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ACCESS –S: S1 Results, Plans for S2, Skill Evaluation

Oscar Alves and the Coupled Modelling and Climate Processes Teams

Science to Services, Bureau of Meteorology

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Plan

ACCESS-S1

- Progress, system, skill, products, etc

ACCESS-S2

Projects

ACCESS-S3 and Beyond

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ACCESS-S1 vs. POAMA

	ACCESS-S1	POAMA-2
Atmospheric model	Latest UKMO atmospheric model (GC2)	Bureau BAM (~10+ years old)
Atmospheric resolution	Horizontal: **60 km** mid latitudes Vertical: **85 levels**	Horizontal: 250 km Vertical: 17 levels
Ocean model	Latest NEMO	MOM version 2
Ocean resolution	Horizontal: **25 km** Vertical: **75 levels**	Horizontal: ~200 km x 100 km Vertical: 25 levels
Land surface model	State-of-the-art land surface model JULES	Simple bucket model
Sea ice model	Latest sea ice model CICE (UK & USA)	No sea ice model
Ocean Initialisation	UKMO: NEMO VAR + UKMO Ice Initialisation	Pseudo EnKF
Atmos/Land	Atmos: Direct ERA Interim/BoM NWP Land: Climatological moisture	Atmos nudging scheme to ERA Interim/BoM NWP
Ensemble Generation	Random static atmos perturbations + stoch Phys	Coupled bred perturbations

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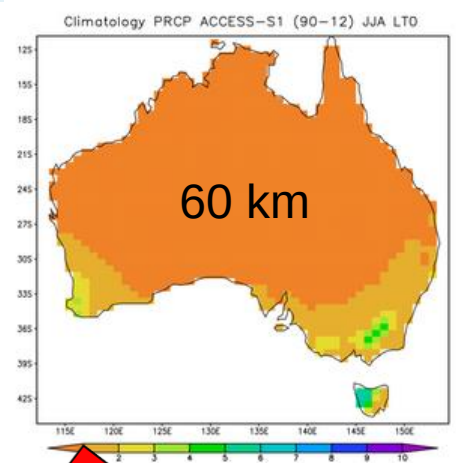
Forecast/Hindcast Output

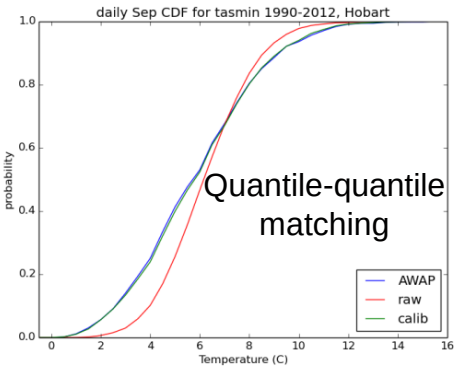
Hindcast

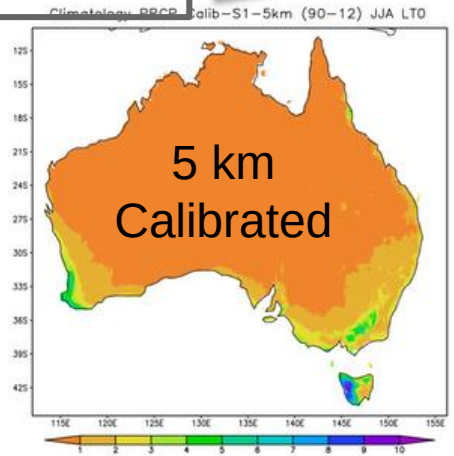
- 23 years 1990-2012
- 4 start dates every month
- 11 member ensemble
- Forecast out to 6 months
- ~700Tb on NCI

