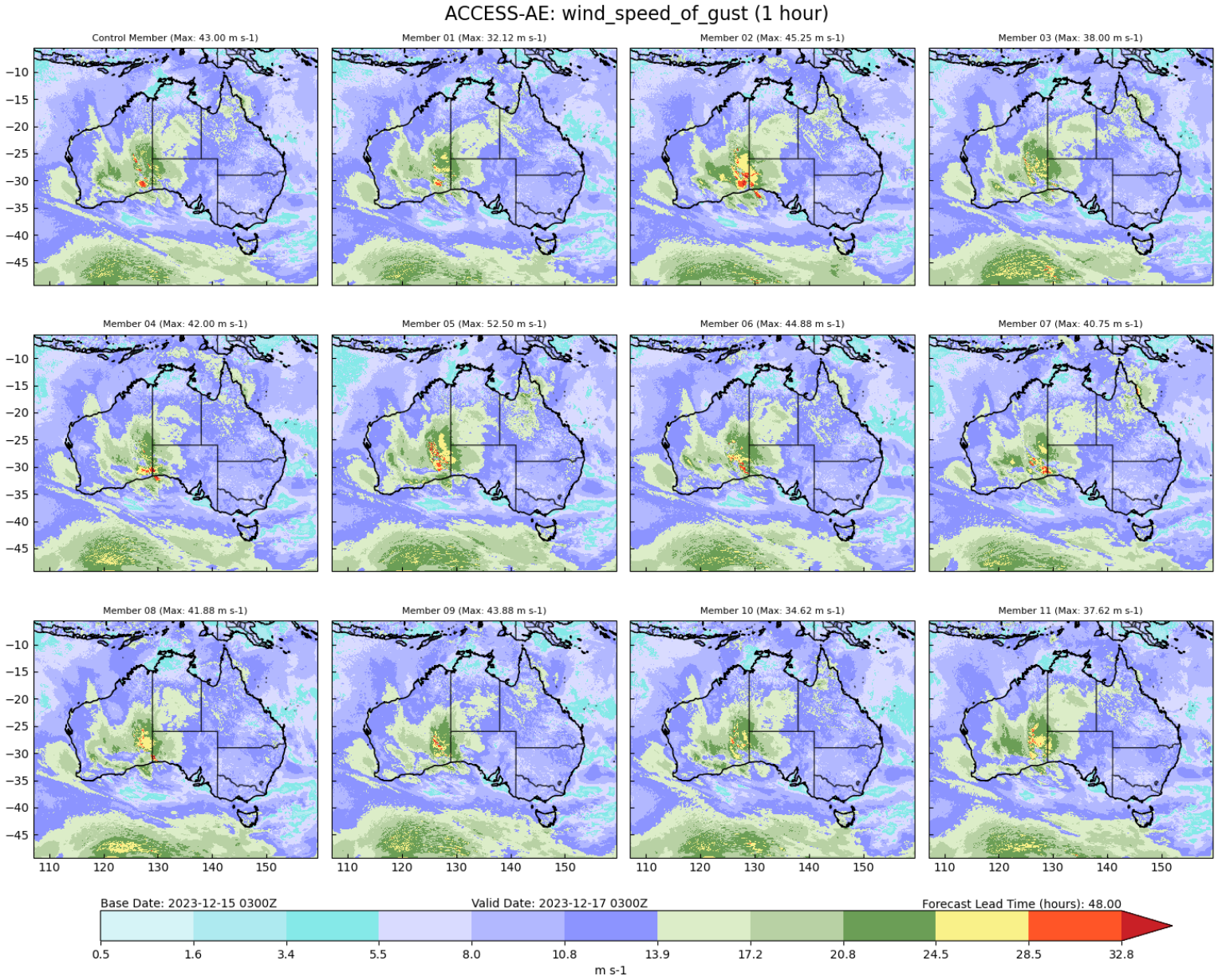
ACCESS-AE

Shaun Cooper, Belinda Roux, Charmaine Franklin

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

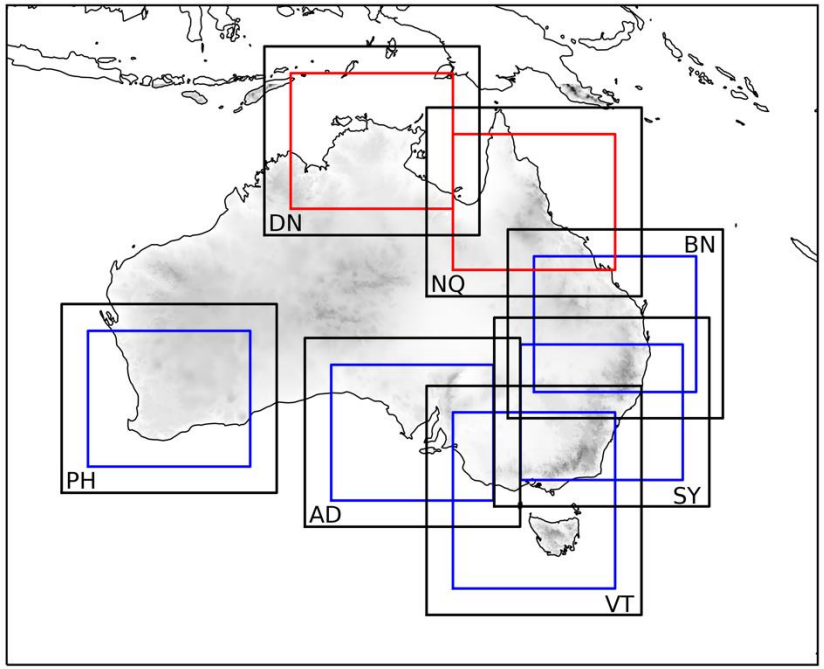
September 10th, 2024

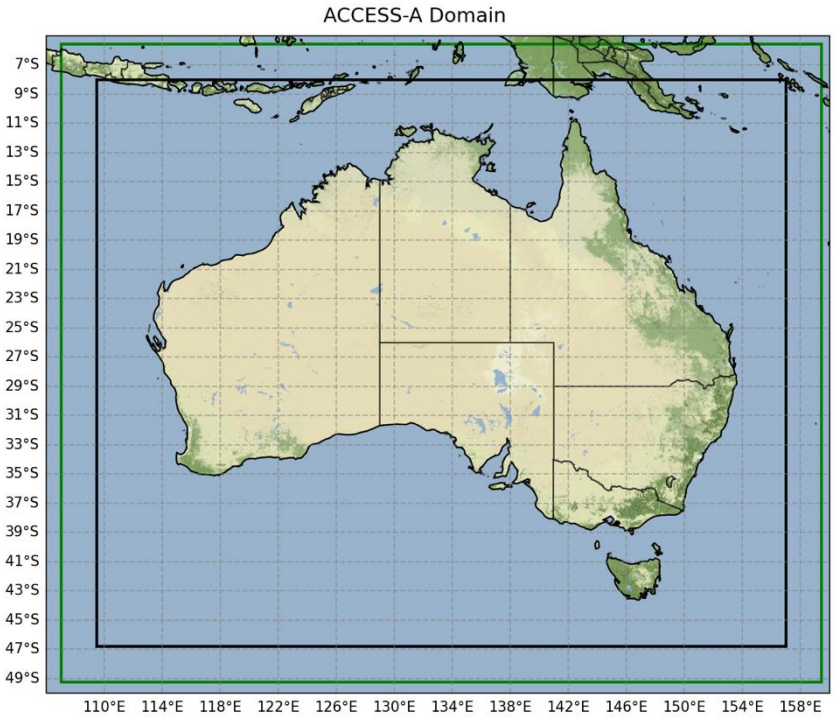


Motivation

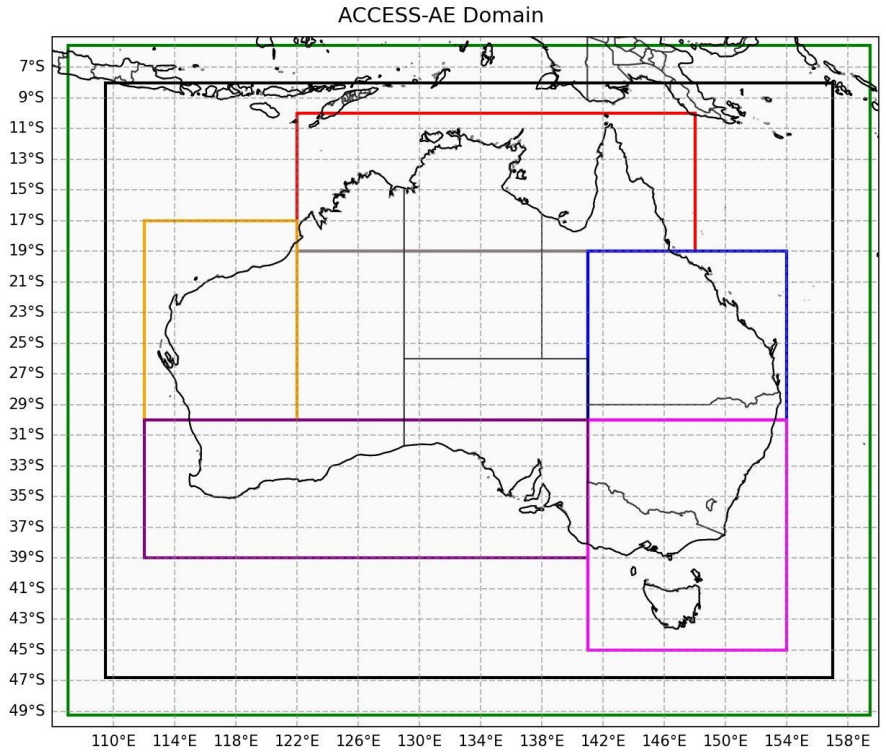
Pan-Australia 2.2 km ensemble NWP system

- The Bureau currently runs 7 individual convective scale NWP domains
  - Five domains run RAL1-M physics and the two northern most domains run the RAL1-T physics
- Provide total coverage of Australia
- ACCESS-AE domain
  - Variable resolution grid (green box)
  - 2.2 km horizontally spaced fixed domain (black box)
  - 90 vertical levels
  - 2524 x 2088 x 90 ~ 475 million total grid points
  - 12 ensemble members
  - 48 hour forecast lead time
- Using RAL3.2 physics
  - Unified physics (tropics and mid-latitude)
