

Anomalously Strong and Rapid Drying of the Tropical Lower Stratosphere in 2016: Connections to Both the QBO and ENSO

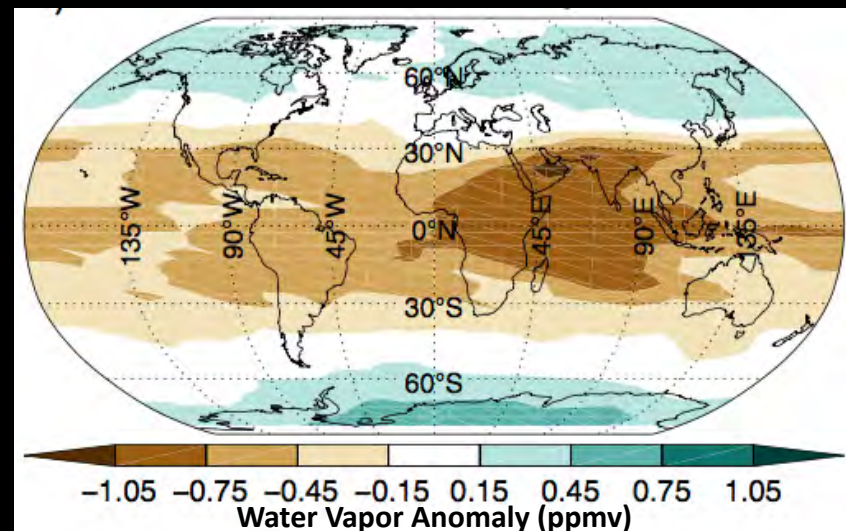
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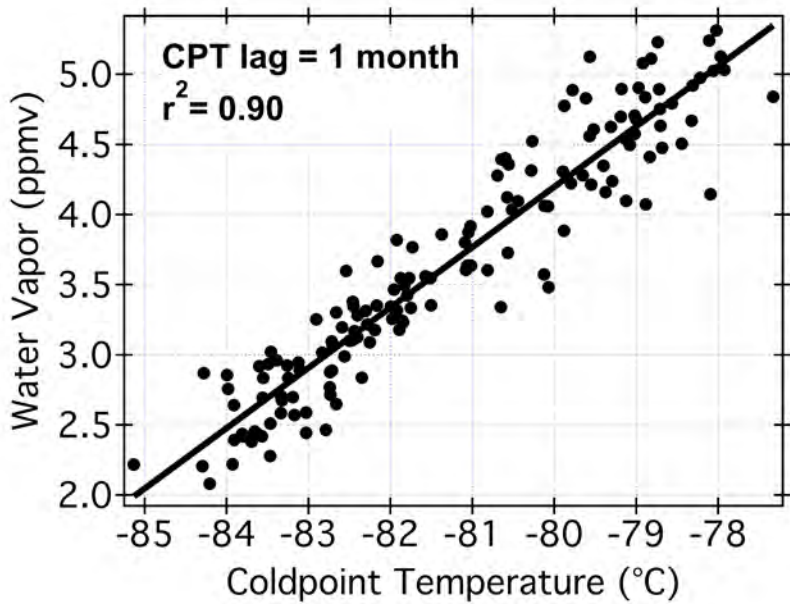
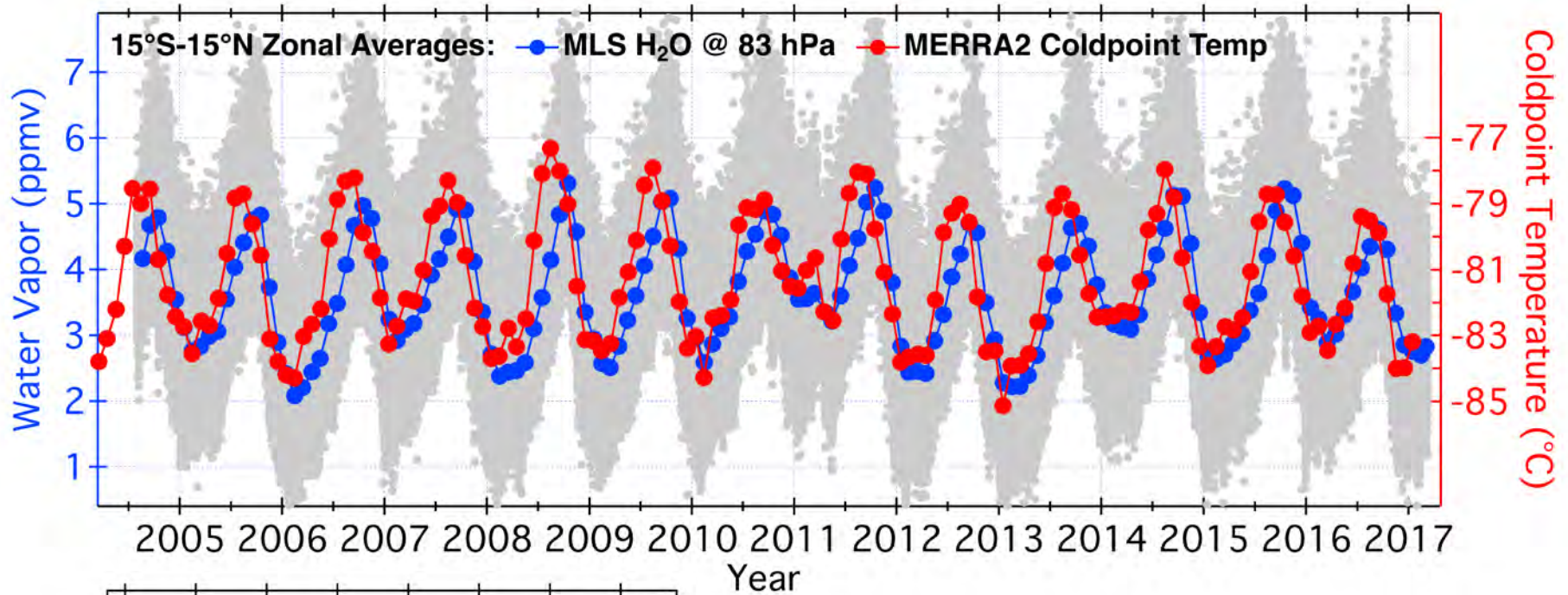
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What controls the amount of WV in the stratosphere?



