Recent developments at ACCESS-NRI: from Global to regional ocean modelling

Helen Macdonald (ACCESS-NRI)
Christopher Bull, Phellipe Couto,
Andrew Kiss, Dougal Squire, Ezhilsabareesh Kannadasan, Anton Steketee, Minghang Li,
Angus Gibson, Claire Yung, Fernando Sobral, Colette Kerry, Andy Hogg

FOO

ACCESS
Australian Earth System Simulator
National Research Infrastructure

COSIMA

The Consortium for Ocean-Sea Ice Modelling in Australia
cosima.org.au

ACCESS-NRI and COSIMA + ANCOMS:

Technical team and scientific community

ACCESS-NRI is funded to develop and maintain Australia's Earth system model capability.

- **5 software engineers** in ocean-ice-wave-BGC development team for **ACCESS-OM3**
- plus **1 software engineer Regional & Coastal Oceans Modelling Team**
- plus a **release team** and **model evaluation and diagnostics team**

ACCESS-NRI draws on COSIMA as a Community Working Group providing **scientific leadership** on ocean, sea ice & BGC model components & configurations.


Christopher Bull

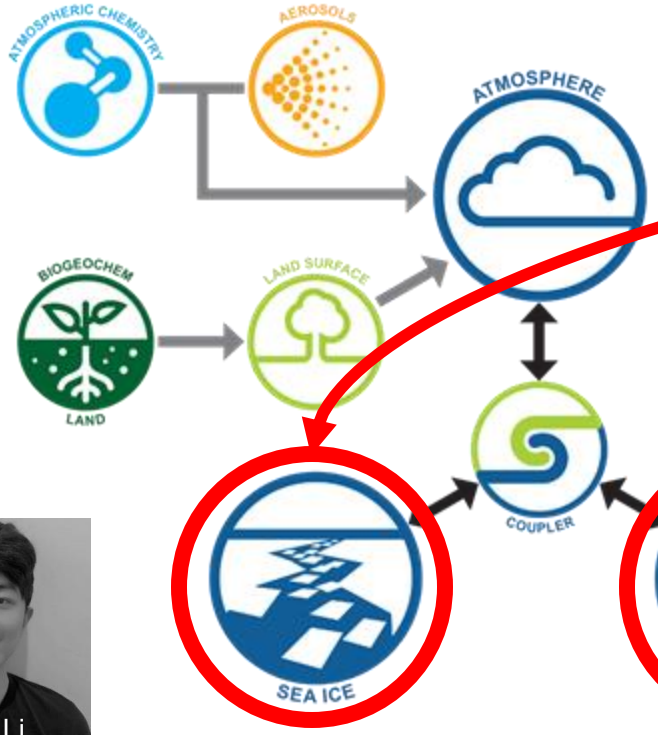