  - More complex moist physics
  - Updated land use including improved urban fractions





ACCESS-AE Development



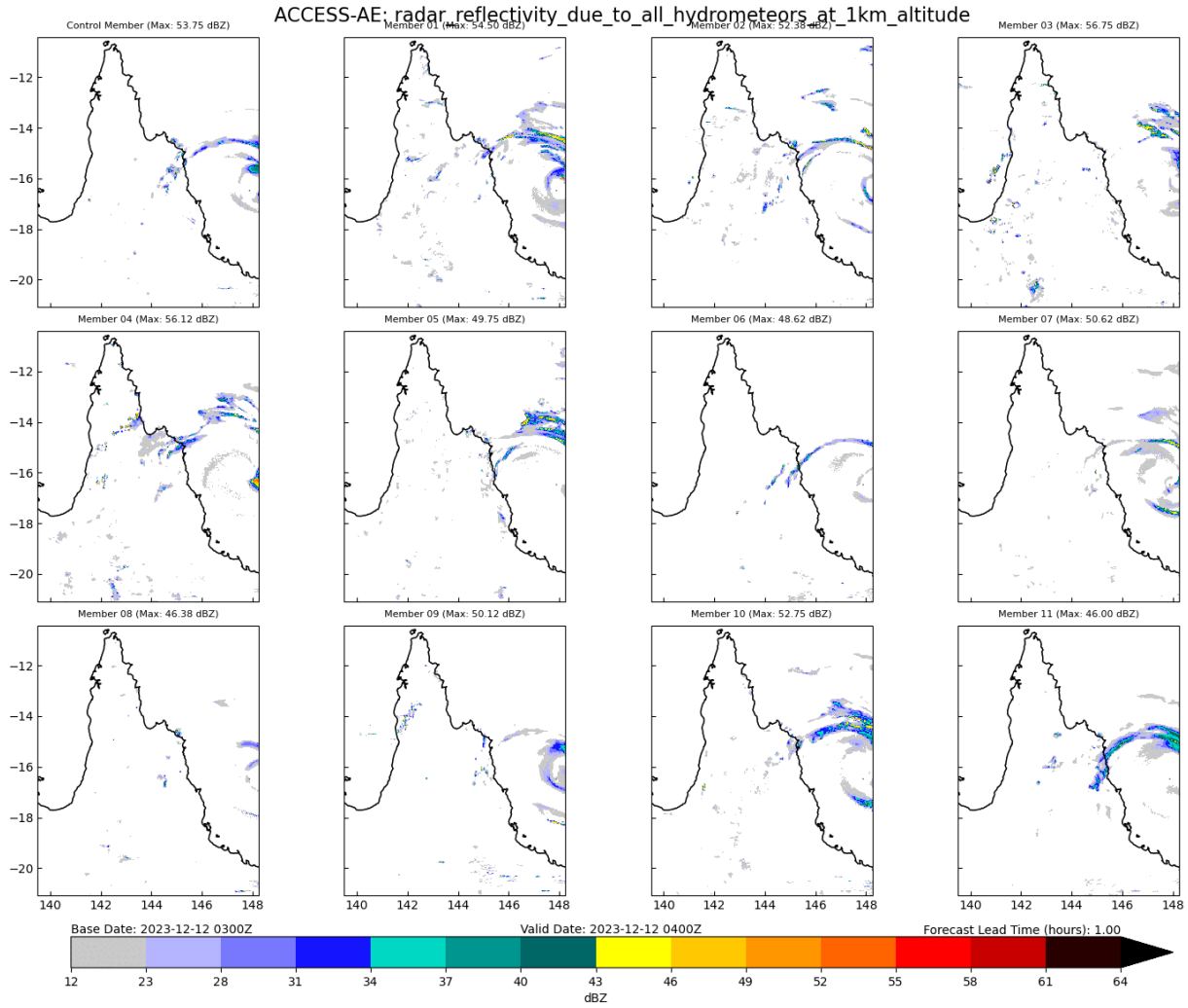
- Development started by running case studies to ensure the grid and science configuration was performing well
- Control Ensemble Experiment
  - Running with the RP2 scheme
- RP Ensemble Experiment
  - Running the updated RP scheme that includes additional parameters in CASIM and land surface
  - See Anne McCabe's presentation tomorrow!
- How should such a large domain, convective scale ensemble system be verified?
  - Currently planning on breaking up the domain into the 6 regions plotted
  - Regions based approximately on climatology / weather type
- I will present rainfall verification today, see Belinda Roux's presentation tomorrow for near-surface verification

