The Bureau
of Meteorology

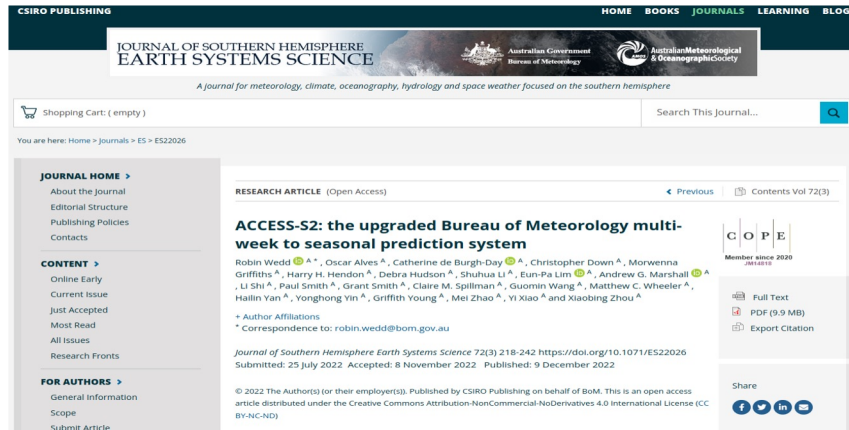# WGSIP24: Bureau of Meteorology research updates

Debbie Hudson

March 2023

ACCESS-S2

- Coupled model: UKMO GC2 (Global Coupled model vn2)

- BoM weakly-coupled data assimilation

- Hindcasts: 38 year (1981-2018)

- Run out to 8 months lead

- Operational Oct 2021

https://www.publish.csiro.au/ES/ES22026

Next version (ACCESS-S3) likely use UKMO GC5

- Starting to evaluate preliminary hindcasts

Atmospheric Model

GA6: Using UM8.6 (UM; Walters et al. 2017, Williams et al. 2015).

Horizontal resolution: N216 (~60 km in the mid-latitudes)

85 levels (extending into stratosphere)

Land Surface Model

GL6: JULES (Best et al. 2011; Walters et al. 2017)

4 soil levels

Ocean Model

GO5: NEMO3.4 (Madec 2008, Megann et al. 2014).