Helen Macdonald

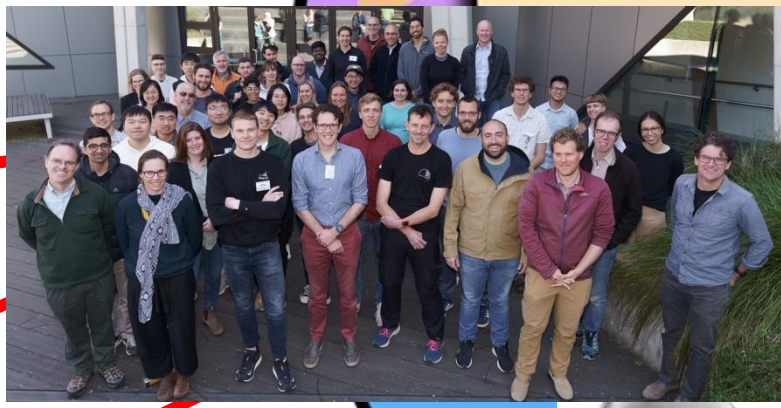

Dougie Squire


Ezhilsabareesh Kannnadasan

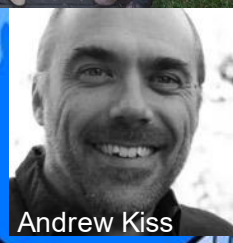

Anton Steketee


Minghang Li



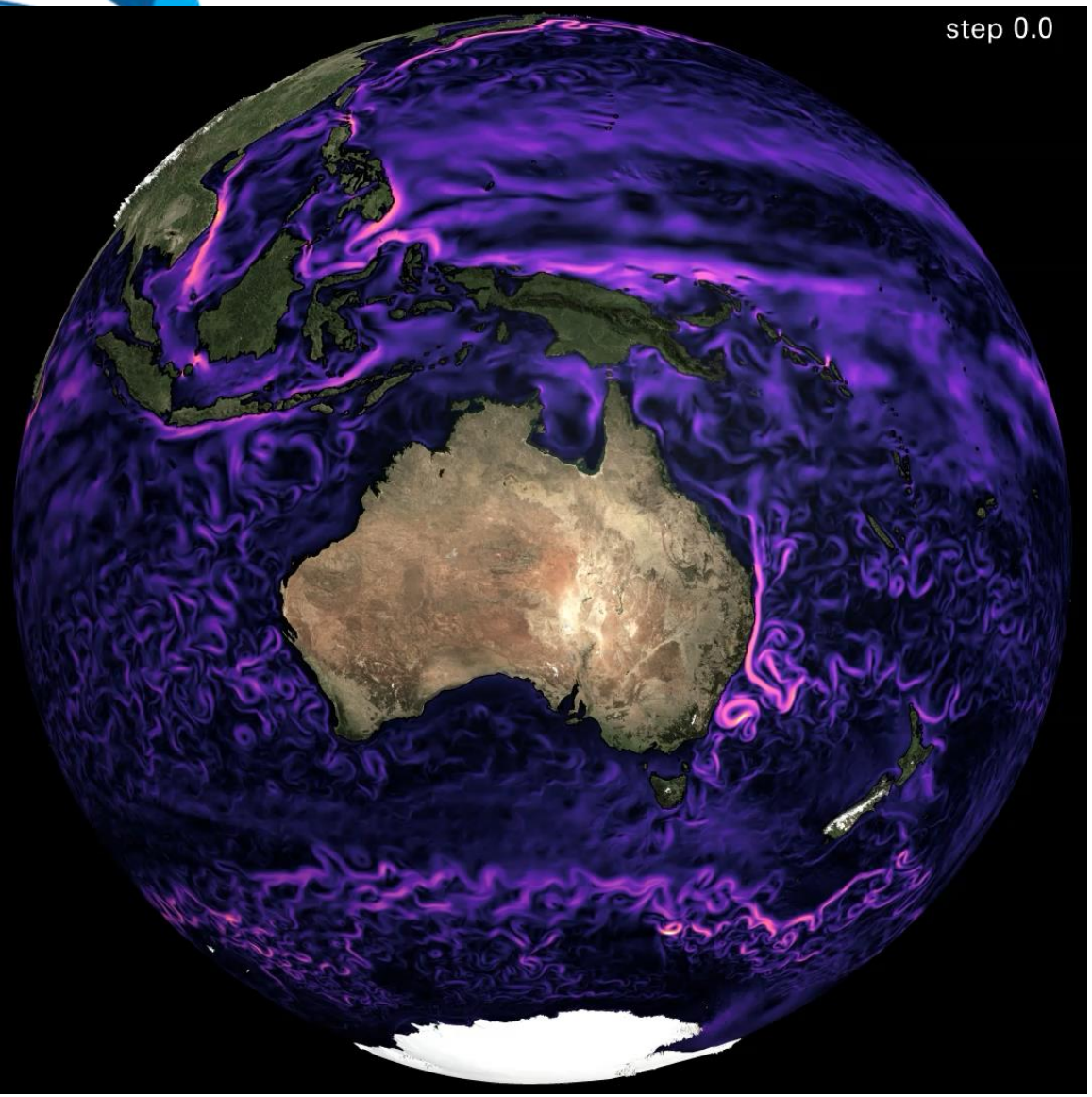


ACCESS-Hive Forum:
forum.access-hive.org.au

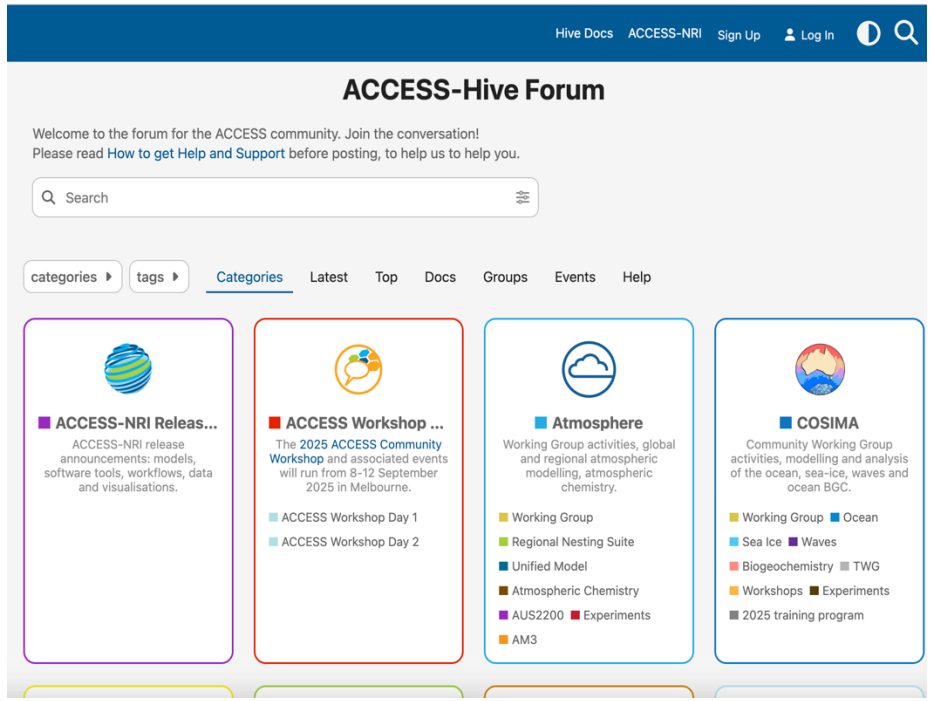

Andrew Kiss

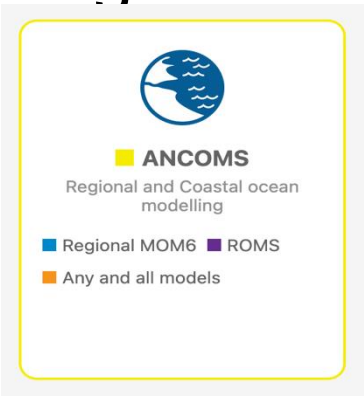

Phellipe Couto

The ACCESS-NRI infrastructure



Reproducible
Version controlled
Centrally managed
Lowered barrier to entry
Supporting community building





Now maintained by ACCESS-NRI

ACCESS-OM2 – COSIMA's current workhorse

- A **global ocean - sea ice model, using MOM5 and CICE5**

Obsolescent model components, circa 2012, 2015

- **1°, 0.25°, 0.1° configs**, with optional WOMBAT BGC, optionally coupled to CICE5 BGC

ACCESS-OM2

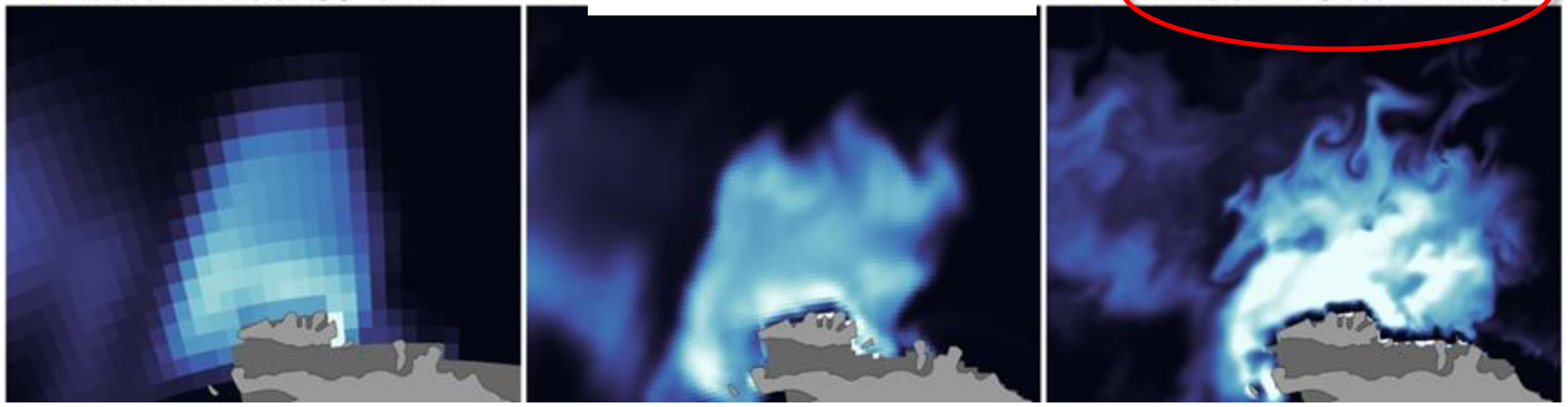
- not eddy-resolving
- **1°** horizontal grid
  360 × 300 cells, 24–111 km
- 50 z^* levels
  Δz = 2.3–220 m
- fast and cheap
  ~ 24min/yr, 0.1 kCPU hr/yr
  on 252 PEs, dt=5400 s
- used in ACCESS-CM2

