
Decadal Variability of Tropical Pacific Temperature in Relation to Solar Cycles

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SORCE, Sedona, 2011

Forcing of Earth's Climate Change

Global

-- 'global warming', 'global forcing'

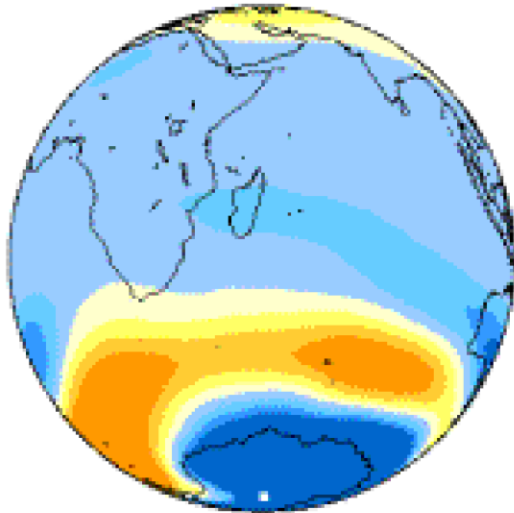
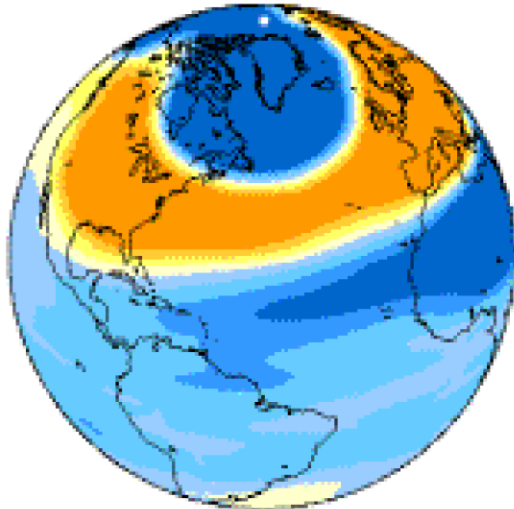
Deviations from Global

-- appear as spatial patterns naturally generated by non-linear, noisy atmosphere-ocean system

Structural Stability of Climate Patterns

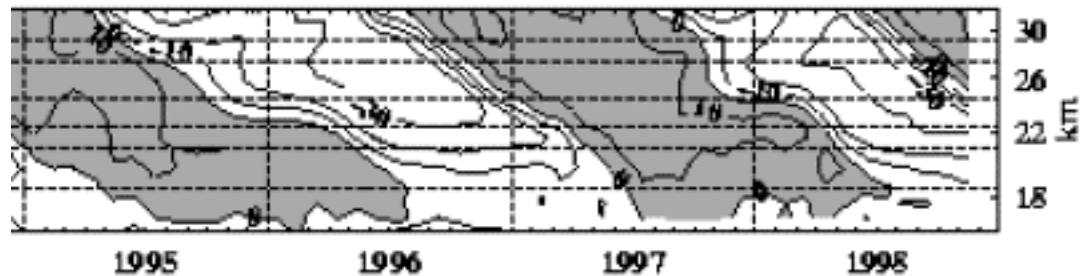
-- against external forcing (anthropogenic, volcanic, **solar**)

Climate Patterns

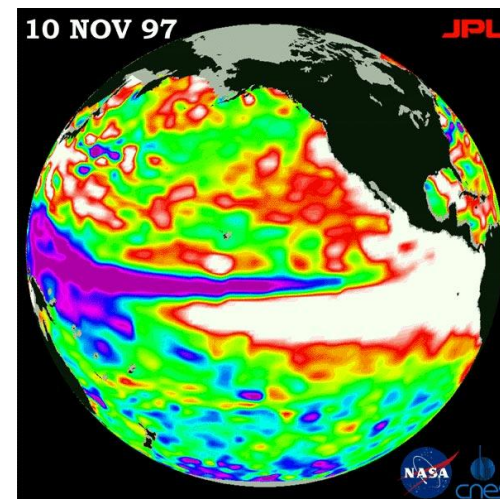


Northern and Southern Annular Modes (NAM and SAM)