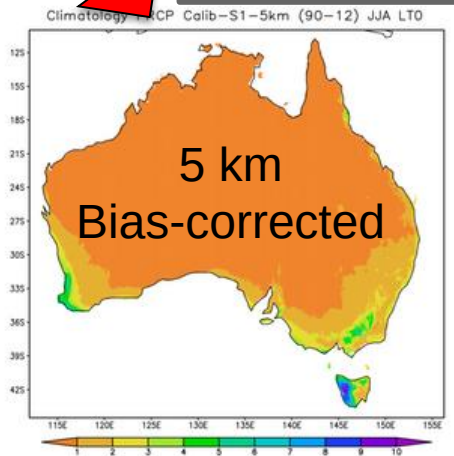


Real-time

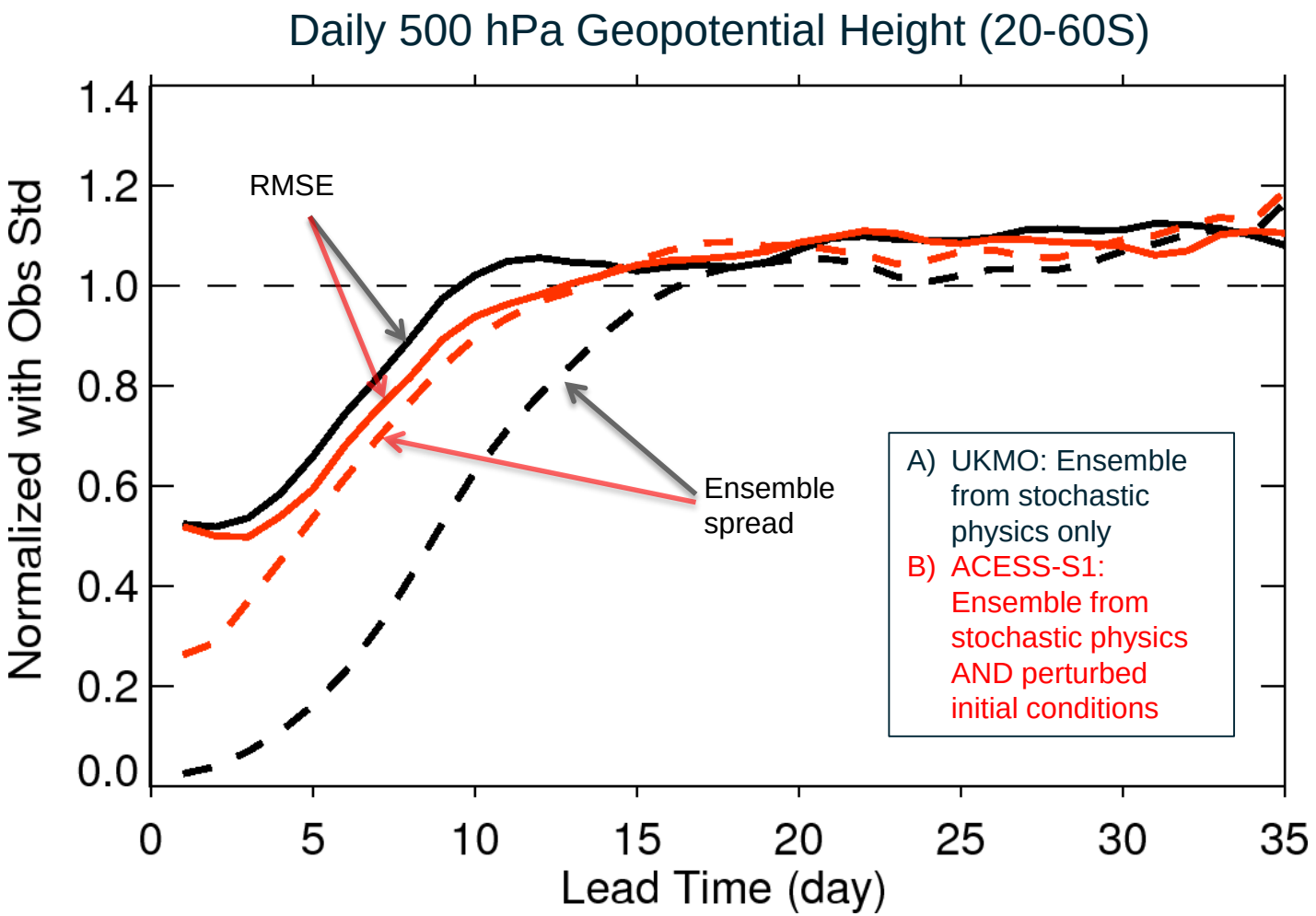
- Updated daily
- Forecast out to 6 months
- 99 member lagged ensemble
- 11 per day to 6 months
- + 22 per day to 6 weeks
- **Operational May'18** (realtime since Nov'17)







Ensemble generation in ACCESS-S1



Underdispersed (overconfident)

$Spread_{ens}$ < RMSE

Consistent/reliable

$Spread_{ens}$ ≈ RMSE

1 May start, 5-member ensemble

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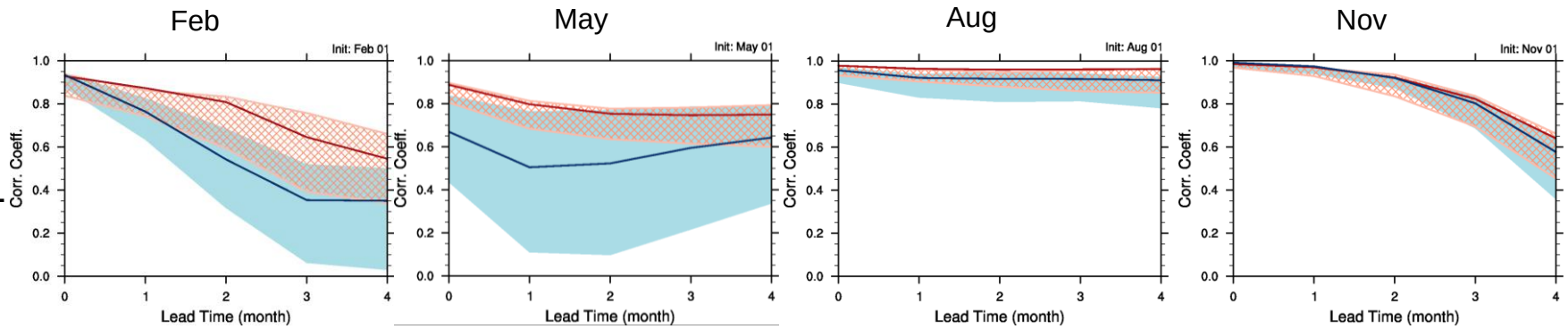
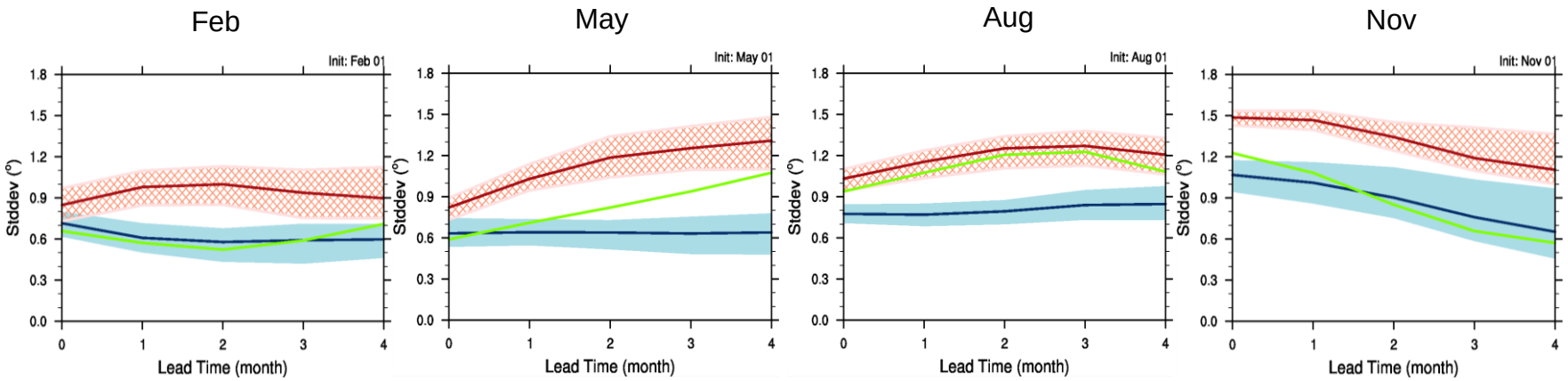
Nino 3 Skill and Variability

