ACCESS
Australian Earth System Simulator
National Research Infrastructure

CMIP7 Evaluation Hackathon

The Australian Earth System Simulator
National Research Infrastructure (ACCESS-NRI)

Model Evaluation and Diagnostics

Romain.beucher@anu.edu.au

Outlines

Today:

- Model Evaluation at ACCESS-NRI
- What is ESMValTool? Why? How?
- What to expect from the hackathon

Tomorrow:

- ESMValTool Usage specifics
- Breakouts

ACCESS-NRI MED TEAM:

Building an Australian community framework for Evaluation of Earth System Models

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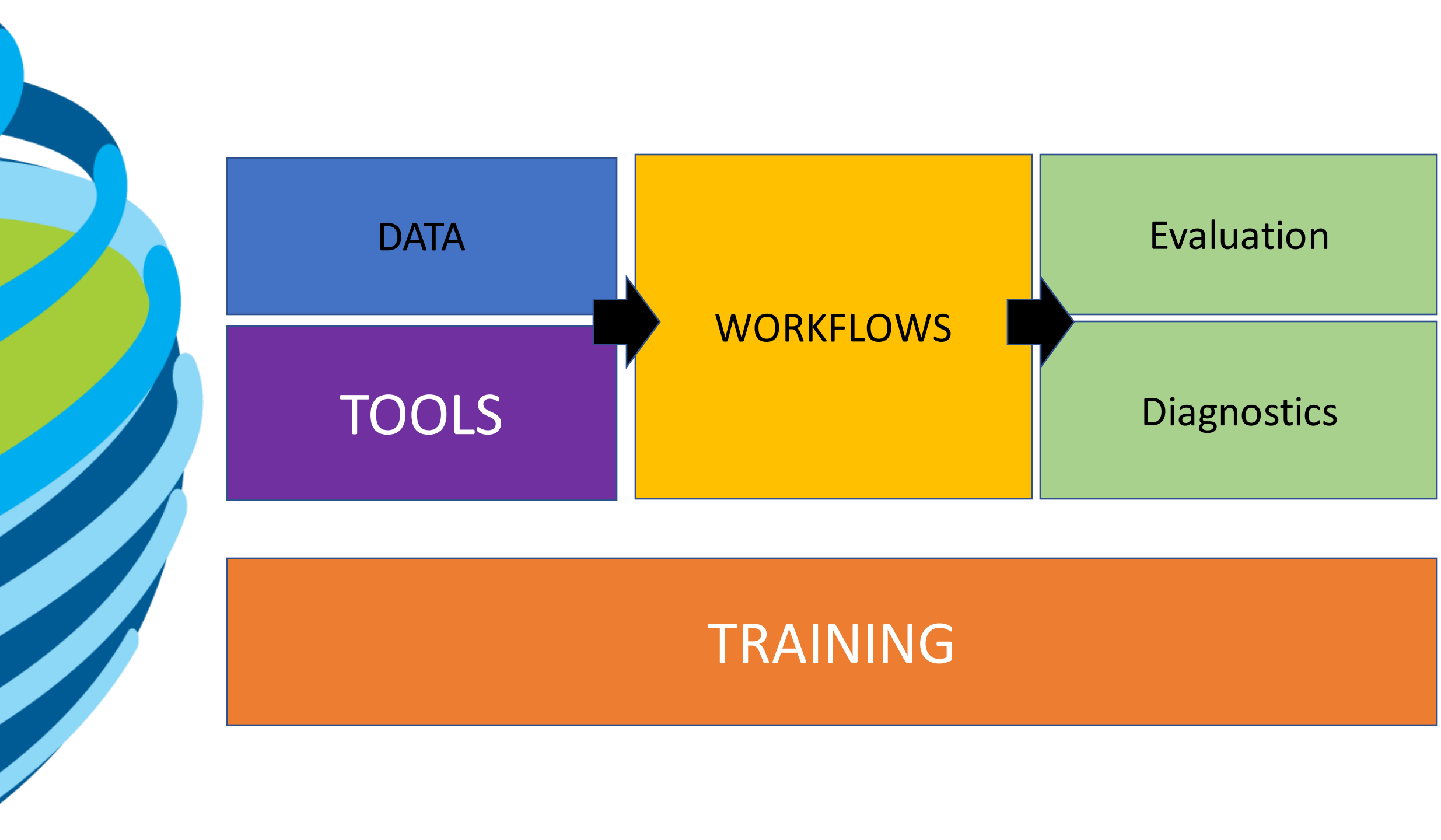
DATA
TOOLS
WORKFLOWS
Evaluation
Diagnostics
TRAINING

MED team is here to help!

We support **infrastructure** (software + data) and provide **technical support** / **training** to the **ACCESS community.**

- Deployment of supported tools on NCI Gadi (e.g. ESMValTool, ILAMB etc.)
- Development and support of evaluation tools and recipes.
- Curating, testing, optimising of new evaluation scripts and assisting for their publication / dissemination.
- Training of all level users.
- Community hub

What have we released and are currently supporting?

- ESMValTool-Workflow on NCI Gadi
- ILAMB-Workflow on NCI Gadi
- CMORised Observation datasets on NCI Gadi
- Integration of NCI Data collections
- Model outputs catalogues
- Live diagnostics tools
- Training material

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- Training material
- International community engagement

ESMValTool-Workflow

Australian Earth System Simulator
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ESMValTool deployed and maintained by ACCESS-NRI on Gadi.

- CMIP collections support
- CMORised observation datasets
- Reanalysis support

Requires access to project XP65 (ACCESS Model Evaluation)

ESMValTool-workflow v1.0 launches today. Here is what you need to know

ACCESS-NRI Releases python, model-evaluation, cmip7, release, esmvaltool

16 Nov

rbeucher Romain Beucher ACCESS-NRI Model Evaluation and Diagnostics Team Lead 2 21d

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16 Nov

What is ESMValTool?

The Earth System Model Evaluation Tool (ESMValTool) is a tool developed for evaluation of Earth System Models in CMIP (Climate Model Intercomparison Projects). It allows for routine comparison of single or multiple models, either against predecessor versions or against observations. ESMValTool is a community-developed climate model diagnostics and evaluation software package, driven both by computational performance and scientific accuracy and reproducibility. It is open to both users and developers, encouraging open exchange of diagnostic source code and evaluation results from the Coupled Model Intercomparison Project CMIP ensemble.

What are we releasing?

ACCESS-NRI is releasing an NCI configuration of ESMValTool under the name **ESMValTool-workflow**.

10d ago

ESMValTool-workflow is the **ACCESS-NRI software and data infrastructure that enables the ESMValTool evaluation framework on NCI Gadi**. It includes the ESMValTool/ESMValCore Python packages, the ESMValTool collection of recipes and diagnostics and some observational datasets. ESMValTool-workflow is configured to use the existing NCI supported CMIP data collections.

ESMValTool-workflow v1.0 includes support for:

- ESMValCore v2.9
- ESMValTool v2.9
- ESMValTool Tier 1 and Tier 2 recipes with live status update available here 1.
- Data Pool of ESMValTool Tier 1 and Tier 2 observation datasets via the ACCESS-NRI Replicated Datasets for Climate Model Evaluation 1.
- Support for CMIP[5-6] data collections at NCI
- Native support of ERA5 monthly datasets.
- Nightly updates of the ESMValTool development container.

ESMValTool-workflow v1.0 includes limited support for:

- CMIP3 NCI data collections
- ERA5 daily datasets
- Tier 3 recipes

See post

What have we released and are currently supporting?

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ILAMB-Workflow
(International Land Model Benchmarking)

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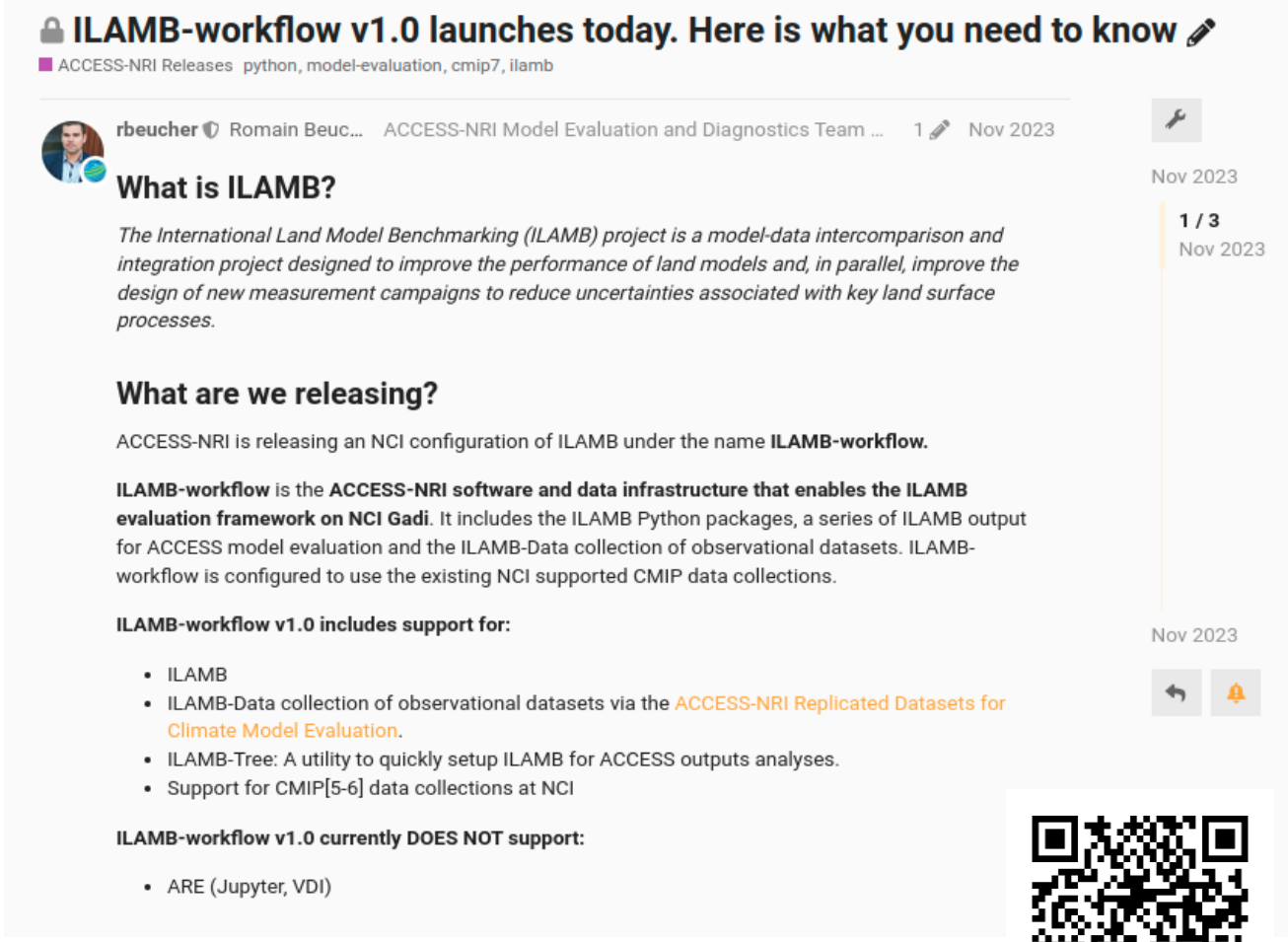
ILAMB deployed and maintained by ACCESS-NRI on Gadi.