ACCESS-AE Trial

December 10-17, 2023

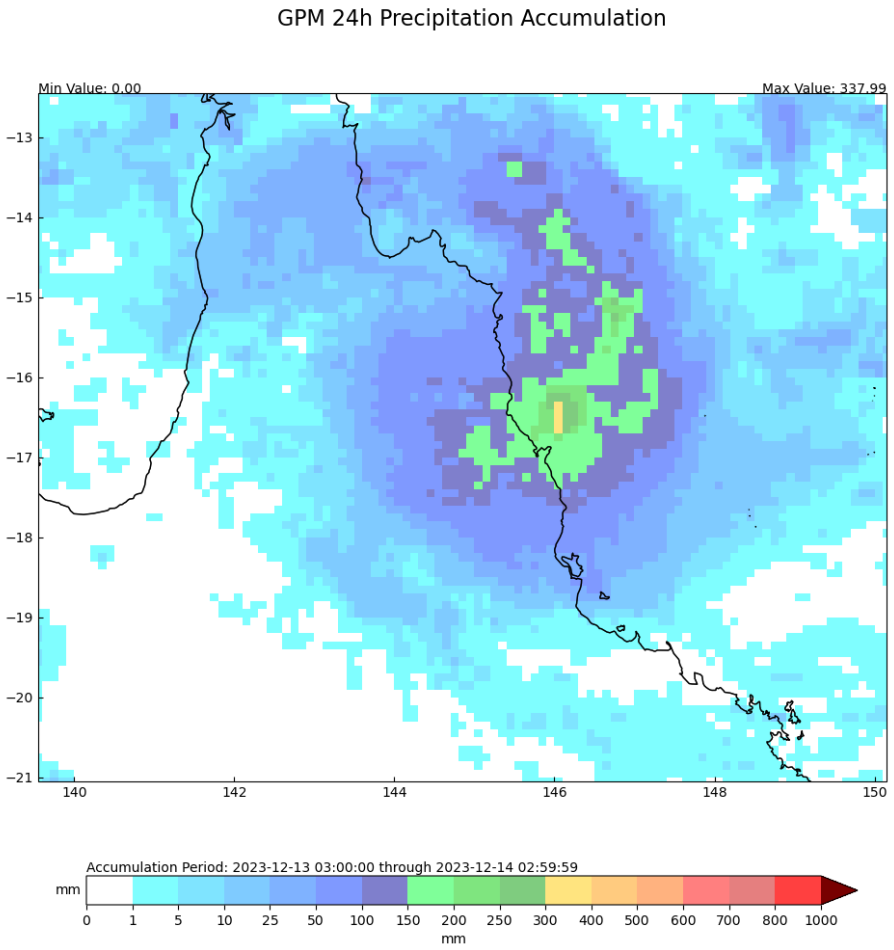
- Two cycles per day
  - 00Z and 12Z
  - 48 hour forecast length

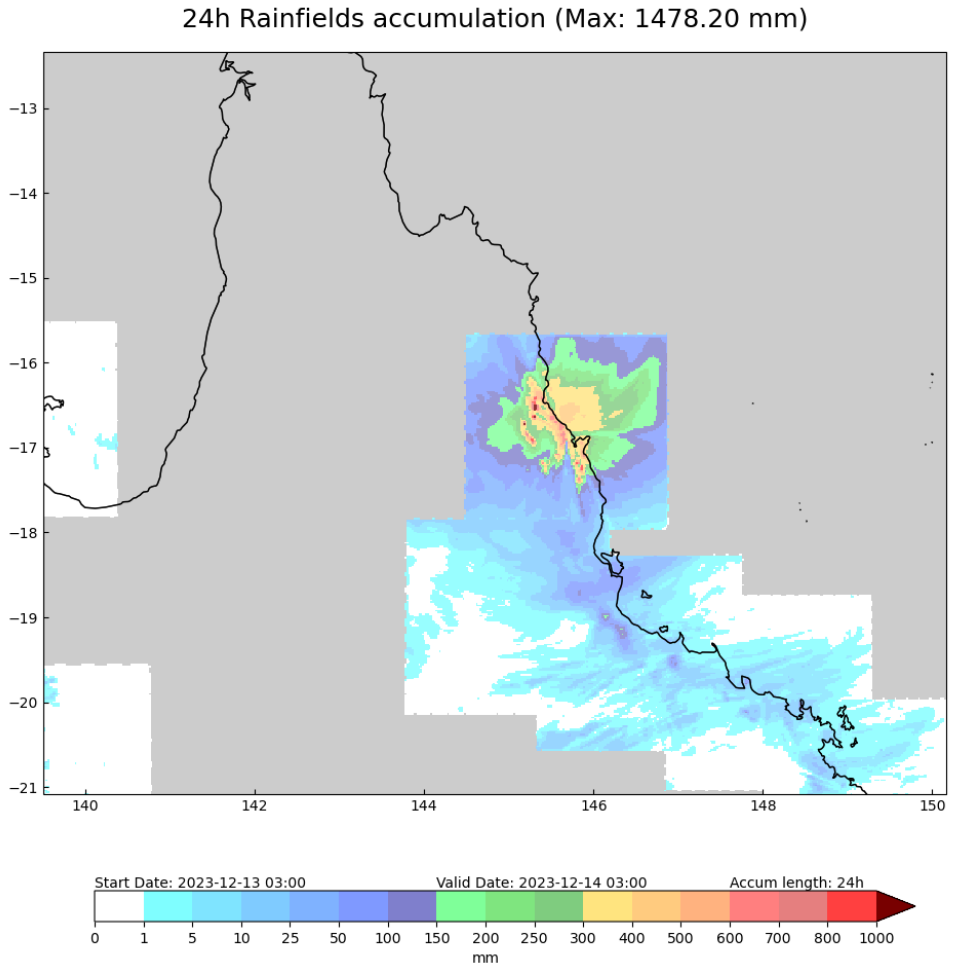
- ACCESS-AE is currently a downscaling model
  - Using UK (MOGREPS-GE) initial conditions/boundary conditions
  - Future versions may use the ACCESS-A analysis to 'centre' the initial conditions
- Notable weather events during the trial period
  - TC Jasper: Dec 14-19
  - South Australian Severe Weather: Dec 8-12 – winds, thunderstorms and a suspected tornado on the 12th
  - Melbourne Fog: Dec 11-12, 30+ flights cancelled, thunderstorms later in the day
  - NSW Fires: Dec 14
  - Brisbane Thunderstorms: Dec 15 Severe Weather
  - SE Queensland: Dec 16 – 169 km/hr at Archerfield Airport. Rain > 100 mm in some locations



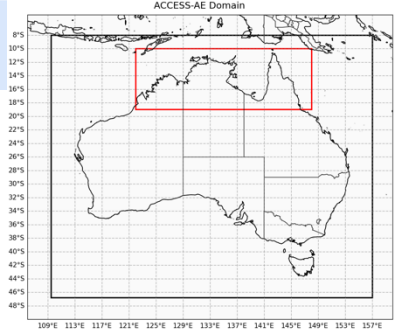
Challenges verifying Rainfall forecasts.

