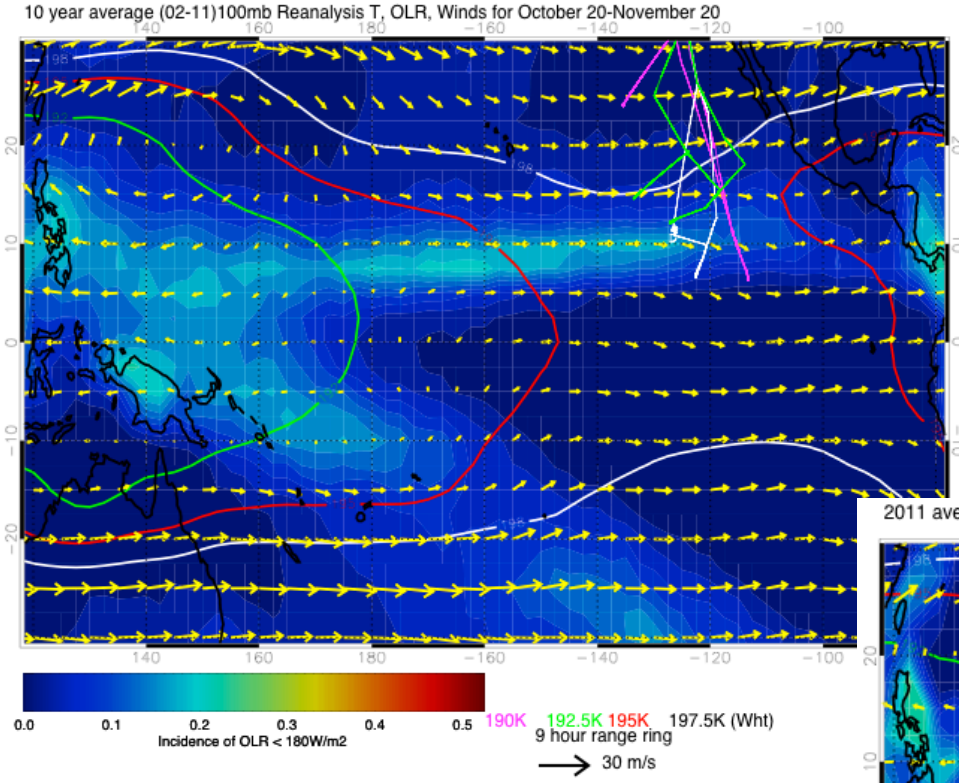
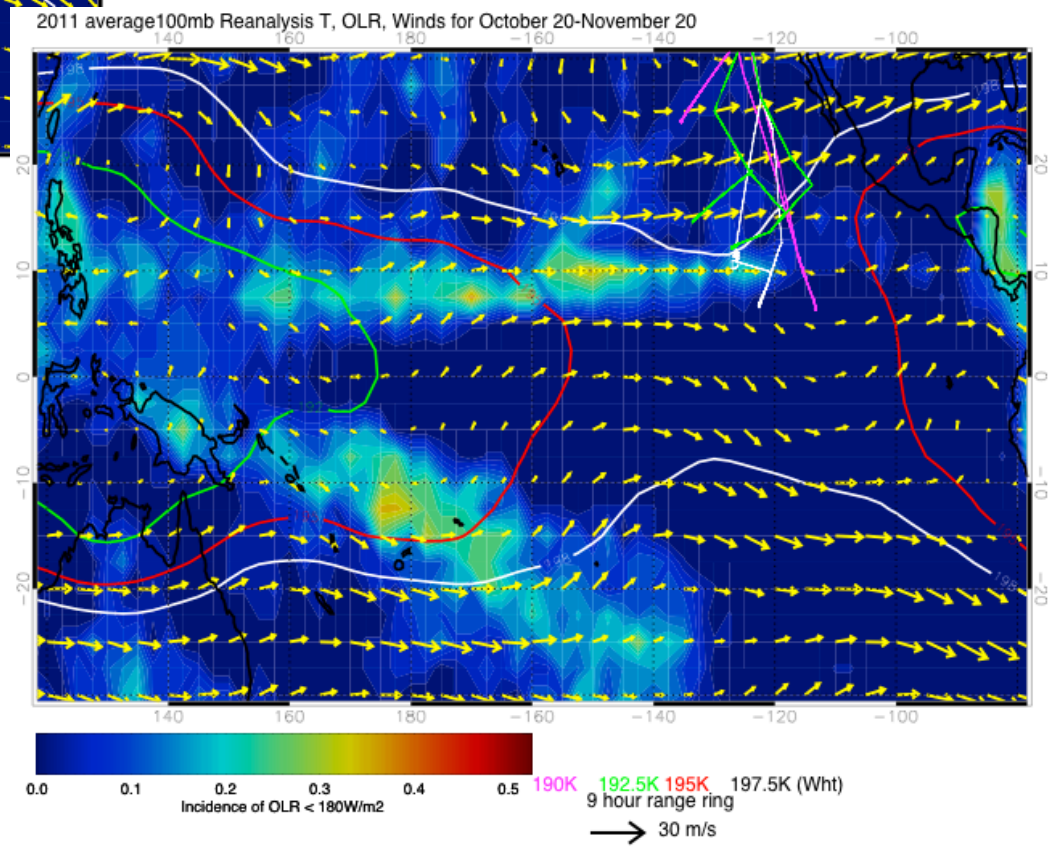
Met overview for Fall 2011 Deployment

- Characteristics of mean circulation and convection in TTL during Fall 2011 deployment, and comparison with typical years. Focus on the period during the three science flights, 10/28-29, 11/05-06, and 11/09-10
- Movie of convection and 100mb meteorology during this period.
- Hovmuller analysis of 100mb temperature variations
- Rudimentary air mass analysis (PV maps)
- Summary

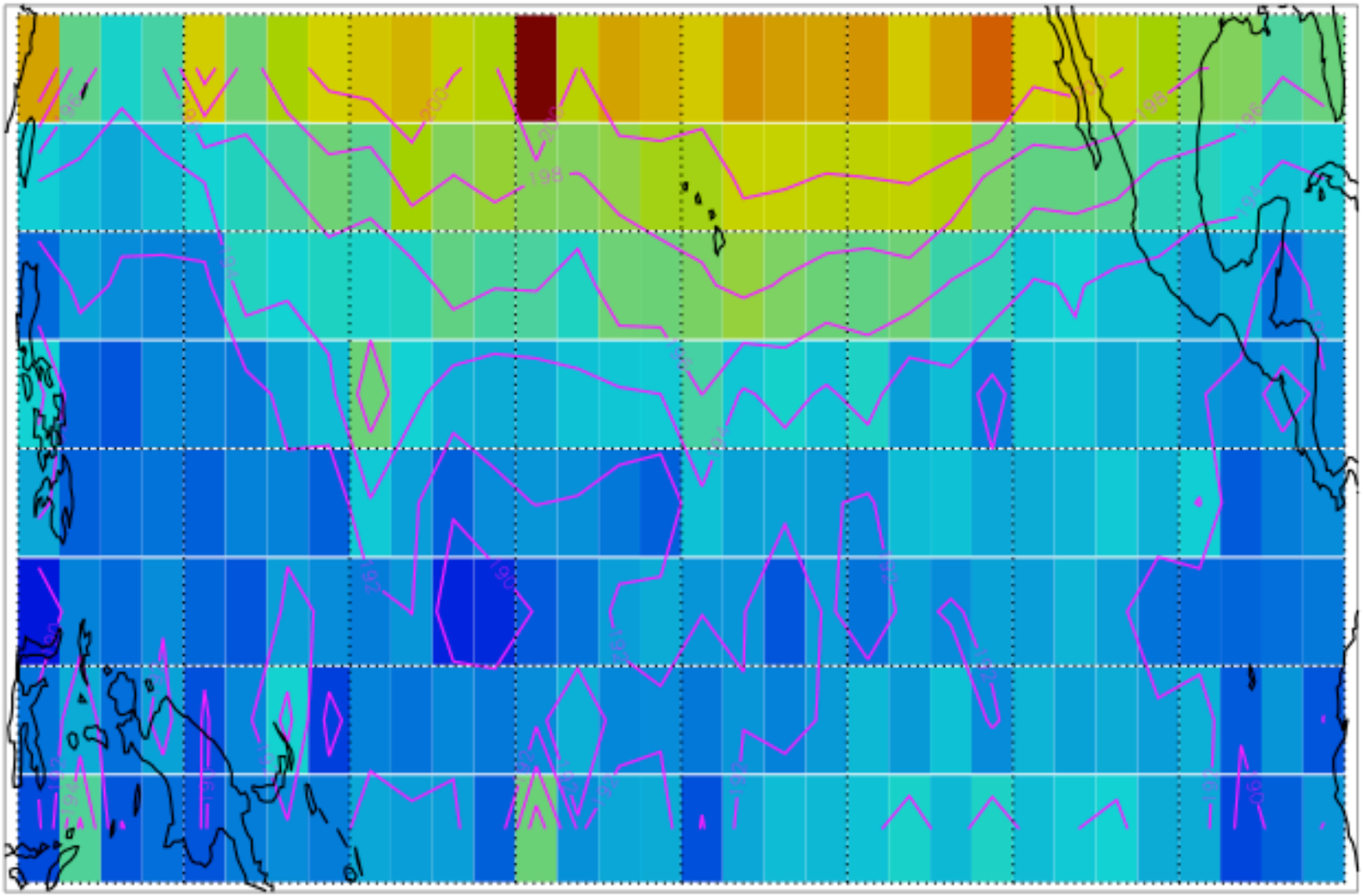
100mb Temperature, OLR Incidence < 180W/m2, flow