Horizontal resolution: 0.25°

75 levels. Level thicknesses range from 1m near the surface to about 200 m near the bottom (6000 m depth).
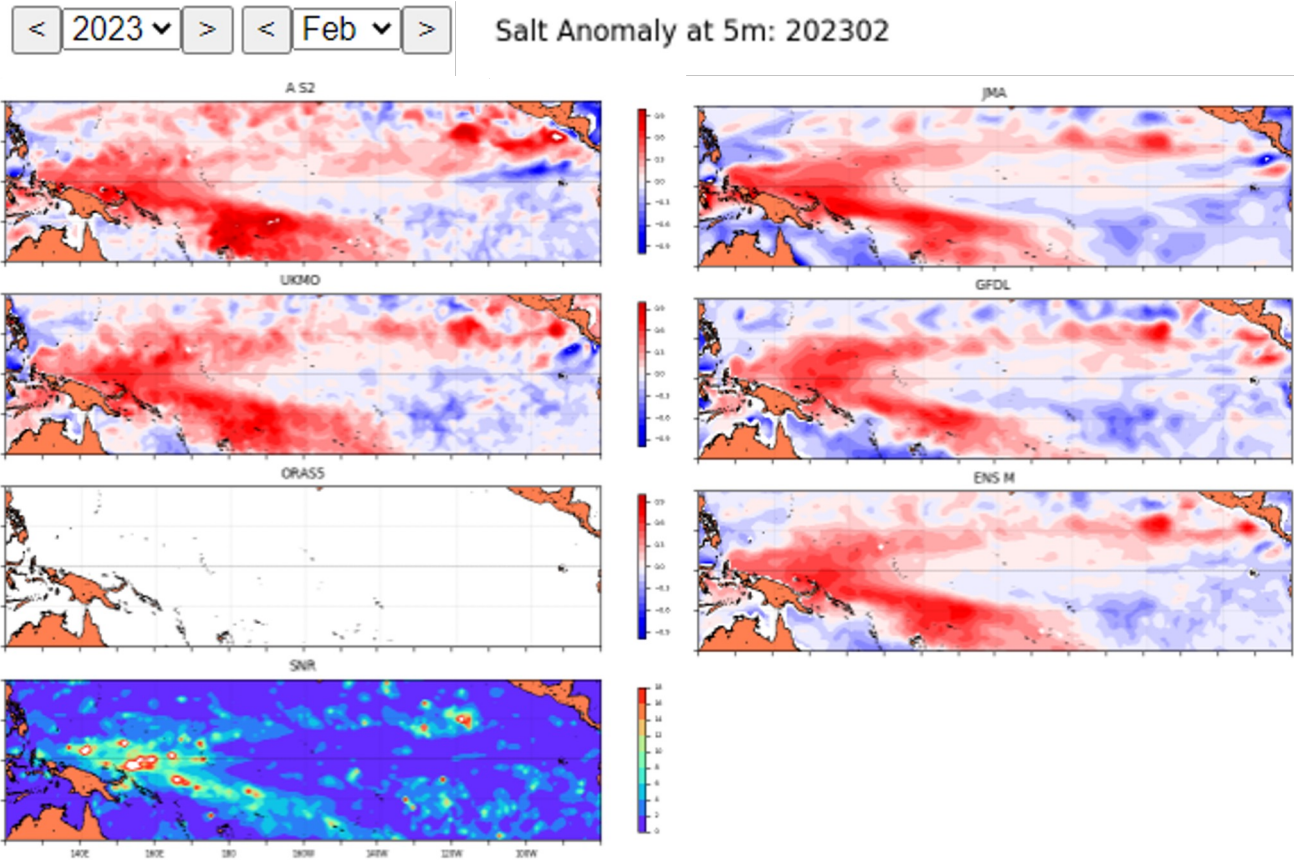
Sea Ice Model

GSI6.0: CICE (Hunke and Lipscomb 2010; Rae et al. 2015).

Coupler

Ocean Atmosphere Sea Ice Soil coupler version 3.0 (OASIS3, Valcke, 2013)

Contact: Debbie Hudson

ACCESS-S2 in international inter-comparisons

International Ocean Reanalysis Project (ORA-IP)

- ACCESS-S2 has been included in the ORA-IP international ocean reanalysis project.

- Bureau hosts the ORA-IP website for salinity. The website has been upgraded (http://poama.bom.gov.au/project/salinity/index.html)

- NCEP hosts the ORA-IP website for temperature (https://www.cpc.ncep.noaa.gov/products/GODAS/ocean_briefing.shtml)
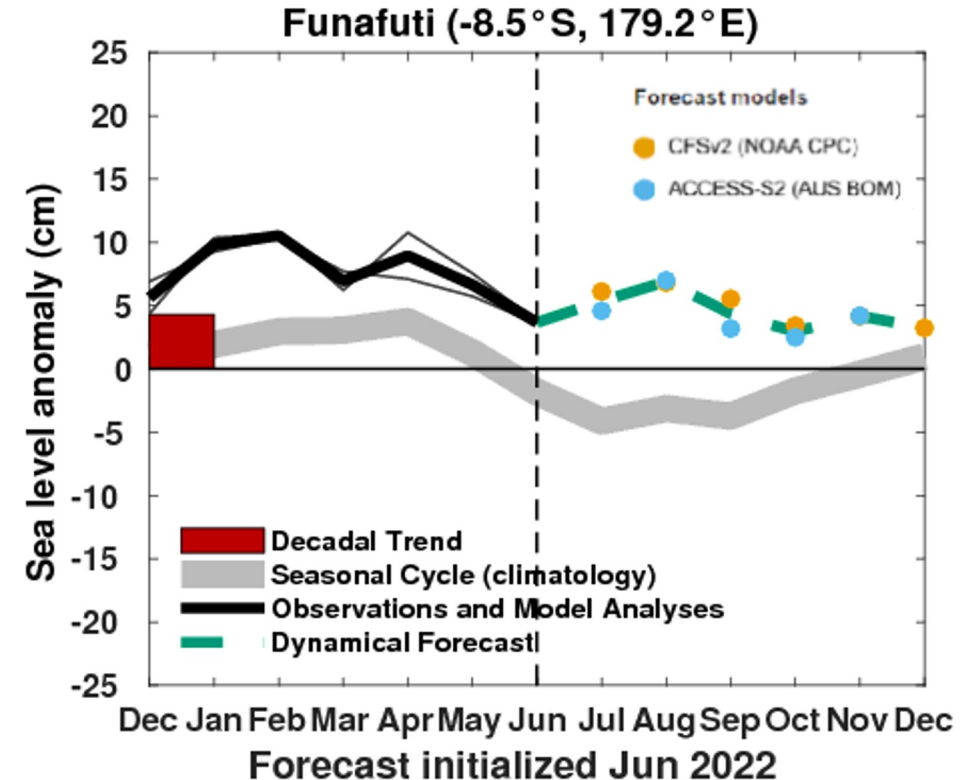
- Contact: Robin Wedd