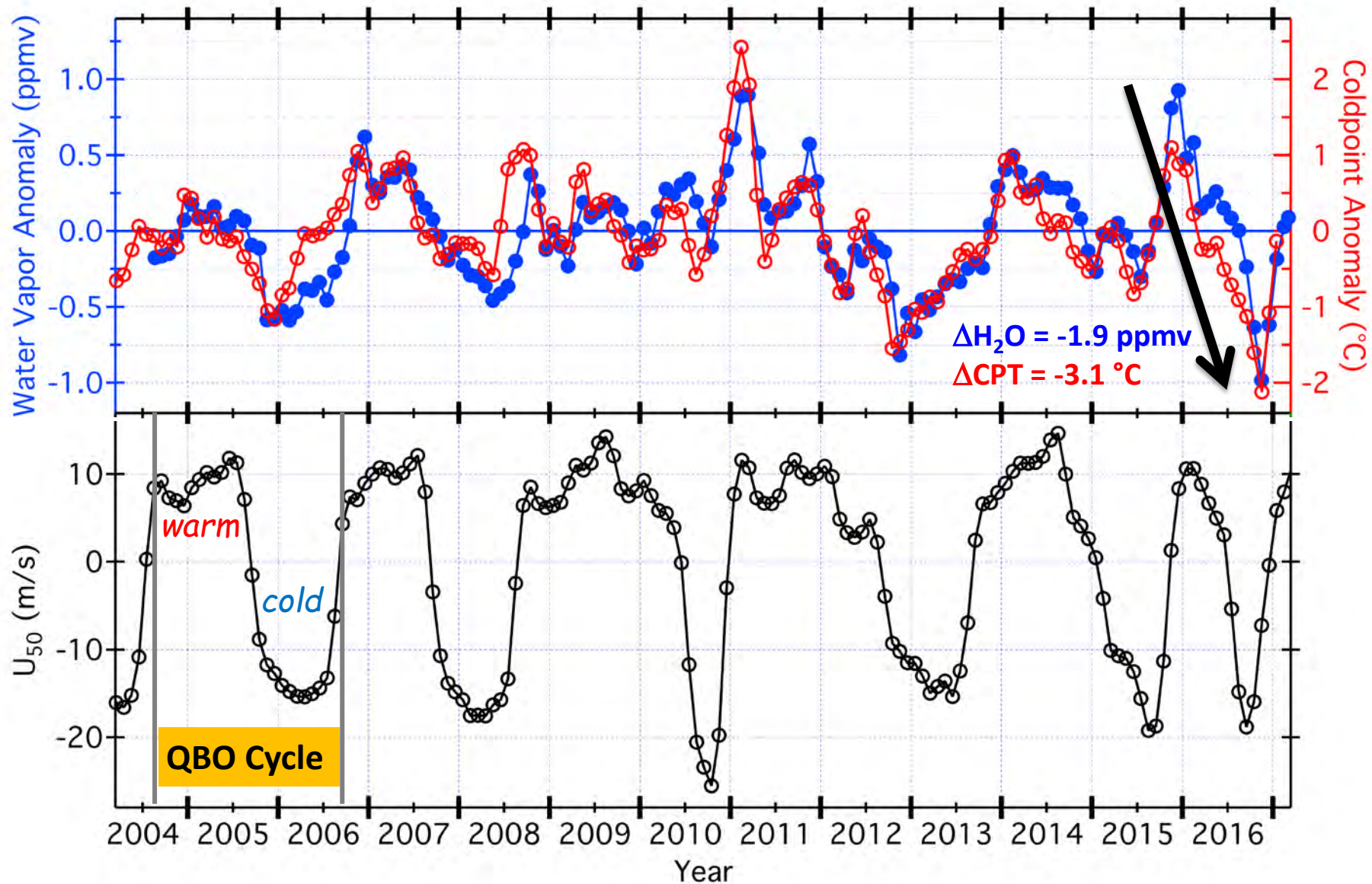
Other Contributors

- Transport through tropopause breaks
- Ice lofting by deep convection
- Asian Monsoon (?)