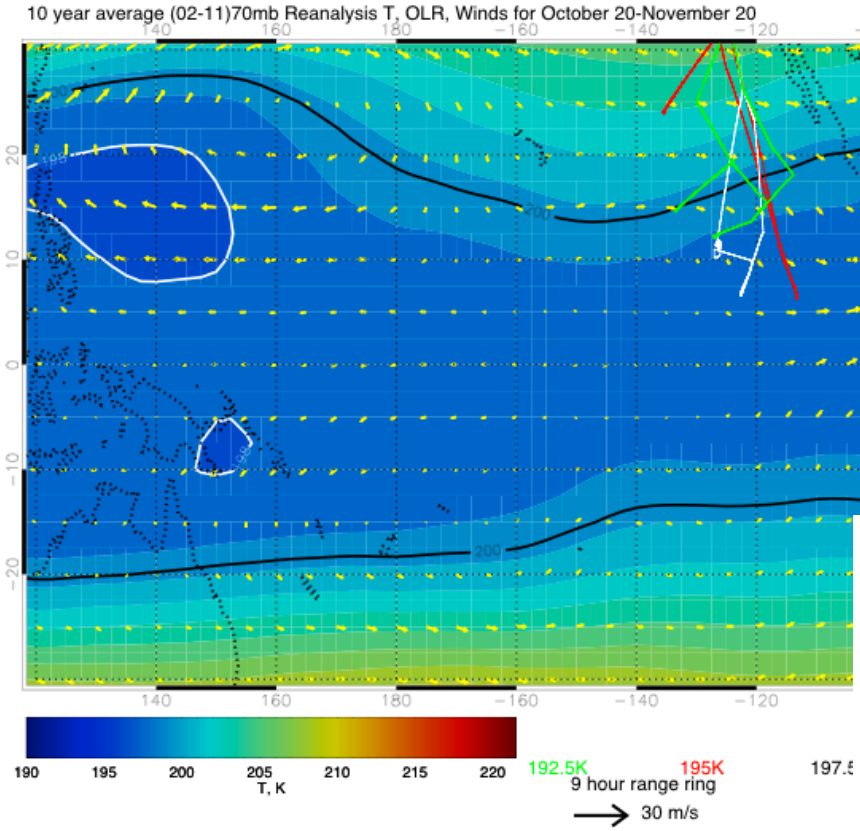
Transition season. Cold pool is starting to develop in the West Pac, along with weak anticyclone, with mean trough in the East Pac. Still have a strong northern ITCZ, with weaker SPCZ. Still raining in Central America. Temperatures at 100mb in 2011 are comparable to mean. Trough is sharper, probably giving rise to more convection at 15N in Central Pac. SPCZ is stronger.

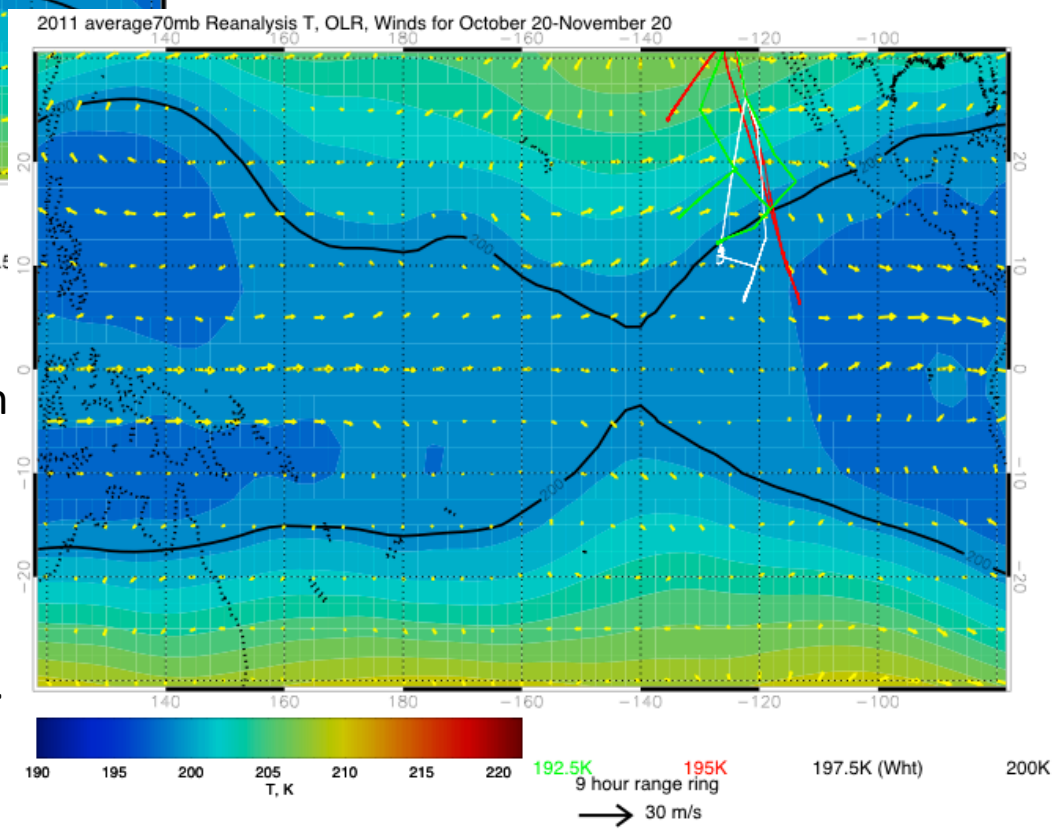
Mean GPS cold point Temps (Oct 26, 2011 - Nov 11, 2011)



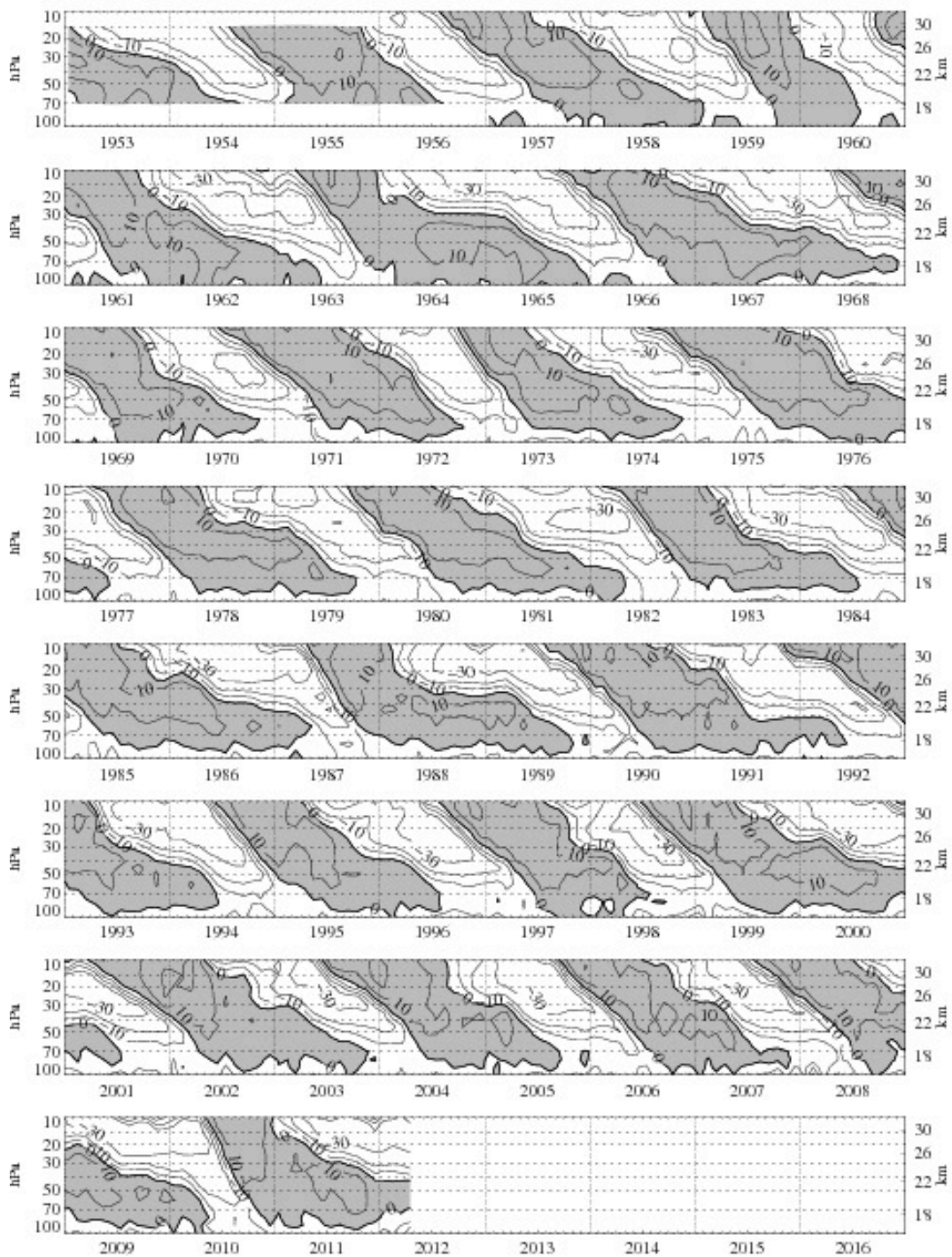
GPS mean cold points are about 1-2K colder than 100mb Reanalysis means. 100mb is very close to cold point in this season

