ENSO Warming vs. CO_2 Warming

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Intro

- Follow up to my presentation: "**Does ENSO Dominate Global Warming?**" https://youtu.be/Lrvn7Sihgtg

- There, I argued that ENSO warming plausibly explains most of the observed global warming over past half century.

- But I ignored a comparison of CO2 warming to ENSO warming.

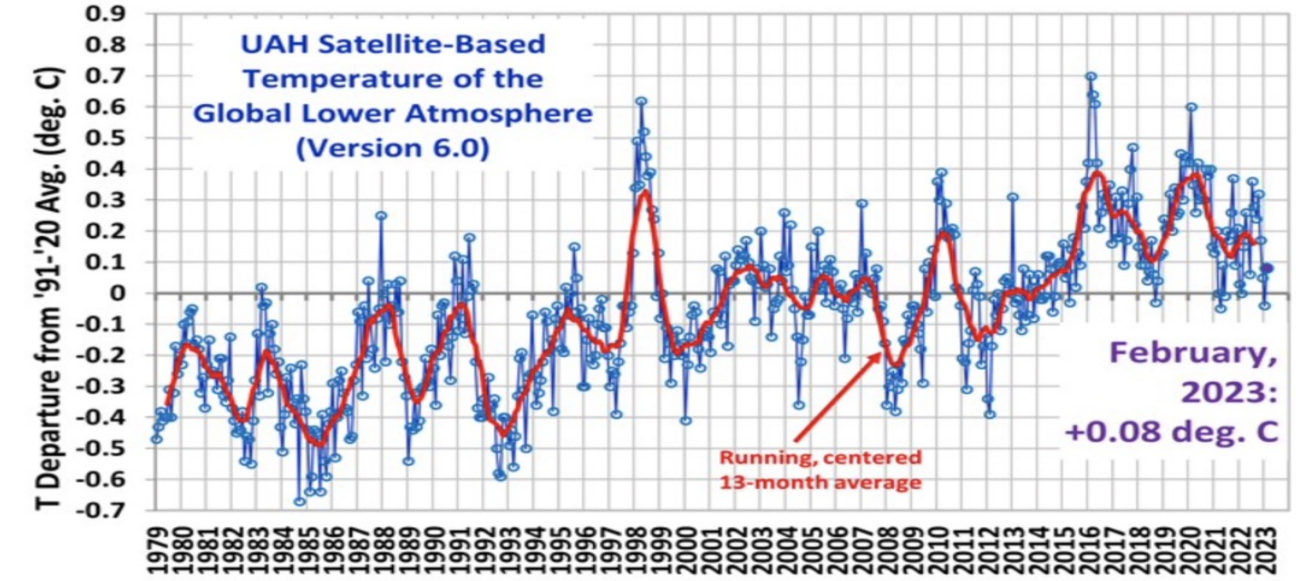
- Yet we know that CO2 does radiative forcing, hence *could* be warming atmosphere along with ENSO warming…..

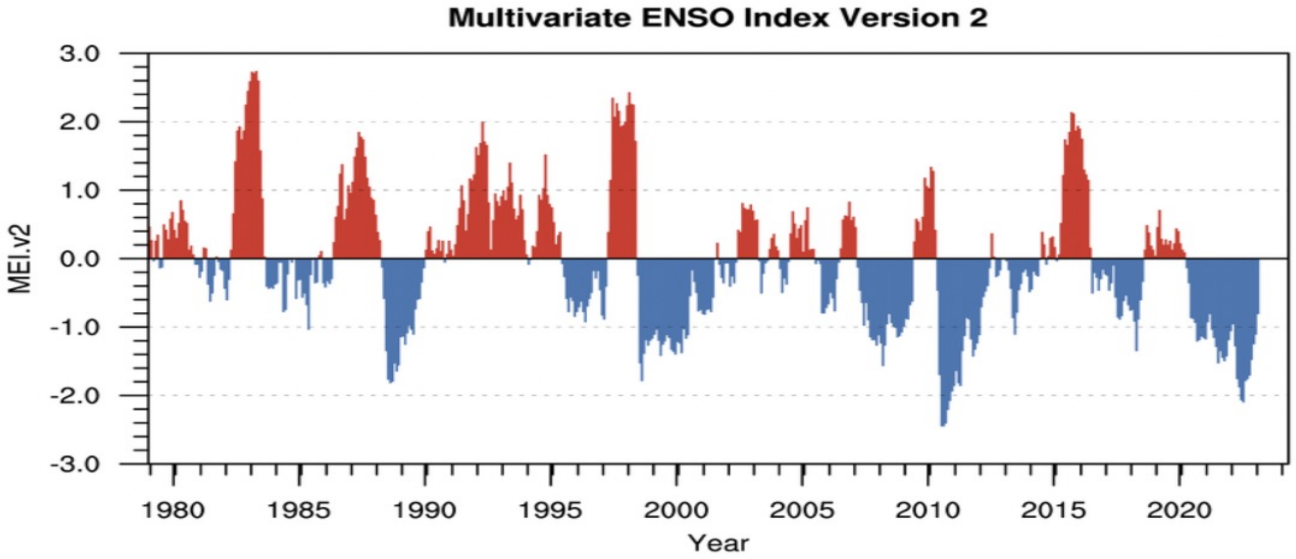
Objectives

- 1) What is the place of CO2 warming relative to ENSO warming?
- 2) How does magnitude of CO2 warming compare to that of ENSO warming?
- 3) Does evidence for ENSO warming give insight into size of CO2 warming?
- 4) How might CO2 warming impact ENSO warming?

First, quick recap of evidence for ENSO warming dominance.

ENSO dominance: visual evidence

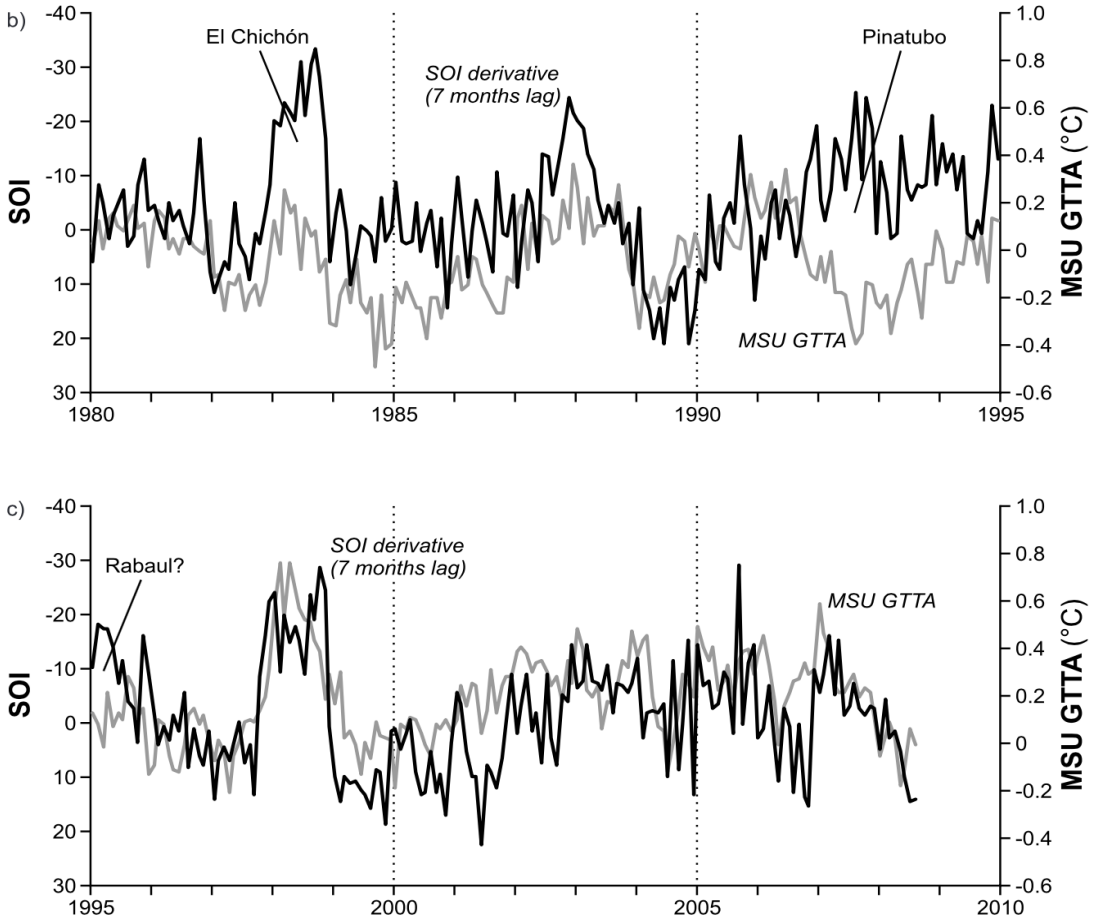




Sources: https://www.drroyspencer.com/latest-global-temperatures/
https://psl.noaa.gov/enso/mei/

ENSO dominance: McLean et al. (I)