TC Jasper Rainfall observations: 24-hour accumulations to 2023-12-14 0300Z

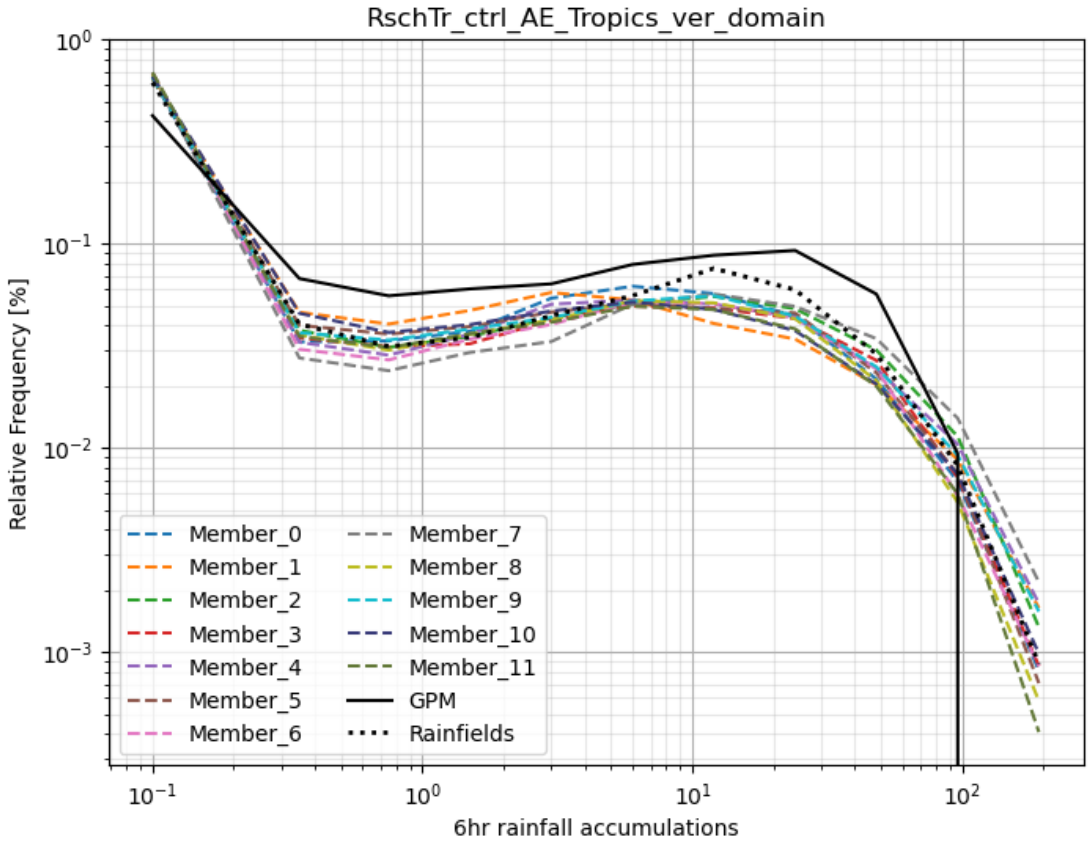


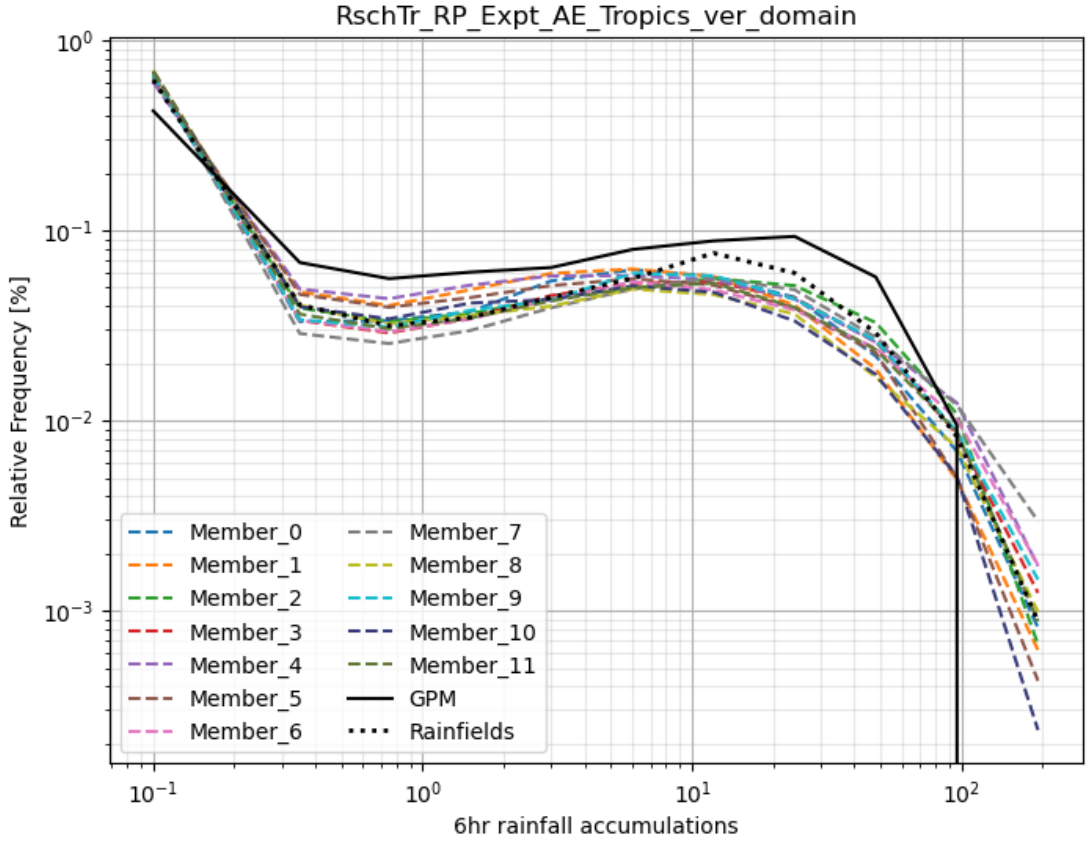


Rainfall distributions

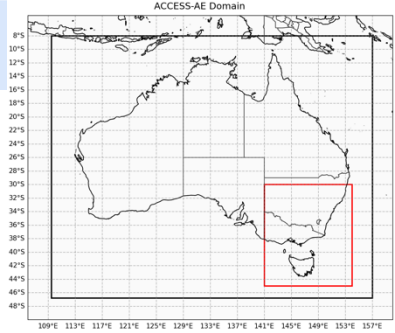


Tropics domain: Against GPM and RainFields



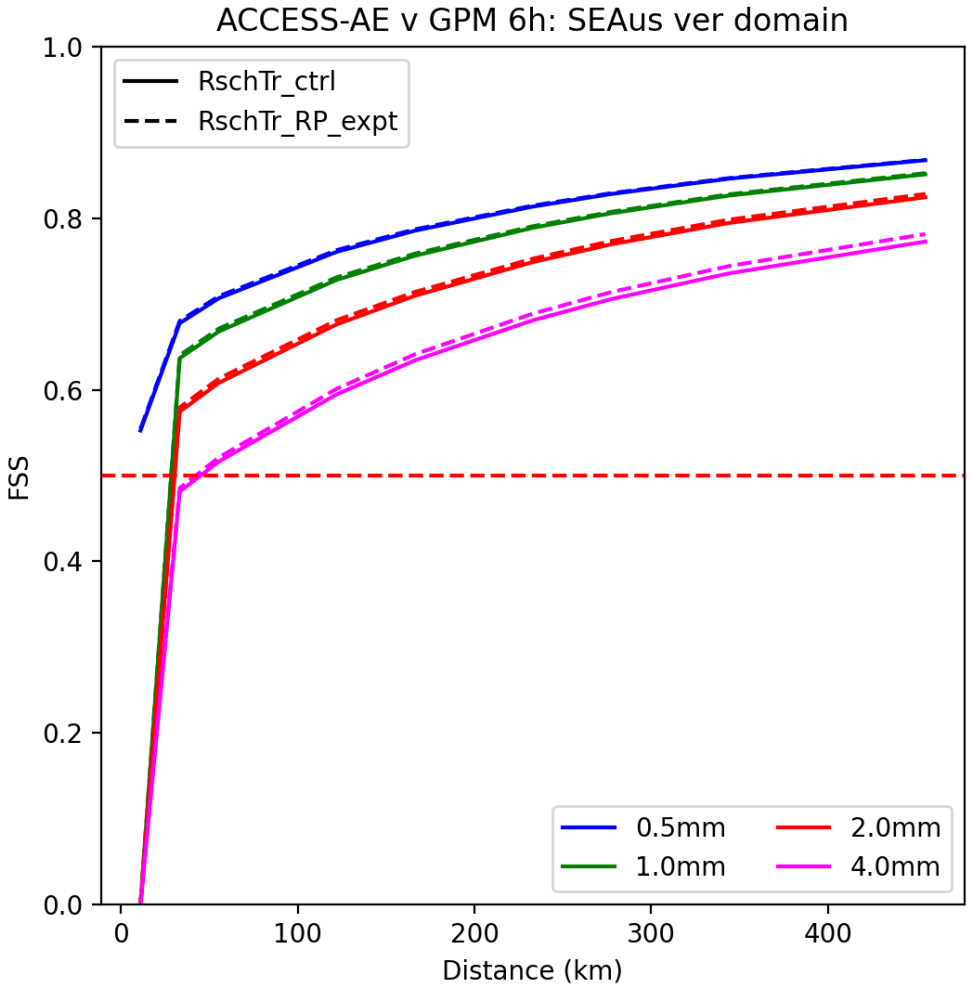


South East Australia Verification Domain

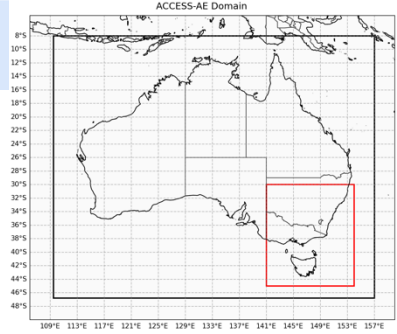


Fractions Skill Score

- FSS is a neighbourhood based verification score.
- Rainfall accumulated to required period, 6 hours accumulations used here.
- Model and observations regridded onto the coarsest grid.
  - ~11 km for GPM.
  - ~2.2 km for Rainfields (obs onto ensemble grid).
- Convert the observations into binary event/non event fields for a given threshold.
- For the ensemble, I have simply computed the fraction of the members that forecast an event/non event.
- Calculate the number of events within a given a window around each grid point.
  - Ideally, the forecast and observations would contain the same fraction of events in the window.
- A score greater than 0.5* indicates skill in the forecast.
  - *So long as the observed wet-area ratio is not too large.

