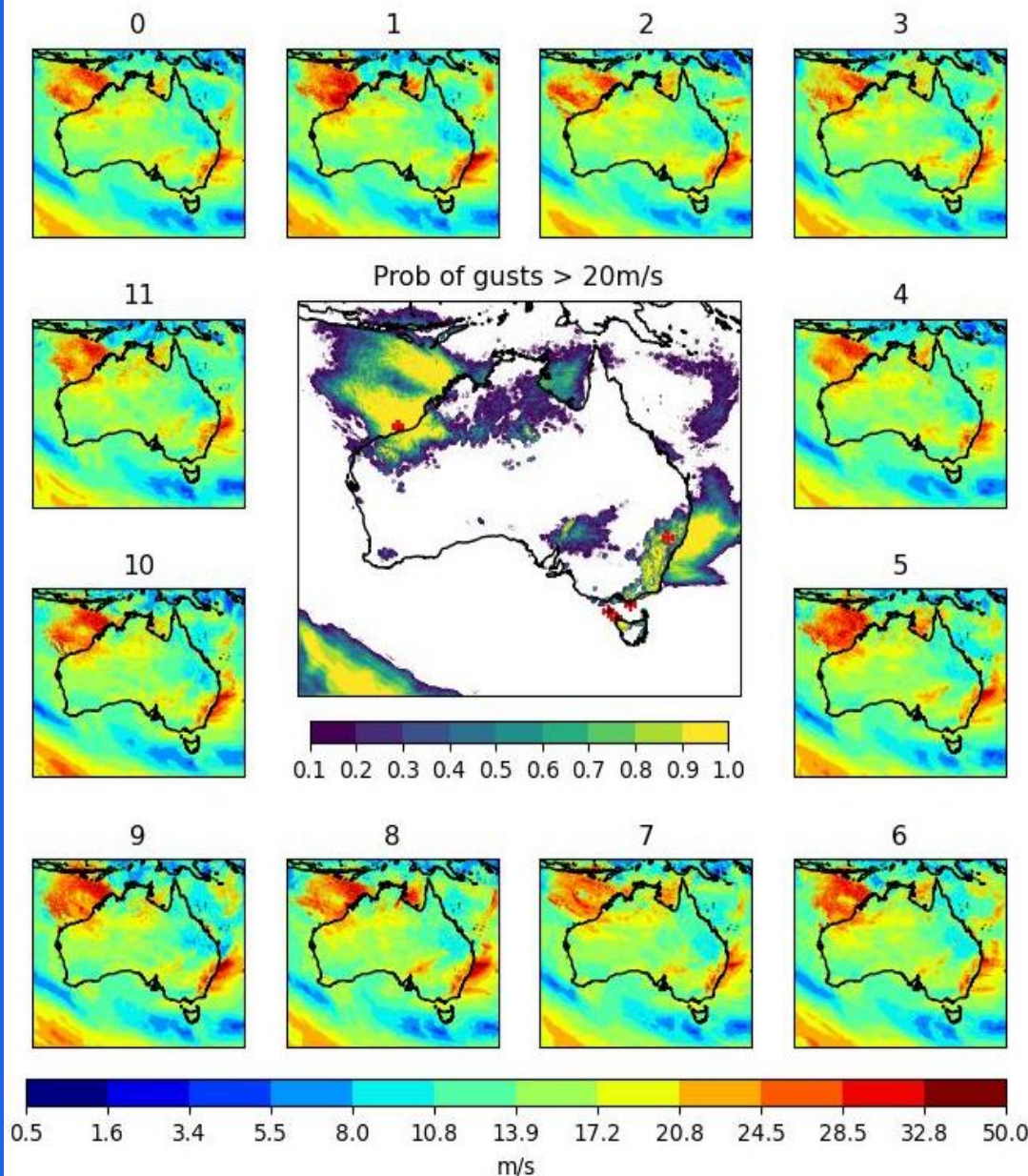# ACCESS-AE

## Testing updates to the Random Parameter scheme over Australia

Belinda Roux, Shaun Cooper, Charmaine Franklin

11 September 2024

Joint Annual R&D and 6th Momentum Partnership Convective Scale Workshop



Max gust for 20210318T0000 48 hour run

# ACCESS-AE

## Developing a national km-scale NWP ensemble model for Australia

**Motivation:**

- Currently 7 x 1.5 km operational domains covering most populated areas
- Desire to have high-resolution forecasts nationally
- Australia spans tropics to mid-latitudes – unified configuration

**ACCESS-AE:**

- RAL3.2 configuration
    - A unified midlatitude – tropical configuration
    - Includes double moment cloud microphysics scheme CASIM and new bimodal cloud cover scheme
    - including MORUSES urban scheme
    - updated land use including improved urban fractions
- 2.2 km horizontal grid spacing, 12 members
- Full domain: 2524 x 2088 x 90 (x 12)

**Research setup:**

- IC and LBC from UKMO global model
- Running case studies and short trials
- Out to 48 hours



Current operational domains



ACCESS-A/AE Domain
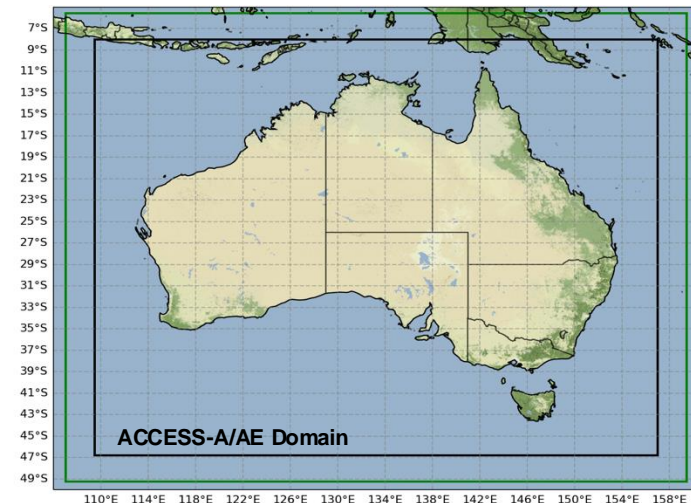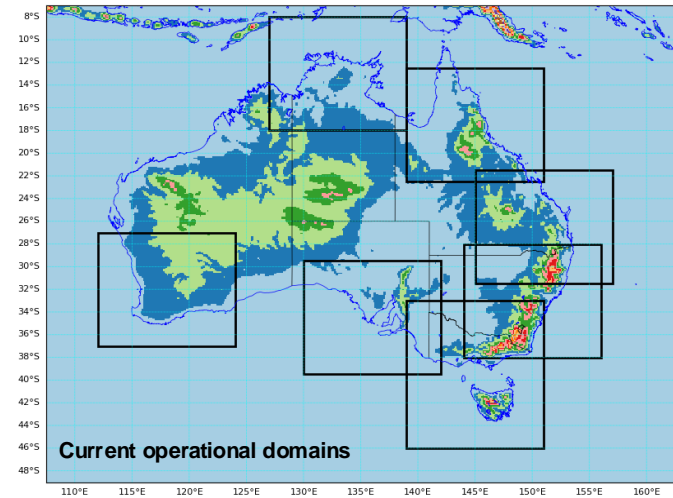
# Random Parameter (RP) scheme

