GSM – Grand Solar Minimum. You really should do the Research!

CSS-82a AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – Paul Burgess

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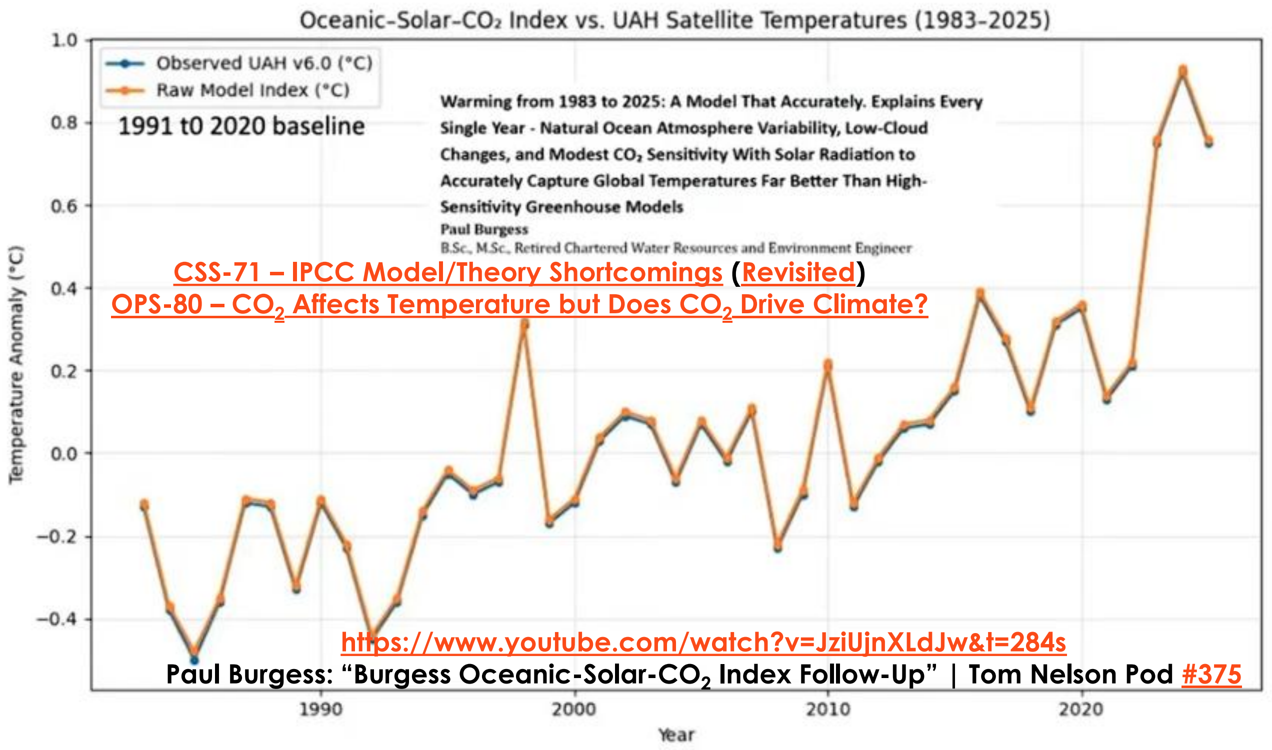

WE LIVE BY THE PULSE OF THE OCEANS

Why CO_2 Is Included (1 of 2)

- CO_2 is included as an explicit background forcing term.
- Important point of agreement:
- • The direct effect of CO_2 (no feedbacks) is ~1°C per doubling.
- • This is broadly agreed by both sceptics and the IPCC.

- The real disagreement is not the direct effect.
- It is about **feedback amplification**.

Why CO_2 Is Included (2 of 2)

- IPCC-style projections add strong positive feedbacks.
- This paper tests whether such feedbacks are required by data.
- Sensitivity testing result:
- • Only the low-sensitivity case fits the satellite era cleanly.
- • **Best fit occurs near 1°C ECS NOT 3°C .**
- **Conclusion:**
- **No strong positive feedback signal is found.**

3. Fully Worked Example — Year 2023

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3.1 Look-up Values (Observed Indices)

Quantity	Value	Source / Meaning
AMO z-score	+1.15	Strong warm Atlantic phase
PDO z-score	+0.65	Moderately warm Pacific
IOD z-score	+0.20	Weak positive Indian Ocean dipole
ENSO z-score	+1.40	Moderate-to-strong El Niño
TSI z-score	+0.30	Near solar maximum

3.2 Weighted Natural Index Calculation

Component	Weight	z-score	Contribution
AMO	0.36	1.15	0.36 × 1.15 = 0.414
PDO	0.20	0.65	0.20 × 0.65 = 0.130
IOD	0.15	0.20	0.15 × 0.20 = 0.030
ENSO	0.10	1.40	0.10 × 1.40 = 0.140
Solar	0.19	0.30	0.19 × 0.30 = 0.057

Total Natural Index (N_index) = 0.771

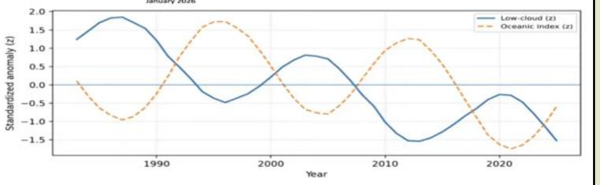
From soon to be released paper

Low-Cloud Variability as a Key Mechanism in Natural Ocean-Atmosphere Driven Global Temperature Changes: Empirical Evidence from Satellite Observations (1983–2025) and Implications for Climate Sensitivity

Paul Burgess

B.Sc., M.Sc., Retired Chartered Water Resources and Environment Engineer

January 2026



Low cloud cover and the Oceanic Index are anti-correlated

Figure 4: Time series of global low-cloud fraction (blue) vs. Burgess (2025) oceanic index (red), highlighting anti-phase behaviour.

