a climate model?




- 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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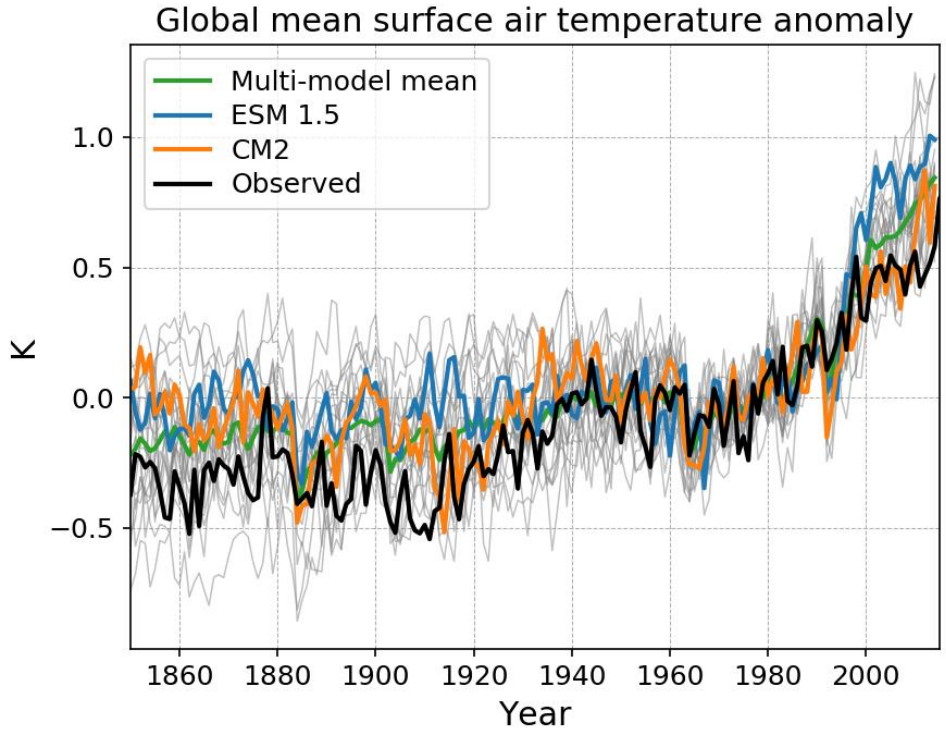
# Climate model uses

- 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

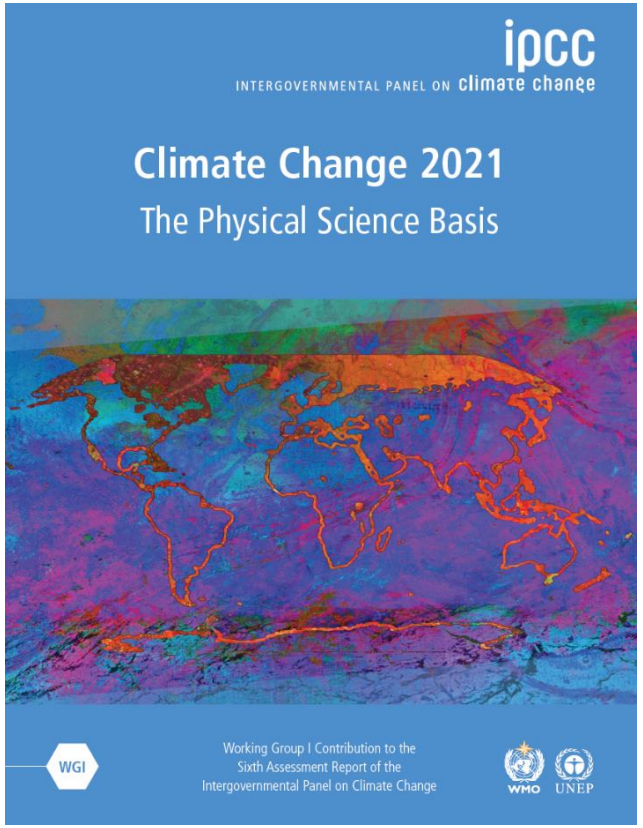
- Traditional climate models include atmosphere, ocean, land, sea-ice
- Earth System Models add
  - Carbon and other biogeochemical cycles
  - Dynamic vegetation
  - Atmospheric chemistry and ozone photochemistry
  - Dynamic ice sheets
- Allows extra feedbacks and also more interesting experiment design

# 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

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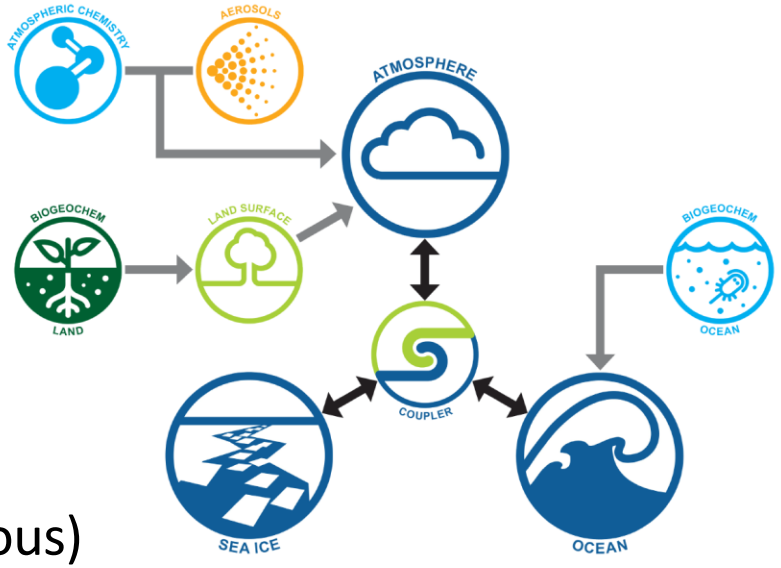
# ACCESS configurations for CMIP6




- 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

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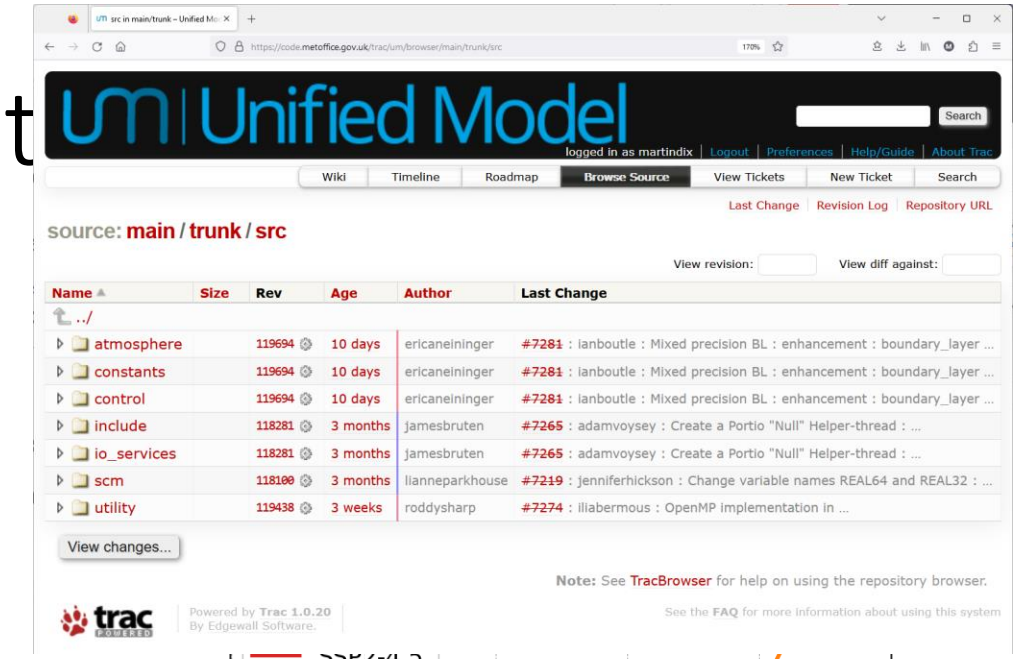
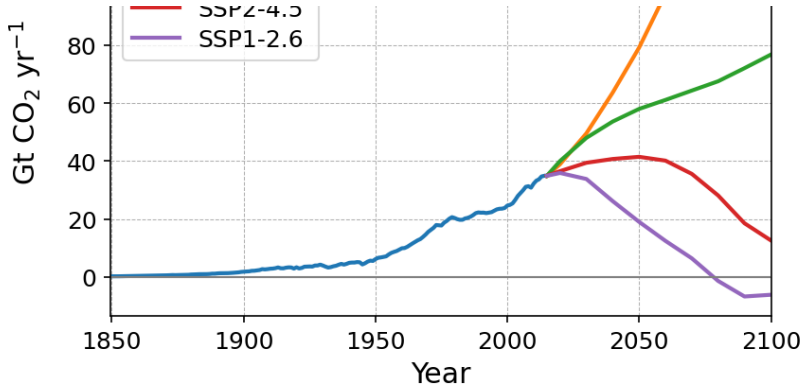
# ACCESS development plans