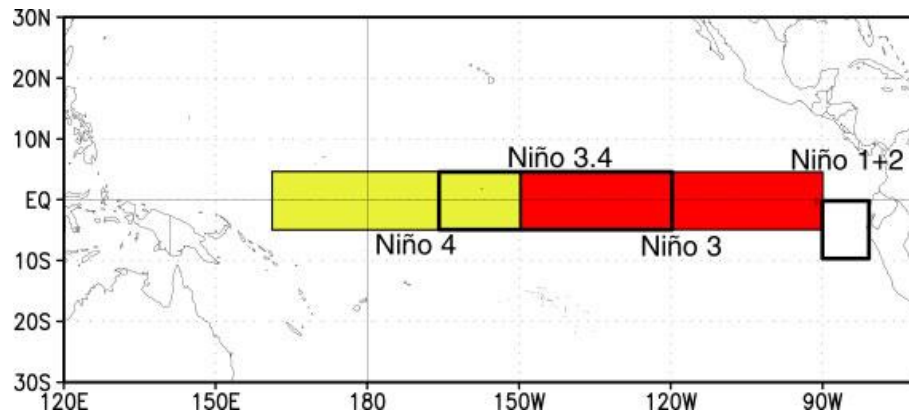
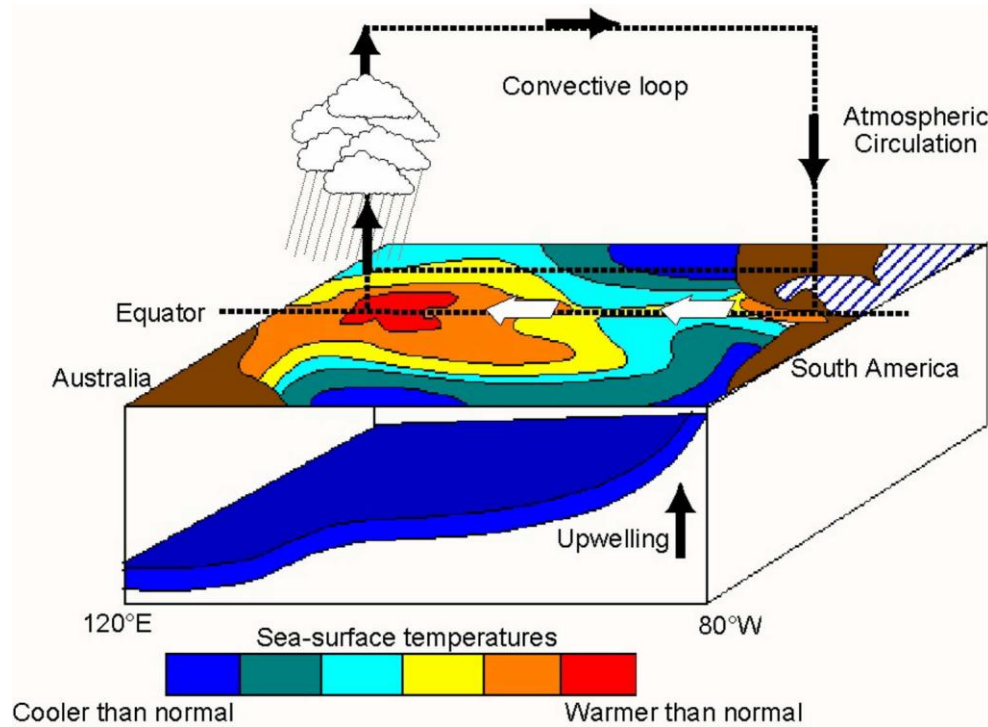
Quasi Biennial Oscillation (QBO)



