The role of sea-surface temperatures in a June 2016 east coast heavy rain event: insights from AUS2200 simulations.

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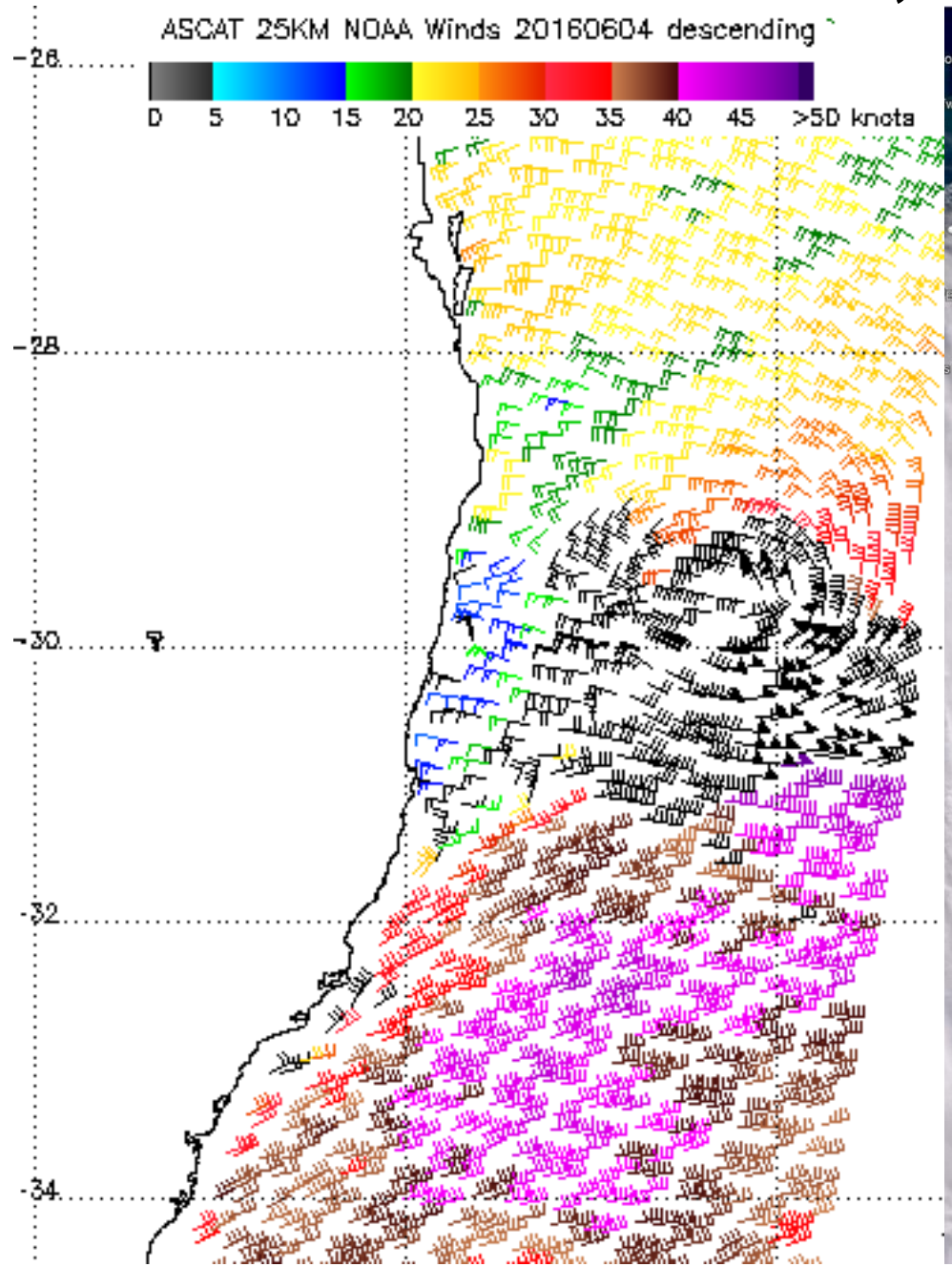
5 June 2016 Himawari-8: subtropical cyclone development within rainband.

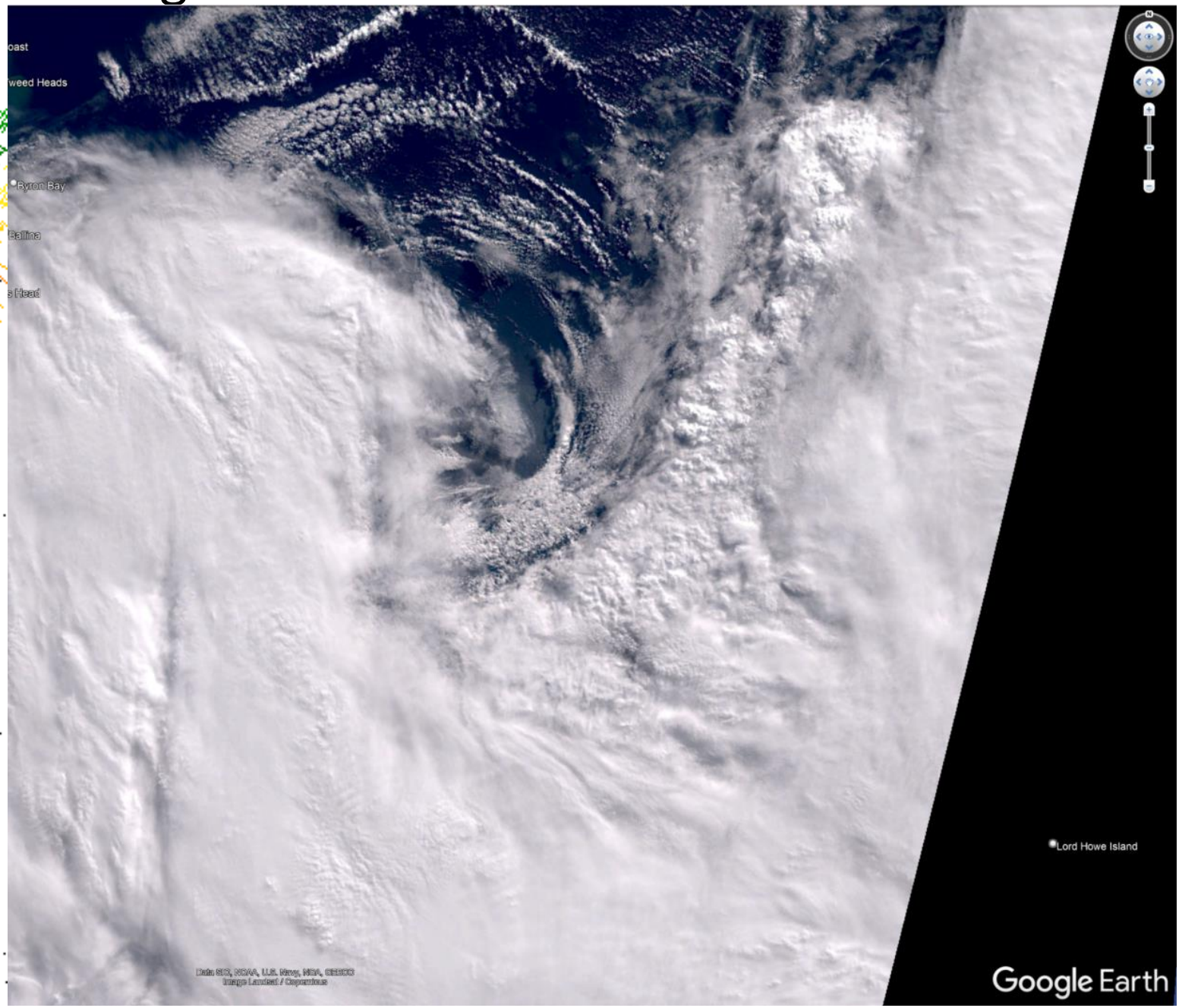
Four sensitivity simulations using ERA5 skin temperatures over water

1. "Climatology" 1980-2019, 3 June average skin temperature.
2. "Fixed" 3 June 2016 skin temperature.
3. "Evolving" skin temperature (daily updating).
4. "Smooth" – gradients around warm eddy removed but area-average skin temperature unchanged.