- 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, renanalyses
- Forcing
  - Historically changing emissions
- Compute options
  - Decomposition, coupling, task dependencies and cycling

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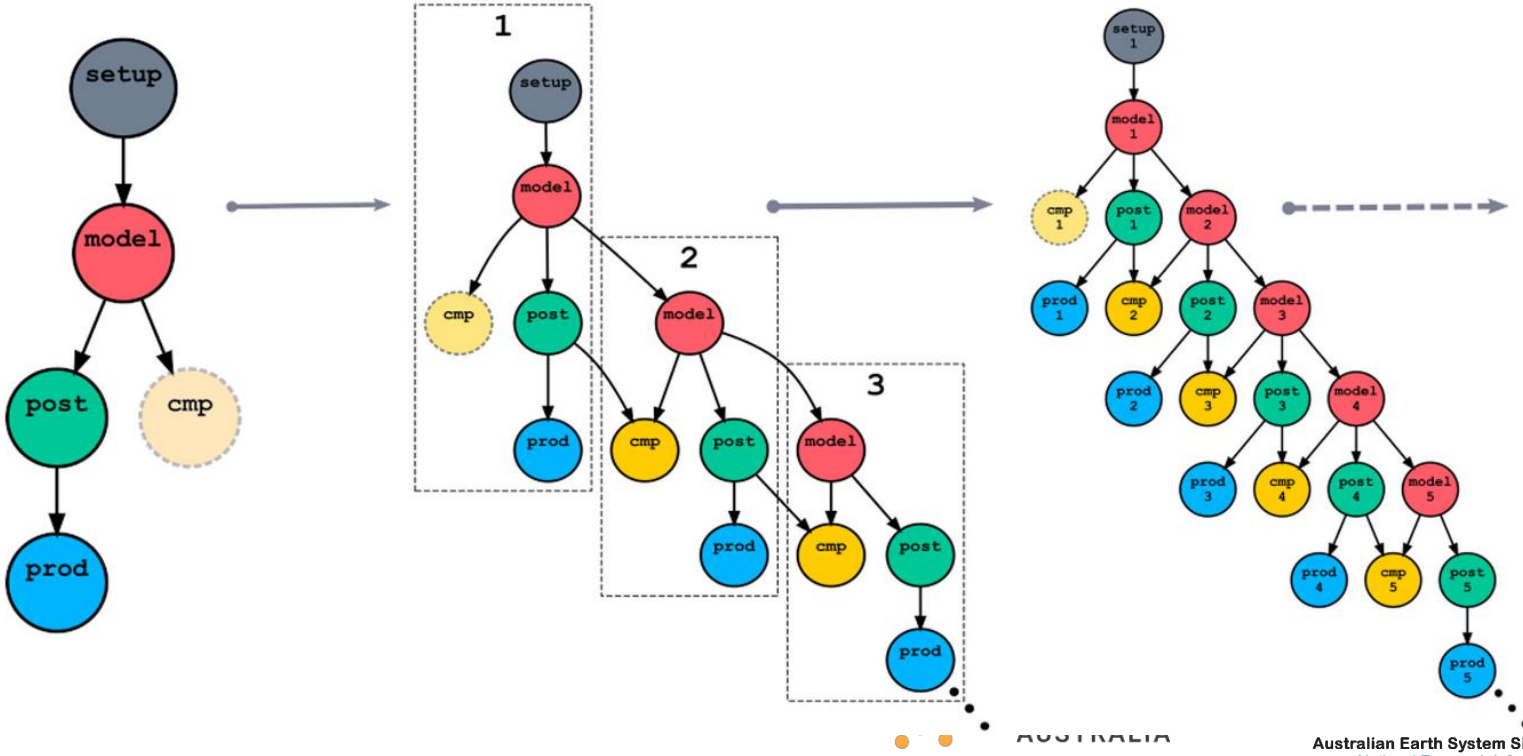
# Managing a climate model experiment

- 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

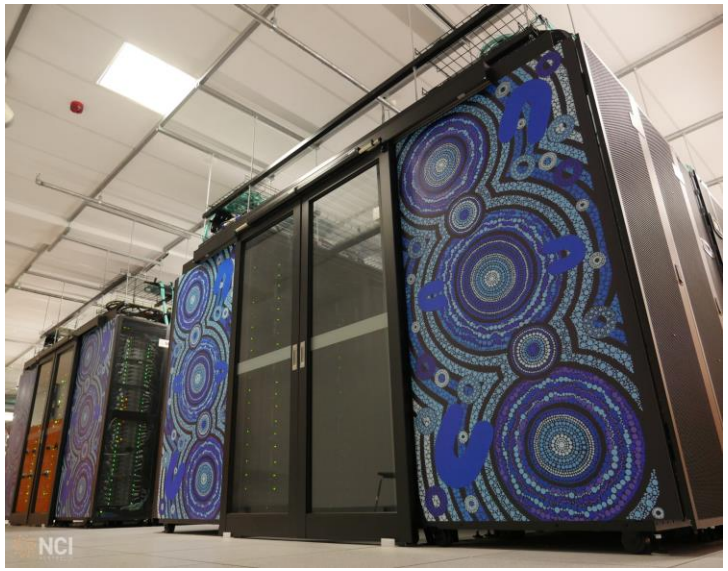
- Cylc is a workflow engine that automatically executes tasks according to schedules and dependencies.
  - https://cylc.github.io/
  - https://cylc.github.io/cy
- Developed by NIWA general
- We're currently usin
  - Python 3
  - Web based GUI
  - Cylc 7 suites should run



