Impacts & Nuances of the IPO *aka*

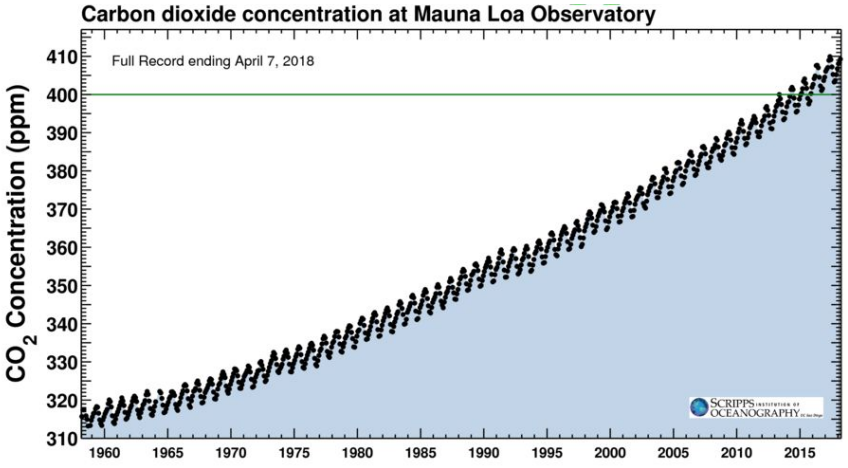
Alphabet Soup

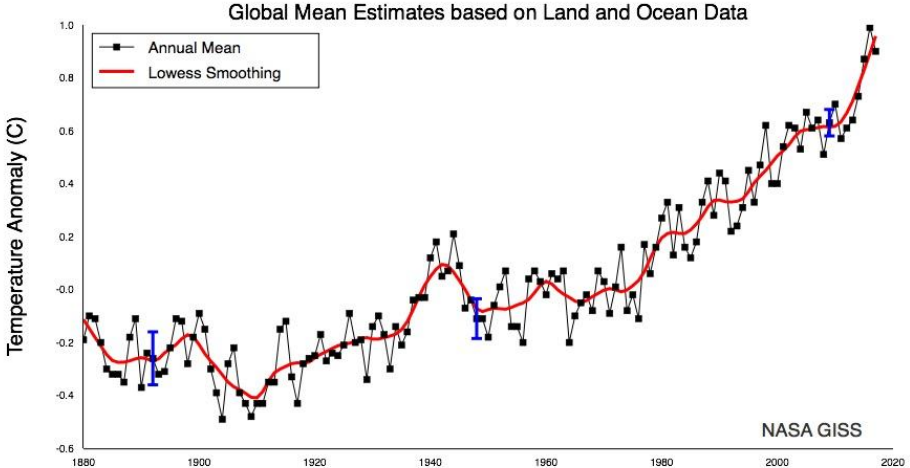
PDO/IPO/PDV/SPDO/SHPDO/etc.

England et al. 2014, DeLong et al. 2012

England et al. 2014

Forcing vs. Response





Do patterns of increasing CO_2 match those of rising SAT's?

Hiatuses and pauses and slowdowns...oh, my!

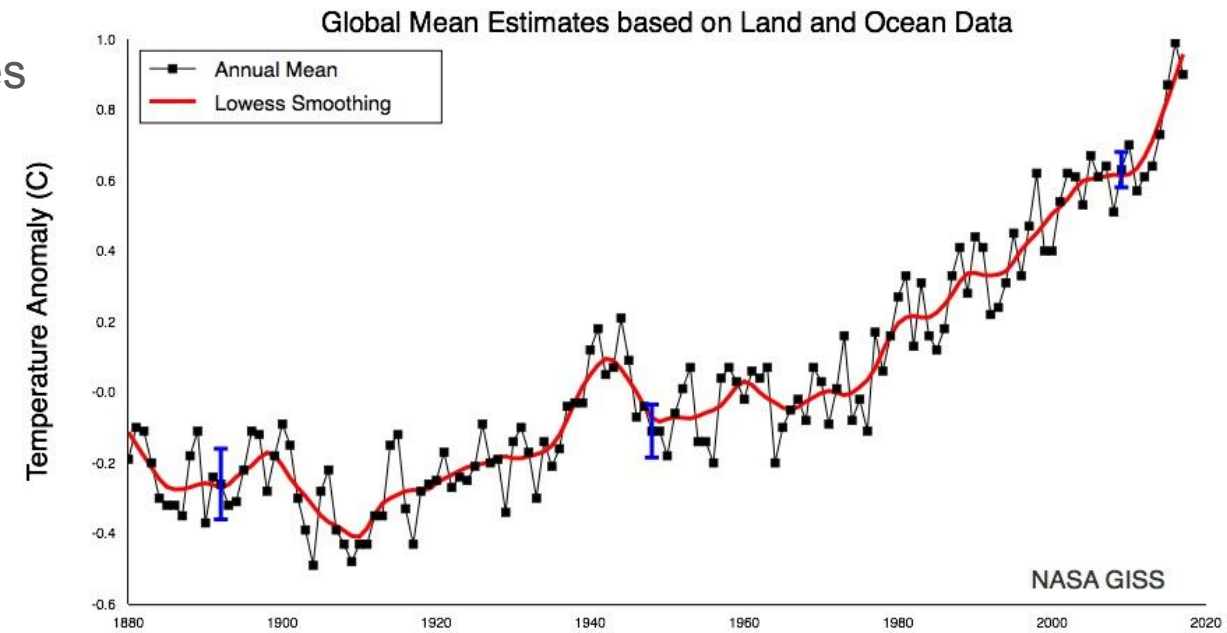
Little-to-no warming in global mean temperatures ~1998-2015

Real or Imagined?

The fake debate:

- Spurious trendlines
- Generally begins in 1998 (why?)

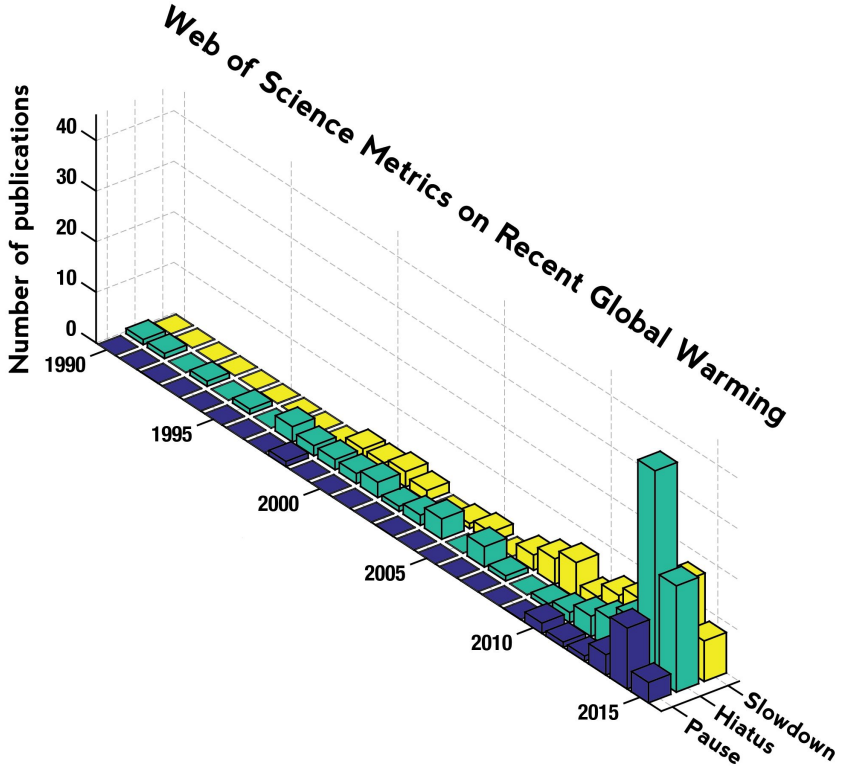
El Niño raises global T



Hiatuses and pauses and slowdowns...oh, my!

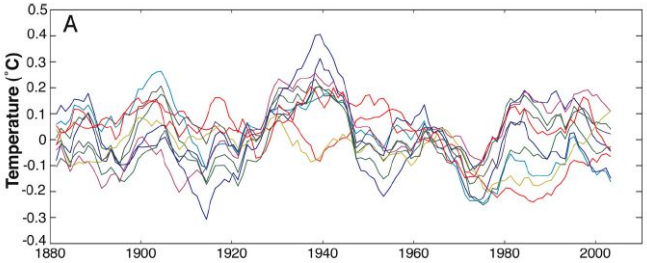
The real debate:

1) What caused the slowdown in warming?
2) How common are these hiatuses?

