

Intersatellite Calibrated HIRS Upper Tropospheric Water Vapor

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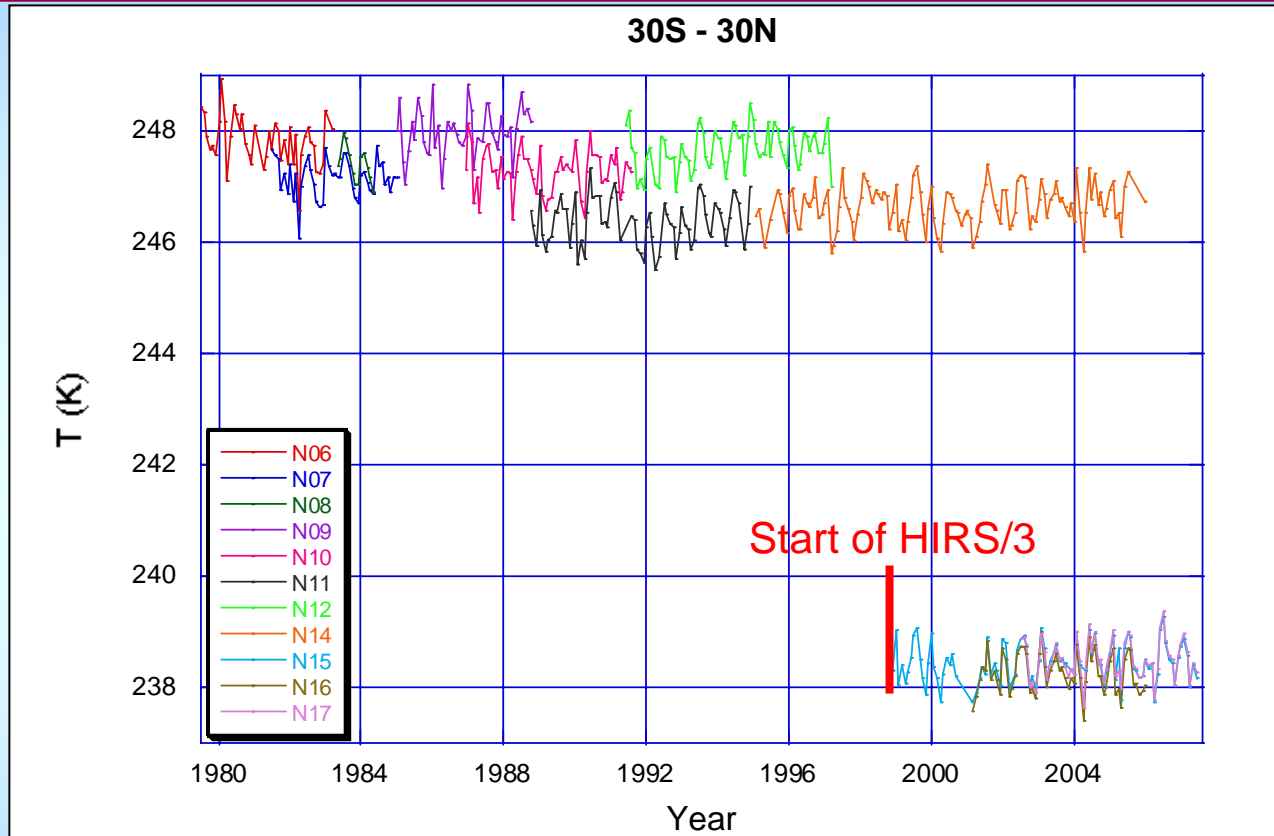


Outline

- Motivation
 - Time series discontinuity from satellite to satellite, particularly from TOVS to ATOVS
 - Upper tropospheric water vapor (UTWV) is an important fundamental climate data record (CDR)
 - UTWV is key to water vapor feedback
- Approach
 - New and improved intersatellite calibration based on two datasets
 - Overlaps of zonal means
 - Simultaneous nadir overpass (SNO)
- Result
 - Extended time series of the fundamental CDR to present



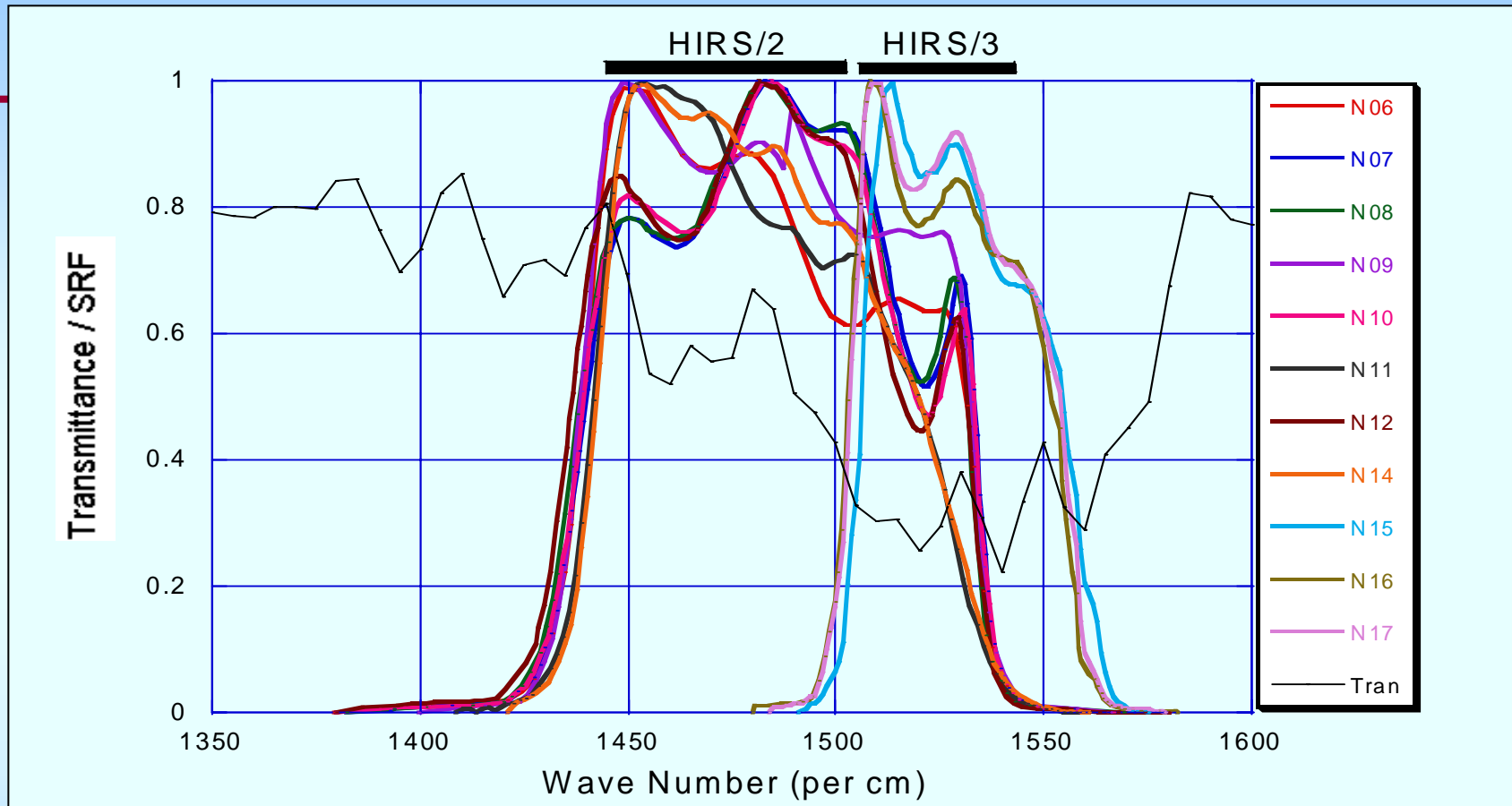
Motivation – Uncorrected Intersatellite Differences of UTWV (Channel 12)