- CMIP collections support
- CMORised observation datasets



ILAMB-workflow v1.0 launches today. Here is what you need to know

ACCESS-NRI Releases python, model-evaluation, cmip7, ilamb

rbeucher Romain Beuc... ACCESS-NRI Model Evaluation and Diagnostics Team ... 1 Nov 2023

Nov 2023

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Nov 2023

What is ILAMB?

The International Land Model Benchmarking (ILAMB) project is a model-data intercomparison and integration project designed to improve the performance of land models and, in parallel, improve the design of new measurement campaigns to reduce uncertainties associated with key land surface processes.

What are we releasing?

ACCESS-NRI is releasing an NCI configuration of ILAMB under the name **ILAMB-workflow.**

ILAMB-workflow is the **ACCESS-NRI software and data infrastructure that enables the ILAMB evaluation framework on NCI Gadi**. It includes the ILAMB Python packages, a series of ILAMB output for ACCESS model evaluation and the ILAMB-Data collection of observational datasets. ILAMB-workflow is configured to use the existing NCI supported CMIP data collections.

ILAMB-workflow v1.0 includes support for:

- ILAMB
- ILAMB-Data collection of observational datasets via the ACCESS-NRI Replicated Datasets for Climate Model Evaluation.
- ILAMB-Tree: A utility to quickly setup ILAMB for ACCESS outputs analyses.
- Support for CMIP[5-6] data collections at NCI

ILAMB-workflow v1.0 currently DOES NOT support:

- ARE (Jupyter, VDI)

Nov 2023

Requires access to project XP65 (ACCESS Model Evaluation)

See post

What have we released and are currently supporting?

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Replica datasets for Model Evaluation

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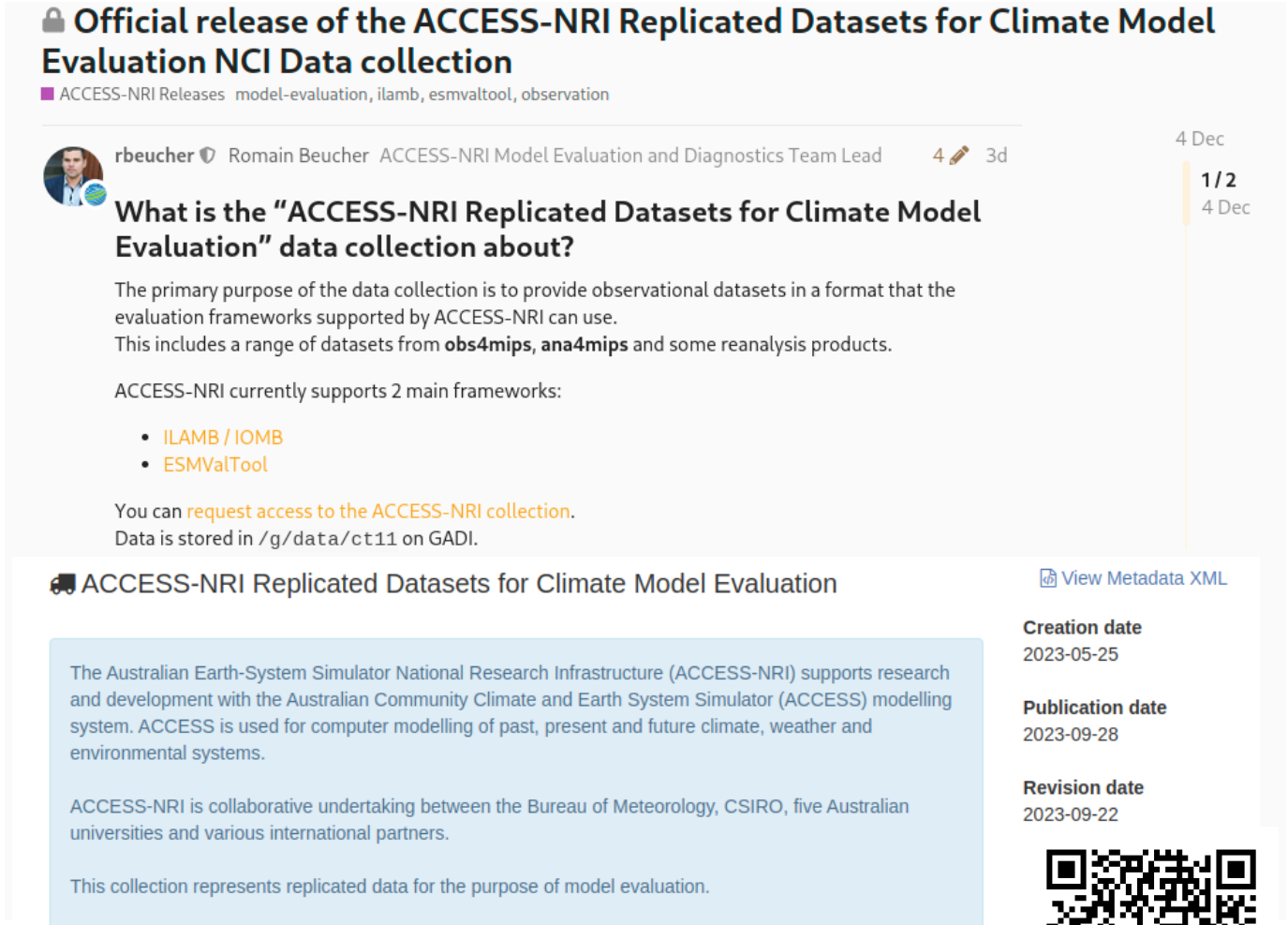
CMORised Observations datasets:

- ILAMB sub-collection
- ESMValTool sub-collection

Requires access to project CT11 (ACCESS-NRI replica datasets)



Official release of the ACCESS-NRI Replicated Datasets for Climate Model Evaluation NCI Data collection

ACCESS-NRI Releases model-evaluation, ilamb, esmvaltool, observation

4 Dec

rbeucher Romain Beucher ACCESS-NRI Model Evaluation and Diagnostics Team Lead 4 3d

1 / 2
4 Dec

What is the "ACCESS-NRI Replicated Datasets for Climate Model Evaluation" data collection about?

The primary purpose of the data collection is to provide observational datasets in a format that the evaluation frameworks supported by ACCESS-NRI can use.
This includes a range of datasets from **obs4mips**, **ana4mips** and some reanalysis products.

ACCESS-NRI currently supports 2 main frameworks:

- ILAMB / IOMB
- ESMValTool

You can request access to the ACCESS-NRI collection.
Data is stored in `/g/data/ct11` on GADI.

ACCESS-NRI Replicated Datasets for Climate Model Evaluation

View Metadata XML

The Australian Earth-System Simulator National Research Infrastructure (ACCESS-NRI) supports research and development with the Australian Community Climate and Earth System Simulator (ACCESS) modelling system. ACCESS is used for computer modelling of past, present and future climate, weather and environmental systems.

ACCESS-NRI is collaborative undertaking between the Bureau of Meteorology, CSIRO, five Australian universities and various international partners.

This collection represents replicated data for the purpose of model evaluation.

For more information and documentation, refer to the ACCESS-NRI website (https://www.access-nri.org.au) and 'ACCESS-Hive' portal (https://access-hive.org.au).

Creation date
2023-05-25

Publication date
2023-09-28

Revision date
2023-09-22

See post

Replica datasets for Model Evaluation

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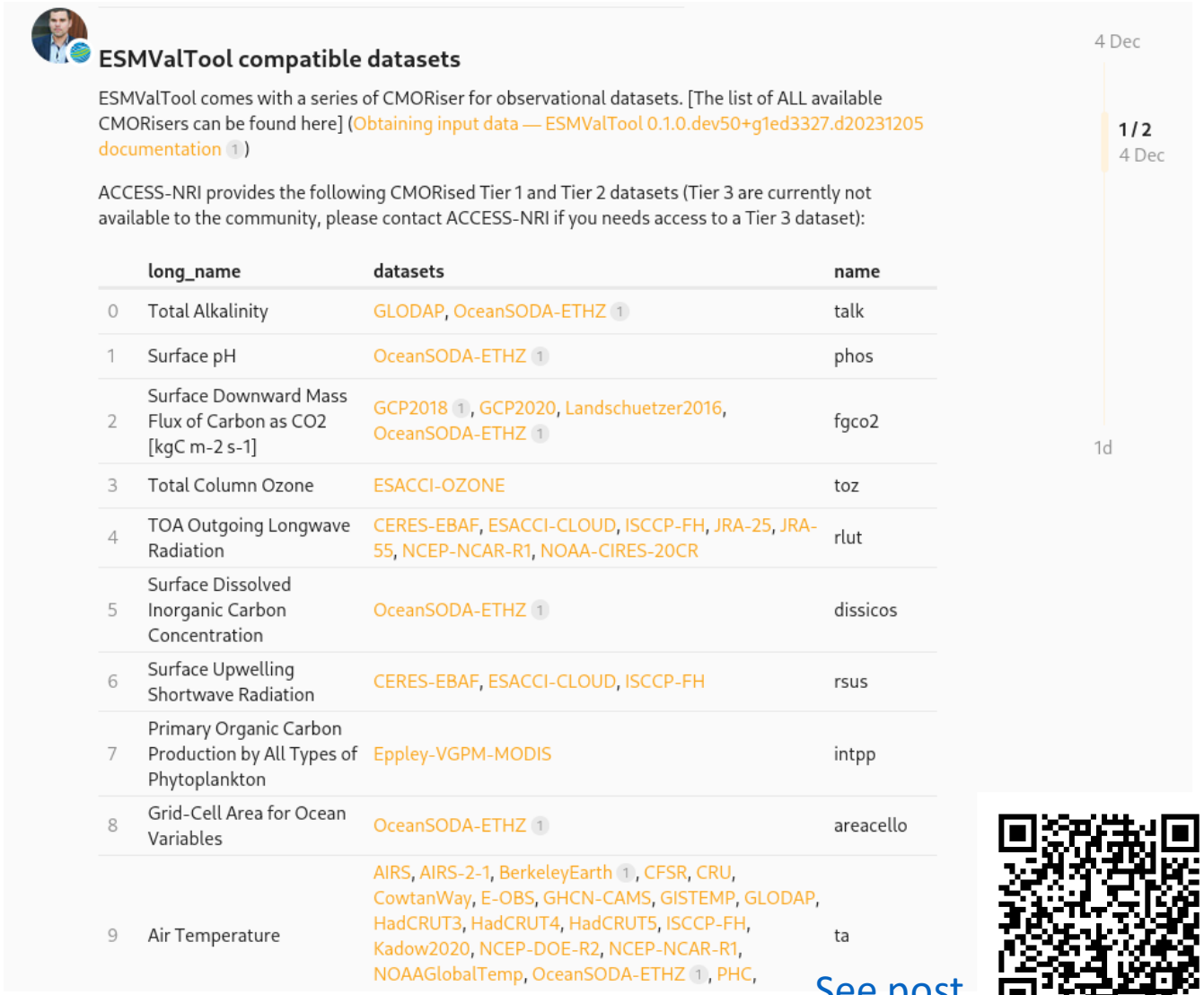
CMORised Observations datasets:

ESMValTool sub-collection

"Tier 1" and "Tier 2" public

Currently working on moving Licensed (restricted) datasets to the public collection.