- 5-day simulations:
  0000 UTC 3 June to 0000 UTC 8 June
- 70 vertical levels.
- 2.2 km resolution at equator.

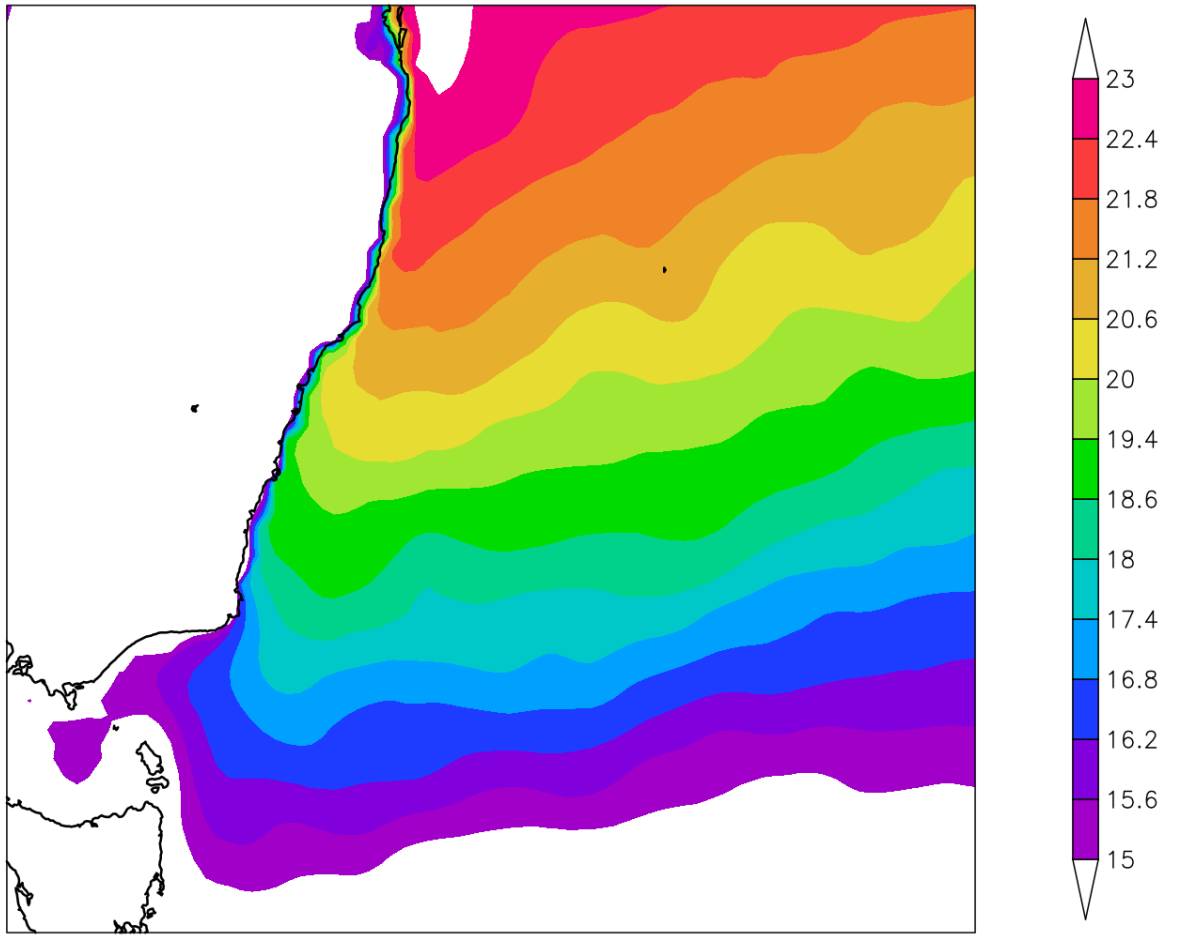
Sentinel-3, morning of 5 June 2016





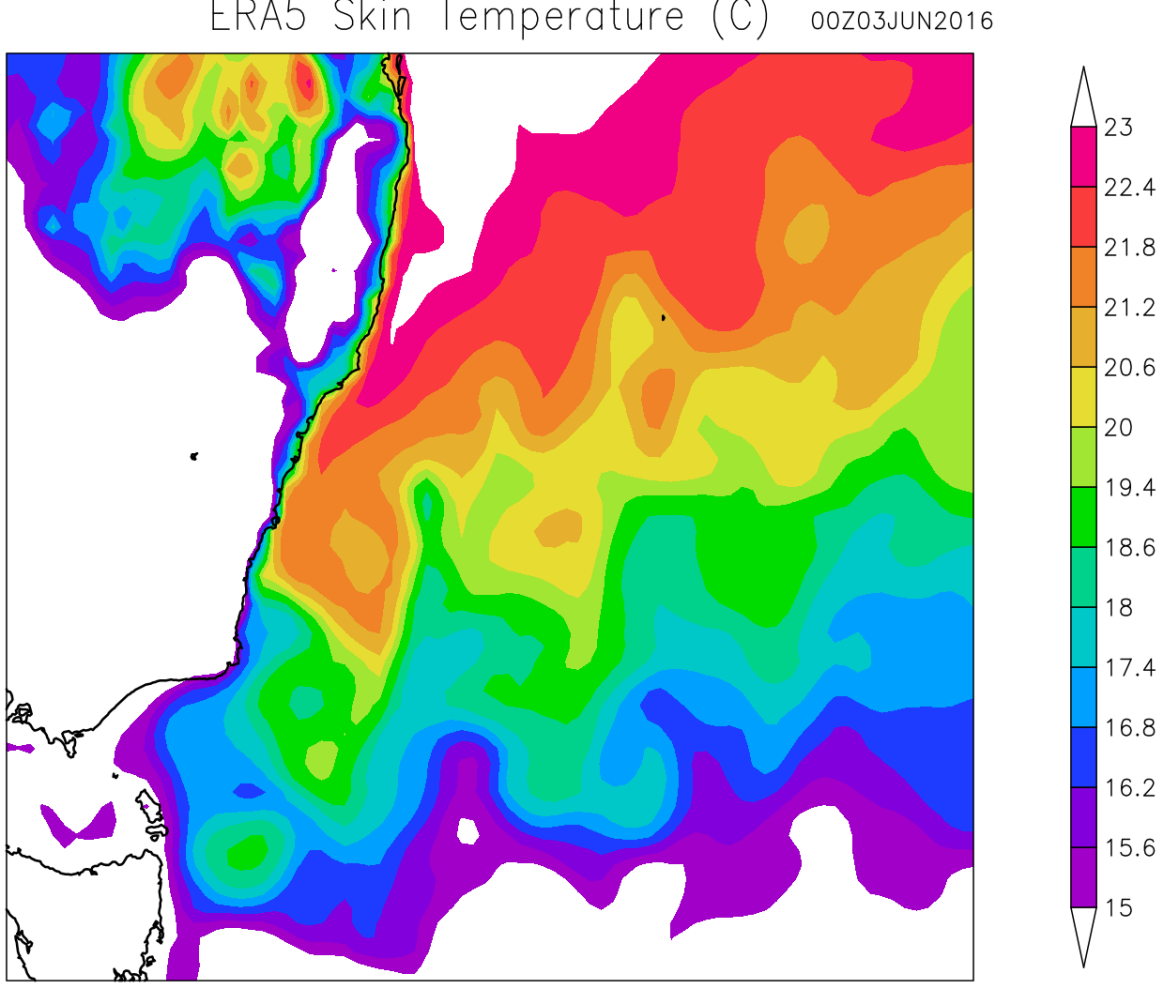
Climatology

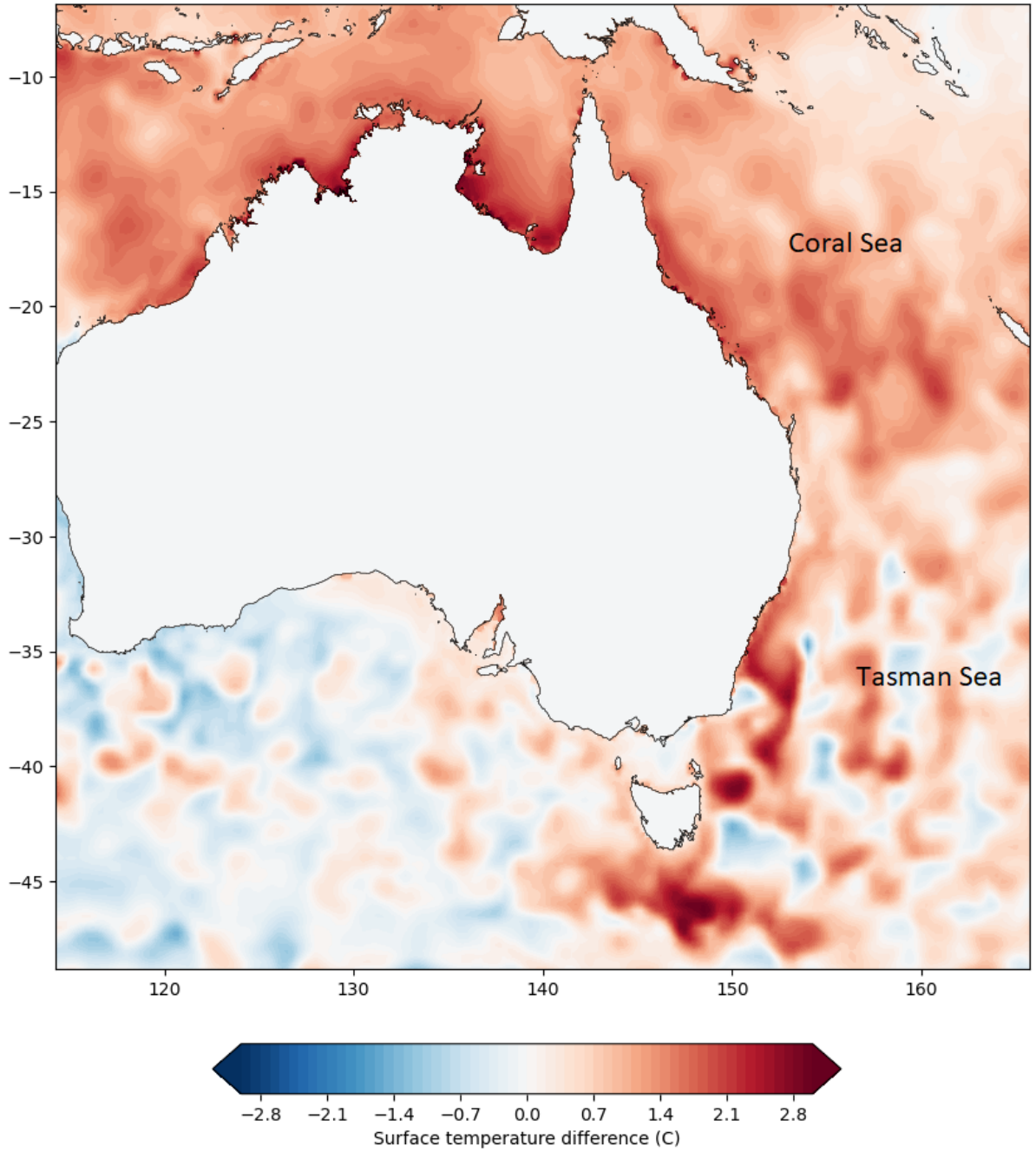
1.) 1980-2019, 3 June ERA5 average skin temperatures.



Fixed

2.) 3 June 2016 ERA5 skin temperatures.