- Ensembles capture effects of uncertainties
  - Initial and boundary conditions
  - Representation of model physics

- RP scheme perturb physics parameters stochastically
  - Increase ensemble spread
  - Capture wider range of possible scenarios
  - Perturb unknown parameters within plausible ranges

- Bimodal cloud scheme and CASIM microphysics require new parameters into RP scheme
  - Also changes to land-surface parameters
  - Developed and tested in the UK (Anne McCabe)
  - Currently testing it over Australia with ACESS-AE trials

# Trial & verification details

## Summer trial:10-17 Dec 2023

- 2 cycles per day (00Z & 12Z) out to 48 hours
  - 16 base dates

- 2 Experiments
  - RAL3.2 with original RP scheme (AE_orig)
  - RAL3.2 with new parameters (AE_newRP)

- Includes range of significant weather
  - TC Jasper, thunderstorms, fog, fire, severe weather (high winds and rain)

## Near-surface verification

- Average stats over whole period
  - Temperature, dewpoint temperature, wind speed
  - 6 regions (showing 2 today)
  - Spread & error, CRPS/RPS

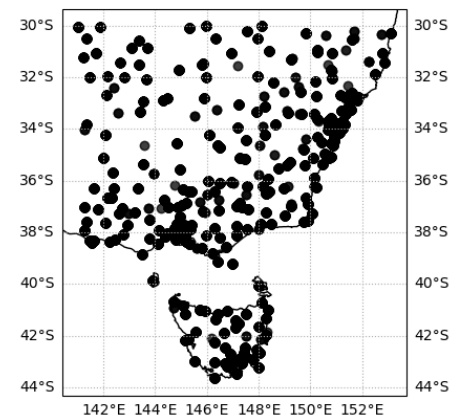- Case studies
  - Melbourne fog event: 11 Dec 2023

Shaun Cooper presented rainfall verification on 10 September



ACCESS-AE Domain
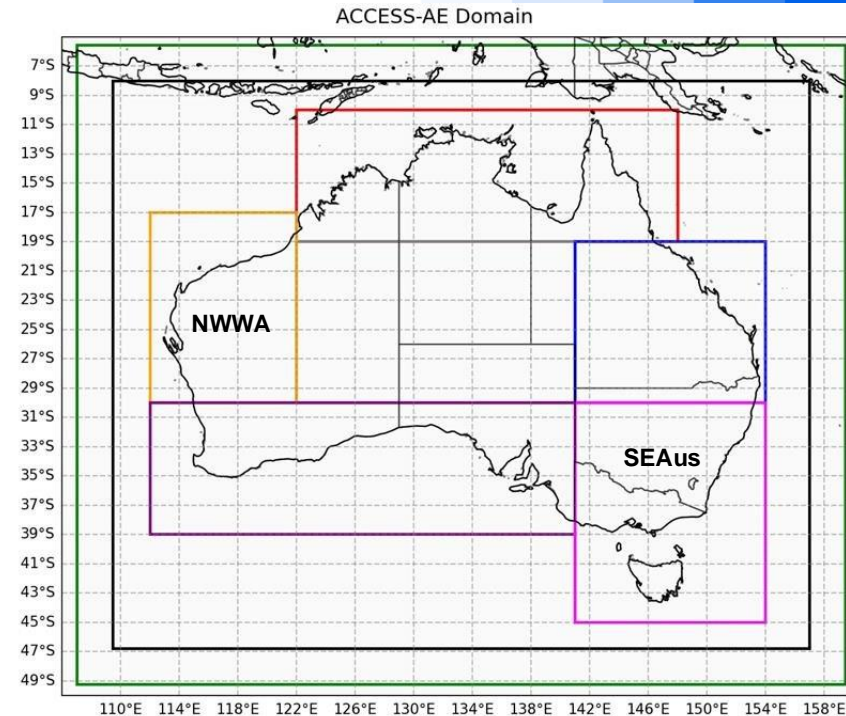


NWWA verification region and ODB locations
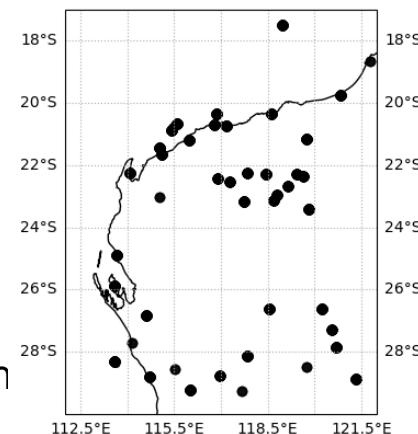