ACCESS-OM2-025

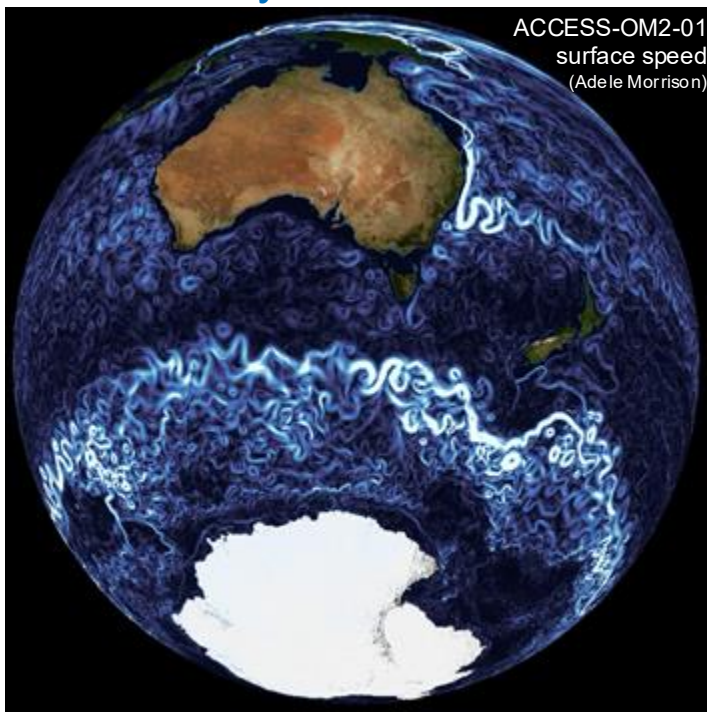
- eddy "permitting"
- **0.25°** horizontal grid
  1440 × 1080 cells, 6.0–27.8 km
- 50 z^* levels
  Δz = 2.3–220 m
- fairly fast, less cheap
  105 min/yr, 4.5 kCPU hr/yr
  on 1824 PEs, dt=1800 s
- used in ACCESS-CM2-025

ACCESS-OM2-01

- eddy-rich
- **0.1°** horizontal grid
  3600 × 2700 cells, 2.2–11.1 km
- 75 z^* levels
  Δz = 1.1–198 m
- slow, expensive
  9 hr/yr, 55–65 kCPU hr/yr
  on 5096 PEs, dt=600 s
- in Bluelink OceanMAPS4



- **Community shares code**, **output** (>550Tb, >240 users) and **analysis scripts**
- **>90 papers** in 5 years, with collectively ~2000 citations



MOM6-CICE6-WW3 MOM5-CICE5

New capabilities of ACCESS-OM3 vs ACCESS-OM2

- **All components at the forefront of international modelling** under active development with a large community (whereas ACCESS-OM2 components are now legacy code)

MOM6

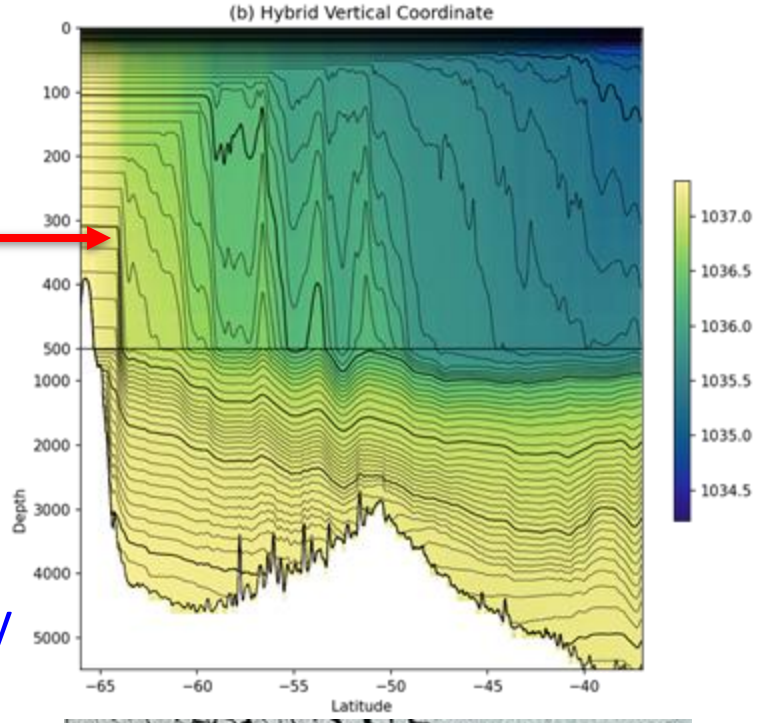
- **ALE vertical coordinates**, supporting **hybrid coordinates**, reducing spurious diapycnal mixing & improving topography
- **Circulation in cavities** under ice shelves
- **Wetting/drying** – e.g. ice sheet retreat, shoreline change
- **No vertical CFL constraints** on velocity or tracers
- **C-grid** for narrower channels and better & easier topography
- **Regional domains** (1-way nested open boundaries)
- **Tides** in both global and regional configurations
- **Cheap tracers**: ~10x longer tracer timestep (e.g. for BGC)

CICE6

- **Sea ice floe size distribution** (to represent pancake ice, etc.)
- **Landfast ice; C-grid**
- **Advanced, depth-resolved sea ice BGC**

WW3

- **Surface waves** (surface wave mixing, sea ice interaction, etc.)