S2S and Copernicus

- BOM (ACCESS-S2) recommencing contribution to S2S in coming 1-2 months

- Contribution to Copernicus to follow

- Contact: Claire Spillman

Seasonal sea level forecasts

- Combine seasonal sea level forecasts, tidal predictions, regional long-term trends & sea level rise estimates

- Bureau operational service planned under Australian Climate Service Program

- Leverage existing work in the Pacific:

  o COSPPAC (and PACCSAP) seasonal sea level outlooks

  o Uni Hawaii experimental multi-model forecasts

- Input to briefings for Defence via quarterly Global Seasonal Outlook

UNIVERSITY OF HAWAII
SEA LEVEL CENTER

Funafuti (-8.5°S, 179.2°E)

Forecast models
- CFSv2 (NOAA CPC)
- ACCESS-S2 (AUS BOM)

Sea level anomaly (cm)

- Decadal Trend
- Seasonal Cycle (climatology)
- Observations and Model Analyses
- Dynamical Forecast

Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Forecast initialized Jun 2022

Contact: Claire Spillman

Trial marine heatwave forecasts

- Bureau-CSIRO research project

- Prototype seasonal MHW forecast products running in trial mode

- Plans to be operationalised

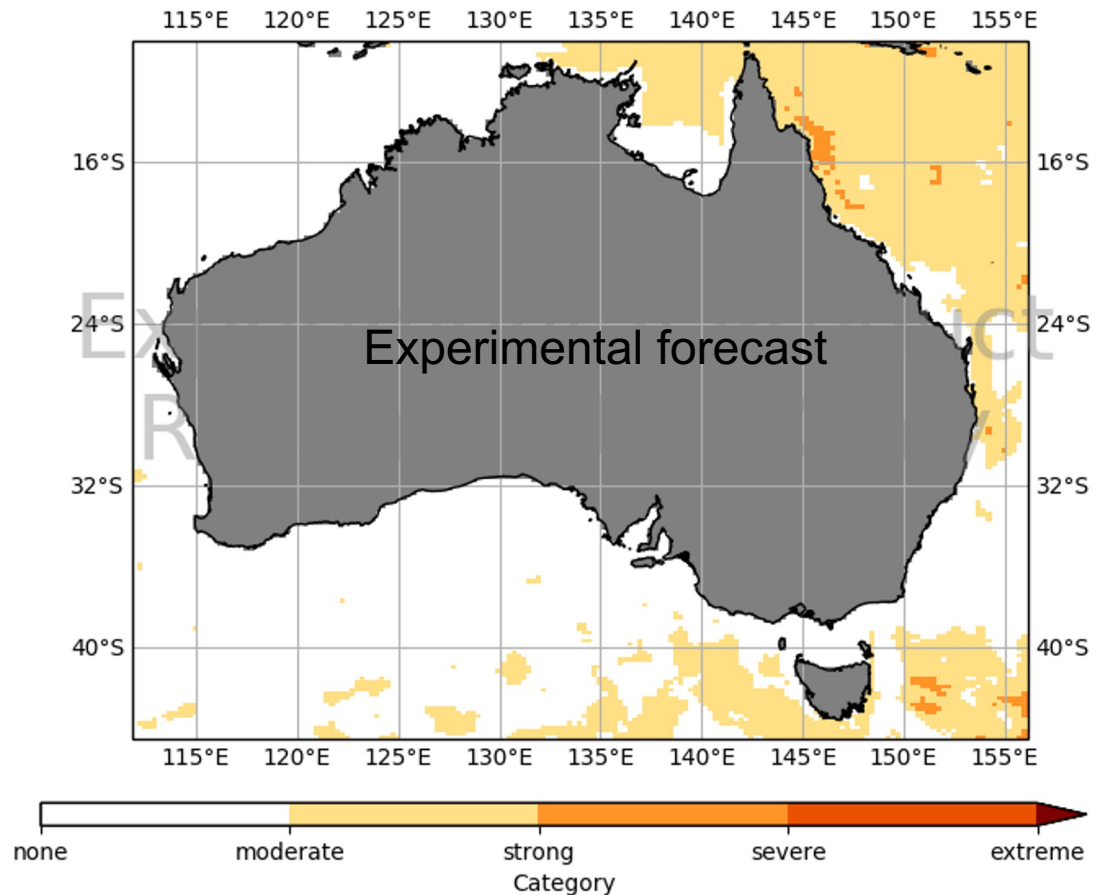- Funded by Fisheries Research and Development Corporation