SKILL



STD



ACCESS-S1 POAMA OBS

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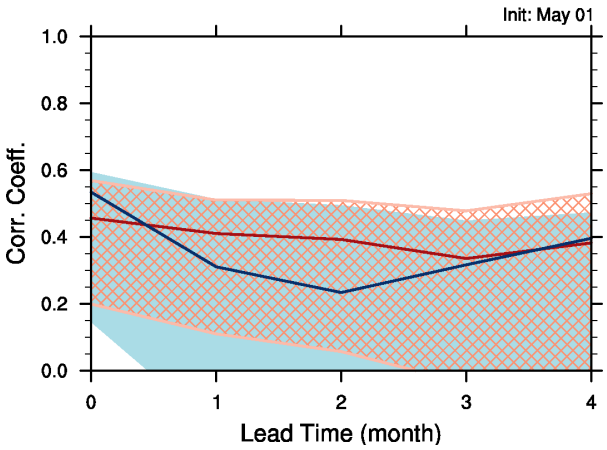
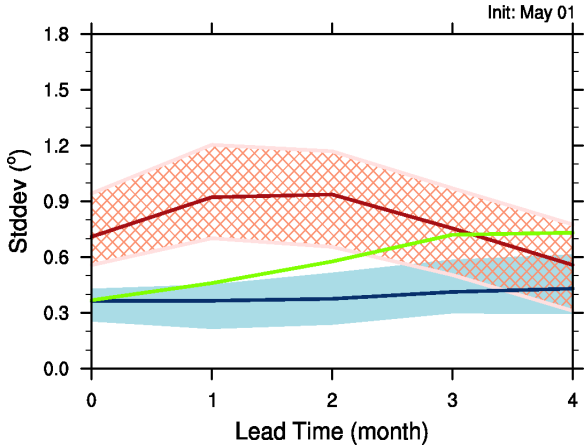
Prediction of IOD