- Due to the independence of individual HIRS instrument's calibration, biases exist from satellite to satellite.
- These intersatellite biases have become a common source of uncertainty faced by long-term studies.



Spectral Filter Functions



- Differences between HIRS/2 and HIRS/3 are expected due to different filter functions.
- In-orbit performance still has biases unexplained by filter functions.
- Thus empirical approach is considered.

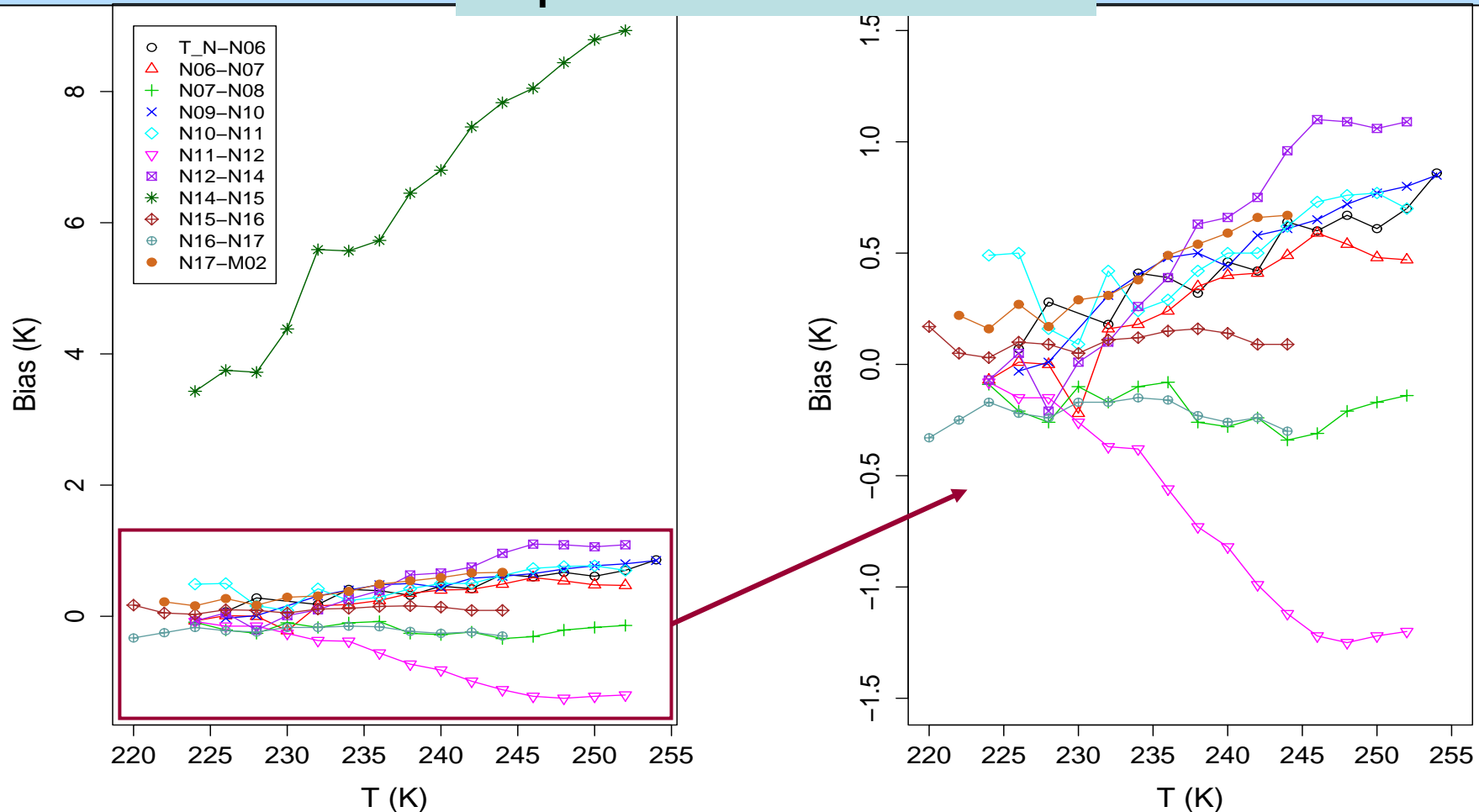
Approach – Two Datasets for Intersatellite Calibration to Cover Diverse Atmospheres

- Overlaps of zonal means for tropical and mid-latitude atmosphere cases
 - Zonal means of channel 12 (UTWV) are computed for every 10-degree latitude belt.
 - Differences are derived from overlapping satellites.
- Simultaneous nadir overpass (SNO) observations for polar cases
 - SNOs occur when two satellites cross each other
 - Data taken at the same location at the satellite nadir within a few seconds
 - In the regions 70-80N and 70-80S