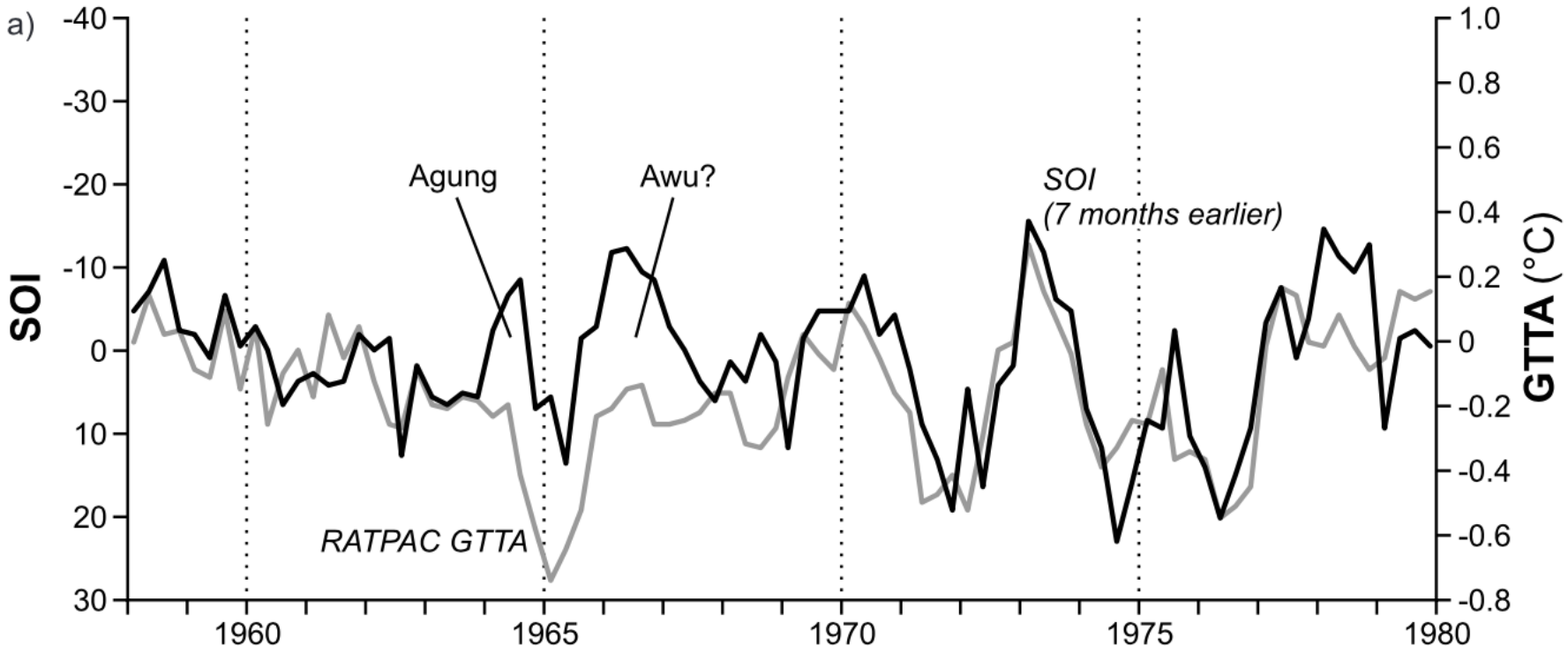
J. D. McLean, C. R. de Freitas, and R. M. Carter, "Influence of the Southern Oscillation on tropospheric temperature", J. Geophys. Res. (2009).



- Southern Oscillation Index accounts for 72% of monthly variance in global UAH (satellite) record, 68% in RATPAC (balloon) record, 81% in Tropics (UAH).

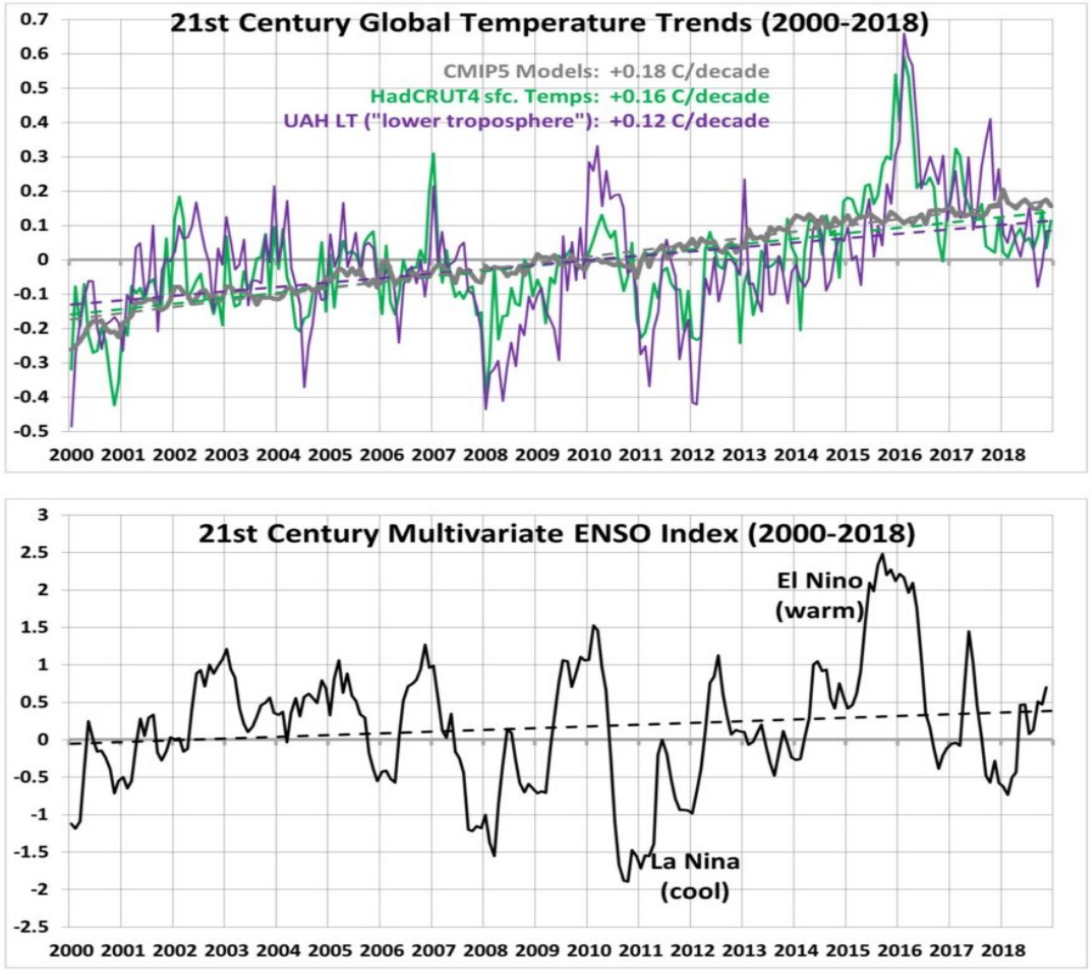
Source: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2008JD011637

ENSO dominance: McLean et al. (II)



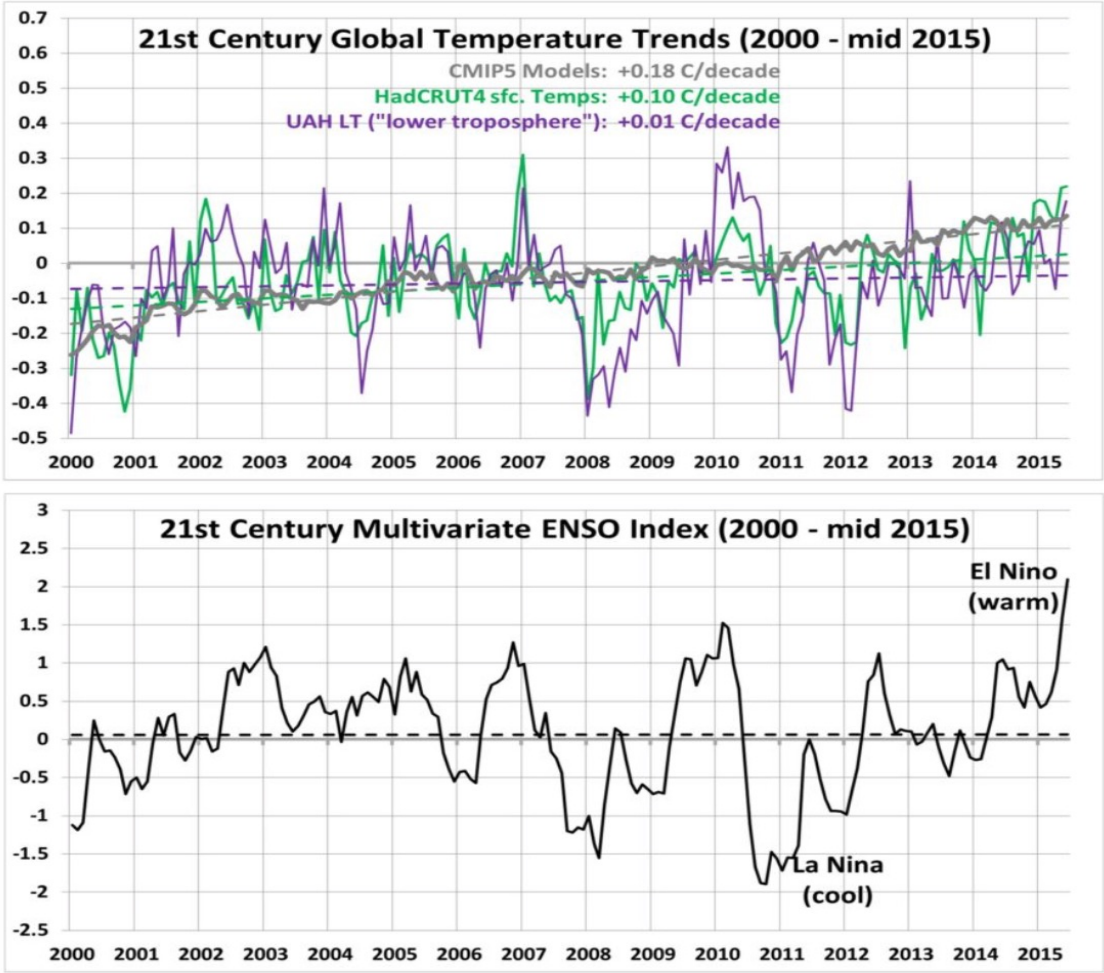
Source: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2008JD011637