SKILL

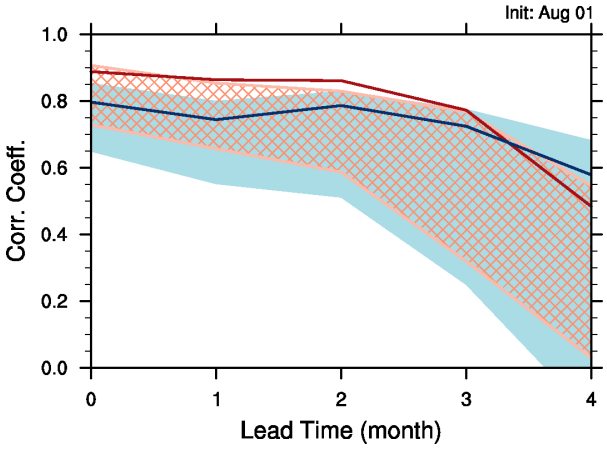
STD

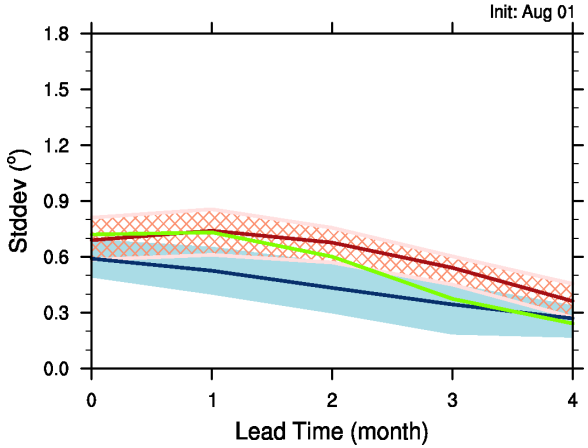
May





Aug





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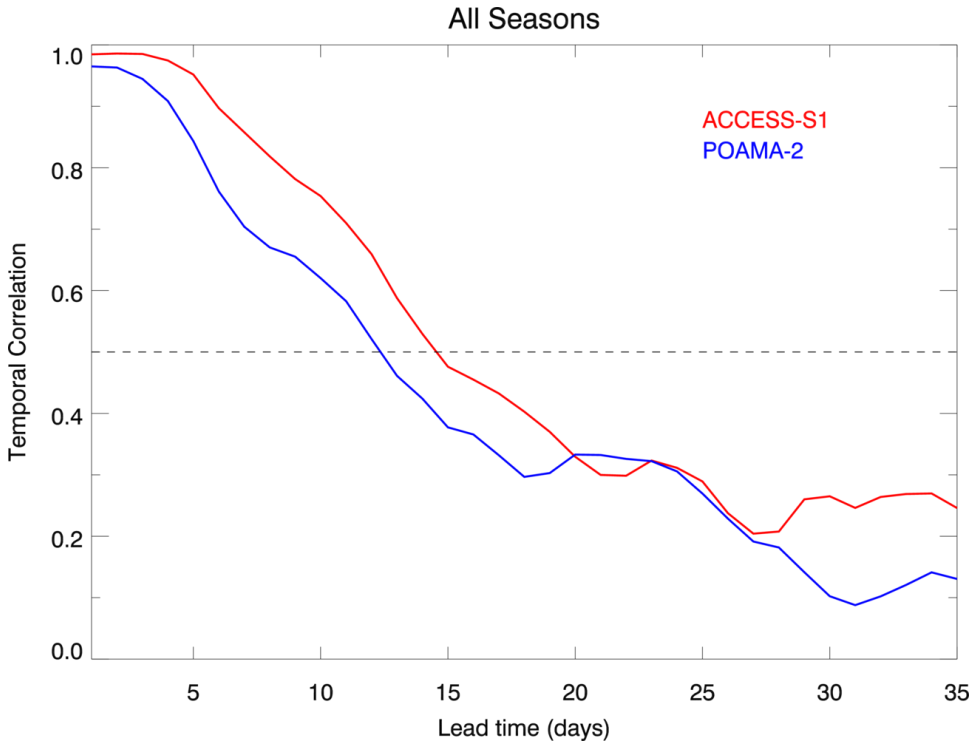
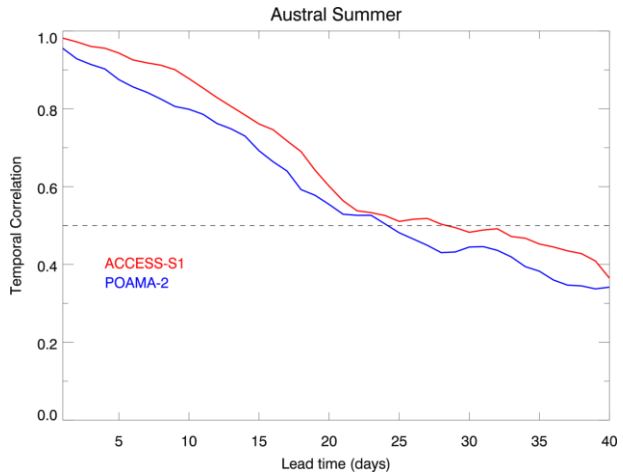
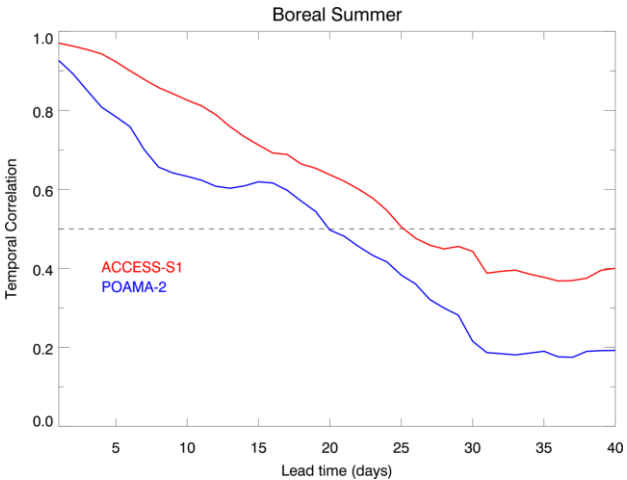
Prediction of the SAM and MJO

Southern Annular Mode



Madden Julian Oscillation





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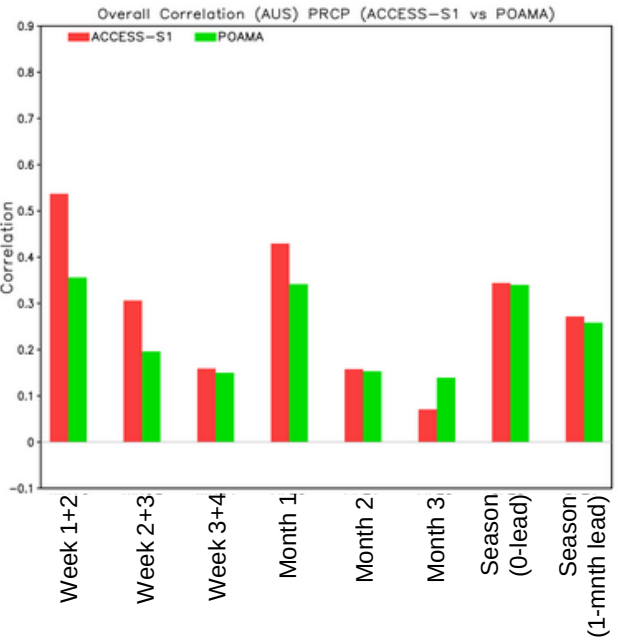
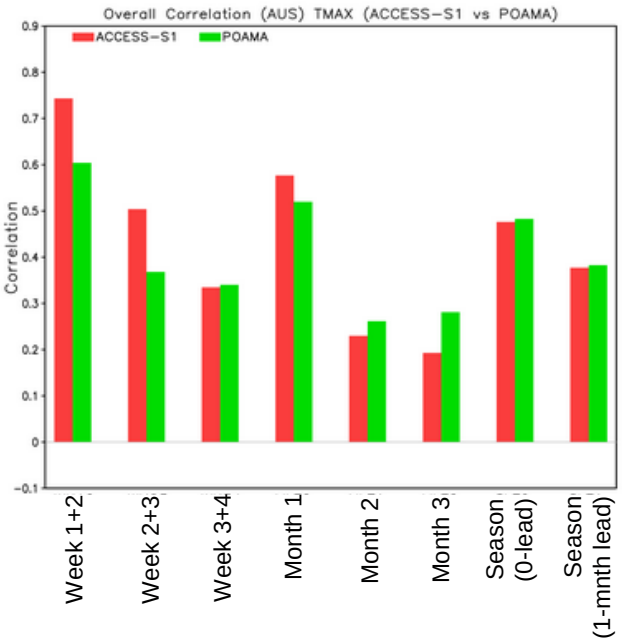
Prediction of Australian Climate

Correlation skill for all AUS and times of year for forecasts at different timescales and lead times