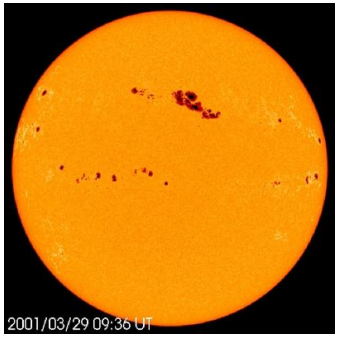


kaustubh.info/paleowave

What factors *might* explain variations in surface air temperature trends?

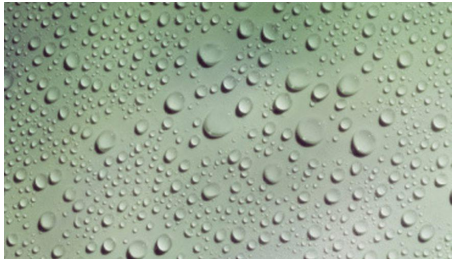


Internal variability



Low Insolation

Volcanic Activity

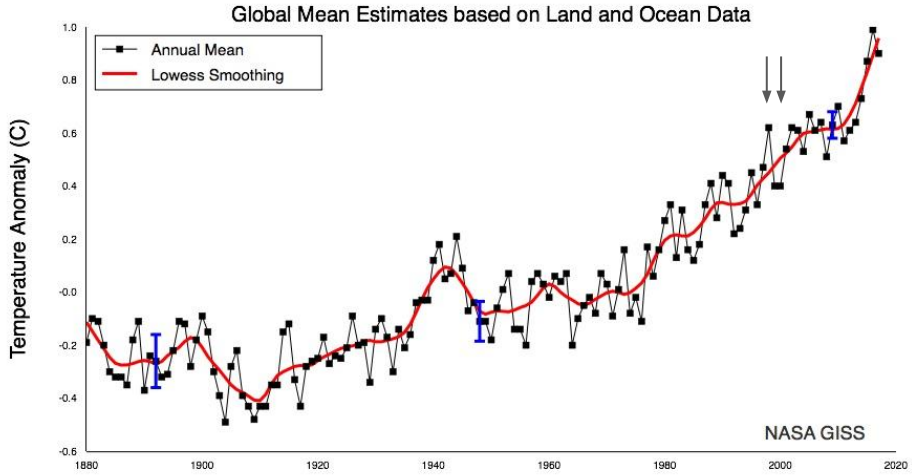


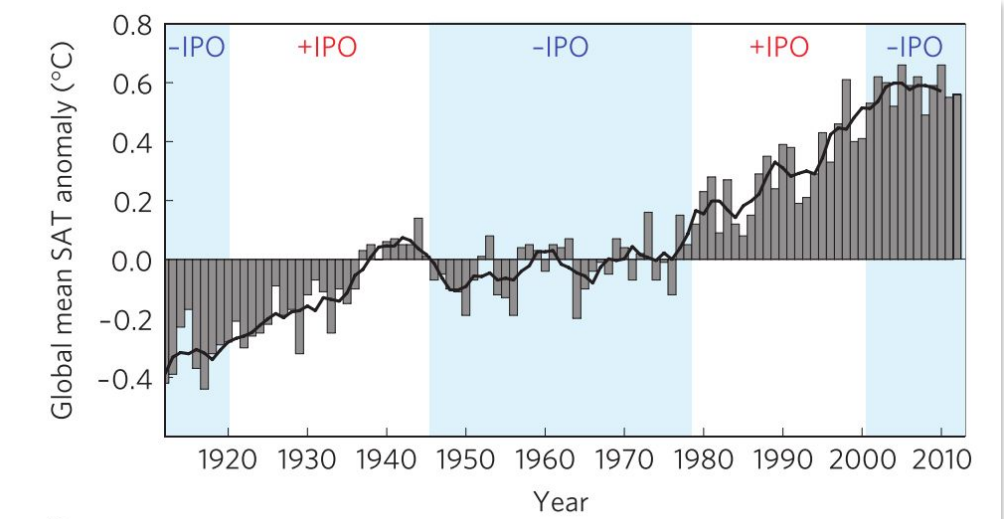
Water Vapor & Aerosols

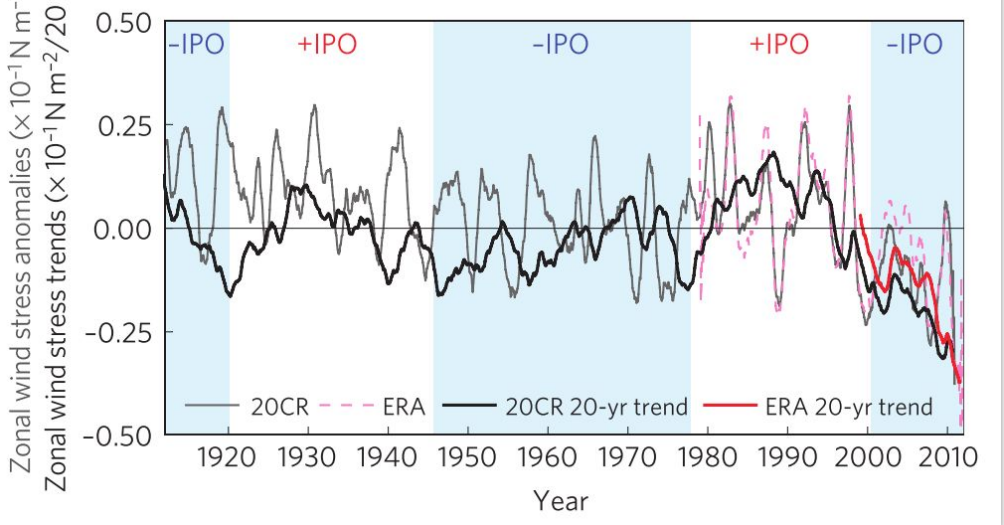
How is the global warming “hiatus” defined here?

The period since 2001 with little change in global SAT’s

Even ignoring the 1997-98 “Super El Niño,” a slowdown in SAT warming is still clear