In Situ Production

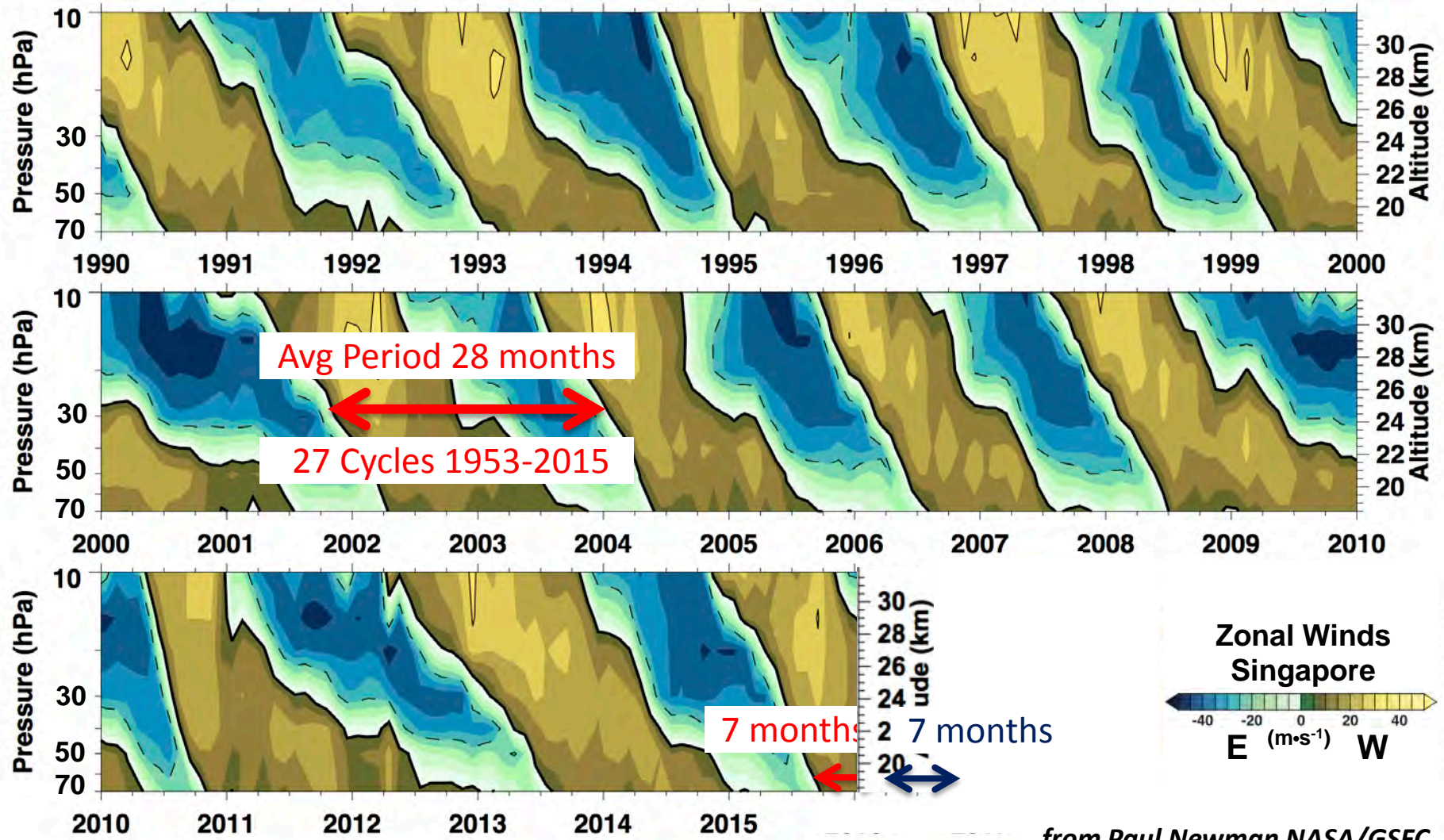
- Oxidation of stratospheric CH₄ and H₂

Monthly Tropical (15°S-15°N) Average Anomalies



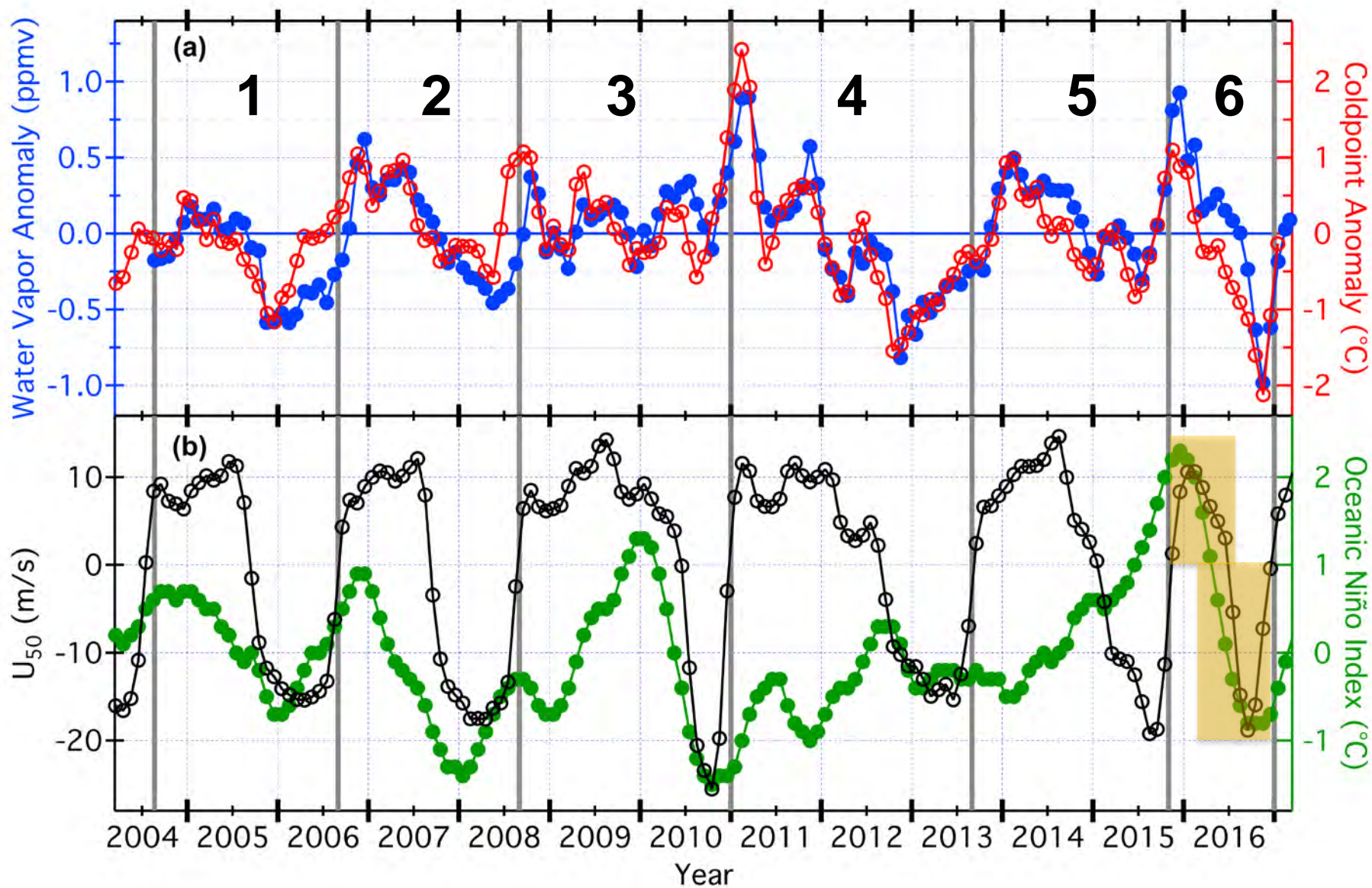
Quasi-Biennial Oscillation (QBO)