ENSO dominance: Dr. Roy Spencer (I)



Source: https://www.drroyspencer.com/2019/05/half-of-21st-century-warming-due-to-el-nino/

ENSO dominance: Dr. Roy Spencer (II)

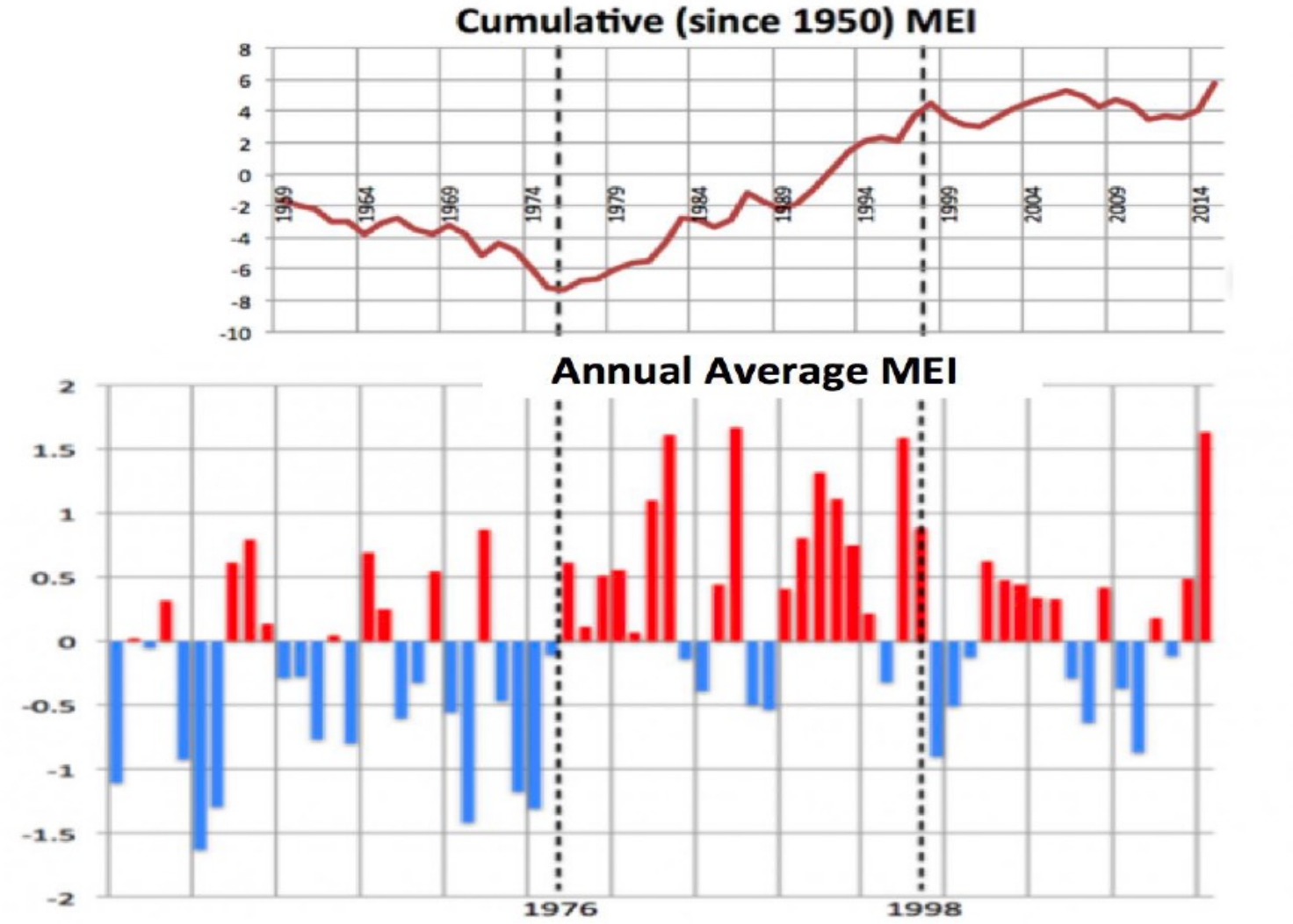


Source: https://www.drroyspencer.com/2019/05/half-of-21st-century-warming-due-to-el-nino/

ENSO dominance: Wallace-Christy-D'Aleo (I)

- 2016 report by Wallace, Christy, and D'Aleo – "On the Existence of a 'Tropical Hot Spot' & The Validity of EPA's CO_2 Endangerment Finding"
- Asks: does adjusting temperature time series ***only*** for the impact of ENSO – via MEI, cumulative MEI, and "1977 Pacific shift" MEI variable – account for all of the positive and statistically significant warming trend?
- Answers via standard econometric modeling – regression analysis – of 13 different temperature time series (9 Tropics, 1 for U.S., and 3 Global).
- **Yes** in all 13 cases!

Figure VI-2



Source: http://www.esrl.noaa.gov/psd/enso/mei/table.html

Source: https://thsresearch.wordpress.com/2016/09/17/ths-exec-sum/

Figure XX-3

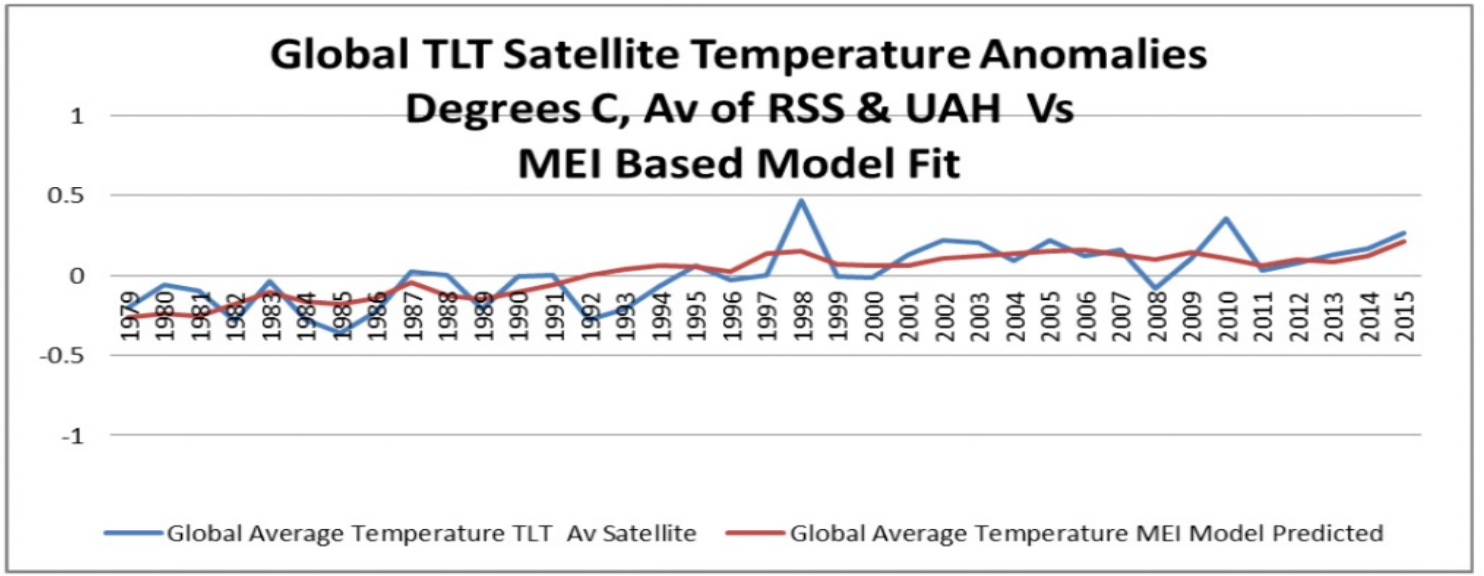
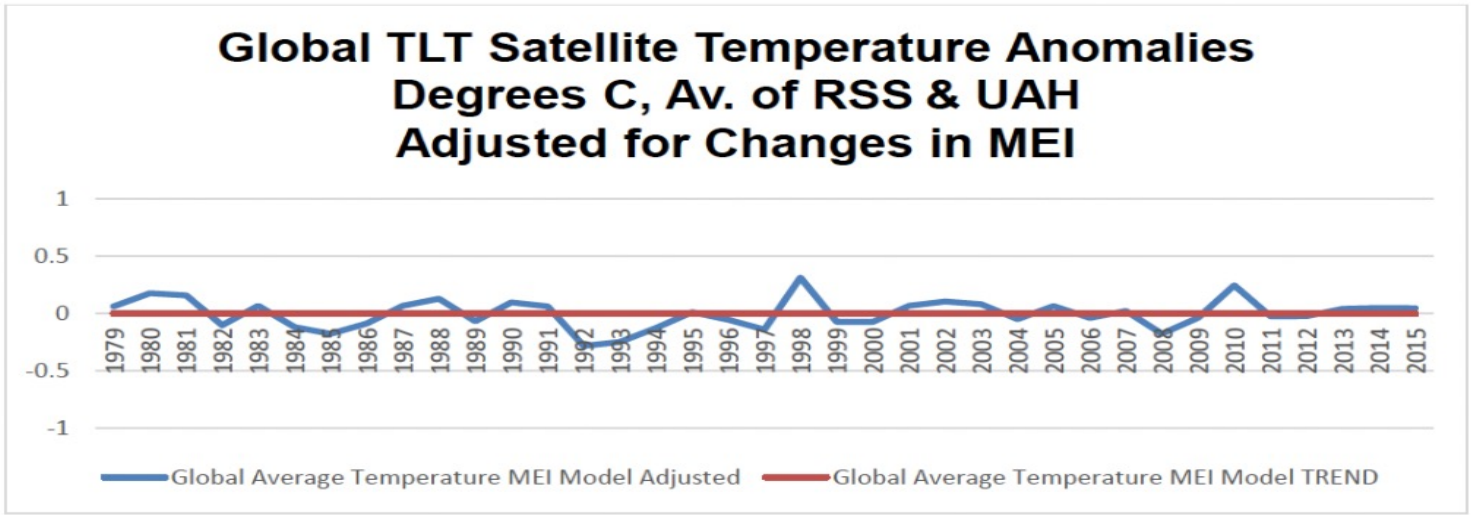