ESMValTool compatible datasets

ESMValTool comes with a series of CMORiser for observational datasets. [The list of ALL available CMORisers can be found here] (Obtaining input data — ESMValTool 0.1.0.dev50+g1ed3327.d20231205 documentation 1)

ACCESS-NRI provides the following CMORised Tier 1 and Tier 2 datasets (Tier 3 are currently not available to the community, please contact ACCESS-NRI if you needs access to a Tier 3 dataset):

	long_name	datasets	name
0	Total Alkalinity	GLODAP, OceanSODA-ETHZ 1	talk
1	Surface pH	OceanSODA-ETHZ 1	phos
2	Surface Downward Mass Flux of Carbon as CO2 [kgC m-2 s-1]	GCP2018 1, GCP2020, Landschuetzer2016, OceanSODA-ETHZ 1	fgco2
3	Total Column Ozone	ESACCI-OZONE	toz
4	TOA Outgoing Longwave Radiation	CERES-EBAF, ESACCI-CLOUD, ISCCP-FH, JRA-25, JRA-55, NCEP-NCAR-R1, NOAA-CIRES-20CR	rlut
5	Surface Dissolved Inorganic Carbon Concentration	OceanSODA-ETHZ 1	dissicos
6	Surface Upwelling Shortwave Radiation	CERES-EBAF, ESACCI-CLOUD, ISCCP-FH	rsus
7	Primary Organic Carbon Production by All Types of Phytoplankton	Eppley-VGPM-MODIS	intpp
8	Grid-Cell Area for Ocean Variables	OceanSODA-ETHZ 1	areacello
9	Air Temperature	AIRS, AIRS-2-1, BerkeleyEarth 1, CFSR, CRU, CowtanWay, E-OBS, GHCN-CAMS, GISTEMP, GLODAP, HadCRUT3, HadCRUT4, HadCRUT5, ISCCP-FH, Kadow2020, NCEP-DOE-R2, NCEP-NCAR-R1, NOAAGlobalTemp, OceanSODA-ETHZ 1, PHC,	ta

4 Dec

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4 Dec

1d

See post

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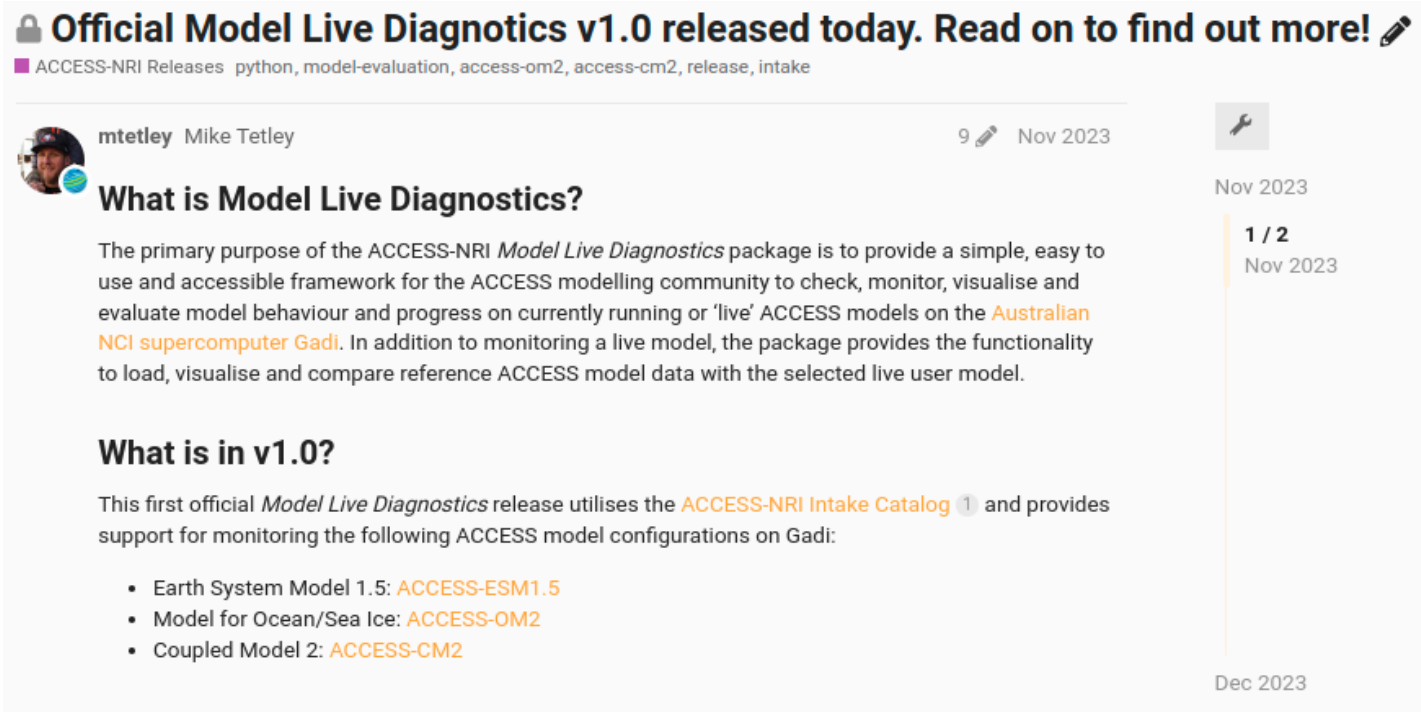
Model Live Diagnostics (v1)

- Check
- Monitor
- Visualise
- Evaluate

of currently running or ‘live’ ACCESS models

Currently exploring integrating ESMValTool and ILAMB



Official Model Live Diagnotics v1.0 released today. Read on to find out more!

ACCESS-NRI Releases python, model-evaluation, access-om2, access-cm2, release, intake

mtetley Mike Tetley 9 Nov 2023

Nov 2023

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Nov 2023

Dec 2023

What is Model Live Diagnostics?

The primary purpose of the ACCESS-NRI *Model Live Diagnostics* package is to provide a simple, easy to use and accessible framework for the ACCESS modelling community to check, monitor, visualise and evaluate model behaviour and progress on currently running or ‘live’ ACCESS models on the Australian NCI supercomputer Gadi. In addition to monitoring a live model, the package provides the functionality to load, visualise and compare reference ACCESS model data with the selected live user model.

What is in v1.0?

This first official *Model Live Diagnostics* release utilises the ACCESS-NRI Intake Catalog 1 and provides support for monitoring the following ACCESS model configurations on Gadi:

- Earth System Model 1.5: ACCESS-ESM1.5
- Model for Ocean/Sea Ice: ACCESS-OM2
- Coupled Model 2: ACCESS-CM2

[See post](bitly)

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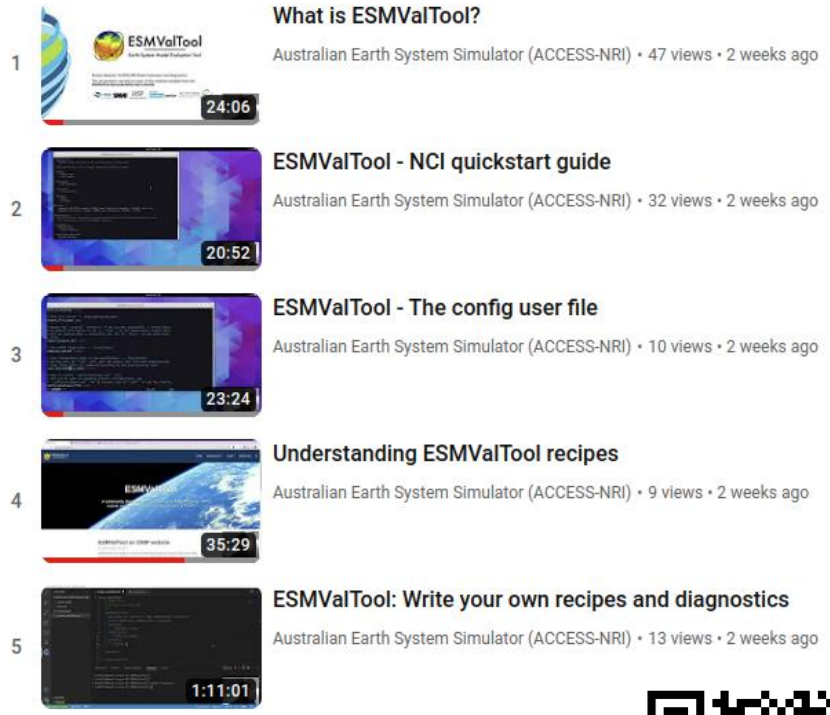
ESMValTool-Workflow: Youtube Training

Target ACCESS users on NCI Gadi



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Community engagement

- ESMValTool consortium
- ACCESS-NRI MED has joined:
  - ESMValTool Core development team
  - ESMValTool Observation data group
- EGU 2024 ESMValTool splinter session
- ESMValTool Annual Workshop 2024 (Munich, Germany)
- Organisation of Pacific time friendly community meeting
- ACCESS Q&A Virtual Drop-in sessions

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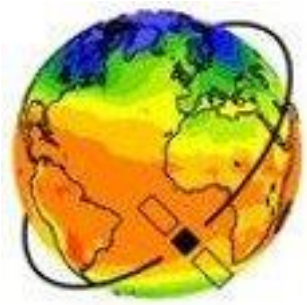