Ocean Index-TSI-CO_2 Paul Burgess

Paul Burgess, a retired, chartered Water Resources and Environmental Engineer has put together a Climate Index that puts together four major ocean indices (AMO, PDO, ENSO, and IOD, shown to the right), the Total Solar Irradiance (TSI), and atmospheric CO_2 concentrations (based on a CO_2 Equilibrium Climate Sensitivity (ECS) equal to 1 °C. His work is summarized in the link included in the above chart. A link to his detailed paper can be found on his Substack (link here). The chart (above) shows a rather amazing correlation between the average yearly University of Alabama, Huntsville (UAH) satellite temperature measurements and his "Raw Model Index". The weightings for each parameter (outside of CO_2, which has a set ECS of 1 °C, described in the middle two panels above) are laid out in the table above, far right. The obvious question is how can the correlation be close? In my opinion, the concept makes sense and is in line with my thought processes. In my past work, I have combined the AMO, PDO and ENSO but more on a qualitative rather than a quantitative basis. The PDO and ENSO are more erratic than the AMO. The AMO Index moves in a consistent sinusoidal pattern that can be used to forecast with some confidence. So, I focused on the AMO, TSI, and CO_2 (ECS = 0.8 °C) which produces far better history matches than anthropogenic forcings alone. The other ocean cycles would just enhance that history match. This post explores the information shown here to see if I can replicate his work. I would expect more scatter.

Oceanic Components of the Index

- The Oceanic Index includes:
- • AMO – Atlantic Multidecadal Oscillation
- • PDO – Pacific Decadal Oscillation
- • ENSO – El Niño / La Niña
- • IOD – Indian Ocean Dipole
- Each represents large-scale heat redistribution in the oceans.

AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – AMO

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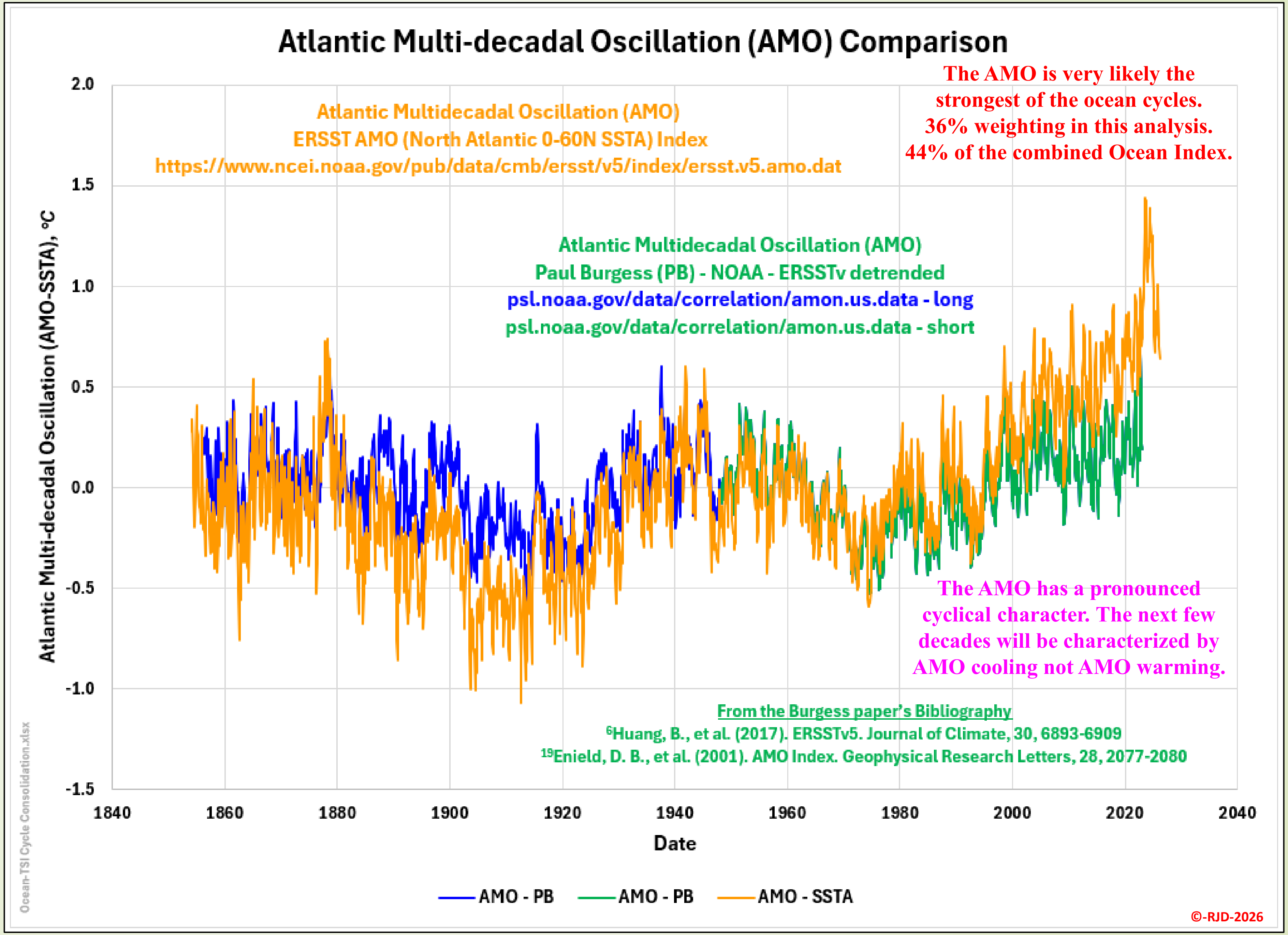
There are many sources of data for all the various components of the proposed Climate Index. I will compare some of them to the data referenced in Paul's paper. Note, not all the links provided by Paul were active. The first look will be the Atlantic Multi-decadal Oscillation (AMO). I believe Paul used the detrended (short version (1948 to 2023)) data from NOAA's Physical Sciences Laboratory (PSL). I could not find a direct link to the data in his paper. Both the long and short versions (the same data from 1948 to 2023) were plotted here along with the full dataset from NOAA's National Centers for Environmental Information (NCEI). The NCEI dataset has not been detrended. Note, the NOAA-PSL data set does not cover the anomalously high temperatures that occurred in 2023 and 2024. The difference in the two curves (the gold and the blue/green curve is just their detrended or and un-detrended characteristics. The detrended data was only updated to January 2023. That recent temperature spike is likely due to a combination of a warm El Niño, the Hunga-Tonga Hunga stratospheric water injection volcanic eruption, Cycle 25 solar activity highs, and cleaner ocean fuel standards. NOT CO_2!!! Could be less cloud cover also?

