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Bureau of Meteorology

Modelling Centre Update: BoM

Debbie Hudson

WGSIP22, October 2020





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ACCESS-S1

- UKMO global coupled model (GC2). Atmos: ~60km (N216); Ocean: 25km
- Uses UKMO assimilation & BoM ensemble generation (atmos perturbations + stochastic physics)
- Hindcast: 23 years (1990-2012); 11 ensemble members
- Real time: 99 members (uses burst and lagged)
 - Sub-seasonal: 6-weeks
 - Seasonal: 6 months
- Calibrate (quantile-matching) to 5km for key variables over Australia



ACCESS-S2 is transitioning to operations

ACCESS-S2

- Break dependency on UKMO Initial conditions
- Same GC2 model as ACCESS-S1 (UKMO GC3 showed no improvements) but tweaks/corrections (e.g. inland lakes, ozone error, coupling frequency)
- BoM weakly-coupled assimilation (and includes soil moisture initialisation)
- More hindcasts: 37 year (1981-2017); bigger ensemble for skill; utilizes daily-lagged (more consistent with real-time)
- Run out to 9 months lead
- Real-time ensemble size same as S1 (i.e., products based on 99-member time lagged ensemble)

Operational April 2021

ACCESS-S2 weakly-coupled assimilation

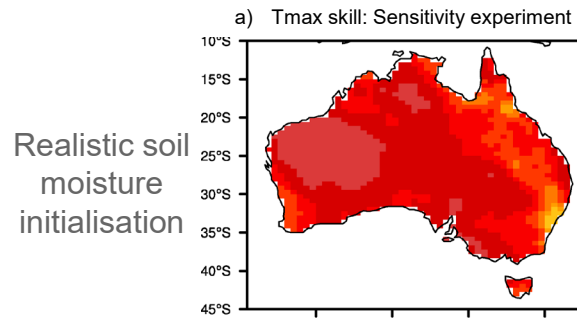
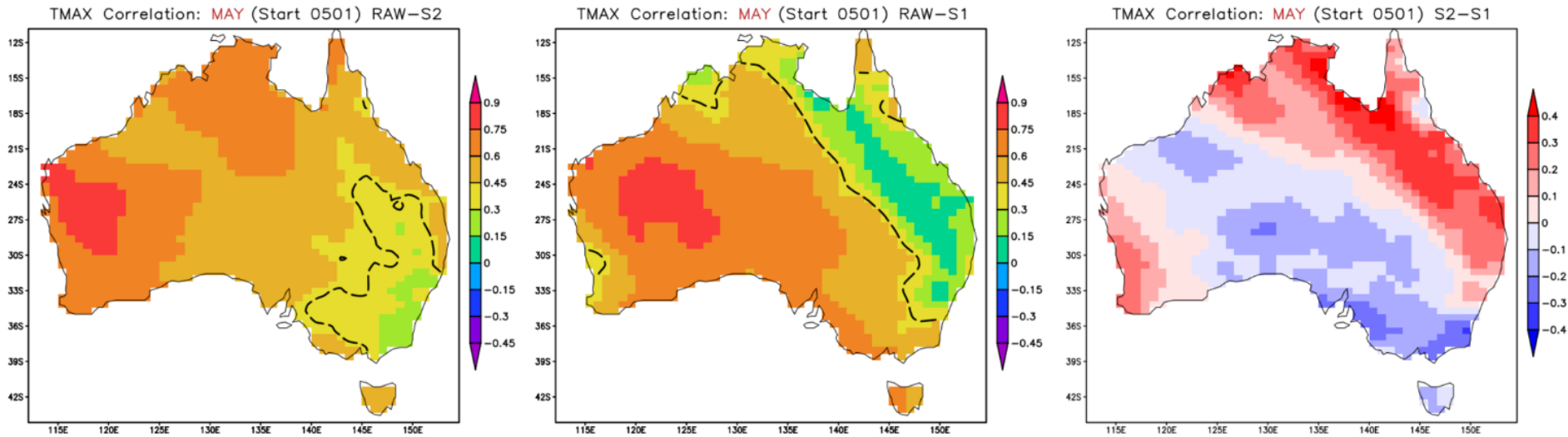
- Weakly coupled daily cycle
- Direct replacement of atmos basic variables (from ERA-interim in hindcasts and NWP in real-time)
- Ensemble OI in ocean – using static ensemble (simpler than POAMA)
- Ocean assimilation uses the background state from the coupled model
- Land surface and sea ice indirect through coupling
- Stronger nudging of SST than UKMO
- No Altimeter (only T/S profiles)
- Multi-variate – ocean current increments
- 1981-present re-analyses
- Same adhoc perturbation scheme as in ACCESS-S1 (only the atmosphere is perturbed) for ensemble generation



