A case study of a tropical low over northern Australia using high solution model

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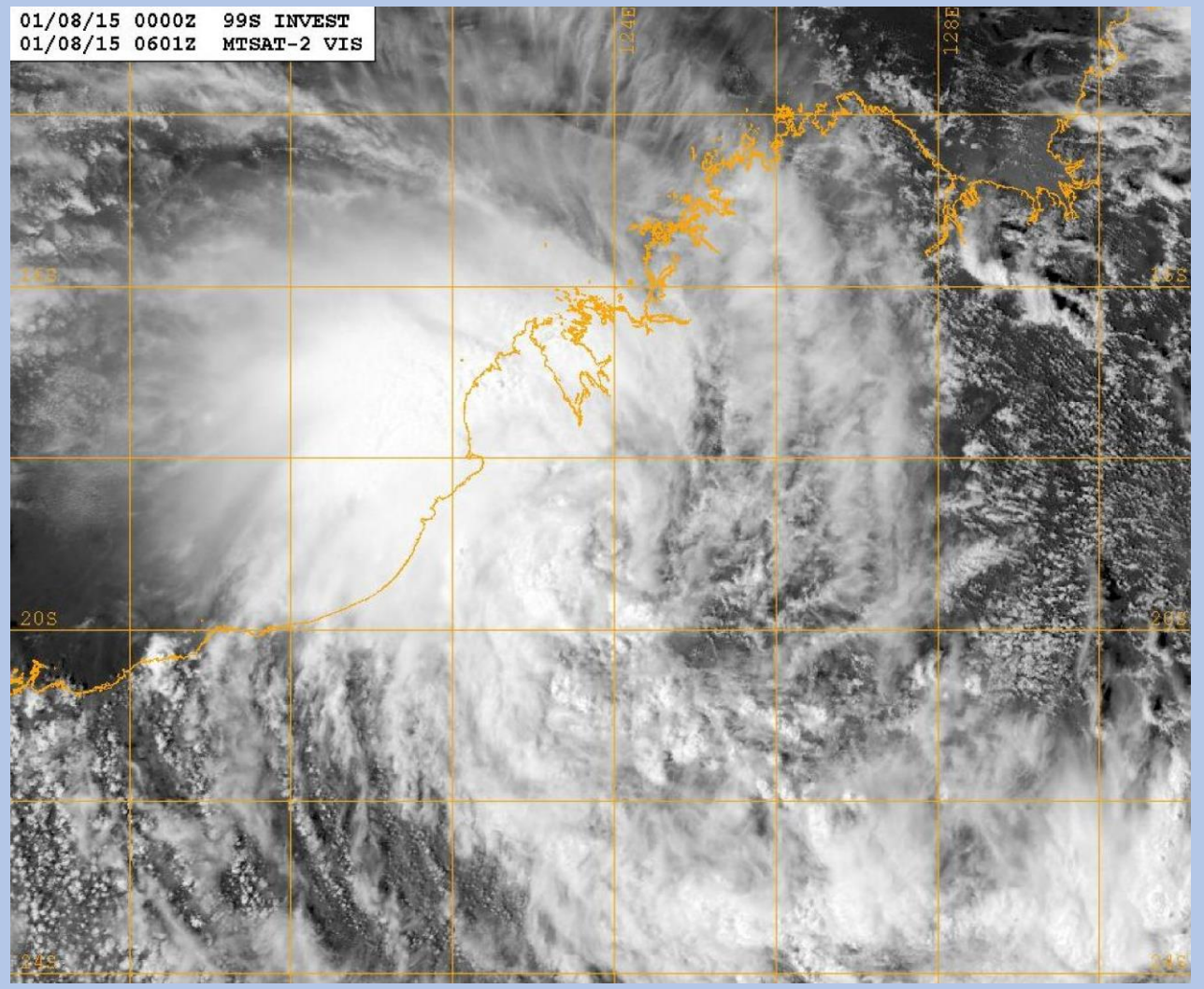