70mb Temperature, flow





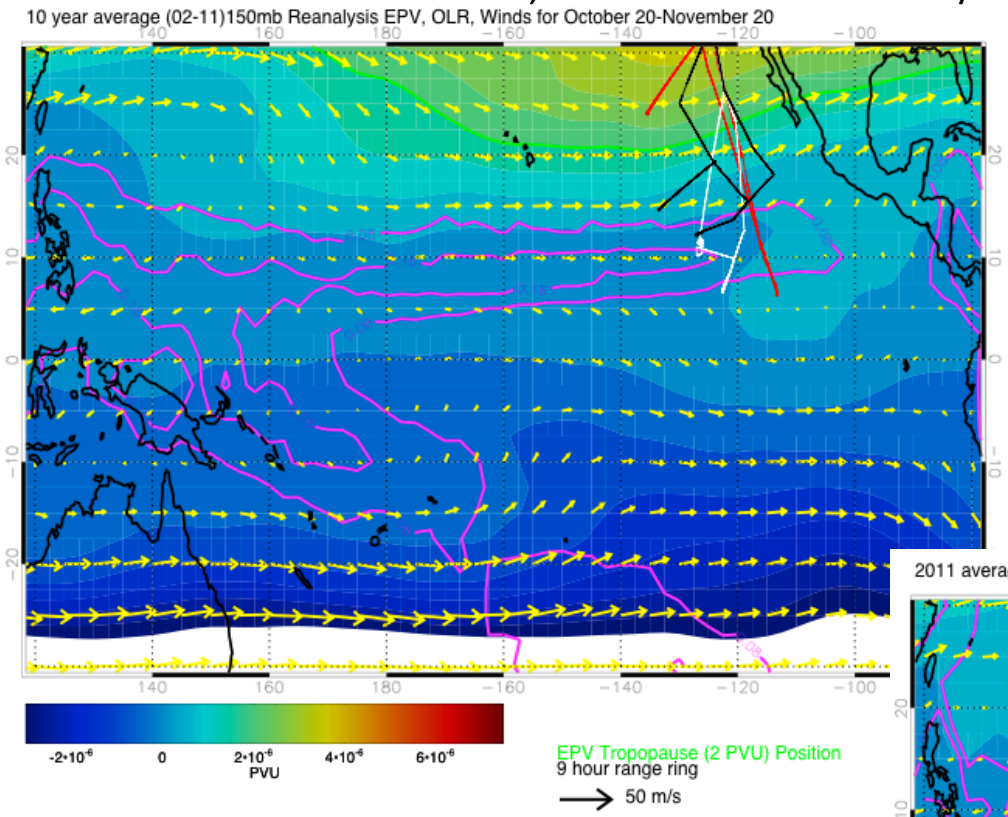
70mb pattern shows anomalous warmth and anomalous westerlies, consistent with QBO phase (QBO westerlies above your level means anomalous warmth). The anomalous warmth means that the tropopause is a bit lower than usual. During this period, the cold point was quite close to 100mb.

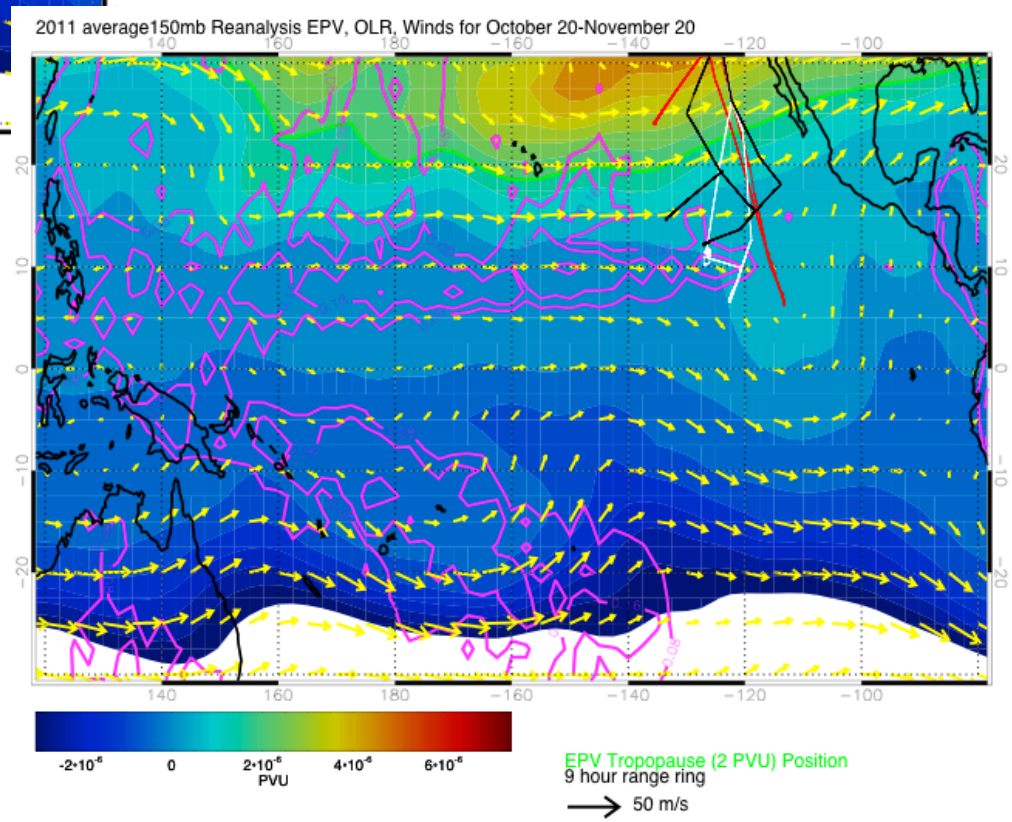


QBO from Freie Universitaet Berlin

Westerly winds are above us, indicating a warm phase.