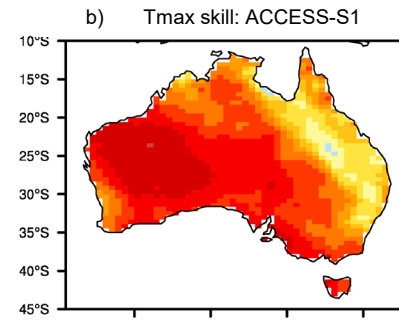
ACCESS-S2 vs S1 Skill

Tmax: May correlation skill from 1st May Starts

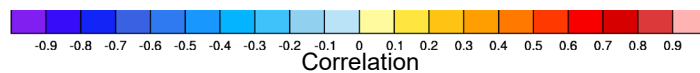
Difference (S2-S1)



Realistic soil
moisture
initialisation



Climatological soil
moisture
initialisation



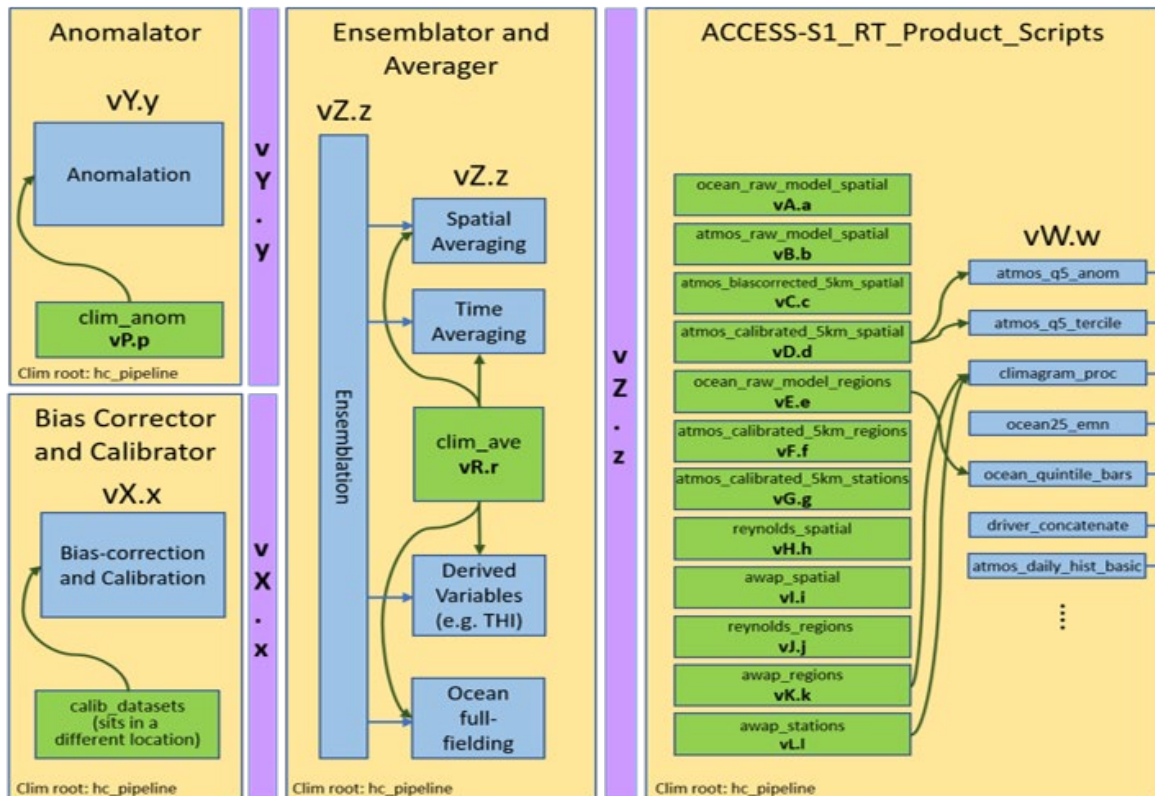


Enhanced post-processing and product generation pipeline to support customer needs

Run on Bureau supercomputer

Characteristics:

- Centralised
- Modular
- Includes calibrated forecasts to 5km grid over Australia
- New products easily added
- Reduces duplication of effort
- Forecast product traceability
- Includes complex referencing to observations and hindcasts
- Supports BoM website products and data delivery via other channels





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Work towards ACCESS-S3

Installing UKMO GC4 at BoM - N216 and N96 versions

Baseline for future development (will do re-analyses for initial conditions)

Indo-Pacific PEG (Process evaluation group) with UKMO partners and ECMWF - initial pilot study to intercompare and document the UKMO/BoM/ECMWF model biases over the tropical Indian and Pacific Oceans in a consistent way

Would like to start linking to coupled NWP

Potential ACCESS-S3/4 coupled with ACCESS-GE (the NWP global ensemble), resolution decreases with lead time

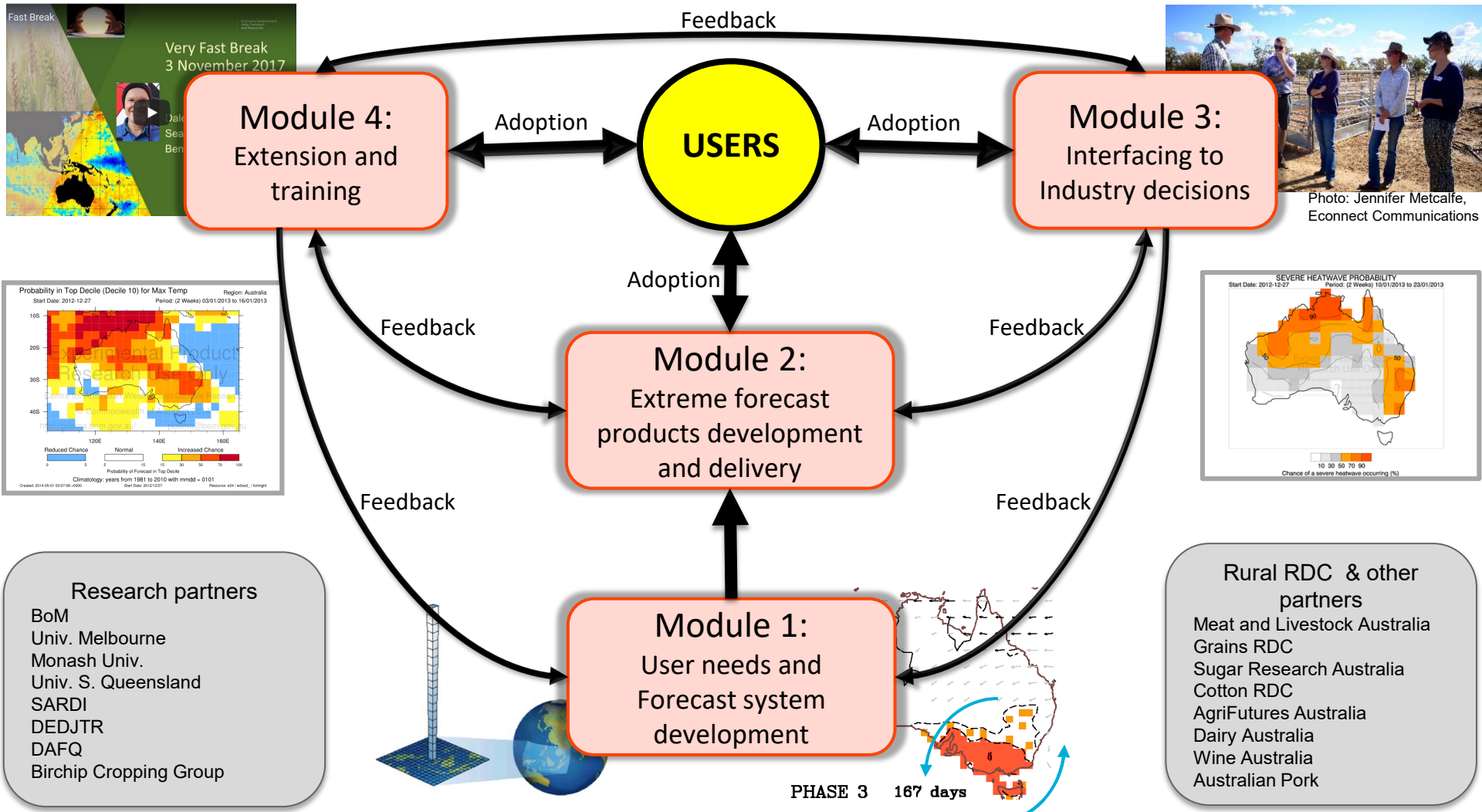


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Rural RnD4Profit Project: Forewarned is forearmed (FWFA)