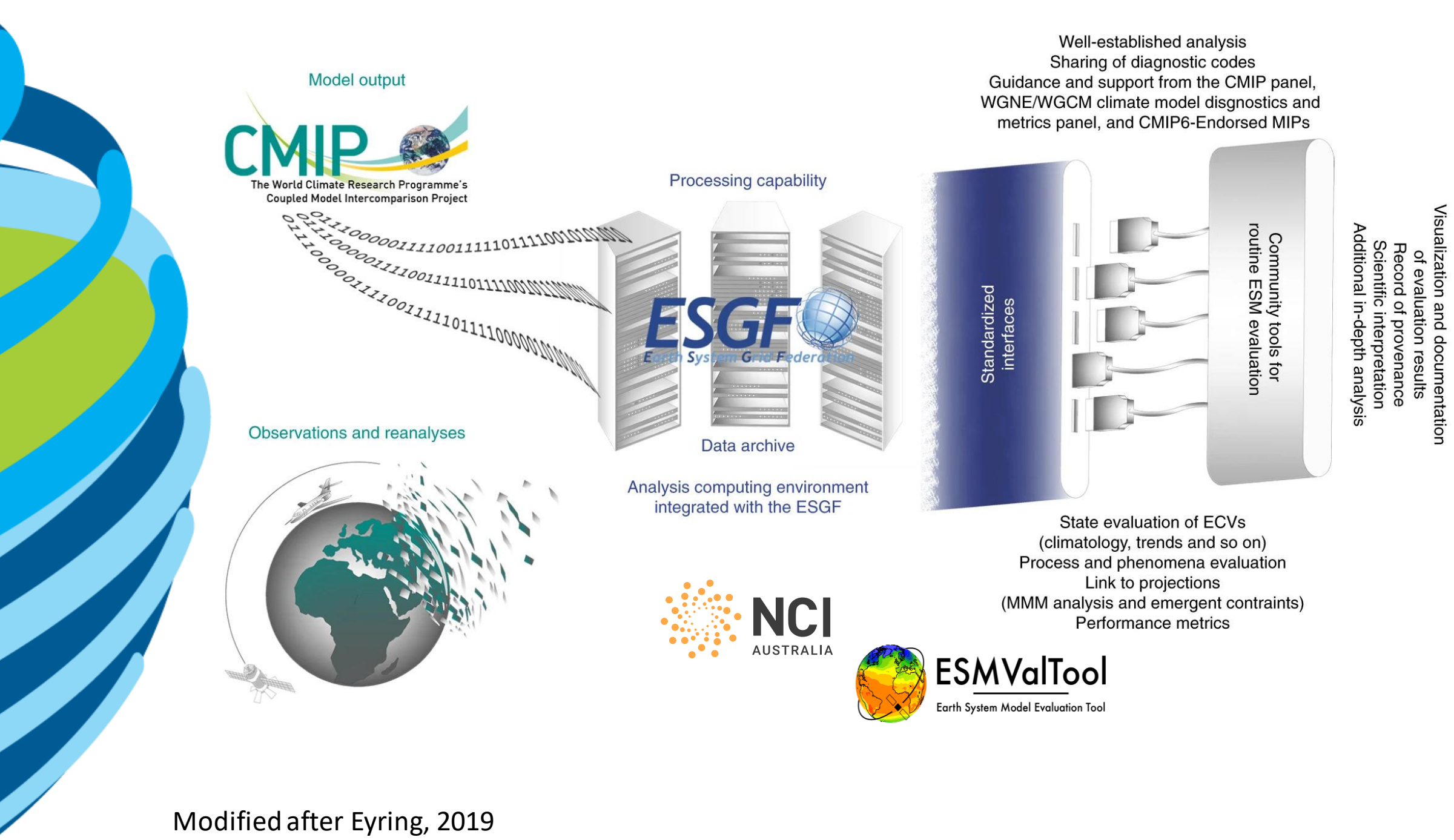
ESMValTool

Earth System Model Evaluation Tool

Romain Beucher: ACCESS-NRI Model Evaluation and Diagnostics

This presentation reproduces parts of the material available from the **ESMValTool documentation and tutorials.**

DKRZ DEUTSCHES KLIMARECHENZENTRUM
SMHI
EUCP European Climate Prediction system
netherlands eScience center
is-enes INFRASTRUCTURE FOR THE EUROPEAN NETWORK FOR EARTH SYSTEM MODELLING



Modified after Eyring, 2019

What is ESMValTool?

ESMValTool has a wide range of uses.

✓ **A tool to analyse climate data**
✓ **A collection of diagnostics for reproducible climate science**
✓ **A community effort**

What is ESMValTool?

The Earth System Model Evaluation Tool, ESMValTool, is a python-based software toolkit built to evaluate models of the Earth's climate.

ESMValTool is made to be:

- Versatile
- Flexible
- Modular
- Standardised
- Community driven

Why are we supporting ESMValtool?

- Already available and usable.
- Best to support / improve an existing tool than to reinvent the wheel.
- Large, active community in Europe. Opportunities for collaboration and joint development.
- Consortium of established organisations in Europe
- Supported by the UK MET Office. Plan is to replace Auto-Assess and use ESMValTool for routine evaluation to support development of the Unified Model.

What resources from ACCESS-NRI?

- Technical Expertise
- Trained Research Software Engineers
- Mirrored data-pool of observation datasets
- Southern Hemisphere / Pacific / Australian perspective

A tool to analyse data

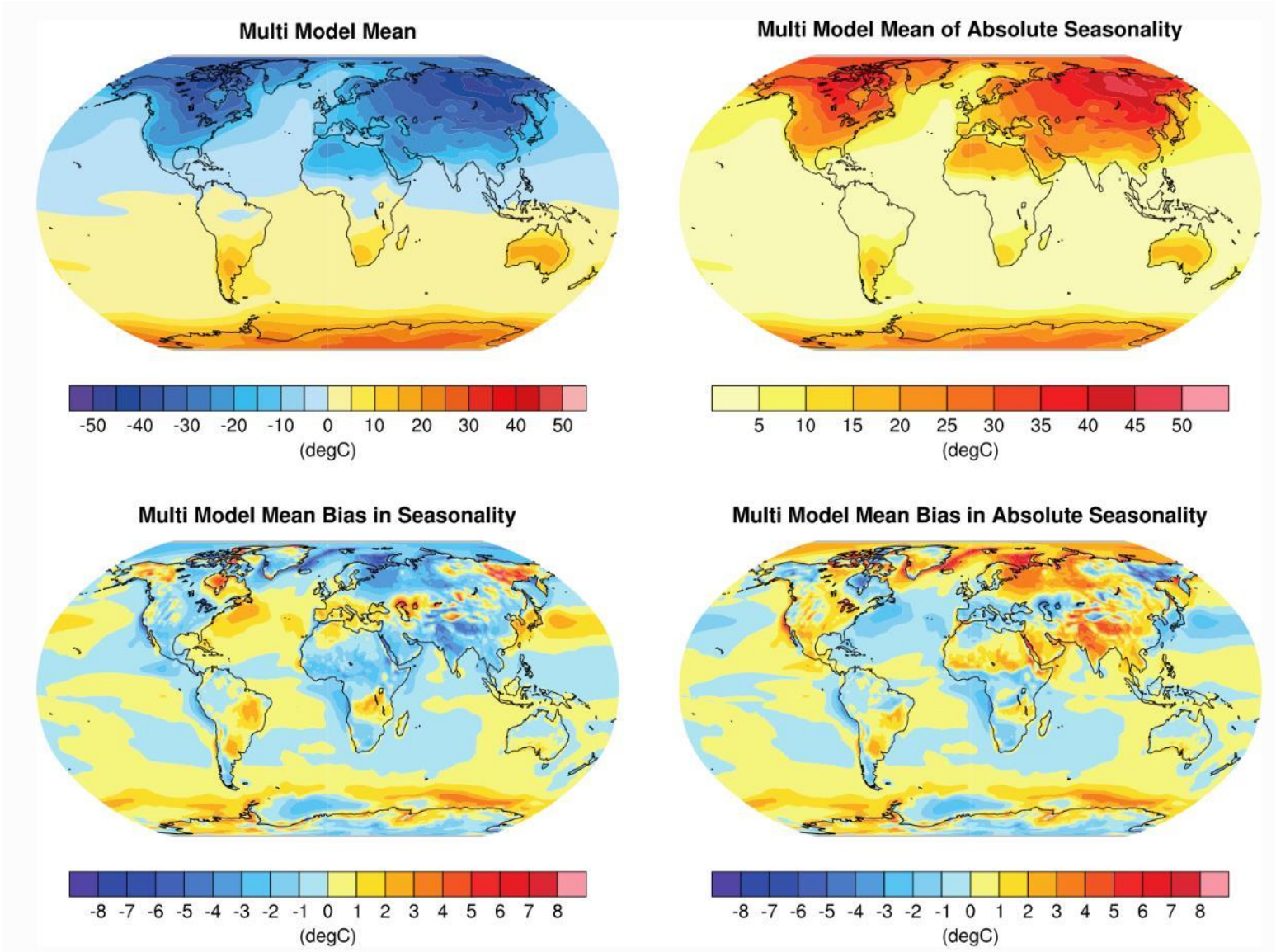
ESMValTool takes care of **finding**, **opening**, **checking**, **fixing**, **concatenating**, and **preprocessing** CMIP data and several other supported datasets.

The central component of ESMValTool is the **recipe.**

A set of instructions (workflow) on how to reproduce a result.

Routine evaluation of Climate models

- Model vs Model
- Model vs Observation
- Observation vs Observation



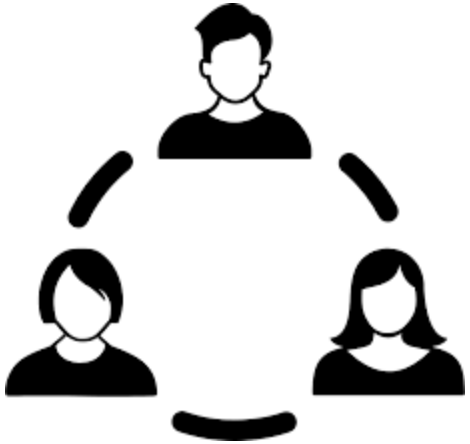
It facilitates the analysis of Earth system model data.

Advantages?

others can understand our analyses

we spend less time on developing code

we can re-use code
instead of re-implementing it



We can coordinate our efforts with the community

CMIP
Coupled Model Intercomparison Project

Disadvantages?

Takes time to master.

Developing new recipes can be slow

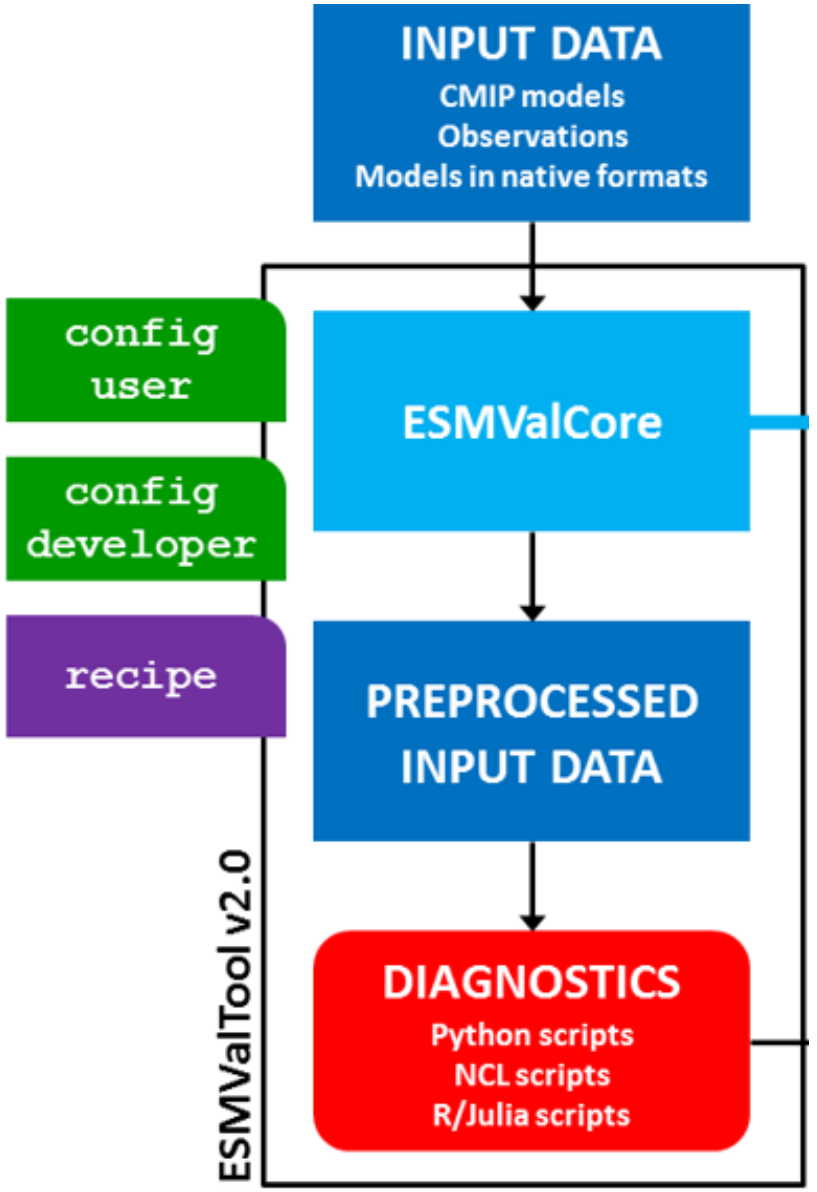
Existing recipes often need to be adapted to our needs

ACCESS-NRI
IS
HERE
TO
HELP!!!