Ocean Index-TSI-CO_2 AMO



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CSS-82c

AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – PDO

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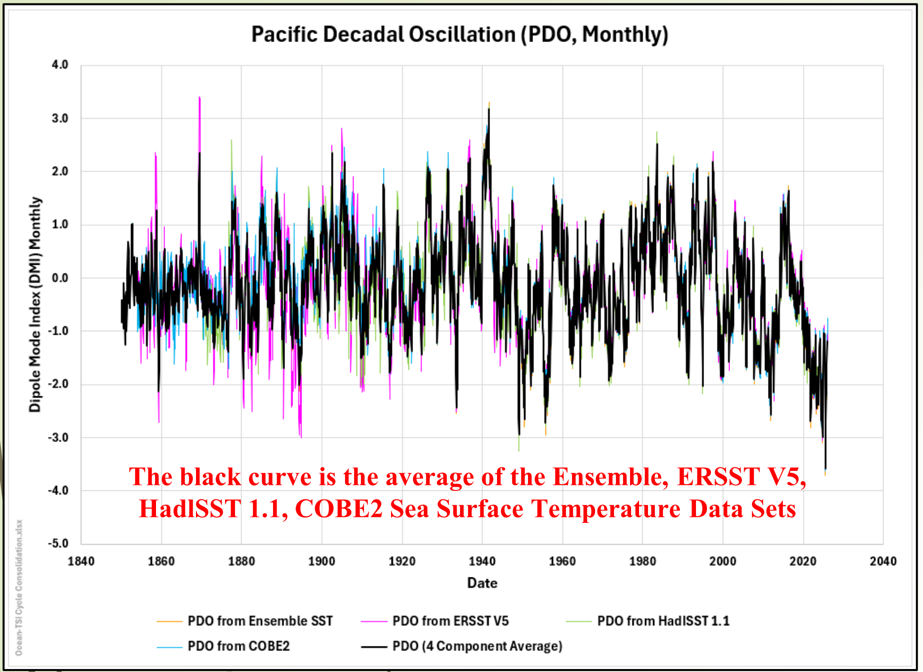
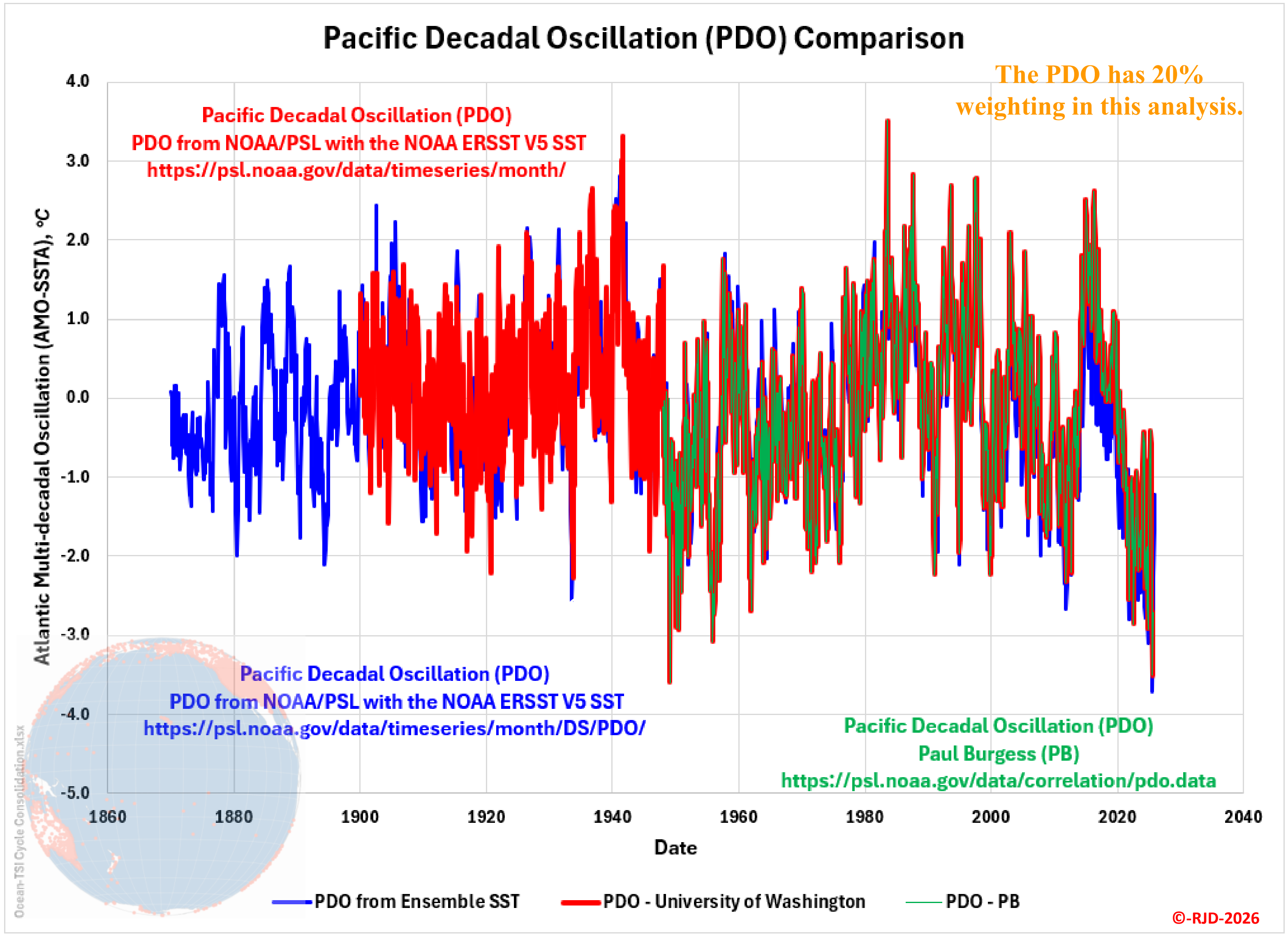