Temperature-dependent Intersatellite Differences from Zonal Mean Approach

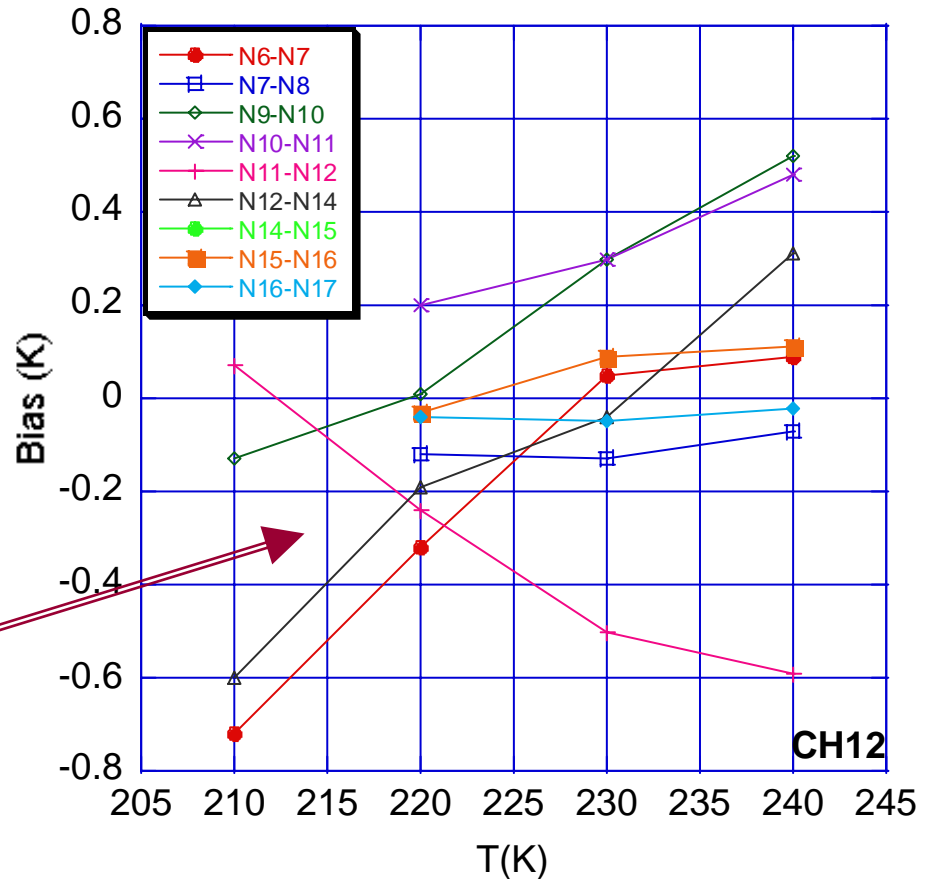
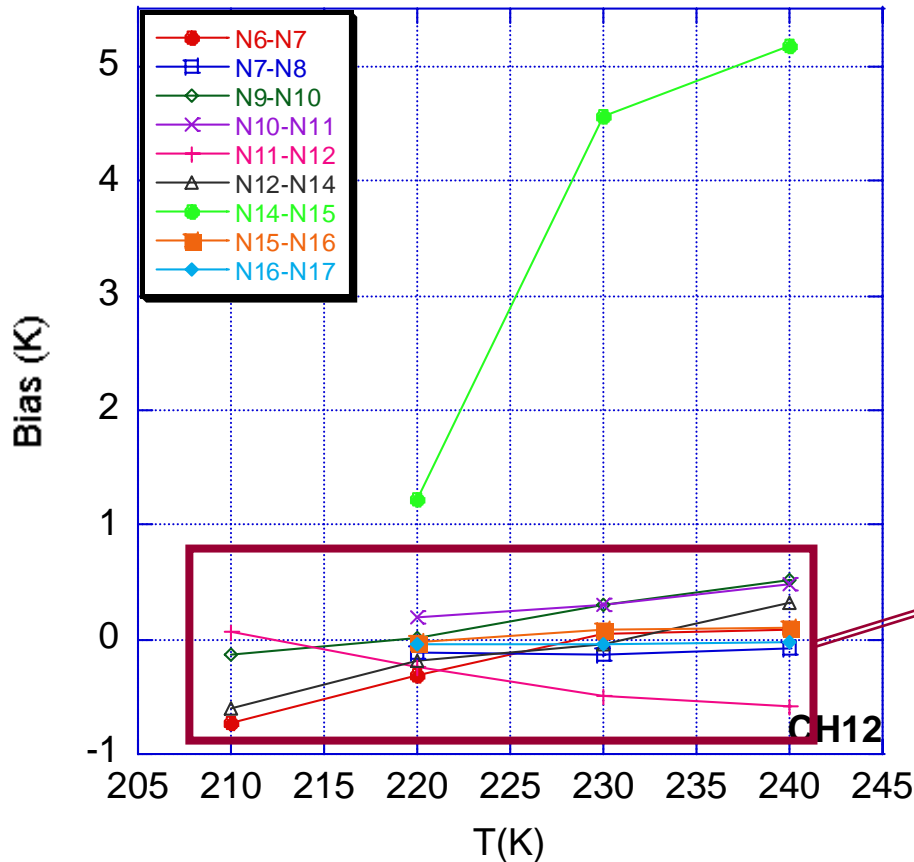
Tropical and Mid-latitude Cases



- More than half of satellites have bias variations larger than 0.5 K.