# 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

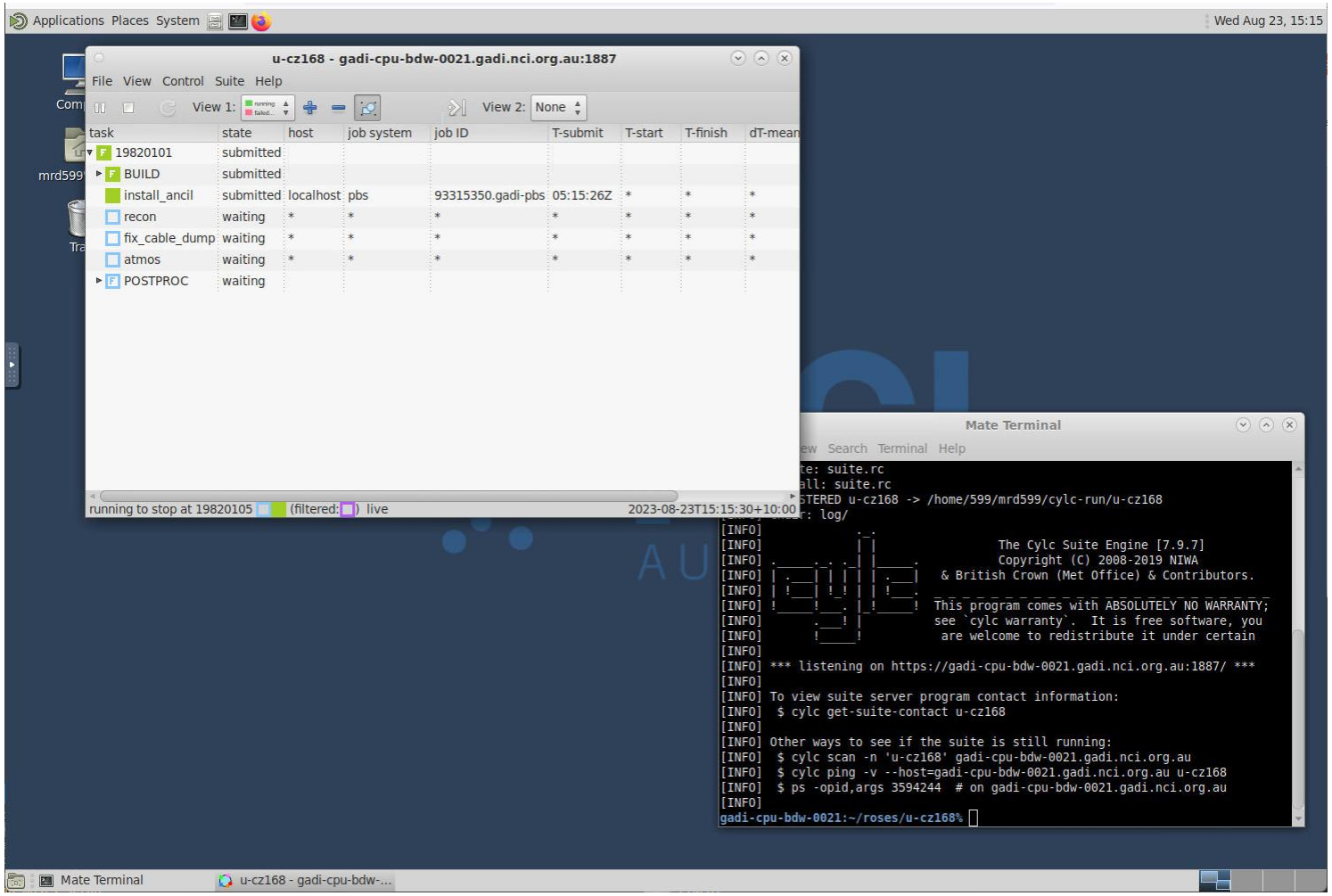
Details of exercises

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

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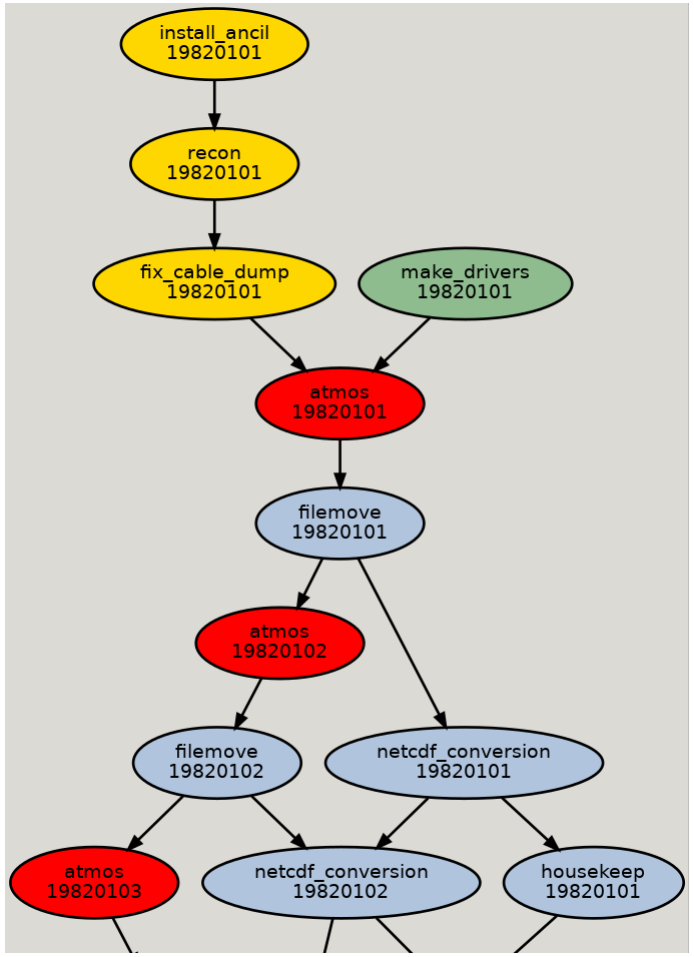
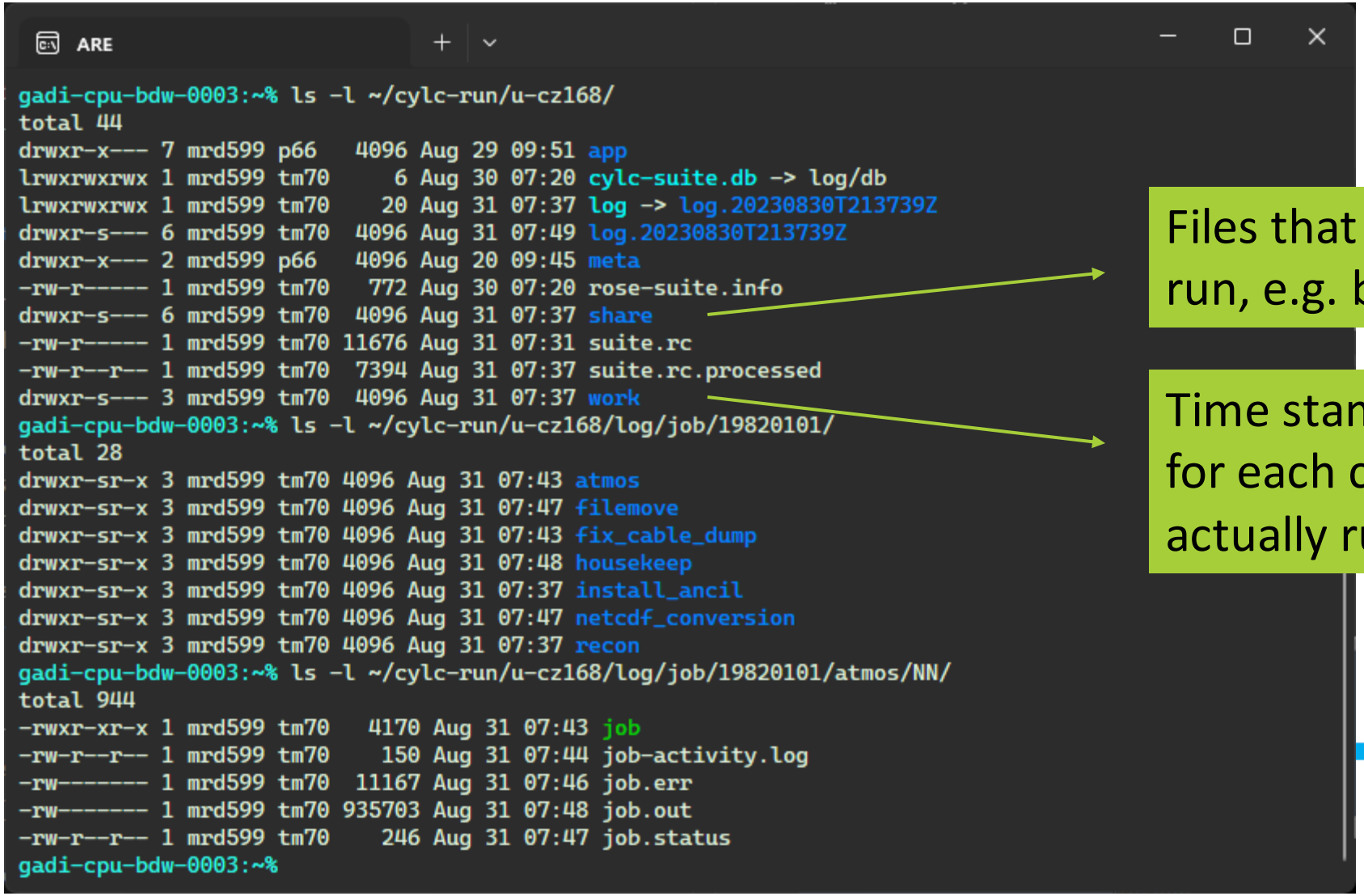
# u-cz168 example suite