The Pacific Decadal Oscillation (PDO) weighting is set at 20% for this evaluation (24.7% of the total Ocean Index). There were several PDO reconstructions available. A set of four PDO reconstructions were used to produce an average PDO as shown in the chart to the right. There is more scatter in the pre-1950 data which is likely a function of data quality which deteriorates the further in the past the analysis goes. All four datasets are generally similar. The blue curve in the chart below was pulled from NOAA's PSL division (the same curve (Ensemble SST) from the chart to the left, shown in magenta). The red and green curve (the same data from 1948 to mid-2025) was



also pulled from NOAA's PSL division. The same organization with two similar but definitely different datasets for the same parameter. All the datasets shown here highlight the PDO's erratic nature. The PDO data also has Some cyclicity but not as consistent as the AMO data on the previous slide. The high temperatures of the Dirty Thirties are visible in the PDO (with carryover into the 1940s). Temperatures dropped significantly into the 1950s then climbed back up to new highs in the 1980s and 90s. Another decline followed by a sharp increase that coincided with the strong El Nino pulse beginning in 2015 followed almost immediately by an equally sharp decrease towards the second lowest PDO level on record. The Pacific Ocean (transparent image to the right) does not appear to be following the All CO_2, All the Time alarmist narrative very well. The Pacific Ocean covers 32% of the planet. A rather large area to be out of sync with the "consensus". Why is the PDO at a near record low with high CO2?

Ocean Index-TSI-CO_2 PDO

CSS-82d AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – IOD-DMI

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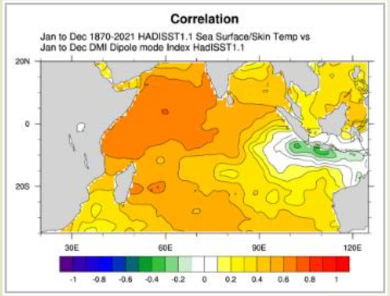
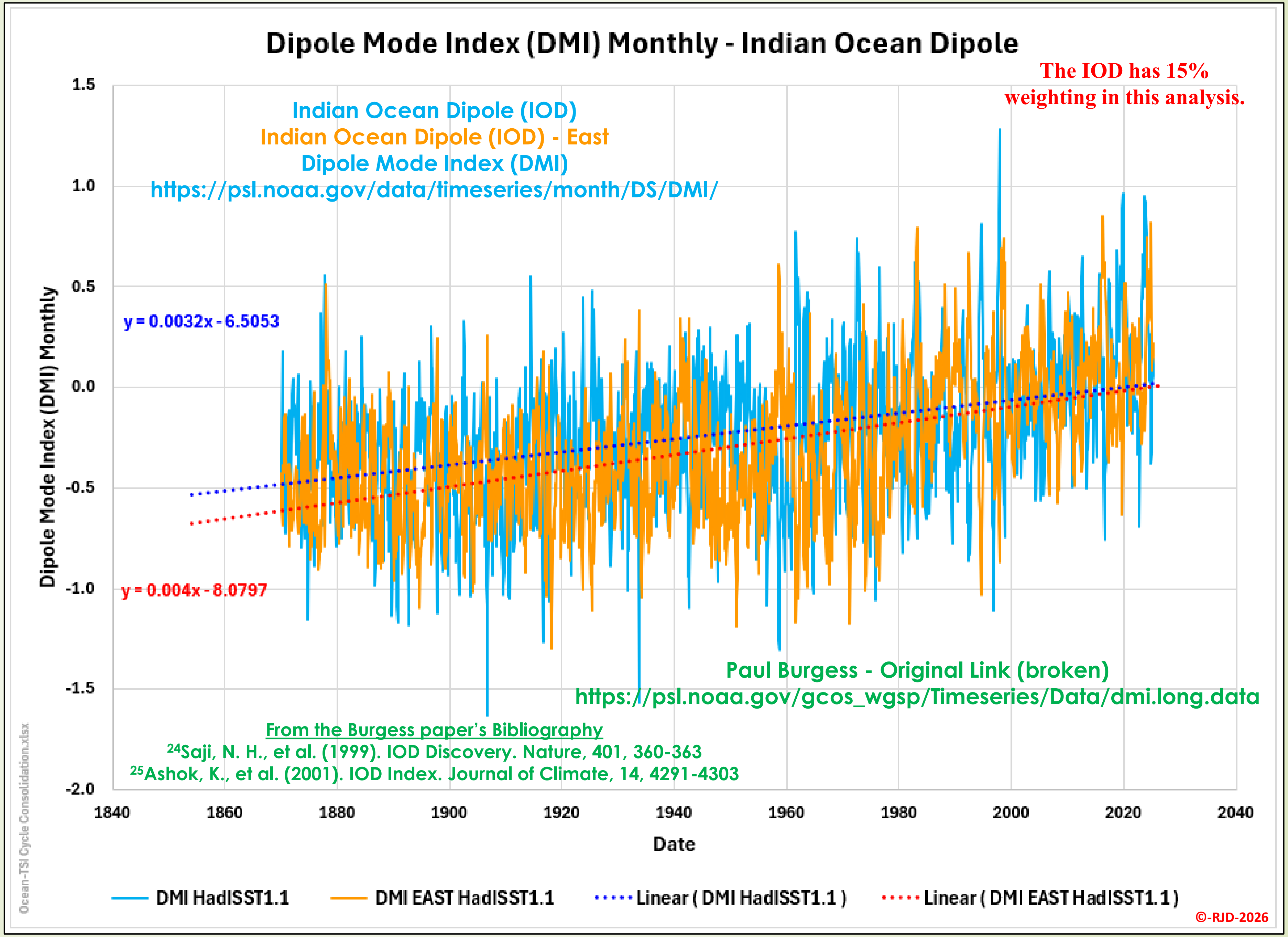
The Indian Ocean Dipole (IOD), also called the Dipole Mode Index (DMI), has been assigned a 15% weighting in this analysis (18.5% of the total Ocean Index). The IOD was not a parameter that I had investigated in much detail in the past. But as an engineer, I like new data, so here is my analysis. The DMI has been rising steadily since the late 1800s. Conversely, the DMI-East was generally flat for a century, increased rapidly in the 1980s and has been relatively flat since then. Not really consistent with a CO_2 forcing? Regardless CO_2 does not drive ocean indices. CO_2 may have a small effect on the immediate surface temperatures but not the index itself. As with the AMO and PDO, the data is very erratic but without the prominent longer-term cycles present in the AMO and PDO. The link provided in the Burgess paper was broken so there is not an option to to compare my dataset and the Burgess data. They should be very comparable. Warming was just ±0.6 °C over 155 years. Again, not a CO_2 response.