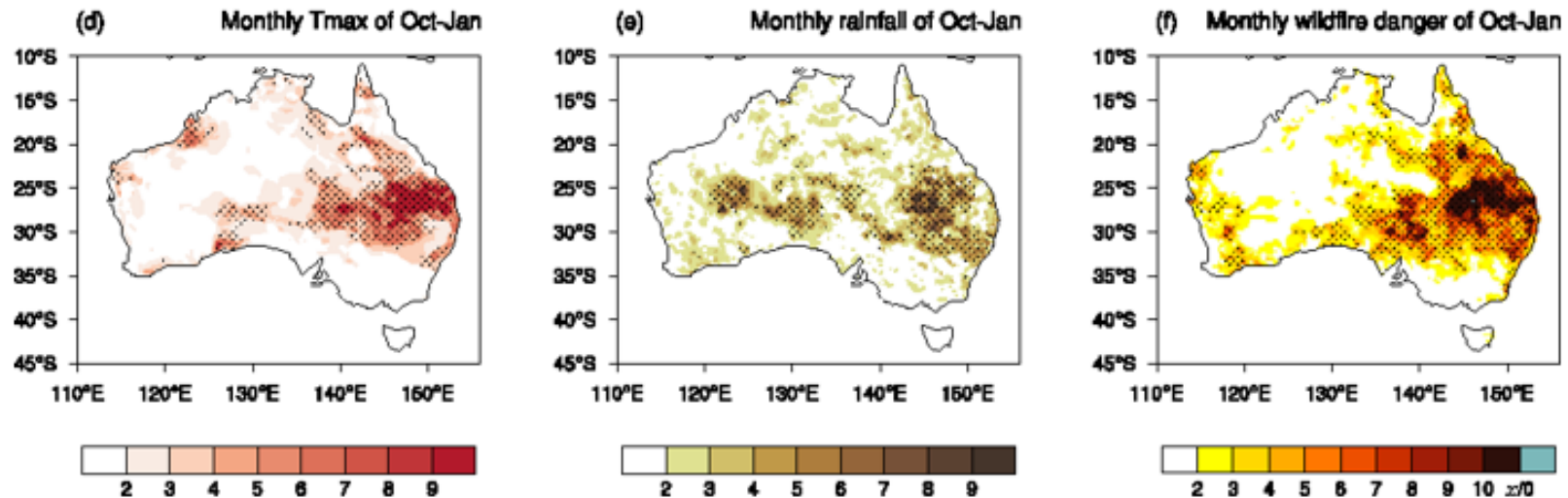
Australian Government
Department of Agriculture





FWFA: underpinning science

Increased chance of extreme (outer decile) hot, dry and fire danger conditions in stratospheric vortex weakening (warming) years.



Lim et al, 2019, Australian hot and dry extremes induced by weakenings of the stratospheric polar vortex *Nature Geoscience* <https://doi.org/10.1038/s41561-019-0456-x>

Hendon et al, 2020, Impact of interannual ozone variations on the downward coupling of the 2002 Southern Hemisphere stratospheric warming *JGR* <https://doi.org/10.1029/2020JD032952>

King et al, 2020, Sub-seasonal to seasonal prediction of rainfall extremes in Australia *QJRM* <https://doi.org/10.1002/qj.3789>

Wang and Hendon, 2020, Impacts of the Madden–Julian Oscillation on wintertime Australian minimum temperatures and Southern Hemisphere circulation *Clim Dyn.* <https://doi.org/10.1007/s00382-020-05432-x>