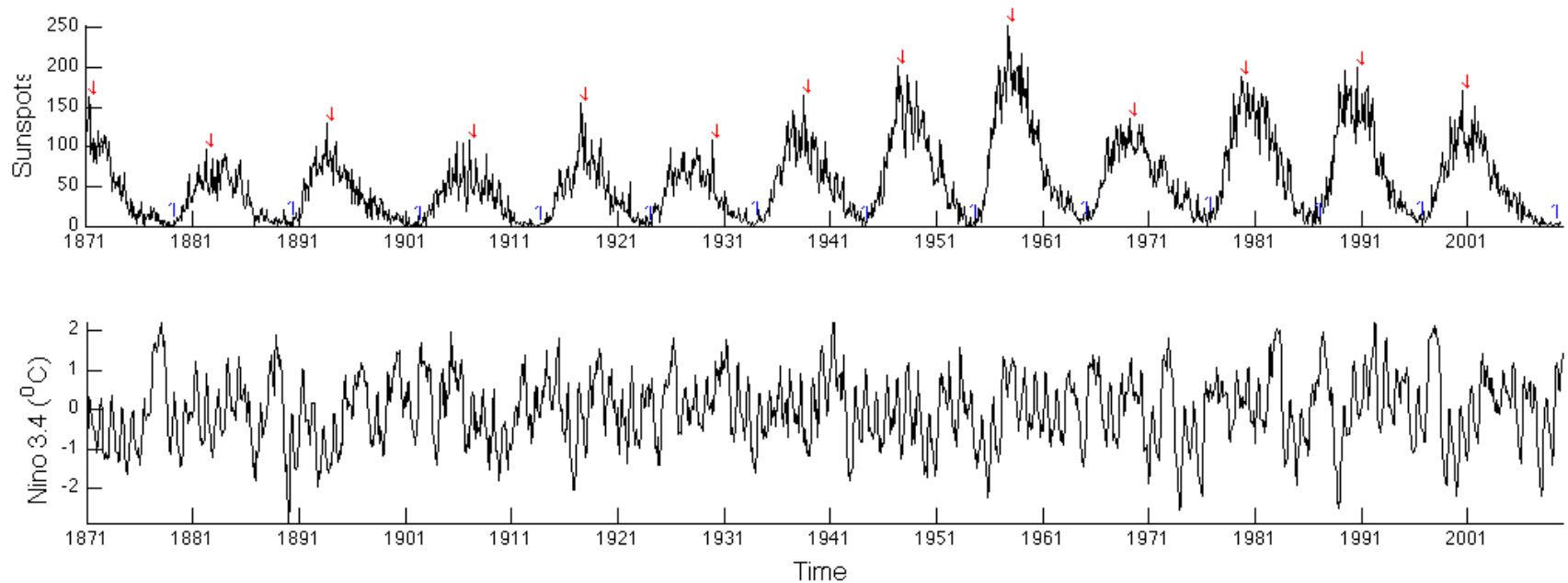
El Nino & Southern Oscillation ENSO



ENSO

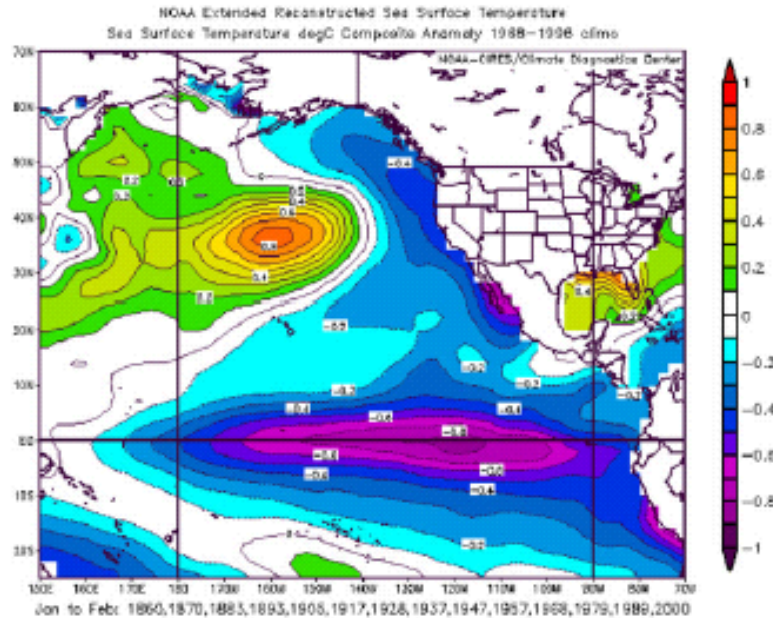


Solar Variability (SSN) & Nino 3.4 SST (13 cycles, 1871-2010)



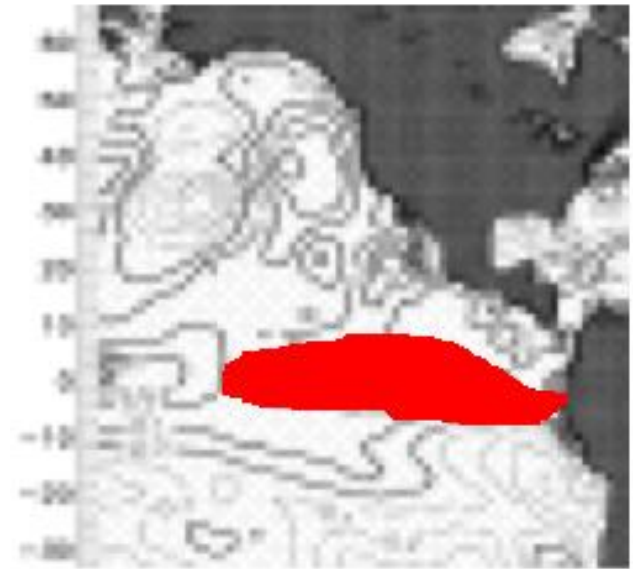
No correlation between SSN and Nino34. No trend in Nino3.4 SST.