Ocean Index-TSI-CO_2 IOD-DMI





AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – ENSO Detail

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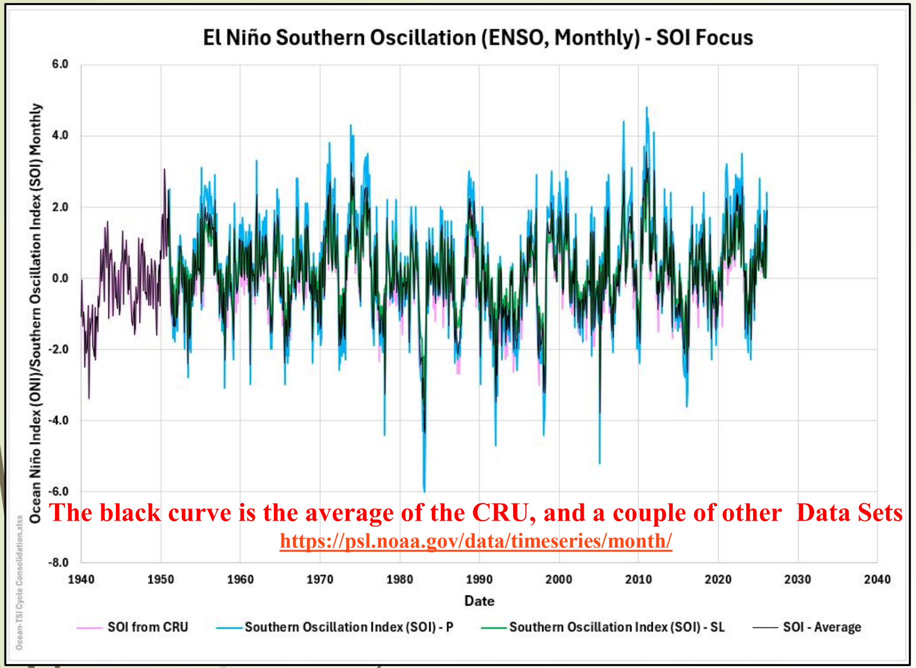
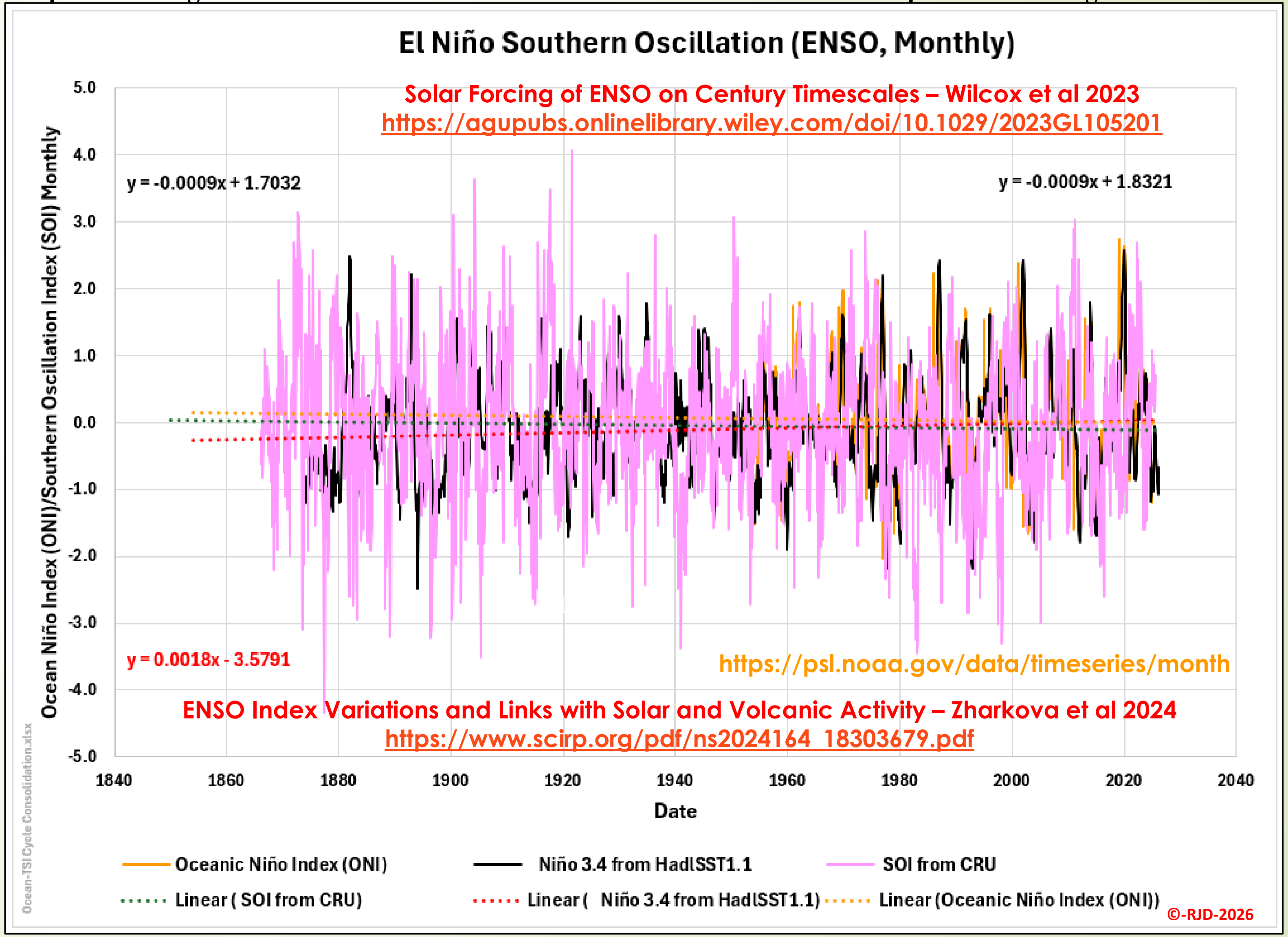
The El Niño Southern Oscillation (ENSO) is the last ocean index used in the consolidation. The weighting in this evaluation is 10% (which equates to 12.3% of the total Ocean Index). The ENSO has a very dramatic and frequent oscillation between the warm periods (El Niño) and cool periods (La Niña), the general trend is almost statistically flat regardless of the reconstruction used, and the periodicity is harder to nail down. The cycle lengths have a lot of variability. According to Bing's AI (Co-Pilot) "El Niño events typically occur every two to seven years, with each episode lasting about nine to twelve months". The smaller chart to the left compares and averages 3 different ENSO data sets (including one from the Climate Research Unit (CRU)). All three reconstructions are similar but there are noticeable differences. The chart to the right plots the CRU data with two of the other main parameters that go into describing ENSO. The main spikes (to the right) on each of these three curves do not always line up. The choice one makes will affect the correlation. The ENSO has been tied to solar and/or volcanic activity. A 2024 paper by Zharkova (link included to the right) explored those connections. Another paper by Wilcox et al (2023) explored the connection on longer time frames. There are many 60ish year cycles visible within the earth's biosphere. The AMO has a strong cycle presentation, the PDO's cycle is present but more erratic. These 60-year cycles are related to Solar barycenter cycle and Jupiter's eccentricity. ENSO's solar/volcanic relationship may be related more to gravitational interactions than the amount of energy that the sun puts out and/or how much gets to the surface.



Ocean Index-TSI-CO_2 ENSO - Detail



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CSS-82f AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – ENSO-Final