150mb PV, OLR Incidence < 180W/m2, flow

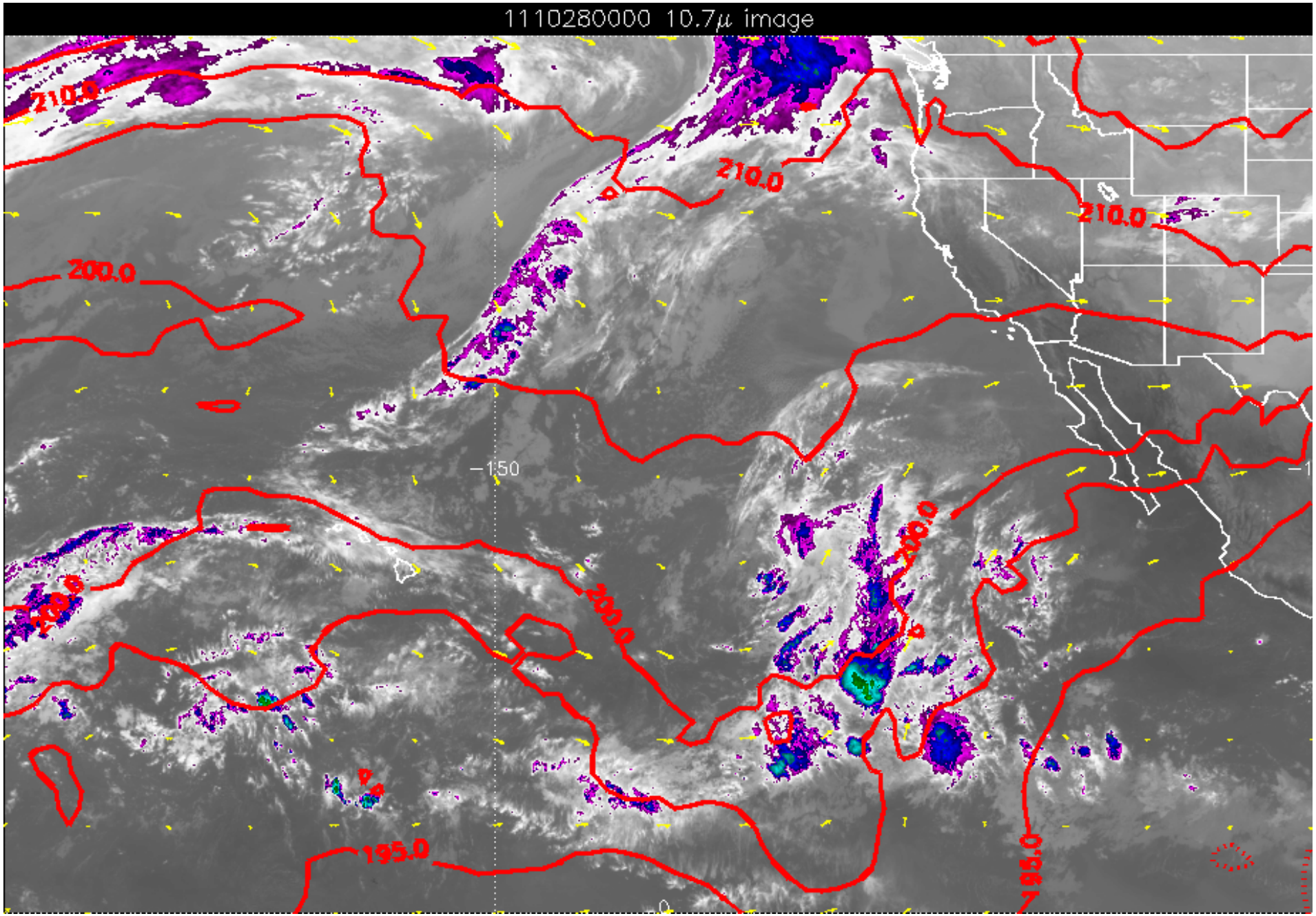




Mean trough at our longitudes is clearly in evidence for both the 10 year mean (above) and 2011(right). Deeper penetration near HI is evident during 2011. There should also have been plenty of opportunity for convective influence in the observed flights.

Examine Evolution during “science flight” period

- Starts 10/28 (first science flight), ends 11/10
- 100mb flow and temperature
- Note developing midlatitude troughs after Nov 1
- Note Cold temps developing Nov 4.
- Cloud top BTs probably minimize near -80 (193K), so a lot of these are probably getting to the CPT (190K)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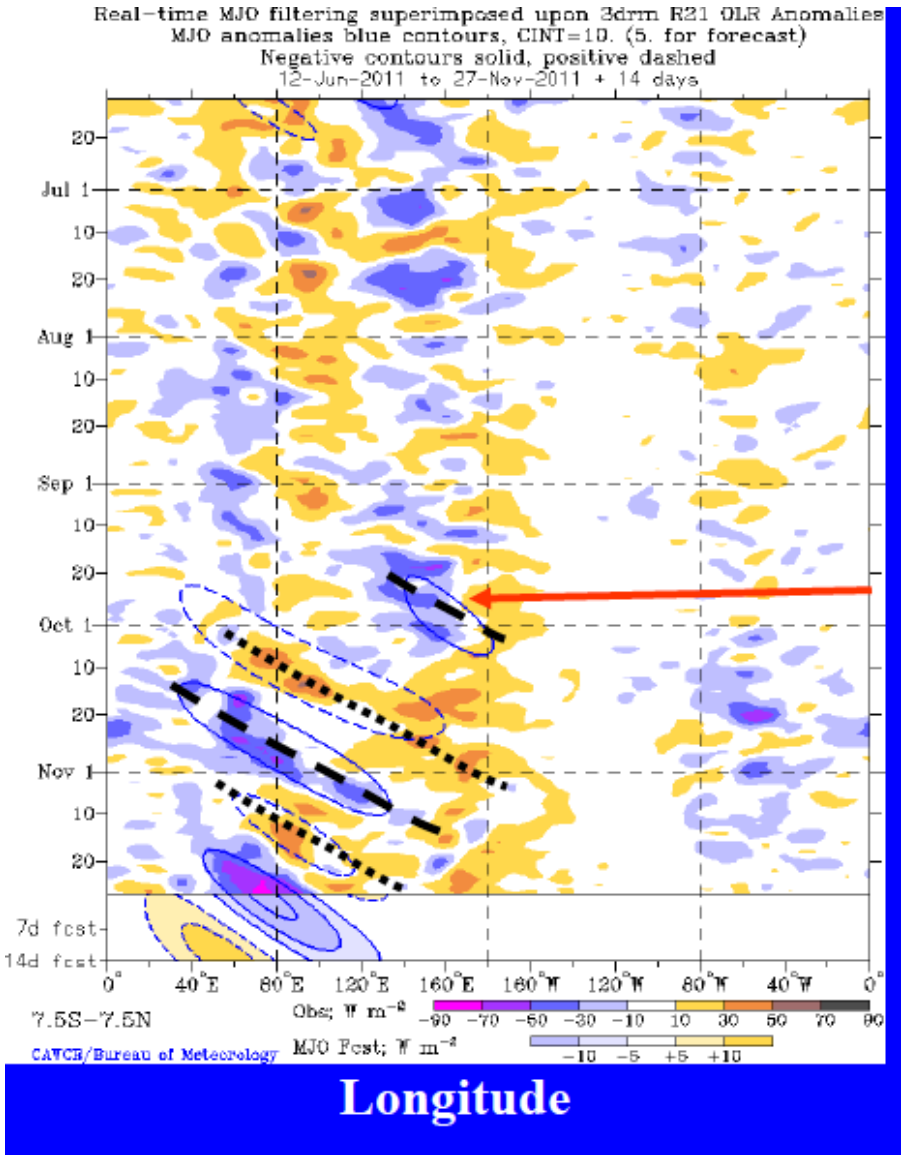
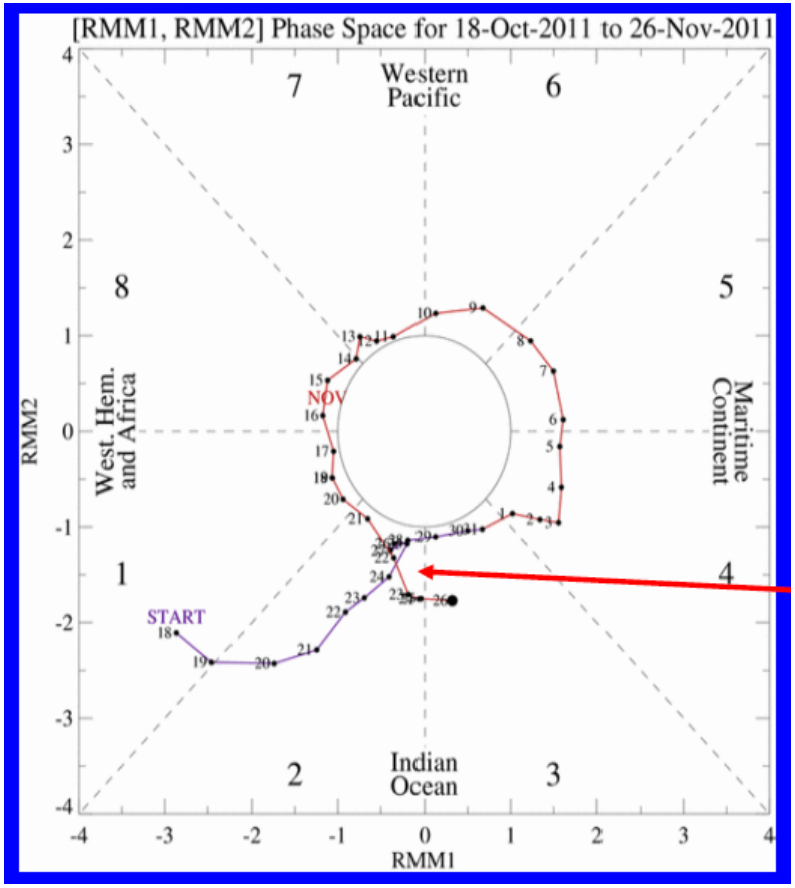
What is driving the 100mb temperature variation?