Response of Pacific to Solar Cycle



Cool response of Tropical Pacific SST to max of solar activity

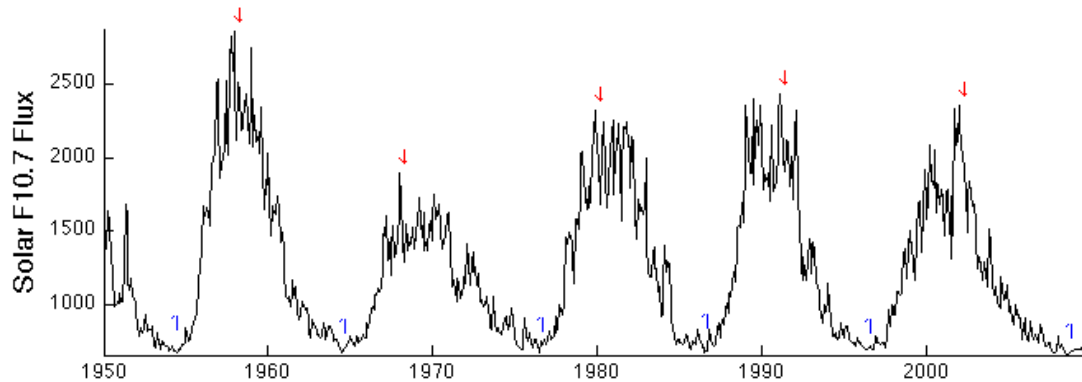
van Loon and Meehl, 2008



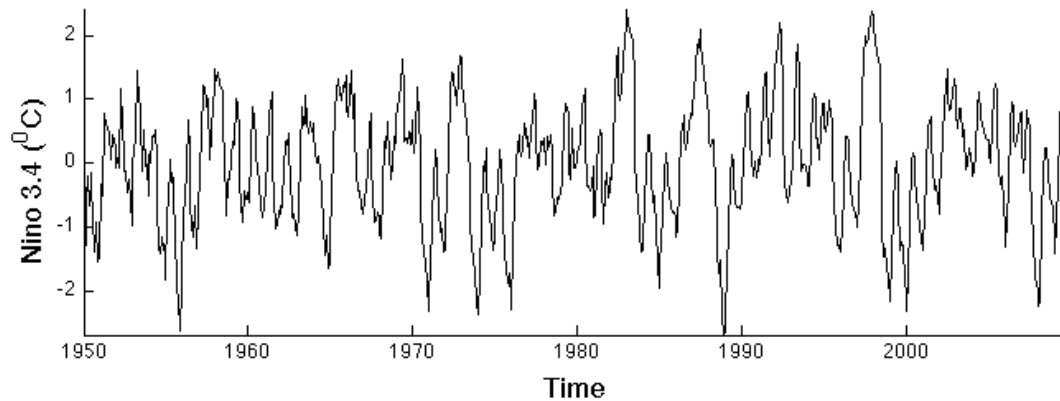
Warm response of Tropical Pacific SST to max-min of solar activity