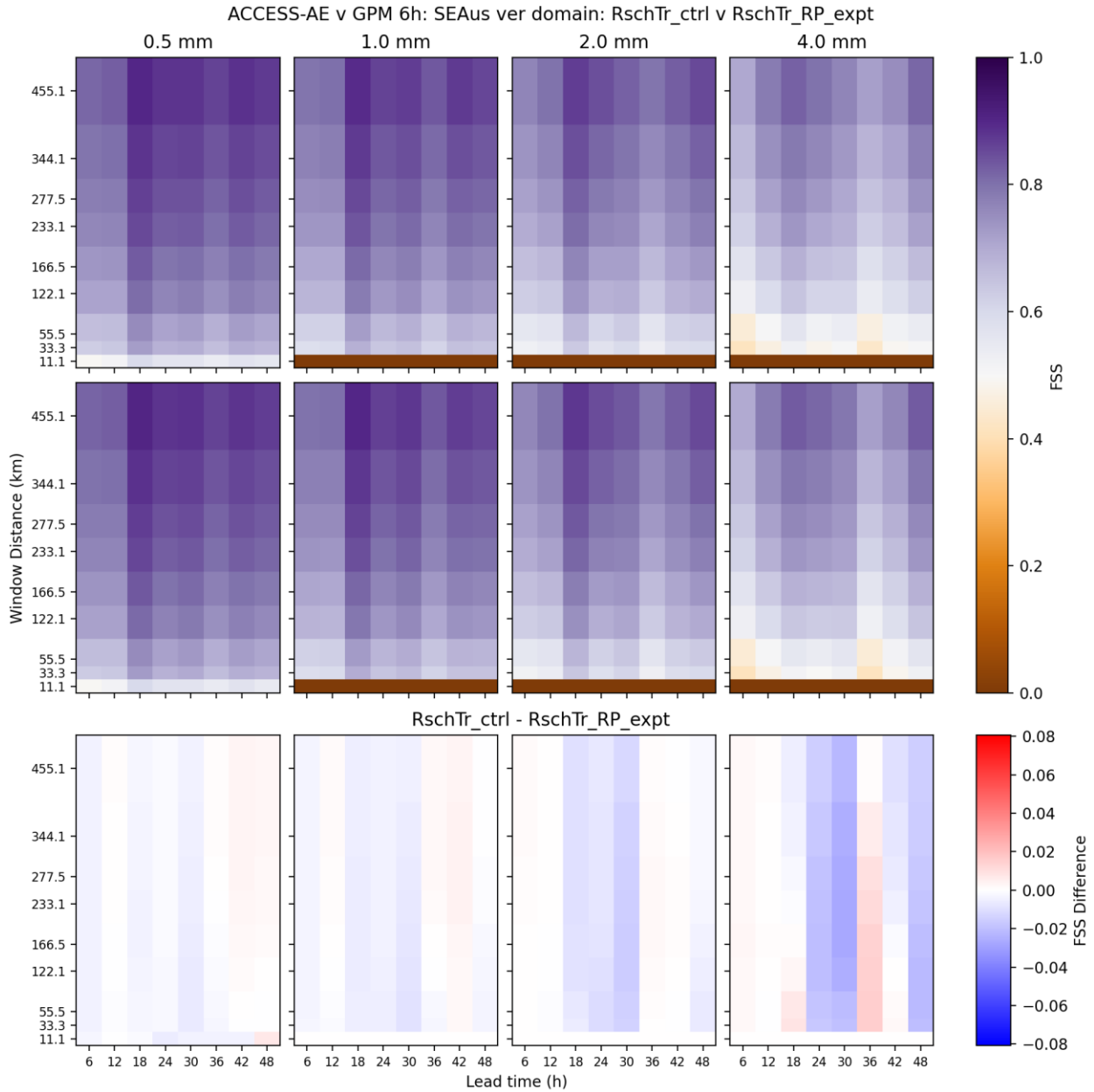


FSS v 6hr GPM: SEAus domain



Purple colours indicate FSS skill

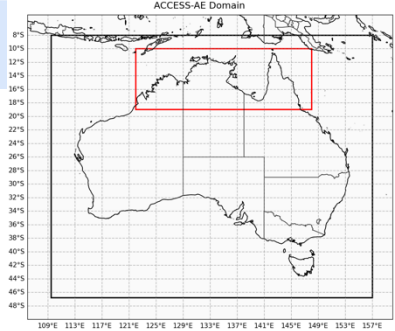
Orange/Brown colours indicate no FSS skill