Temperature-dependent Intersatellite Differences from SNO Approach

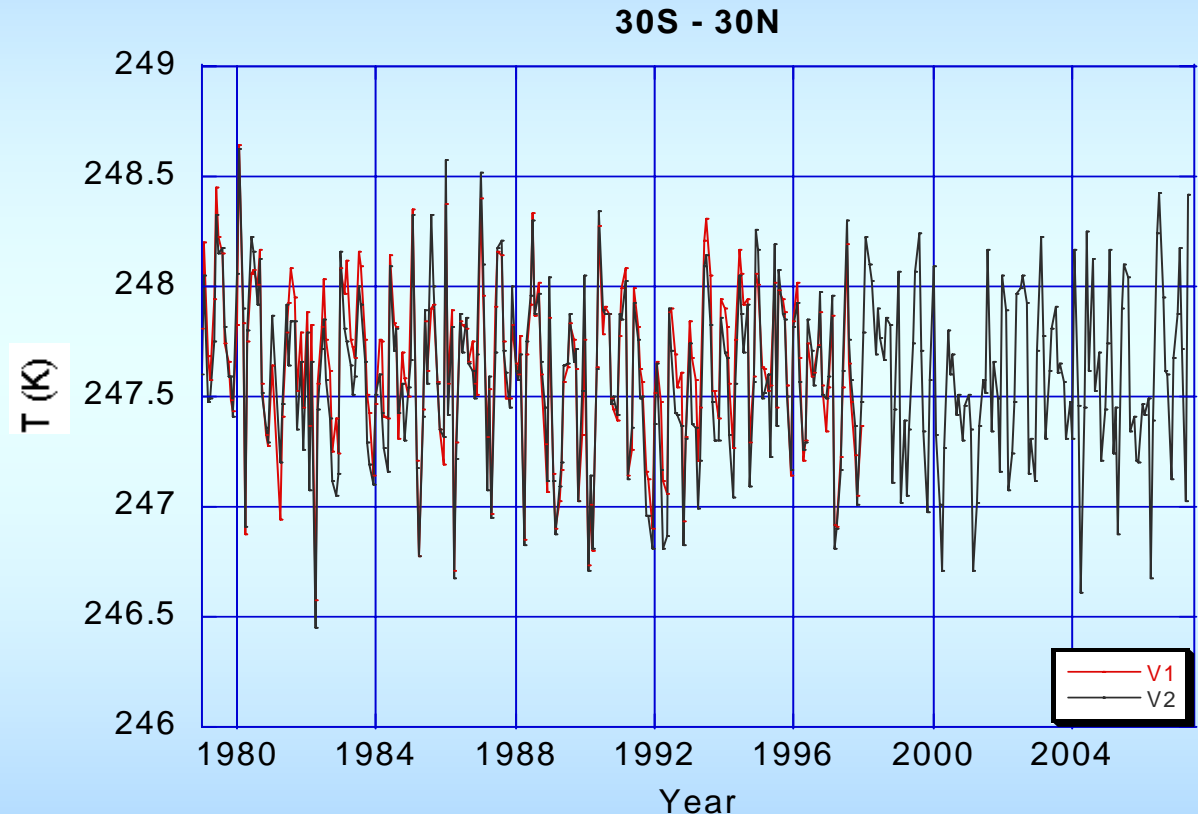
Polar Cases



- Biases are also temperature dependent.

Extension of Time Series

- Orbital, daily, and monthly, 1979-present
- At both pixel resolution and 2.5x2.5 lat/lon grids
- Intersatellite-calibrated

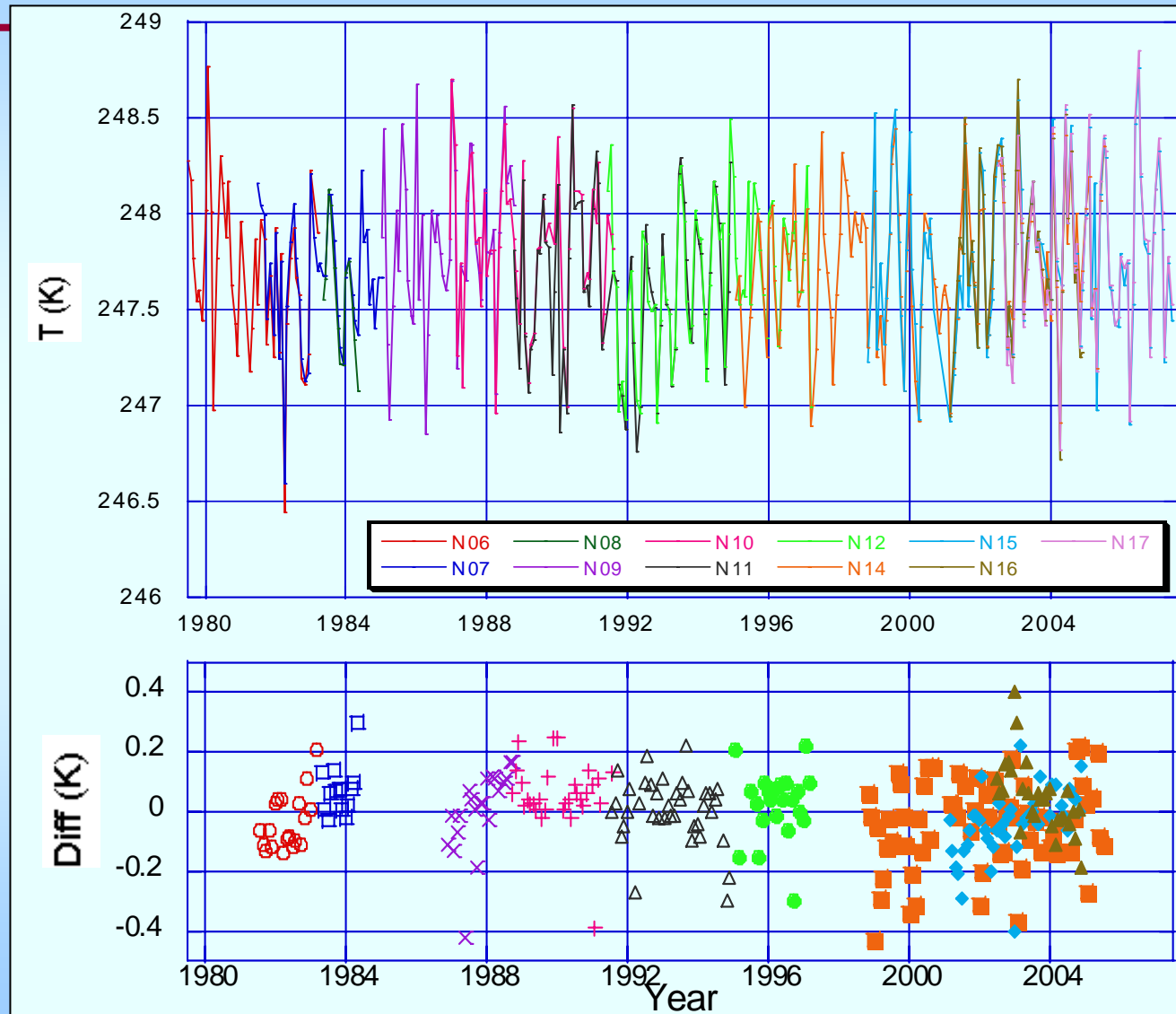


* V1 is derived based on methods discussed in Bates, J. J., X. Wu, and D. L. Jackson, (1996) Interannual variability of upper-troposphere water vapor band brightness temperatures. *J. Climate*, **9**, 428-438.