https://research.csiro.au/cor/research-domains/climate-impacts-adaptation/marine-heatwaves/dynamical-forecasting-of-marine-heatwaves/

Monthly emn Marine Heatwave Category
Region: Australia
Start: 11-Nov-2022
Period: Month 01-Dec-2022 to 31-Dec-2022

Experimental forecast

Category: none — moderate — strong — severe — extreme

Created: 2022-11-13 06:31:59 +0000   Climatology: 1981-2018   Resource: access-s2 /_s_ens /_s_ens /_s_ens

Smith & Spillman (in prep), Smith et al (in prep)

New operational outlook products

## Indication of chance of "extremes"

http://www.bom.gov.au/research/projects/FWFA/

Some videos about the products:
- Overview
- Beef case study
- Wine case study
- What is the Rainfall burst product
- How can you use the Rainfall burst forecast?
- Deciles and how you use them
- Probability of Exceedance product

Contact: Debbie Hudson
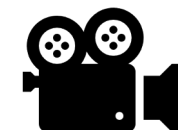
ENSO-IOD alert system for a warming world

- New project

- Workshop Aug 2022, with participation from BoM, NOAA, NIWA, NEA, Meteo France (New Caledonia), Monash Uni, CSIRO

- Will consider both the definition/indices of ENSO and IOD as well as the criteria for providing a "watch" and "alert"

- Seeking indices that are resilient to climate change e.g., relative Nino3.4 (Oldenborgh et al. 2021)