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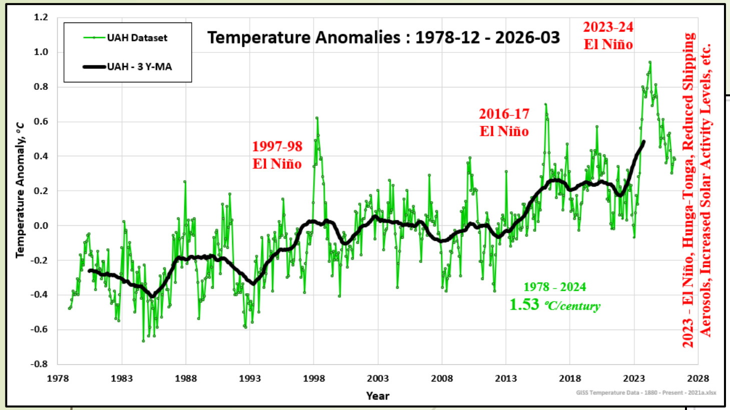
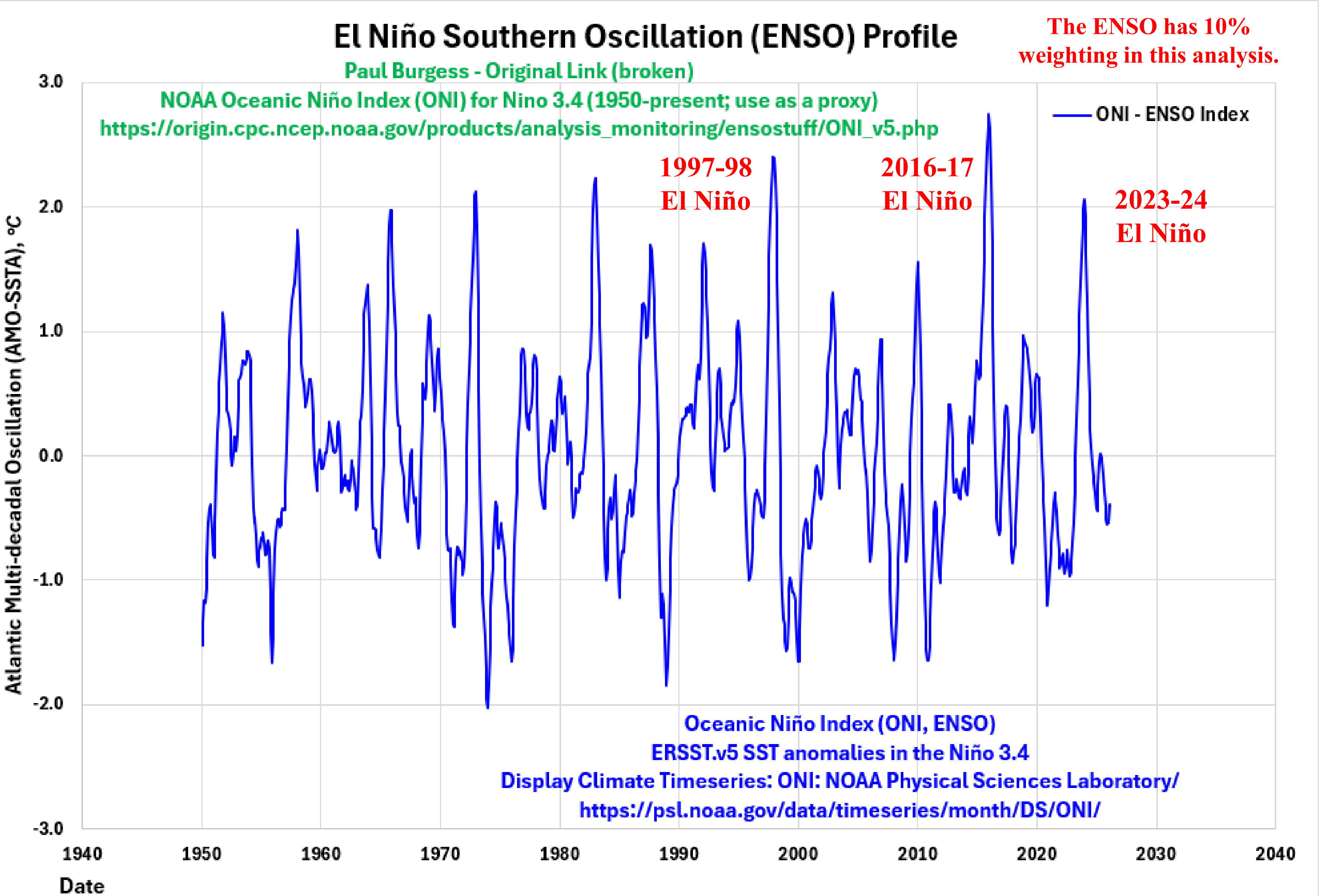


Given that the Burgess link was broken, I opted to go with the Oceanic Nino Index (ONI). The ONI appeared to line up the best with the El Nino temperature spikes identified in the University of Alabama, Huntsville (UAH) satellite temperature dataset above. The 1997-98 El Nino was the strongest in the satellite record until the new mark was set in 2016-17. Bothe of these El Ninos were responsible for satellite era temperature anomaly records as well. A new high temperature record has since been set in April 2024. The 2023-24 El Nino was not strong enough to produce the record high temperatures. The record temperatures had some help from other factors (the Hunga Tonga eruption and stratospheric water injection, reduced shipping aerosol emissions, peak solar cycle 25 activity and potentially some increased seismic/volcanic activity in the deep oceans. The ONI overall trend has been slightly down (as shown on the previous slide). That completes the detailed look at the Oceanic Indices.