SEAus verification region and ODB locations
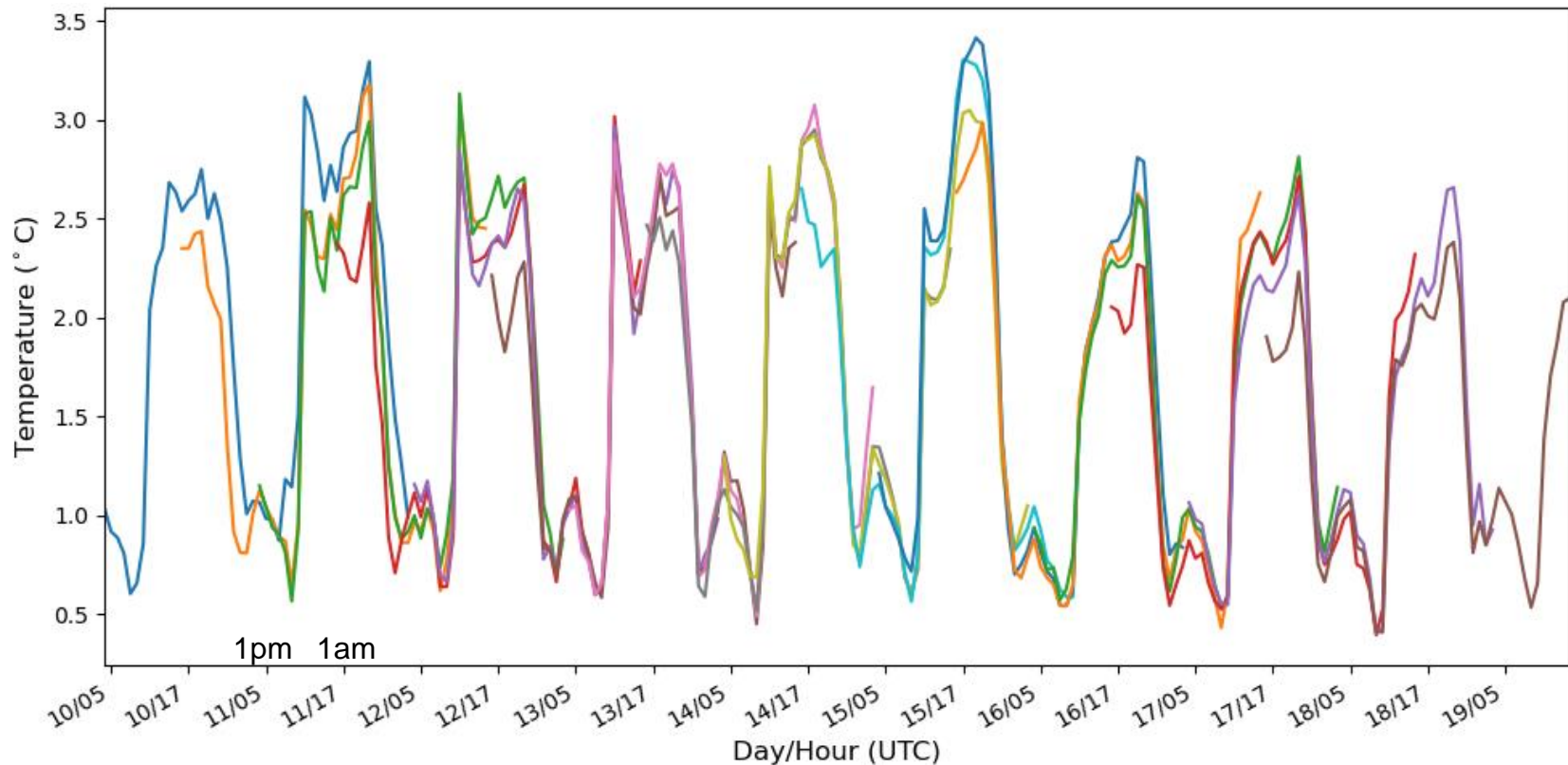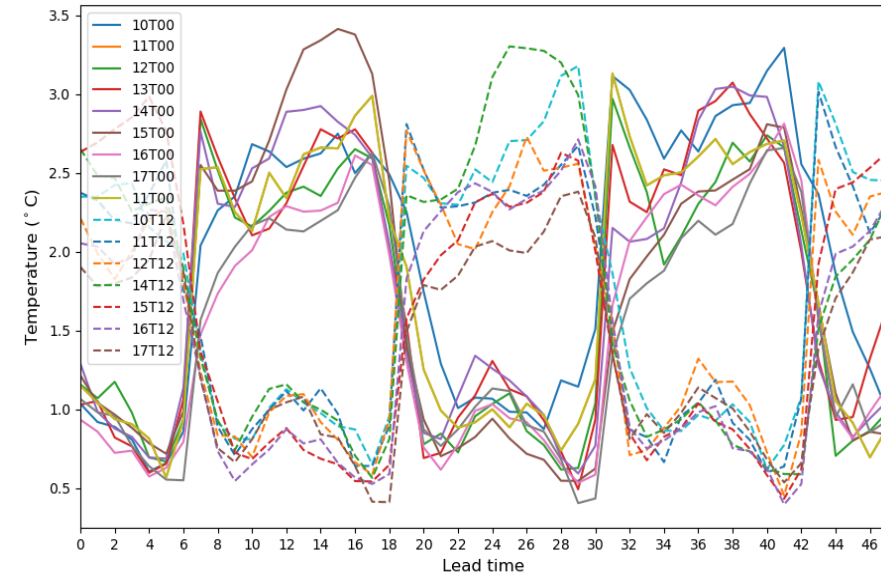
# Average temperature stats over trial period

- AE_newRP better spread/error ratio overall
  - Larger error but also larger spread