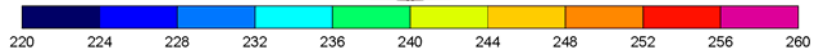
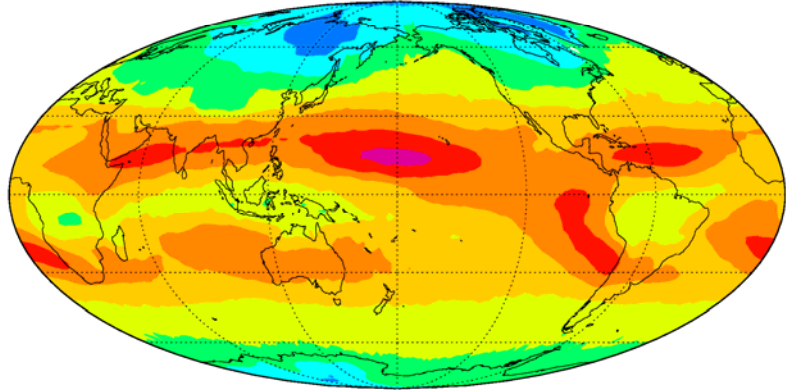
Intersatellite Calibrated to N-12 (showing 30S – 30N)

- Biases minimized.
- Temperature dependent biases accounted for.
- Similar overall variances between HIRS/2 and HIRS/3.
- Time series can be extended as variance preserved.

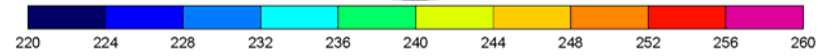
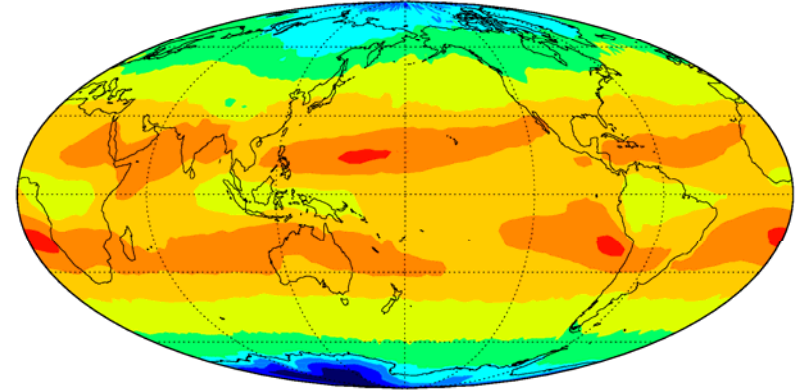


Climatologic Mean for Jan, Apr, Jul, and Oct

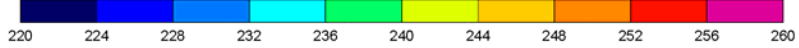
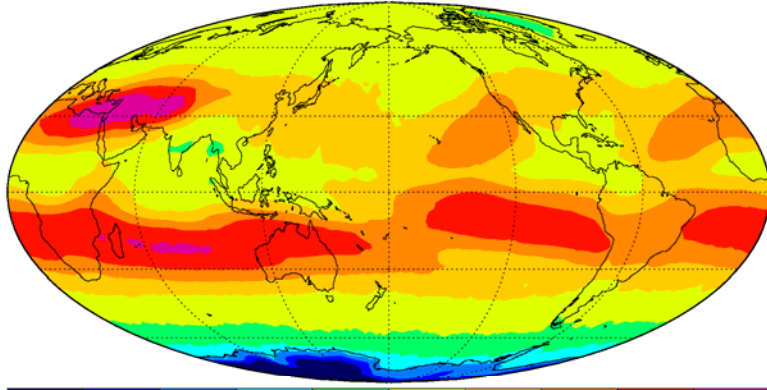
1980-2006 Mean for Jan



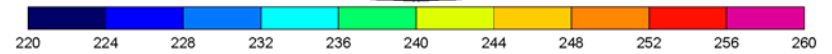
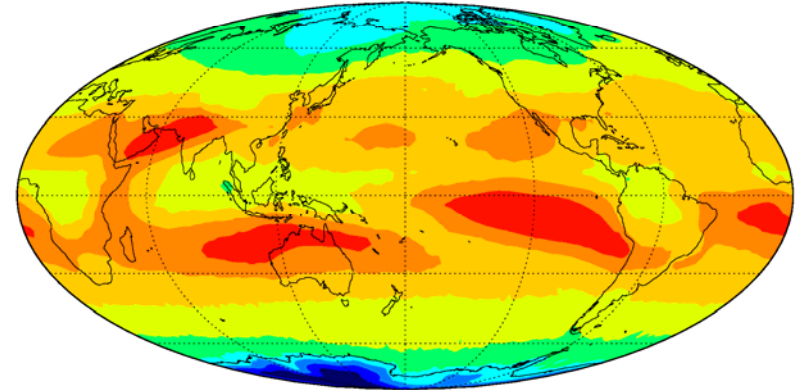
1980-2006 Mean for Apr