Figure XX-4



Source: https://thsresearch.wordpress.com/2016/09/17/ths-exec-sum/

Figure XXI-2

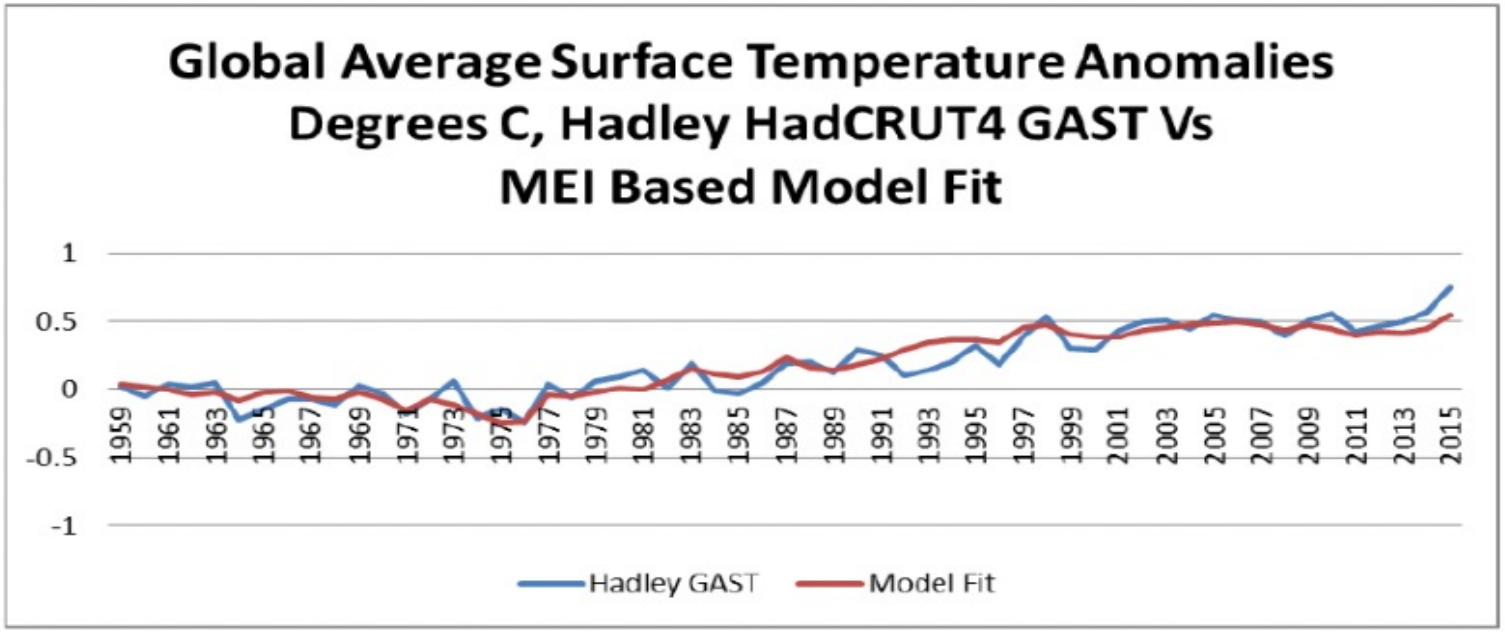
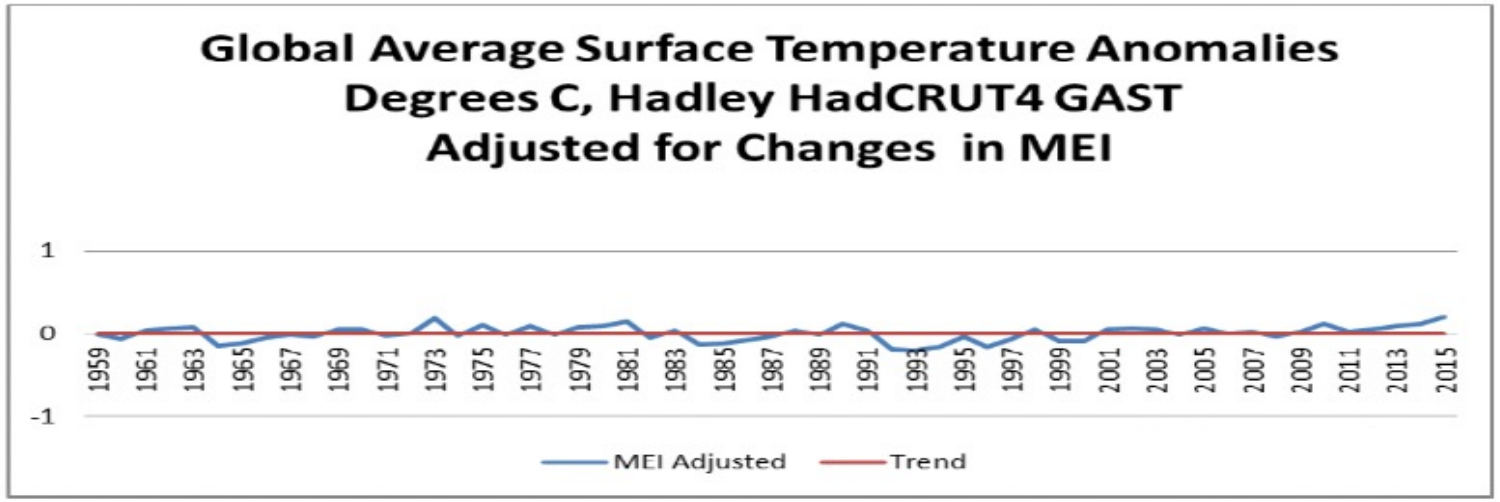