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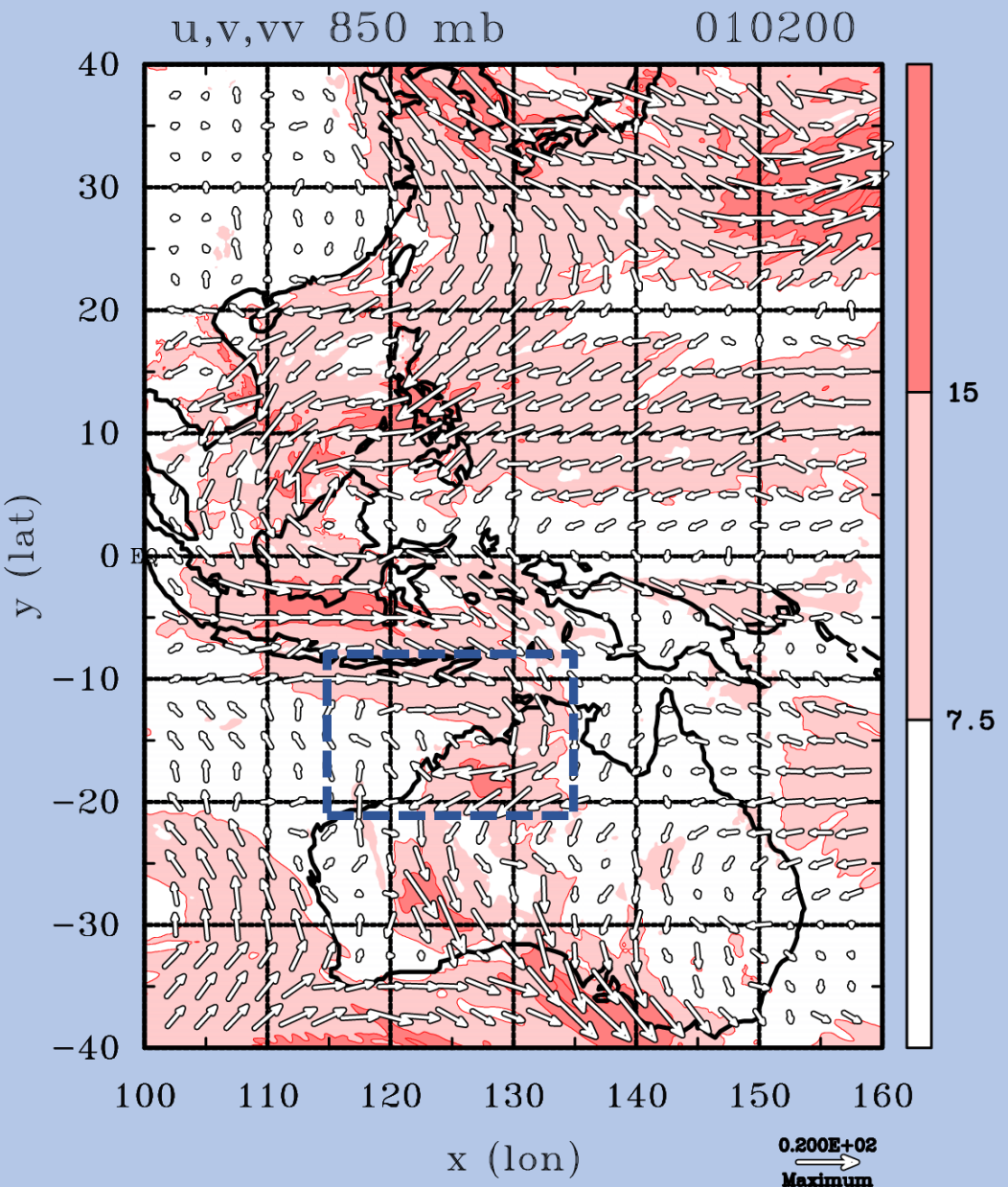
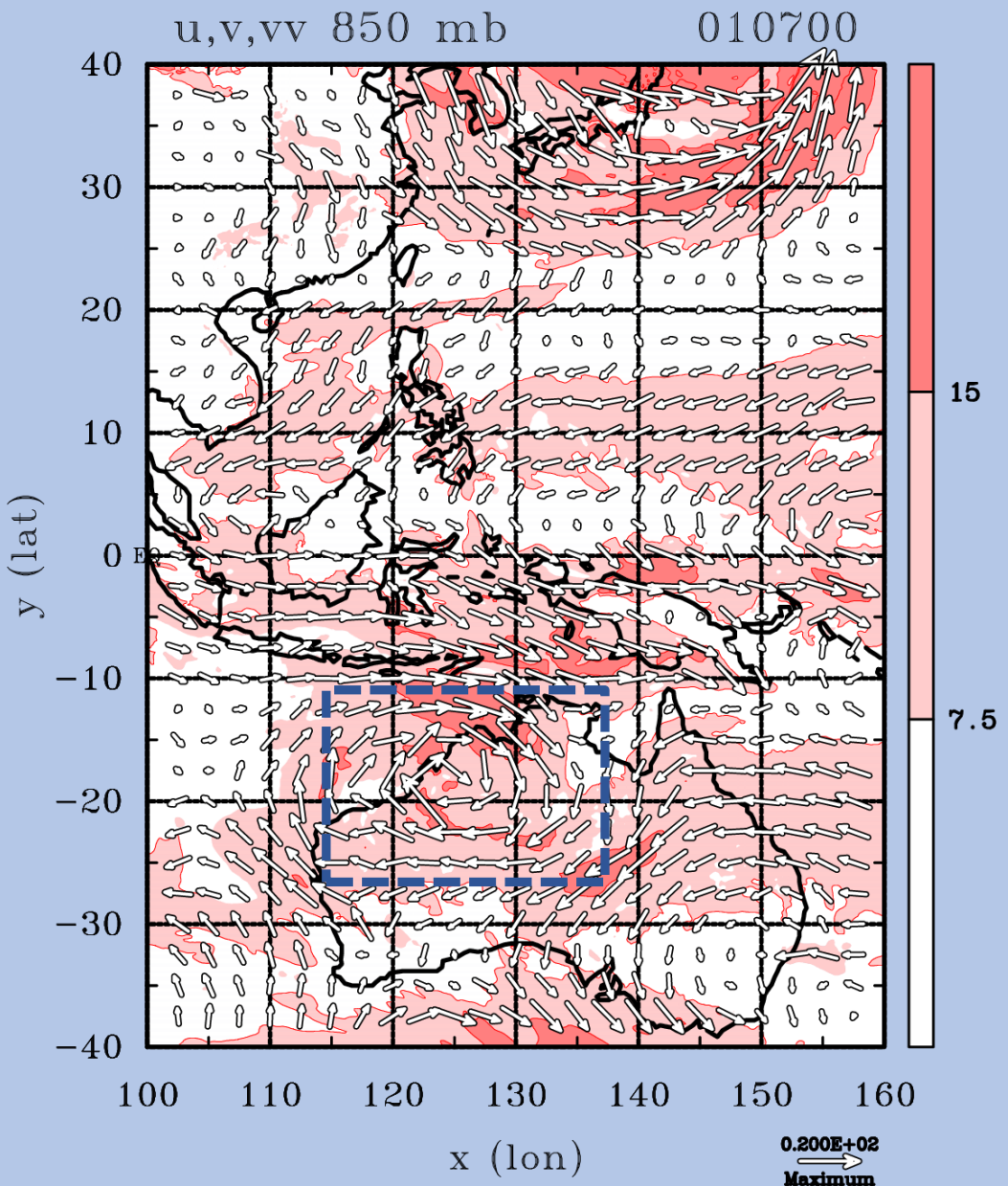
ECMWF Analyses