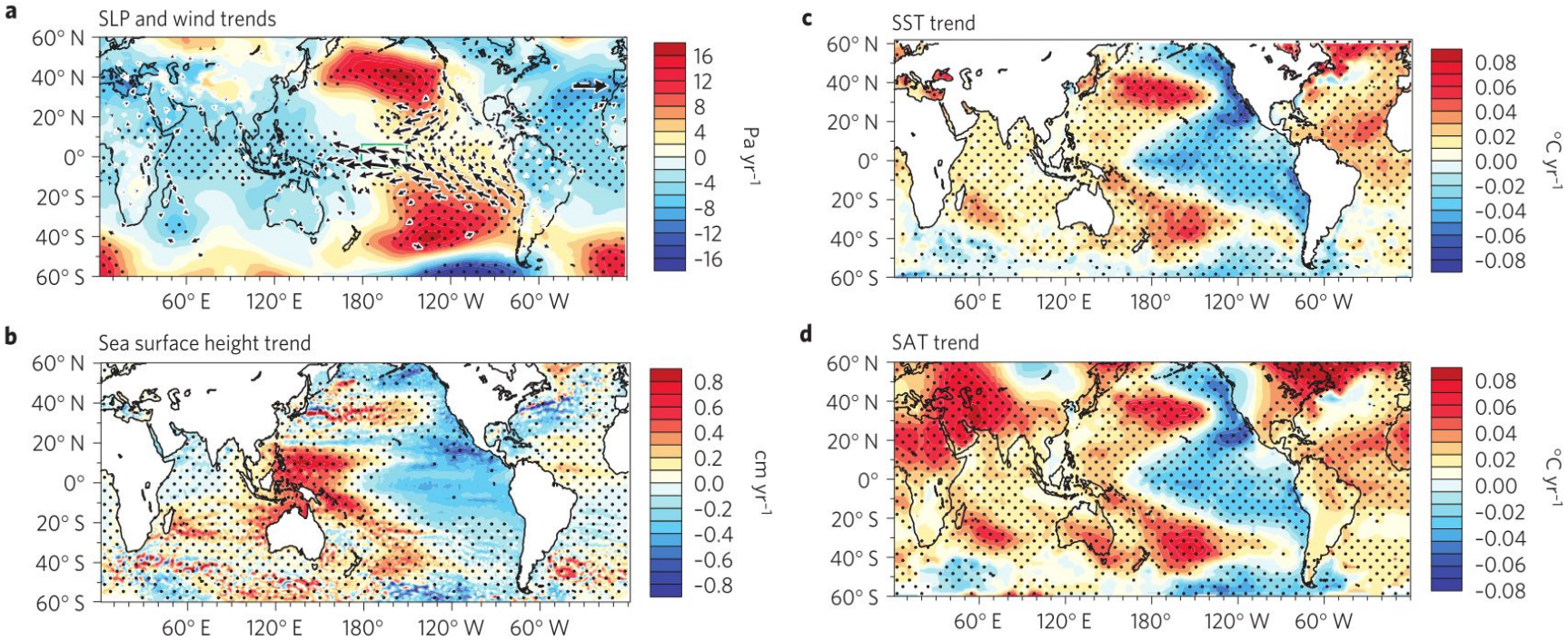




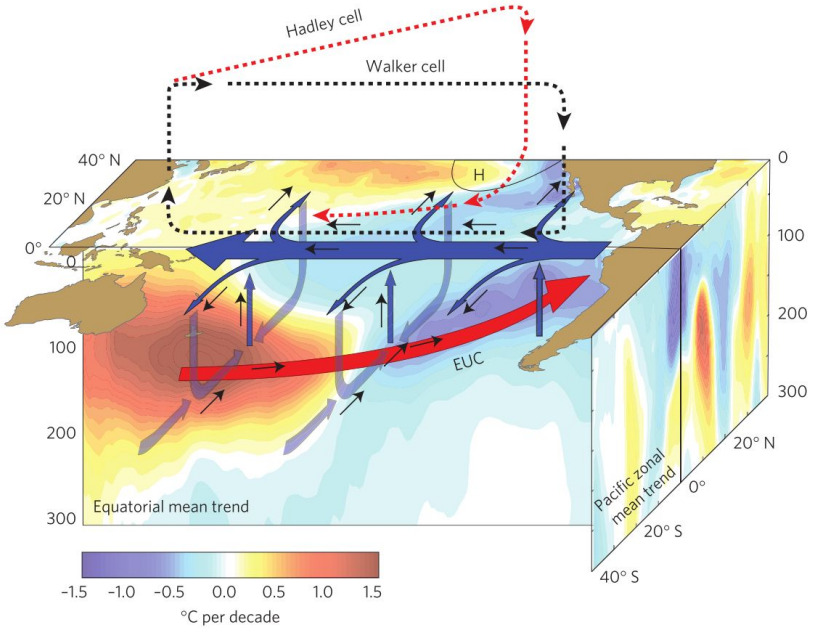


IPO-Driven Wind Stress Trends

What is the proposed relationship between the IPO, trade winds, and ocean heat uptake?



How does this mechanism account for unusually cold sea surface temperatures in the eastern Pacific?



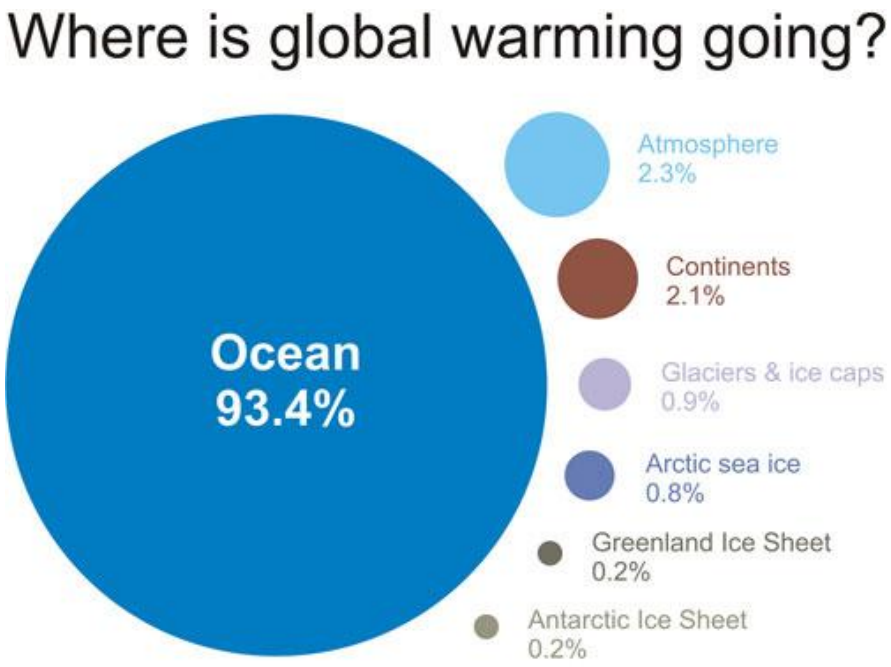
increased W Pacific convergence of near-surface mass/heat→downwelling→stronger equatorial undercurrent→more upwelling in E Pacific→cool E Pacific SST

Why does this study rely on both coupled and ocean-only climate models?

Ocean only: prescribe winds (better understood/observed), see how the ocean responds (less well known)

Coupled models show atmospheric teleconnections

Increased Ocean Heat Uptake

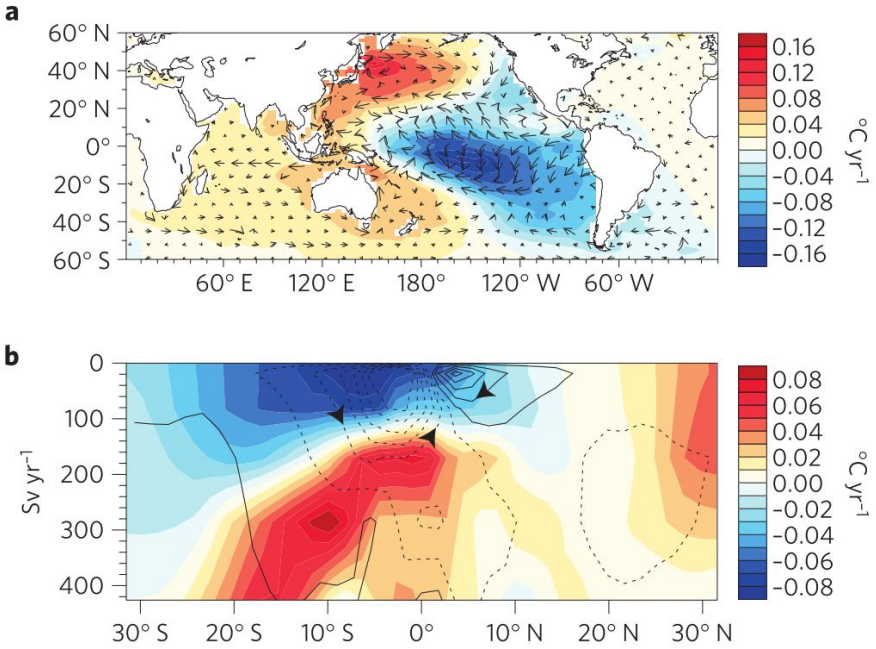


skepticalscience.com, adapted from IPCC AR4

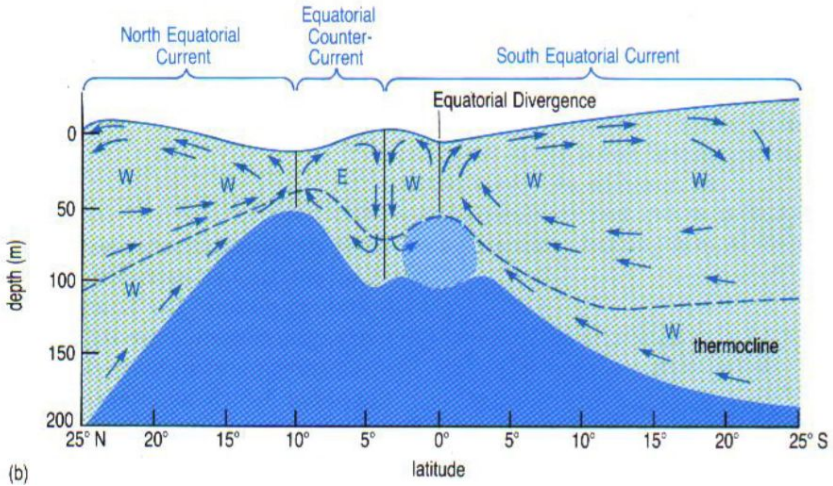
How much of the radiation deficit during the hiatus can be explained by wind-induced cooling?

Net ocean heat gain = 1.2×10^{22} J

Why do the central and south Pacific show modeled decreases in SST as winds increase, yet ocean heat uptake increases?