Figure XXI-4



Source: https://thsresearch.wordpress.com/2016/09/17/ths-exec-sum/

CO2 warming I

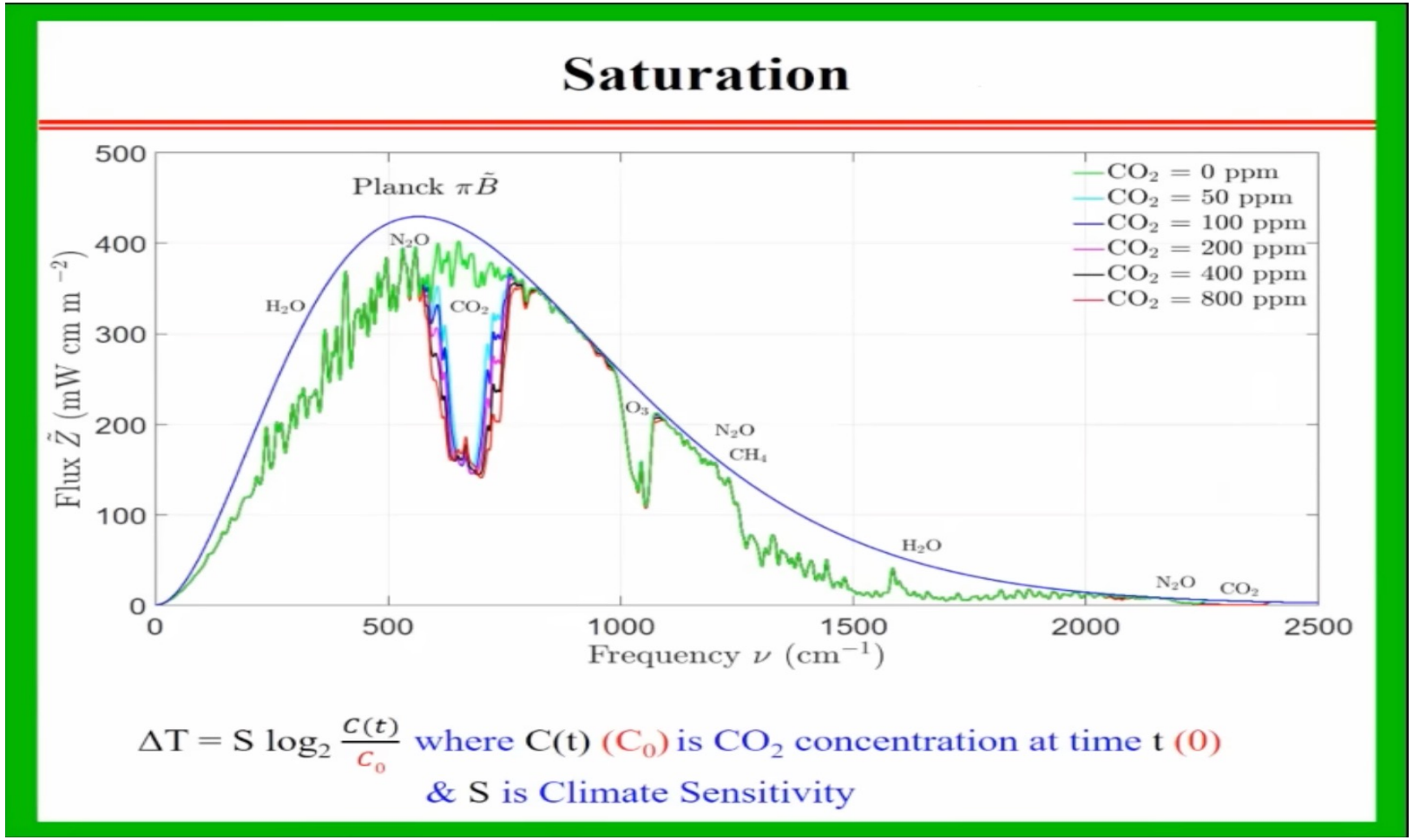
- How big is *direct* greenhouse warming from atmospheric CO2 alone?

- Wijngaarden & Happer (2023): Detailed calc of effects of GHGs shows **doubling** atmospheric CO2 reduces radiation flux to space by ~ 1% (clear sky model) hence radiative forcing of ~ 3 W/m^2 .

- To first approx, increases surface absolute temperatures by ~ 1/4% or ~ **0.75 C.**

- Ex: Pre-industrial CO2 = ~ 280 ppm. Doubling to 560 ppm increases absolute surface temp by only ~ 0.75 C! (Currently we're at 420 ppm).

CO2 warming II



Source: W. van Wijngaarden's Tom Nelson podcast

CO2 warming lll

- We show direct warming from CO2 is too small to account for observed warming:
- UAH satellite global trend in LT since Jan 1979 as of Feb 2023: +0.13 C/decade.
- Actual warming since Jan 1979: $\Delta T_{actual} \sim$ **+0.57 C**
- Atmospheric CO2 concentration in 1979, ~338 ppm: Δ(CO2) ~ +82 ppm.
- CO2 direct warming since 1979: $\Delta T_{CO2} \sim$ **+0.18 C**

Amplified CO2 warming? I

- Direct warming from CO2 far too small. So how does IPCC get “best estimate” of 3 C by 2100??
- *Assumption* among proponents of anthropogenic warming: water vapor and clouds provide **net positive** feedbacks to amplify warming from CO2. Put into climate computer models (CMIP).
- Basic idea: direct warming from CO2 increases T of atmosphere, hence more evaporation occurs and more atmospheric water vapor, the most abundant GHG hence more powerful as GHG than CO2. The more atmospheric water vapor, more warming occurs. And the more CO2 put in atmosphere, more water vapor it retains, and so on.
- Anthropogenic warmists (e.g. IPCC) estimate water vapor feedback using Clausius-Clapeyron relation from thermodynamics: says atmosphere holds 7% more water vapor per 1 C rise in T.
- Well-established in lab experiments. But does it hold for the climate system?

Amplified CO2 warming? II

- Some clouds (e.g. thick low clouds and "warm" clouds) strongly reflect sunlight back into space, little impact on IR radiation escaping to space: act as significant **negative** feedback to CO2 warming.

Amplified CO2 warming? III

- Upper-level thin cirrus clouds let sunlight through; effectively prevent heat from escaping to space. **Positive** feedback to warming!

- However: "Iris effect" (Lindzen et al.) means such cloud coverage in Tropics reduces in response to warming (confirmed by satellites). Hence **negative** feedback!

Amplified CO2 warming? IV

- IPCC AR6 report: “clouds remain the largest contribution to overall uncertainty in climate feedbacks [in climate models] (*high confidence*).” (IPPC, 2021, pp. TS-59).

- At any time, ~ 2/3 of earth’s surface covered by clouds! Blue marble.

Amplified CO2 warming? III

- Patrick Frank, in Front. Earth Sci (2019):

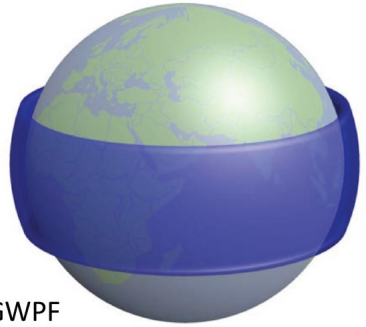
  The reliability of general circulation climate model (GCM) global air temperature projections is evaluated for the first time, by way of propagation of model calibration error. An extensive series of demonstrations show that GCM air temperature projections are just linear extrapolations of fractional greenhouse gas (GHG) forcing. Linear projections are subject to linear propagation of error. A directly relevant GCM calibration metric is the annual average ±12.1% error in global annual average cloud fraction produced within CMIP5 climate models. This error is strongly pair-wise correlated across models, implying a source in deficient theory. ***The resulting long-wave cloud forcing (LWCF) error introduces an annual average ±4 Wm^{-2} uncertainty into the simulated tropospheric thermal energy flux. This annual ±4 Wm^{-2} simulation uncertainty is ±114 × larger than the annual average ~0.035 Wm^{-2} change in tropospheric thermal energy flux produced by increasing GHG forcing since 1979****….*

Amplified CO2 warming? IV

- NOAA's International Satellite Cloud Climatology Project:

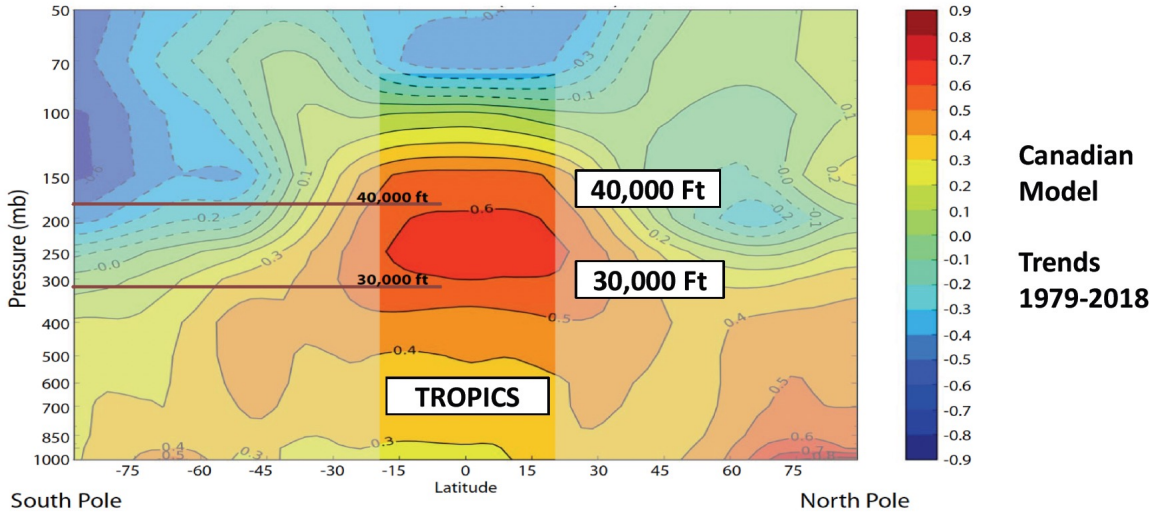
  "A doubling in atmospheric carbon dioxide (CO_2), predicted to take place in the next 50 to 100 years, is expected to change the radiation balance at the surface by only about 2 percent. Yet according to current climate models, such a small change could raise global mean surface temperatures by between 2-5°C (4-9°F), with potentially dramatic consequences. If a 2 percent change is that important, then a climate model to be useful must be accurate to something like 0.25%. Thus **today's models must be improved by about a hundredfold in accuracy**, a very challenging task."

Amplified CO2 warming? V



GWPF

Test Metric: Temperature, Tropical upper troposphere 300-200 hPa (~30k-40k ft)



Canadian Model

Trends 1979-2018

- Prediction of naïve net positive feedback mechanism from water vapor: Tropical “hot spot”.