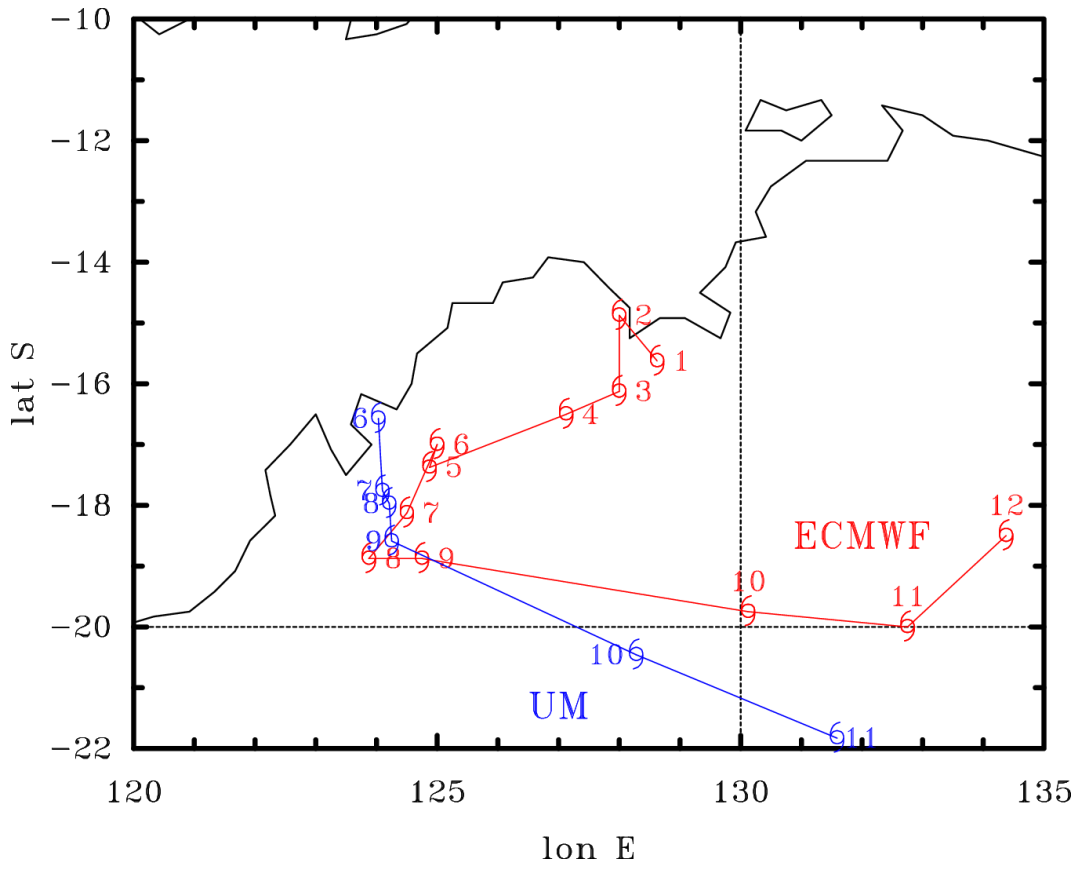
Motivation

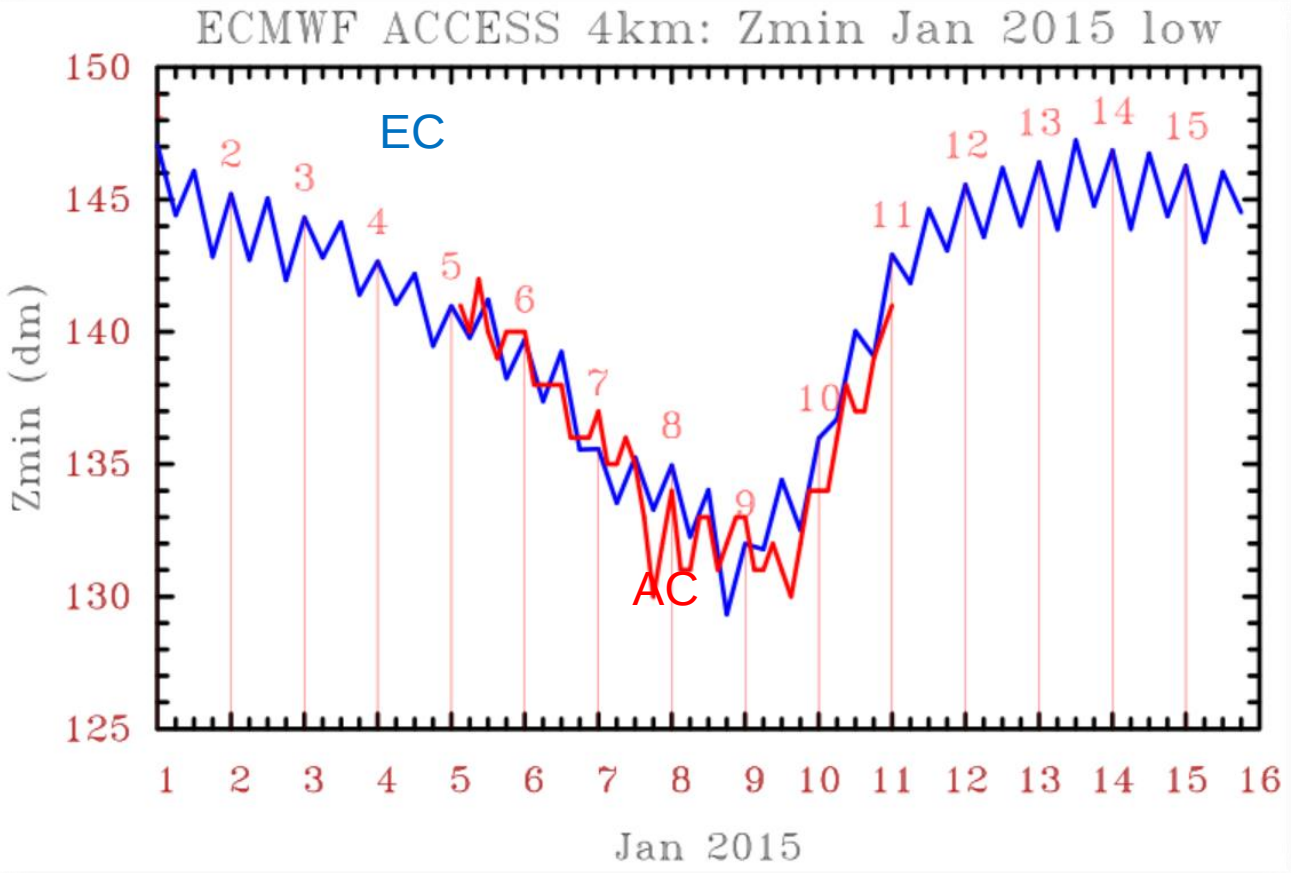
- How well does ACCESS perform using EC analyses as "truth"?
- What can we learn about the storm behaviour from the ACCESS forecast?
- How important is high soil moisture for the intensification of the low?