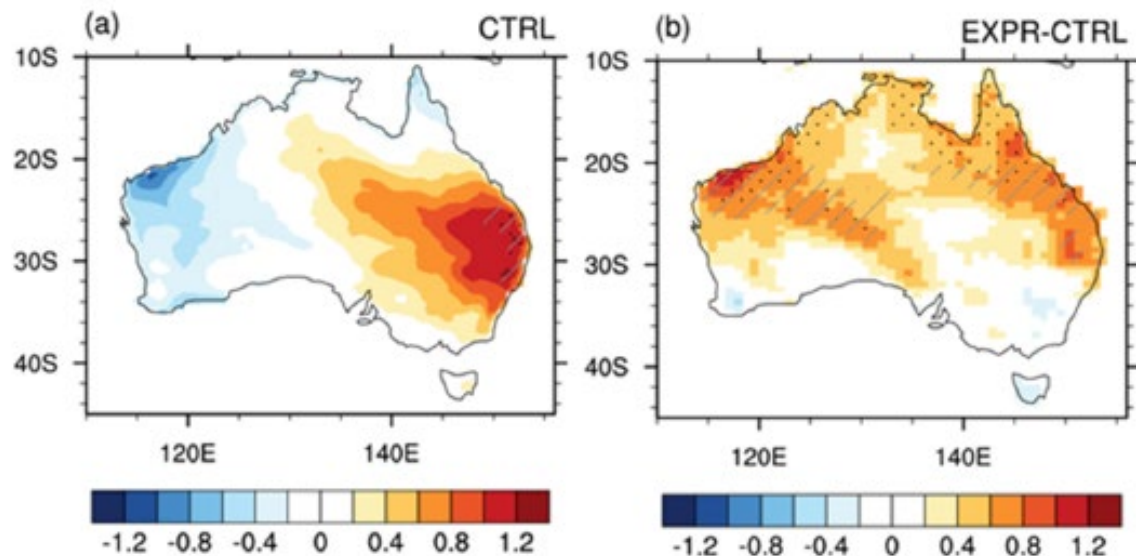
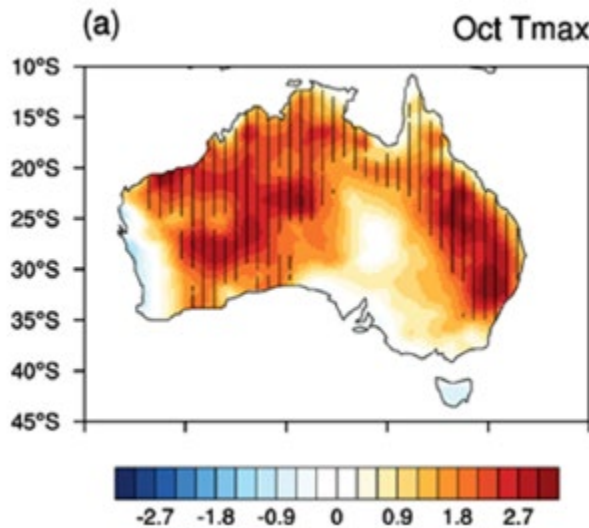


FWFA: underpinning science

Stratospheric polar ozone variation is large enough to matter for the downward coupling to the surface following the 2002 stratospheric warming.

Implication is that ozone variations could be a source of predictability and including interactive ozone in seasonal (and even sub-seasonal) prediction systems could be beneficial