NOAA: *The increased moisture content of the atmosphere amplifies the initial radiative heating due to the greenhouse gas increases…. The re-establishment of a new thermal equilibrium in the climate system involves the communication of the added heat input to the troposphere and surface, leading to surface warming…. From the preceding discussions, the lapse rate can be expected to decrease with the resultant increase in humidity, and also to depend on the resultant changes in atmospheric circulation. In general, the lapse rate can be expected to decrease with warming such that temperature changes aloft exceed those at the surface.*

Source: https://clintel.org/new-presentation-by-john-christy-models-for-ar6-still-fail-to-reproduce-trends-in-tropical-troposphere/

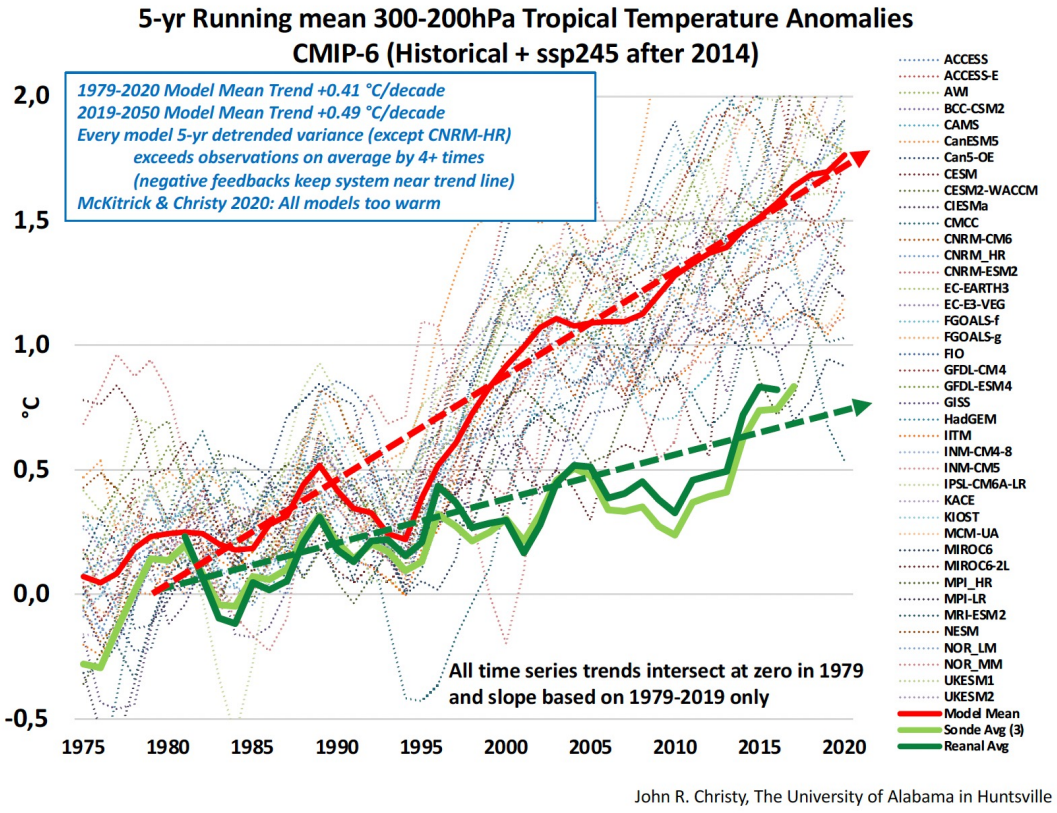
Three questions

- How do climate model predictions/retrodictions compare to observations for *global* avg temp anomaly in the troposphere?

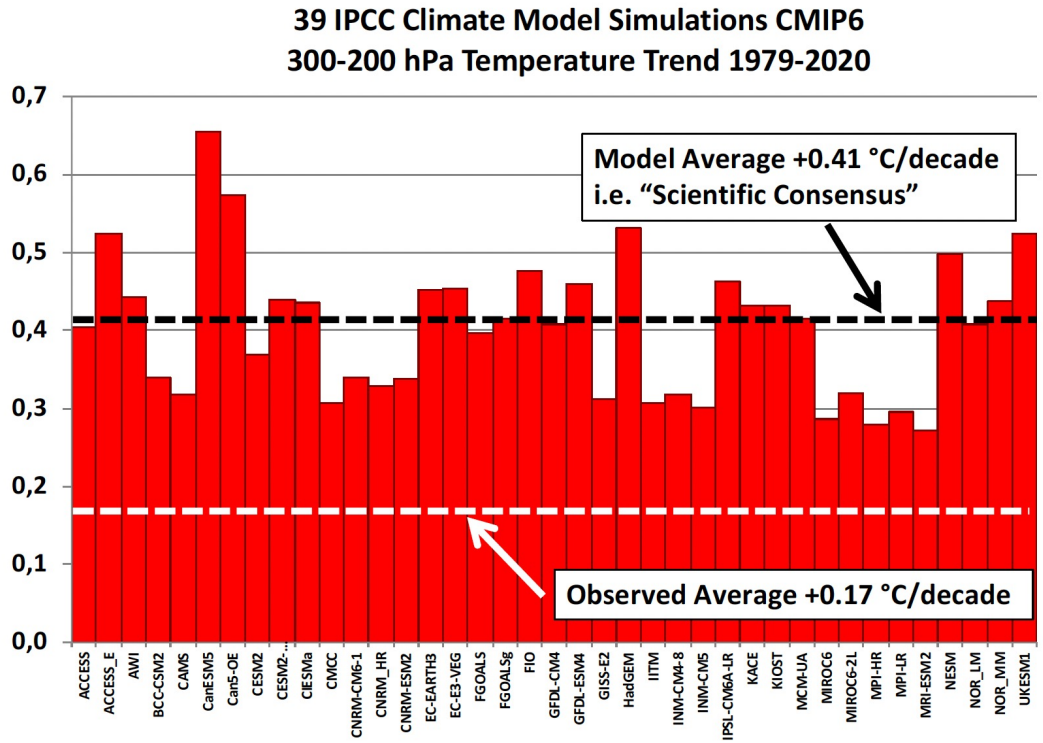
- How do climate model predictions/retrodictions compare to said observations in troposphere over the *Tropics*?

- By comparison, how well do ENSO warming models fit observations of tropospheric warming over the Tropics? Globally, saw they fit extremely well.

Models too warm I



John R. Christy, The University of Alabama in Huntsville



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Models too warm II

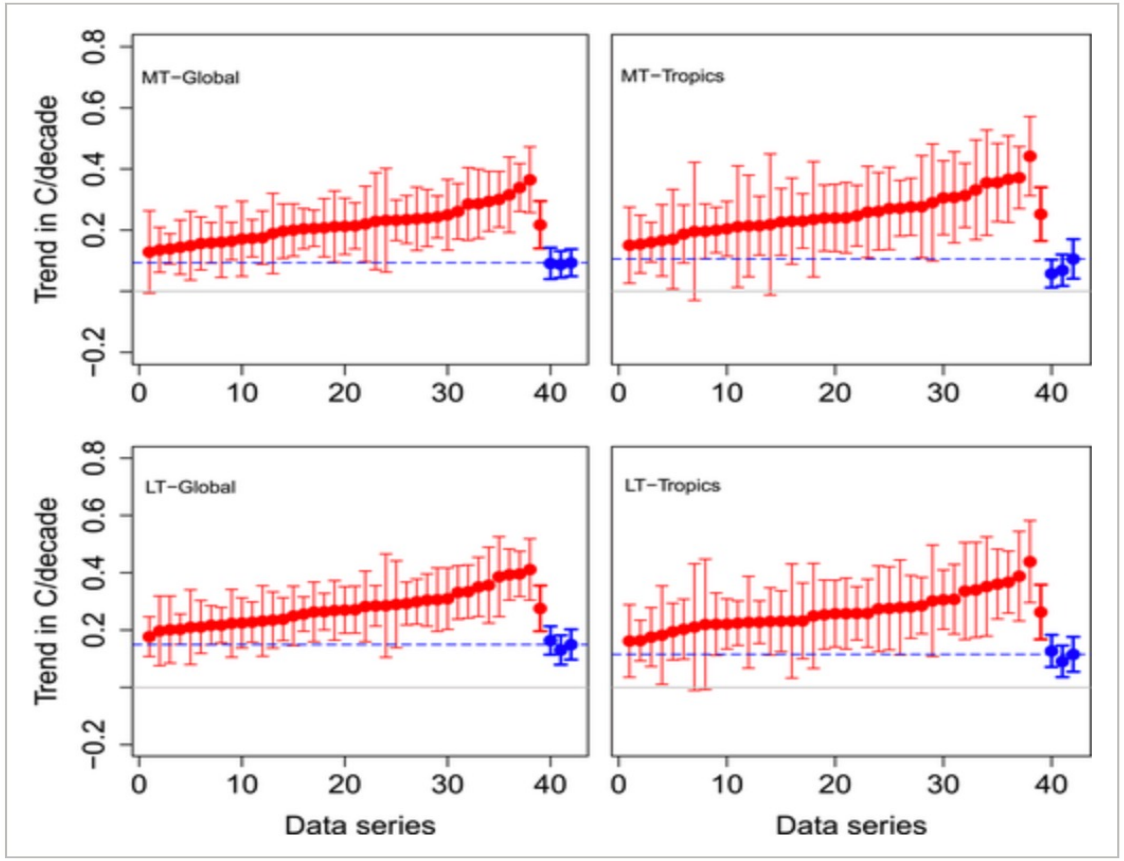


Figure 3 Open in figure viewer | PowerPoint

Trends and 95% CIs for individual models (red dots and thin bars), CMIP6 mean (red dot and thick bar), and observational series (blue). Horizontal dashed line shows mean satellite trend.