- SEAus more consistent difference
  - Higher spread/error ratio overall

- NWWA more disjointed
  - Function of 2 daily cycles
  - Strong diurnal signal in errors
  - Higher RMSE, lower spread
  - Less difference between experiments
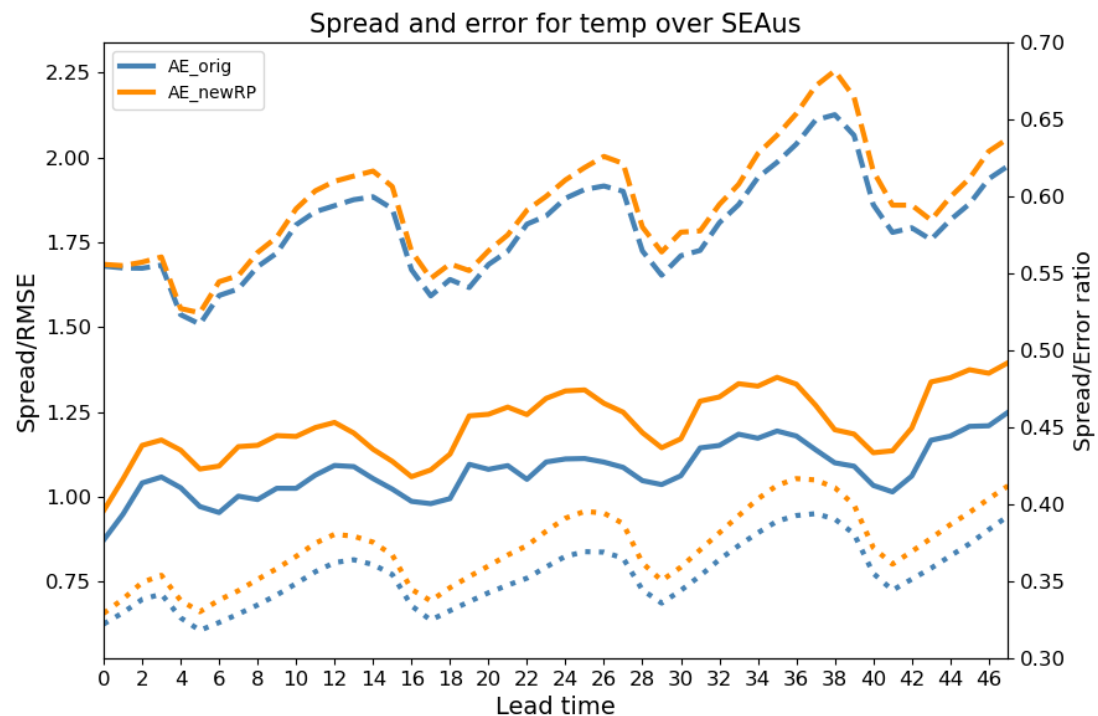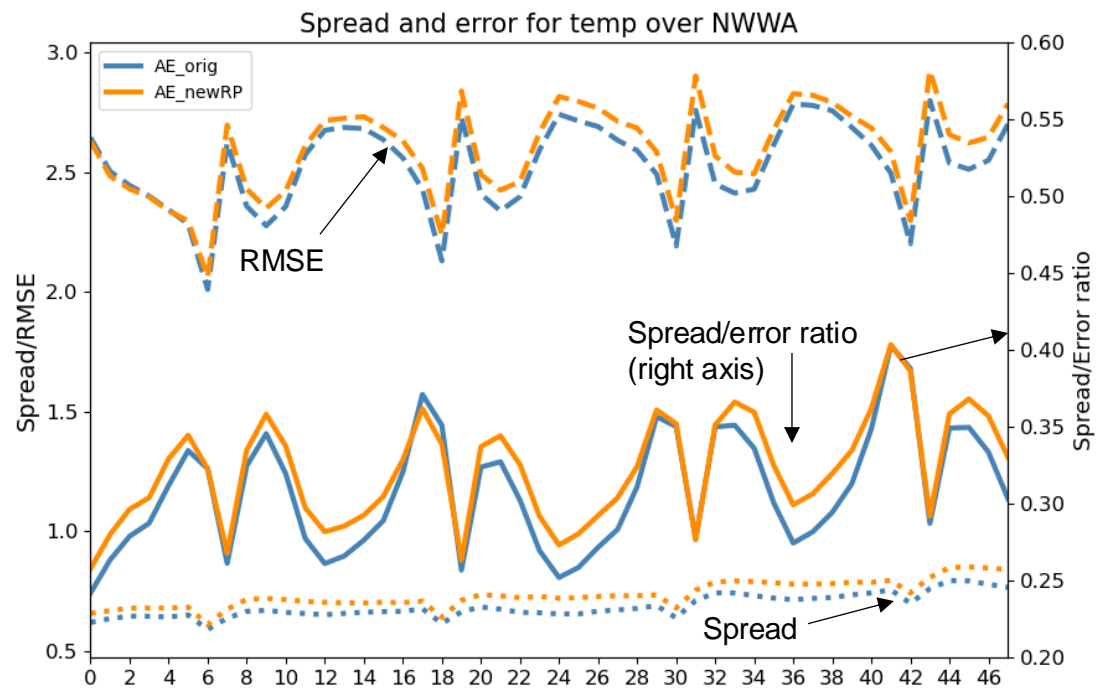
# Diurnal cycle of temperature errors over NWWA (AE_orig)

Continuous ranked probability score (CRPS)

- Compare cumulative distribution functions of ensemble and obs (similar to deterministic MAE)

- Higher errors during the night, lower during the day

- To be investigated further

# Average dewpoint temp stats over trial period

- Smaller differences between experiments (compared to temperature)

- AE_newRP still better spread/error ratio overall

- NWWA much higher RMSE than SEAus

  - And higher spread than temperature

- Noticeable increase in spread with lead time for SEAus but not for NWWA

Spread and error for dewp over NWWA



Spread and error for dewp over SEAus
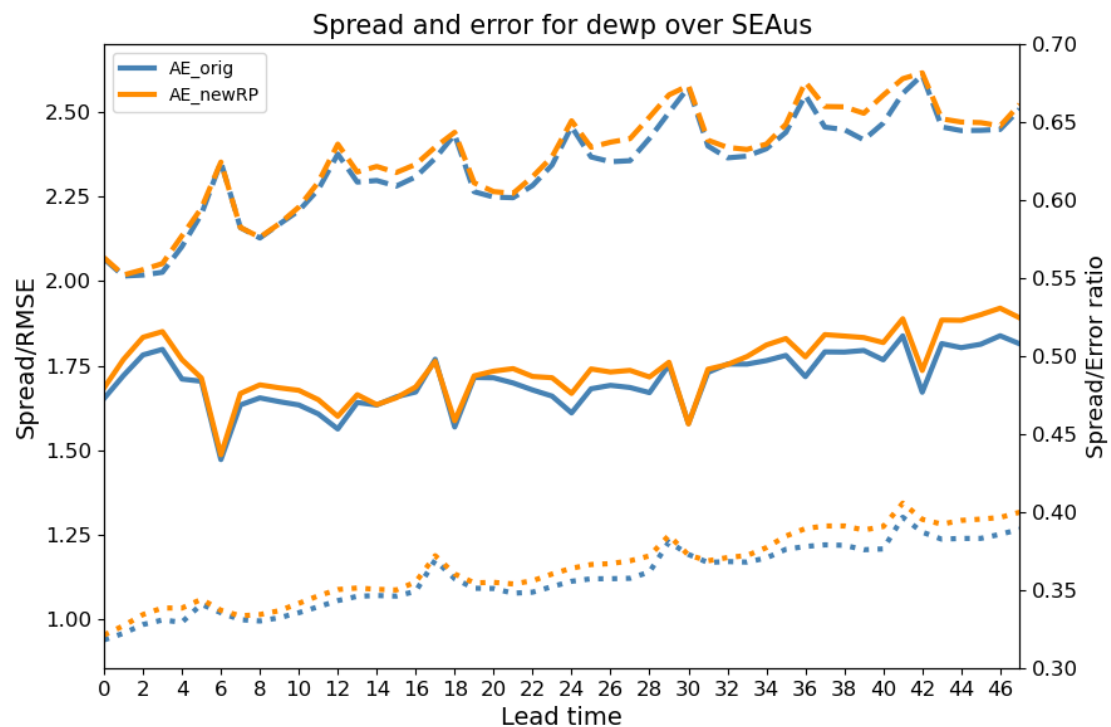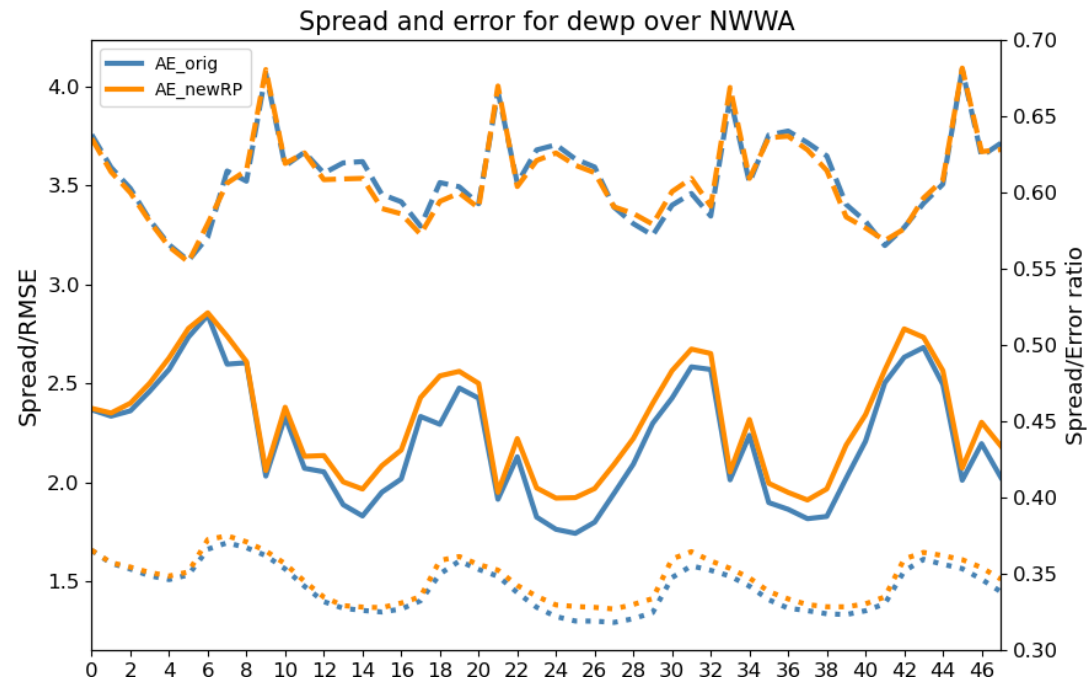
# Average wind speed stats over trial period