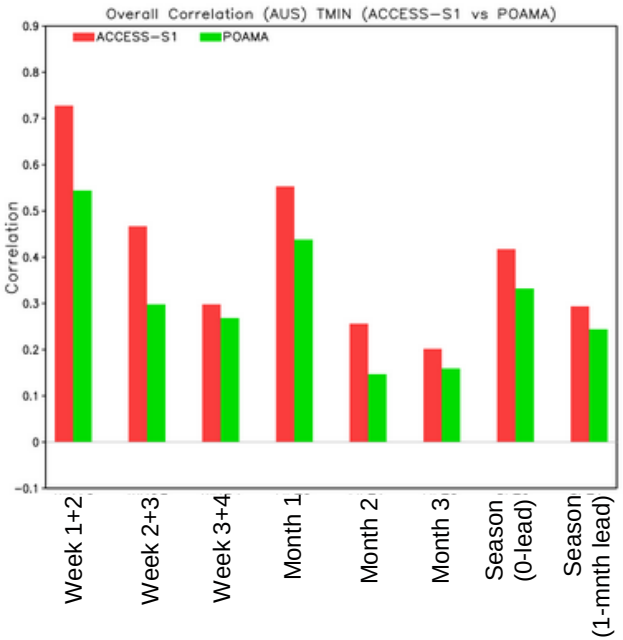
Rainfall



TMAX



TMIN



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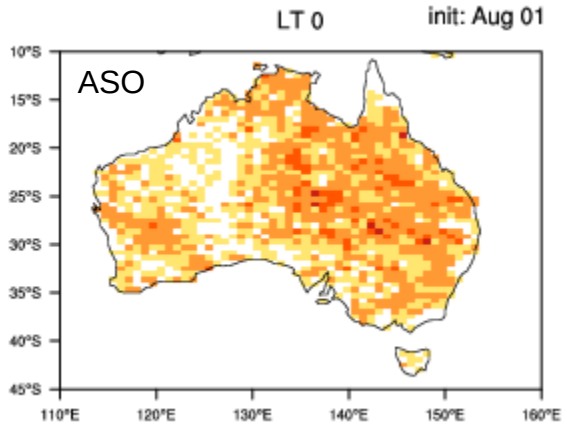
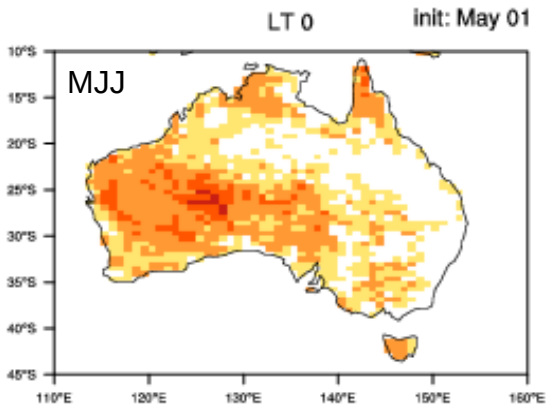
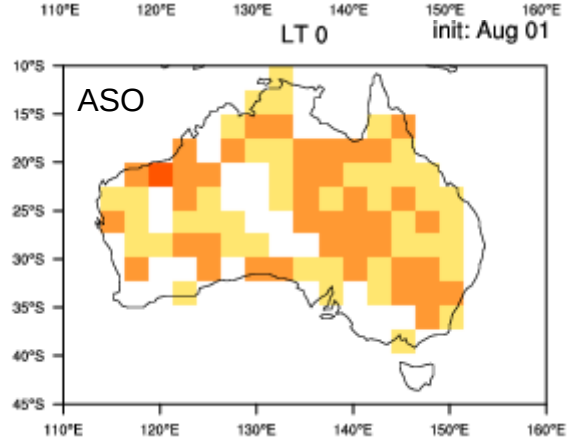
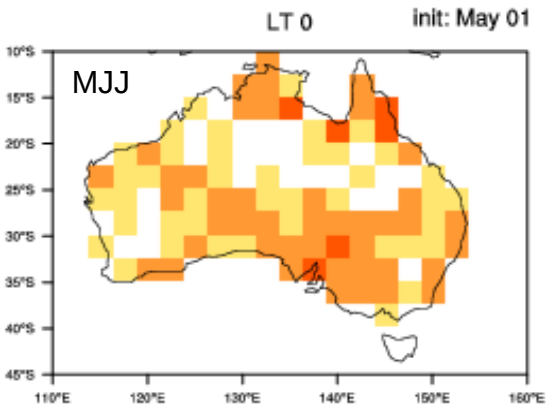
Prediction of Australian Climate

Seasonal 0-lead: Some seasonal differences in performance

	Spring Rainfall	Winter Tmax
ACCESS-S1		
POAMA		

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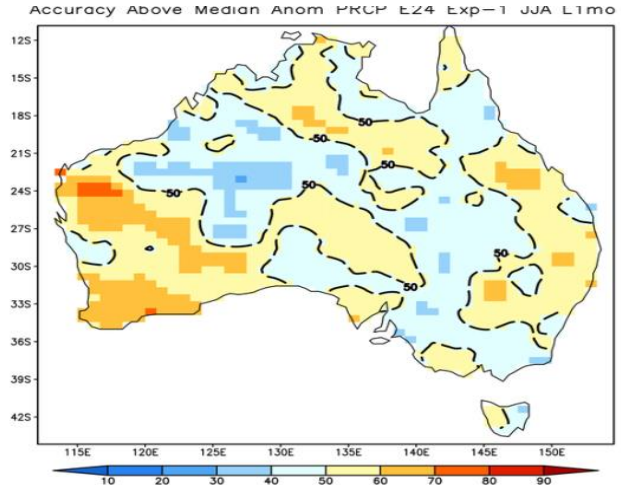
Is 23 years 11 members enough for regional skill ?