White et al, 1997; Roy & Haigh, 2010

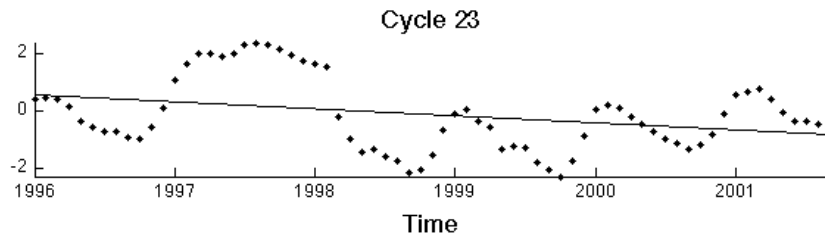
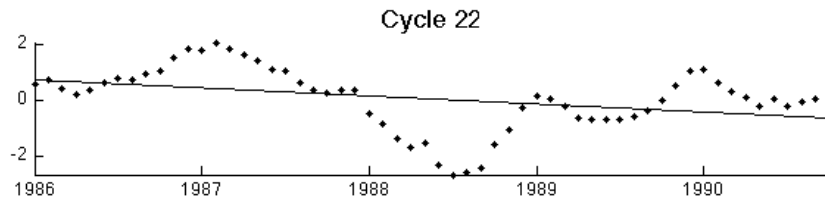
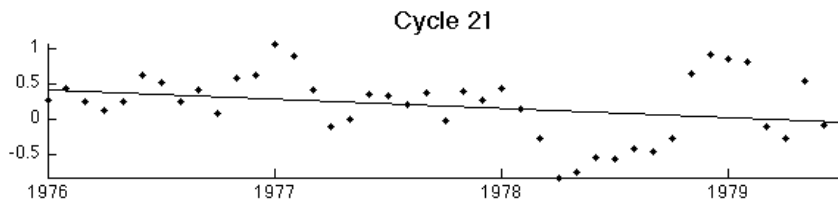
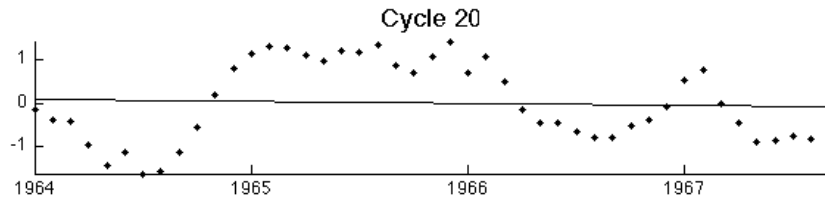
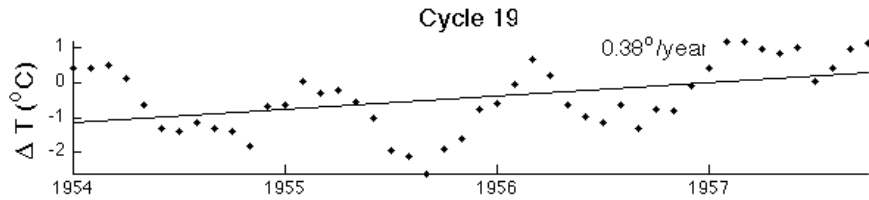
Solar UV and Observed SST Record



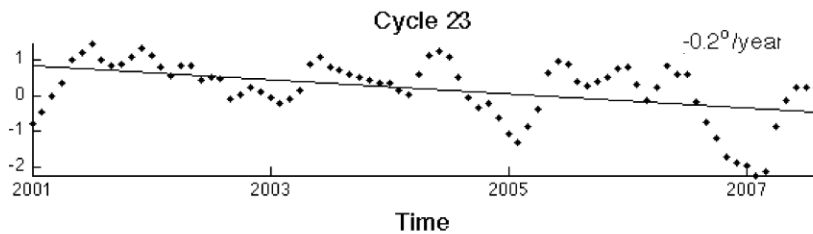
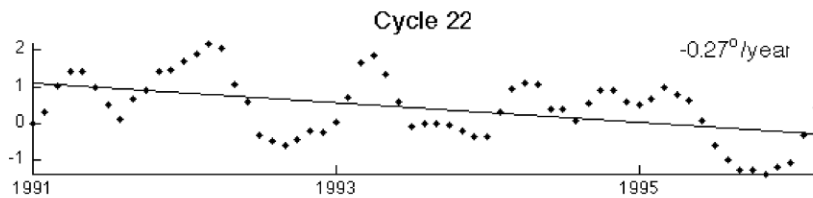
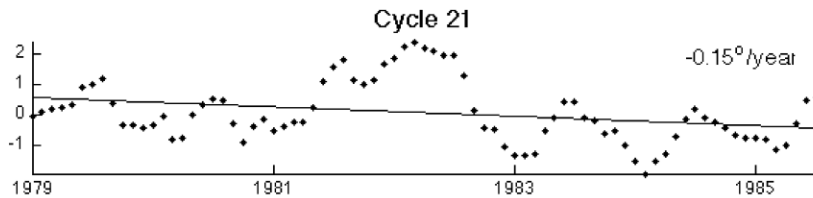
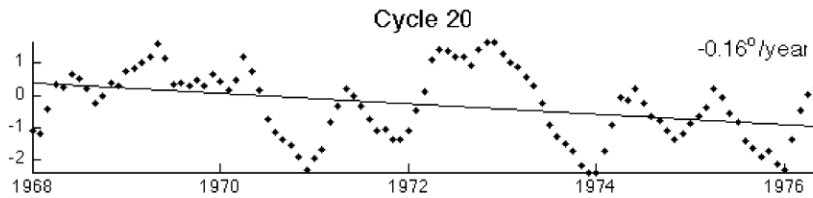
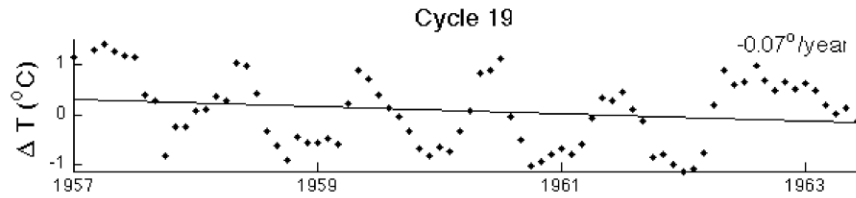
4-year rise
7-year fall