Skin temperature over water anomalies 3 June 2016 (Fixed – Climatology).

Both the Coral and Tasman Sea averages were at record levels.

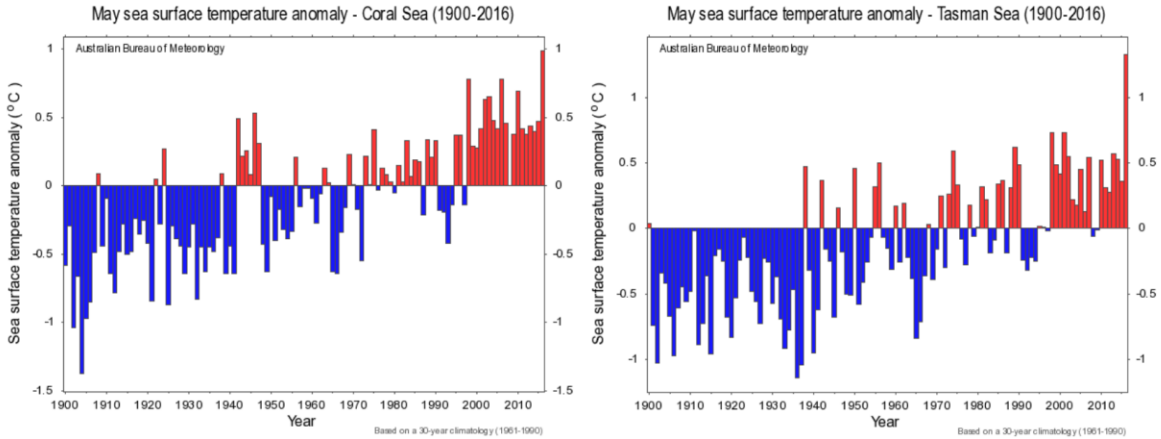


Figure 6. May 2016 sea surface temperature anomalies in the Coral Sea (left) and Tasman Sea (right) highlighting the record warmth in the oceans which served as a source for the low pressure system.