- AE_newRP consistently better spread/error ratio
  - Larger difference in spread compared to RMSE between experiments

- NWWA better spread error ratio than SEAus
  - Lower RMSE compared to SEAus

- Spread increase with lead time for both regions



Spread and error for wspd over NWWA



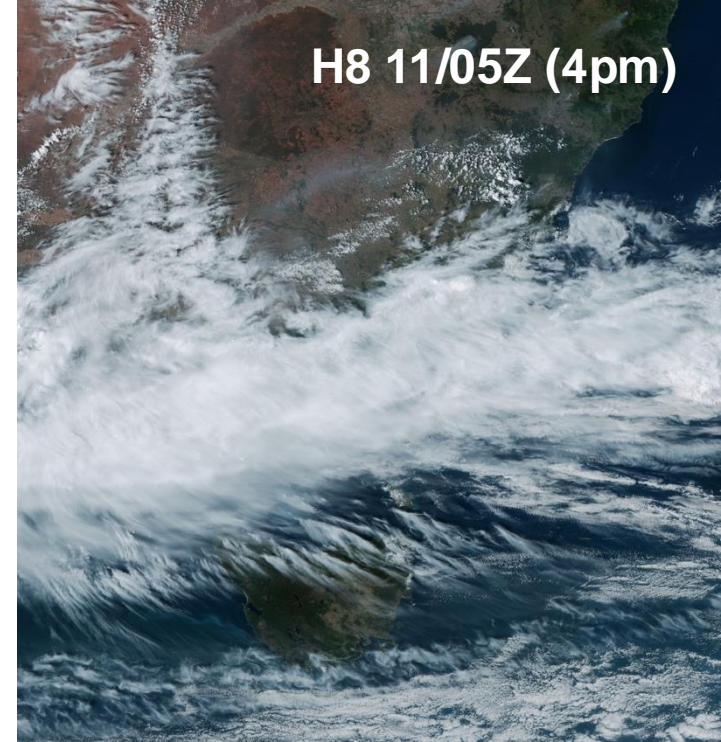Spread and error for wspd over SEAus
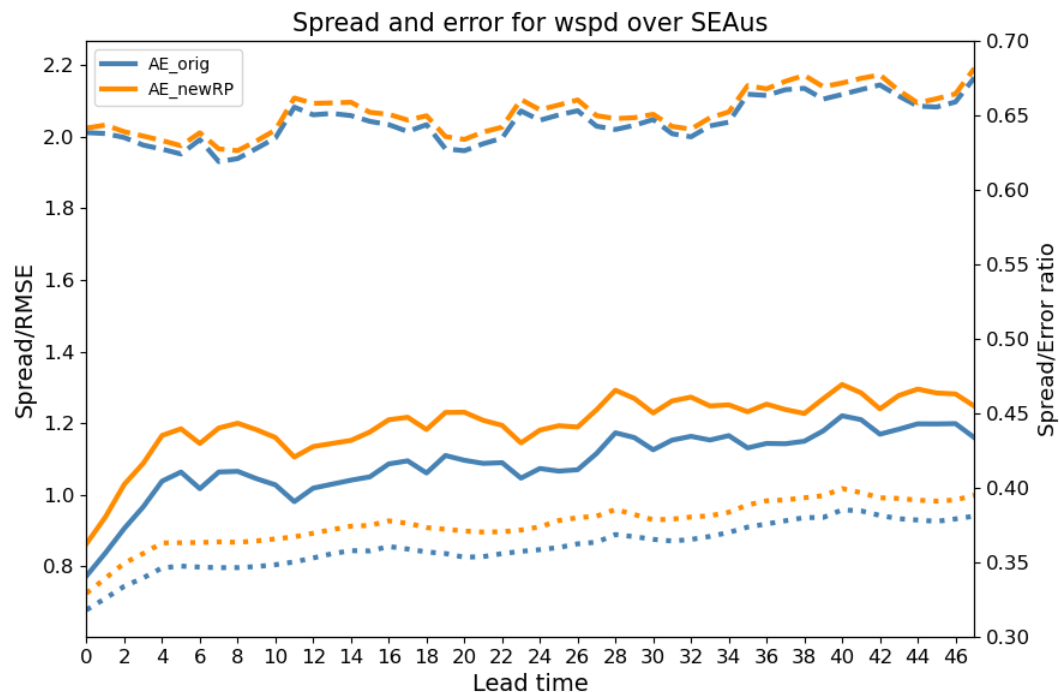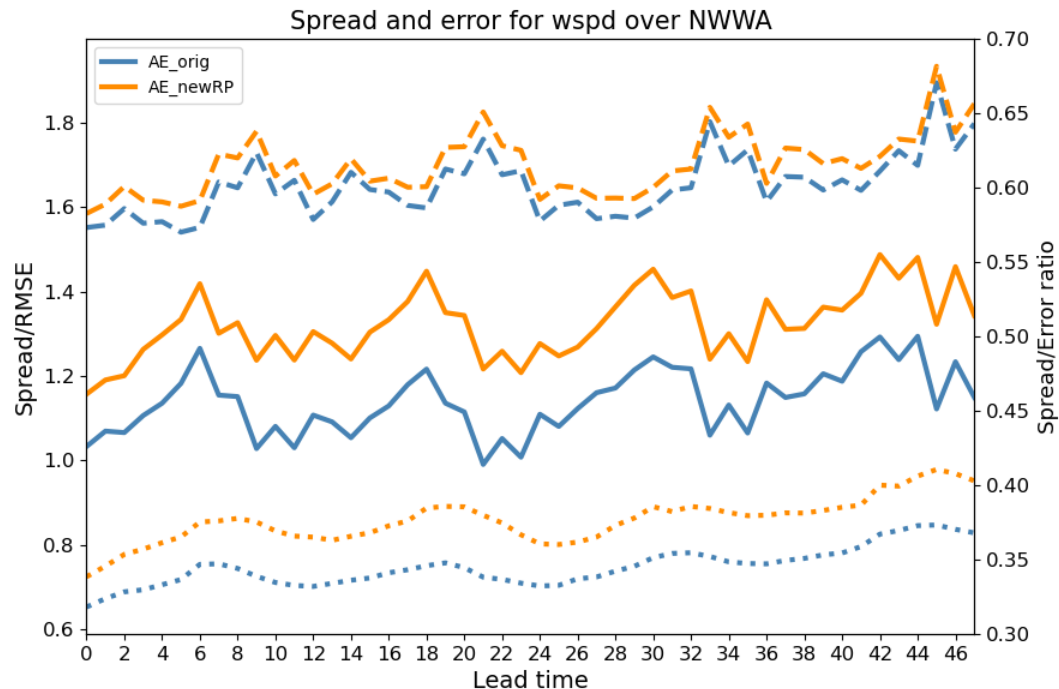
# Case Study: Melbourne Fog