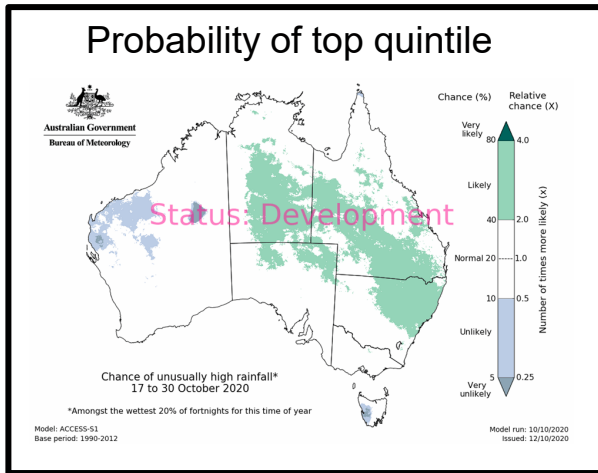
Oct 2002 Tmax anomaly



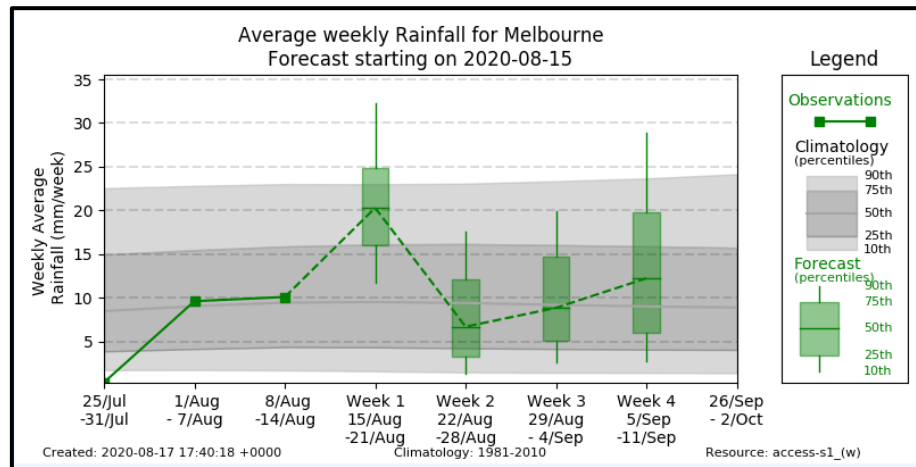
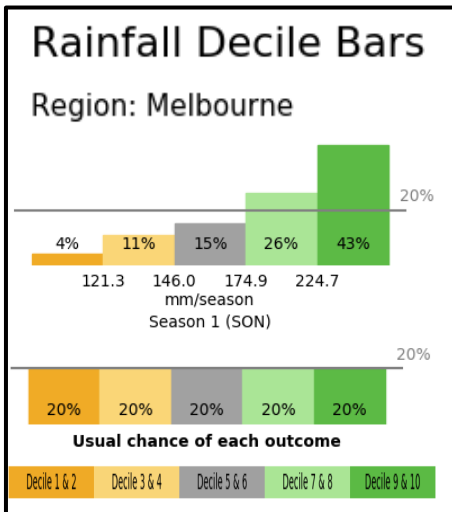
CNTRL: Prescribed climatological monthly mean ozone
EXPR: Observed monthly mean ozone during 2002 is prescribed during the "forecast"
Forecasts initialised on 1st August.



FWFA: products



- Develop a range of heat, cold and rainfall multi-week/seasonal experimental extremes forecast products from ACCESS-S ;
- Make experimental products available on a research web server for trial and feedback;
- Feedback from reference groups of users in the dairy, beef, sheep, grains, sugar and wine industries.
- Deliver operational forecasts for a subset





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Northern Australia Climate Program (NACP)

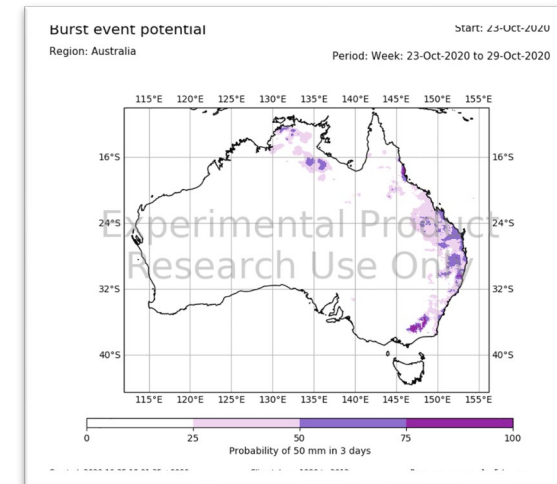
- Funded by QLD government, Meat & Livestock Australia, University of Southern Queensland (USQ)
- MJO/Wet Season/Flash drought forecasts
- Explore multi-year prediction (drought over Northern Australia)
- Model improvement over Northern Australia (collaboration with UKMO)



Cowan et al., 2020, Improving the seasonal prediction of Northern Australian rainfall onset to help with grazing management decisions <https://doi.org/10.1016/j.cliser.2020.100182>

Cowan et al., 2019 Forecasting the extreme rainfall, low temperatures, and strong winds associated with the northern Queensland floods of February 2019 <https://doi.org/10.1016/j.wace.2019.100232>

Nguyen et al., 2019 Using the evaporative stress index to monitor flash drought in Australia <https://doi.org/10.1088/1748-9326/ab2103>



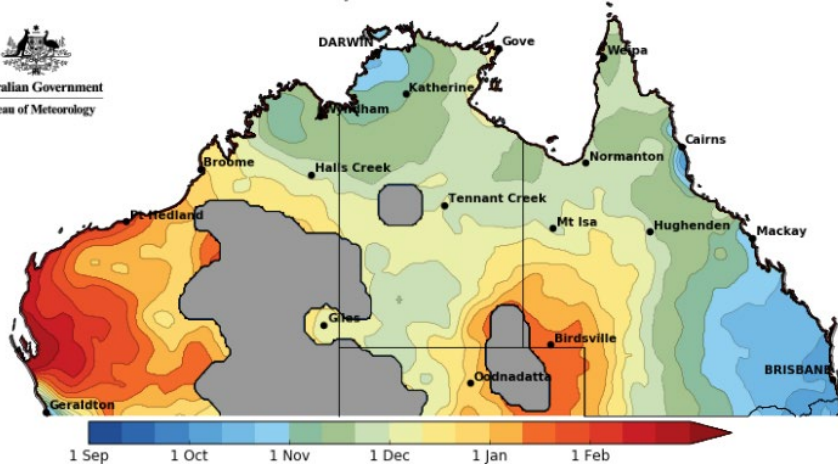
Currently trialing a burst potential product