Downward propagating zonal wind shift in the tropical stratosphere

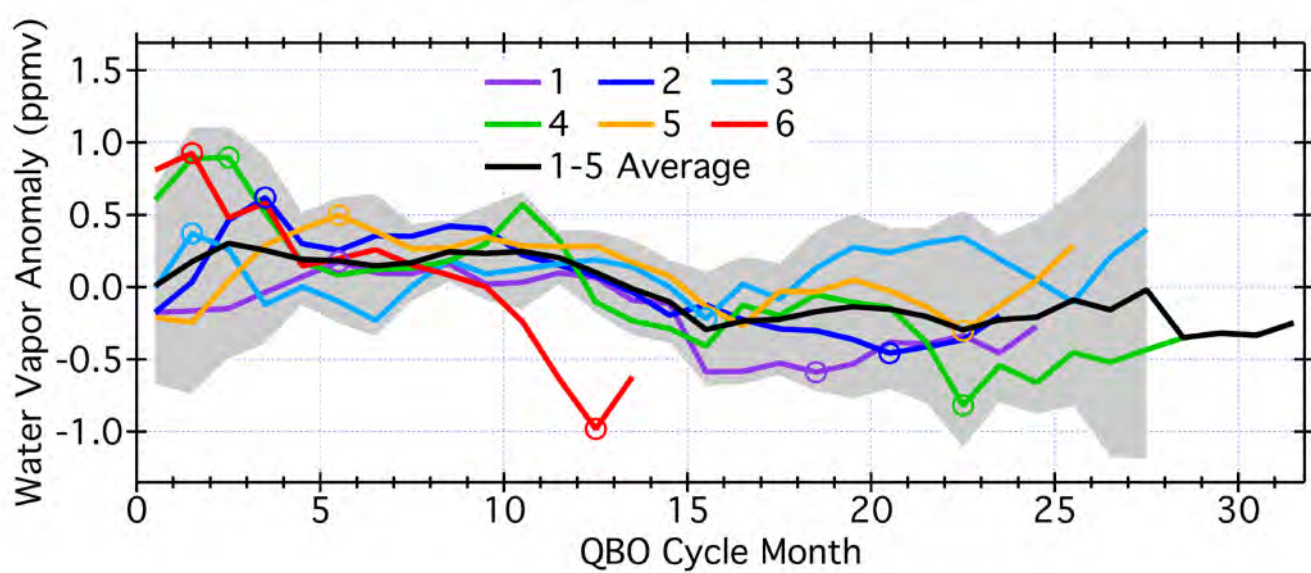


from Paul Newman NASA/GSFC

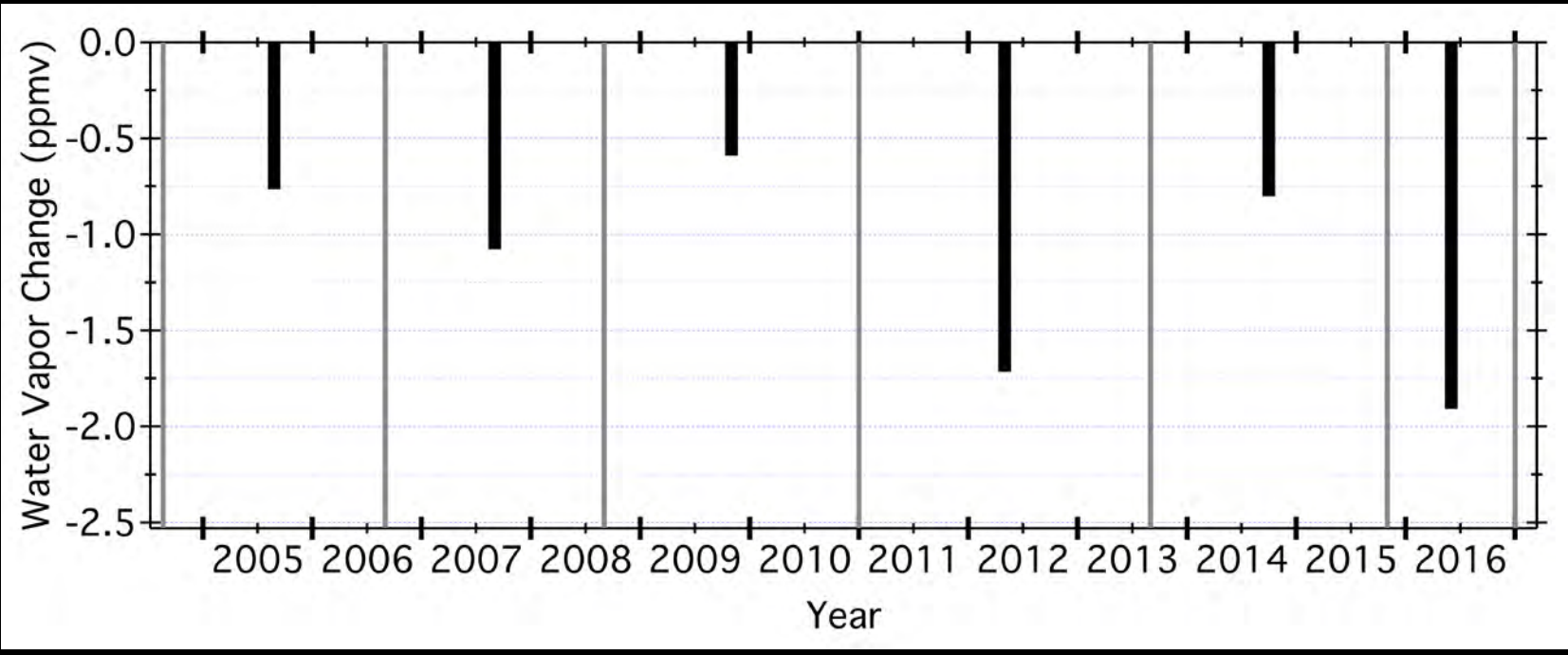
Monthly Tropical Average Anomalies in 6 QBO Cycles