Ocean Index-TSI-CO_2 ENSO - Final



Ocean-TSI Cycle Consolidation.xlsx

From the Burgess paper's Bibliography

[27]Trenberth, K. E. (1997). ENSO Overview. Bulletin of the American Meteorological Society, 78, 2771-2777

[28]McPhaden, M. J. (2015). ENSO Evolution. Annual Review of Marine Science, 7, 385-413

CSS-82g AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – Ocean Consolidation

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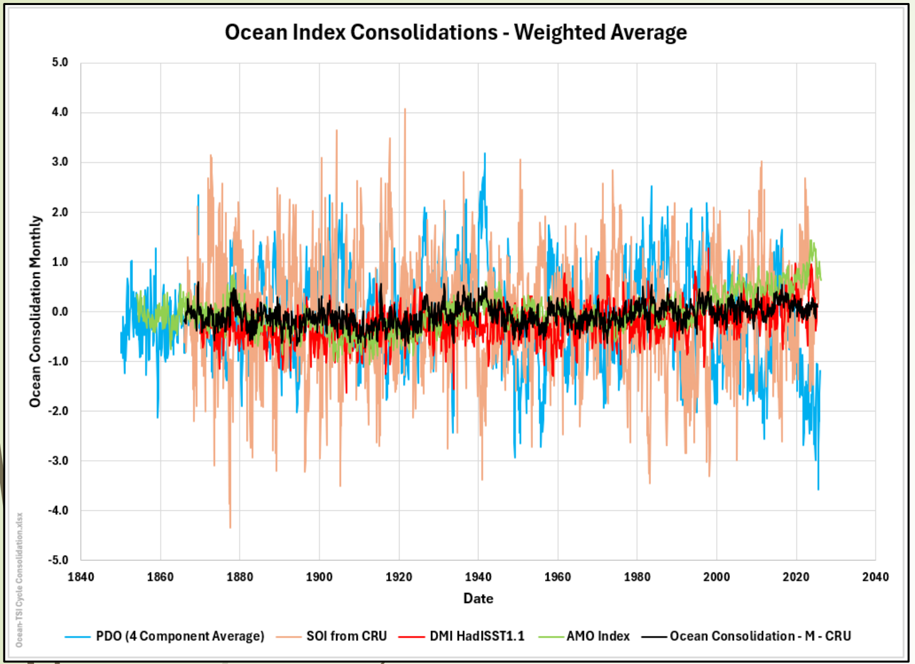
The next step is combining the four ocean indices into one representative index. The chart to the right shows all four of the individual indices (AMO, PDO, DMI (IOD), and SOI (ENSO)) and the weighted average of those four individual indices. The magnitude of the PDO and SOI (ENSO) monthly fluctuations are much greater than the AMO and the DMI (IOD) monthly fluctuations. The weighted average Ocean Index is on the same order of magnitude as the AMO. In general, the combined indices are complicated. The PDO and DMI (IOD) appear to move in opposite directions on many occasions. Since the turn of the century, the AMO has been rising steadily