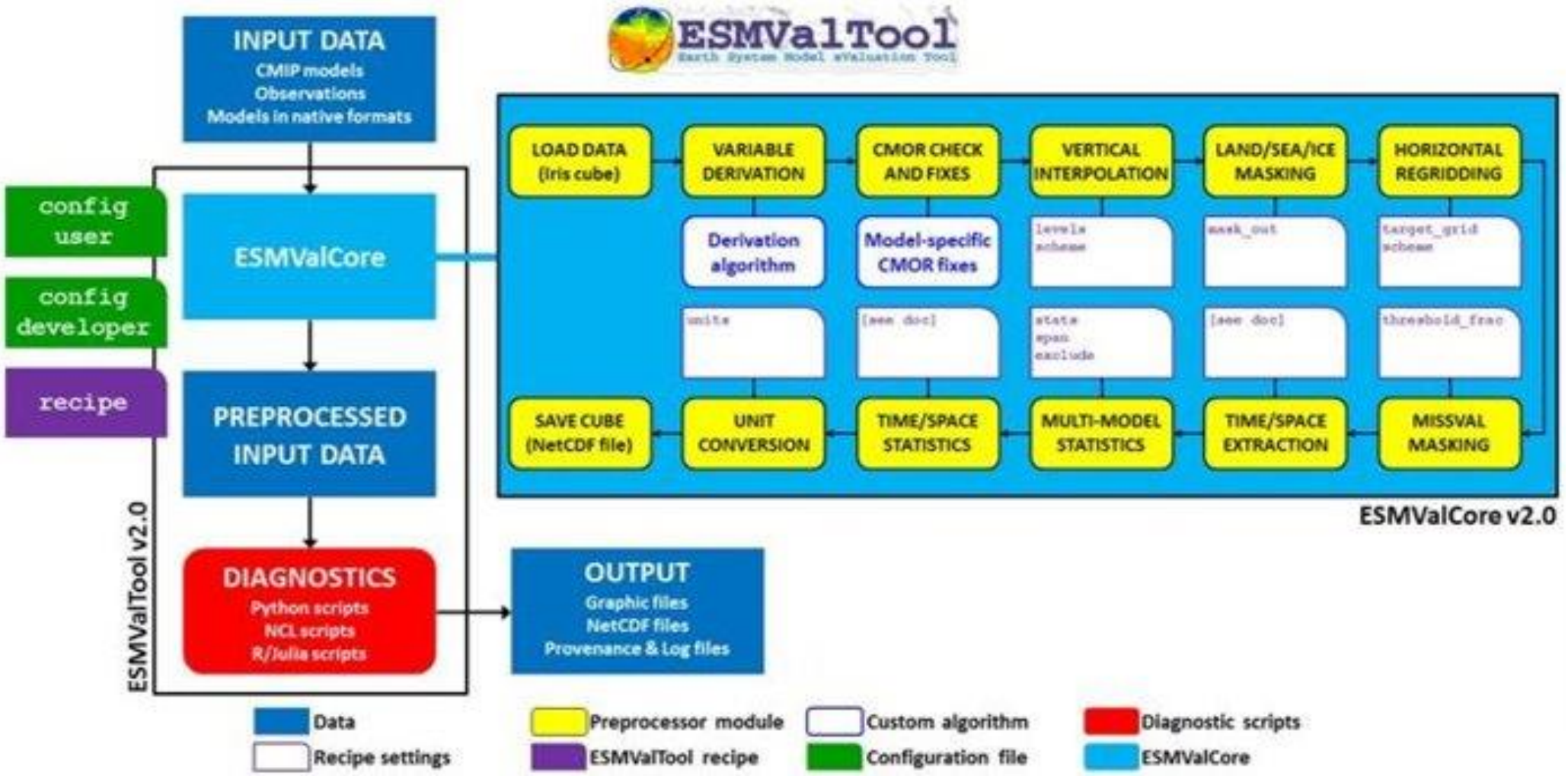
ESMValCore:
- Finds data
- preprocessors

ESMValTool:
- Recipes: Orchestration between Data, preprocessors, and diagnostics.

Pre-configured to use NCI CMIP data collections and ACCESS-NRI CMORised observations datasets (**ESMValTool-Workflow**)



A quick overview of the CORE

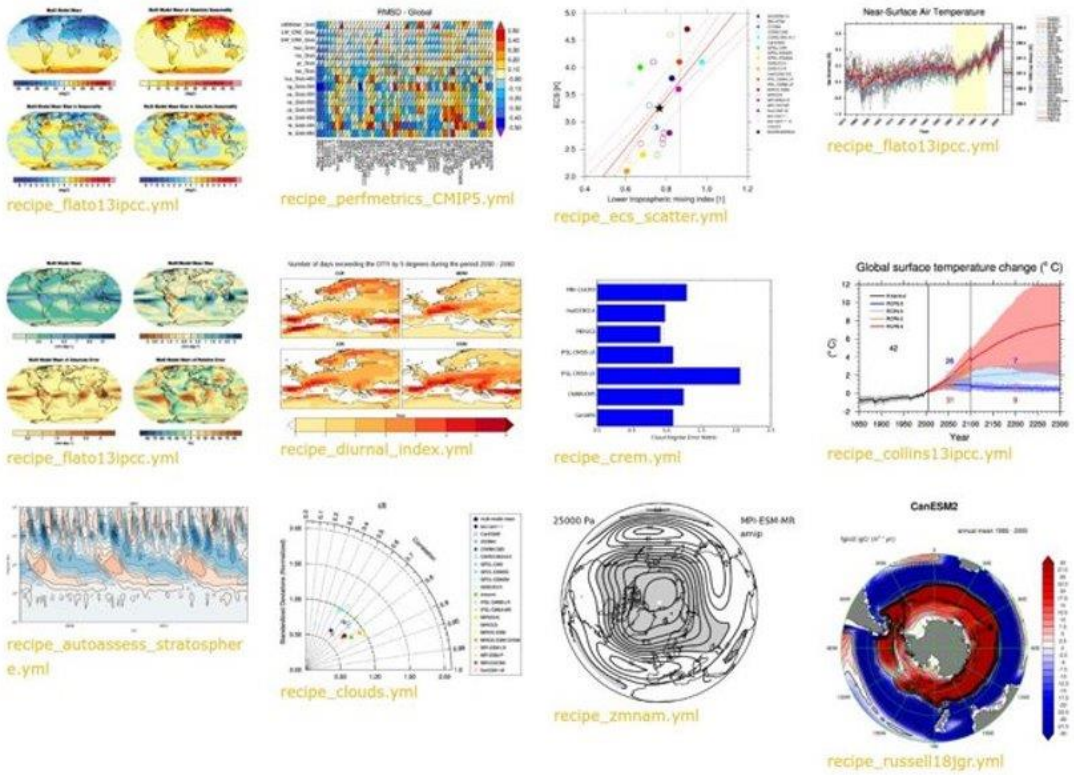


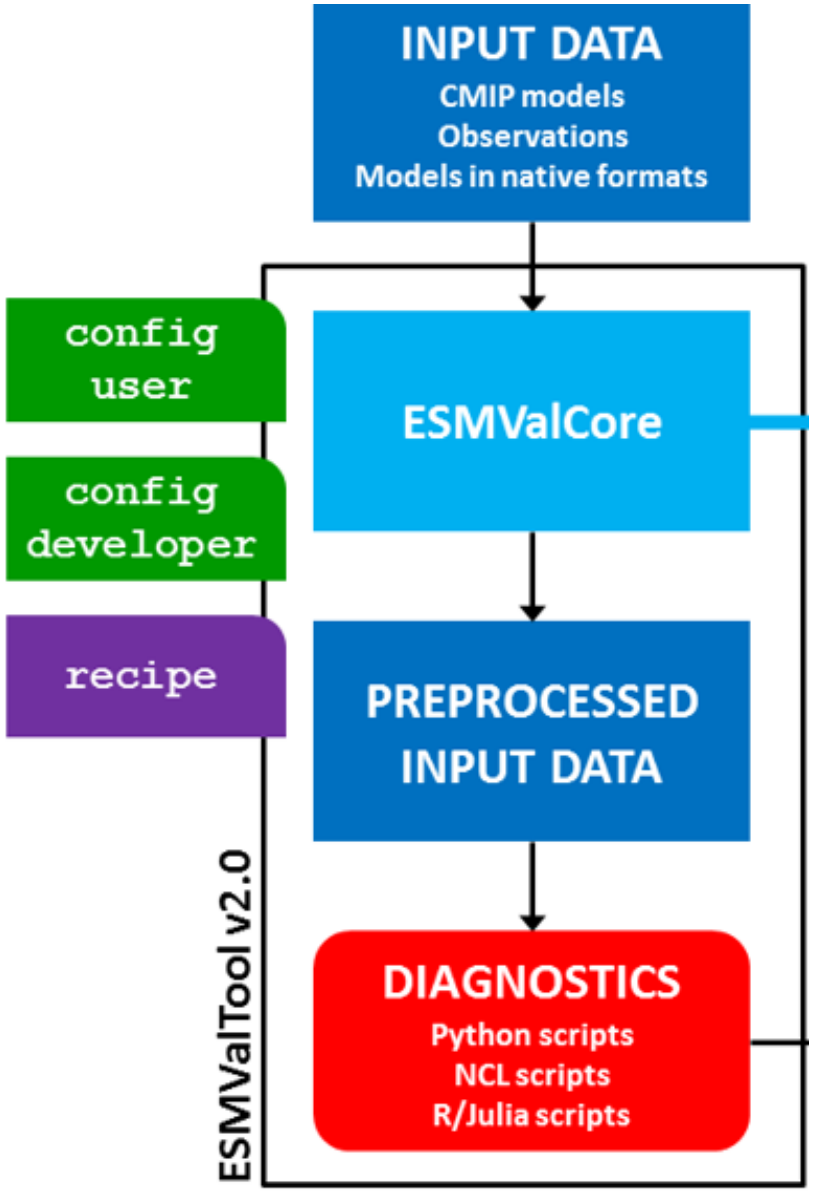
A collection of diagnostics for reproducible climate science

More than a tool, ESMValTool is a collection of publicly available recipes and diagnostic scripts. This makes it possible to:

- Reproduce scientific publications
- Reproduce IPCC reports figures
- Build routine evaluation workflows

https://docs.esmvaltool.org





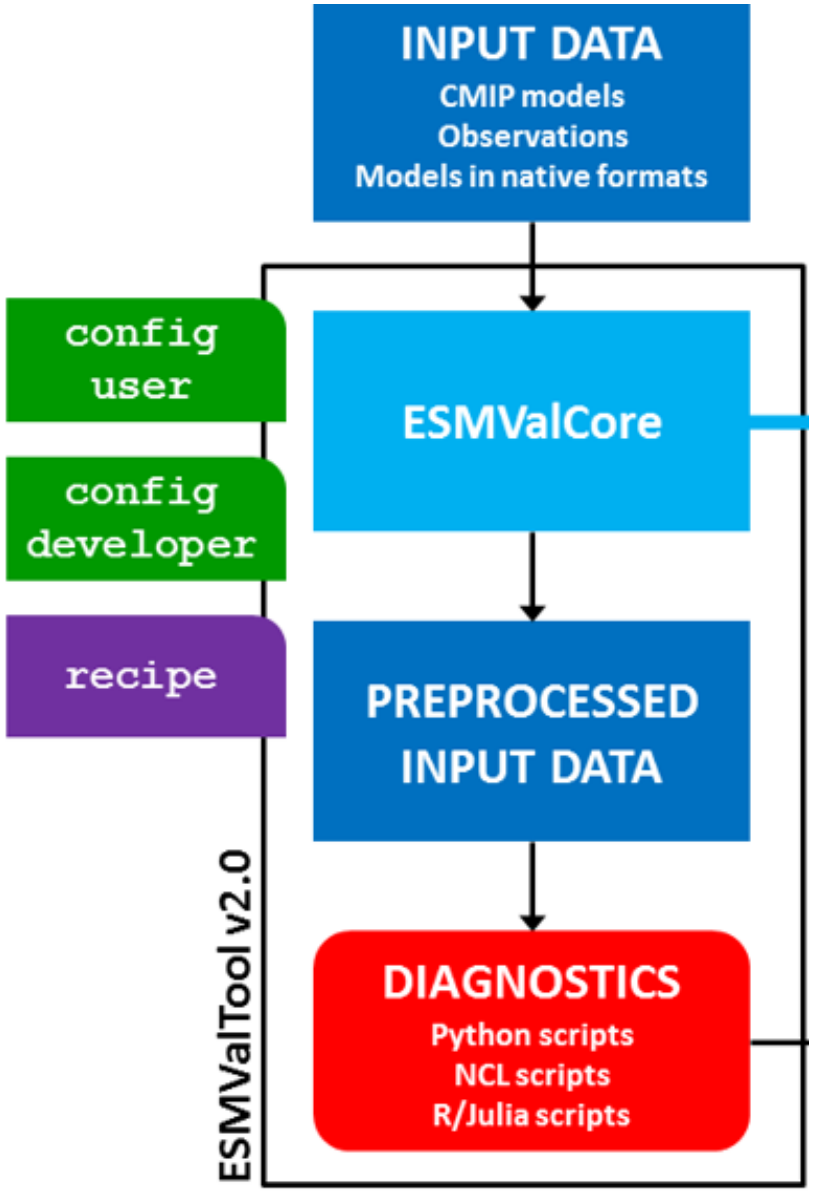
Recipe

Instructions are given to esmvaltool using a YAML script called a recipe.

Instructions like:

- the **datasets** that need to be analyzed,
- the **preprocessors** that need to be applied,
- the specific **diagnostic** analysis to be carried out.

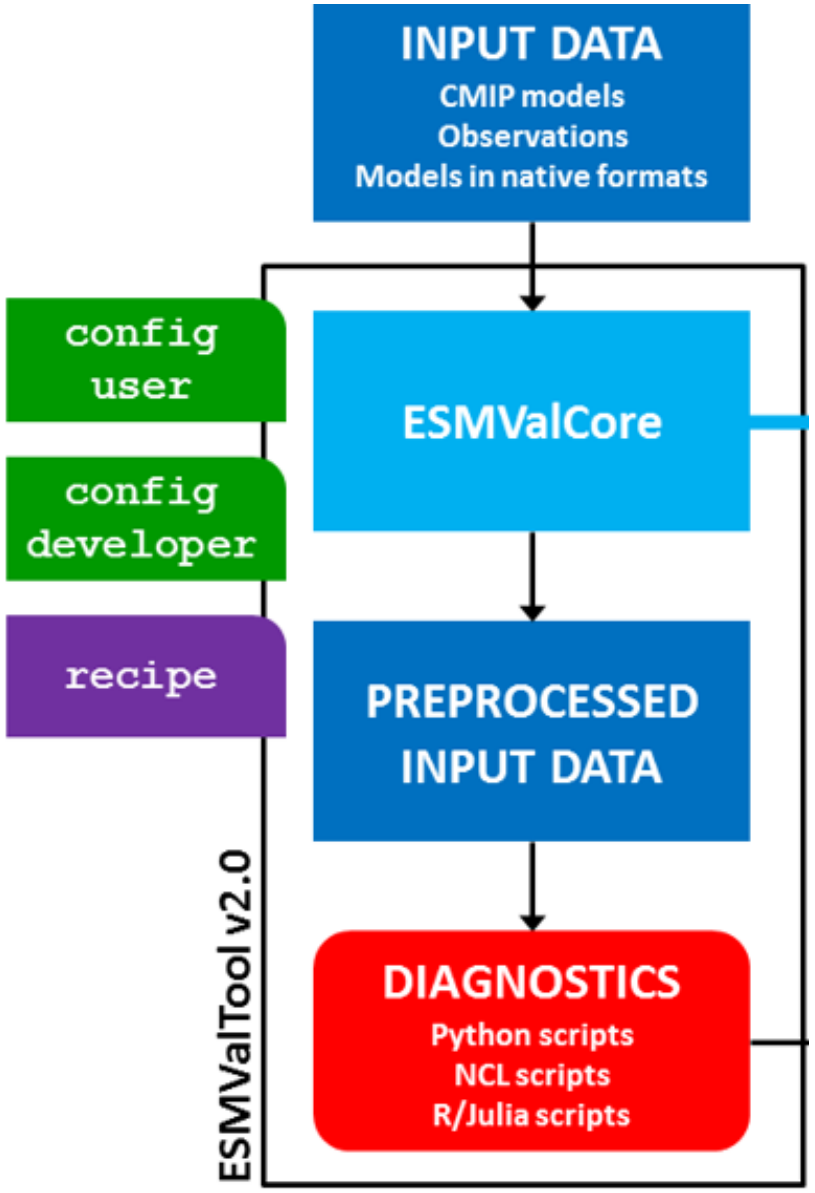
Available recipes:
https://docs.esmvaltool.org/en/latest/recipes/index.html



How to run a recipe:

- ESMValTool as a command-line tool:

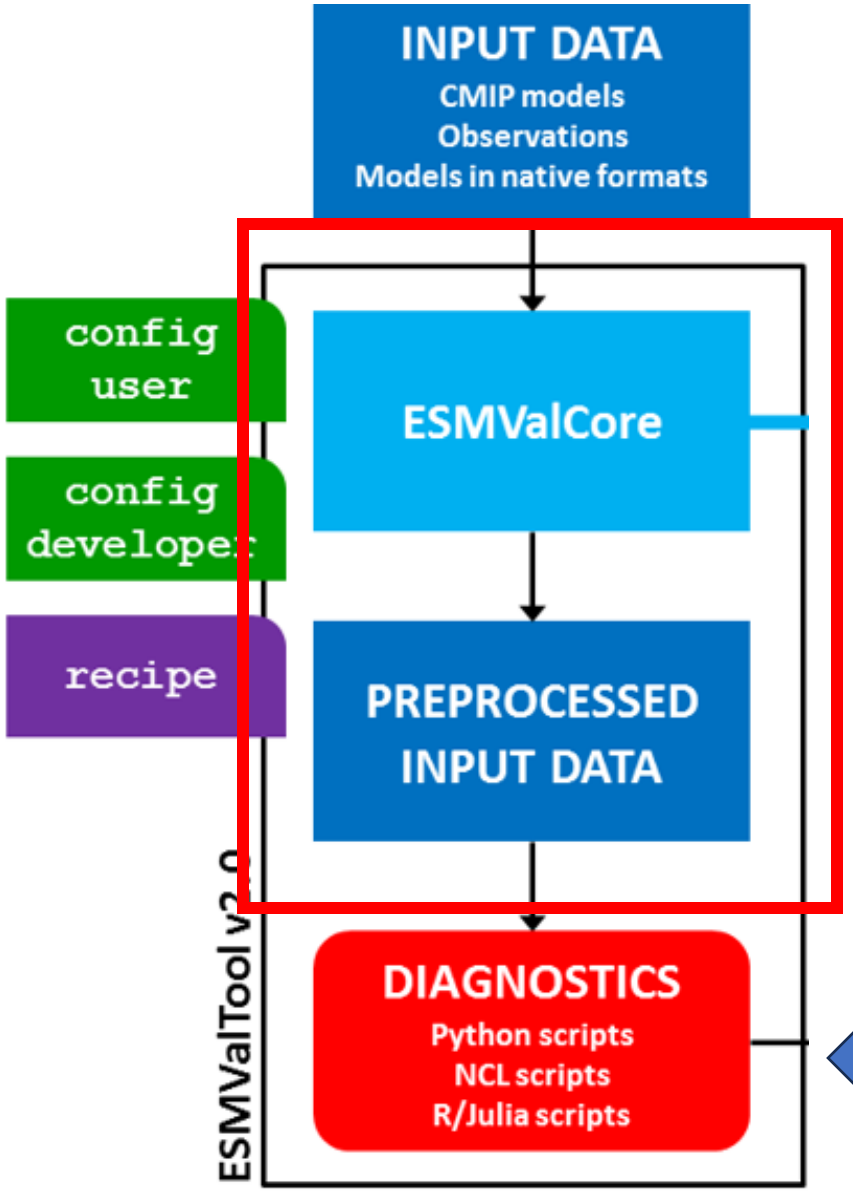
```
esmvaltool run examples/recipe_python.yml
```



The tool is designed to be modular.

Researchers interested in using their own scripts can leverage the ESMValCore capability to find and pre-process data.

There is a variety of workflows.



The tool is designed to be modular.

Researchers interested in using their own scripts can leverage the ESMValCore capability to find and pre-process data.

There is a variety of workflows.

Can point to your own script (Python, NCL, R, Julia) with some small adjustments.

A community effort

ESMValTool is built and maintained by an active community of scientists and software engineers.

It is an open source project to which anyone can contribute.

ESMValTool is released under the **Apache License, version 2.0**. This license applies to all users of ESMValTool.

https://github.com/esmvalgroup

A community effort

ACCESS Australian Earth System Simulator National Research Infrastructure

International community of scientists and software engineers

15 teams in the ESMValGroup organization		Visibility	Members
ESMValTool-CoreTeam Team members can read, clone, and push to this repository.		18 members	2 teams
ESMValTool-DevelopmentTeam Team members can create new feature branches.		190 members	0 teams
ESMValTool-recipe-maintainers		18 members	0 teams
IPCC-maintainers Maintainers of the AR6 repositories		4 members	0 teams
OBS-maintainers Maintainers of shared OBS data pools (DKRZ, Jasmin)		7 members	0 teams
science-reviewers Scientific review team		12 members	4 teams
SIG Regional Special Interest Group on Regional Models and Evaluation		5 members	0 teams
tech-reviewers Technical review team		10 members	0 teams
UserEngagementTeam User Engagement Team		13 members	

GitHub

ESMValTool
Earth System Model Evaluation Tool

Next ESMValTool Workshop: dates are fixed!