Source: McKitrick & Christy (2020), Earth and Space Science, Vol. 7, Issue 9.

Models too warm III

- Models with assumed net positive feedbacks from water vapor + clouds warm too fast globally and in Tropics, compared to tropospheric observations.

- Implies that negative feedbacks from water vapor + clouds are significantly underestimated by models!

- Ex: inputting some degree of “Iris effect” in models via anvil cirrus clouds over Tropics reduces predicted “hot spot” (Mauritsen & Stevens (2015)).

ENSO modeling in Tropics I

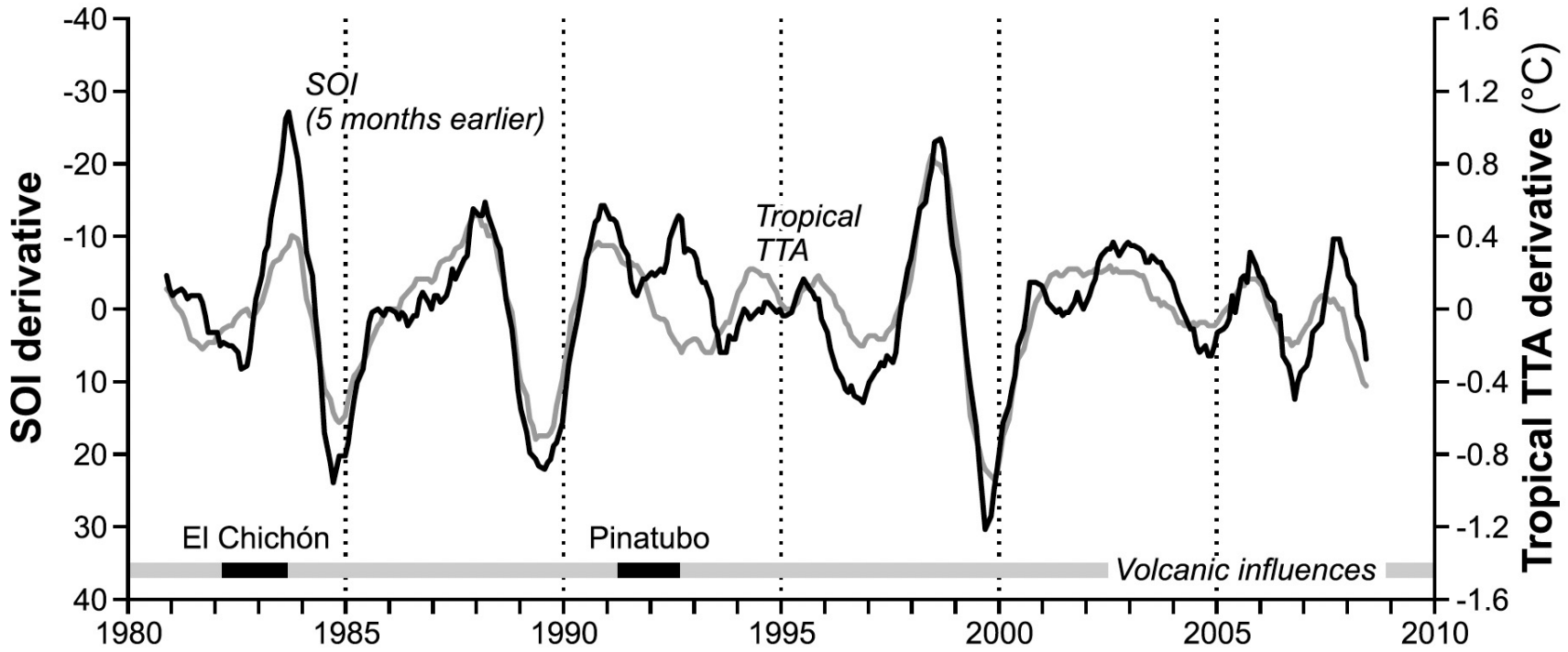


Figure 6. Derivatives of SOI (dark line) and UAH tropospheric temperature anomalies (light line) in the tropics, with SOI from 5 months earlier. The indicated periods of volcanic activity were excluded from calculations. Start date for data is 1981 because of the method of calculation of derivatives.

Source: McLean et al. (2009), J. Geophys. Res., Vol. 114, D14

ENSO modeling in Tropics II

Figure X-1

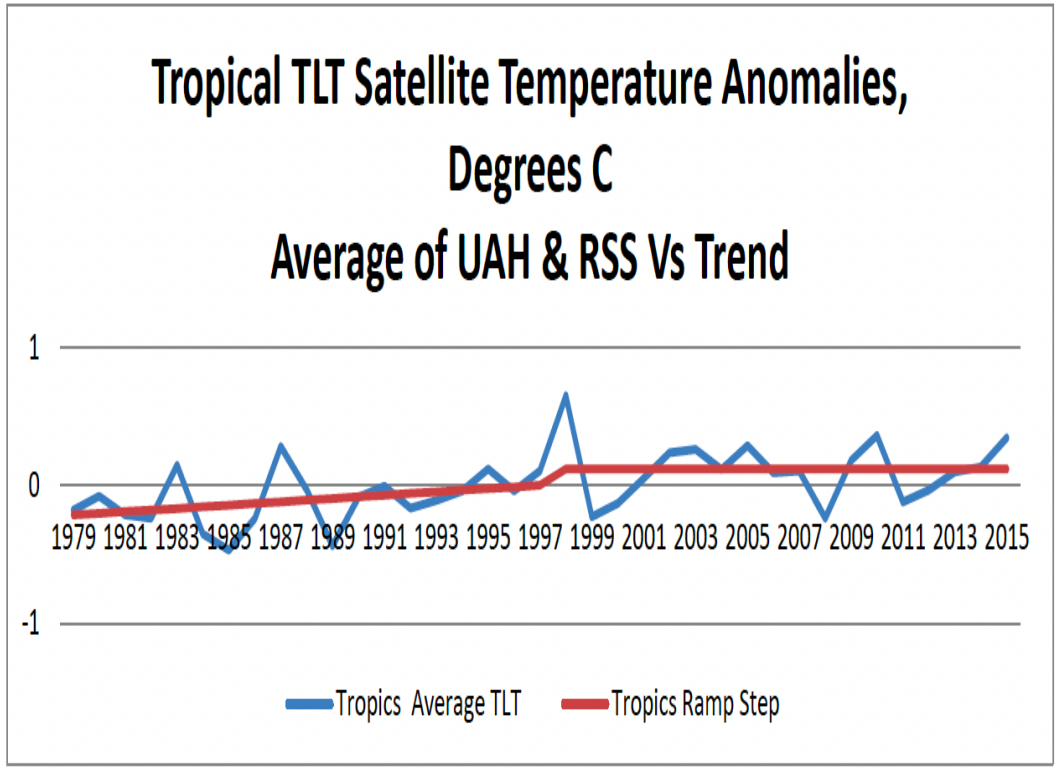
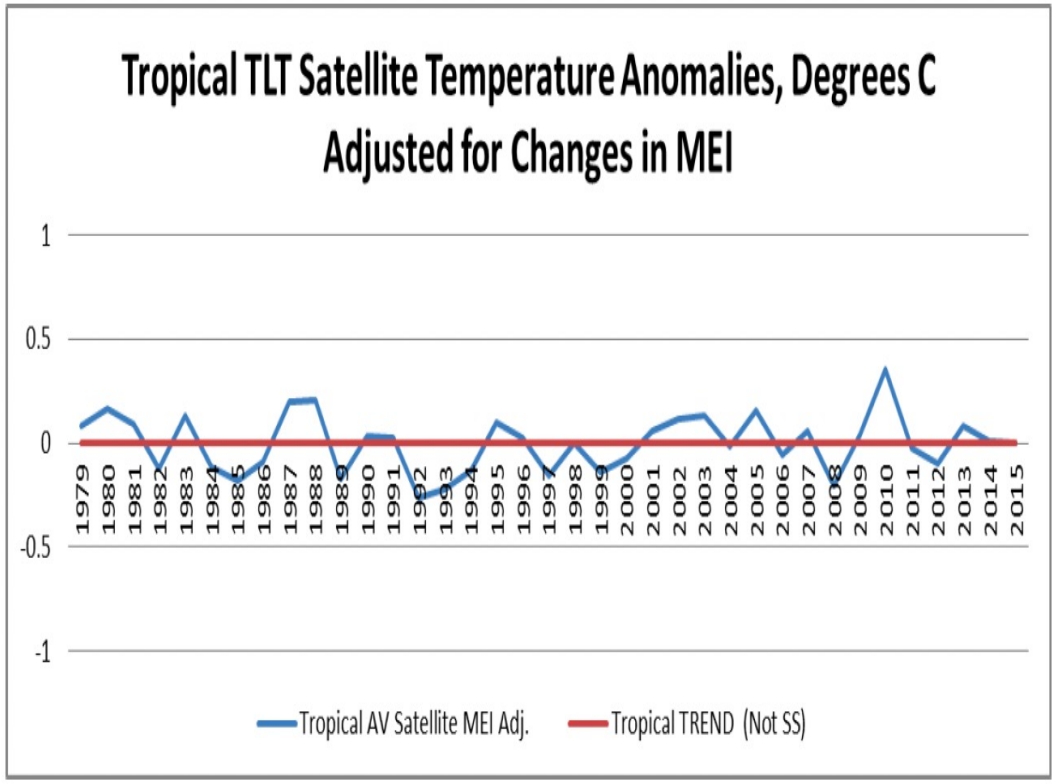