Model description

1. Met Office Regional Atmosphere and land model (RAL1)
2. Tropical setting (PC2 cloud scheme)
3. 6 days forecast starting at 00300UTC on 5 Jan 2015.
4. Horizontal resolution 4km.
5. 80 vertical levels
6. 600X600 grid points

Track and Intensity: ECMWF and ACCESS (4 km)

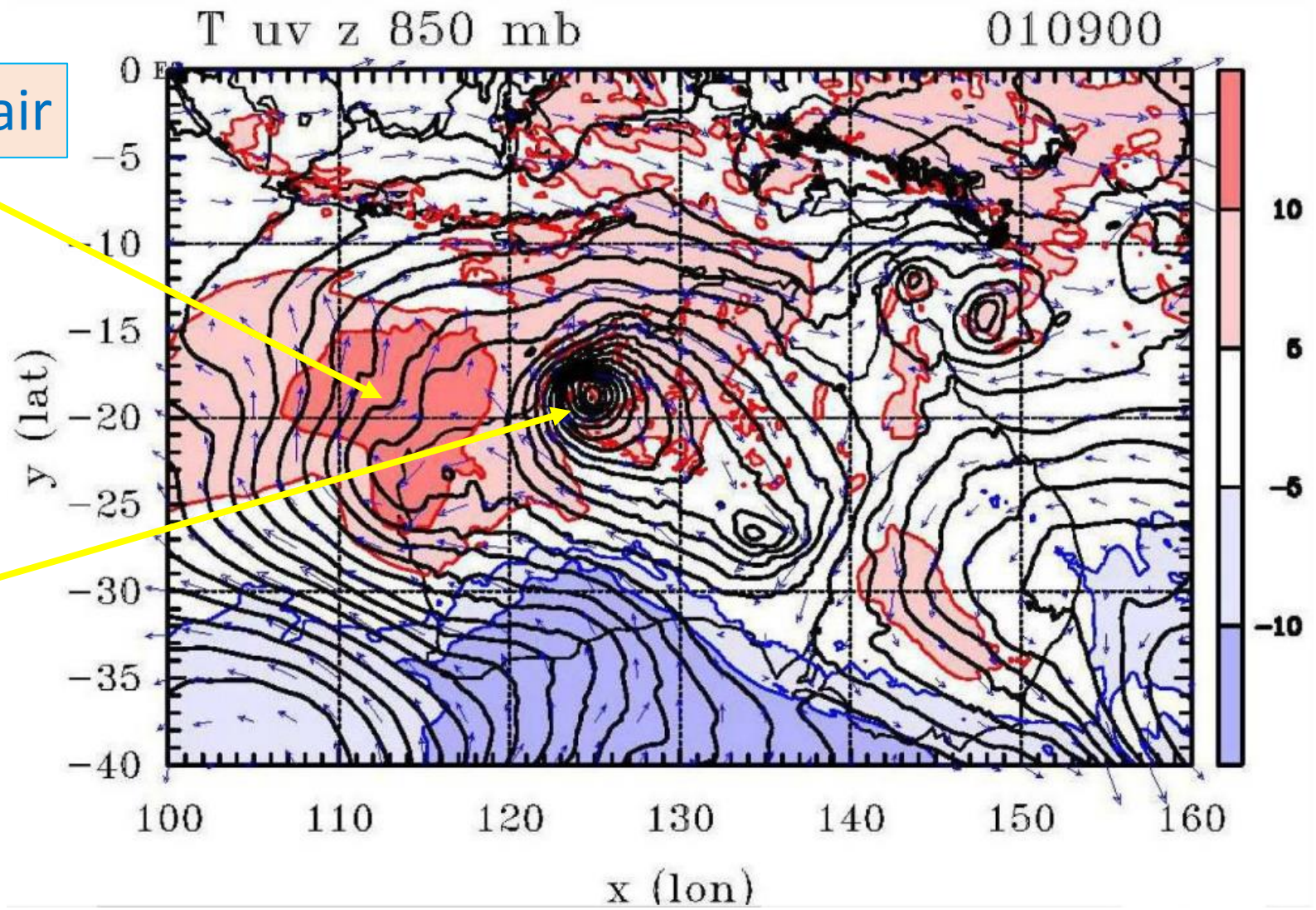




The system is not a heat low

The warmest air

The low



Rotating convection paradigm: schematic

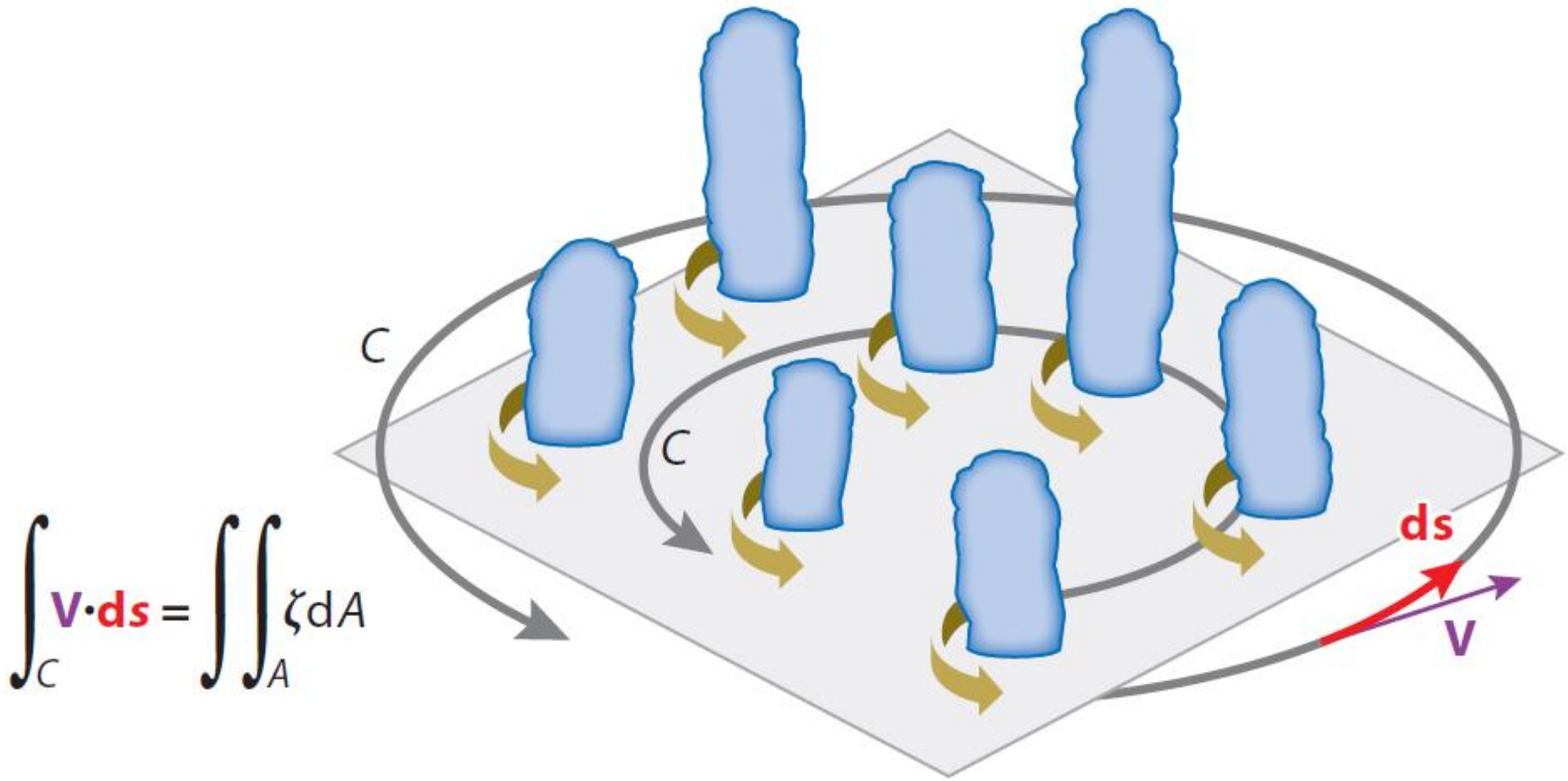
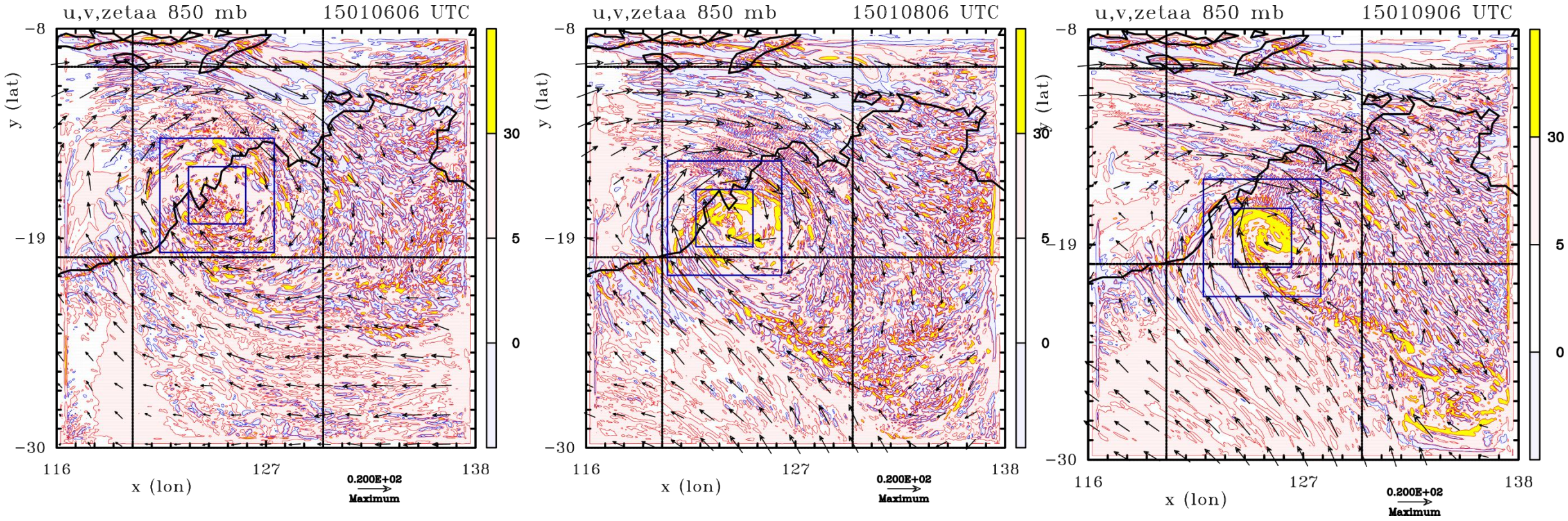