Meetings · hb326

Monthly ESMValTool community meeting February 2024 - Pacific Region Friendly

Meetings · rbeucher

is:open | Sort by: Latest activity | Label | Filter: Open | New discussion

Categories

- View all discussions
- Announcements
- General
- Meetings
- Polls
- Community guidelines
- Community insights

Discussions

2	Monthly ESMValTool community meeting - February 2024 - DATE SET!	paigem started 2 weeks ago in Meetings	9
2	Cleaning up the core teams [community]	axel-lauer started last week in General	4
2	Next ESMValTool Workshop: dates are fixed! [workshop]	hb326 started on Dec 21, 2023 in Meetings	6
1	Monthly ESMValTool community meeting February 2024 - Pacific Region Friendly [monthly community meeting]	rbeucher started last month in Meetings	2

Developments, maintenance, discussions, and collaborations in public
https://github.com/esmvalgroup

GitHub

ESMValTool-Workflow (ESMValTool deployment on Gadi)

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Using ESMValTool on Gadi

ESMValTool is provided through the `xp65` project on Gadi.

Pre-requisites

To enable the *ESMValTool-workflow*, you need to be a member of the `xp65` NCI projects:

Depending on your needs, you may want to also joined the following supported data collections:

- CMIP6: `fs38`, `oi10`
- CMIP5: `rr3`, `al33`
- ERA5 and ERA5-Land: `rt52`, `zz93`
- obs4MIPs: `qv56`

Loading the ESMValTool-workflow modules

To load the the `esmvaltool` module, execute the following commands:

```
module use /g/data/xp65/public/modules
module load esmvaltool
```

ESMValTool-Workflow (ESMValTool deployment on Gadi)

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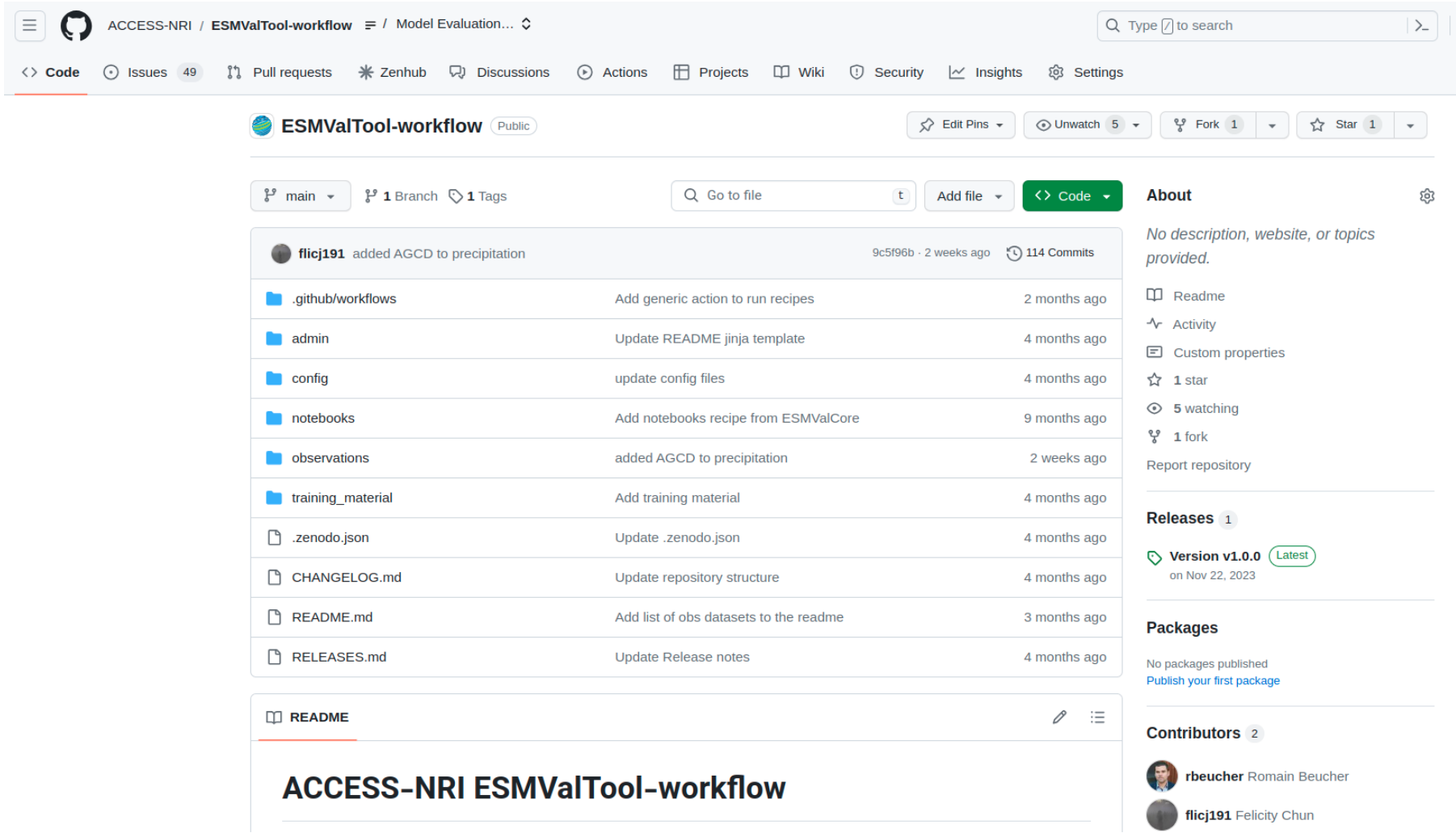

https://github.com/ACCESS-NRI/ESMValTool-workflow

Recipe status and on Gadi

Recipes current status

Recipes without observation datasets

Name	status
recipe_combined_indices	Run recipe_combined_indices passing
recipe_modes_of_variability	Run recipe_modes_of_variability passing
recipe_li17natcc	Run recipe_li17natcc passing
recipe_extreme_index	Run recipe_extreme_index passing
recipe_multimodel_products	Run recipe_multimodel_products passing
recipe_seaice_feedback	Run recipe_seaice_feedback passing
recipe_hyint_extreme_events	Run recipe_hyint_extreme_events passing
recipe_capacity_factor	Run recipe_capacity_factor passing
recipe_ocean_scalar_fields	Run recipe_ocean_scalar_fields passing
recipe_tebaldi21esd	Run recipe_tebaldi21esd failing
recipe_psyplot	Run recipe_psyplot passing
recipe_climate_change_hotspot	Run recipe_climate_change_hotspot failing
recipe_ocean_amoc	Run recipe_ocean_amoc passing
recipe_russell18jgr	Run recipe_russell18jgr passing
recipe_diurnal_temperature_index	Run recipe_diurnal_temperature_index passing

https://github.com/ACCESS-NRI/ESMValTool-workflow?tab=readme-ov-file#recipes-current-status

Load ESMValTool-workflow on Gadi

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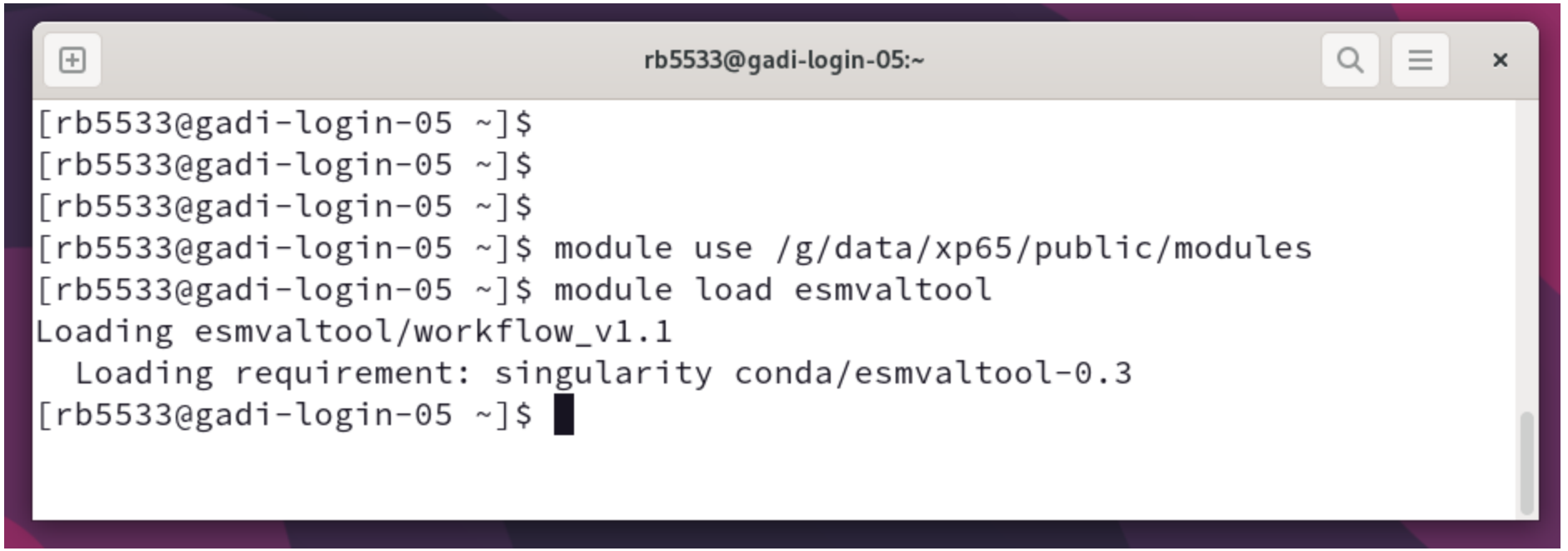
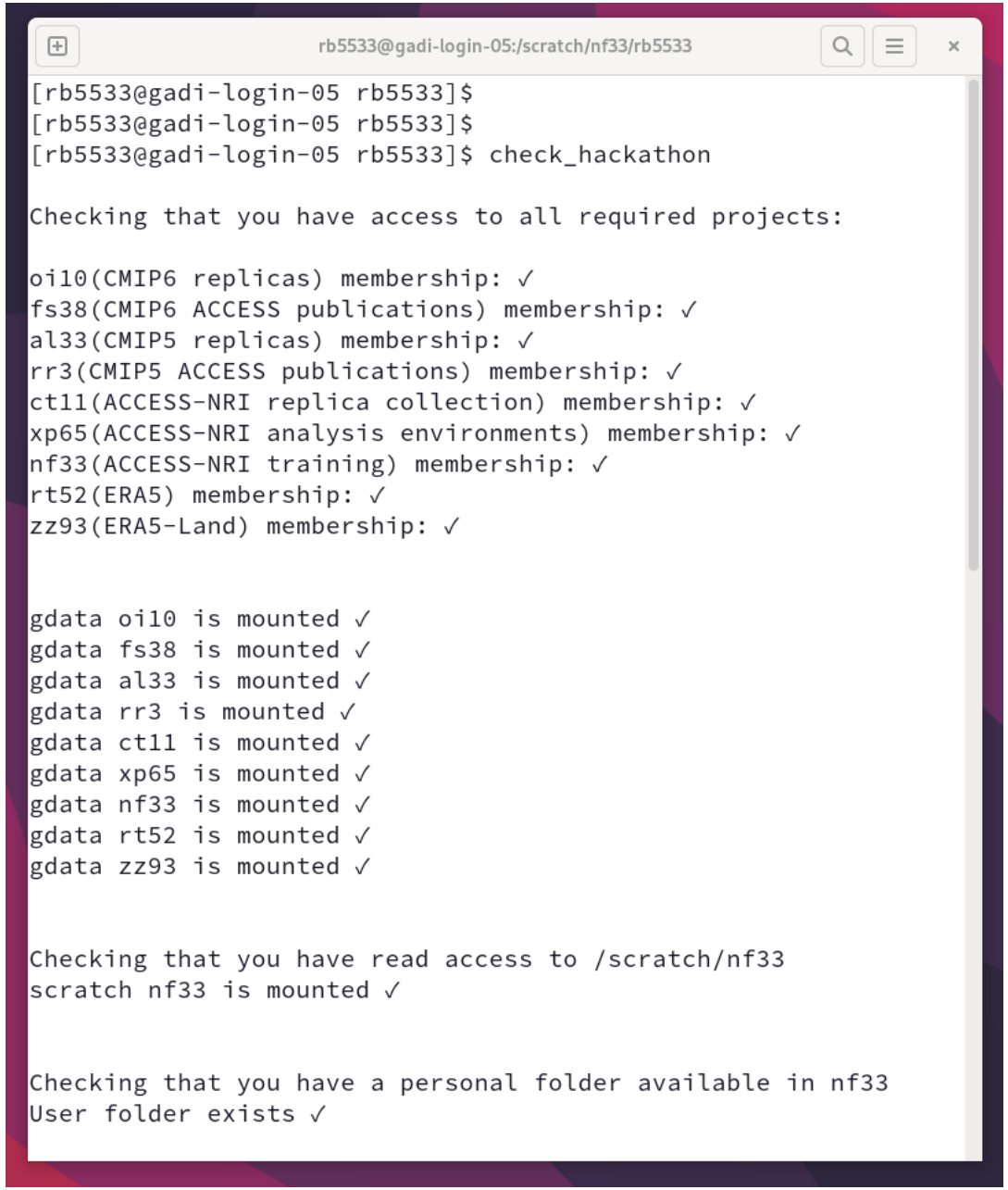