Figure X-2



Source: https://thsresearch.wordpress.com/2016/09/17/ths-exec-sum/

ENSO modeling in Tropics III

Figure XI-3

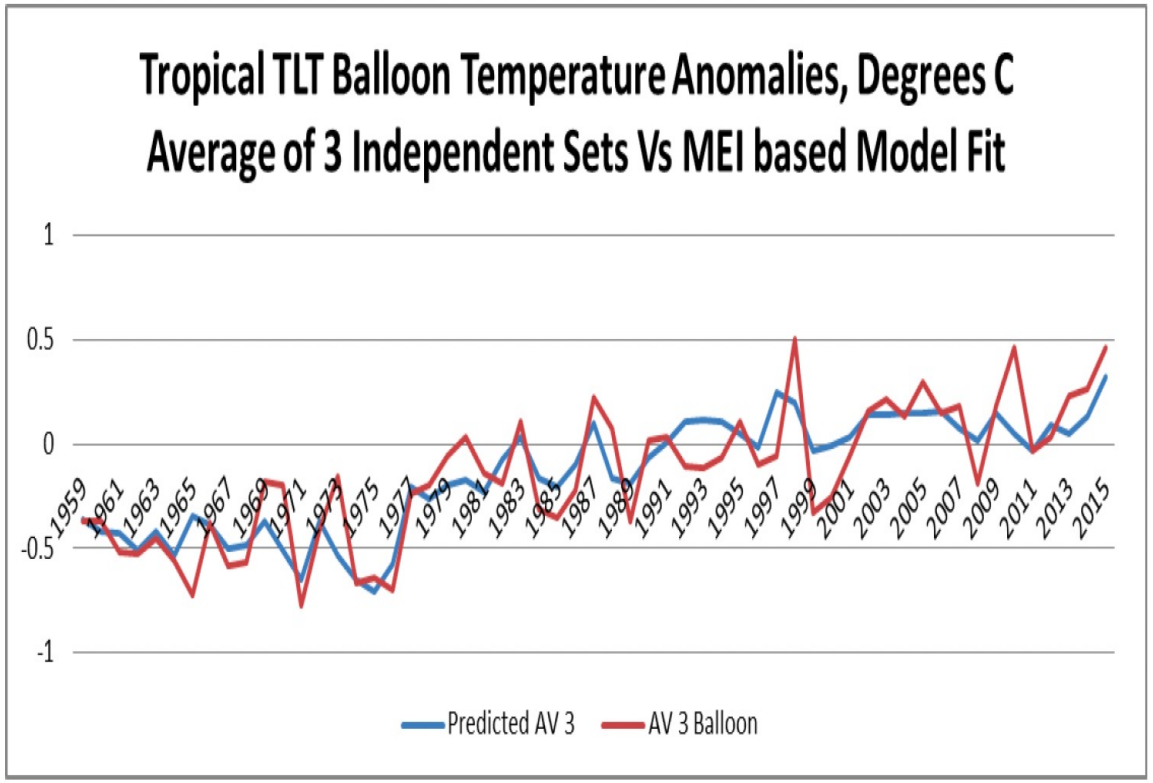
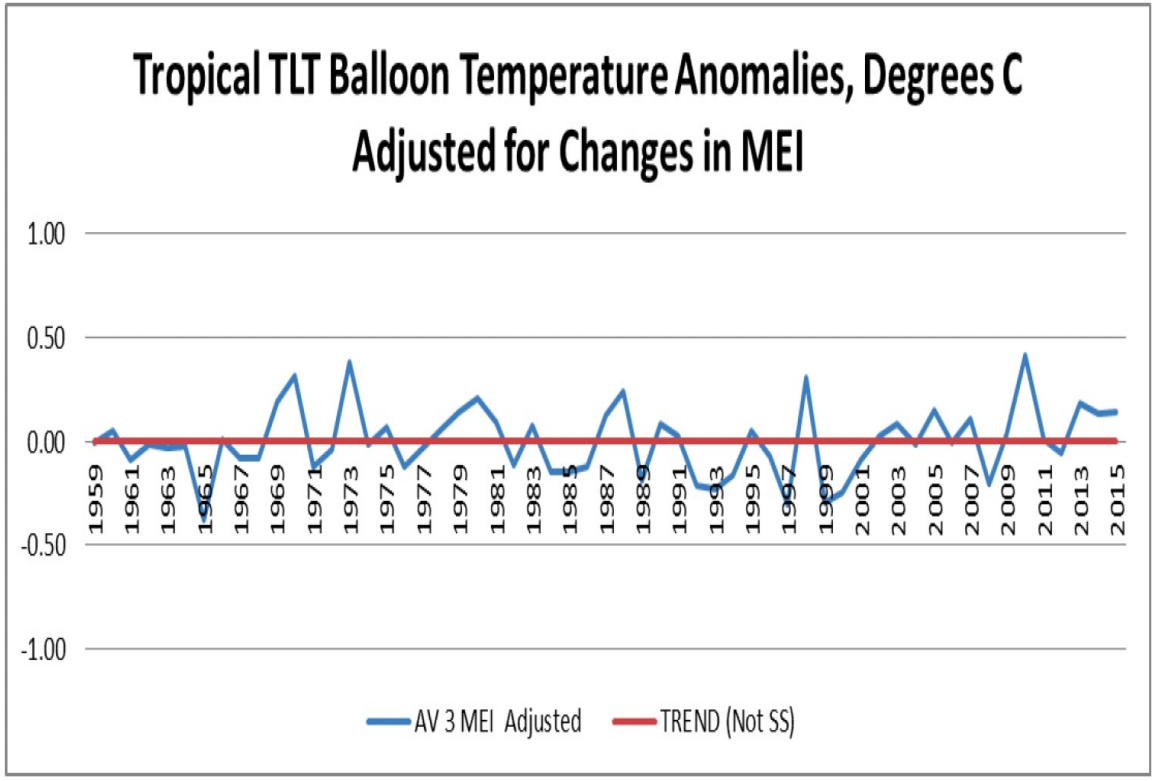


Figure XI-2



Source: https://thsresearch.wordpress.com/2016/09/17/ths-exec-sum/

ENSO modeling in Tropics IV

- Wallace-Christy-D'Aleo also show excellent fits between their MEI-based model and observations in the tropical **upper** troposphere viz. satellites and weather balloons.

- And excellent fit with tropical Pacific temperatures viz. NINO Buoy data, as well as excellent fit with tropical surface temperatures viz. NOAA station data.

- MEI-based regression modeling doesn't need to model feedbacks from water vapor + clouds; avoids massive complication that (IMO) render climate computer models explanatorily and predictively useless!

ENSO warming + amplified CO2 warming?

- Seen that ENSO warming excellently fits warming trends observed globally and in Tropics in past half century. Unlike amplified CO2 warming hypothesis.

- Implications for hypothesis of CO2 warming amplified by water vapor + clouds.

- Implies even amplified CO2 warming, with trend given by satellites ($\sim$ 0.13 C/decade), cannot be: on top of ENSO warming, would get far too much warming than observations show!

- Implies that net feedbacks from water vapor + clouds (+ oceans, etc.) must be either **zero or negative** on CO2 warming.

CO2 warming impact on ENSO?

- But what if CO2 warming significantly impacts ENSO? Maybe causes slightly more and larger El Ninos than La Ninas?

- Direct CO2 warming far too small to account for multi-decadal shifts in magnitude/frequency of El Ninos and La Ninas.

- What about amplified CO2 warming? CMIP6 models tend to predict rise in sea-surface temperature (stronger El Ninos) in 20th and 21st centuries; CMIP5 models ambiguous. Difference based on > positive feedback from water vapor + clouds in CMIP6 models.

- But since CMIP6 and CMIP5 models significantly overpredict warming in troposphere globally and in Tropics, their predictions for ENSO are unreliable.

Wrapping up

- Direct CO2 warming too tiny to agree with observations.
- ENSO warming models fit observations globally and in Tropics vastly better than climate computer models that assume amplified CO2 warming (virtually all of them).
- The latter models predict too much warming relative to observations, implying underestimate of negative feedbacks to CO2 warming.
- ENSO warming + CO2 warming with net-zero / net-negative feedbacks seems fine; amplified CO2 warming + ENSO warming poorly matches observations.
- Hence, CO2 warming must be playing very minor role in global warming, and net feedbacks to it can be inferred zero or negative.

Thanks for your attention
Comments welcome!

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