Shallow Overturning Cells



Drijfhout et al. 2005

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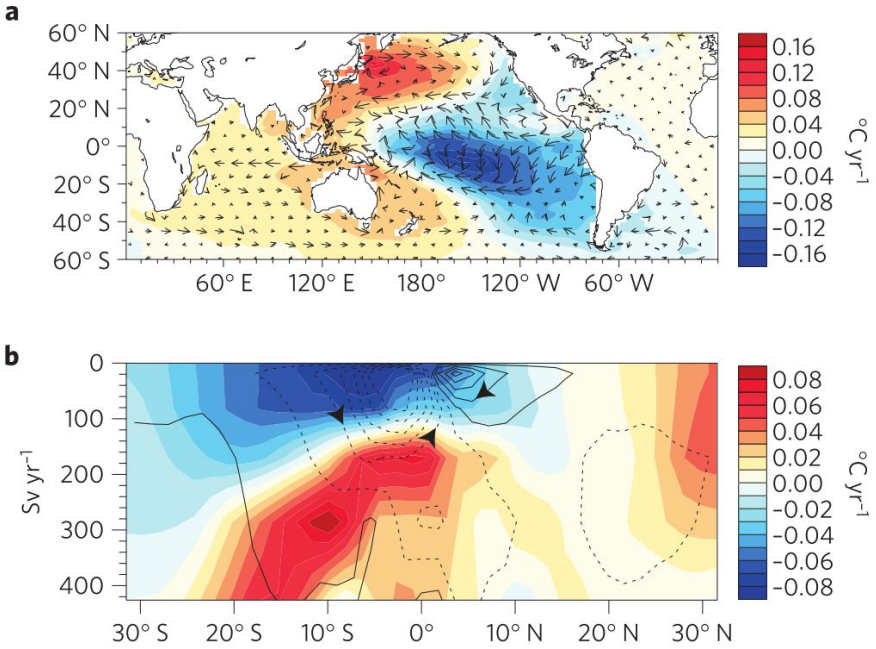

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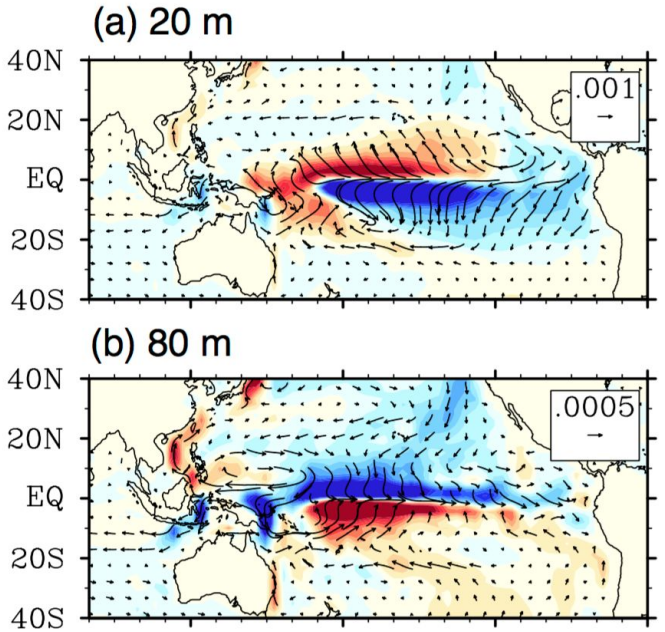
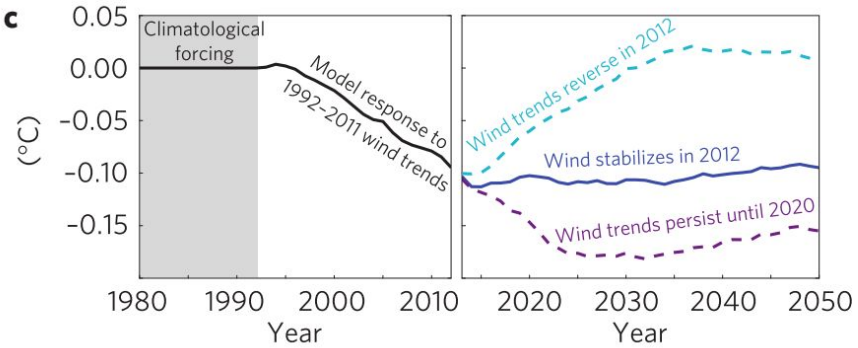


England et al. Supp. Mat.

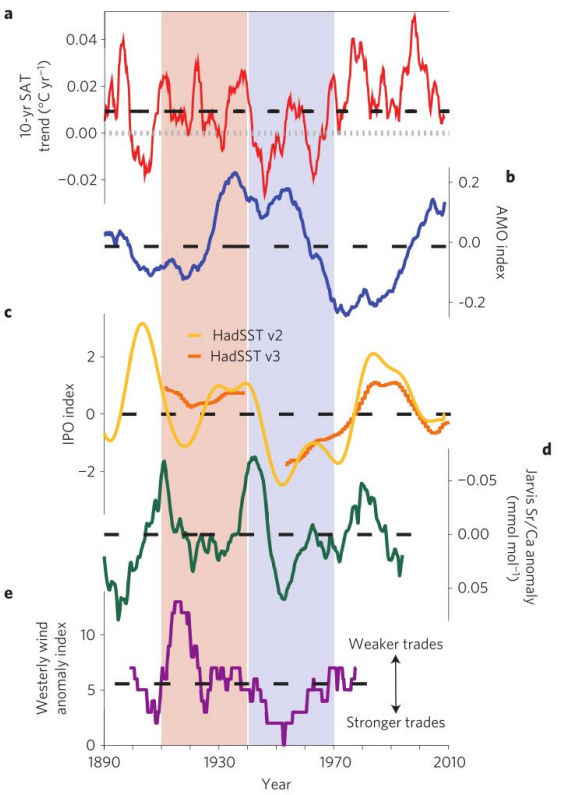
If/when the IPO switches back into a positive phase, what might happen to surface air temperatures?



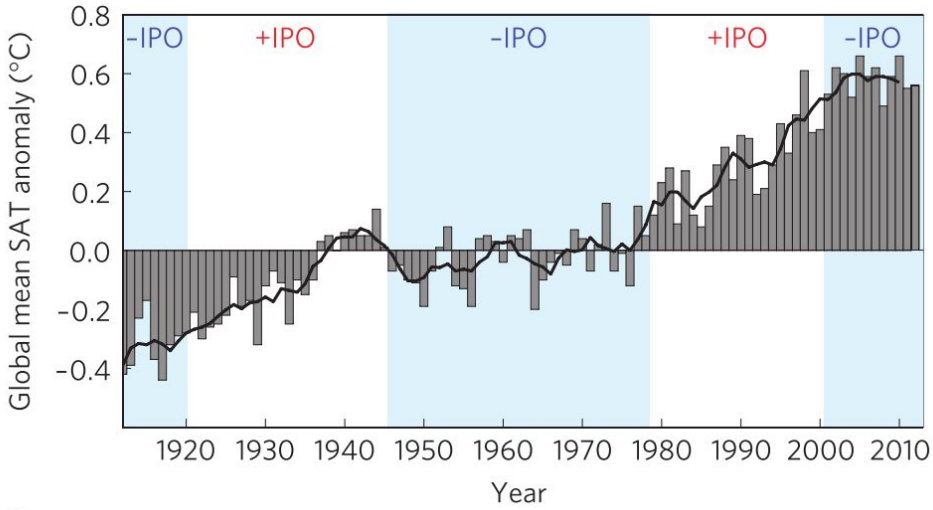
Accelerated warming

But slowly: 5 yrs for detectable trends

Paleoclimate records reflect this, capturing changes in winds associated with accelerated/decelerated warming