Rising Phase of Solar Cycles

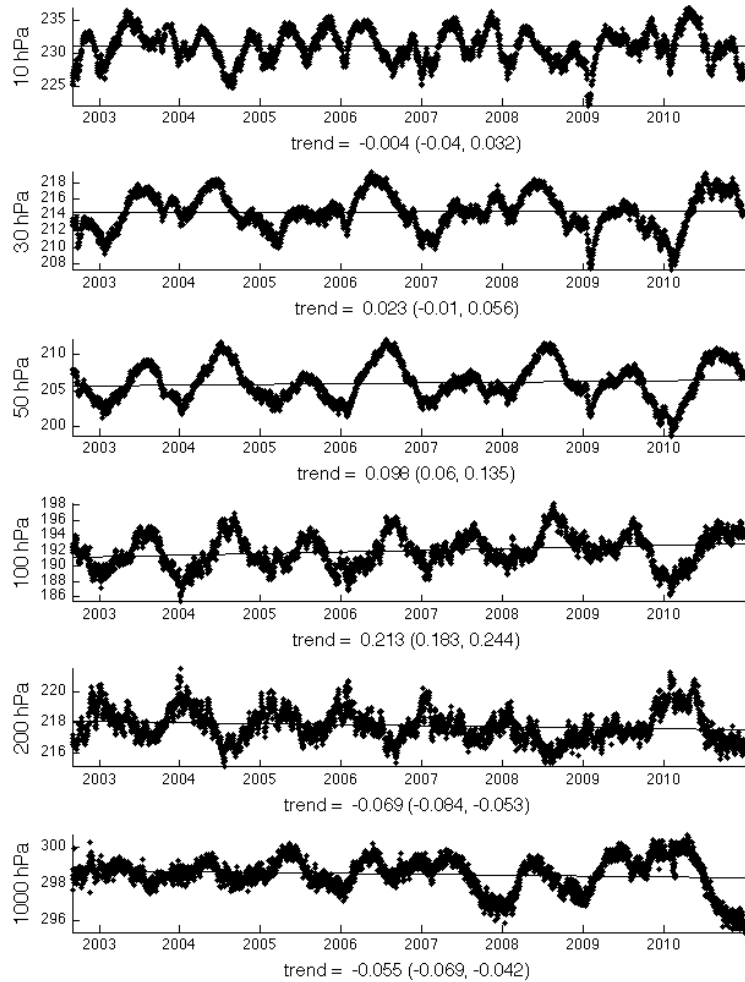


Falling Phase of Solar Cycles

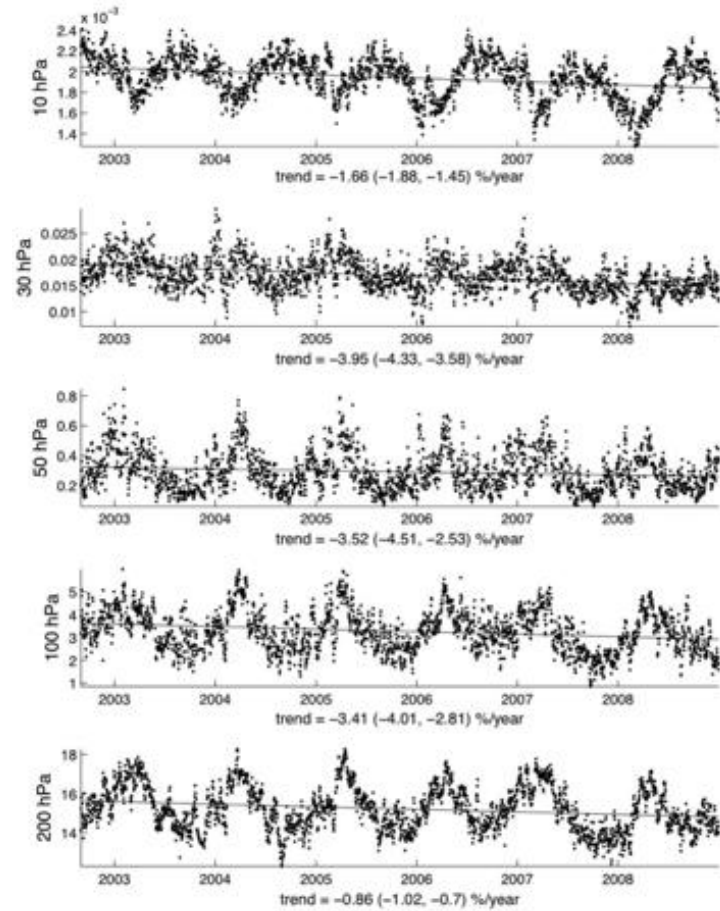


Cycle 23, AIRS data

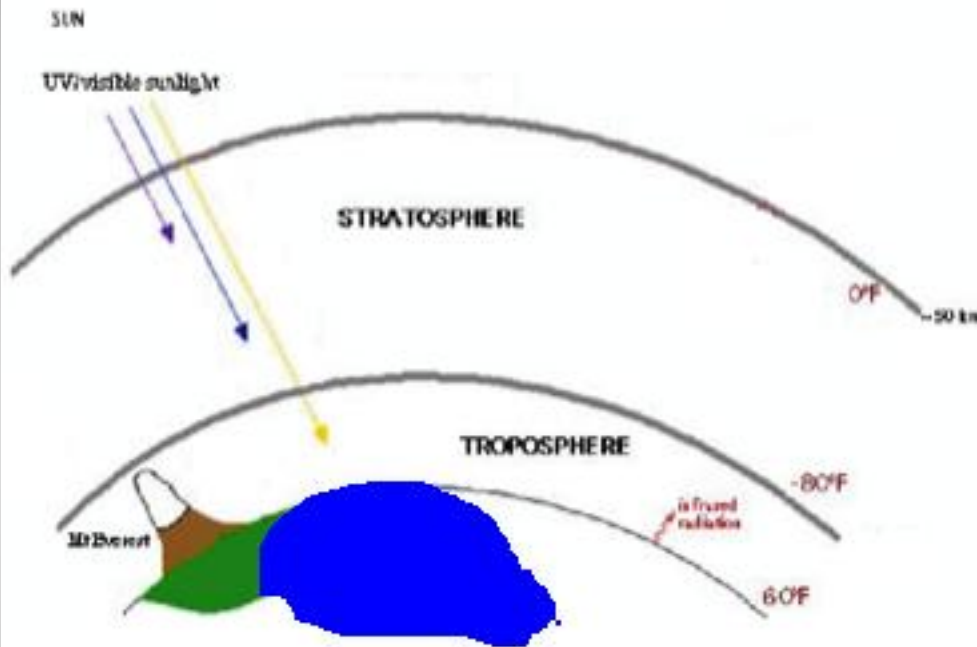