1980-2006 Mean for Jul



1980-2006 Mean for Oct



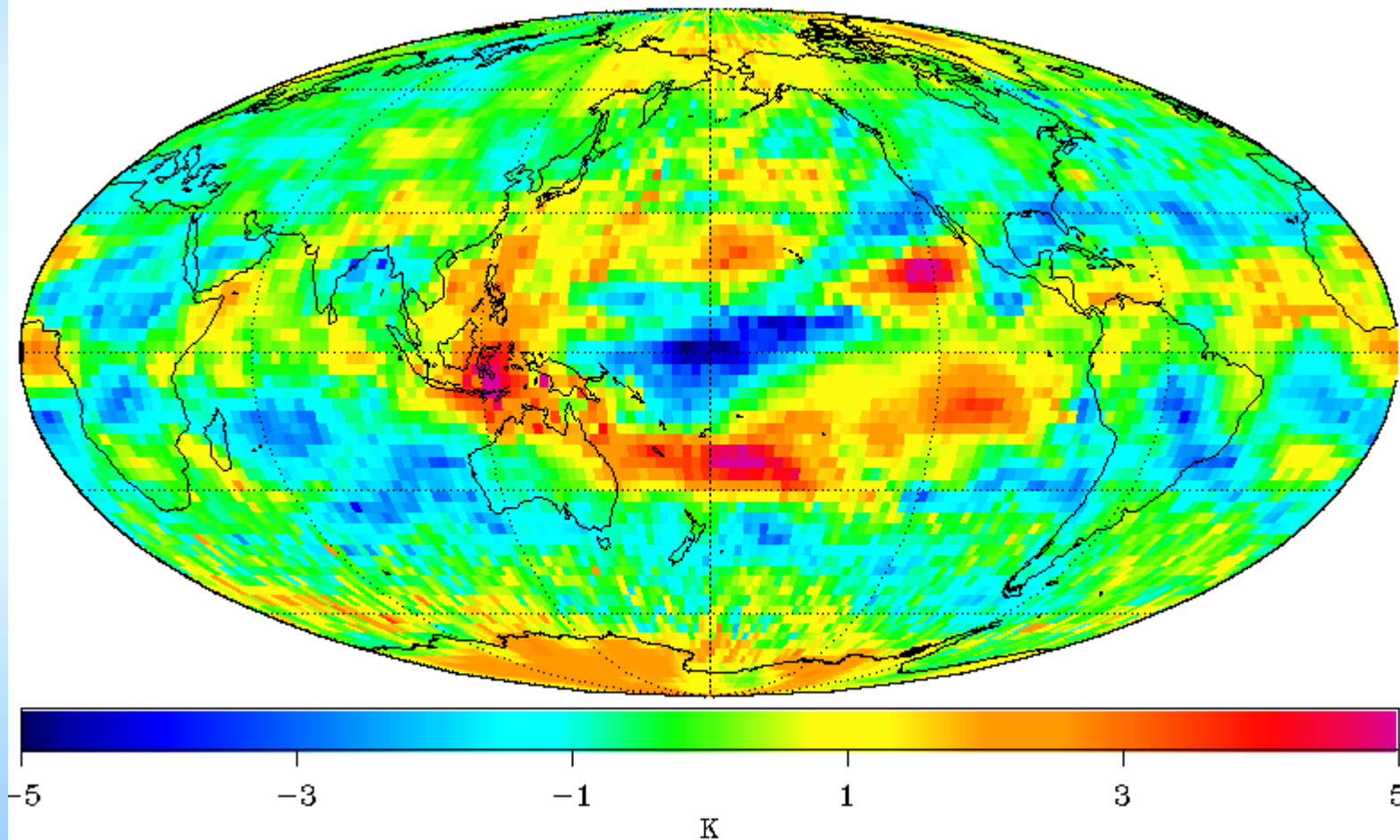
Seasonal Variation

- Within tropics, drier atmosphere produces a higher value of UTWV (channel 12 “sees” lower atmosphere).
- Minima in the tropics indicate moist upper troposphere caused by convection.
- Maxima in northern tropics in January move to southern tropics in July, indicating the move of dry regions in upper troposphere from north to south.
- Zones of low values indicate positions of ITCZ.

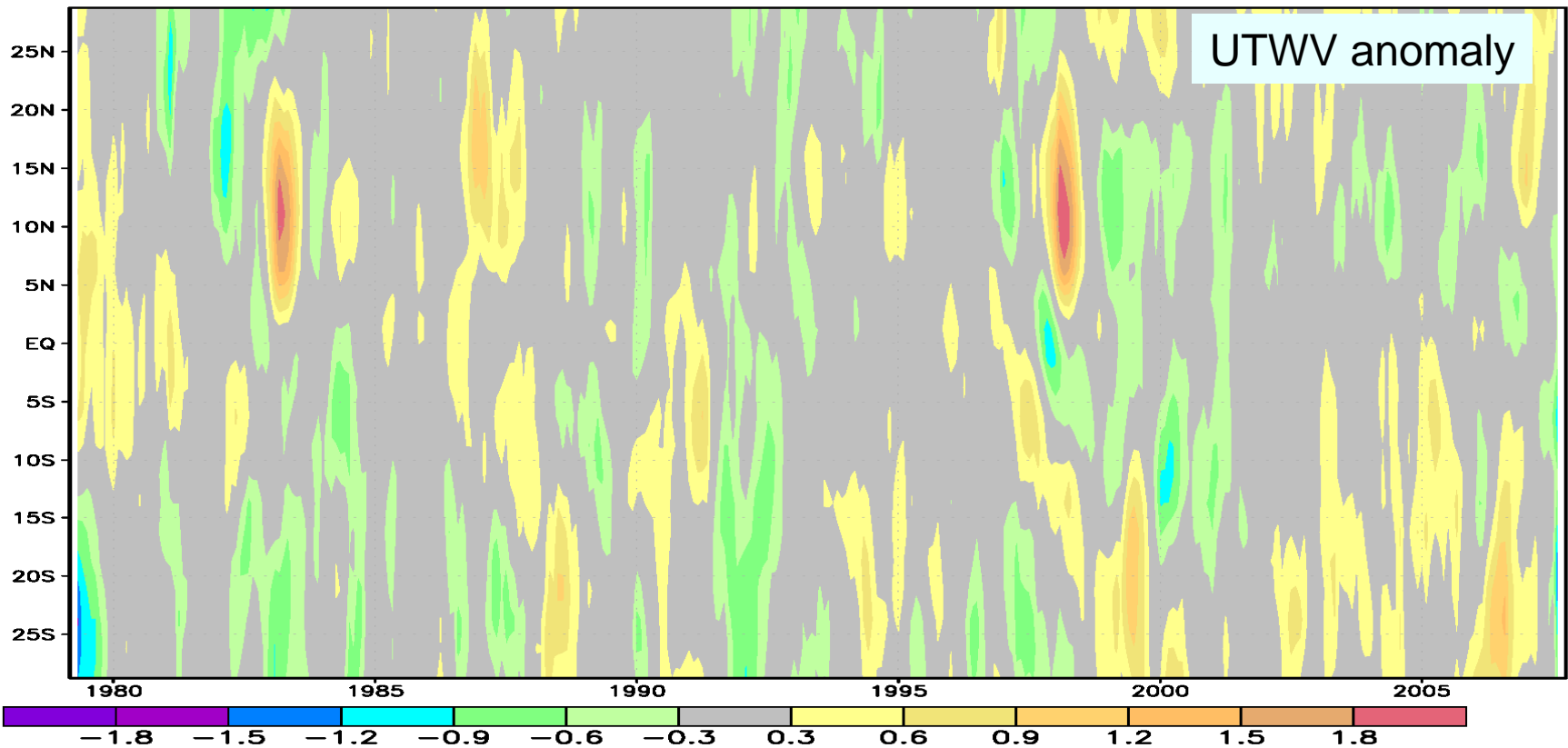
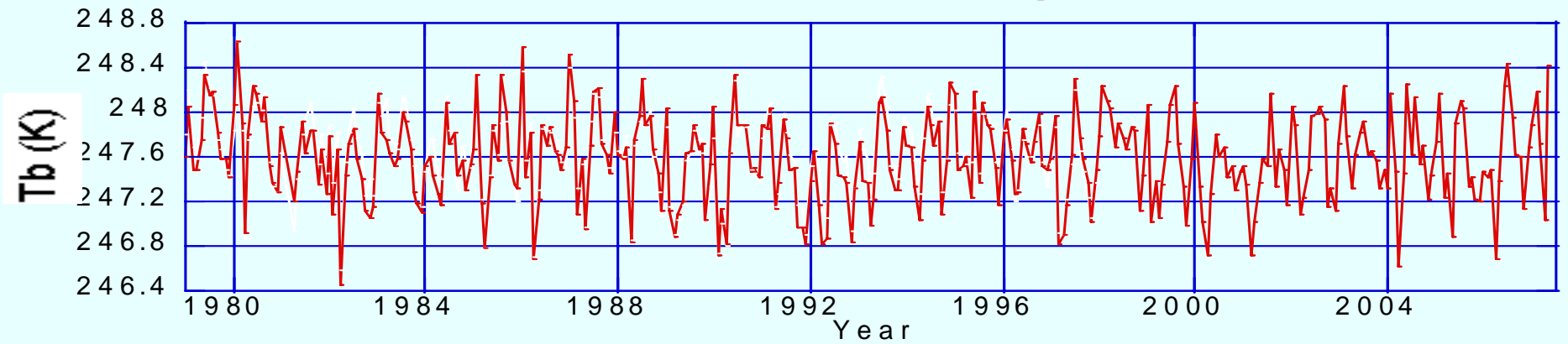