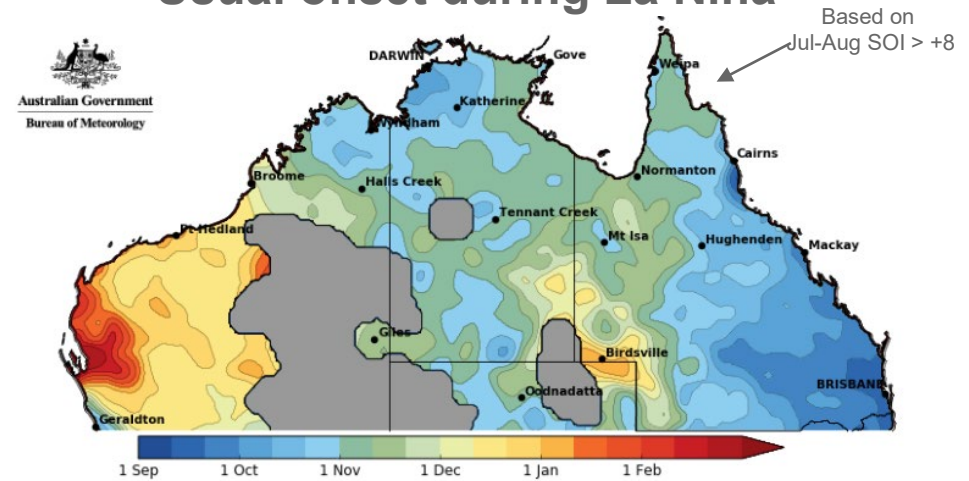
Northern Rainfall Onset

Is the date at which an accumulation of 50 mm is reached after the 1st September. It represents the approximate time when new pasture growth starts after the dry season.

Usual onset



Usual onset during La Niña



Predictions using ACCESS-S1 began in 2019, based on a 99 forecasts per day. Typically there are three official forecast releases (June, July, August).

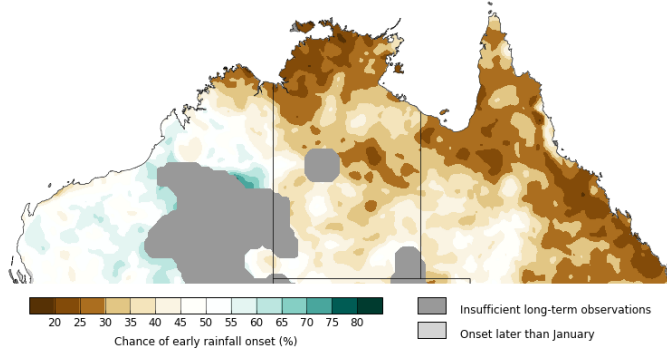
Available to the public: <http://www.bom.gov.au/climate/ahead/>



Northern Rainfall Onset

2019/2020 prediction (25th August forecast)

Chance of early Northern Rainfall Onset

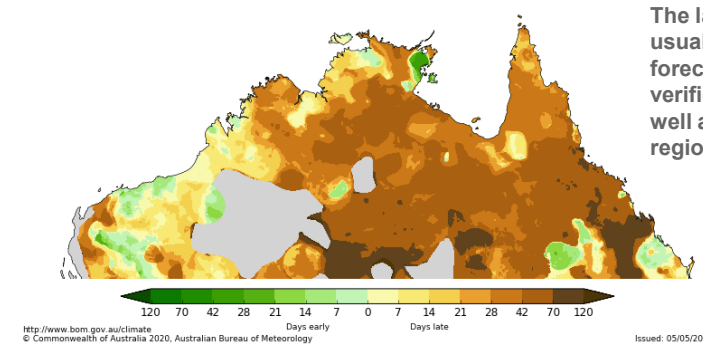


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Model Run: 25/08/2019
Issued: 26/08/2019