Decreases in Water Vapor Anomalies, QBO cycles 1-6



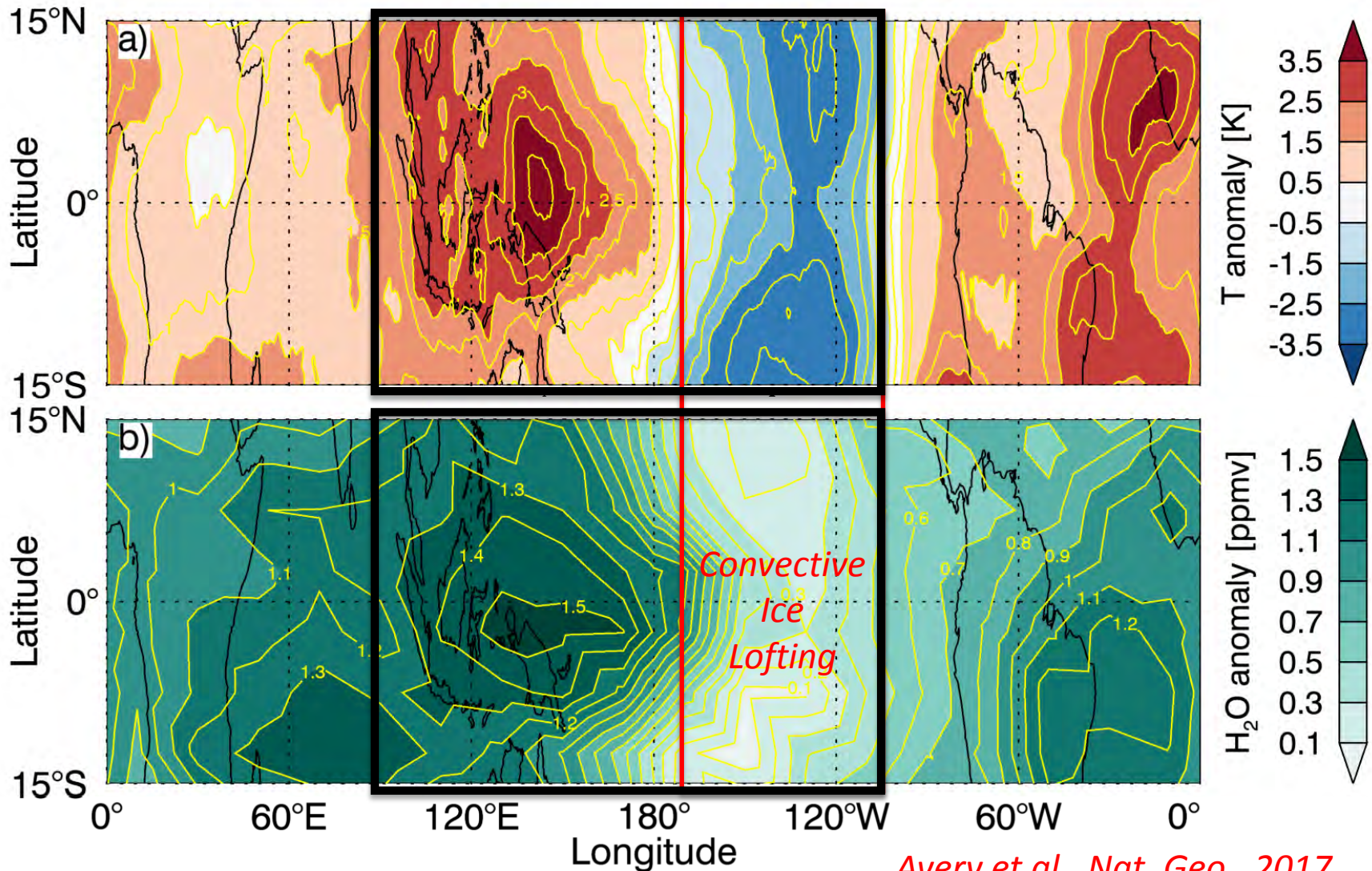
Cycle 6 ΔH_2O_{anom}
-1.9 ppmv in 11 mo
~50% of burden!