- For determining alerts, operational systems currently use some variant of Nino3.4 and consider current weather in some way (e.g., OLR, winds, SOI)
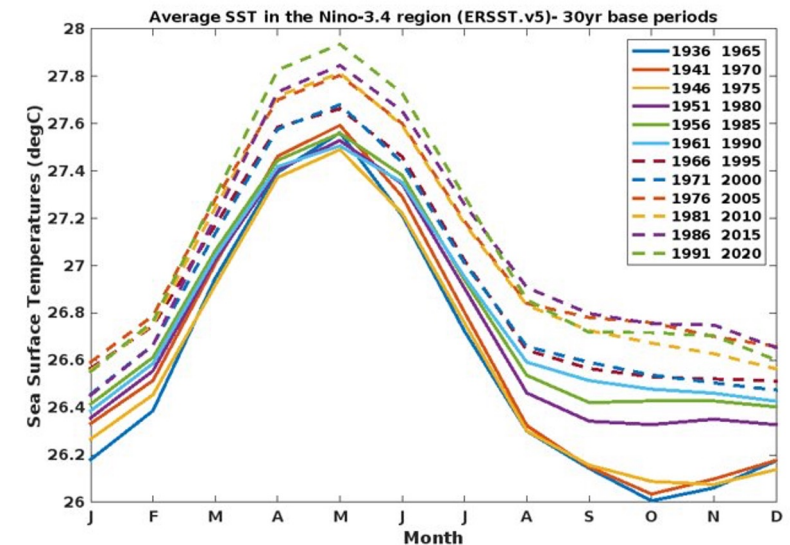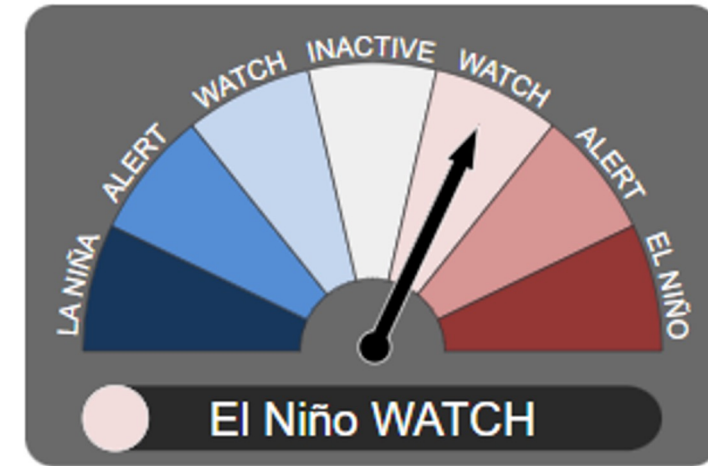
Nino 3.4 SST has a warming trend of 0.3 to 0.8 K since ~1940, depending on month (from Michelle L'Heureux; NOAA)
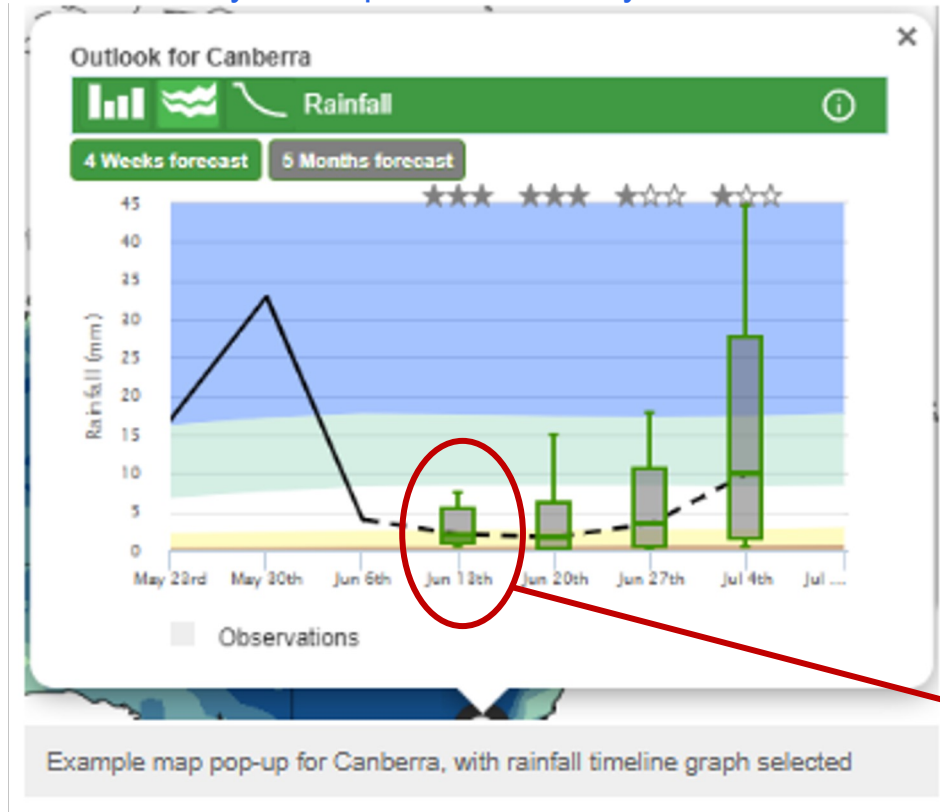
Centre	Threshold (K)	Smooth (months)	Clim period	Climate Change Adjust	Alert levels	Monitor IOD?
NOAA	0.5	3	Rolling for past, 1991-2020 present, updated every 5 yrs	Rolling climatology, unofficial monitoring of rN3.4	5	Informal
NEA	0.65	3	1976-2014	1962-2011 trend removed	5	planned
NIWA	0.7	3	1991-2020	Rolling climatology planned	7	No
MF-NC	informal	1	Unclear	No	n/a	No
BoM	0.8	1	1961-1990	Not yet	7	Yes