- Examine T at 100mb across the tropics
- GMAO GEOS-5 analysis
- Hovmuller diagrams of T and OLR
- Questions:
  - Is the MJO doing anything here?
  - Kelvin waves?
  - Other tropical waves?
  - Midlatitude influence?

MJO *IS* Active

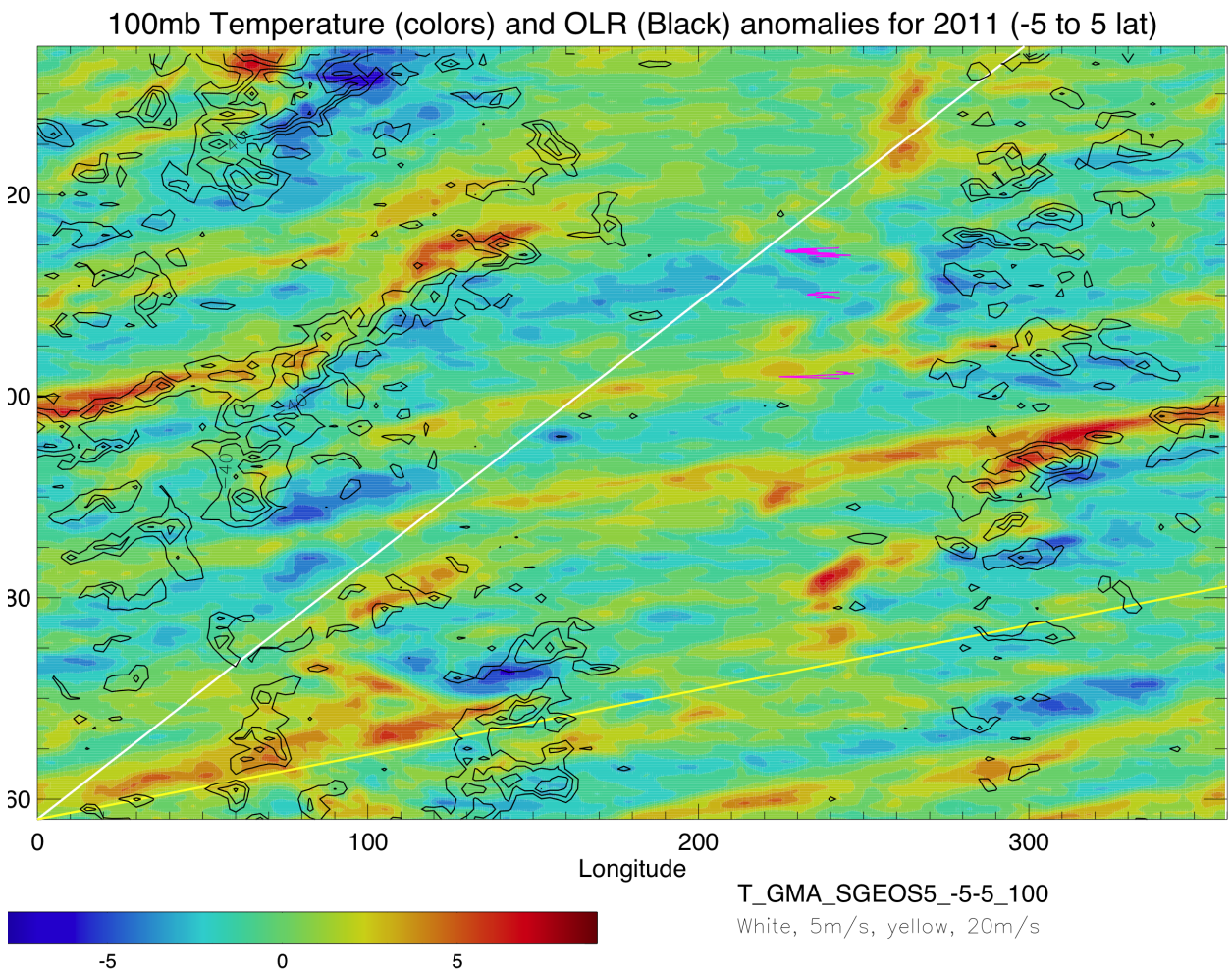


From CPC MJO site



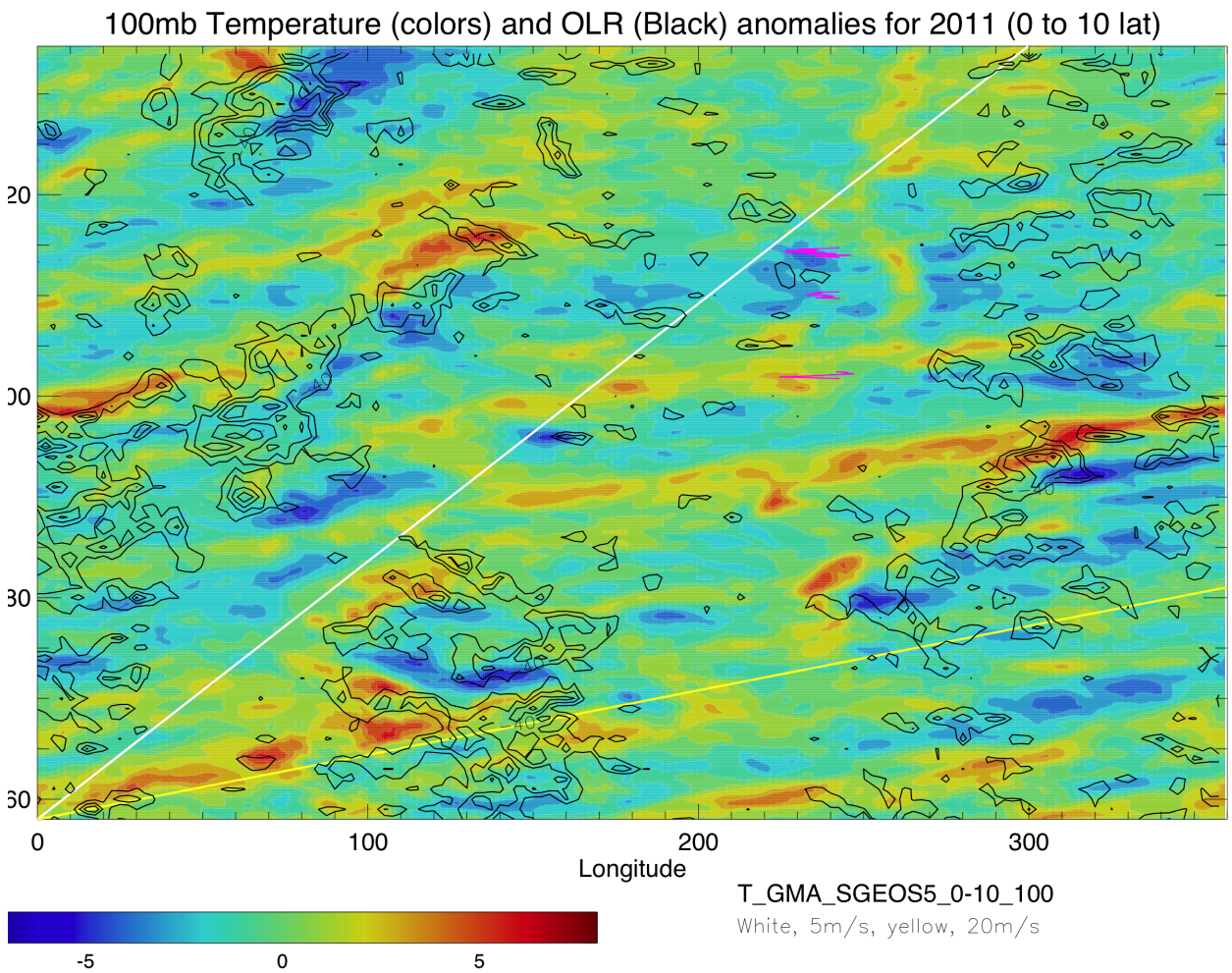
MJO initiated in Indian Ocean about October 20. Negative OLR (enhanced convection) Anomalies propagate eastward at 5 m/s. Note that this is from -5 to 5.