Tropical Anomaly Maps, December 2015

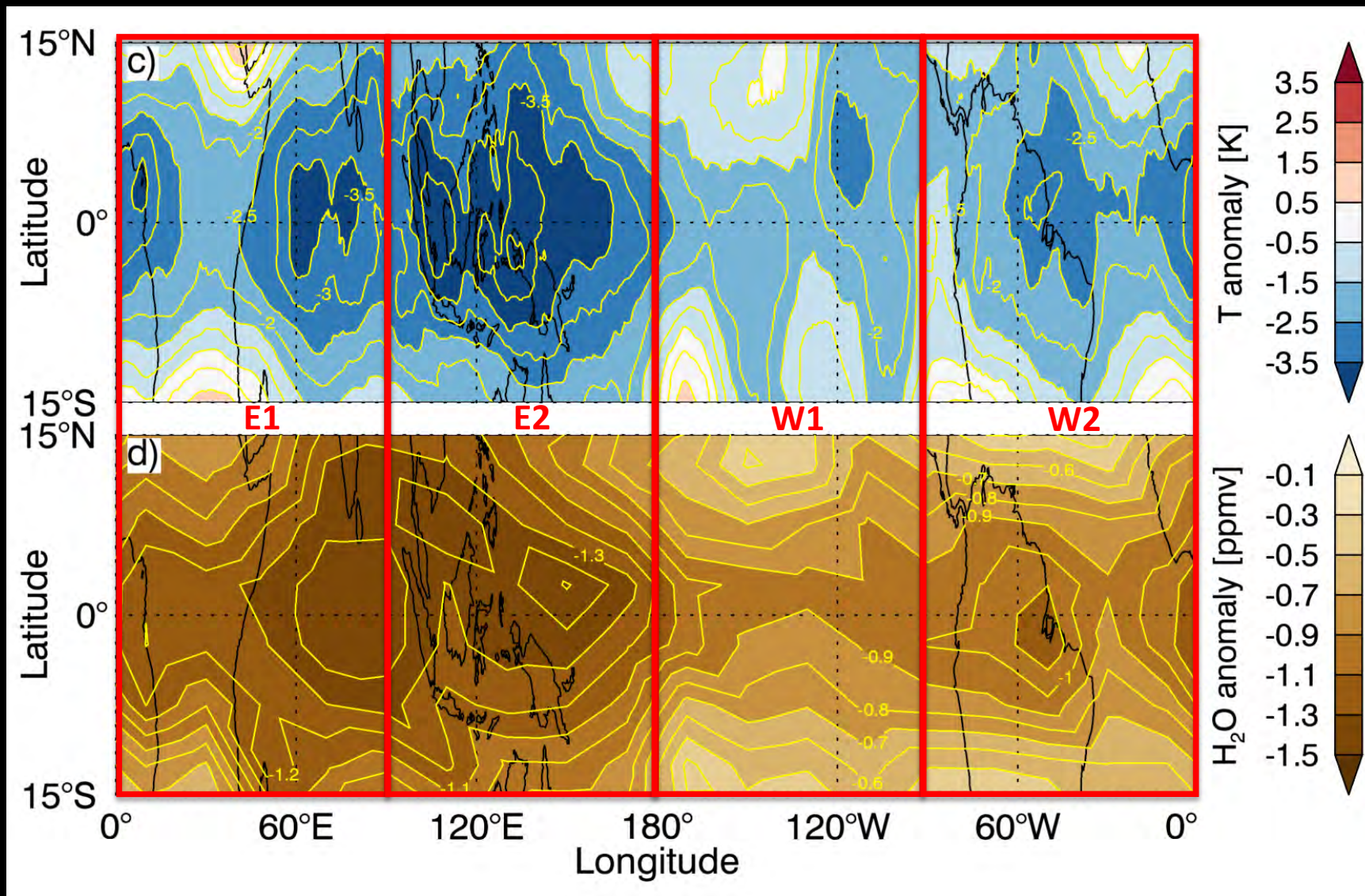
QBO: Warm

ENSO: Warm (Strong El Niño)