Contact: Matthew Wheeler

Statistically blending weather forecasts and S2S

- User feedback shows a strong preference for daily forecast beyond 7-day weather forecast.

- What can we do in the absence of an NWP model that runs to longer leads (> 7days)

Weekly-mean product currently available

Example map pop-up for Canberra, with rainfall timeline graph selected

Week 1: incorporates NWP info

New project to explore:

- How do we optimally blend/combine/post-process information from NWP and seasonal systems?

- How do we best communicate these forecasts so not misinterpreted

- Want to post-process calibrated ACCESS-S2 ensemble so that it is broadly consistent with ADFD (Australian Digital Forecast Database) forecasts − the weather forecast issued to the public

- Can we extend daily weather forecasts to lead days 8-14

Contact: Matthew Wheeler

Towards future model configurations

Bureau research is aligned with Met Office cycle of development
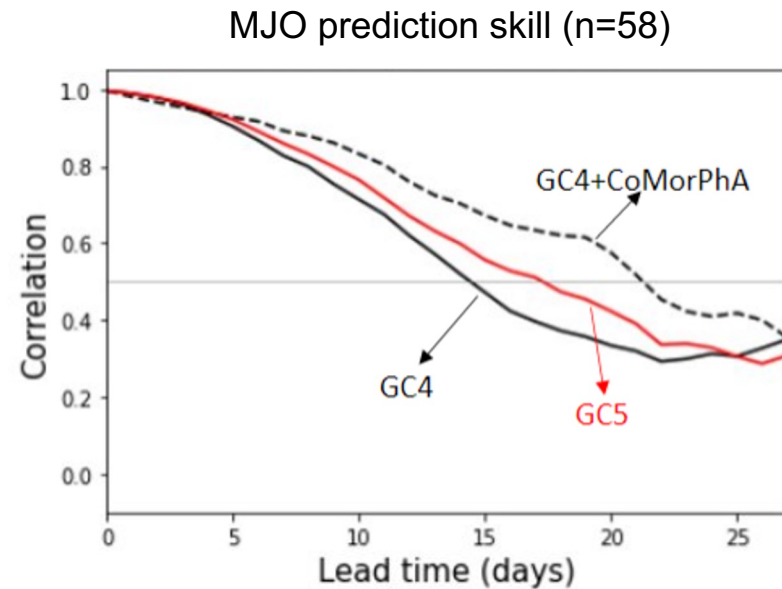
Model development

- Developing a sea-breeze parameterisation

- Interactive vegetation representation in the model using ML

- Evaluation and testing of the new CoMorph convection scheme

MJO prediction skill (n=58)

Model evaluation and testing

Evaluating latest coupled model (GC5) for coupled NWP, S2S and seasonal prediction