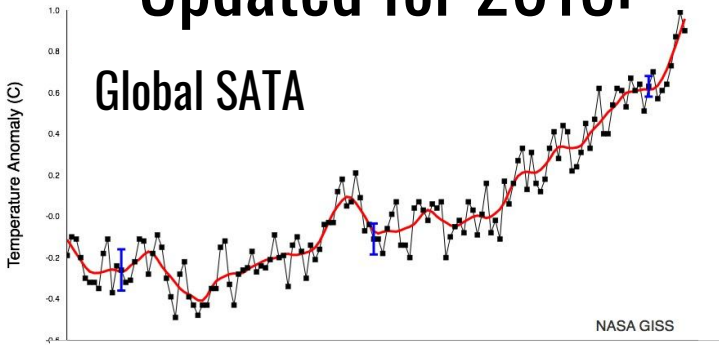


Thompson et al. 2015

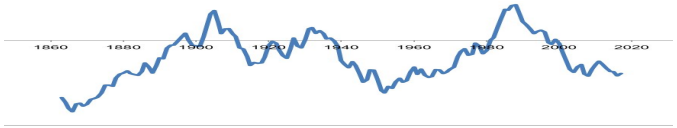


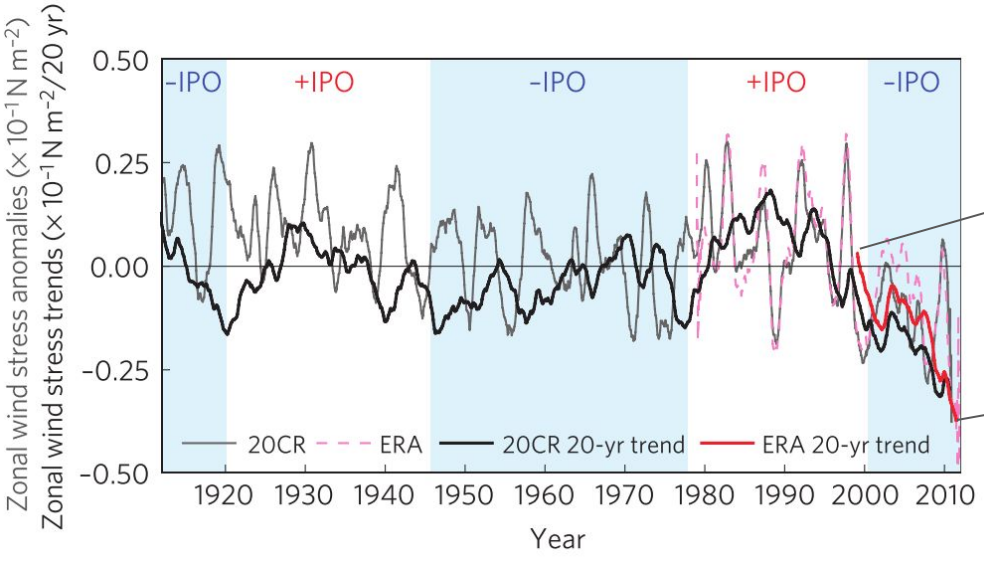
Updated for 2018:

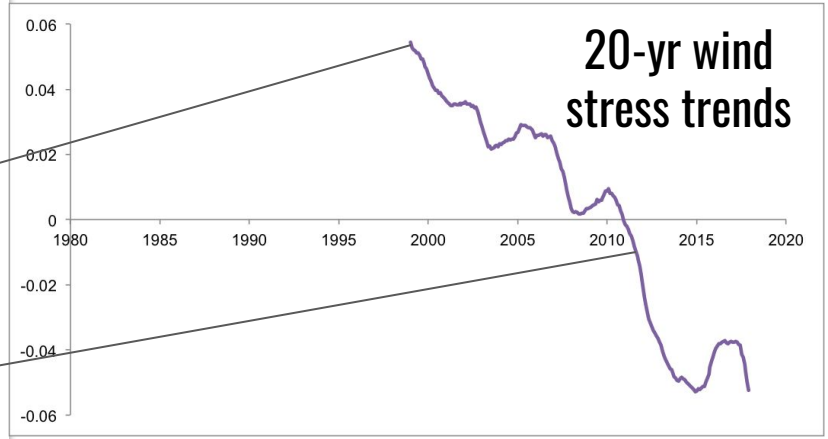
Global SATA



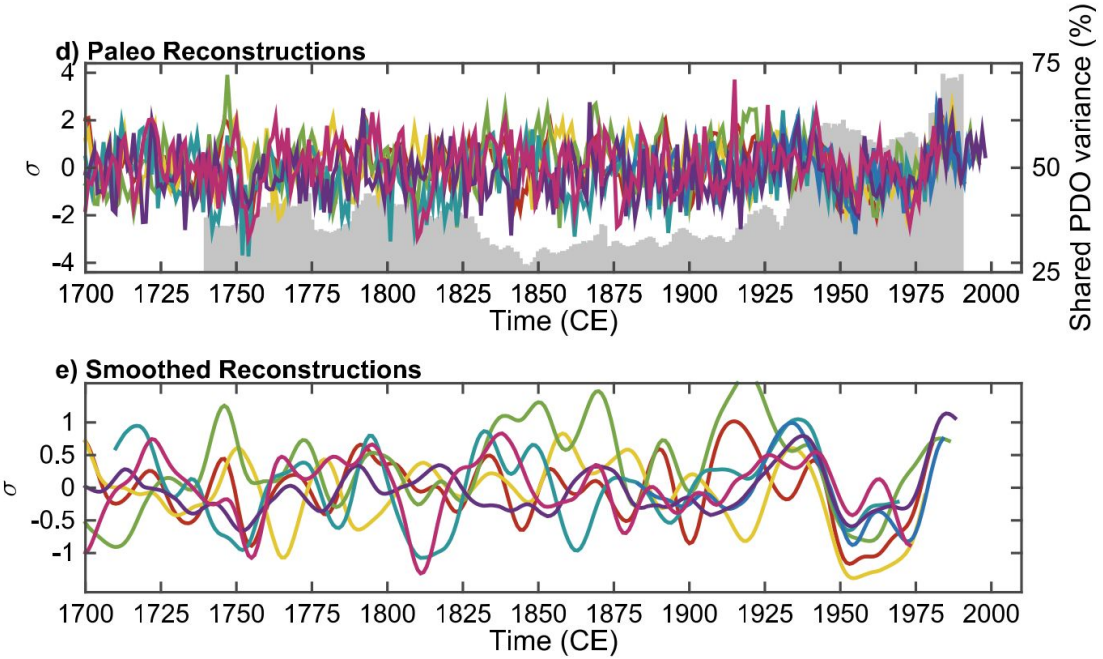
IPO





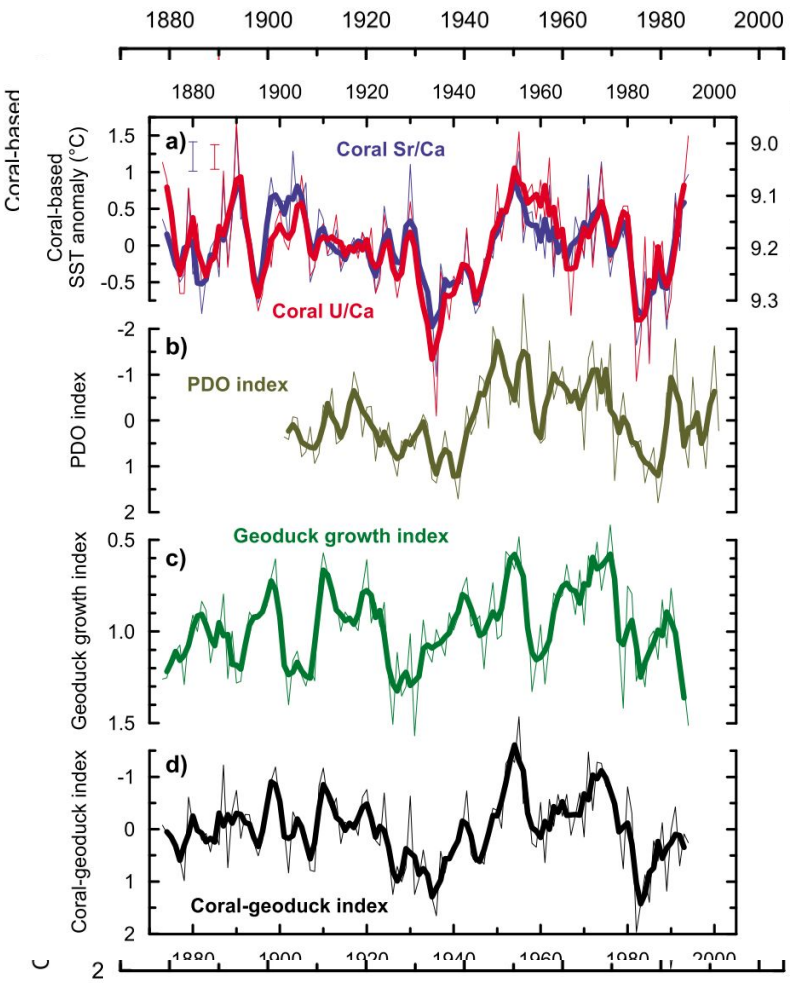


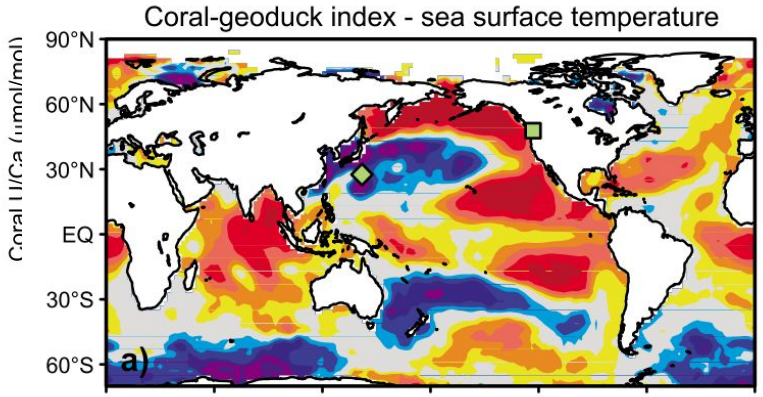
Proxy Record of PDV?