- 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




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

Time stamped directories for each cycle where tasks actually run

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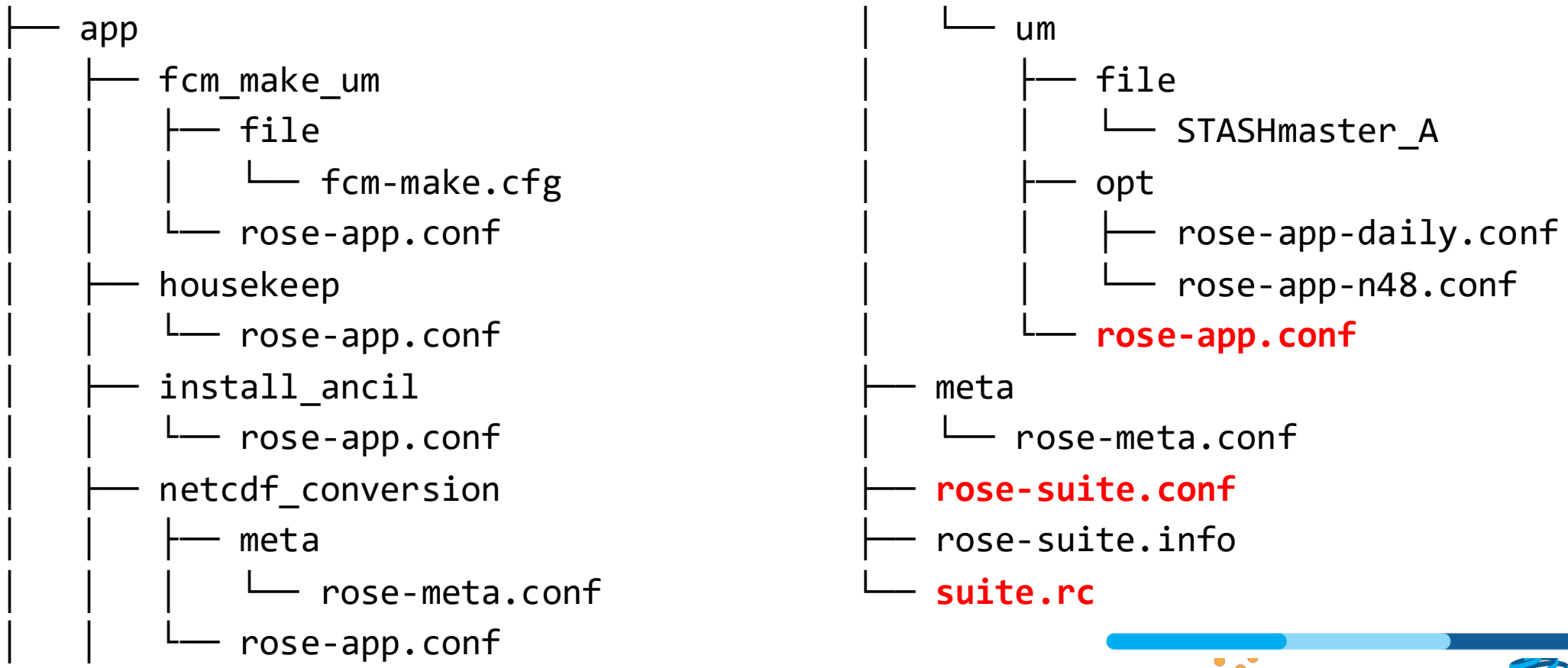
# u-cz168 suite structure

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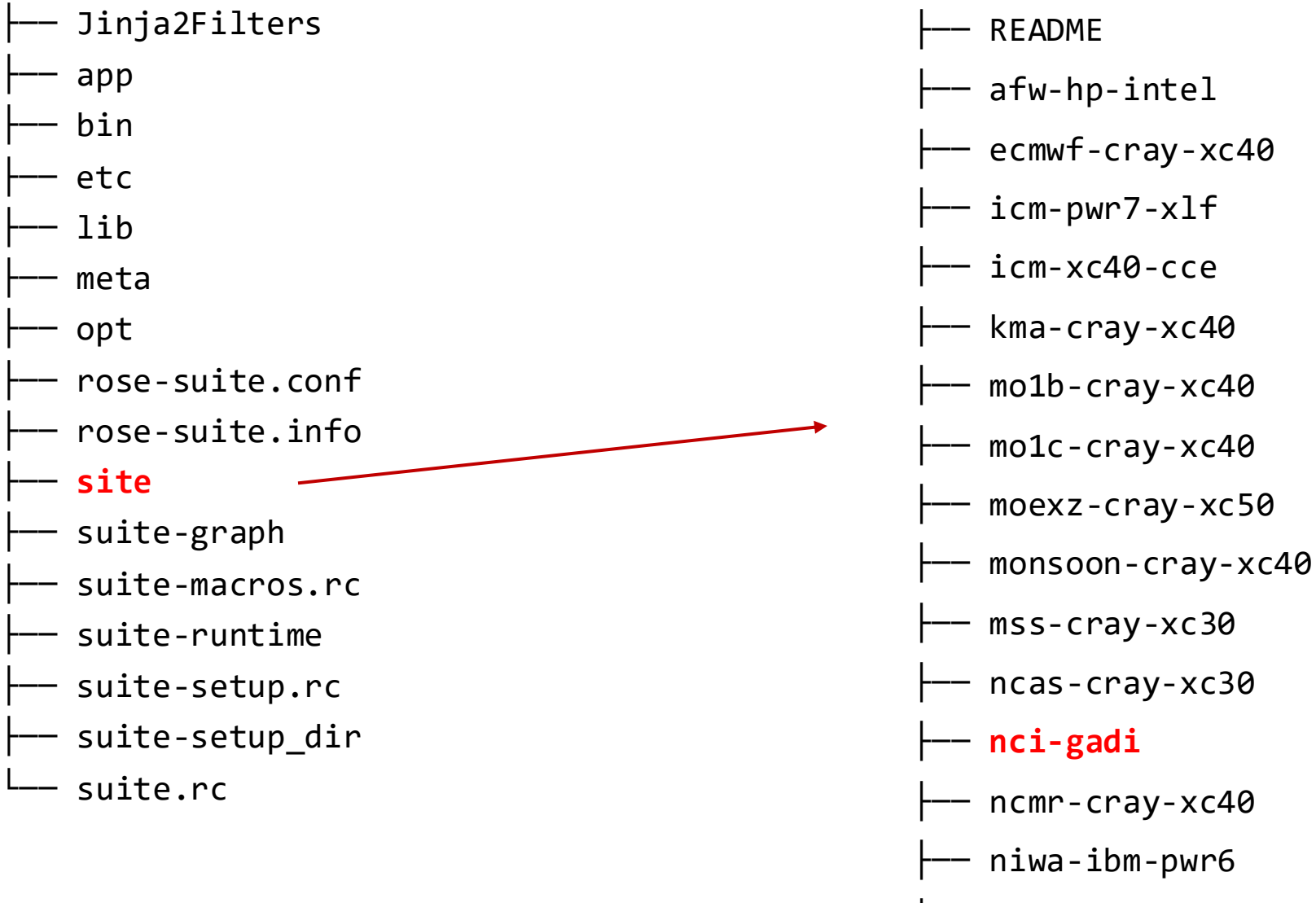
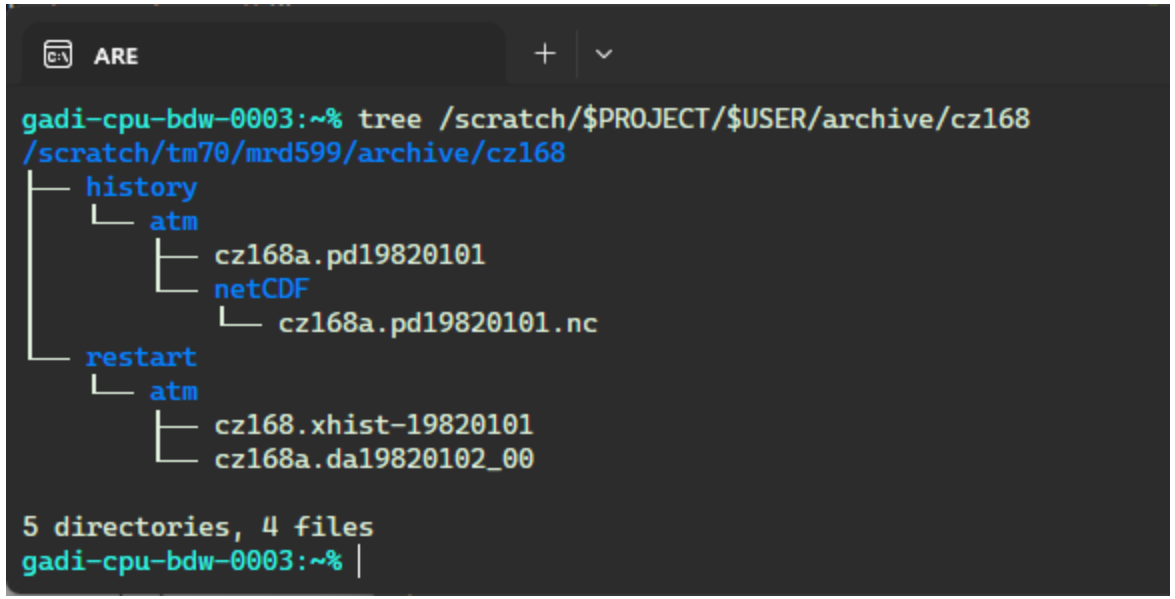
# RAL suite structure: u-cy385