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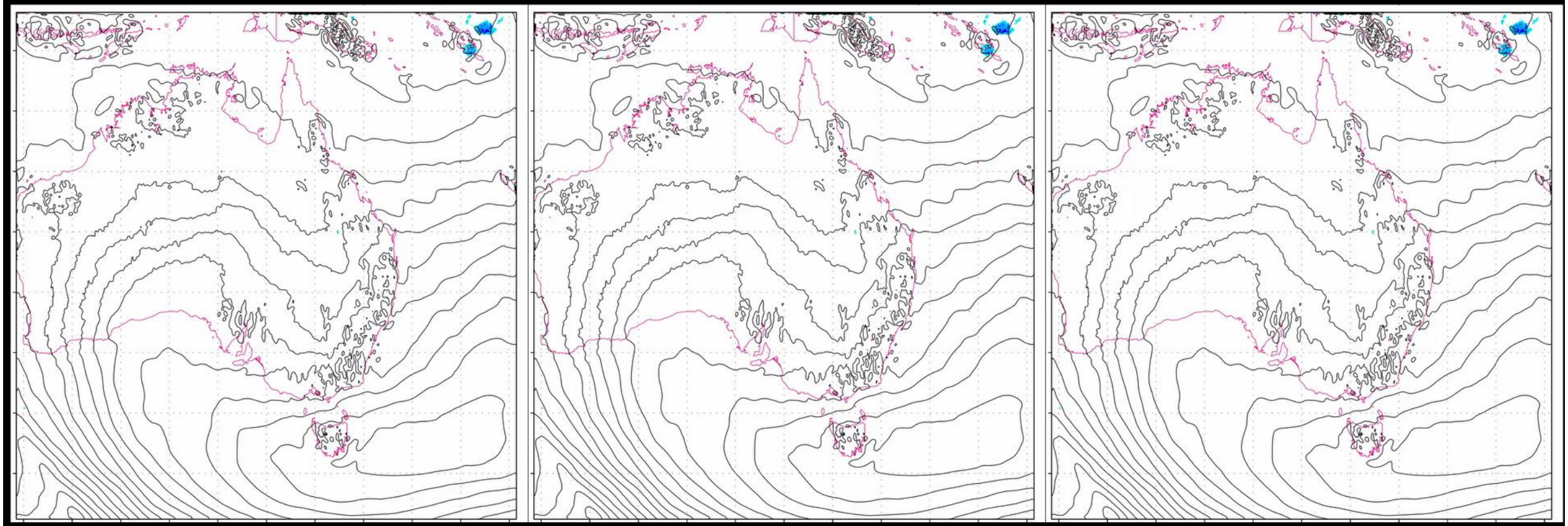
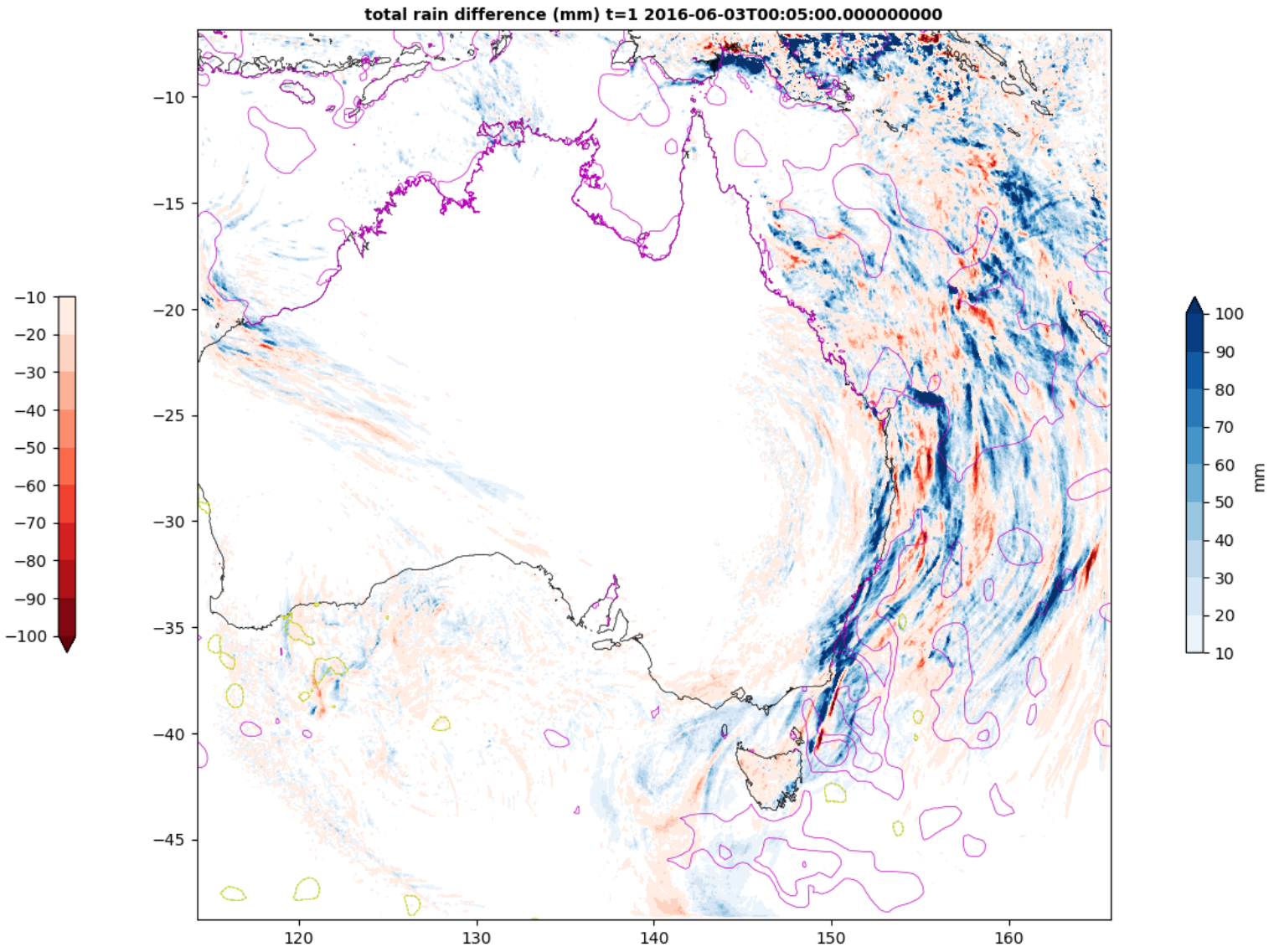
Climatology

Fixed

Evolving



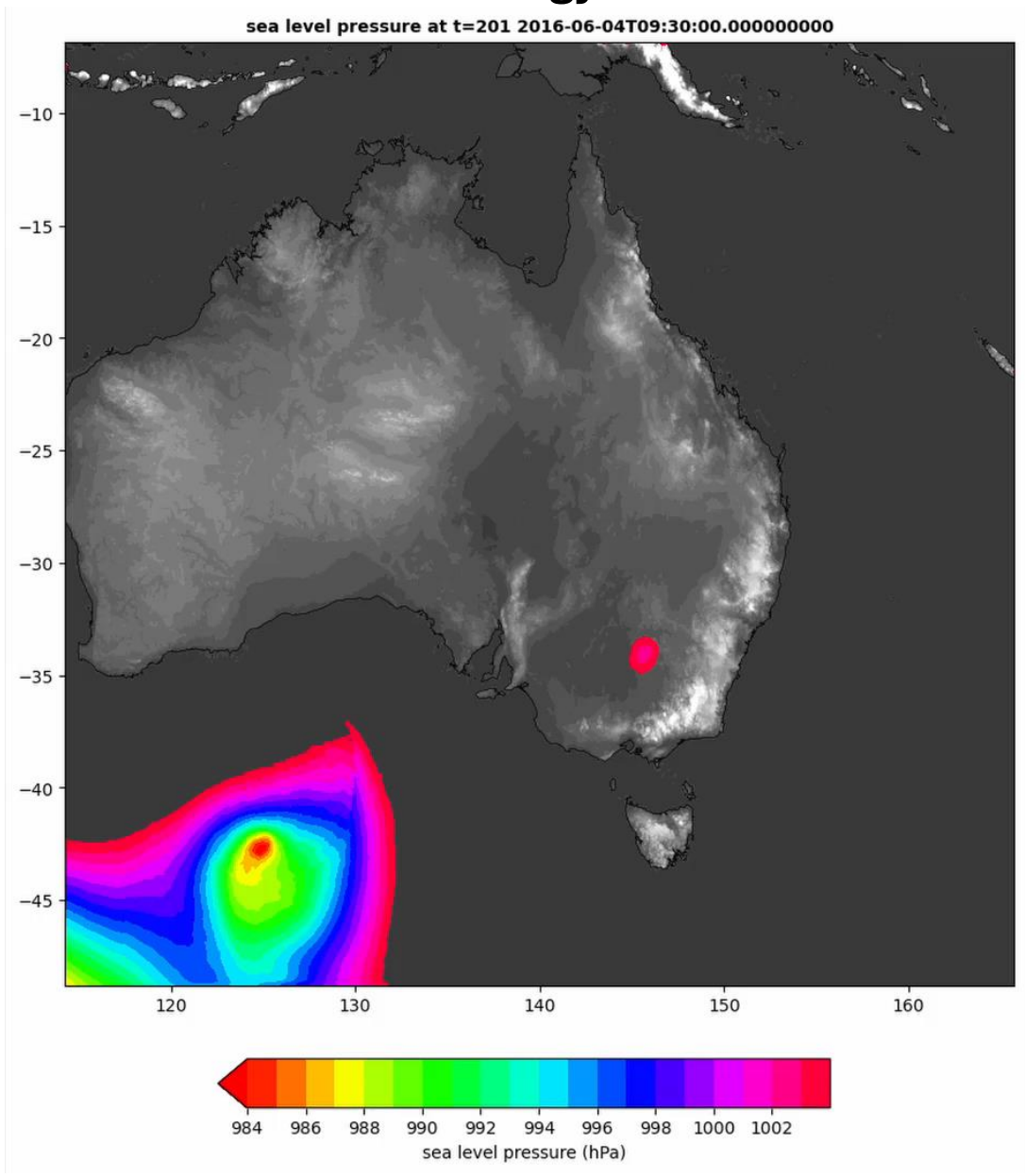
5-day total rainfall difference Fixed – Climatology (mm)