Hovmuller diagrams. Subtract 12 year mean at each day from GEOS-5 temperature at 100mb to get these anomaly plots.

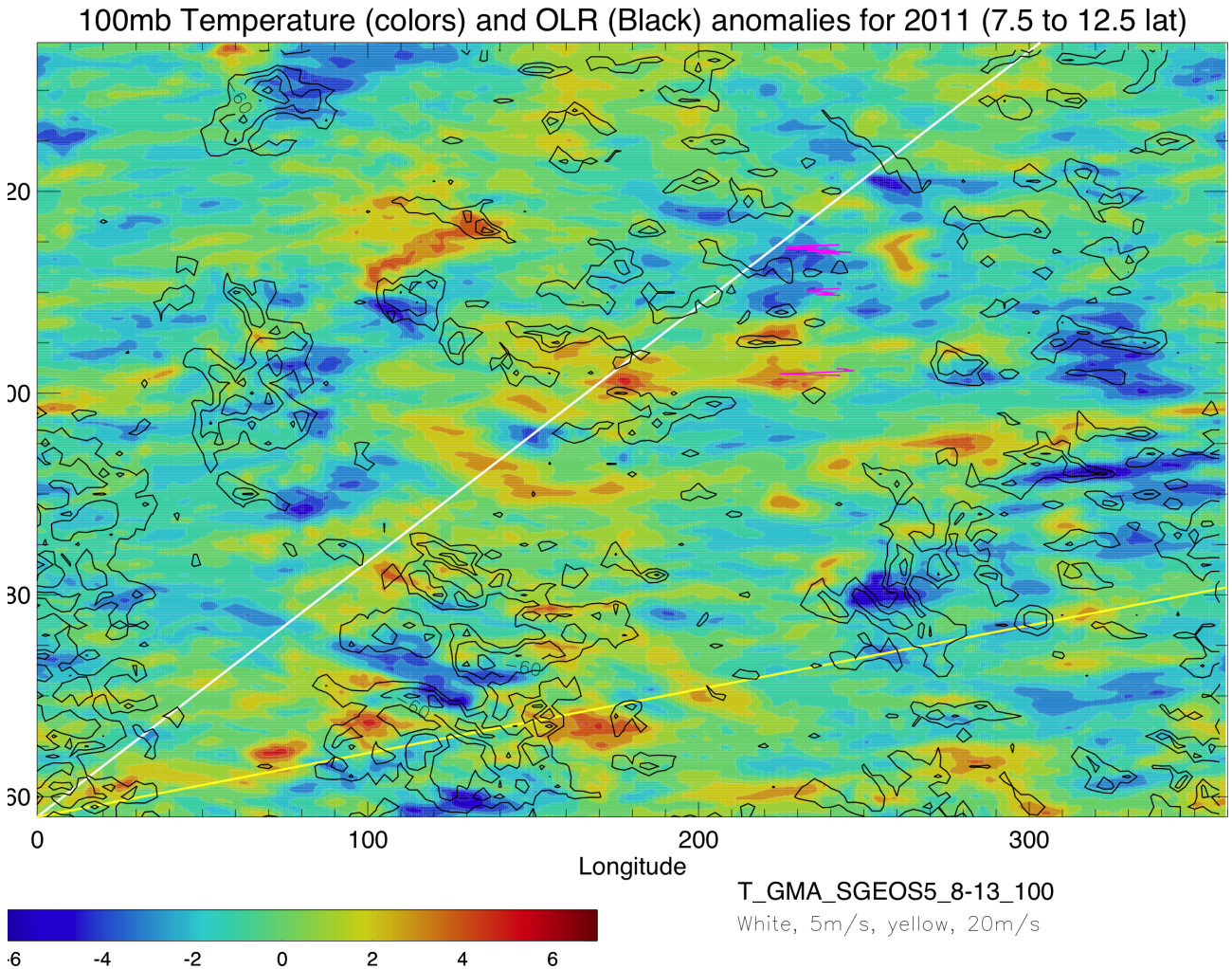


Faster moving Kelvin waves drive temp at these latitudes in the Pacific. Second two flights are in anomalously cold region. These Kelvin waves have been documented by Holton et al 2001.

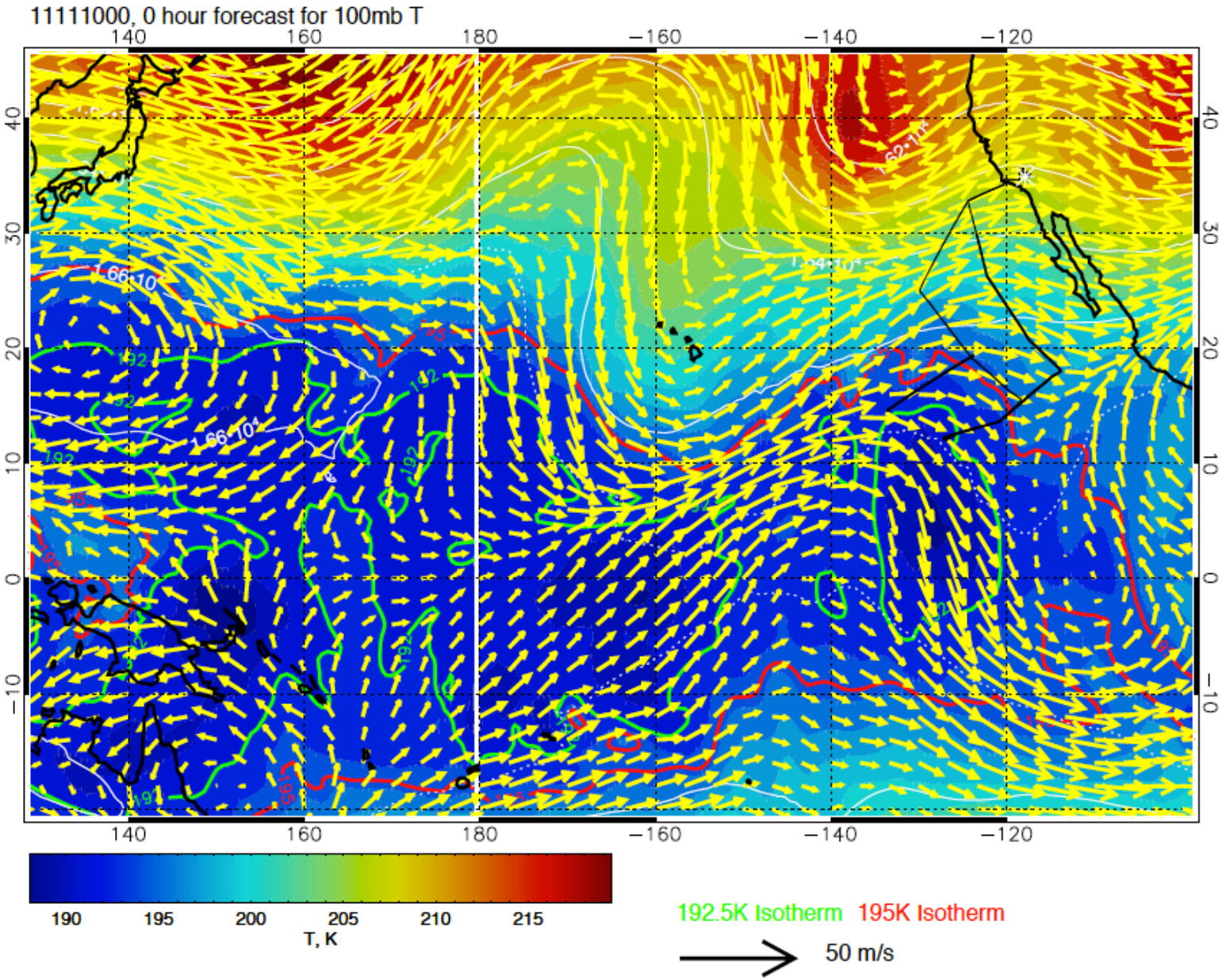
Can see MJO in OLR (speed less than 5m/s – black contours. Matching temperature behavior in Indian ocean/maritime continent



Same as previous, 0 to 10. Still see MJO and Kelvin wave, but some other behavior as well.



Same as previous, 7.5 to 12.5 (our latitudes). Kelvin wave pattern still in evidence, but see reverse propagation (Rossby, R-G, I-G?). Probably have midlatitude influence as well.