Run check_hackathon



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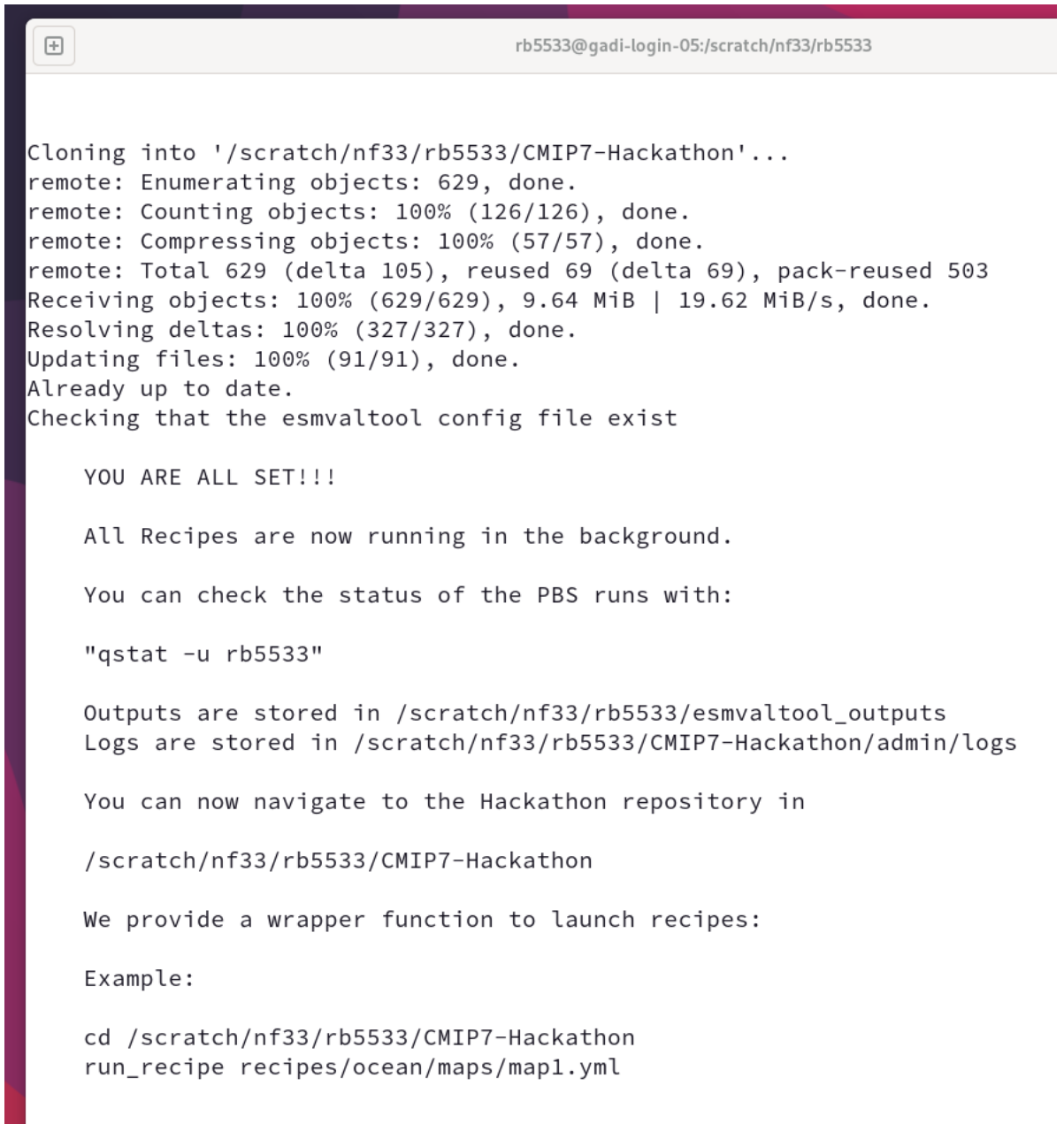
Run check_hackathon (continued)



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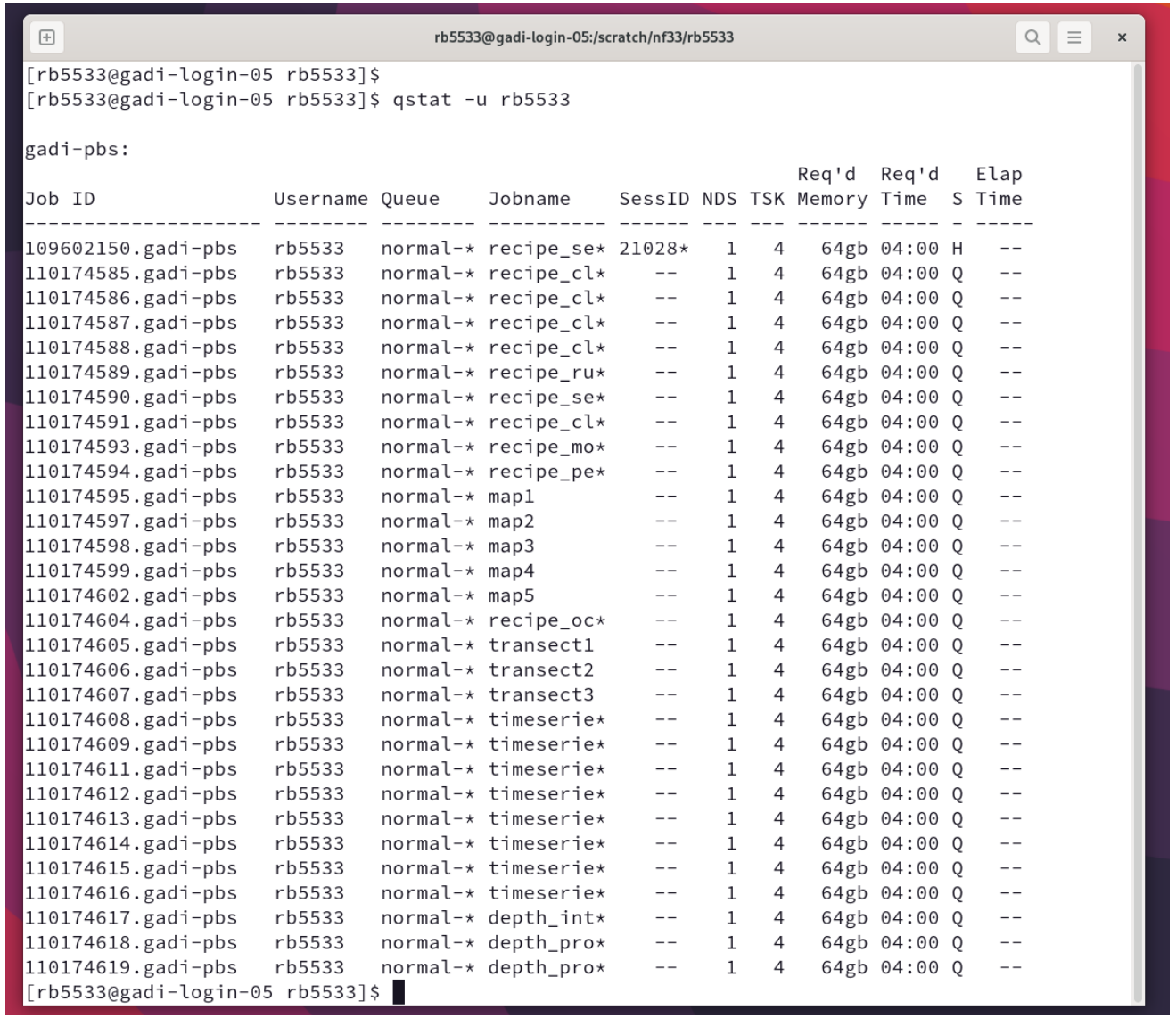
Check PBS job statuses



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What can you expect from the Hackathon?

Will I leave here as an expert in ESMValTool?

You might! But that's not our main goal. ESMValTool has a steep learning curve, so our goal is for everyone to understand what ESMValTool is, how it can be useful for their work, and to get started using it on Gadi.

Will ACCESS NRI be able to answer all my questions?

We will do our best, but almost certainly not! In fact, one of our main goals from this hackathon is to get feedback from all of you on what issues/needs you have or barriers you face to being ready to submit to CMIP7. Ideally, you can help us prioritize those needs so we can best support the community moving forward.

ESMValTool will be easy to use, right?

We are doing what we can to make ESMValTool as easy as possible for all of you. But, it's a sophisticated tool and so might take some time to learn, which may be frustrating. We hope that everyone leaves this hackathon with an understanding of why we are using and supporting this tool. ACCESS NRI is here to help you, so the more you can share with us, the more we can provide assistance and (hopefully) minimize frustrations!

Breakout Sessions

Breakout #1

- Meet group members
- Discuss big picture questions around model evaulation needs in Australia

Breakout #2

- Explore recipes, metrics, and datasets in ESMValTool
- Discuss missing elements

Breakout #3

- Hack away!
- Test recipes and other ESMValTool functionality

Breakout #4

- Hack away!
- Test recipes and other ESMValTool functionality

Break into small, self-organized groups of ~2-4

Breakout #5

- Create a prioritized list of needs/issues/ barriers to model evaluation for CMIP7

4 Domain-specific groups:

- General diagnostics (e.g. drift/conservation) & Coupled (modes of variability) *(Chair: Yann Planton)*
- Ocean & Ice *(Chair:* Pearse Buchanan*)*
- Land & Carbon Cycle *(Chair: Tammas Loughran)*
- Atmosphere *(Chair: Kim Reid)*