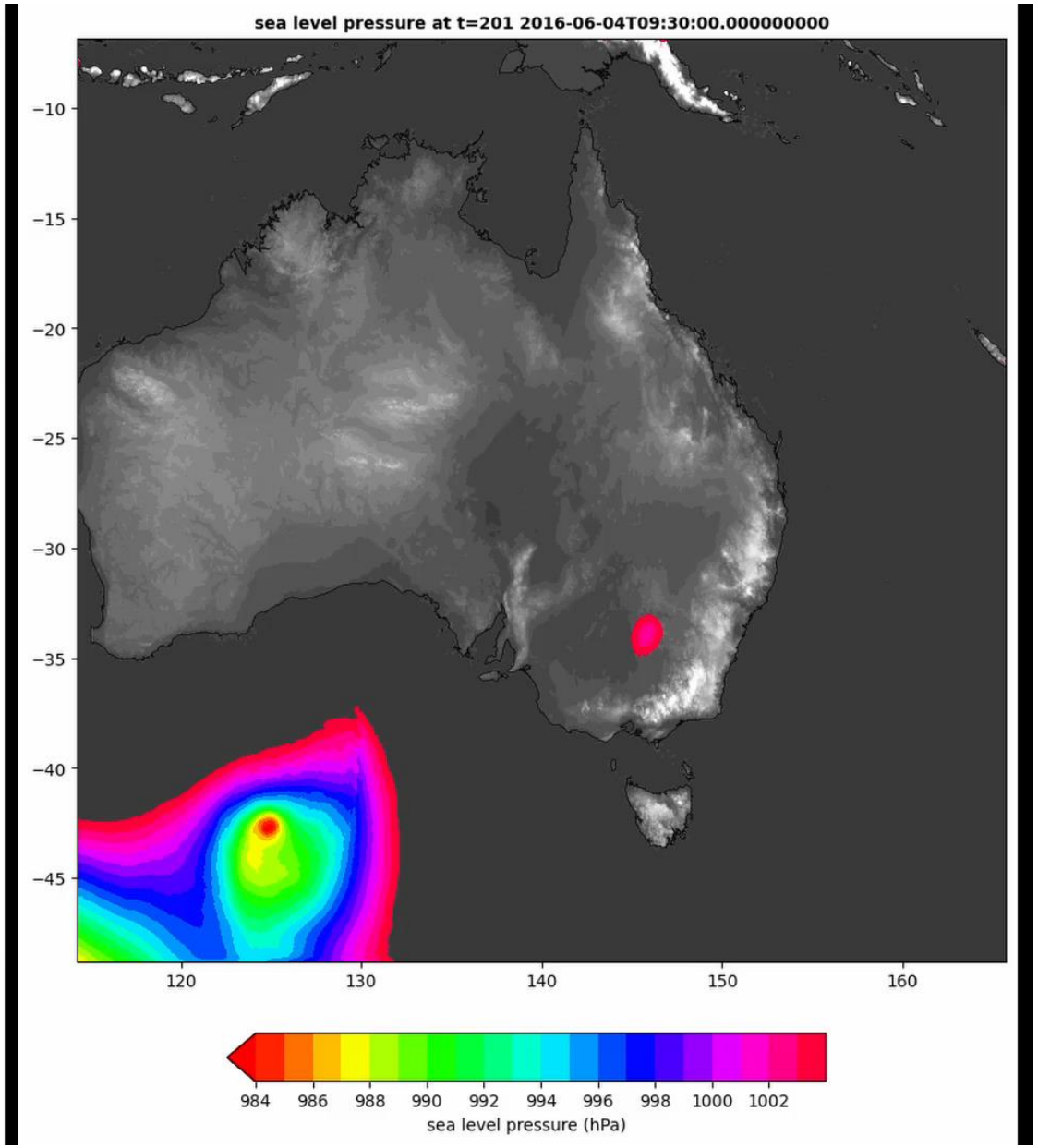
- Clearest signature - increased rainfall over NSW coastal mountains.
- However, only small differences over Tasmania where some of the worst flooding occurred.

Sea-level pressure – focussing on the lower pressures (984 to 1004 hPa)