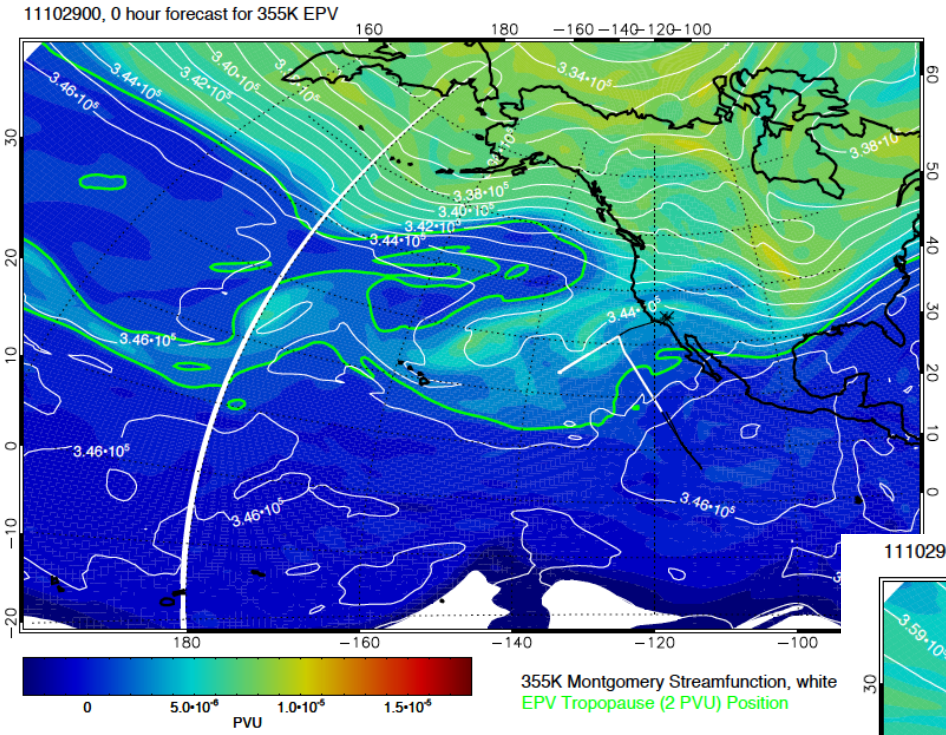


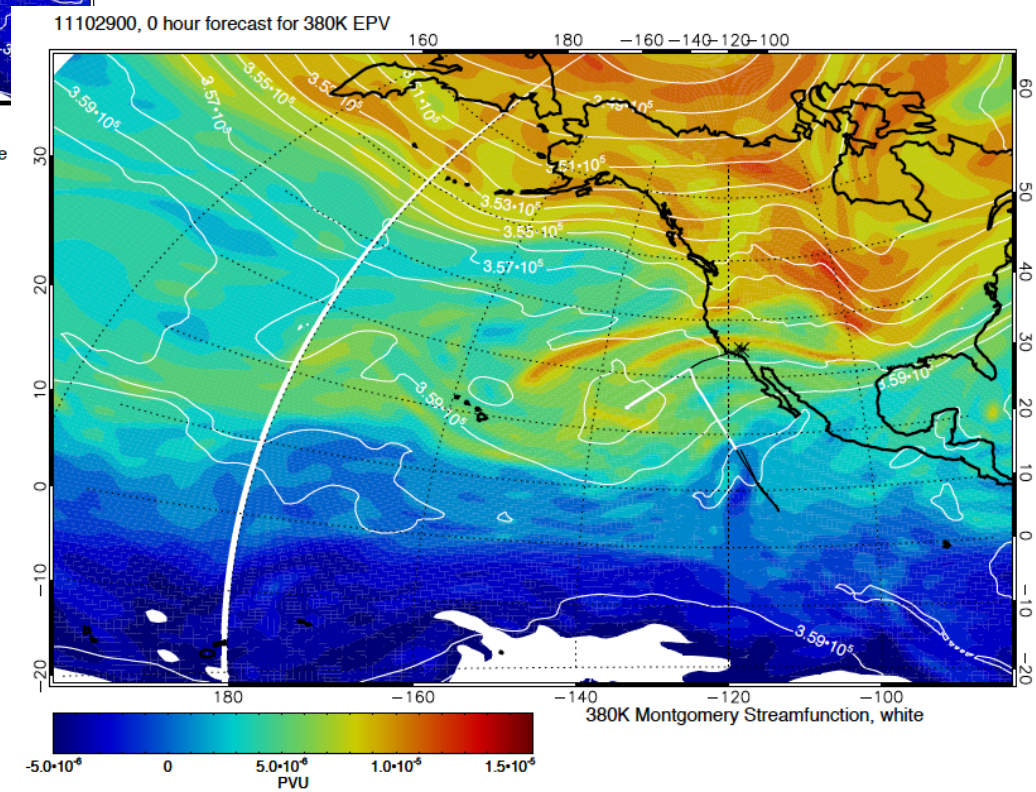
Evolution on this last flight (100mb Temp), clearly shows cold temperatures nosing northward into our region in response to midlatitude trough over HI.

Brief “Air Mass” discussion for each of 3 science flights

- 10/28: Gradients do not look very strong – northern portion in a mixing zone, southern portion has low PV at both 355 and 380K
- Note that PV analysis a bit dangerous here so close to the equator (!)