# Model output (ACCESS-CM2 style)




```
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
```

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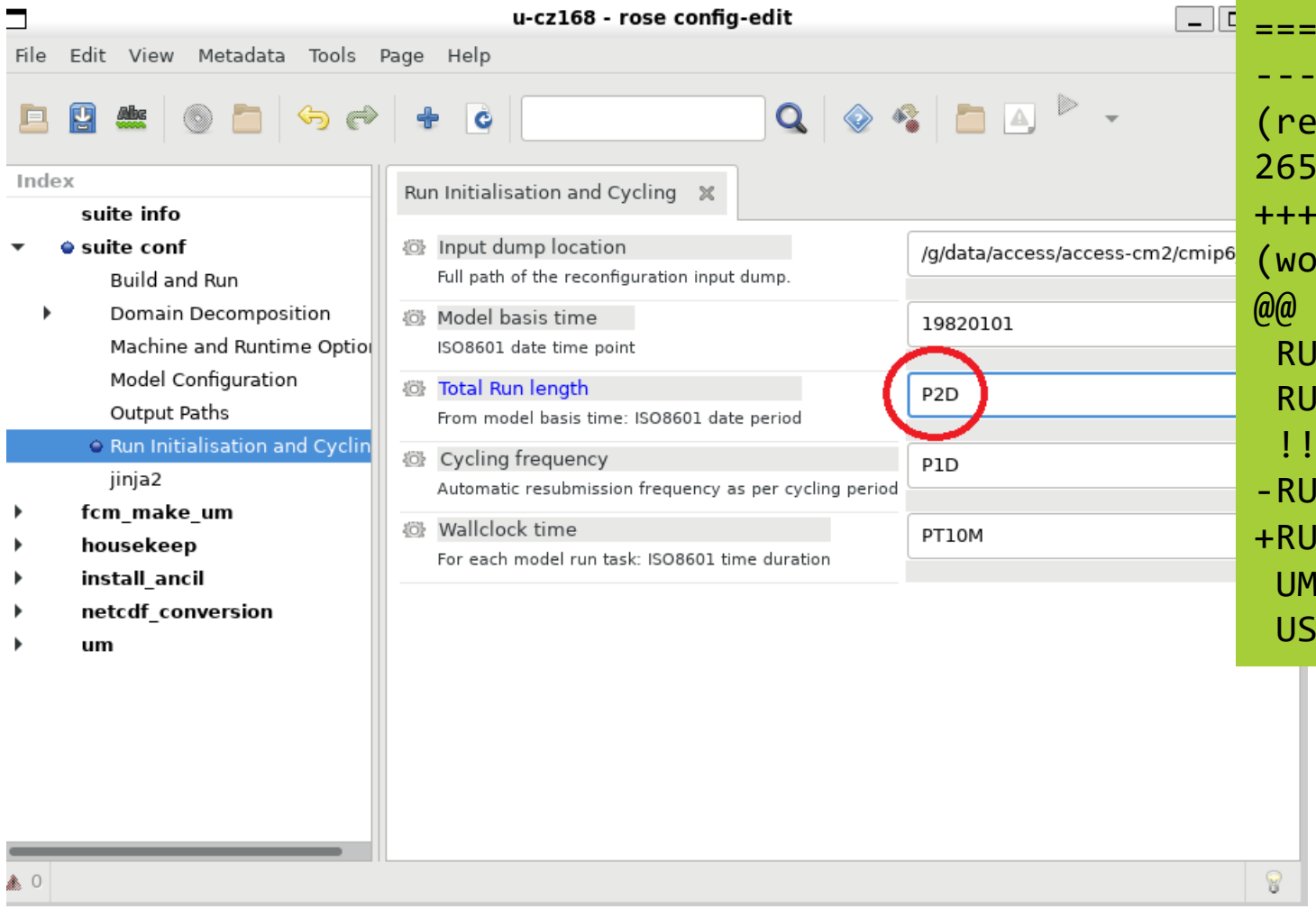
# Exercises with the example suite