Reconstruction	Time period	Proxy used	Season targeted
Biondi et al. (2001)	1661–1991	Tree rings	Winter
D'Arrigo and Wilson (2006)	1565–1988	Tree rings	March–May (MAM)
Gedalof and Smith (2001)	1599–1983	Tree rings	MAM
MacDonald and Case (2005)	993–1996	Tree rings	Annual (January–December)
D'Arrigo et al. (2001)	1700–1979	Tree rings	Winter
→ Felis et al. (2010)	1873–1994	Coral (porites)	November–February (NDJF)
Shen et al. (2006)	1470–1998	Historical documents	Annual

Newman et al. 2016



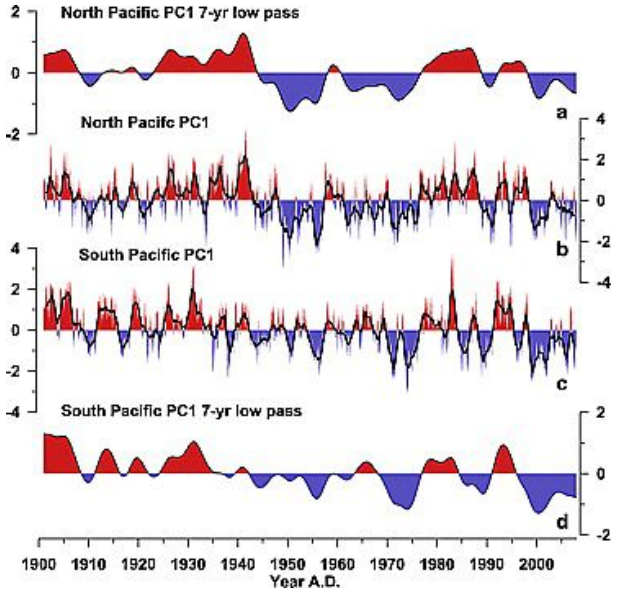


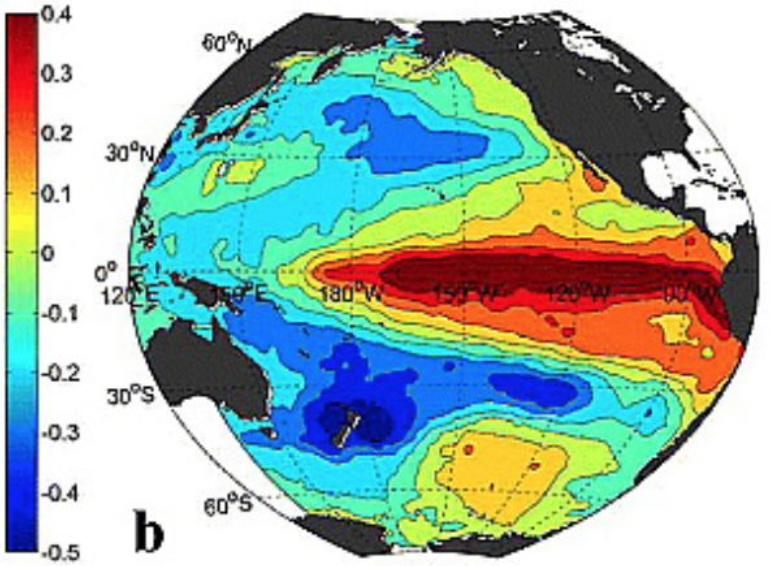
W Pacific Coral & E Pacific Geoducks

Felis et al. 2010

DeLong et al. 2012

Southern (Hemisphere) Pacific Decadal Oscillation



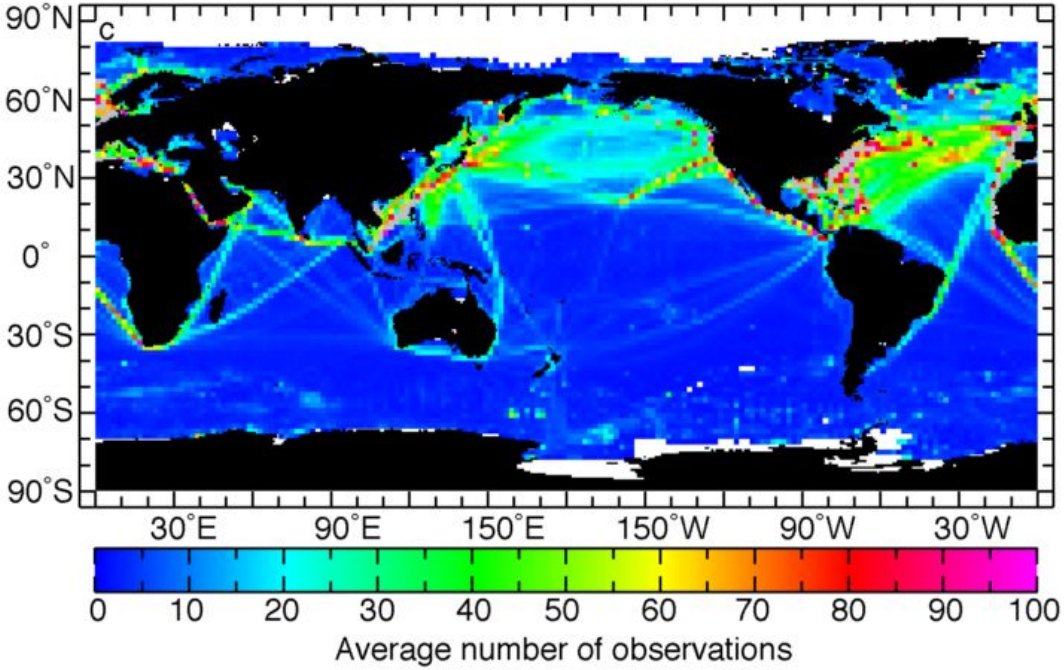


The S Pacific version of the PDO (southern limb of the IPO)

1st EOF of SST variability in South Pacific

Shakun & Shaman 2009

Why are paleoclimate proxies useful for low-frequency climate variability, especially in the S Pacific?



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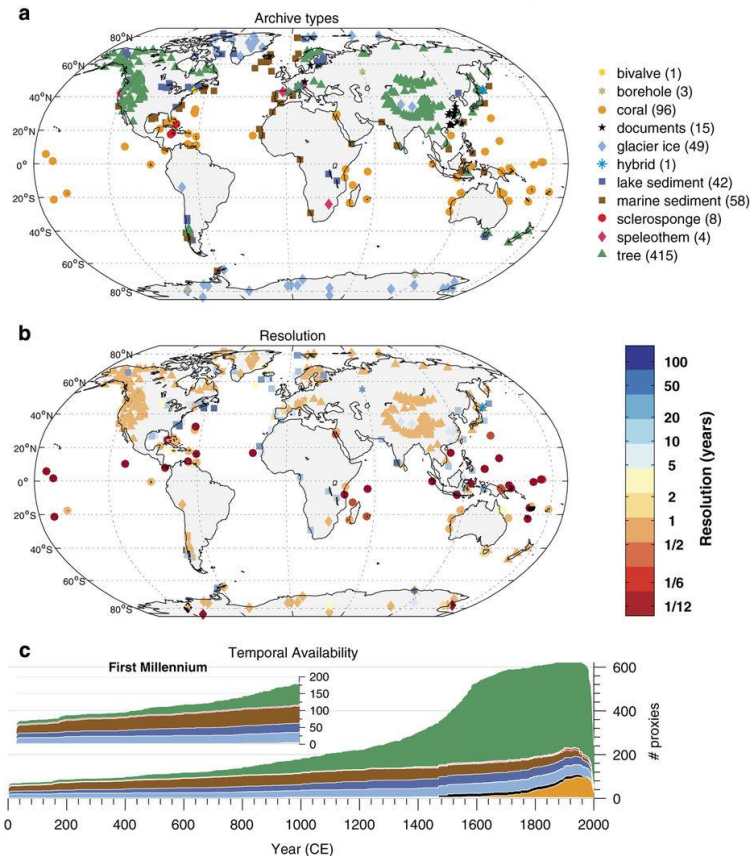


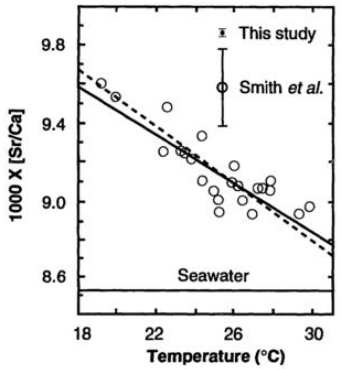
PAGES 2K 2017

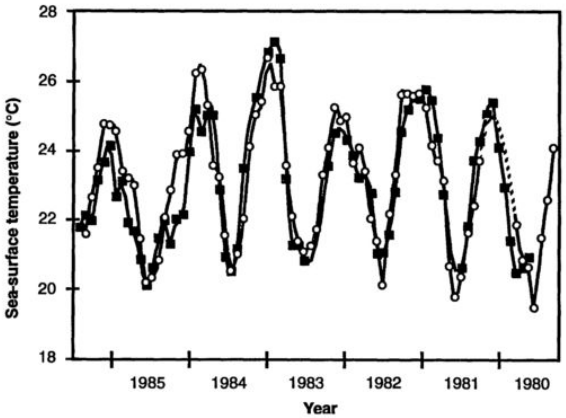
What proxy is used, and what climate variables does it measure in corals? What might be the advantages/limitations of this proxy?