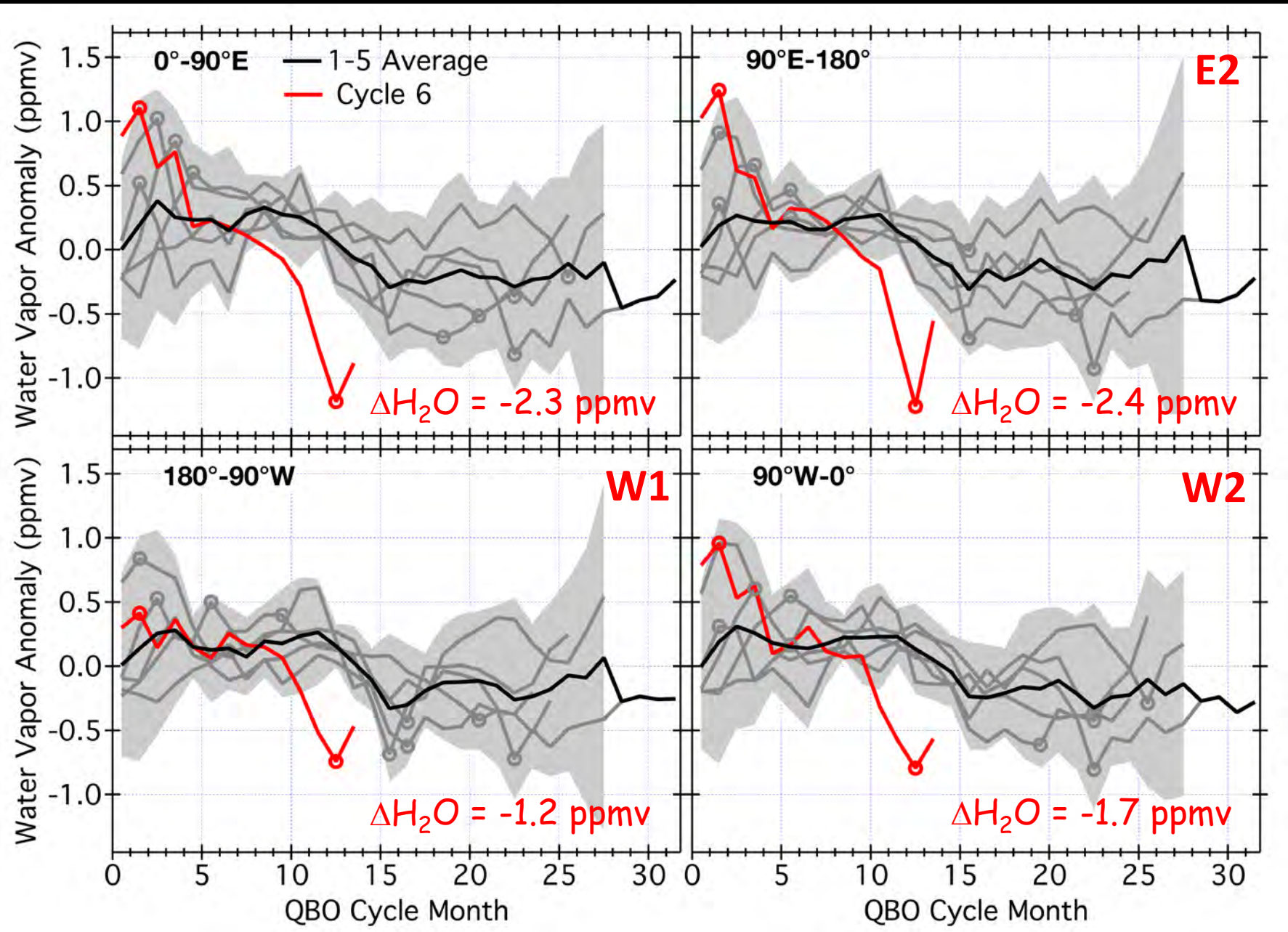


Tropical Anomaly Maps, November 2016

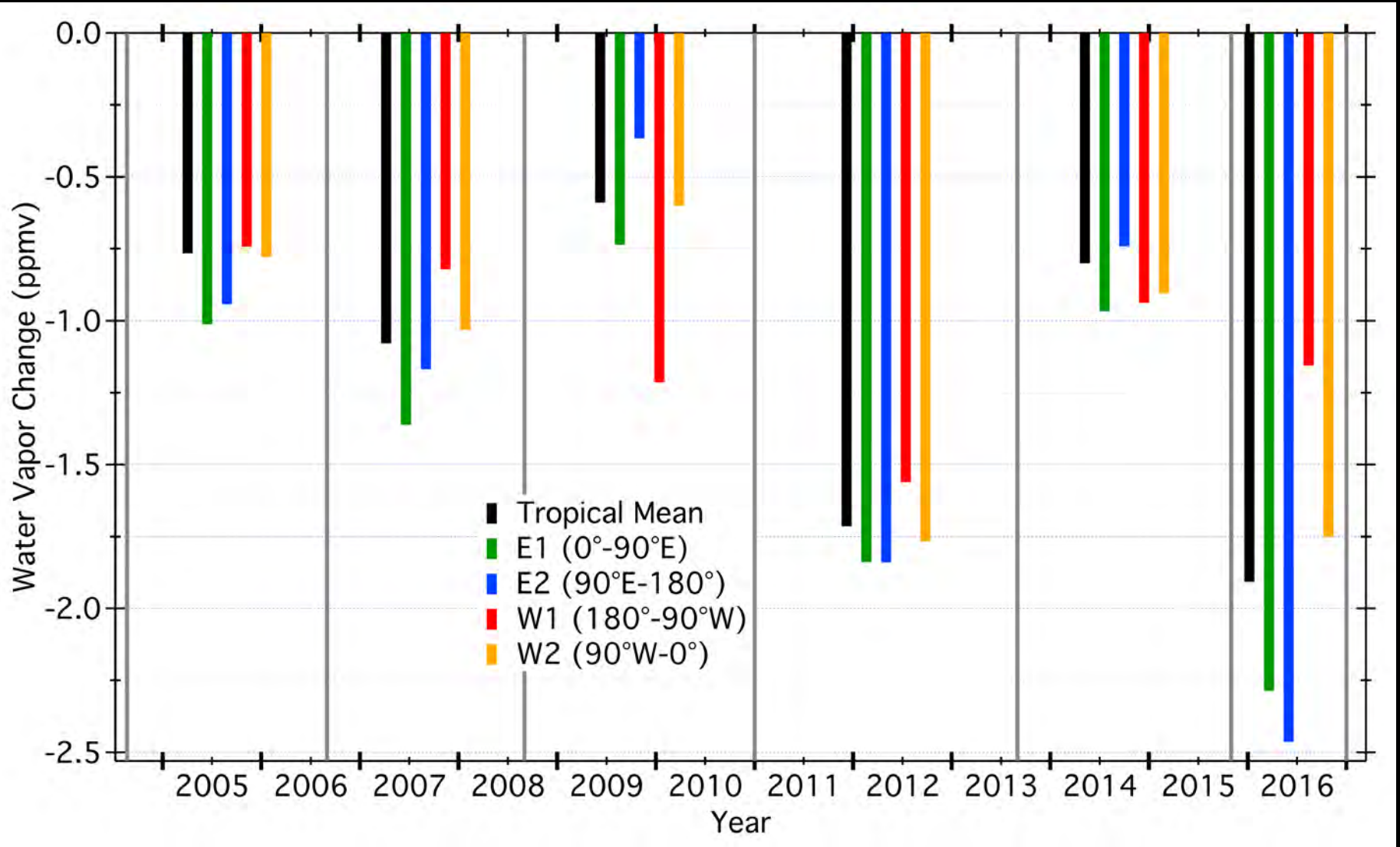
QBO: Cold ENSO: Cold (La Niña)



Decreases in Tropical WV Anomalies, QBO cycles 1-6



Decreases in Tropical WV Anomalies, QBO cycles 1-6



Summary

Tropical average anomalies dropped 1.9 ppmv and 3.1°C in only 11 months (Dec 2015 - Nov 2016)

In-phase QBO (warm) and ENSO (strong El Niño) in late 2015/early 2016 produced strong positive tropical CPT and SWV anomalies, except over the TCP (very cold but avg SWV due to convective ice)

Early transition of 2015-16 QBO from warm to cold phase in mid-2016 kept the QBO and ENSO in sync

Cold phases of QBO and ENSO (La Niña) in late 2016 produced strong negative tropical CPT and SWV anomalies, except over the TCP (moderately cold and dry)

Decrease in WV anomalies in the TWP was twice that in the TCP