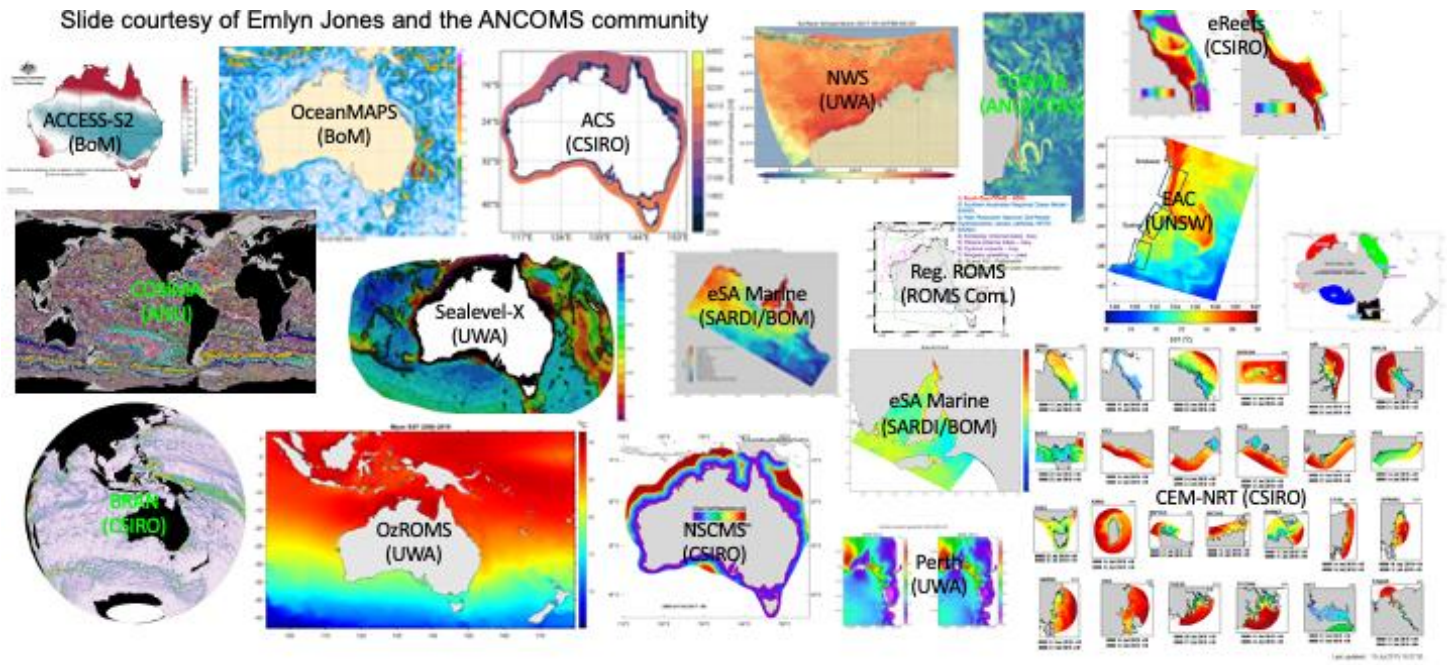


Élie Dumas-Lefebvre & Dany Dumont

ACCESS-OM3 configurations: progress and plans

	100km	25km	8km	4km
MOM6-CICE6	Running; test and tune	Released (beta)	Prototype	Eventually
MOM6-CICE6-WOMBAT	Running; test and tune	Running: test and tune	Maybe	Probably Not
MOM6-CICE6-WW3	Running; test and tune	To do	Maybe	Probably Not
CICE6-WW3	?	To do	Probably Not	No
rMOM6-CICE6-iceshelfs-Panan				Running; test and tune
rMOM6-SuperAus				Prototype

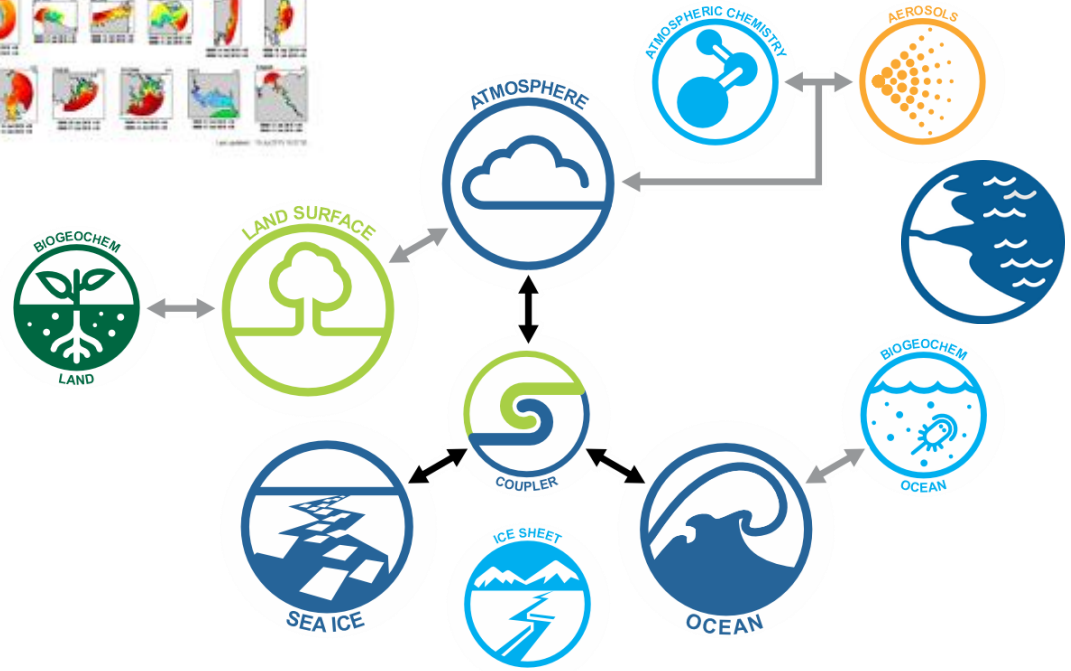
Supporting global through to coastal ocean research



Diversity in processes and scales means we are not converging on a single model.

Goals

1) Recipes or scripts to support large variety of regional and coastal models
2) Tutorials and shared workflows or configurations



CoastRI

https://www.coastri.org.au

CoastRI will be built on collaboration across a number of NCRIS capabilities including:

ACCESS Australian Earth System Simulator National Research Infrastructure

Australian Research Data Commons

Atlas of Living Australia ala.org.au

AURIN aurin.org.au

AuScope

Australian Access Federation AAF.EDU.AU

BioPlatforms Australia

Coastal Research Vessel Fleet

HIA Heavy Ion Accelerators

IMOS Integrated Marine Observing System

NCI Australia

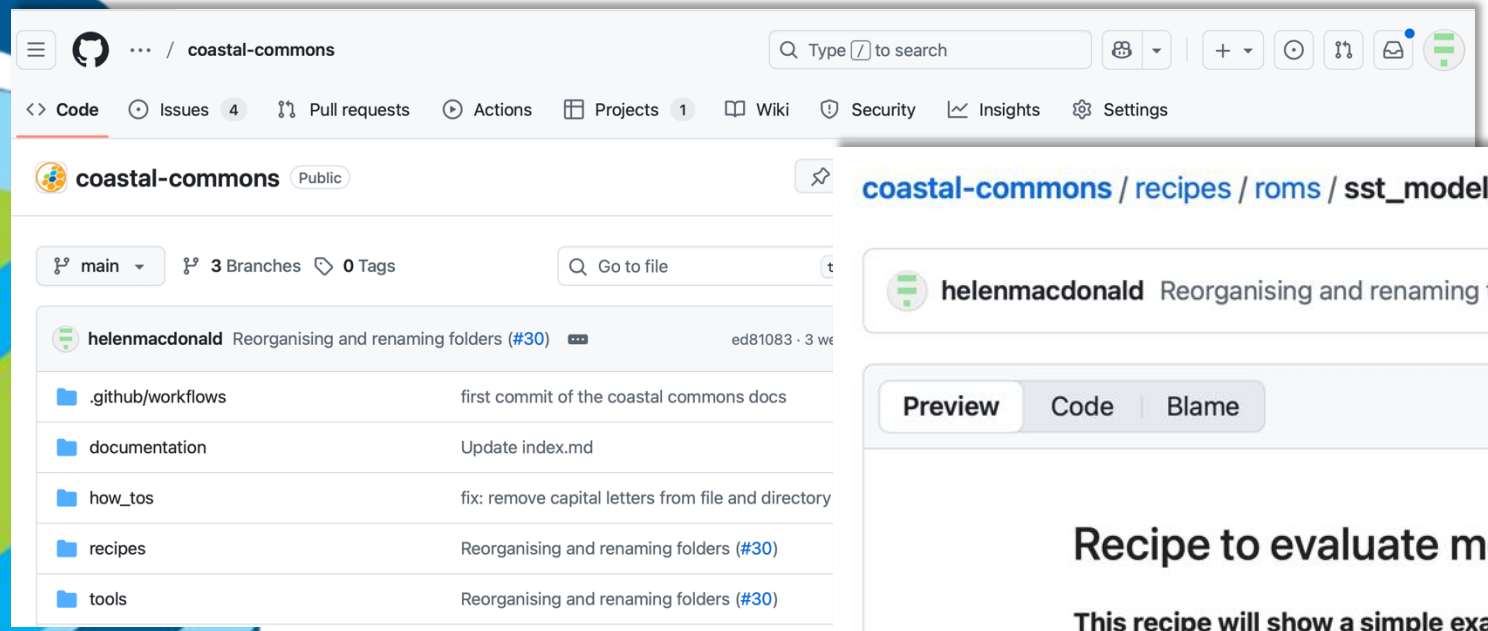
PHRN Population Health Research Network

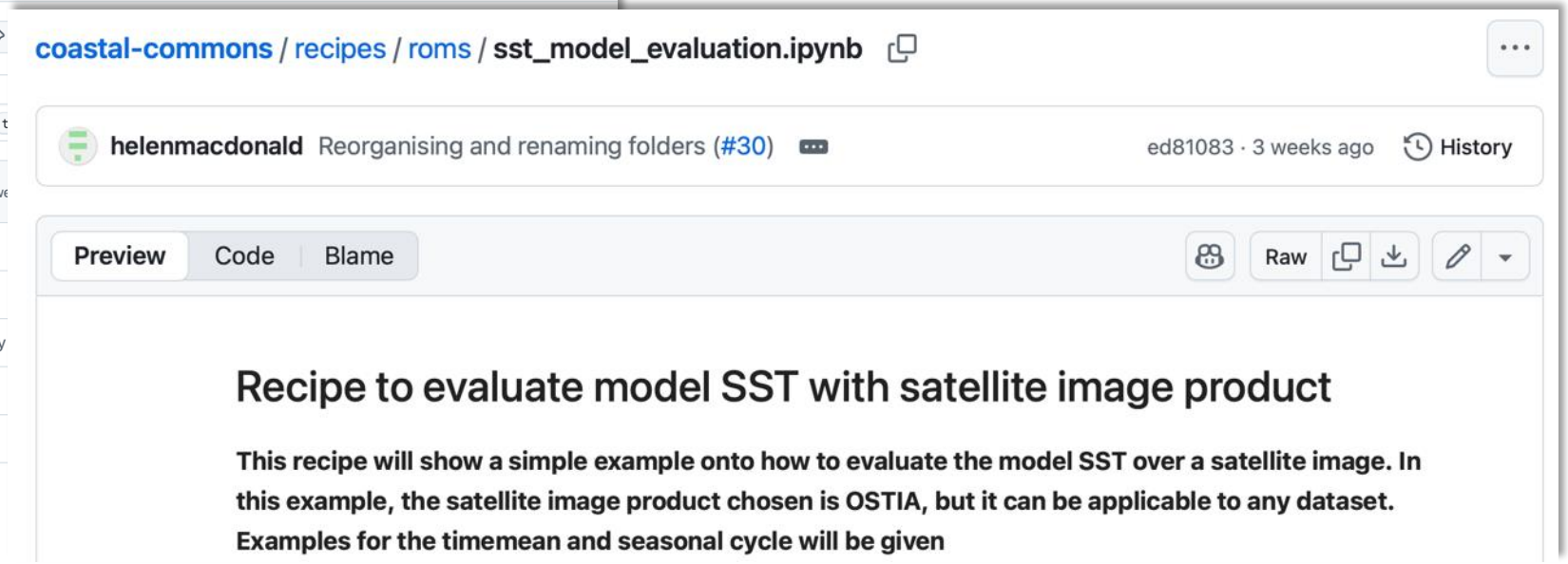
tern Ecosystem Research Infrastructure

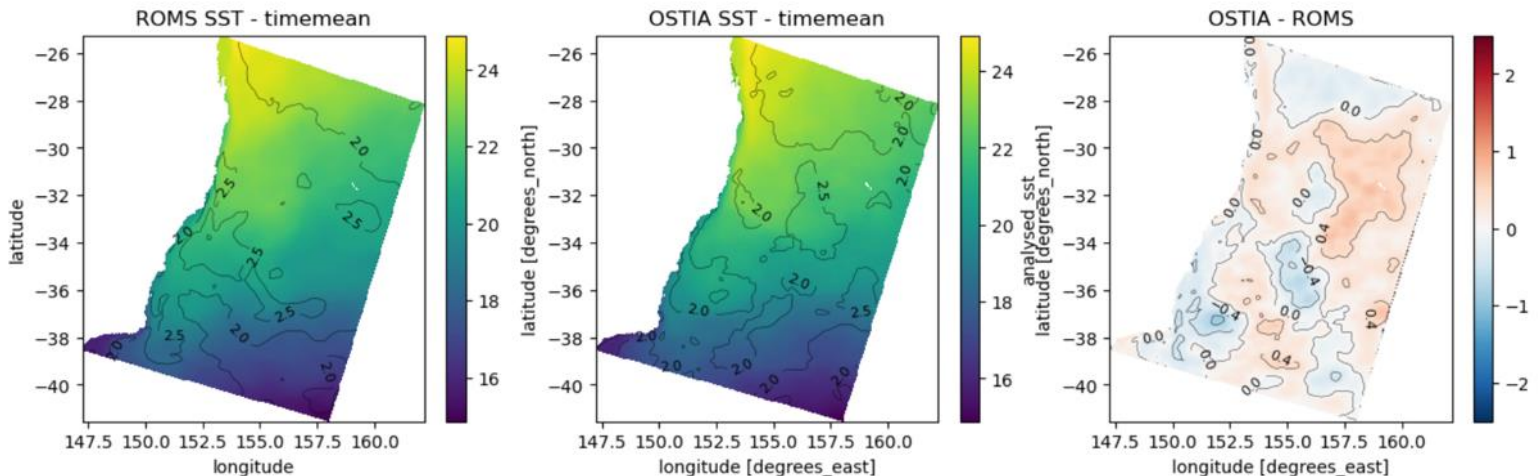
Seed funding for 6 initial projects:
Project 1: Assessing the viability of establishing a coastal ocean modelling commons …