Blue shades indicate improved FSS skill using the updated RP scheme

Red shades indicate degradation in FSS skill using the updated RP scheme

FSS against GPM: Tropics domain

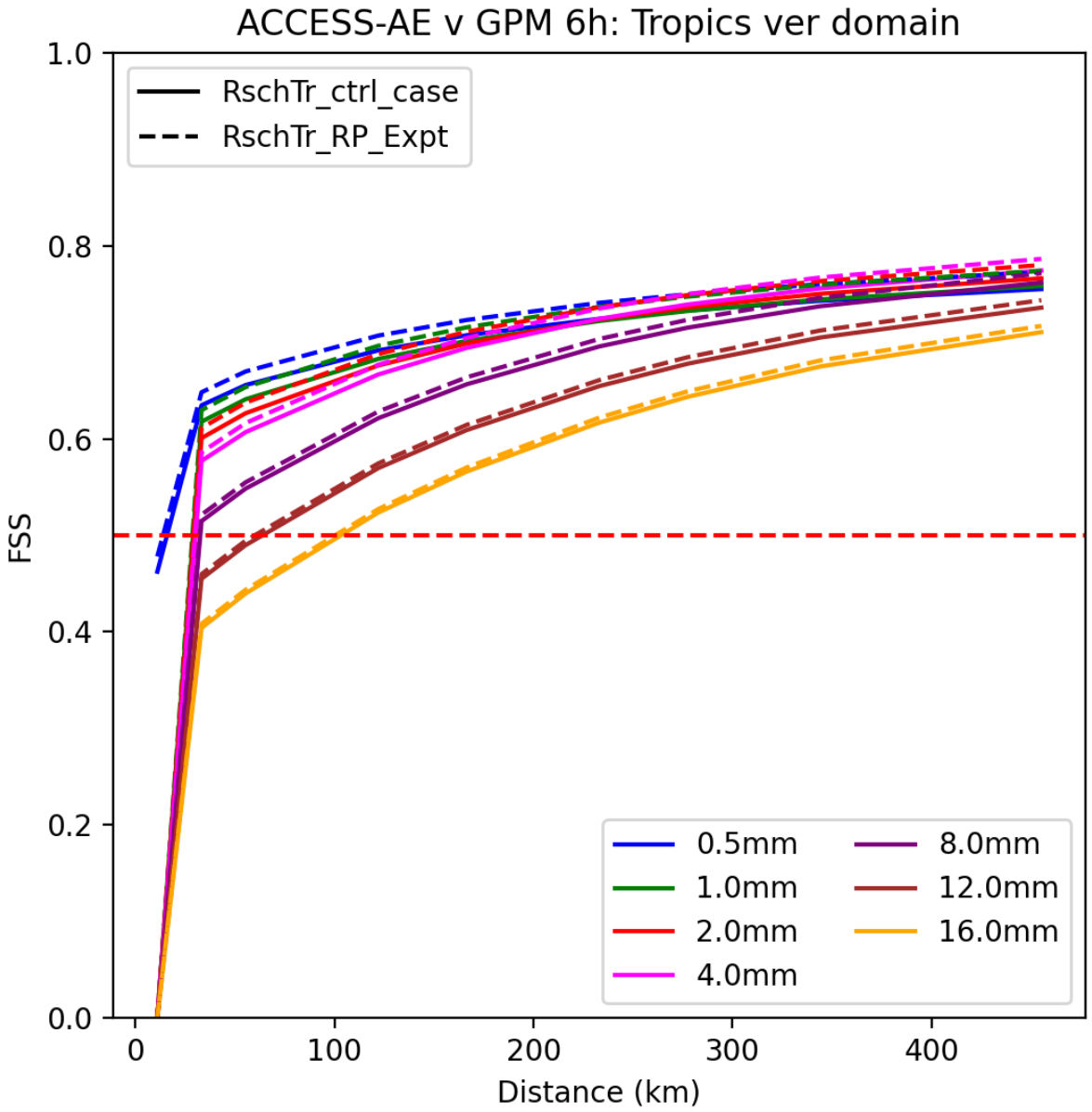


FSS for a single basedate:

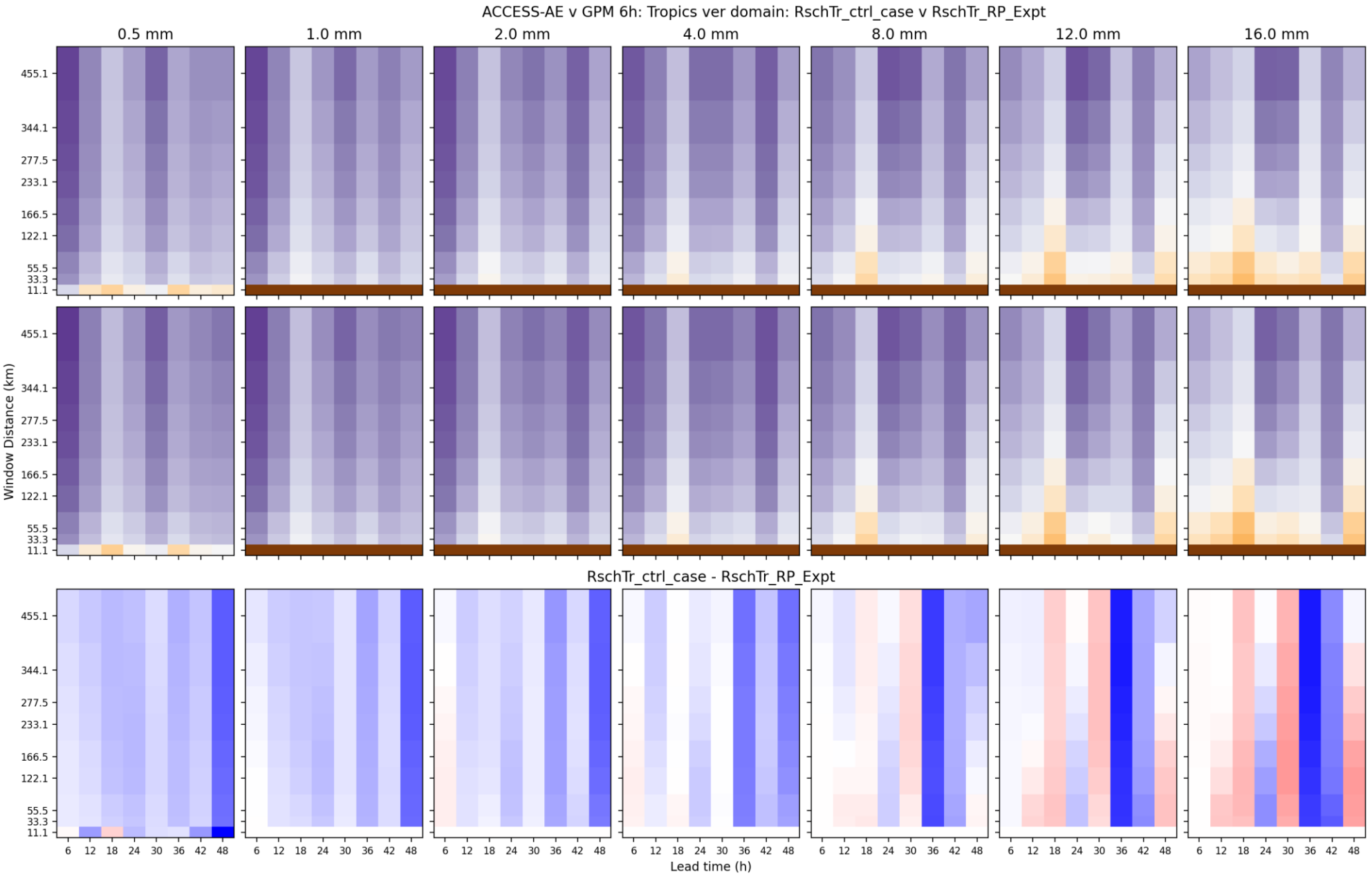
- 15-12-2024 00Z

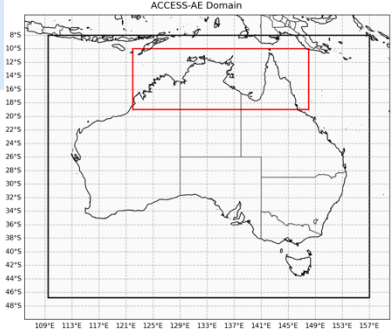
In general, the FSS scores against GPM for the updated RP scheme ensemble are greater than the RP2 scheme

This basedate has been select to start the verification against Rainfields (later slides).



Tropical Verification: FSS v GPM



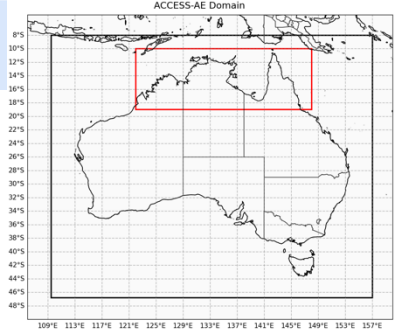


Purple colours indicate FSS skill

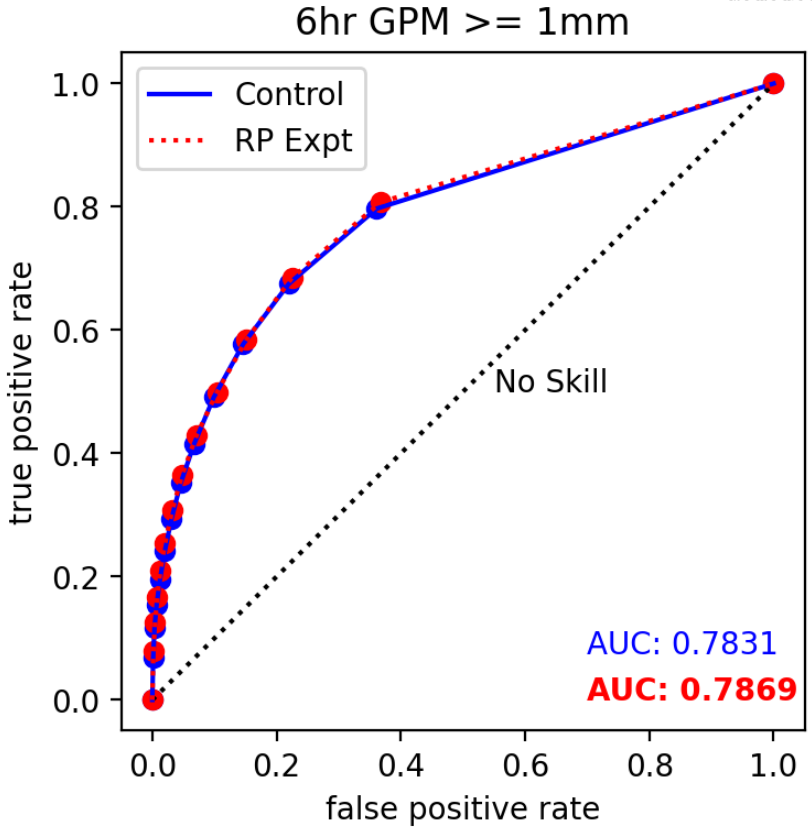
Orange/Brown colours indicate no FSS skill