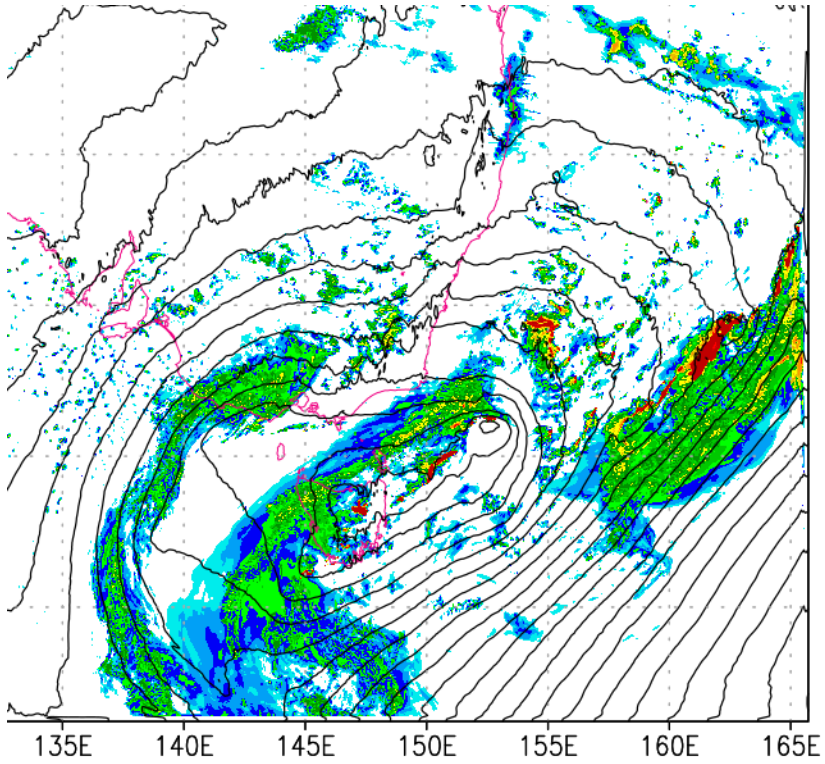
Climatology



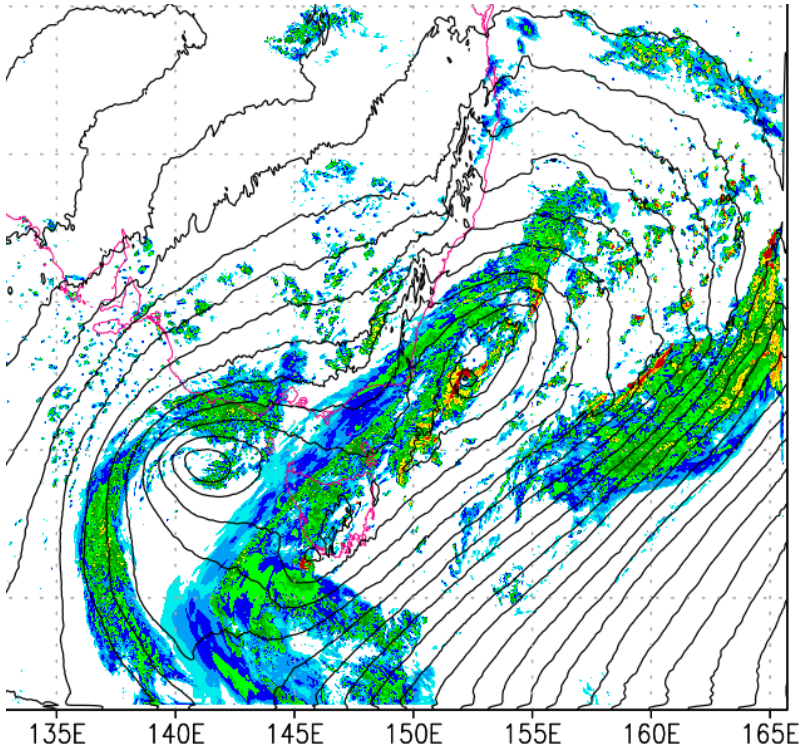
Fixed



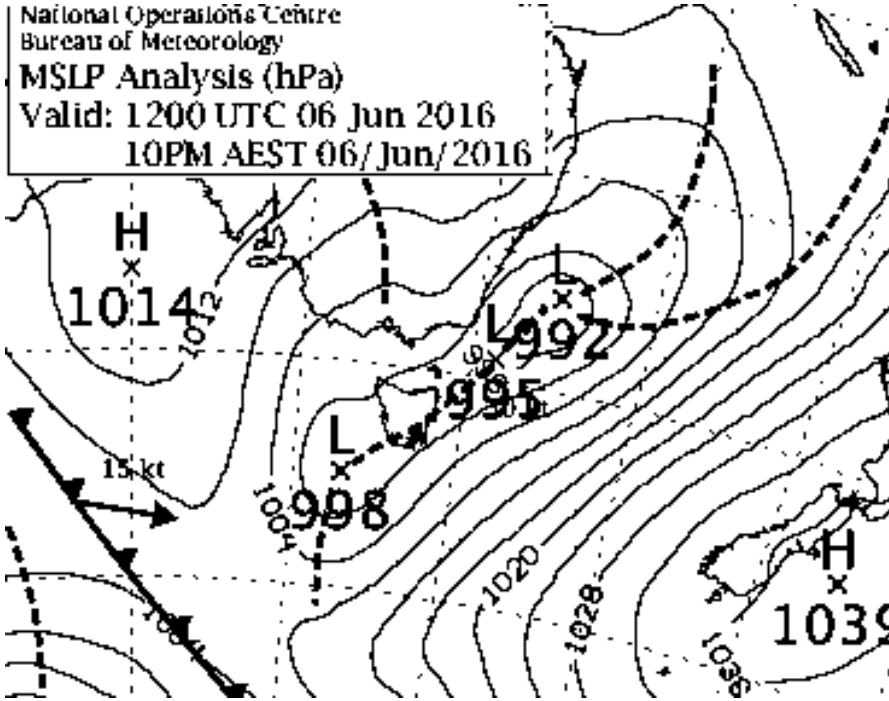
1.) Climatology



2.) Fixed

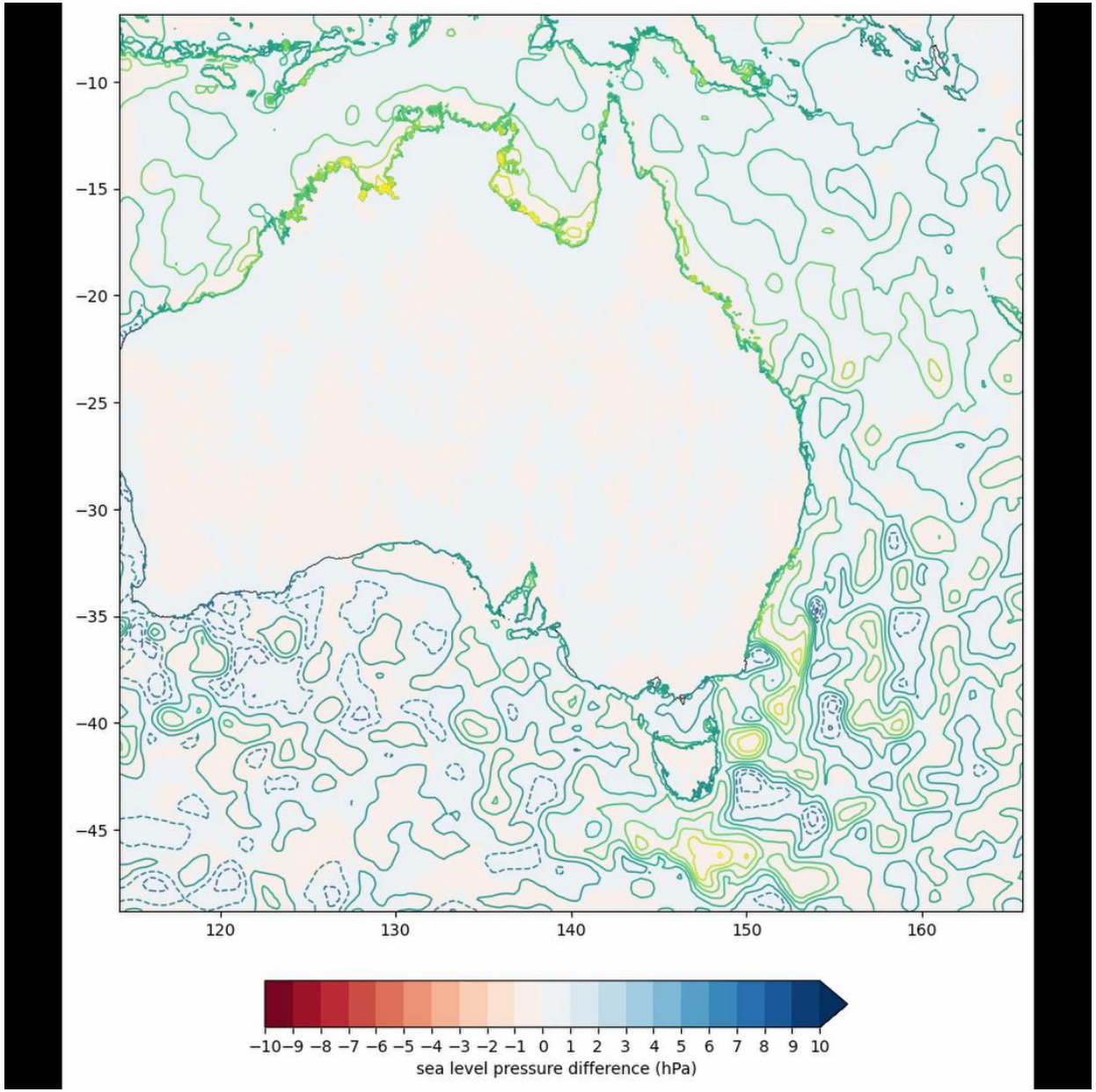


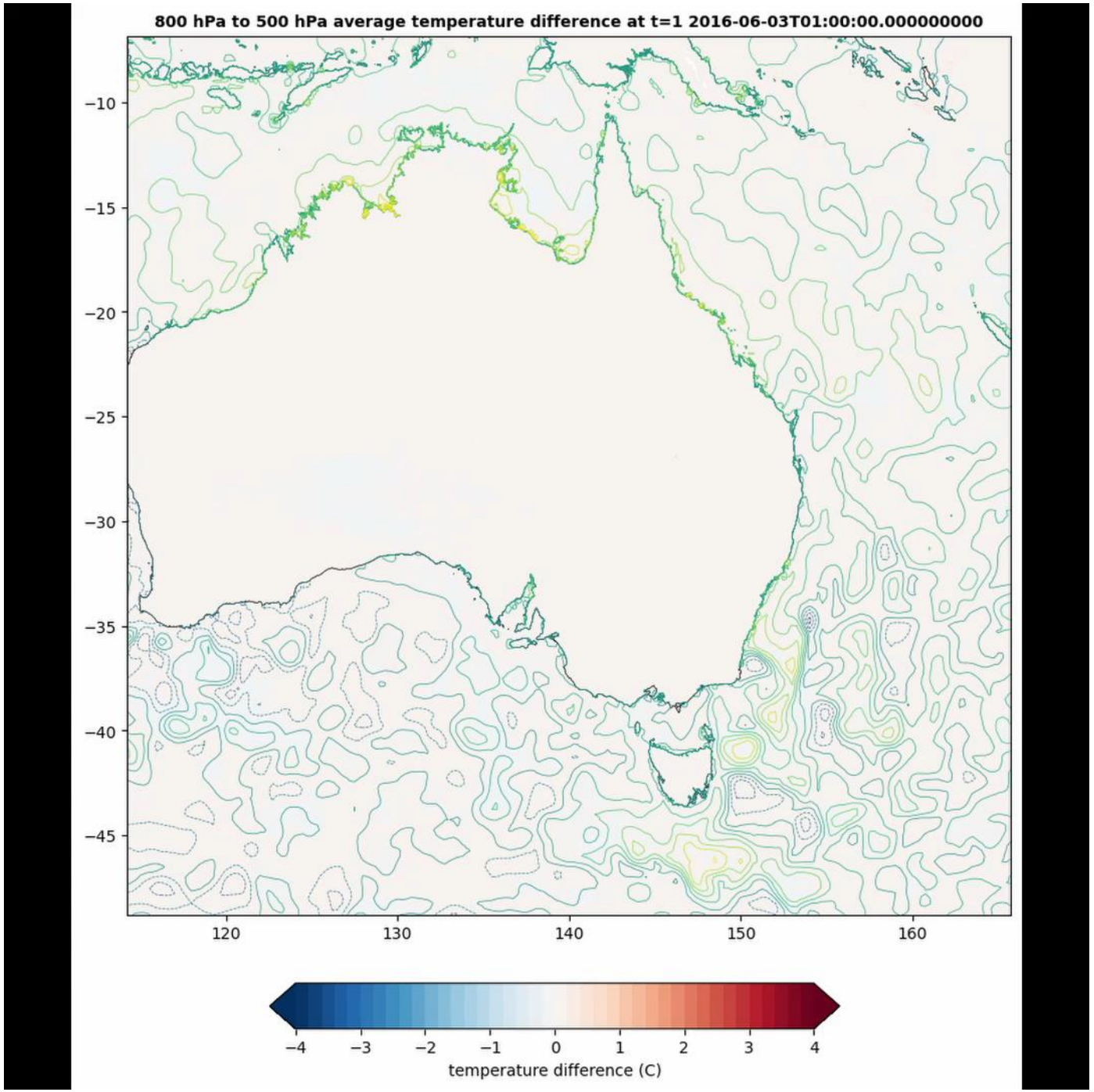
1.) BOM sea-level pressure analysis



1200 UTC 6 June sea level pressure and reflectivity comparison

Sea level pressure difference (fixed – climatology), reds show lower pressures. (SST differences fixed – climatology are contoured on, dashed areas are where the climatology SST is warmer.)