Heavy fog in the Melbourne region 11-12 Dec*

- Multiple crashes on roads, freeway temporally closed

YMML fog 11 Dec ~ 11:00-17:30 UTC (10pm-4:30am)

- cancellation of ~33 flights

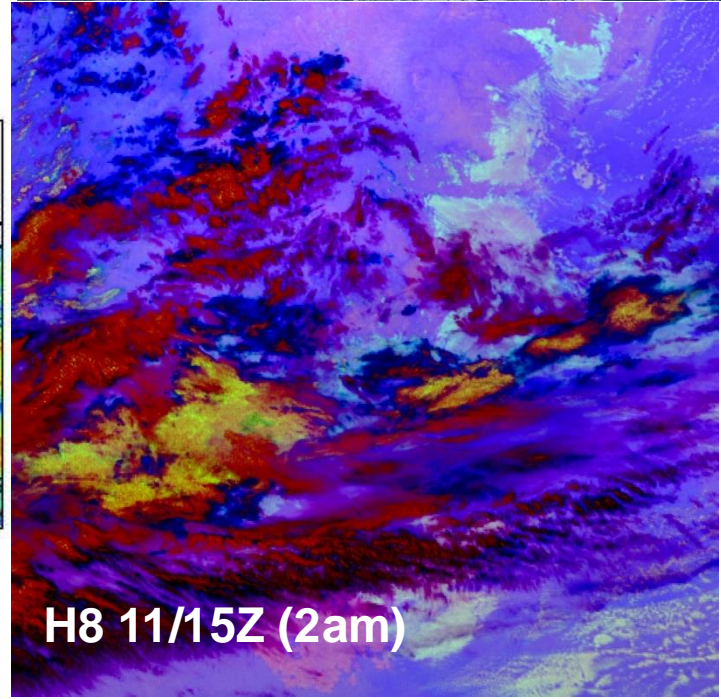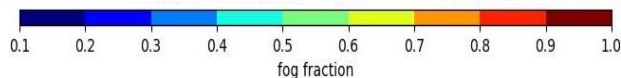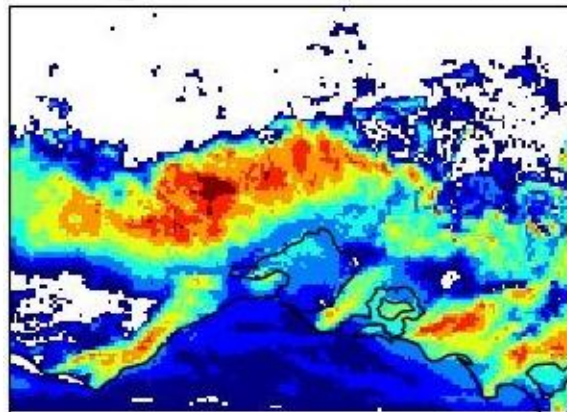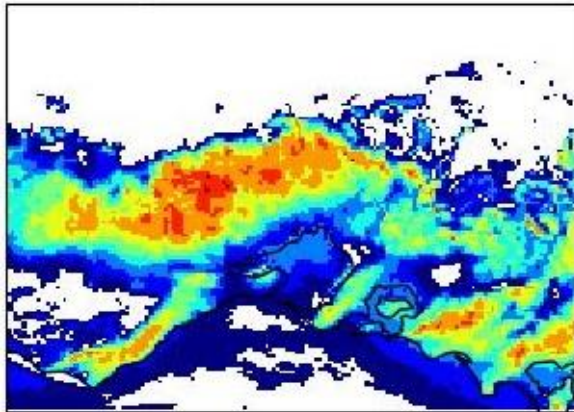*https://www.abc.net.au/news/2023-12-12/heavy-fog-in-melbourne-flights-cancelled/103216830



H8 11/05Z (4pm)