Zhu, H.; Hudson, D.; Li, C., Shi, L.; Young, G.; Stirling, A. ; Whitall, M.; Lock, A.; Lavender, S.; Stratton, R. 2023. **Impacts of the new UM convection scheme, CoMorph-A, over the Indo-Pacific and Australian regions**. In review. To be submitted as a Bureau Research Report.
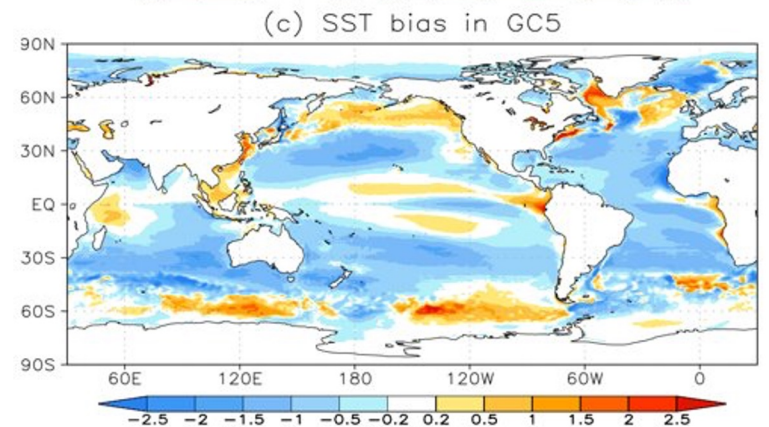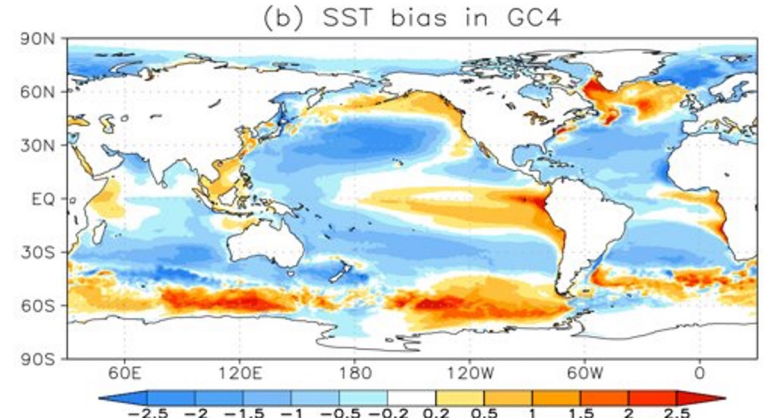
Li, C.; Hudson, D.; Zhou, X.; Zhu, H.; Wheeler, M.C.; Young, G.; Roberts, L.; Marzin, C. 2023. **Biases and teleconnections in GC5 – insights for seasonal prediction and Australia**. In review. To be submitted to Journal of Southern Hemisphere Earth Systems Science.

Coupled model versions 2, 4 and 5

(a) SST bias in GC2

Used in ACCESS-S2

(b) SST bias in GC4

(c) SST bias in GC5
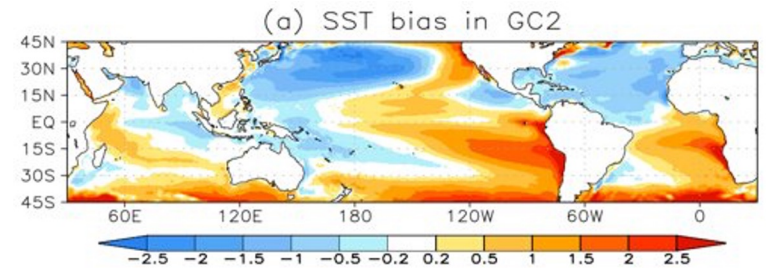
Latest version

Contact: Debbie Hudson

# Evaluating and tackling persistent biases in the Indo-Pacific

Indo-Pacific Priority Evaluation Group (PEG)
Joint activity between UM Partners and ECMWF

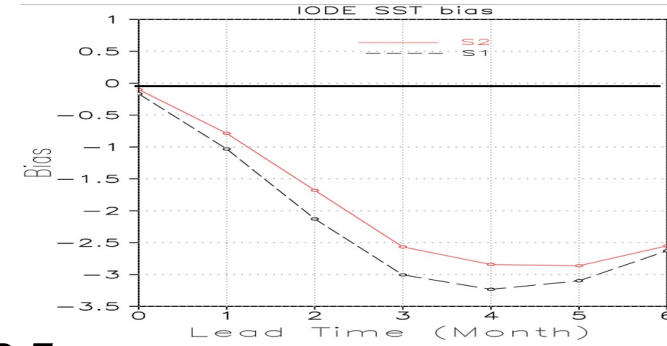Aims to tackle mean and variability errors which have an impact on teleconnections and forecast skill

Co-leads:

- Charline Marzin (Met Office)