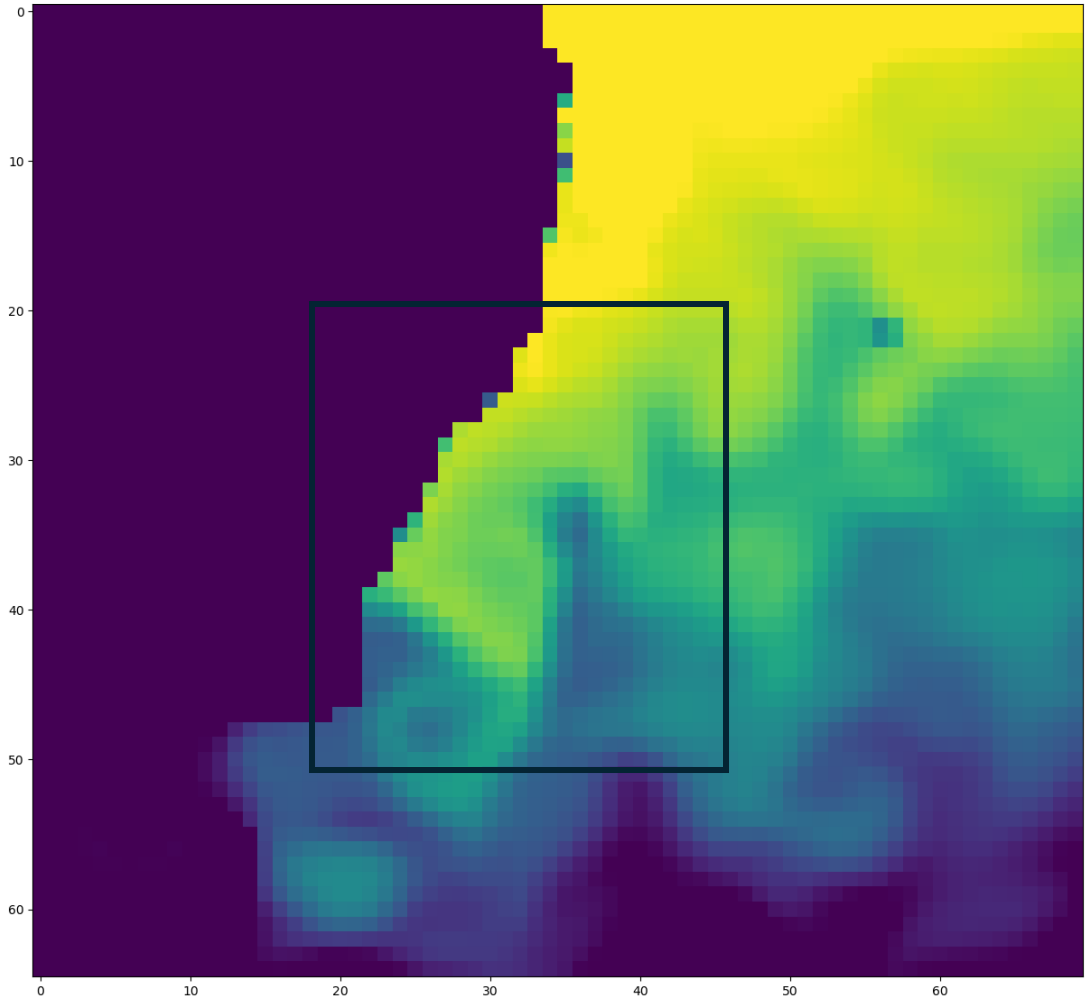




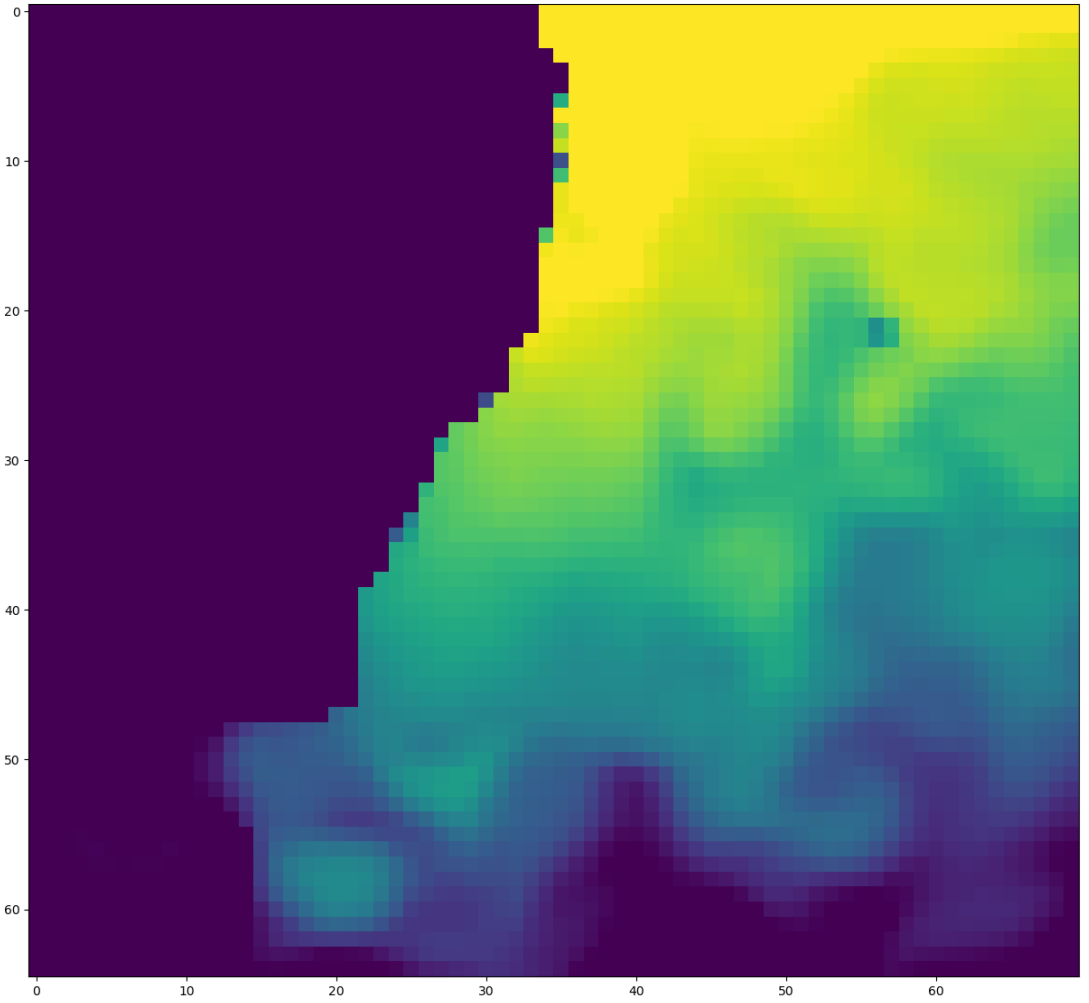
Fixed – Climatology 800 hPa to 500 hPa average temperature difference.

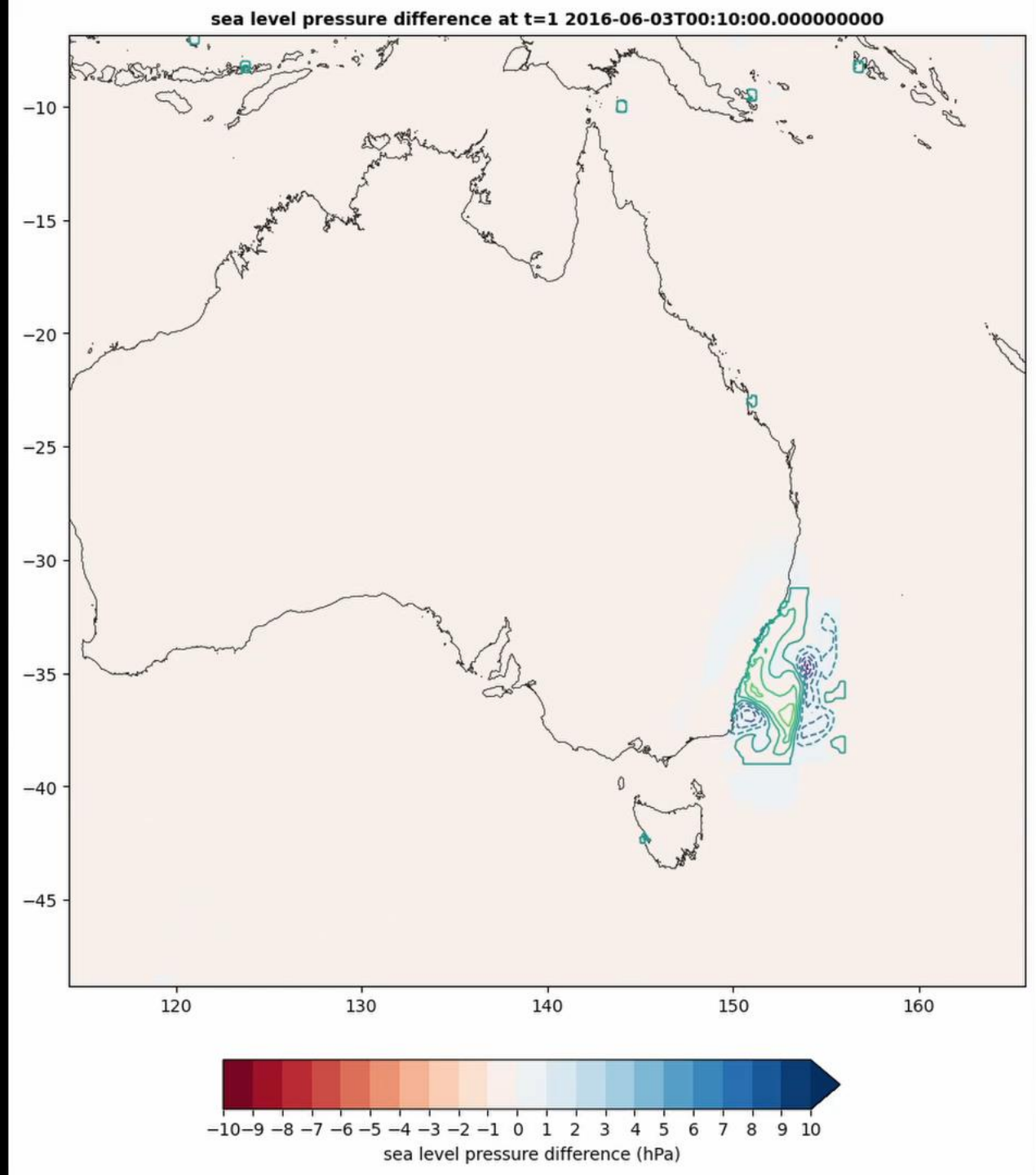
Signature of deep-tropospheric warming.

3 June 2016
ERA5 skin temperature, “fixed”



Eddy-removed, “smooth”, box area replaced with an adjusted climatology such that the area-averaged skin temperature is the same as “fixed”





Sea-level pressure difference (Fixed – Smooth)

No indication that the gradients in SST in the vicinity of the warm eddy triggered the deepening of the subtropical cyclone.

Summary

- When comparing observed SST simulations with a climatological SST run of a June 2016 east coast low event:
  - Increased rainfall along the length of NSW coastal mountains, possibly due to forced uplift in onshore flow off warmer SSTs. But not much change over Tasmania.
  - Development of lower sea-level pressure off the NSW coast associated with a developing subtropical cyclone.
  - Lower pressure holds/prolongs there and then develops into multiple low pressures, seen in observational BOM analyses, while the climatology run instead develops into one larger low-pressure system over Tasmania.
  - Widespread warm-SST-induced deep-tropospheric warming becomes concentrated off the NSW coast by 5 June over the subtropical cyclone.
- When comparing with a smoothed warm eddy run but keeping area-average SST the same:
  - The gradients in SSTs around the warm eddy have no clear impact on the intensification of the subtropical cyclone.

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