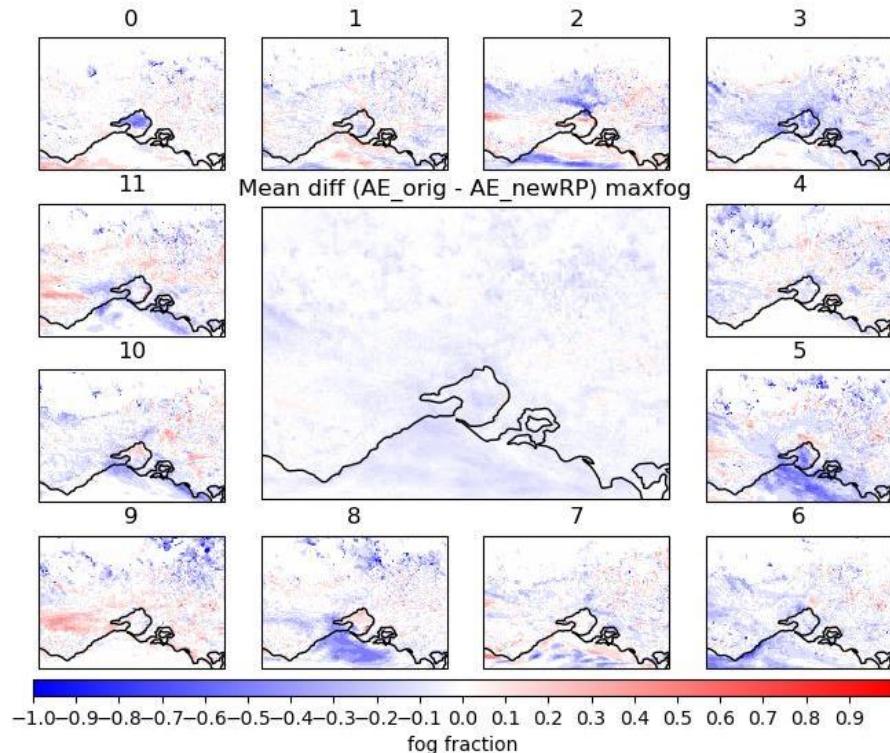

48hr maxfog starting at 20231210T00
AE_orig ensemble mean    AE_newRP ensemble mean
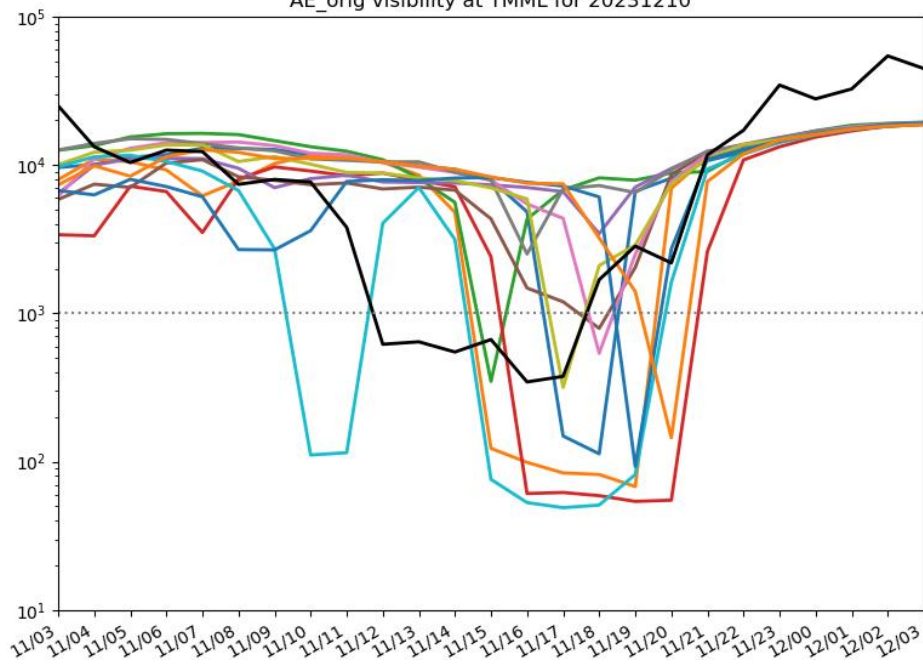
fog fraction

The Bureau of Meteorology



H8 11/15Z (2am)