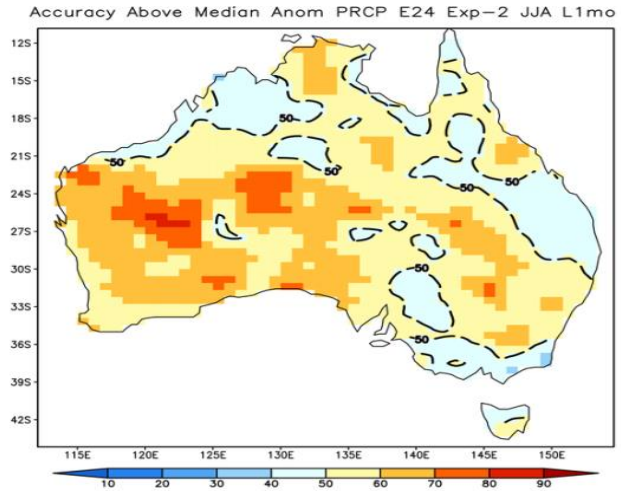
Accuracy of PRCP above median in JJA (1 month lead)

POAMA
11-member (of 33)
Set 1

n=23



POAMA
11-member (of
33) Set 2



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ACCESS-S1 Forecast Visualisation Tool (FVT)

BoM internal

ACCESS-S1

◉ Forecast ○ Hindcast

Forecast Start Date < 2018 > < May > < 01 >

General Products

Climate Drivers
- > Ocean SST indexes
- > Atmos drivers

Atmos Products

Basic Charts
- > 60km
- > 5km bias corrected
- > 5km calibrated

POE Charts
- > Prob rain more than
- > Prob Tmax above
- > Prob Tmax below
- > Prob Tmin above
- > Prob Tmin below

Regions Stations
- > Pie Charts
- > POE
- > Quintile bars

Seamless Products
- > Daily distributions

Heat Extremes
- > Heat wave
- > Livestock heat index

Ocean Products

Basic Charts
- > Horizontal Charts

POE Charts
- > Prob SST more than
- > Prob SST less than

Regions Stations
- > Pie Charts
- > POE
- > Quintile bars
- > Ocean Plume

Sea Ice
- > Southern Hemisphere
- > Northern Hemisphere

Eddies
- > EAC

Product Characteristics

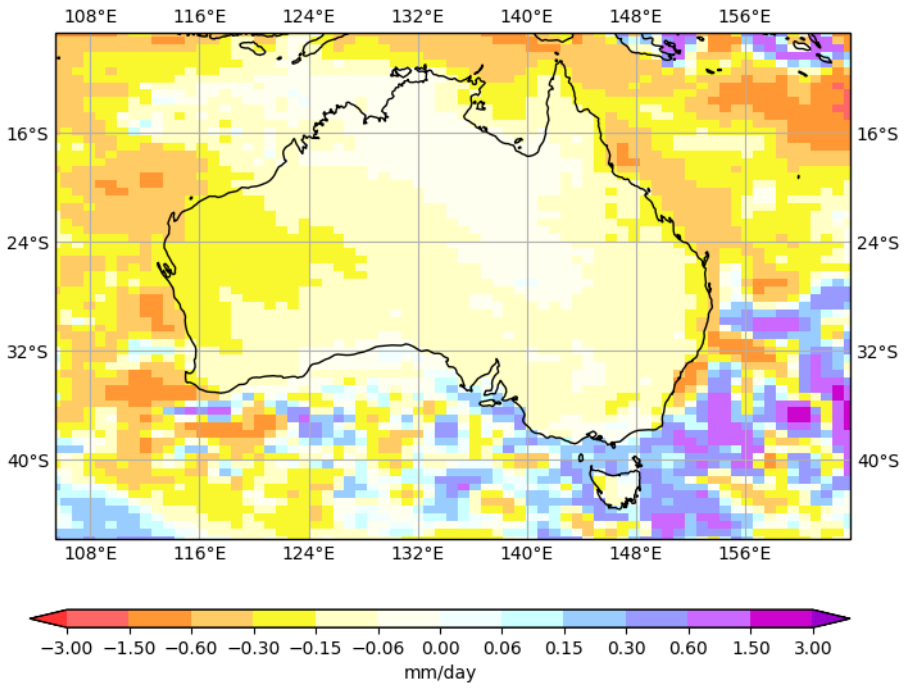
Variable: Rainfall | Domain: Australia | Forecast Period: Season 1 | Value: Ensemble mean anomaly