Difference of UTWV between 2002-2003 El Niño and 1999-2000 La Niña

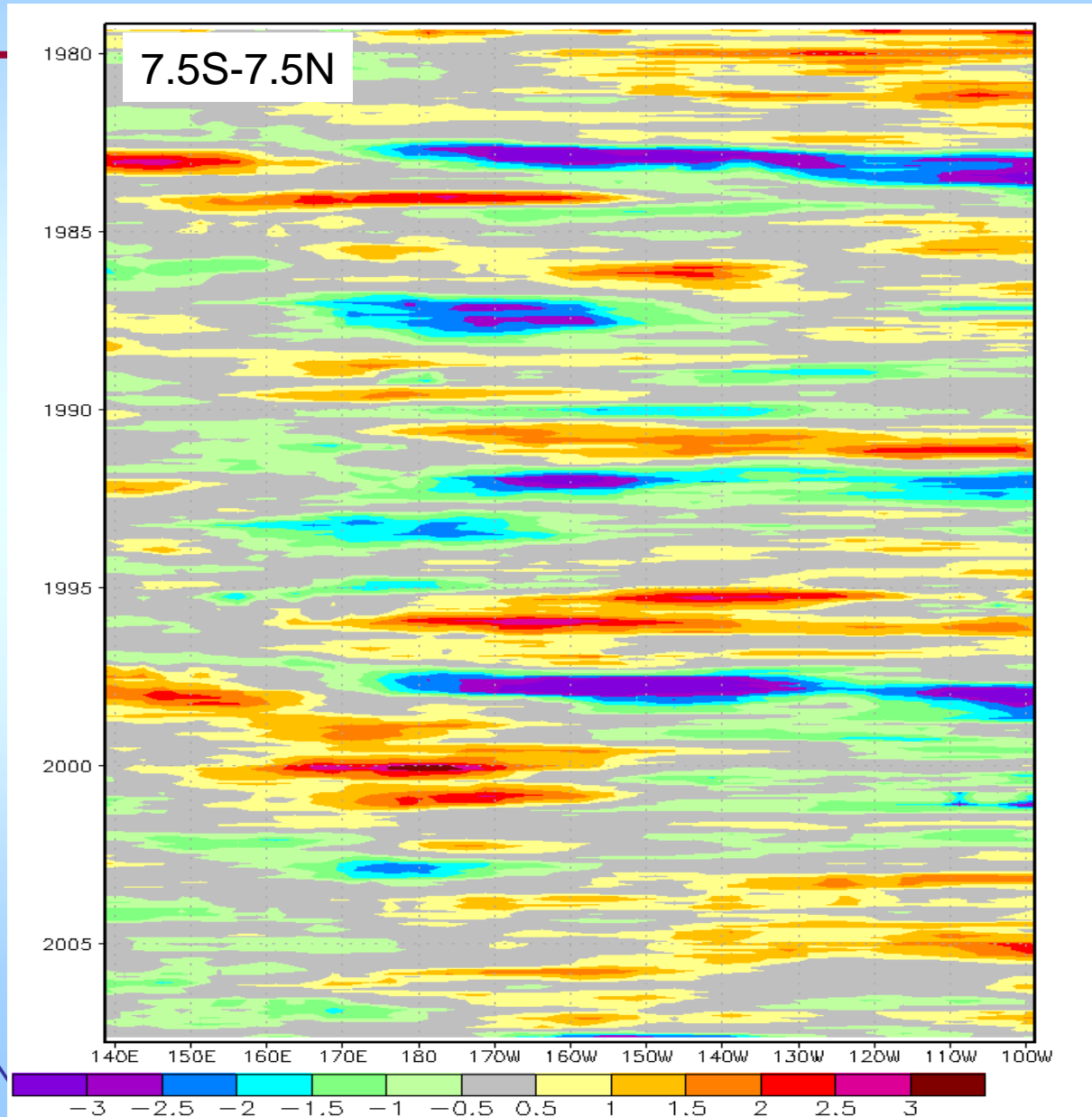
2002-2003 El Niño - 1999-2000 La Niña



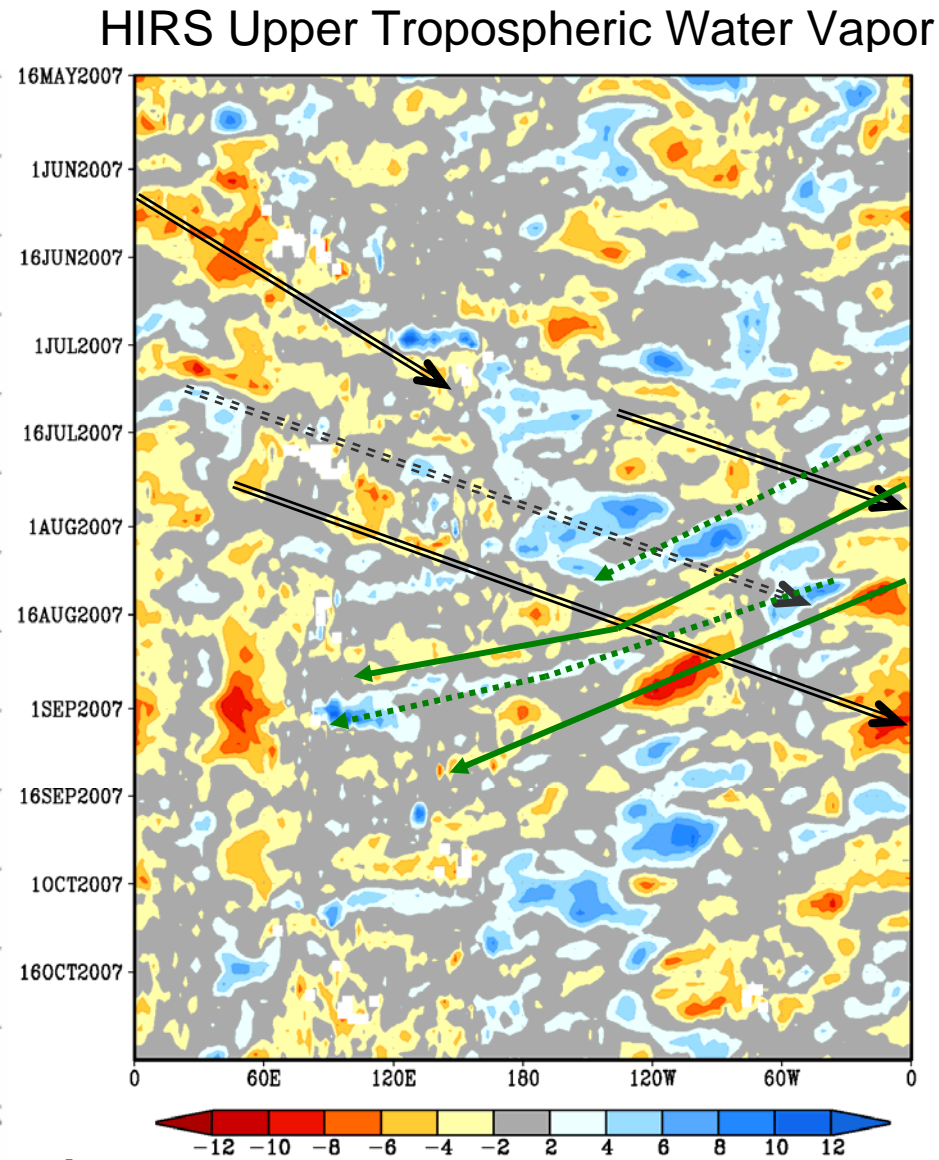
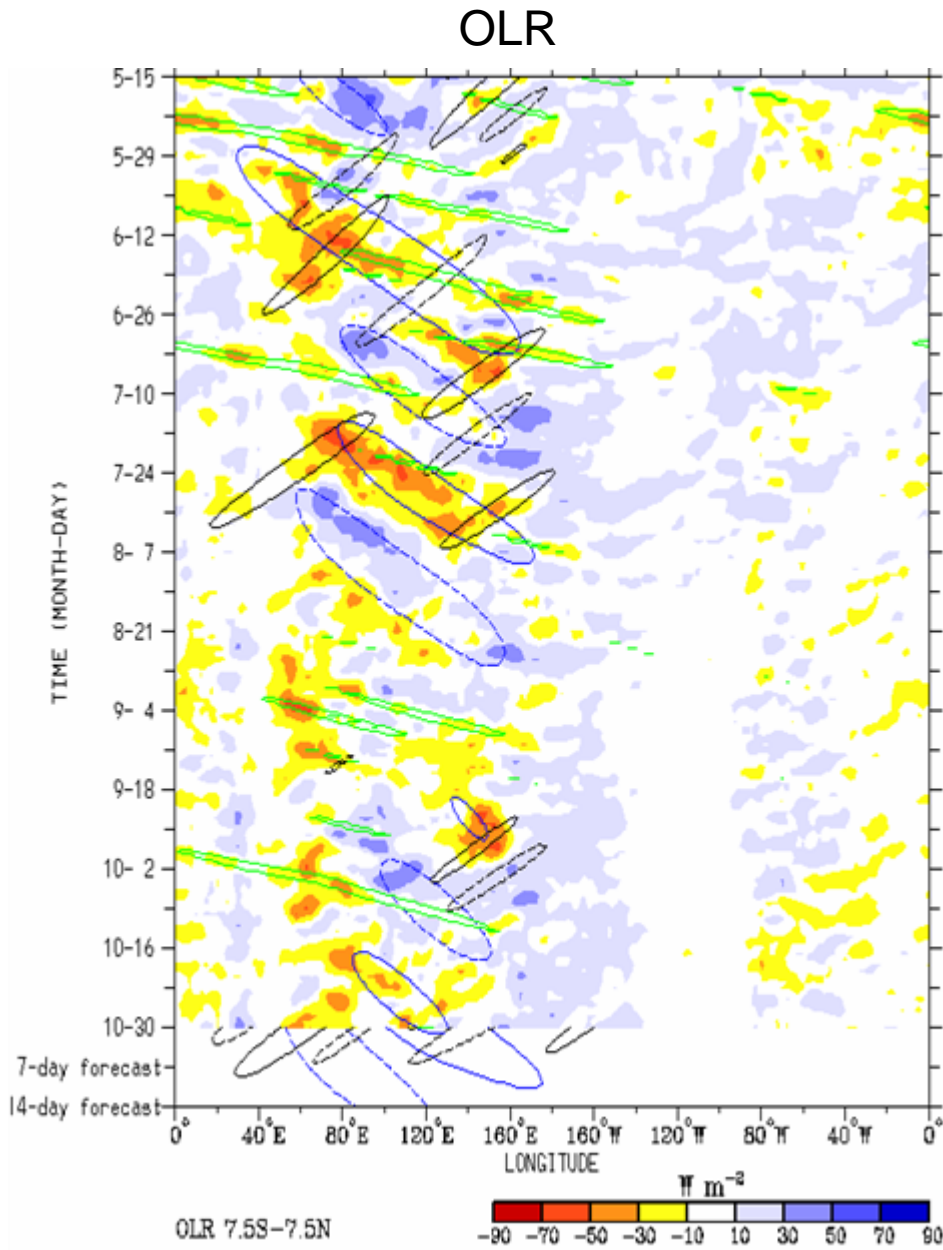
UTWV Time Series (showing 30S – 30N)



Long-term UTWV Anomaly Dataset



UTWV Has Good Coverage for Tropical Convections



← Obtained from
http://www.cdc.noaa.gov/map/clim/olr_modes/hovEa.html

Conclusions

- Improved intersatellite calibration.
 - Temperature dependent inter-calibration
- Extension of time series to current.
 - HIRS/2 and HIRS/3 series connected
- The HIRS UTWV anomaly data are useful in monitoring Madden-Julian oscillation and various equatorial waves.