# Case Study: Melbourne Fog

- AE_newRP more members with earlier onset of fog fraction

- Higher max fog fraction overall



Mean diff (AE_orig - AE_newRP) maxfog

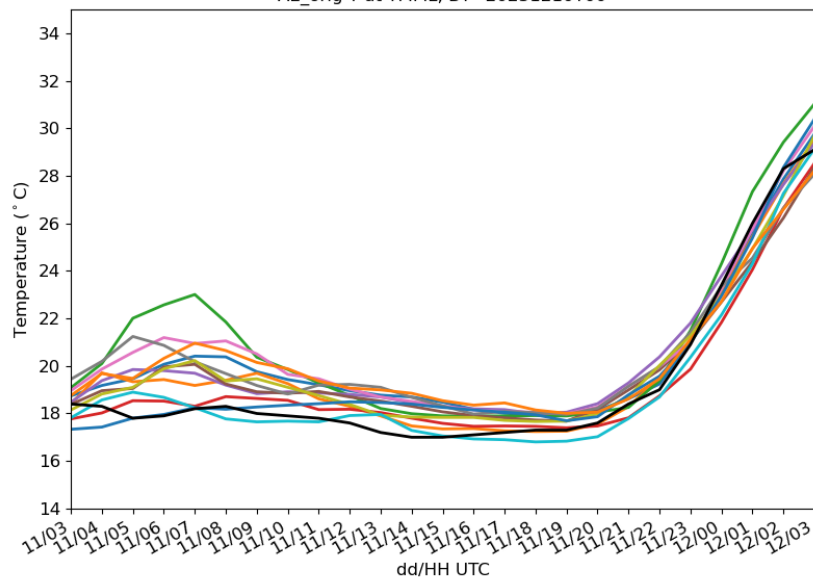fog fraction



AE_orig visibility at YMML for 20231210



AE_newRP visibility at YMML for 20231210
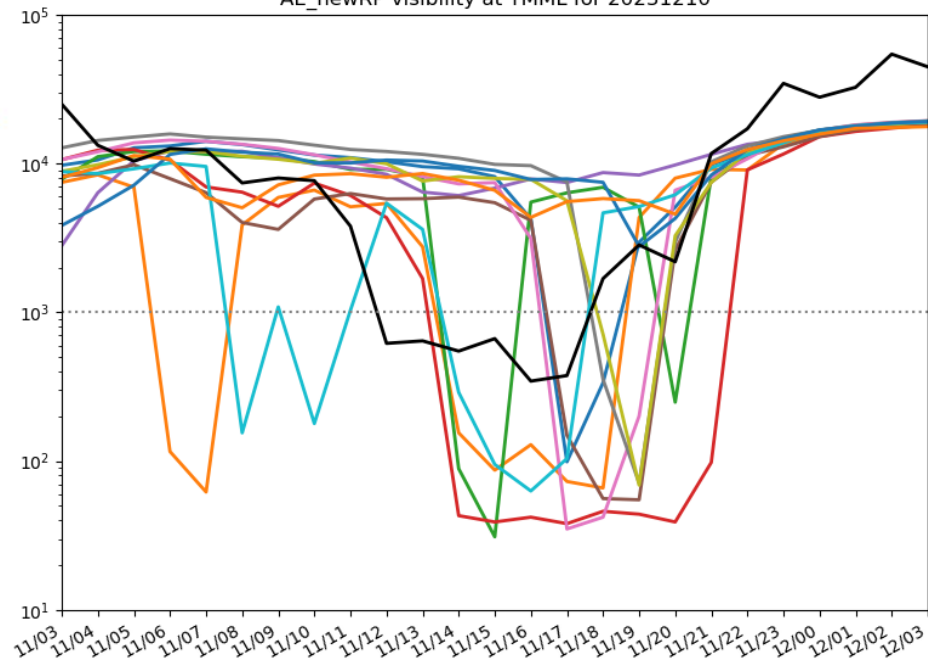
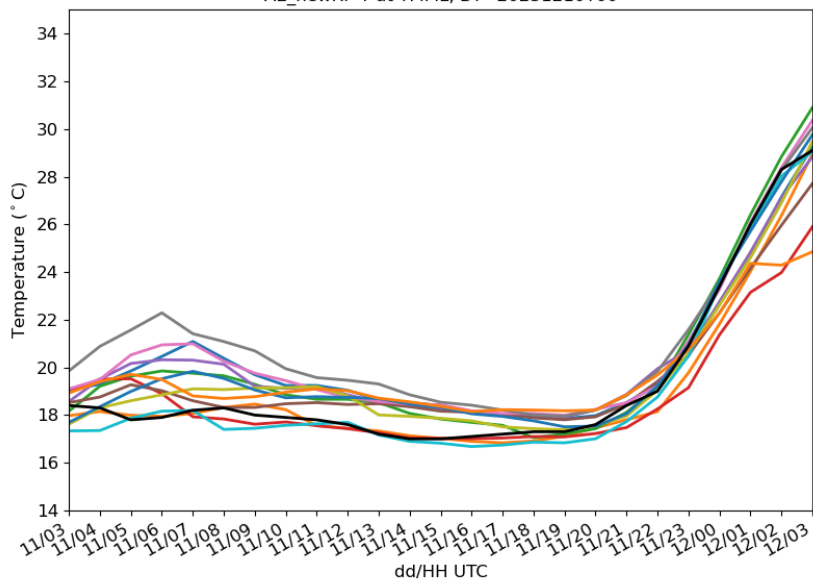# Case Study: Temperature



AE_orig T at YMML, BT=20231210T00



AE_newRP T at YMML, BT=20231210T00



minT mean diff (AE_orig - AE_newRP)

minT min=-5 max=5



maxT mean diff (AE_orig - AE_newRP)

maxT min=-7 max=7
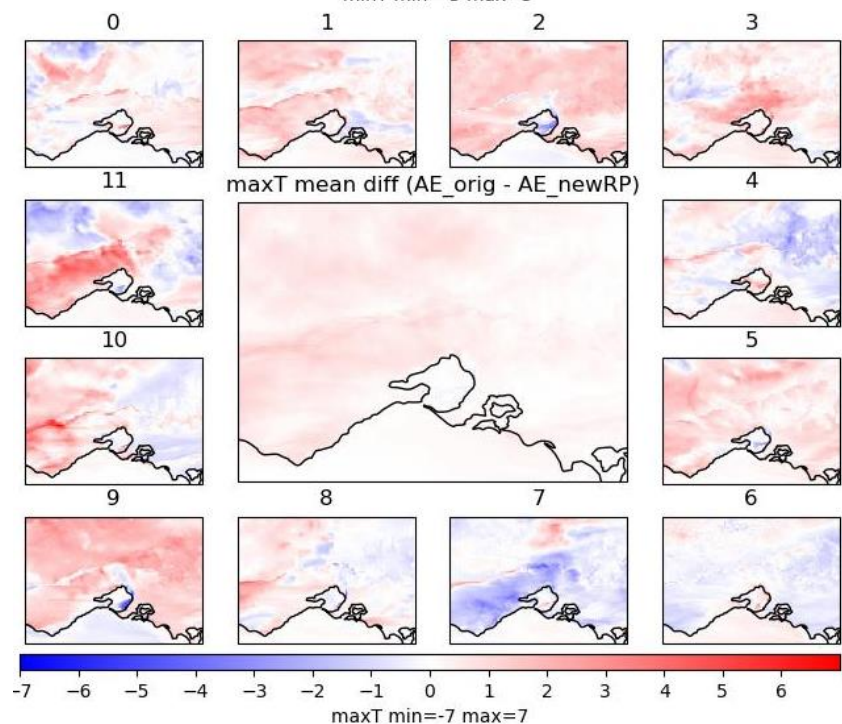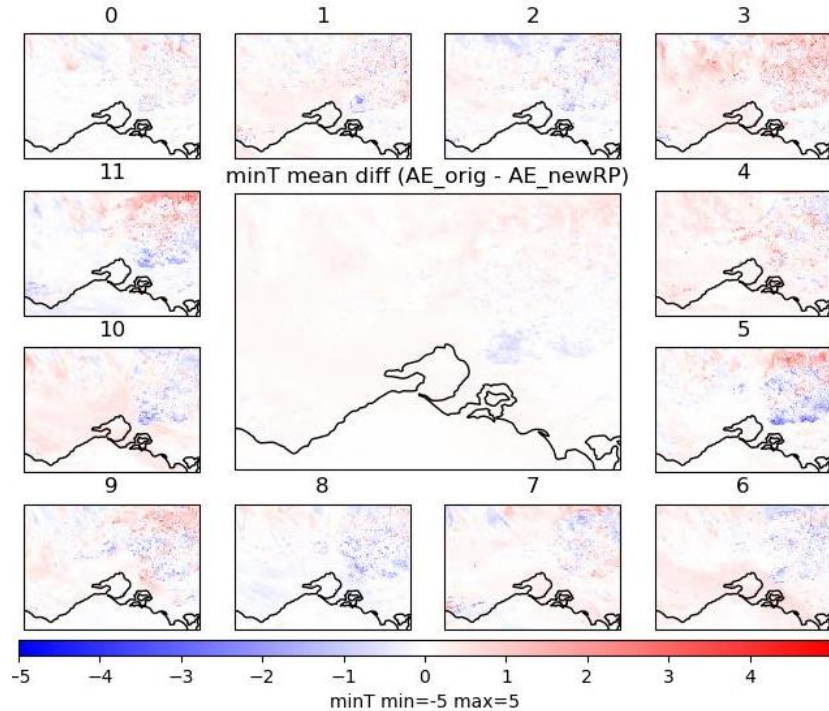
# Conclusions (so far)

- New random parameters generally increase spread
    - RMSE too, but spread/error ratio better
    - Still largely under spread

- Different regions/variables have different responses

- Strong diurnal signal – to be investigated further

## Next steps/Future research

- Complete analysis for all regions

- Investigate diurnal signal of errors

- Continue case study evaluation

- Winter trial to complement summer trial

- Probability of exceedance

    - Does the new RP scheme better represent high impact, low probability events?

- Explore which parameters have largest impact for future RP scheme developments

# Thank you

Belinda Roux

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