Shared scripts

Reducing double-up and lowering the barrier of entry

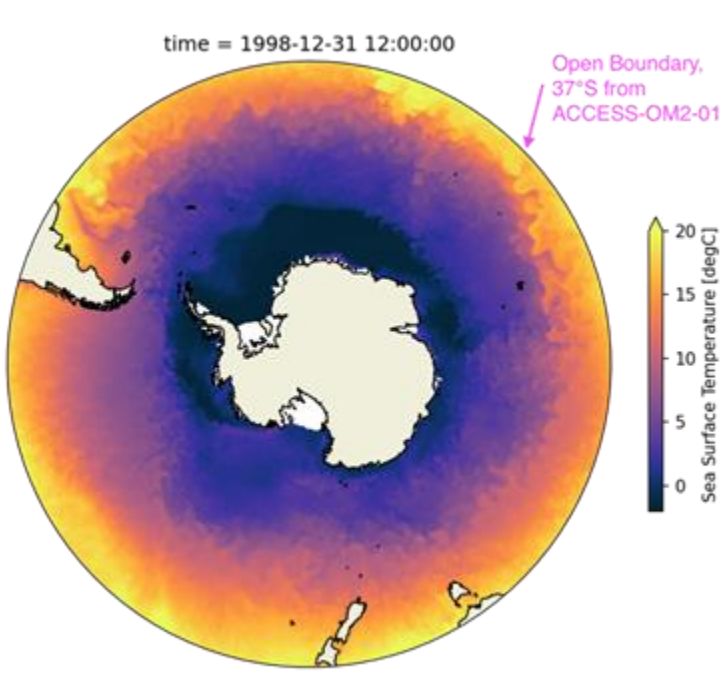


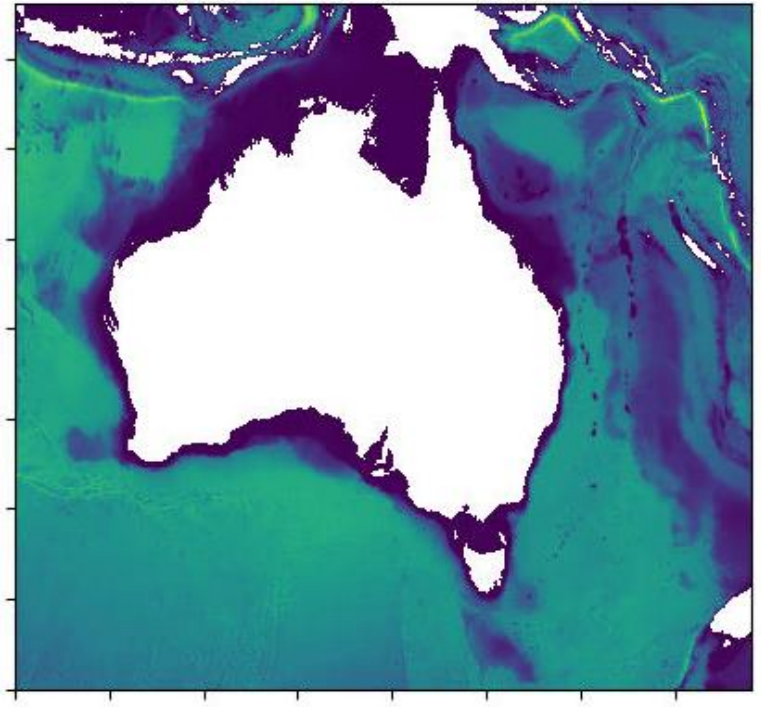




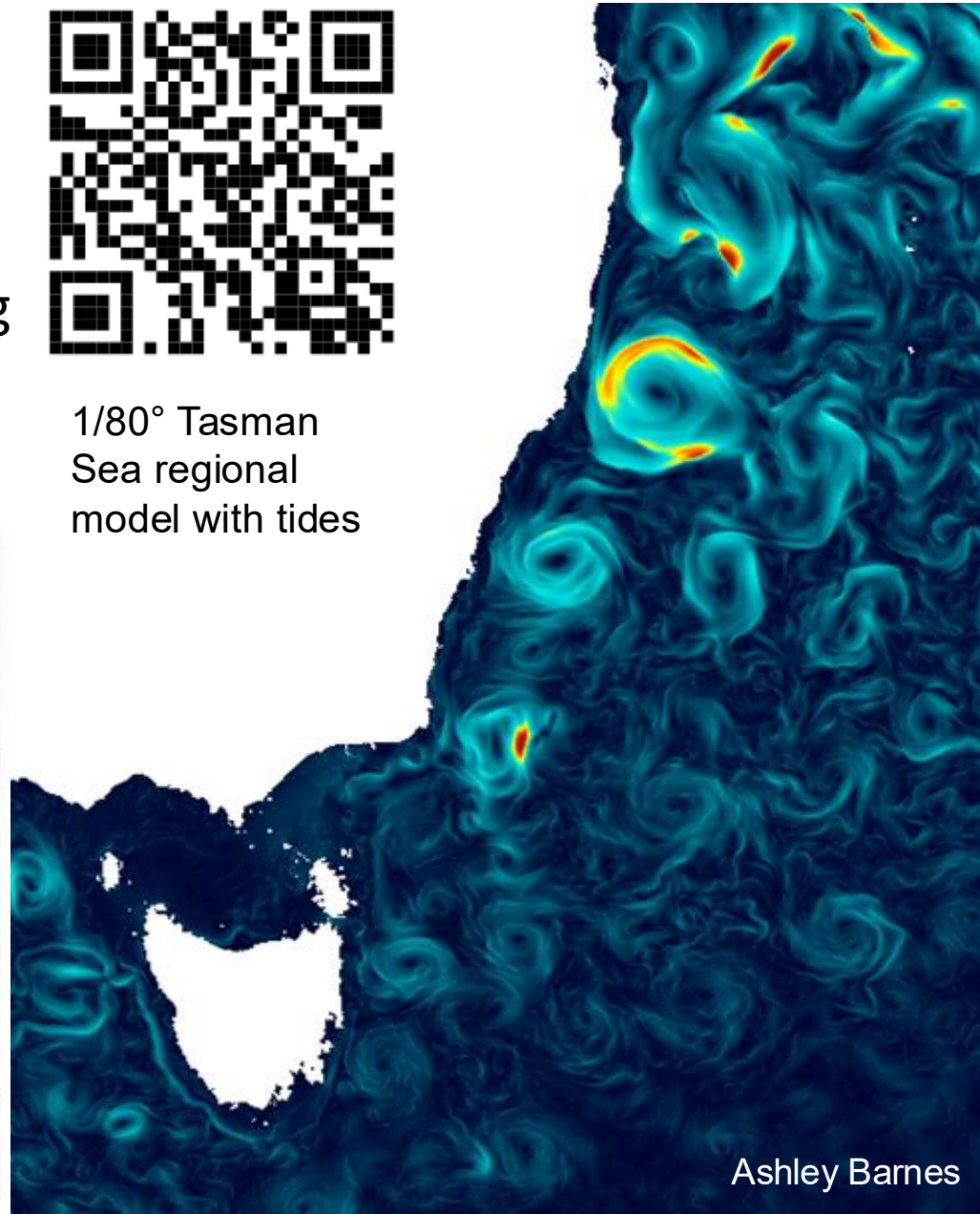
User-friendly MOM6 regional model configuration package

- github.com/COSIMA/regional-mom6
- **Python package to set up a regional MOM6 config**, including grids, surface and boundary forcing, initial conditions, bathymetry, tidal forcing
- Development led by Ashley Barnes, ANU
- Being setup to run on ACCESS-NRI infrastructure