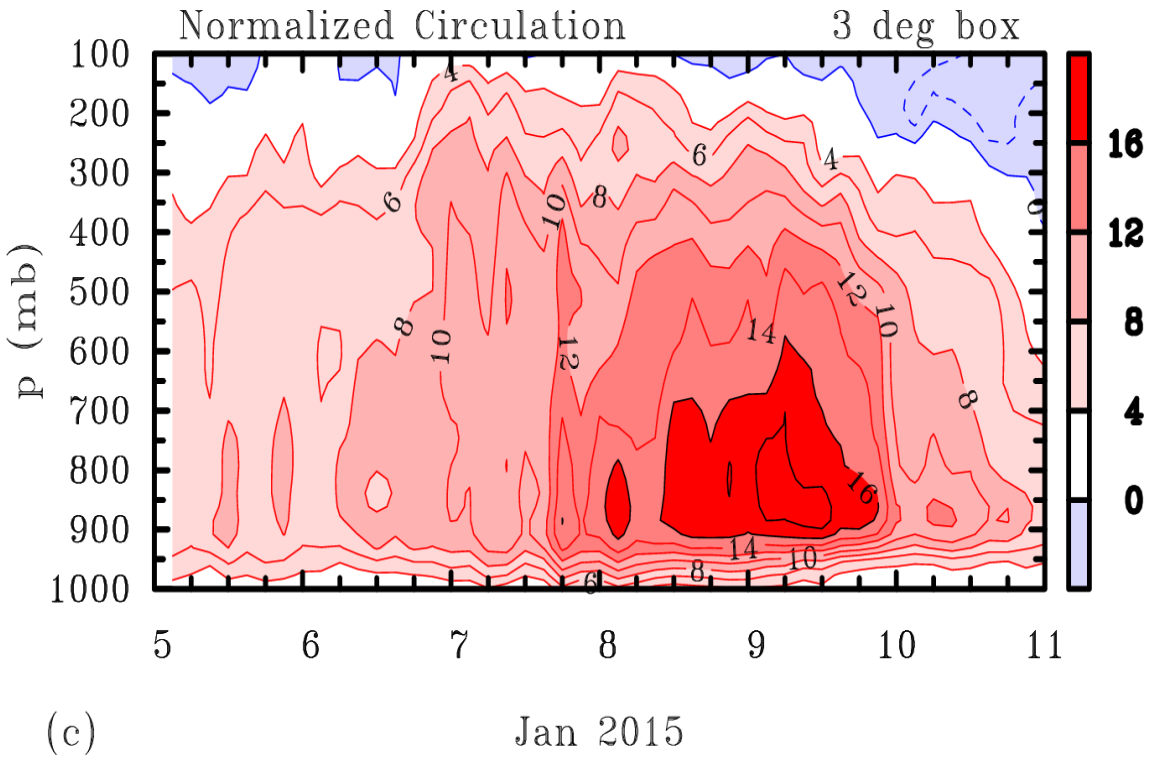
Figure 5

Schematic illustration of a region of deep rotating updrafts with two hypothetical circuits (*gray circles*). By Stokes' theorem, the circulation about either circle is equal to the areal integral of the vorticity enclosed by that circuit. Wide dark yellow arrows denote the local rotational flow associated with the rotating convective updraughts.

ACCESS vertical velocity and absolute vorticity plots at peak low intensity

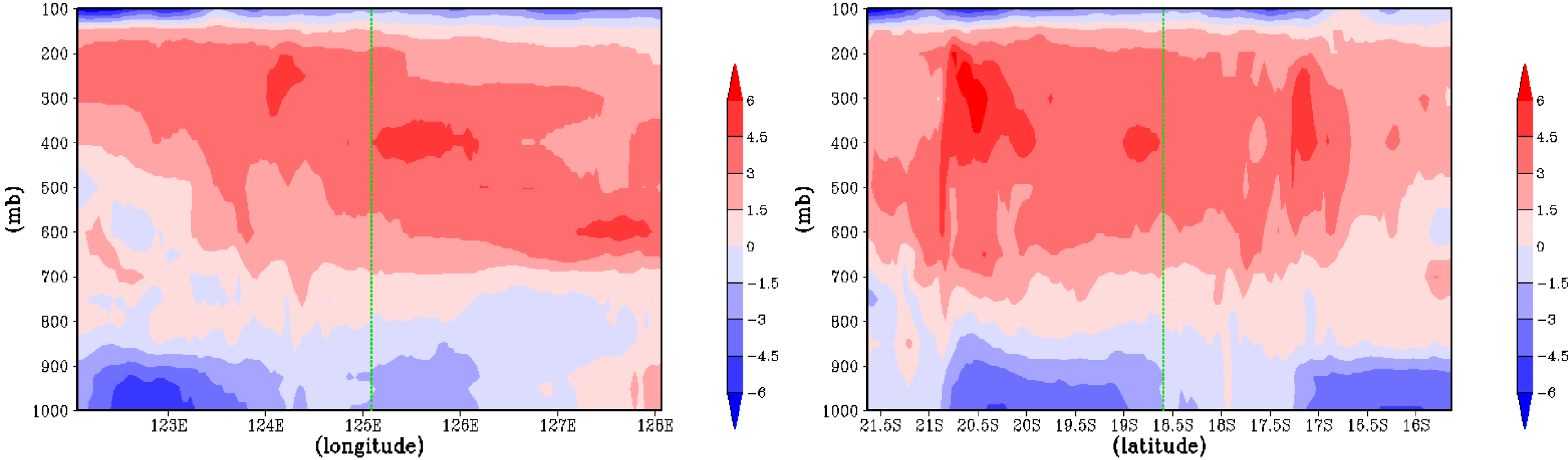


Time-height cross sections of system averaged circulation within a box



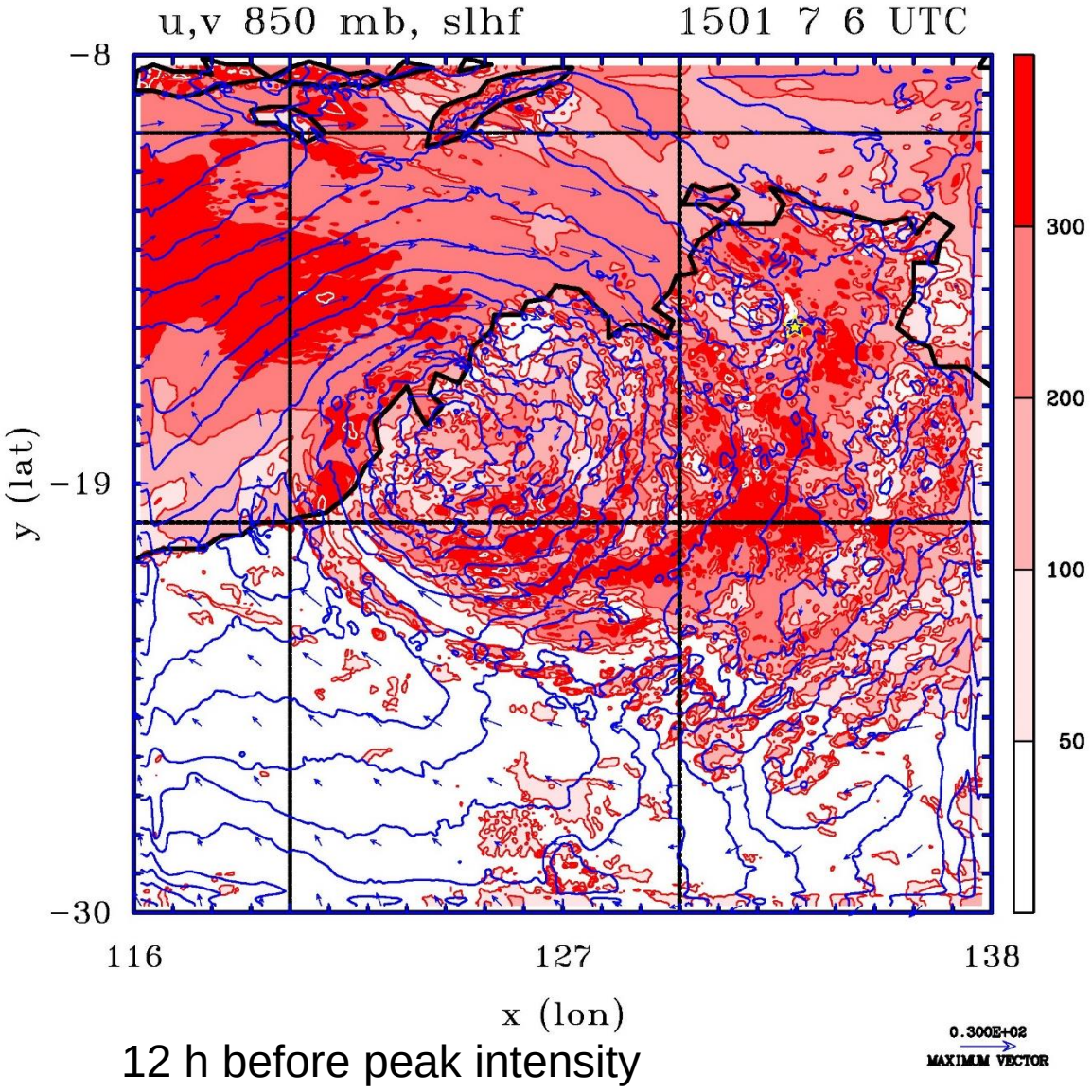
Vertical cross-sections of perturbation potential temperature