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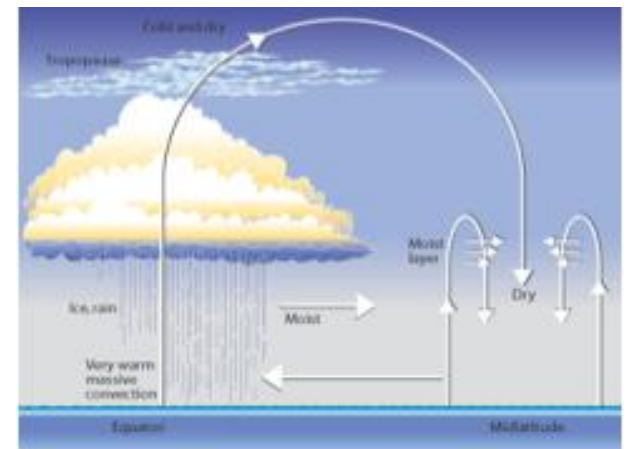
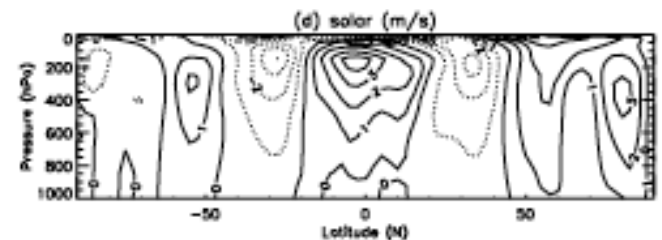
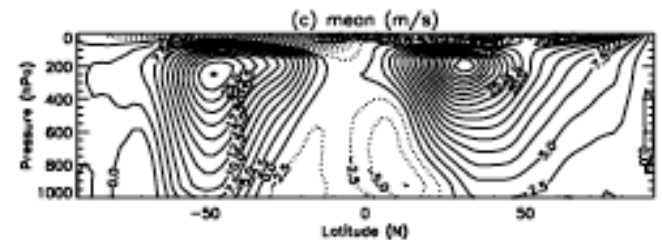
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Bottom-Up & Top-Down Mechanisms