- Debra Hudson; Matthew Wheeler (BoM)
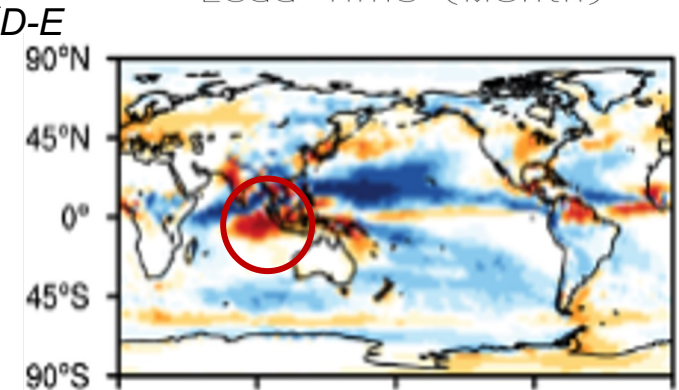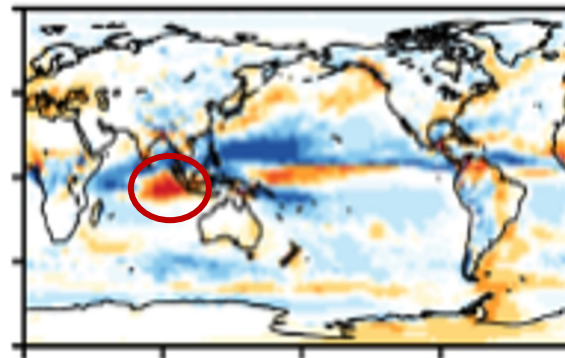
- Magdalena Balmaseda (ECMWF)

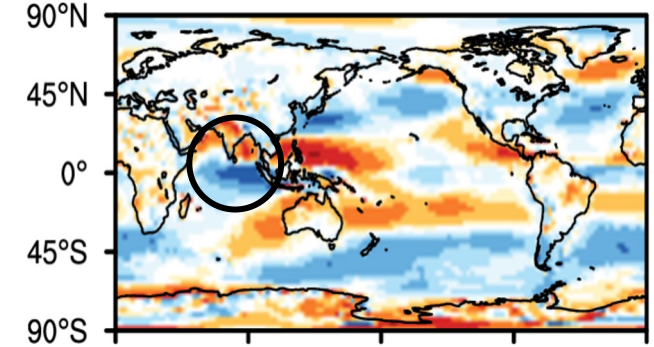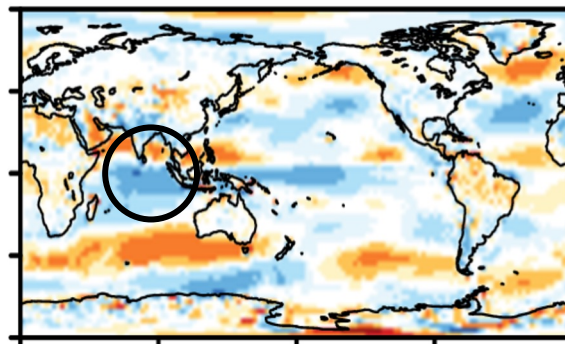**ECMWF System 5**
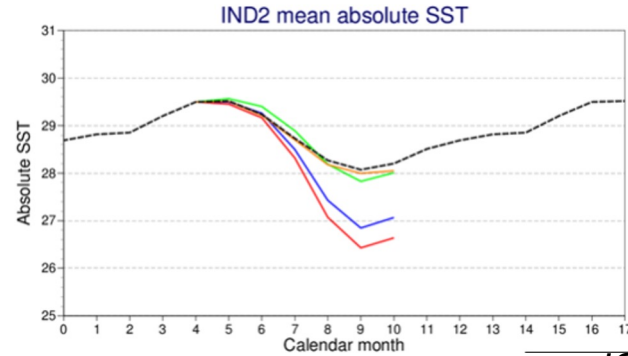
IOD-E

ACCESS-S (similar for GloSea)

IOD-east **COLD BIAS**

Rainfall (red=too dry)

E. Indian Ocean **DRY BIAS**

Indian Ocean **EASTERLY WIND BIAS**

u-wind (blue=too much easterly)

Thank you

Debbie Hudson

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