“Air mass” -- 10/28 flight



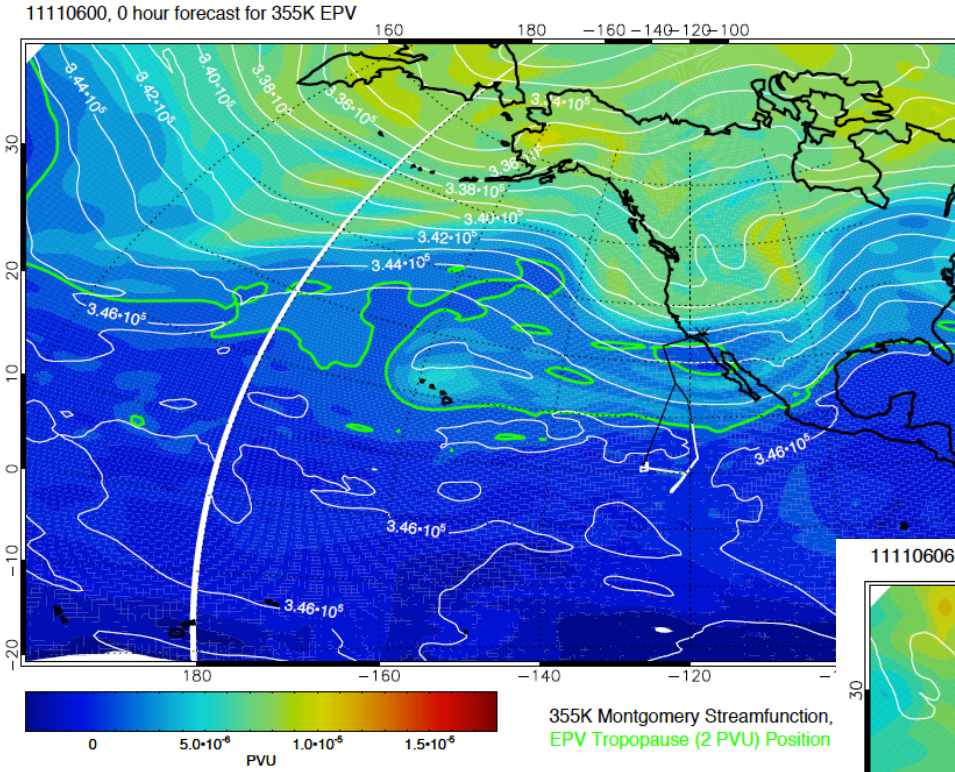


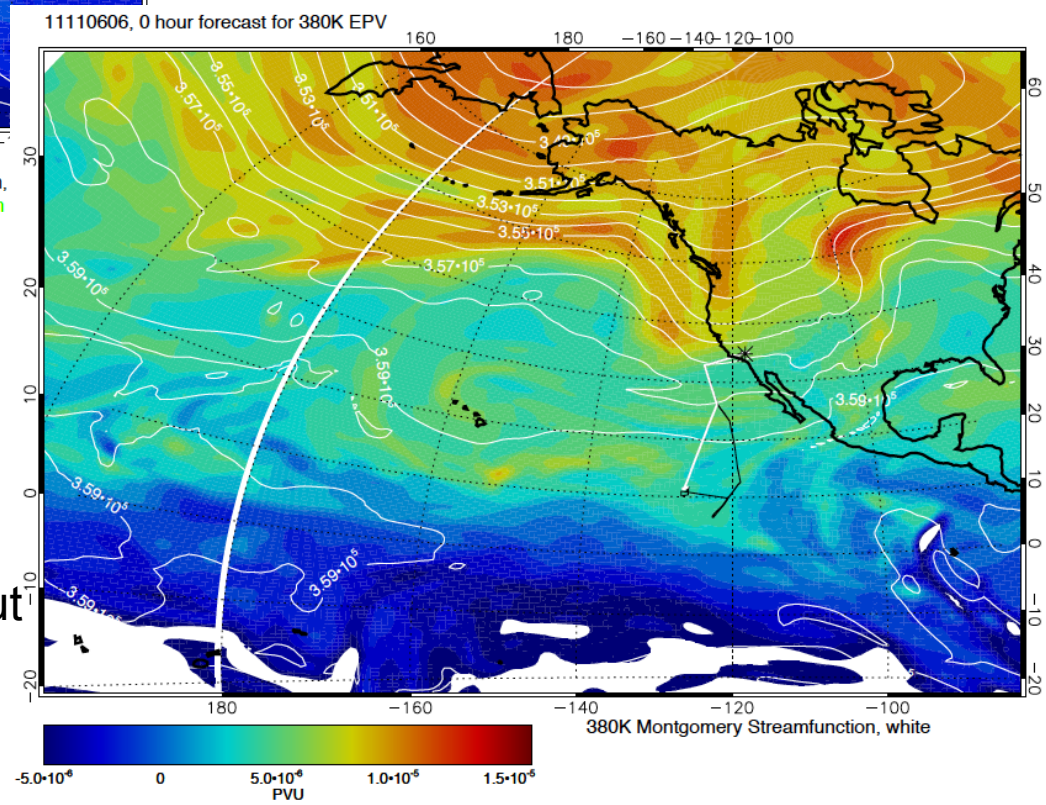
Northern portion has leftover PV junk from a wave breaking event. Tropical air to the south.

355K is about 45kft, 380K is about 55-56kft.

At 380K, we have a transition from “midlatitude” to tropical air

“Air mass” -- 11/05-06 flight

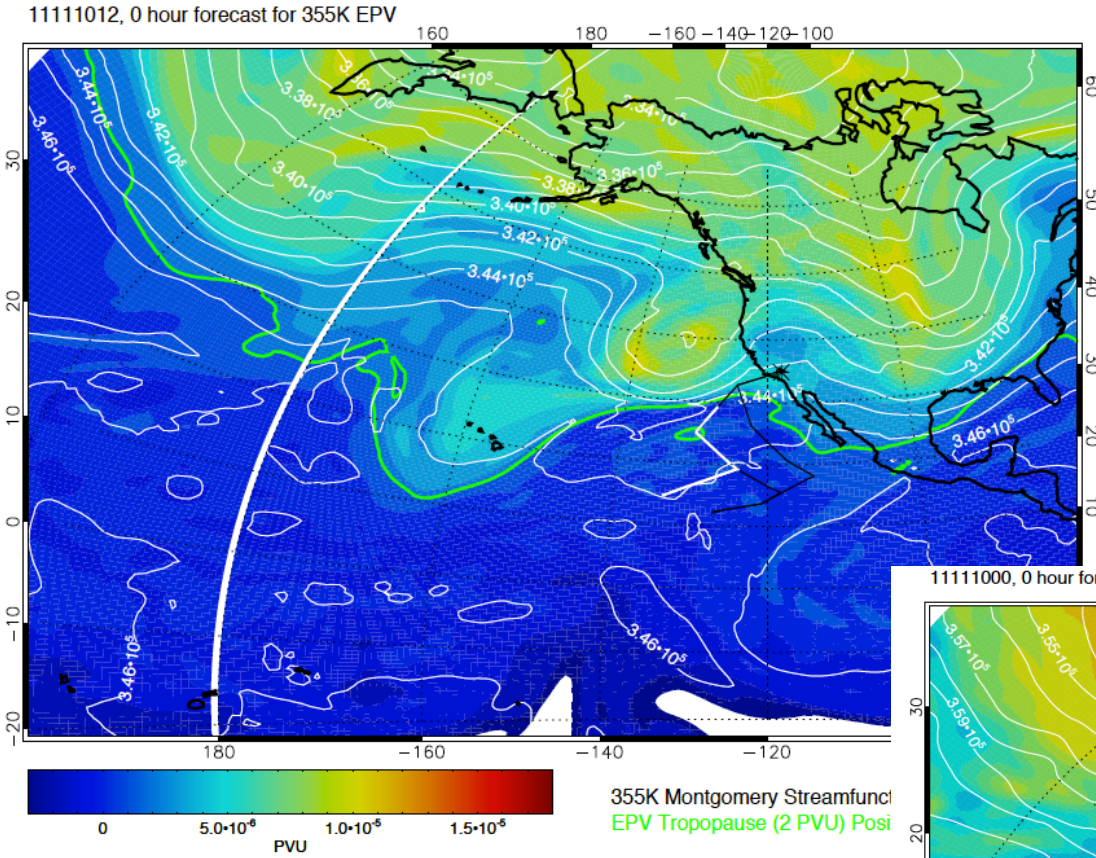


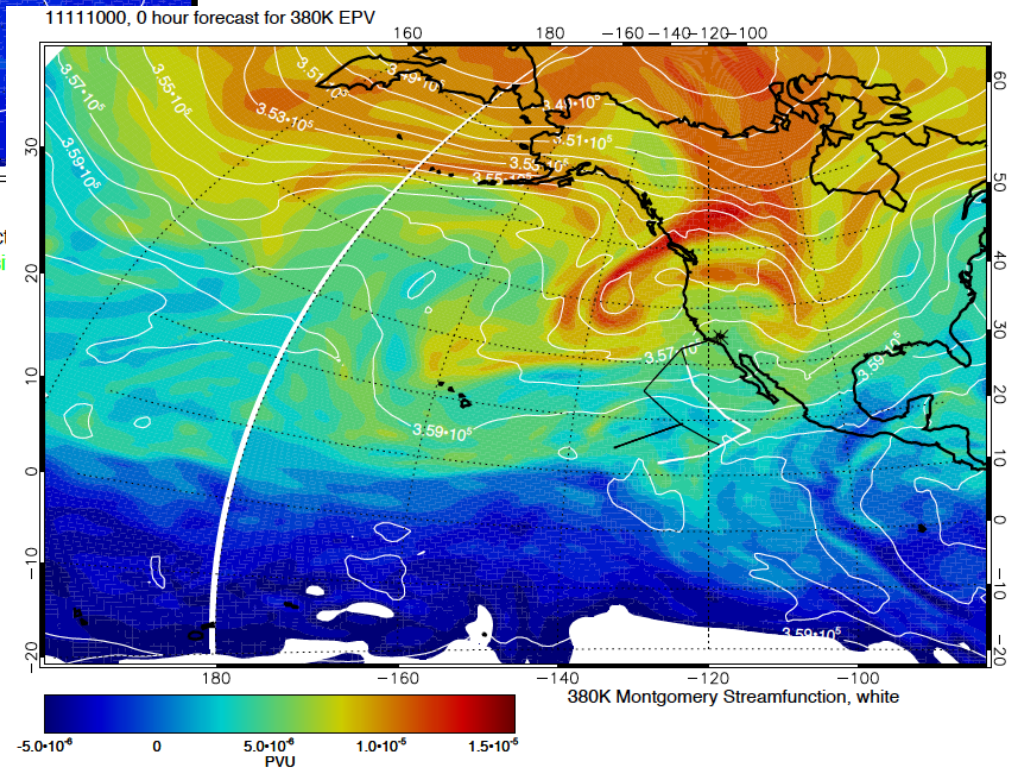


At 355K, transition from a mixing zone (wave breaking) to tropical air.

At 380K, we seem to be in a mixture of tropical and midlatitude air throughout on this flight.

“Air mass” -- 11/09-10 flight





At 150mb, have a sharp midlatitude/ tropical transition (fly upward through STJ – see X-sections on web site).
At 380K, are in a region of various fragments of PV junk

Summary

- Cold point temps – in the mean, trough region is relatively warm. GPS mean temps 1-2 K colder than analyses (and, presumably forecasts). Fall 2011 similar to previous years. 70mb temps anomalously warm (QBO)
- We are in a region of anomalously cold 100mb temps for the last two flights, warm for the first. Influence of a mixture of midlatitude influence, Kelvin wave, and westward propagating waves.
- Air mass analysis for low and mid levels (need to do the 450K level) indicate sharp transitions between well-defined air masses at 355K occurred on the first and third flight. At 380K, we only really got into tropical air on the first flight