Sr/Ca

Sr: well-mixed (1000yr), long residence time in ocean (3 my)→generally homogenous in oceans

Sr substitutes for Ca in coral skeleton: ratio depends on T (+ vital effects)





Beck et al. 1992; Edmond et al. 1992

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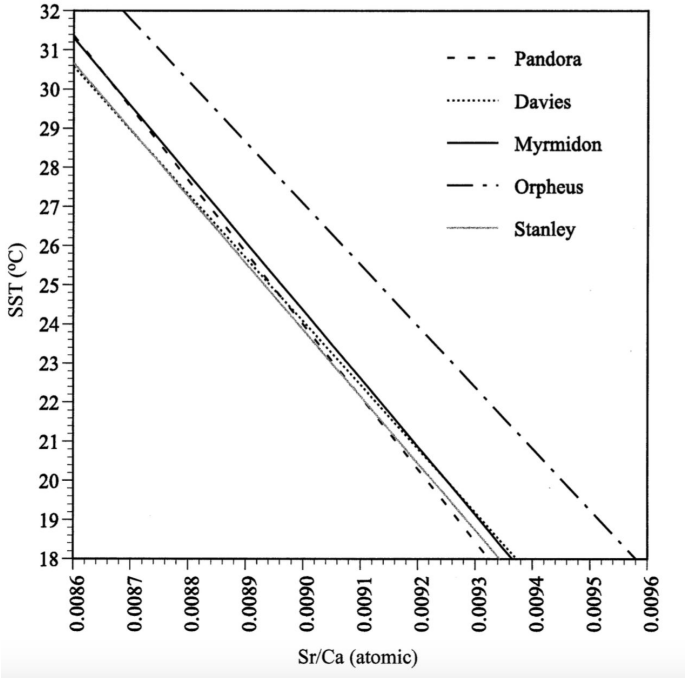
Sr/Ca

Advantage: SST proxy, independent of SSS

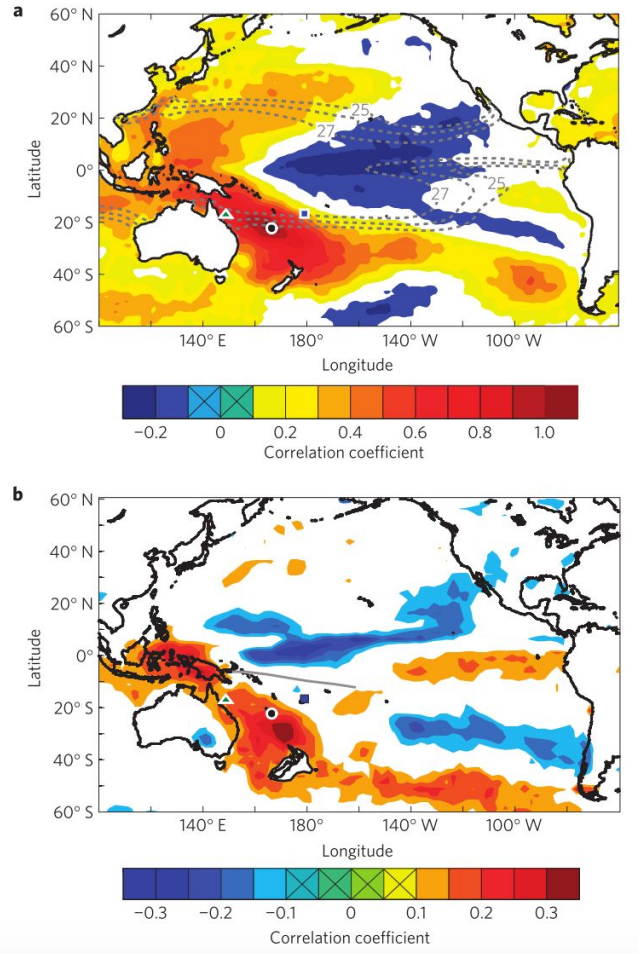
Limitations: Calibrations vary between sites & corals



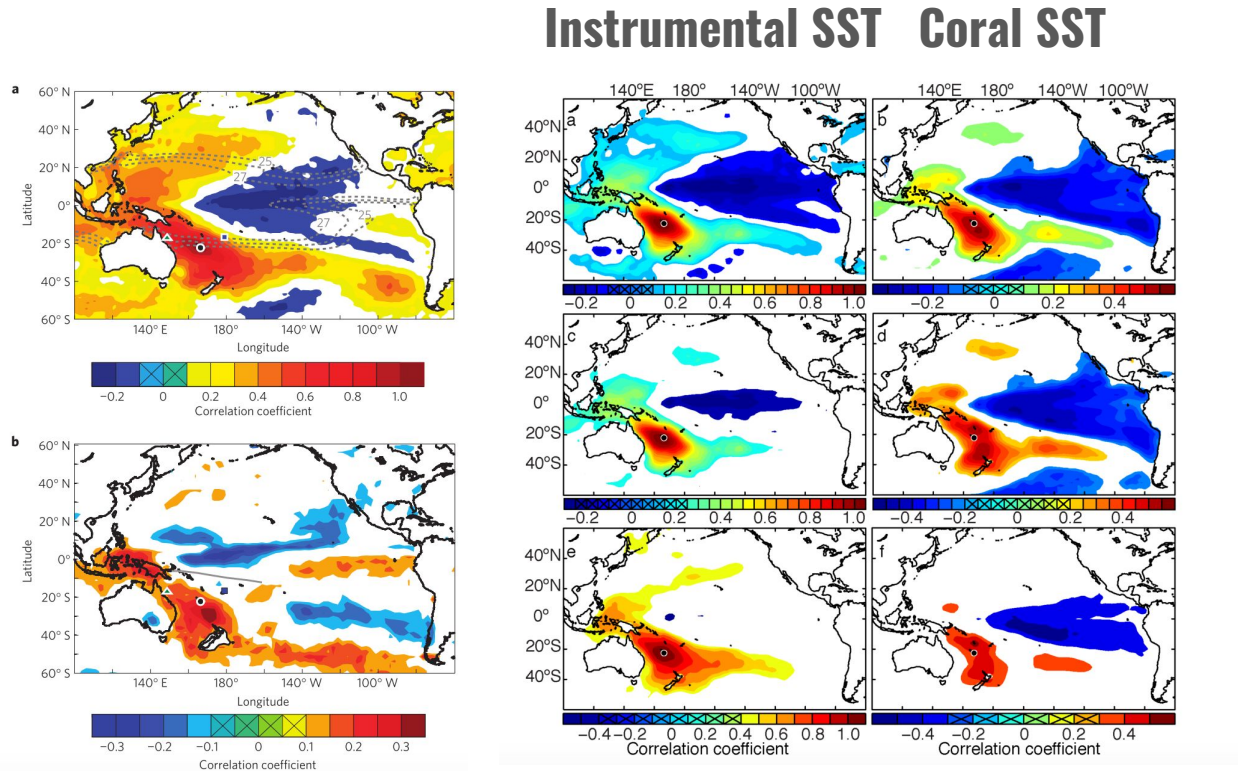
Marshall & McCulloch 2002

How do SST's at New Caledonia relate to the IPO/PDO?

Similar spatial pattern to PDO/IPO (negative phase)



Why might correlations between SST at New Caledonia and the E equatorial Pacific be unusually low?