2019/2020 observed anomaly

Number of days earlier or later than the long-term average onset date
Product of the Bureau of Meteorology



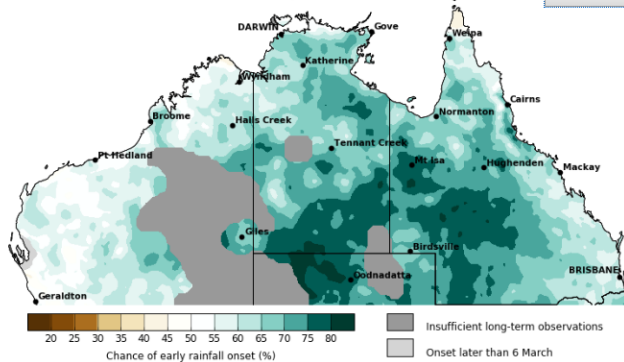
The later-than-usual onset forecasts verified quite well across most regions.

Issued: 05/05/2020

2020/2021 prediction (23rd August forecast)

Chance of early Northern Rainfall Onset

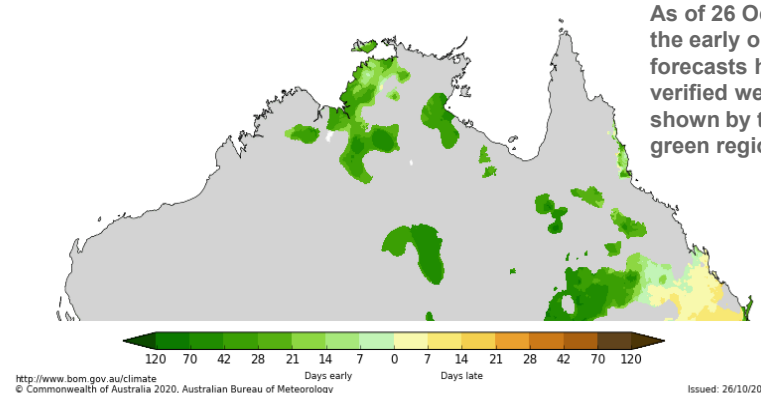
Hide place names



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Model Run: 23/08/2020
Issued: 27/08/2020

Number of days earlier or later than the long-term average onset date
Product of the Bureau of Meteorology



As of 26 October, the early onset forecasts have verified well, as shown by the green regions

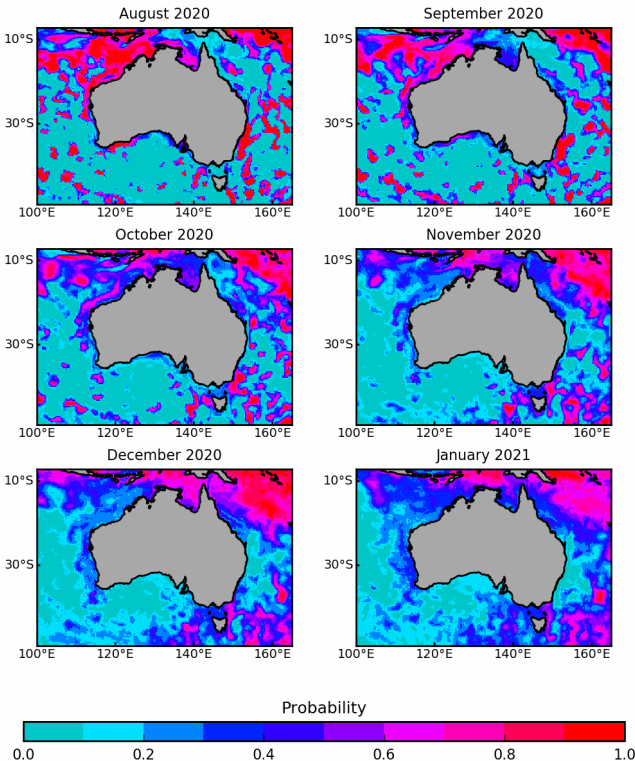
Issued: 26/10/2020



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New Marine Heatwave prediction project

Australia
Probability of SST > 90th Percentile Outlook



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Model Run: 23/07/2020

Model: ACCESS-S1

Issued: 25/07/20

Base Period: 1990-2012

- Seasonal ocean forecasts can provide information regarding likelihood and location of future MHW
- Three year project to develop prototype seasonal ACCESS-S MHW forecast products for Australia
- Event timing, duration and magnitude all important
- Wide range of marine industry applications