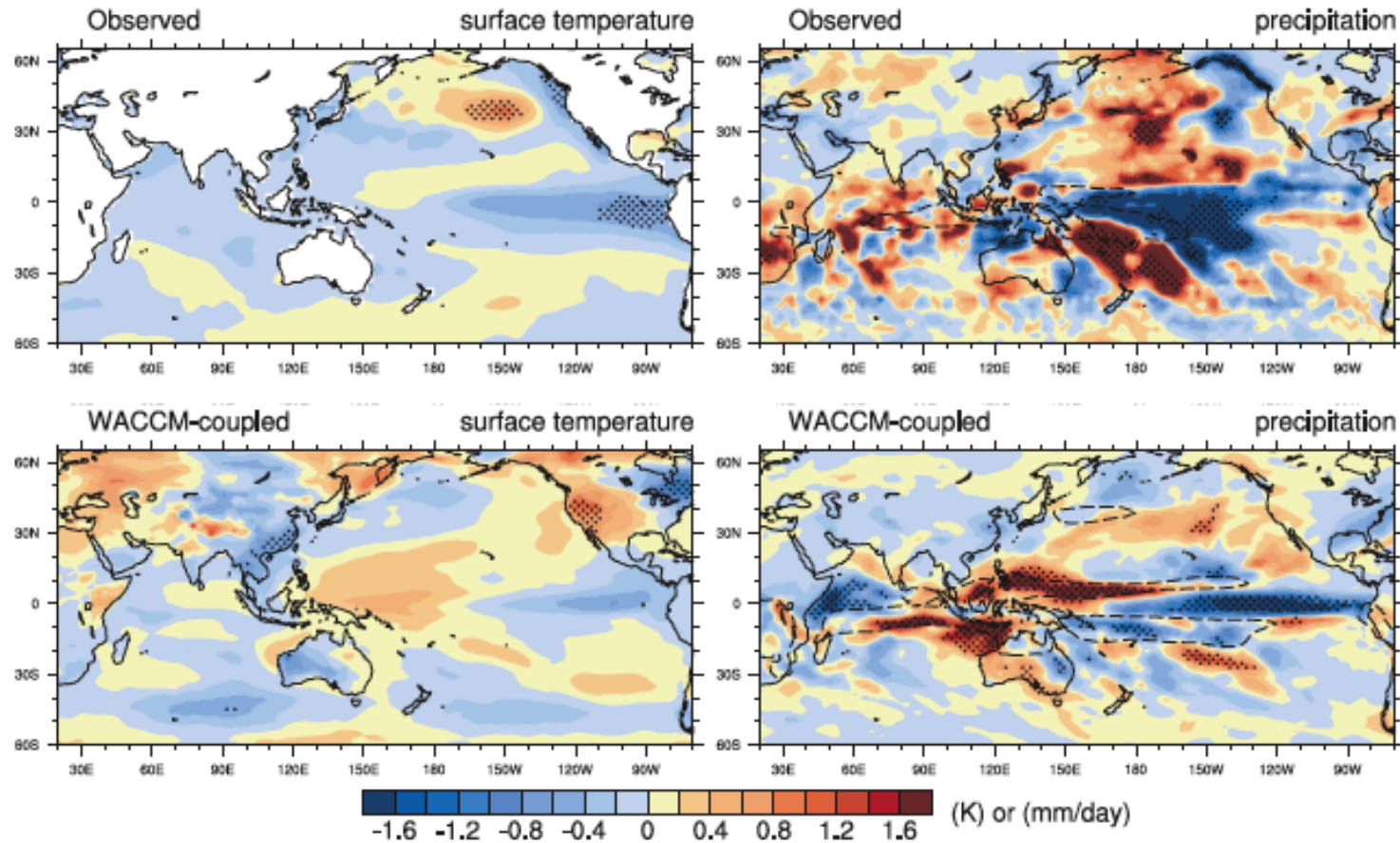


Visible heats clear parts of trop ocean bringing evaporated moisture by trade winds to convergence zone where it strengthen Hadley circulation and trade winds (G. Meehl & H. van Loon)



UV enhances O_3 in trop stratosphere creating ∇T that affects Hadley circulation (J. Haigh)

Coupled Mechanism



Meehl et al., 2009

Conclusions

- ◆ Solar variability influences the ENSO pattern
- ◆ Best seen in the falling phase of solar cycle
- ◆ Emerging understanding of the mechanism