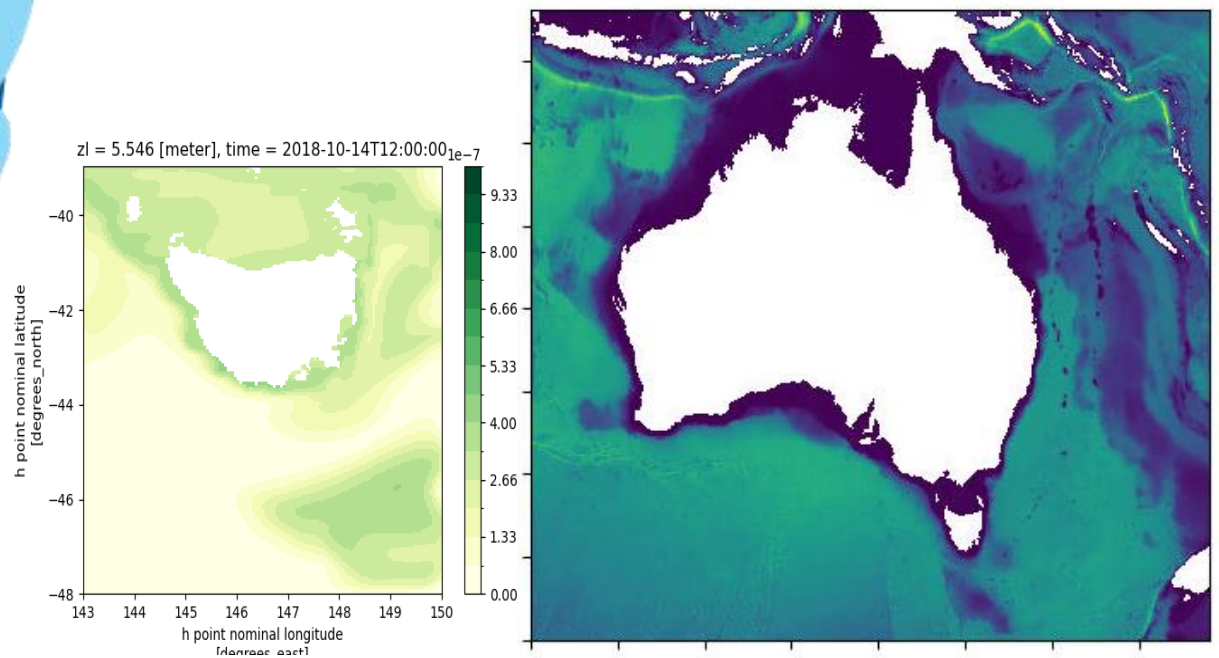
1/80° Tasman Sea regional model with tides

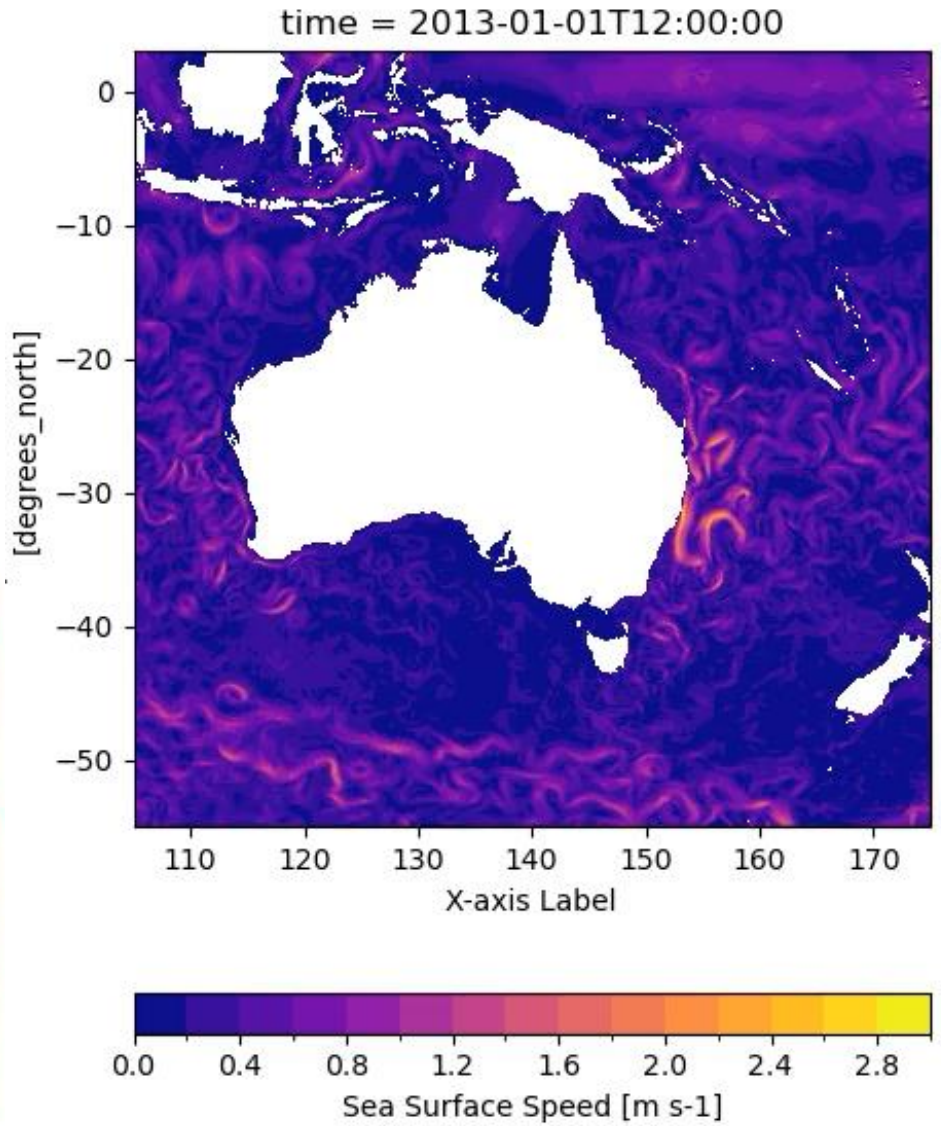


Ashley Barnes

Super-regional Australian model

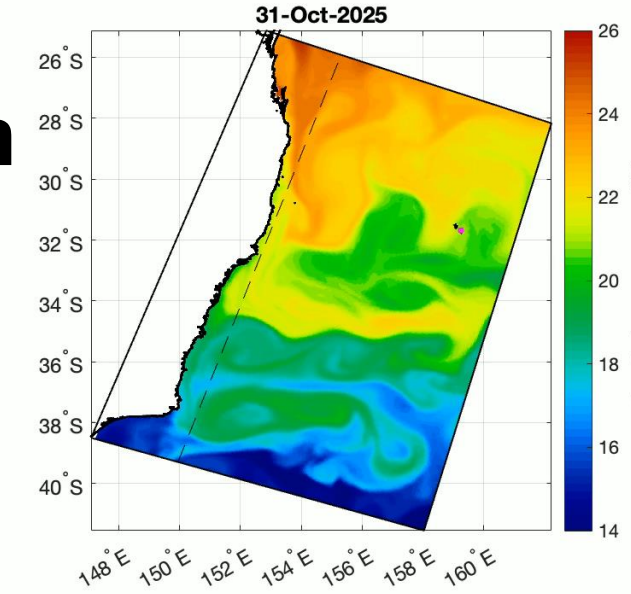
- 5 km resolution
- Have >6-month run
- Output + config files will be available for nesting strategies
- WOMBAT BGC works in regional MOM6