Blue (red) shades indicate improvement (degradation) in FSS skill using the updated RP scheme

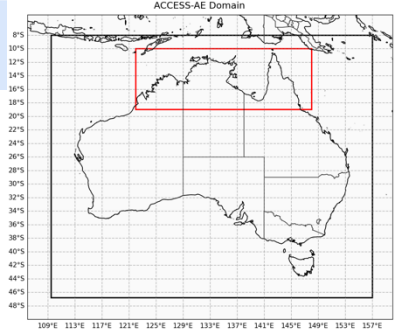
Relative Operating Characteristic (ROC) Curve

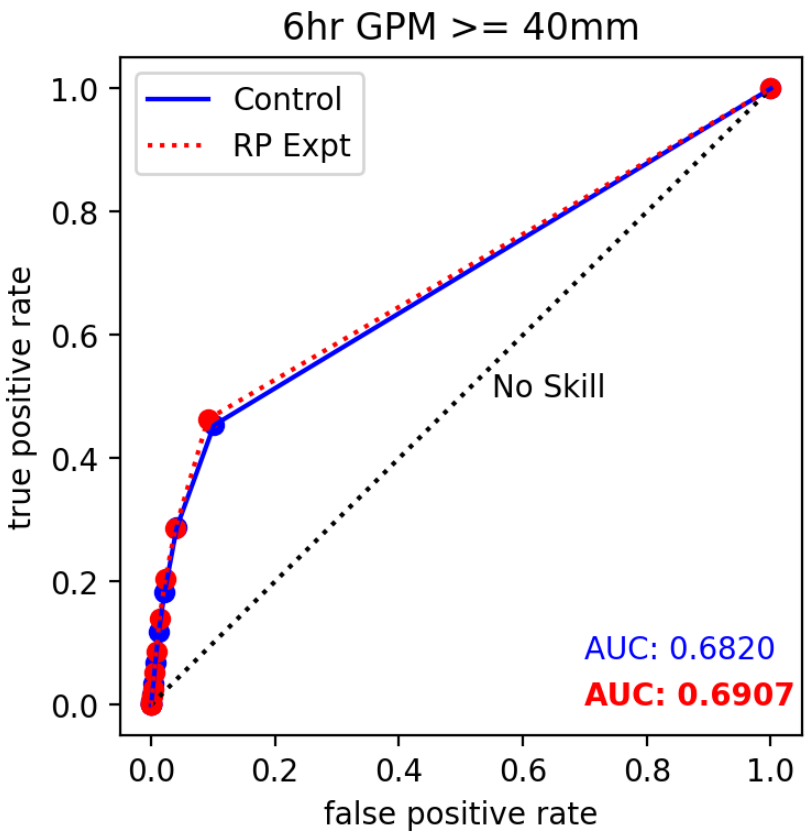


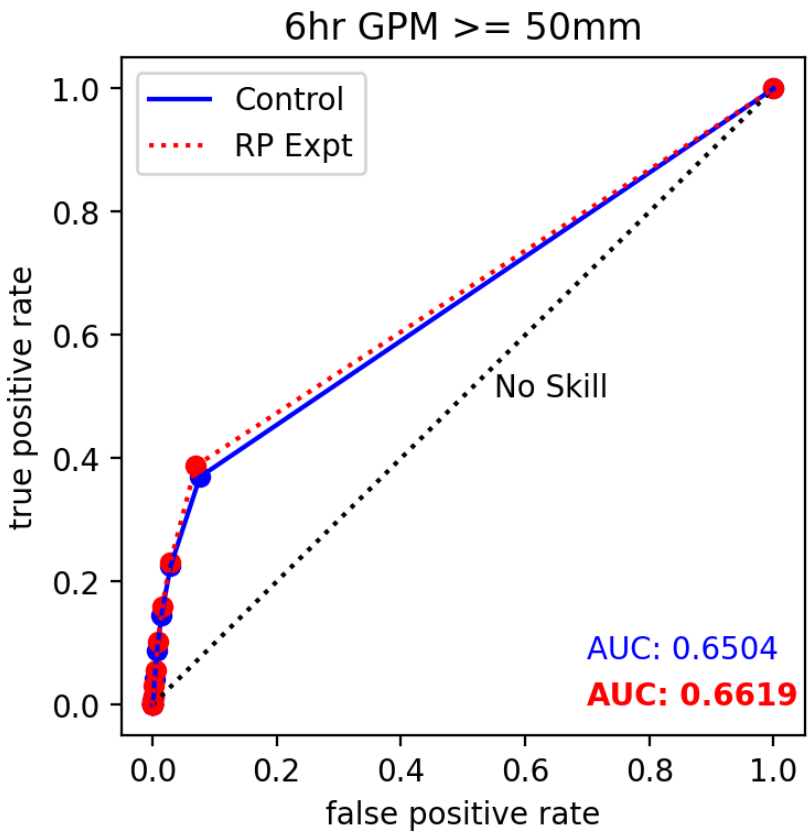
- Measures the model's ability to discriminate against events and non-event.
  - Measure of the forecast's resolution.
- Conditioned on the observations.
  - Complements the reliability curves (not shown here).
- Plots True Positive Rate (aka Hit Rate) against False Positive Rate (aka False Alarm Rate).
- Perfect curve would travel directly to the top left corner and then along the top to the top right corner.
- The Area Under Curve (AUC) ranges from 0 to 1.
  - No skill <= 0.5.
  - Perfect score: 1.
- ROC Curves are not sensitive to forecast bias.
  - Need to look at other verification to assess possible biases.