Average Anomaly Precipition

Start: 20180501

Region: Australia

Period: Season: 20180501 to 20180731



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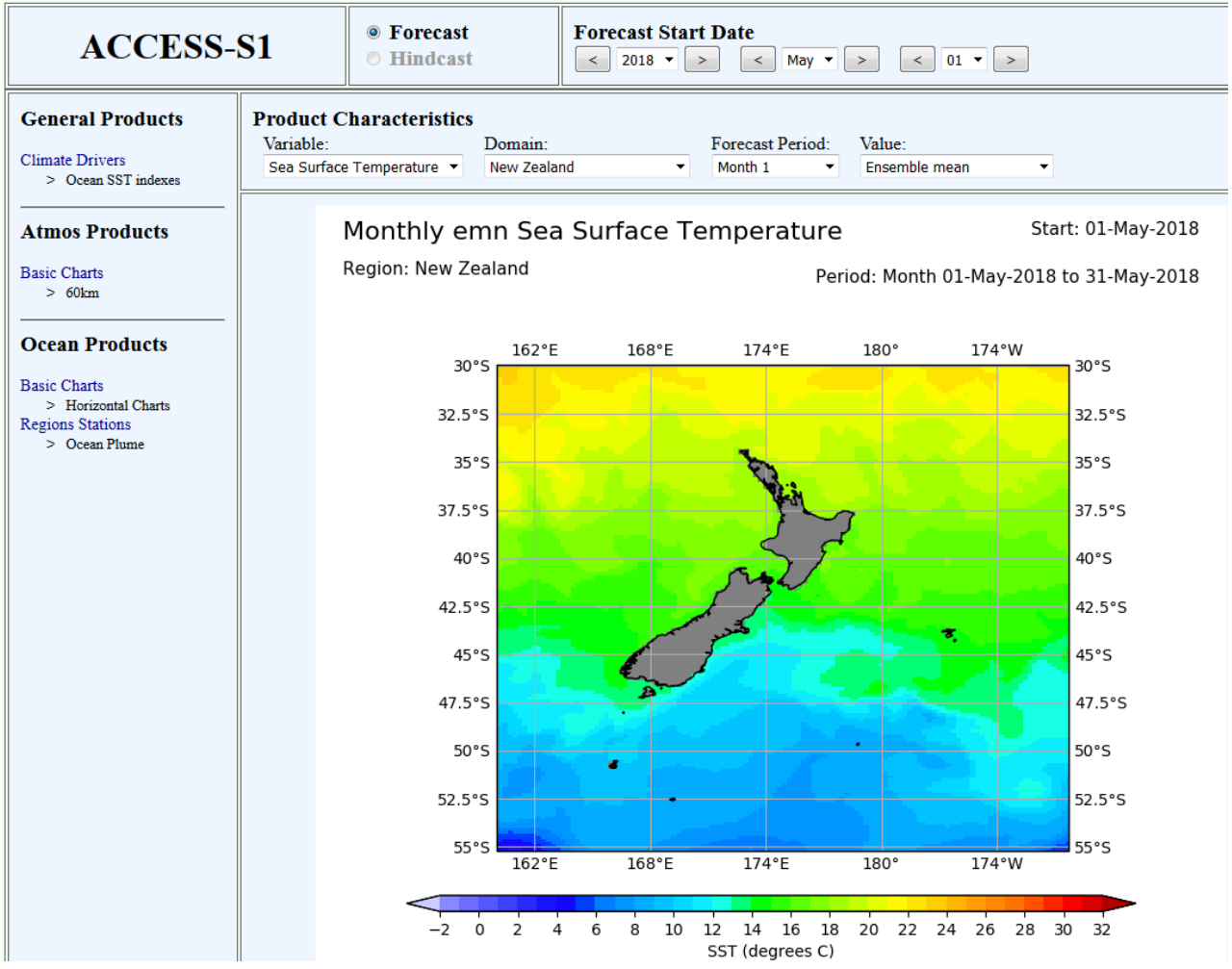
Cut-down version of ACCESS-S1 FVT

For active R&D projects

e.g. New Zealand marine project



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Partnerships

$6M R&D for Profit Extremes Project for Australian Agriculture

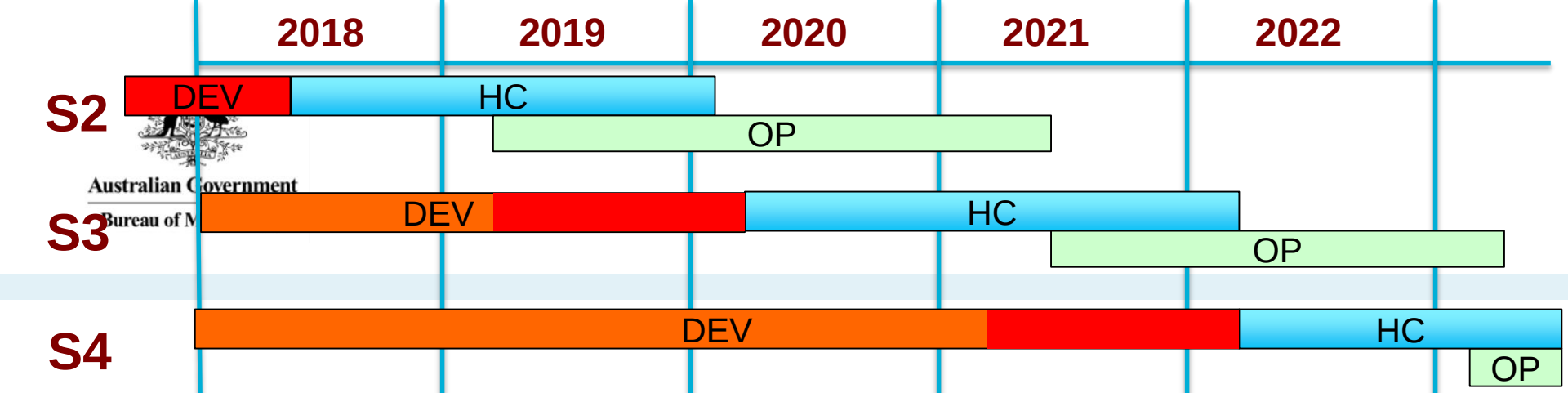
- Development of extremes products
- Underpinning Science and Model Development (with Monash Uni)

$4M Northern Australia Climate Program (NACP)

- Product Development (MJO, Monsoon, drought, etc)
- Model Development (with UKMO – 2 positions at UKMO)
- Explore potential for Multi-year forecasting (especially drought)

Smaller Projects

- New Zealand Fisheries forecasting
- Great Barrier Reef Bleaching Risk forecasts
- Sydney water – multi year forecasts
- Forecasting for Horticulture
- Southern Hemisphere Sea ice Forecasting
- Sheep CRC (Ask Bill Tool)



ACCESS-S2

Same Model – UKMO GC2 (minor tweaks)

Fast Track Local Assimilation (break realtime link to UKMO)

- Weakly coupled using Ensemble OI for ocean + Atmospheric “Nudging” (No Altimeter)
- Land and Sea Ice from coupled model
- Same ensemble generation as ACCESS-S1 (simple static atmos perturbations)