(through the low center (125.1E, 18.6S) at 0600UTC 9 Jan)



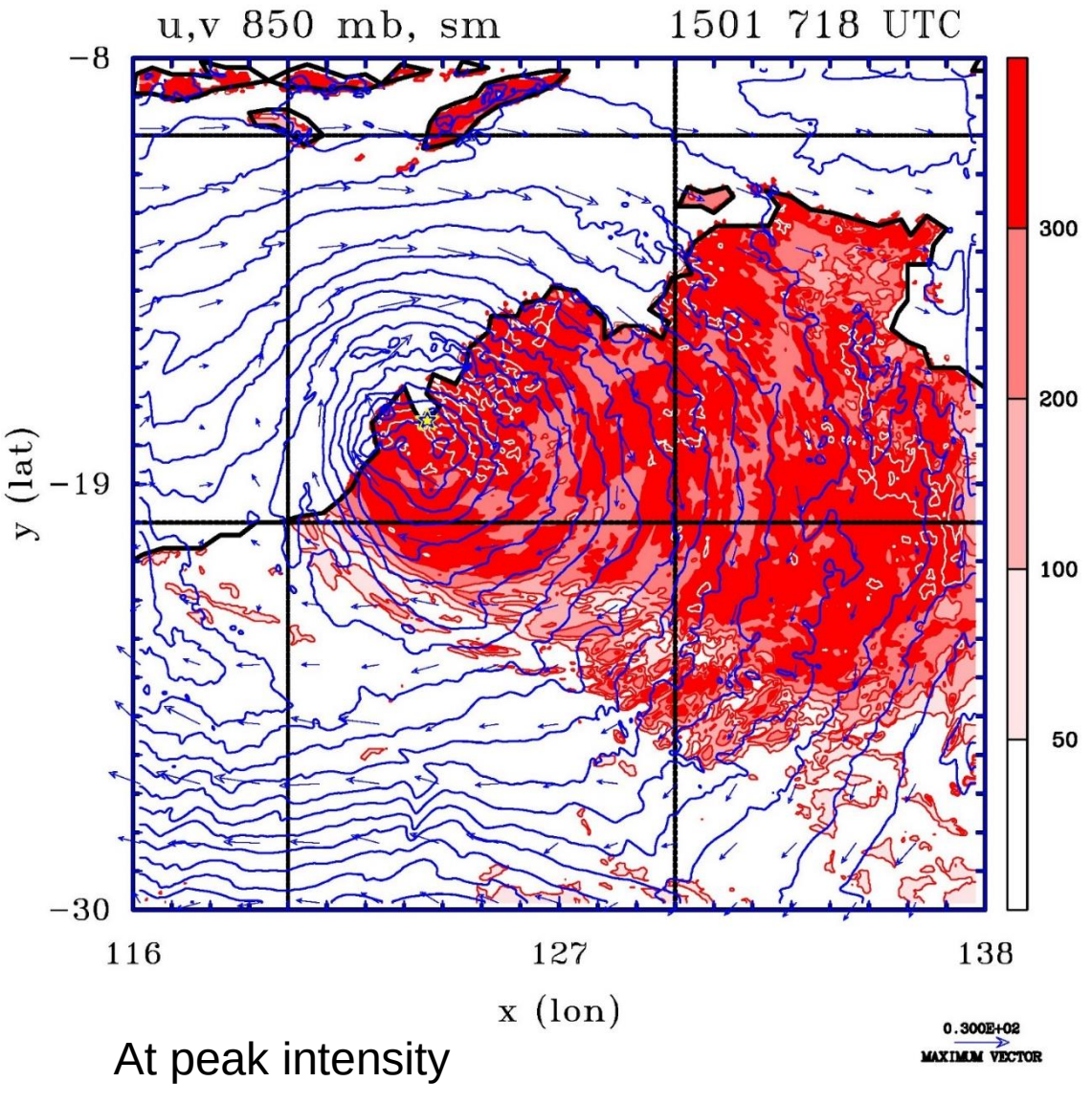
ACCESS surface latent heat flux and Soil Moisture content