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

# 1: Change the model run length




```
~/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
```

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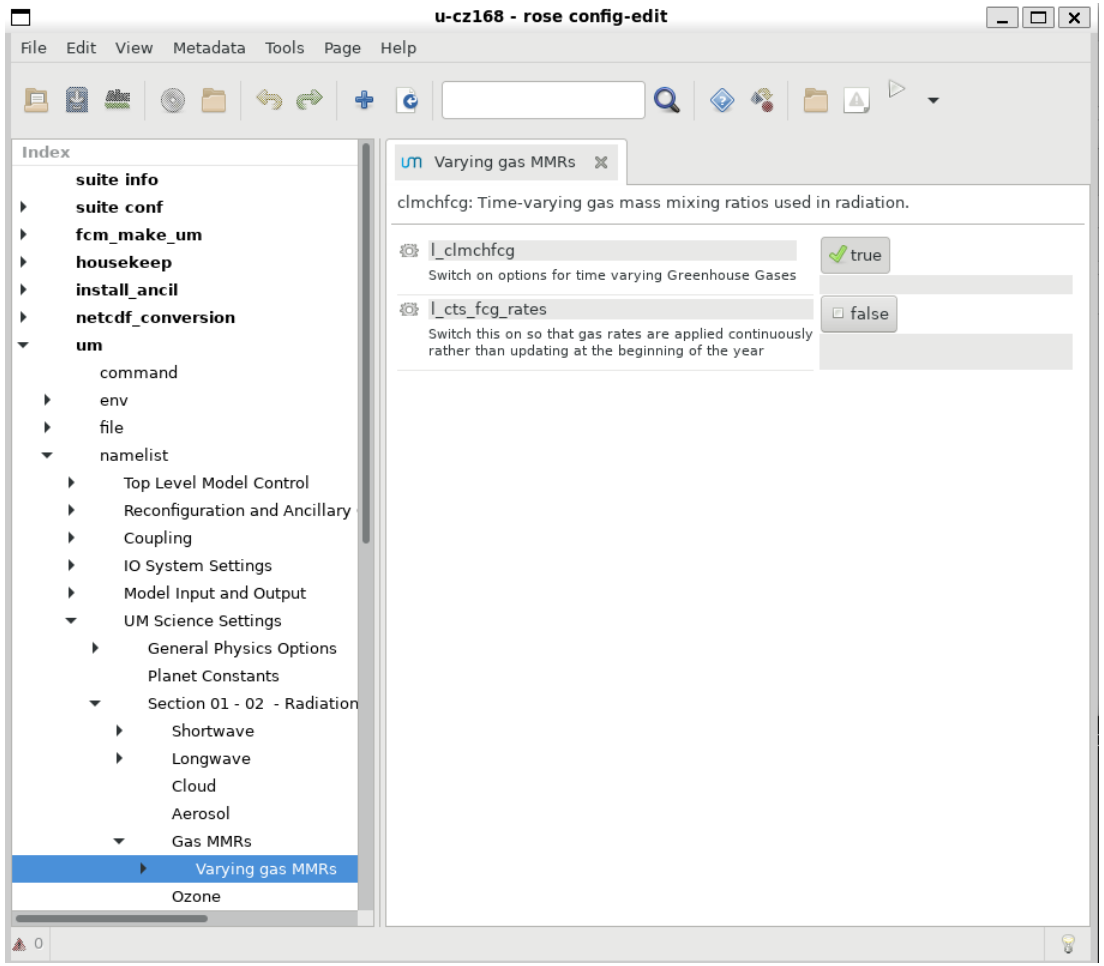
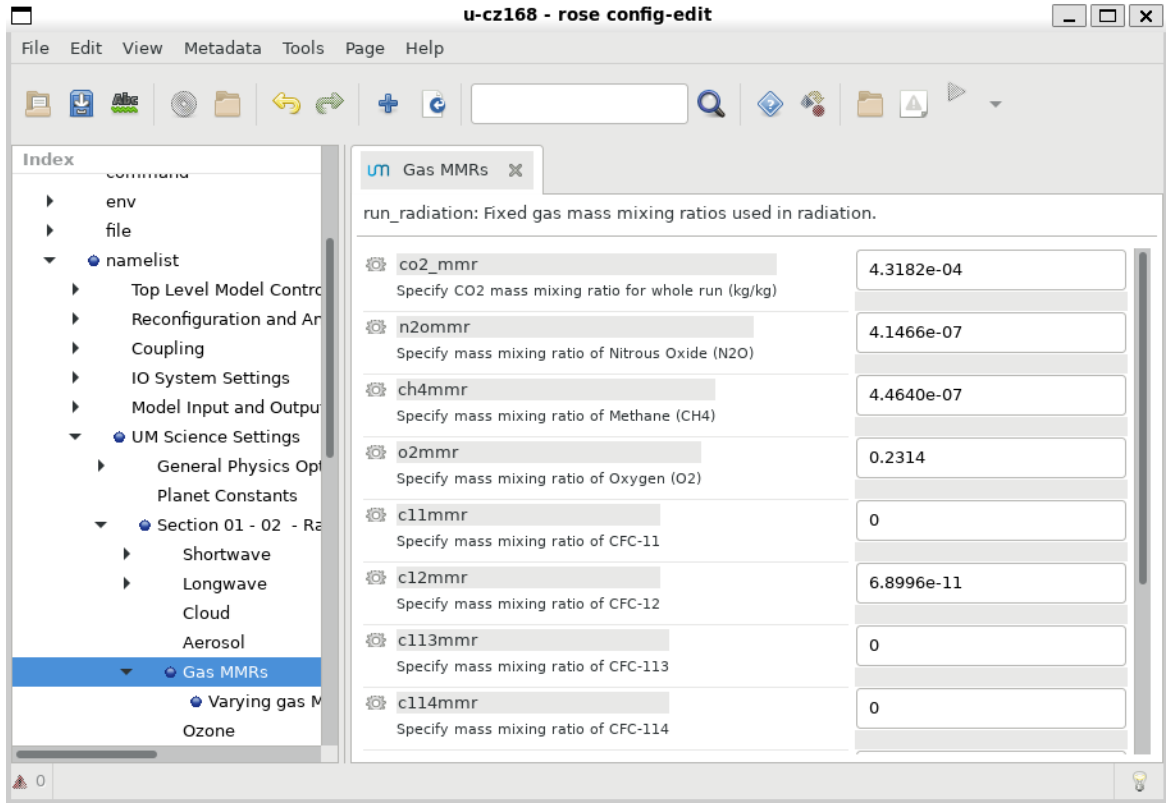
# 2: Changing a model physics option ($CO_2$)