Hindcasts

- 38 years (1981-present)
- 27 member ensemble per month (seasonal+multiweek)
- 18 member ensemble (multiyear – up to 5 years)

Significant computing resources -30% of BoM (would take 30-50 years on our NCI allocation)
Generates ~3Pb of output

ACCESS-S2 Improvements

Skill Improvements from

Land moisture initialisation

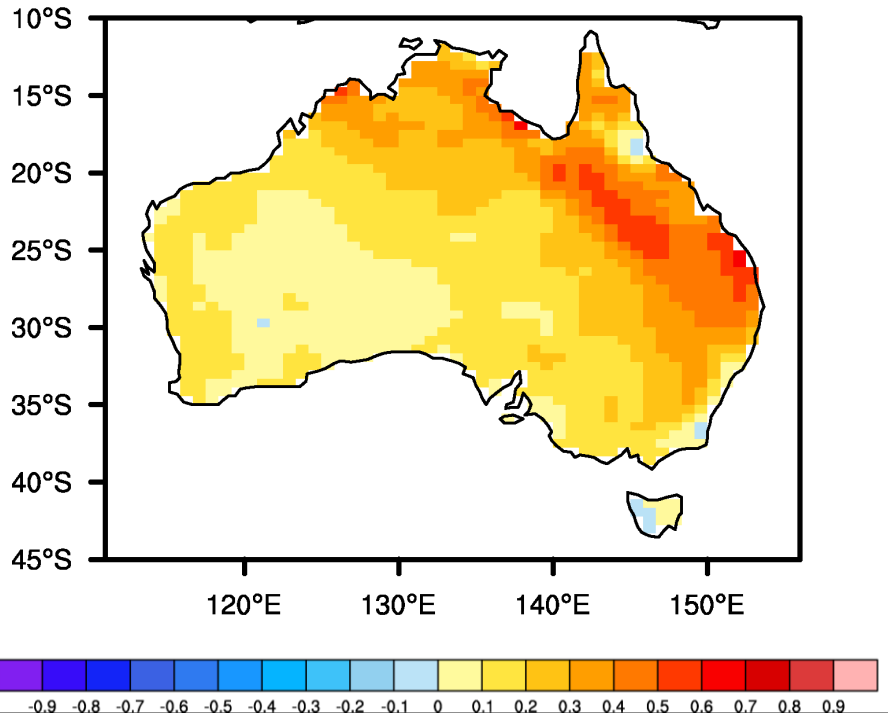
Better Ocean initialisation (See Yonghongs talk)

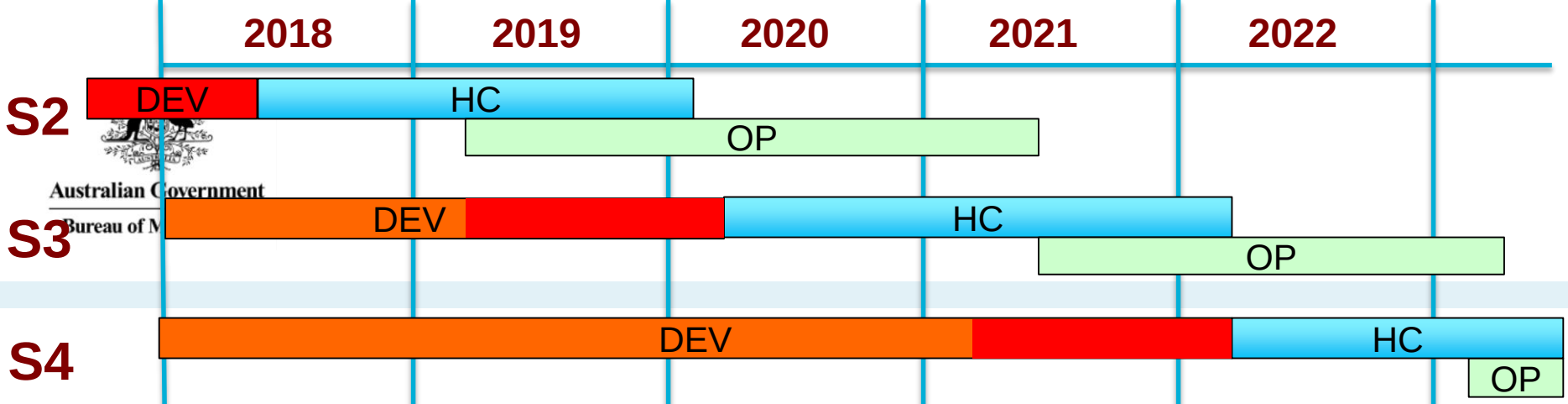
Better Hindcast Set for

More stat significant skill
Better for extremes (larger ensemble)
Explore multi-year predictions

With Land surface – ACCESS-S1

Tmax Correlation skill improvement (May lead 0)





ACCESS-S3/4

Staged implementation of local and overseas enhancements

Model

UKMO – improvements – new convection scheme, better MJO – GC4/5/6 ?
Improvements from Australian projects focussing on Indian Ocean and MJO/Monsoon – e.g. Extremes, NACP projects (via UKMO)

Assimilation

- Strongly Coupled EnKF – including using assimilation perturbations
- Including of Altimeter and satellite salinity
- Sea Ice initialisation
- Improved stochastic physics (e.g. NEMO)

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Summary

ACCESS-S1

- Operational May 2018
- Significant multi-week improvement, modest seasonal improvement
- Much higher resolution 60km (5km after downscaling)
- Major applications projects (Extremes, NACP, Sheep CRC, etc)

ACCESS-S2

- Fast track Local assimilation – improved skill (land surface and ocean initialisation)
- Larger hindcast set (38 years, 27 members, 5 years)

ACCESS-S3

- Local and UKMO model improvements
- Heading towards strongly coupled EnKF + new obs (altimeter, salinity, sea ice)