LHF



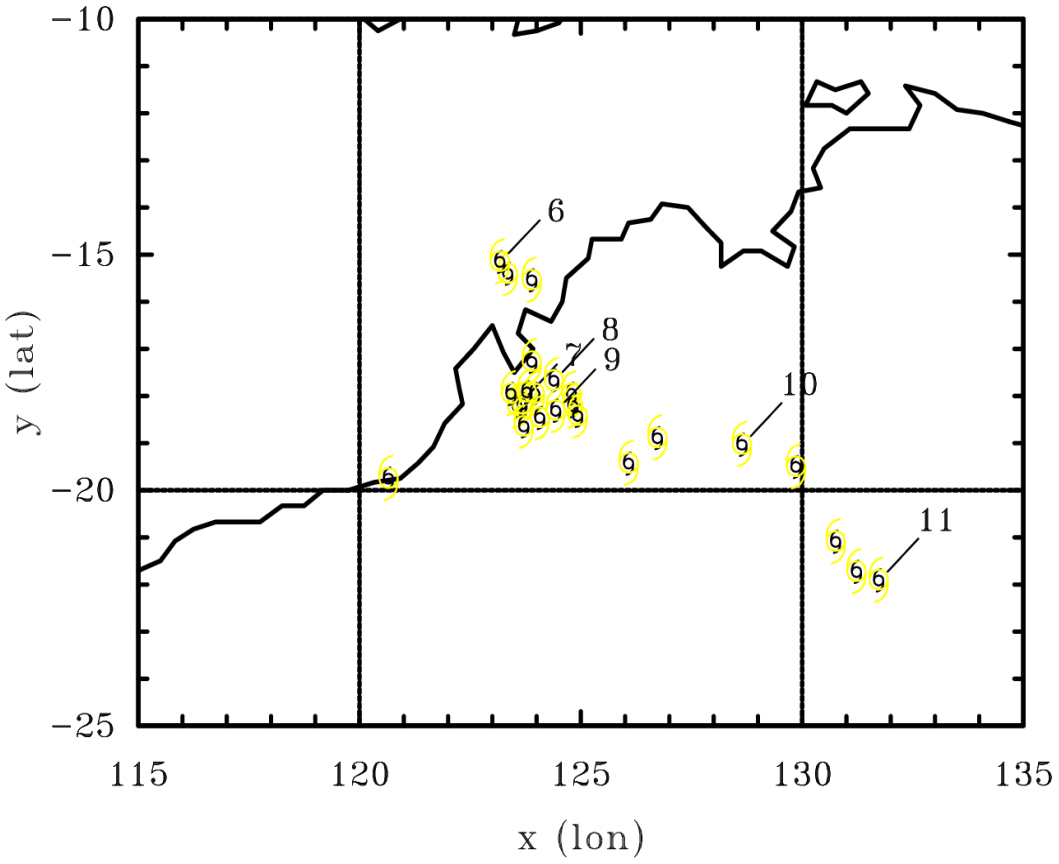
12 h before peak intensity

SM

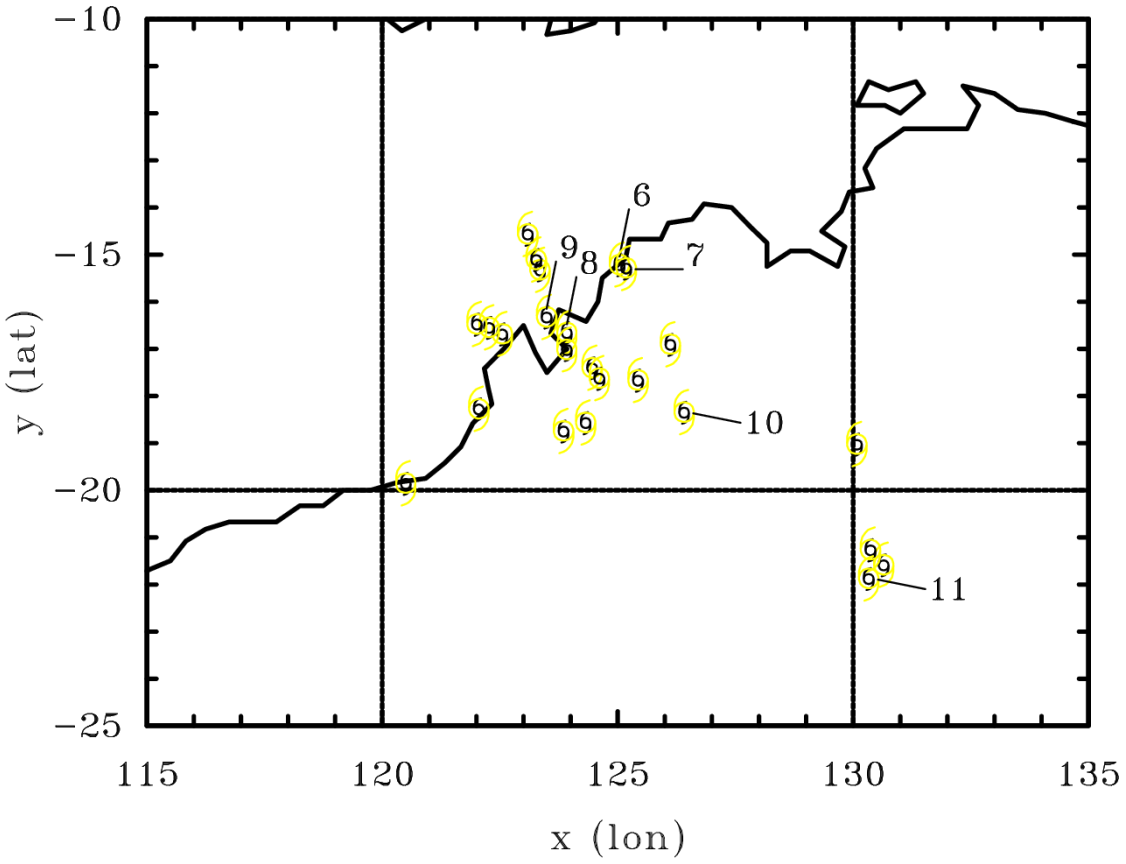


At peak intensity

Location of minimum surface pressure (every 6 hours)



Main simulation



Suppressed surface moisture fluxes over the land

Conclusions

- Model 5 day forecast comparable to ECMWF analyses.
- Tropical low is distinct from the heat low.
- Evolution of the low is consistent with the rotating-convection paradigm.
- The low is a “bottom-up” development, the circulation having a maximum in the lower troposphere.
- Special soil types are not essential to vortex intensification over land.

Zhu H, Smith RK. 2020: A case-study of a tropical low over northern Australia. QJR Meteorol Soc.: 146: 1702-1718.