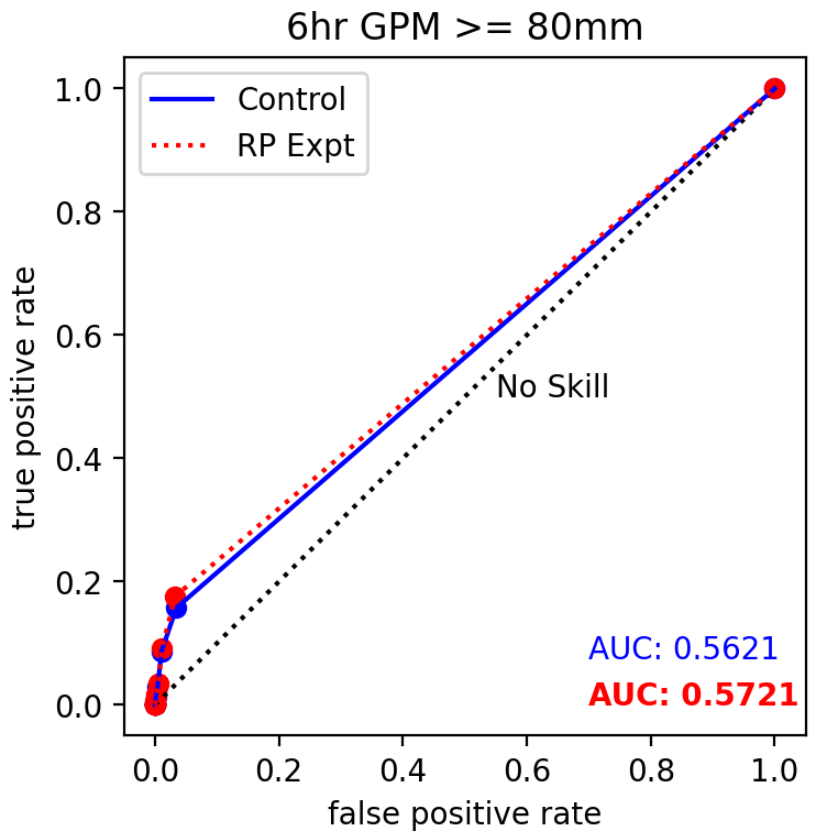


ROC Curves: Tropics Domain vs GPM

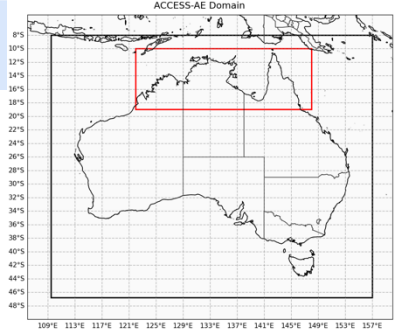


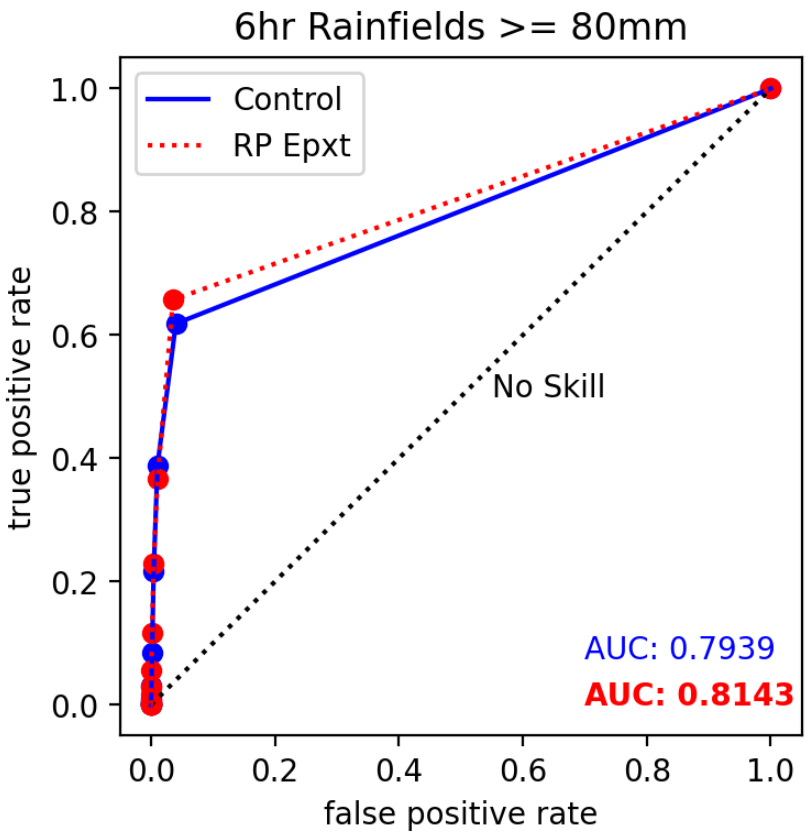


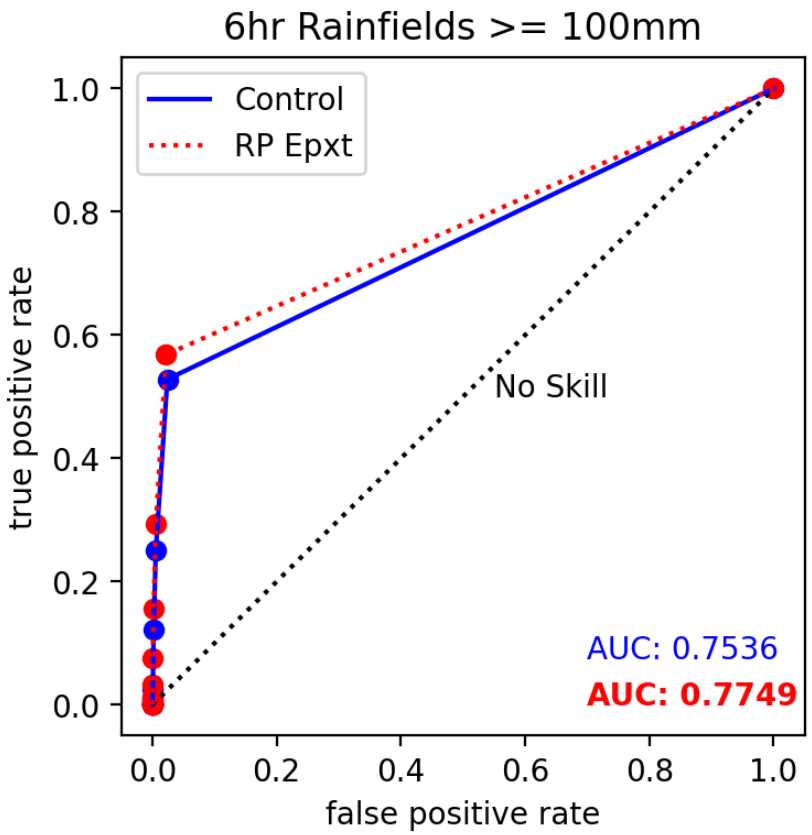


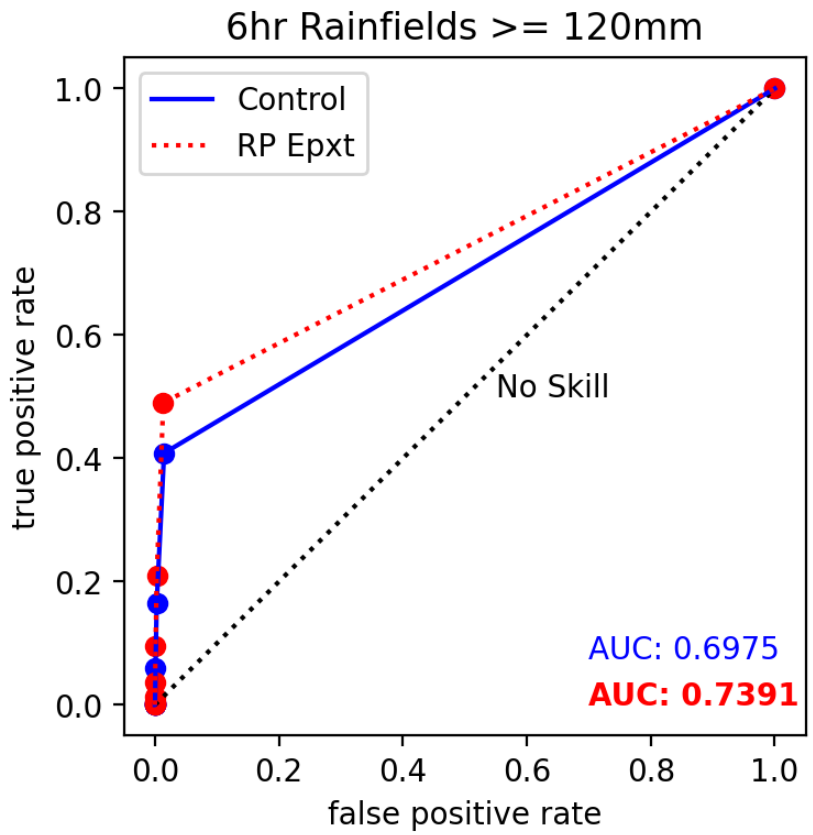


ROC Curves: Tropics Domain vs Rainfields









Future Work

Still lots to do!

- Continue to evaluate/verify the current trial results.
  - Verification against Rainfields has started, but more needs to be done.
  - Belinda will talk about near-surface verification tomorrow.

- Run additional trial periods that include more rainfall.
  - The verification we currently have looks good, but there are limited numbers of high rain rates in several domains.

- Evaluate specific events. The current trial period includes:
  - Suspected tornado in South Australia.
  - Fog in Melbourne.
  - TC Jasper.
  - Fire Weather in NSW.

- Pre-operational trialling: Nesting in ACCESS-GE4.
- Investigate the possibility of centering the initial conditions on the ACCESS-A analysis.

The Bureau of Meteorology

Thank you

shaun.cooper@bom.gov.au