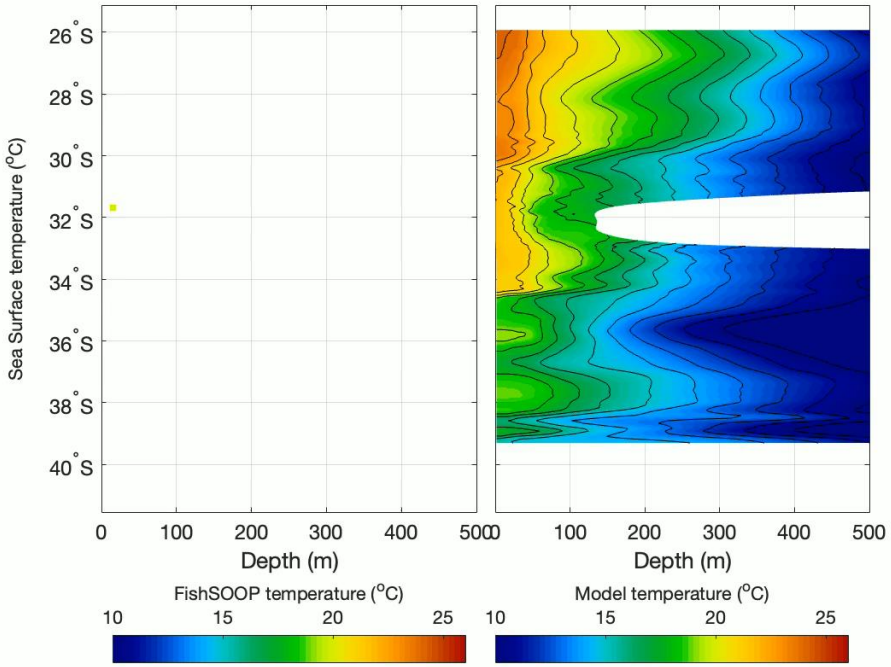


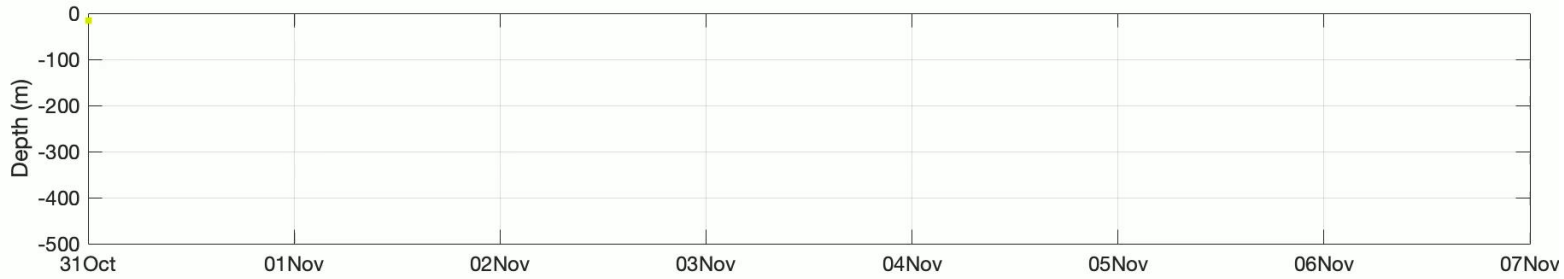


ROMS – EAC configuration

- ROMS EAC and upwelling configs shared via GitHub
- Potential to share other configurations from ROMS and other model codes
- We welcome contributions and feedback







Running the upwelling example

From Gadi, you need to run these commands:

```
module use /g/data/vk83/prerelease/modules;
module load payu/dev
mkdir -p ~/ancoms-roms
cd ~/ancoms-roms/
payu clone -B release-upwelling+testcase https://github.com/ACCESS-Community-Hub/roms-con
cd upwelling+testcase
payu run
```

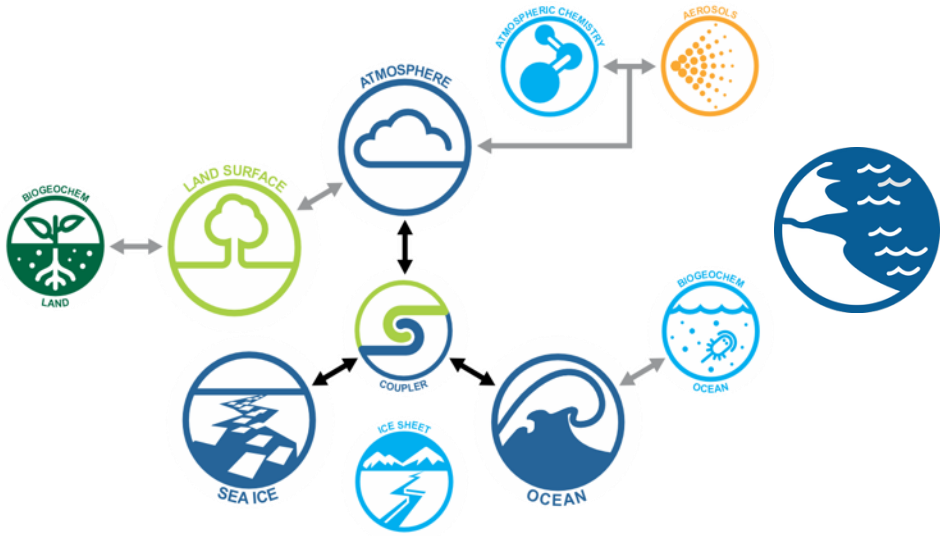
Running the EAC example

Note these instructions assume you have already created your ancoms-roms folder and have payu loaded (as above). These are the commands

```
cd ~/ancoms-roms/
payu clone -B dev-eac4km_barra-ecmwf https://github.com/ACCESS-Community-Hub/roms-configs
cd eac4km_barra-ecmwf
payu run
```

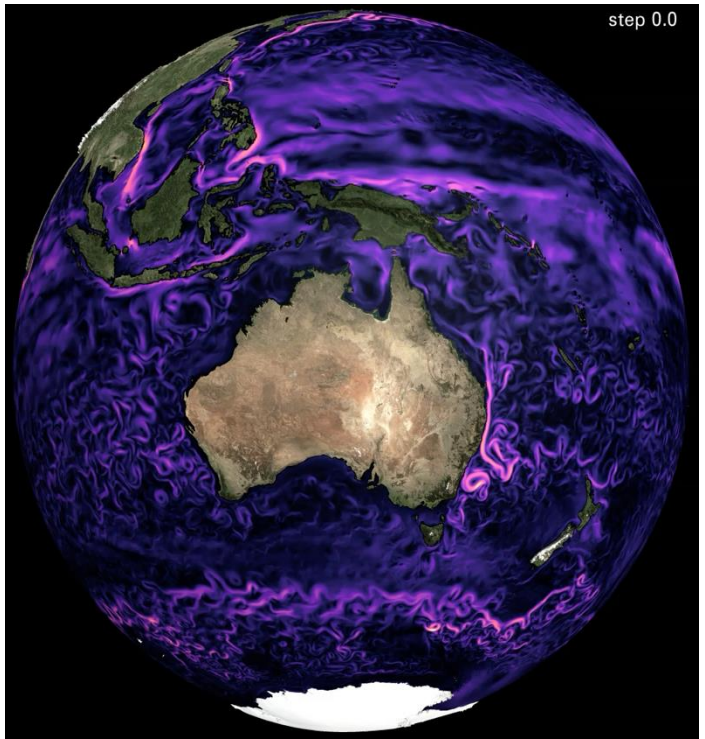
Summary

- ACCESS-NRI is a research infrastructure supporting numerical models, code and ancillaries
- Infrastructure for Community collaboration
- Global configurations developed
- Now have seed funding in the regional and coastal space



Get involved!

- Try running the uploaded scripts and configurations
- Upload your own scripts and configurations
- Join the community



ANCOMS

Regional and Coastal ocean modelling

Regional MOM6 ROMS

Any and all models