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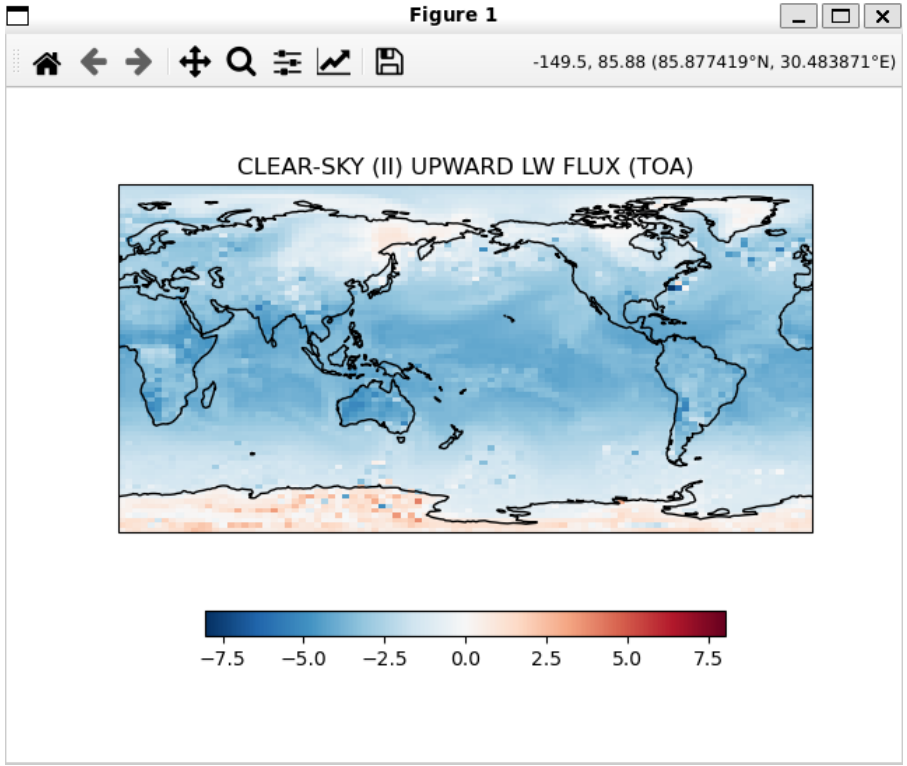
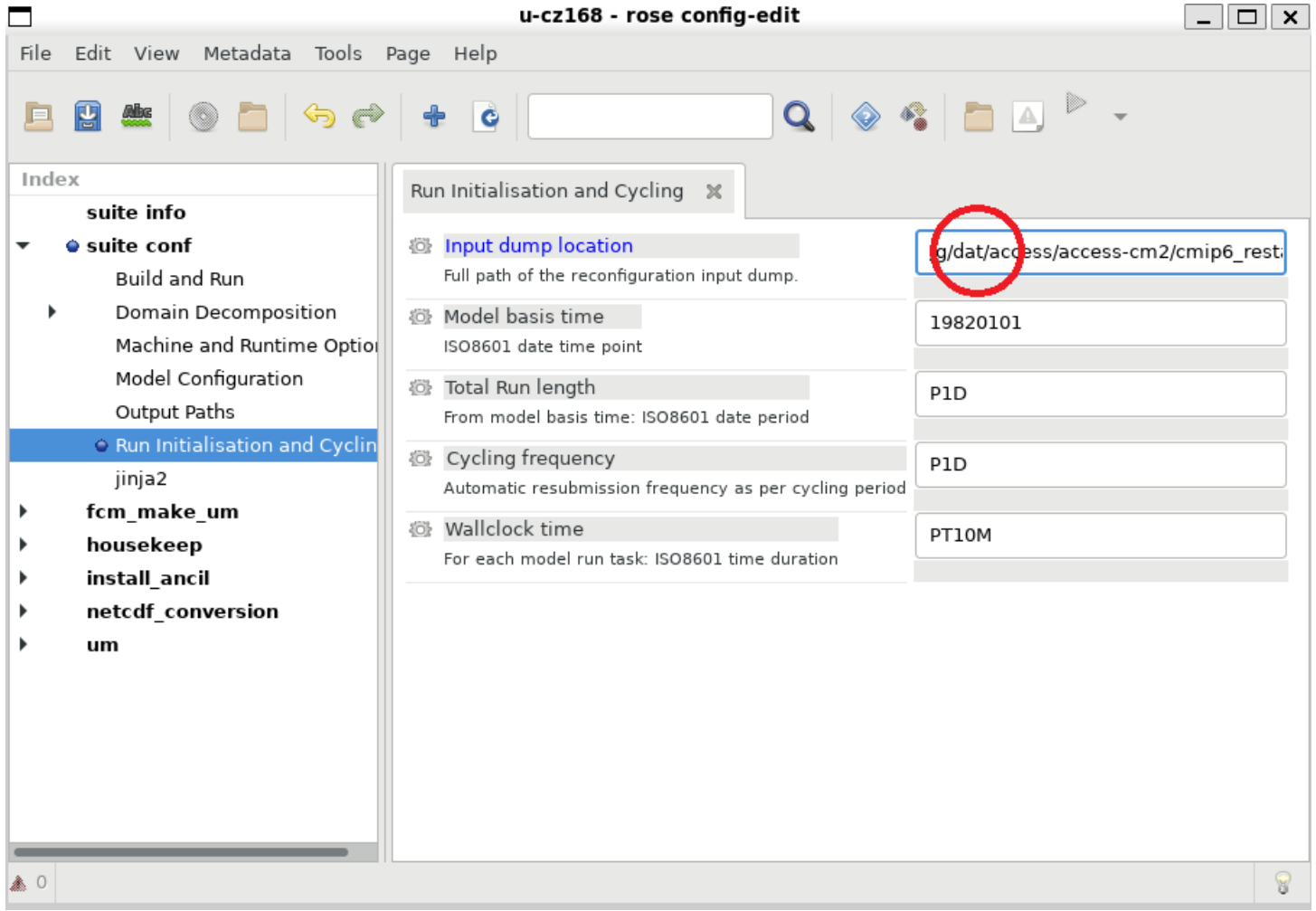
# Changed results

```
% 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

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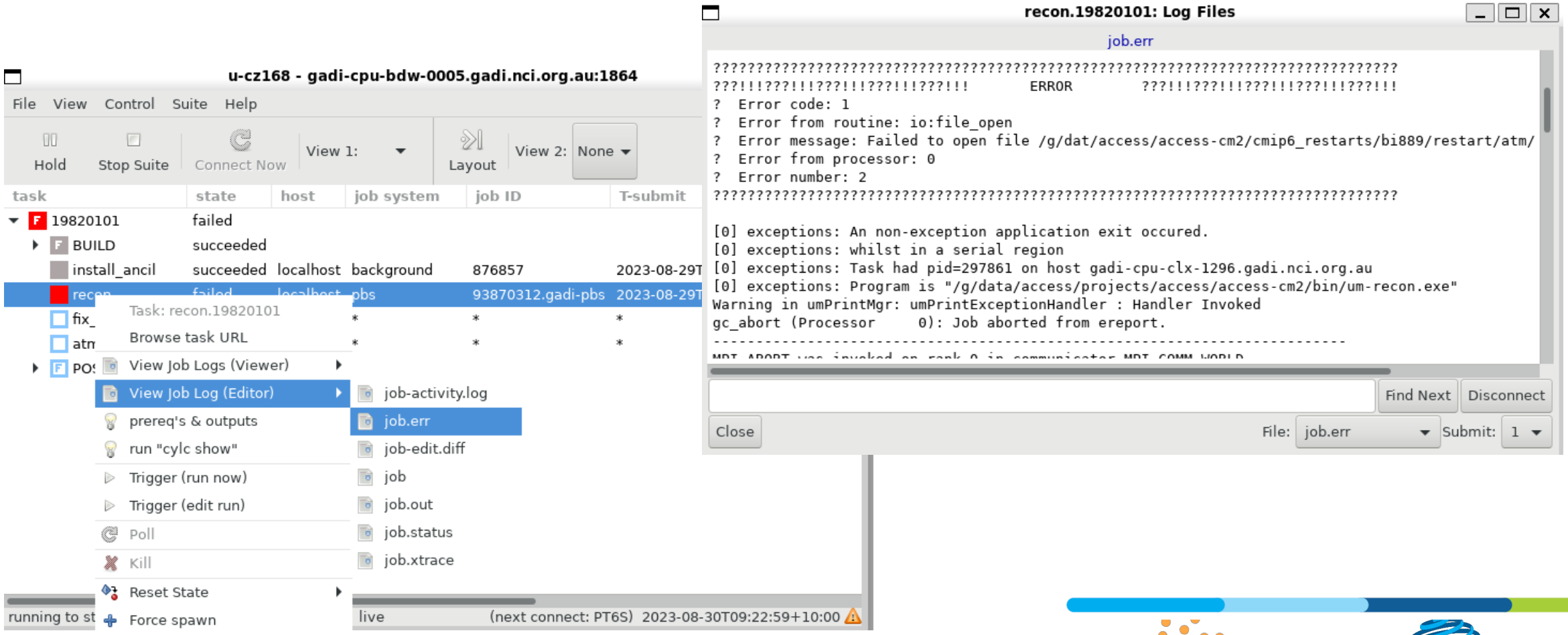
# Troubleshooting: Missing input dump

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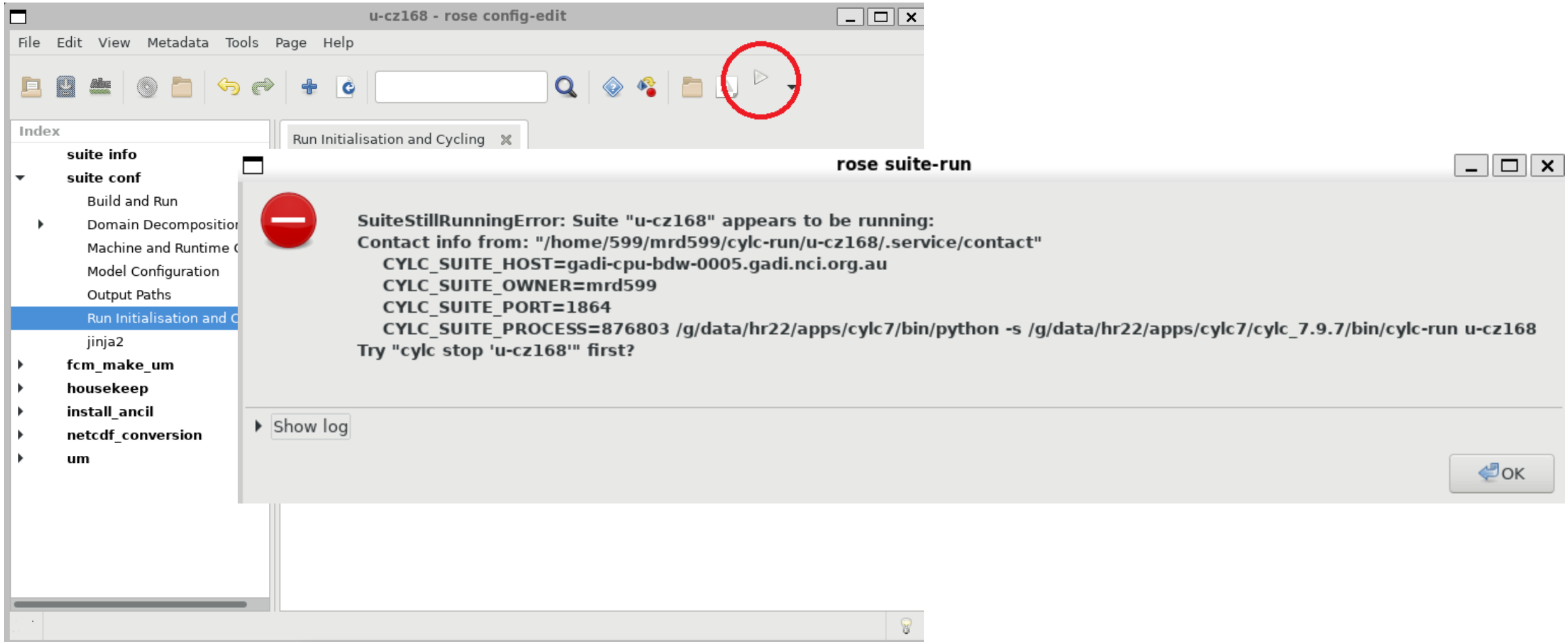
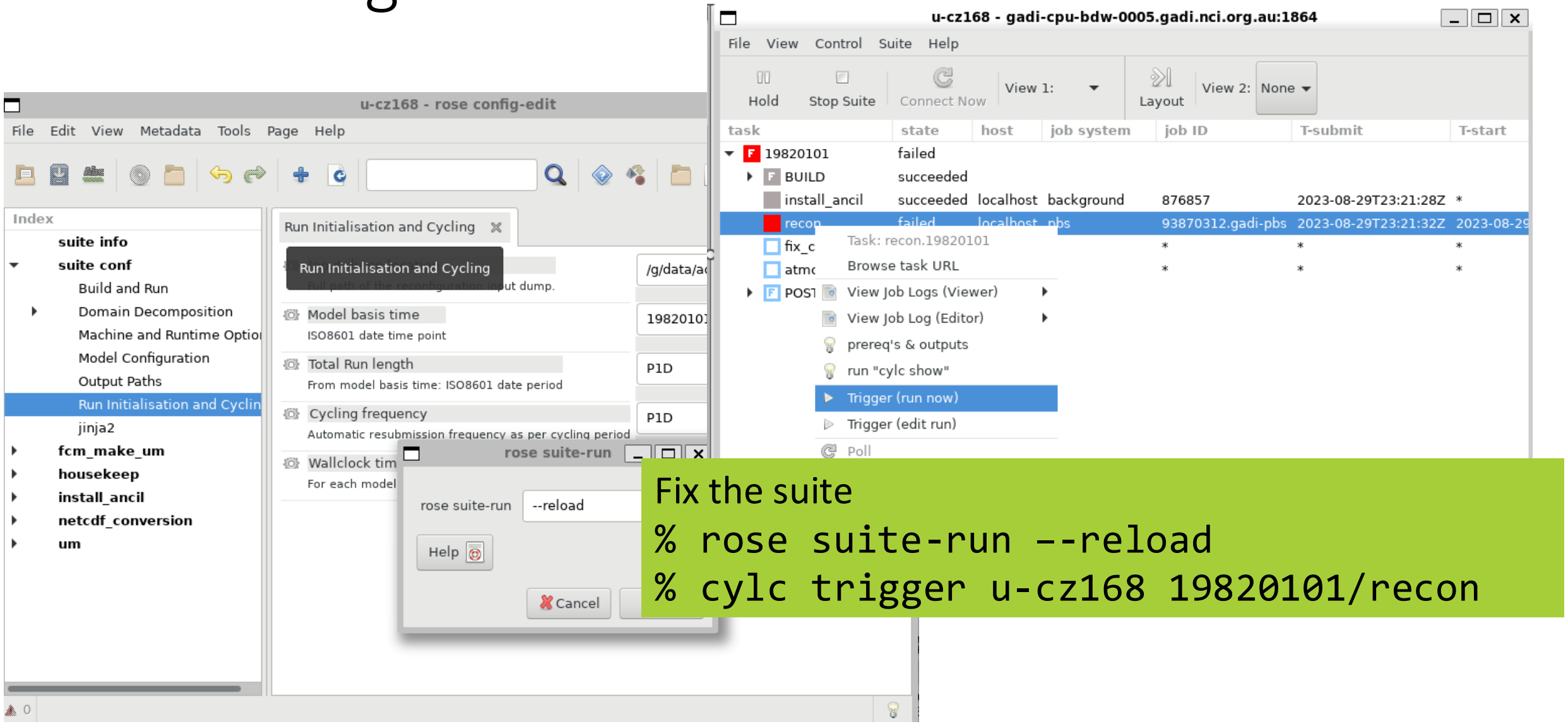
# Restarting after fix



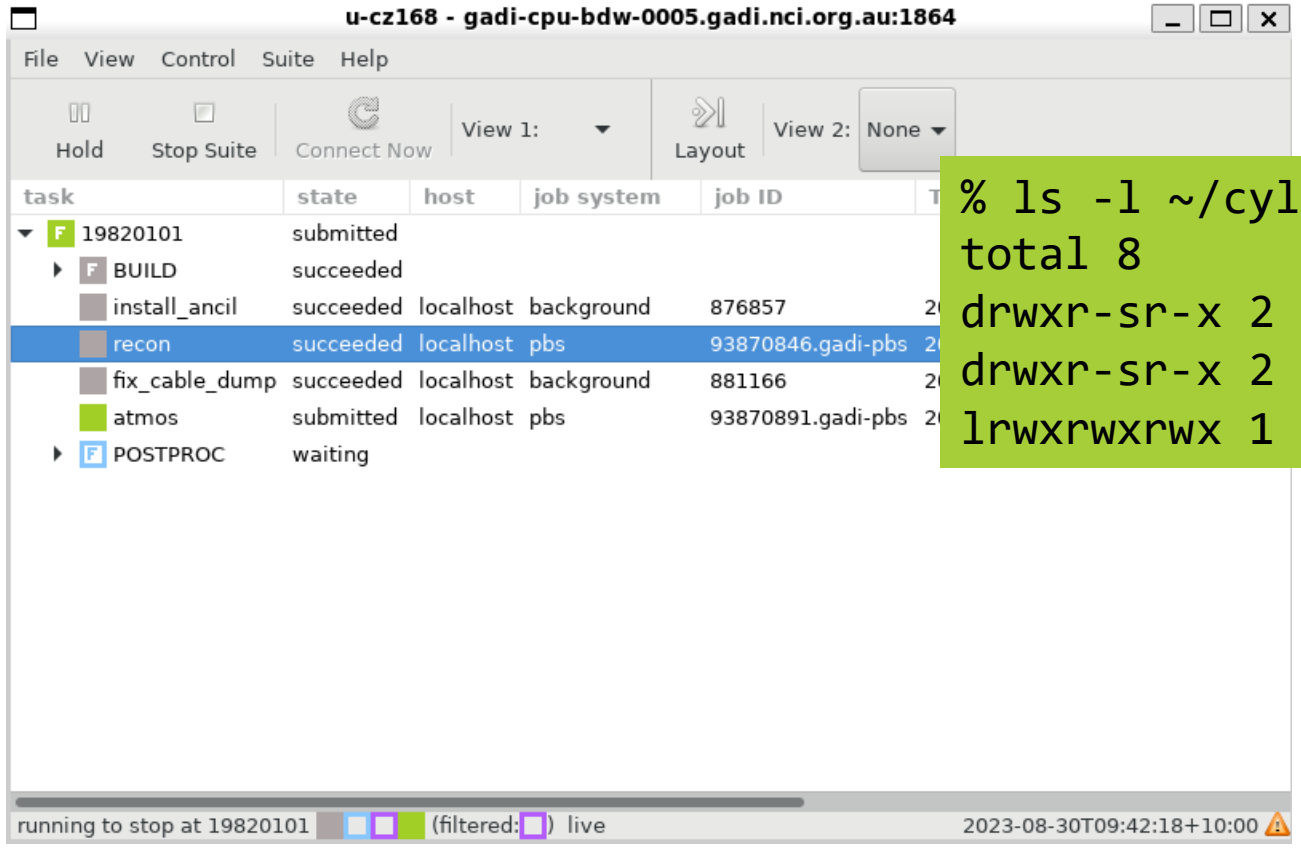
# Restarting with reload




Fix the suite

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

# Restarted success




```
% 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

# Interactive monitoring & **diagnostic analyses** of live ACCESS models.

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## **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 exisiting reference ACCESS models from the ACCESS-NRI Intake catalog
- Integration of diagnostic metrics and ESMValTool recipes currently in development

GitHub /ACCESS-NRI/MED-live-diagnostics

Read the Docs med-live-diagnostics.readthedocs.io

# 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

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