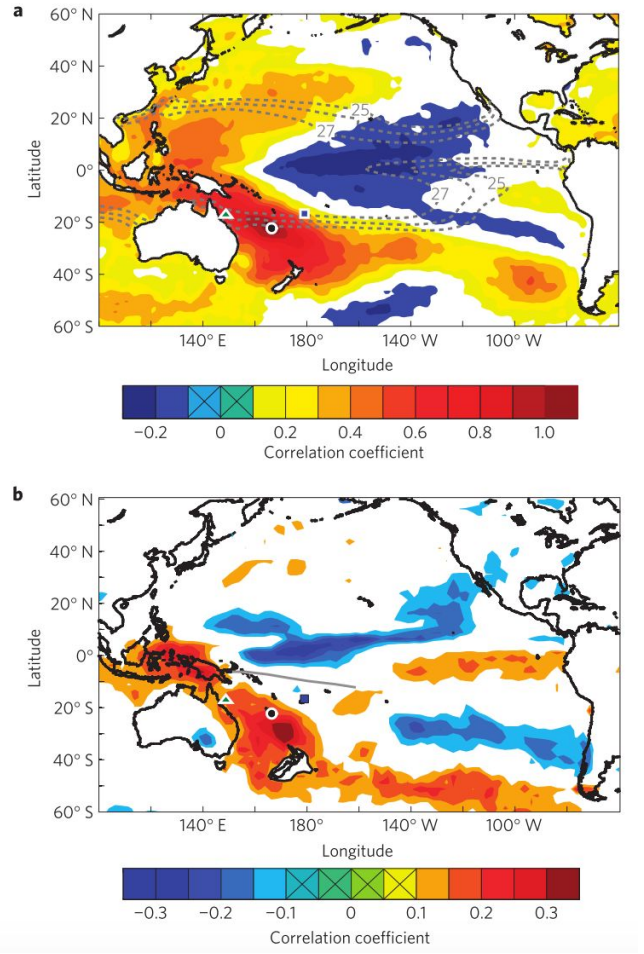


In reconstructed SSTA, it's not!

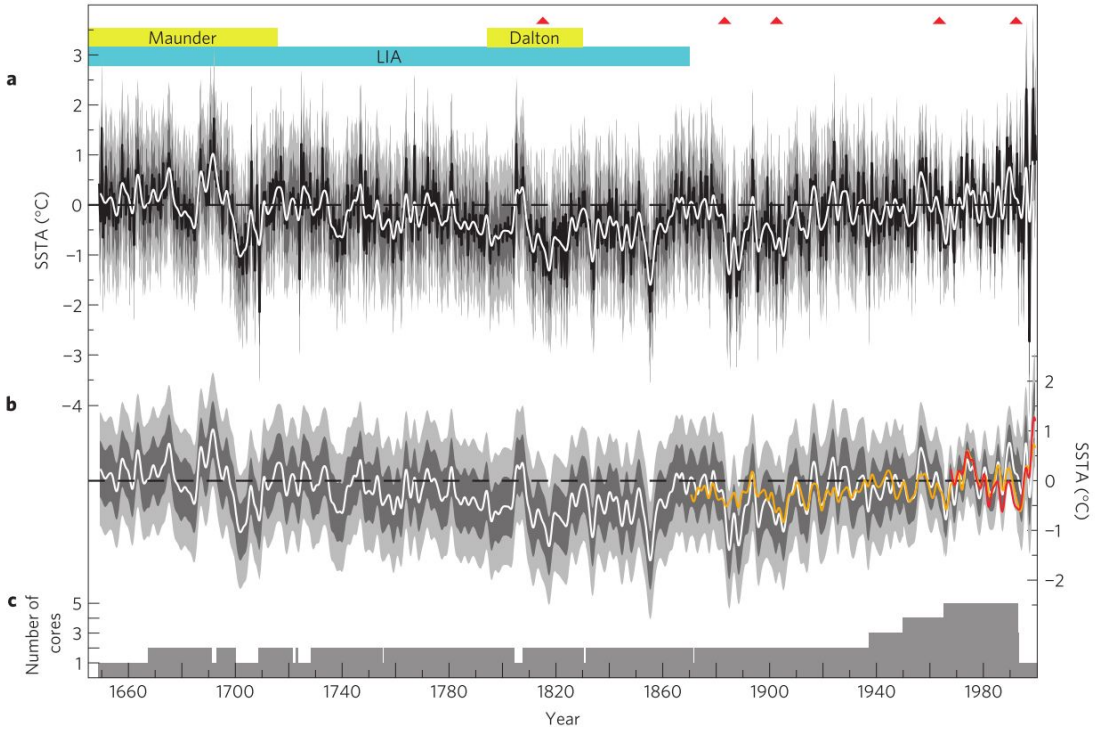
Interpolation in SST datasets could remove teleconnections with E Pacific

Are spatial correlations with precipitation stronger/weaker than those with SST? Why?

Weaker: lower signal:noise ratio



What do the red triangles represent, and why do they often correspond with anomalously cold SST's?

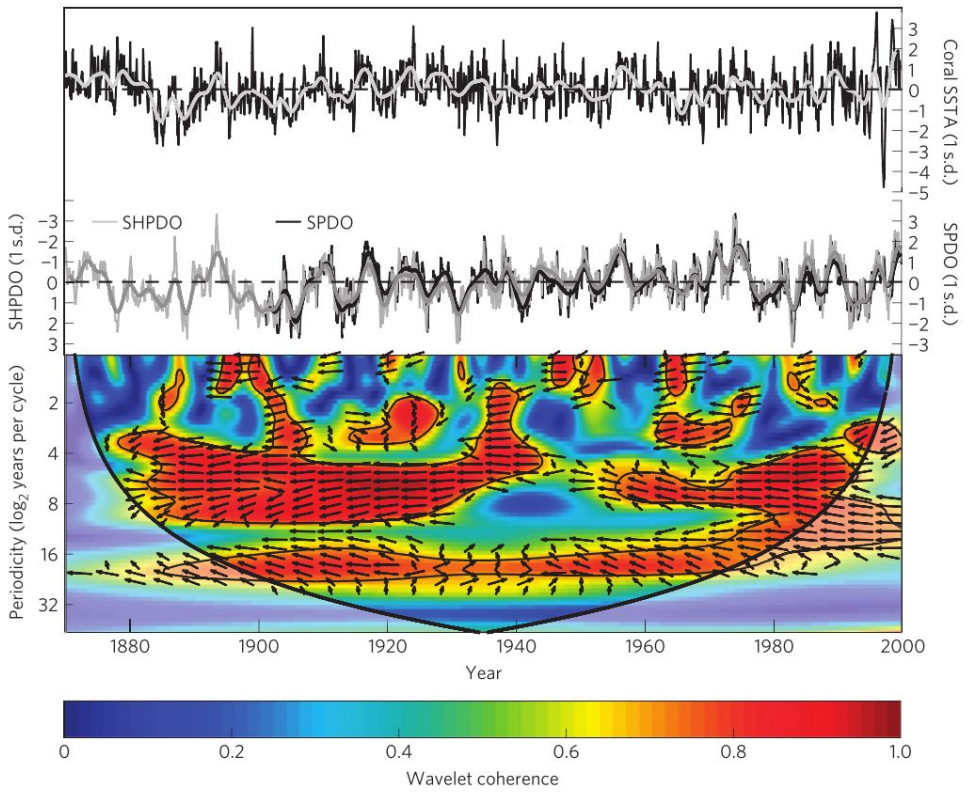


SO_2 lowers global temperatures temporarily

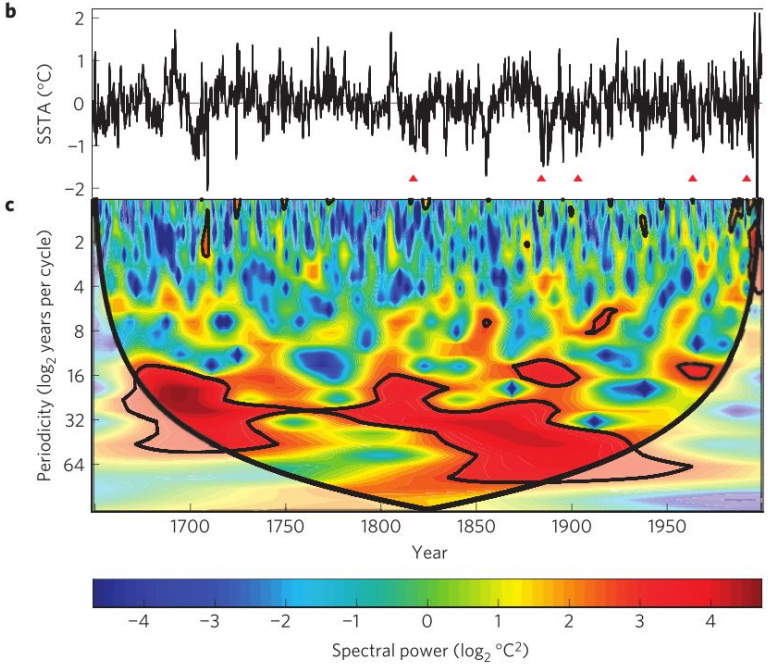
Visible in wavelet spectra: "false oscillations"

How do DeLong et al. conclude that this proxy record accurately reconstructs the SHPDO/SPDO?

16 years →



What do DeLong et al. conclude about changes in decadal/interdecadal variability during the industrial period (1850-present)? What evidence do they use to support their conclusion? Do you agree with this conclusion?



"...decadal scale SST variations modulate in periodicity suggesting a temporal shift in natural decadal variability for this location, which coincides with the beginning of the anthropogenic-warming trend."