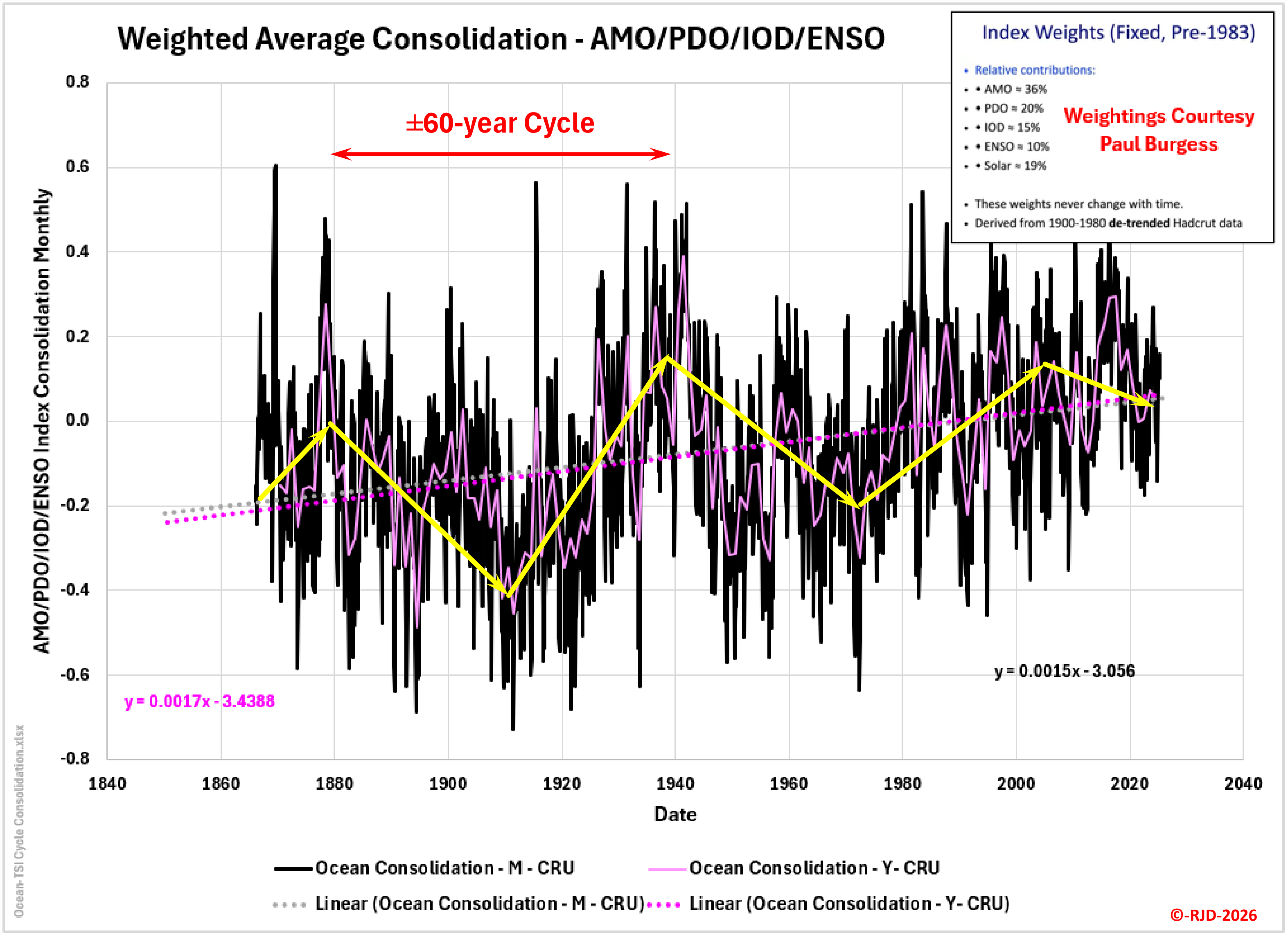


above the consolidated Ocean Index weighted average. The PDO has been erratic but generally running well below the consolidated Ocean Index weighted average. The PDO recorded its lowest value since the late 1870s in mid-2025.

Ocean Index-TSI-CO_2 Ocean Index

The PDO drop over the last decade has been drastic, but a similar drop occurred during the 1940s. The consolidated Ocean Index weighted average (monthly and yearly) is shown on its own to the right.

The 60-year cycle (endemic to the earth's biosphere) is easily visible in the data. That ocean warming and cooling has direct effects on our planet's atmospheric temperatures, but those effects are not included in the IPCC's computer model programming. Note, the consolidated Ocean Index weighted average is also rising at ±0.16 units/century. The early 19th century Ocean Index rise was greater and sharper than the most recent rise and the most recent decline may have begun. The AMO, the strongest ocean driver is dropping into its 30-year cooling phase.



CSS-82h

AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – Index-UAH

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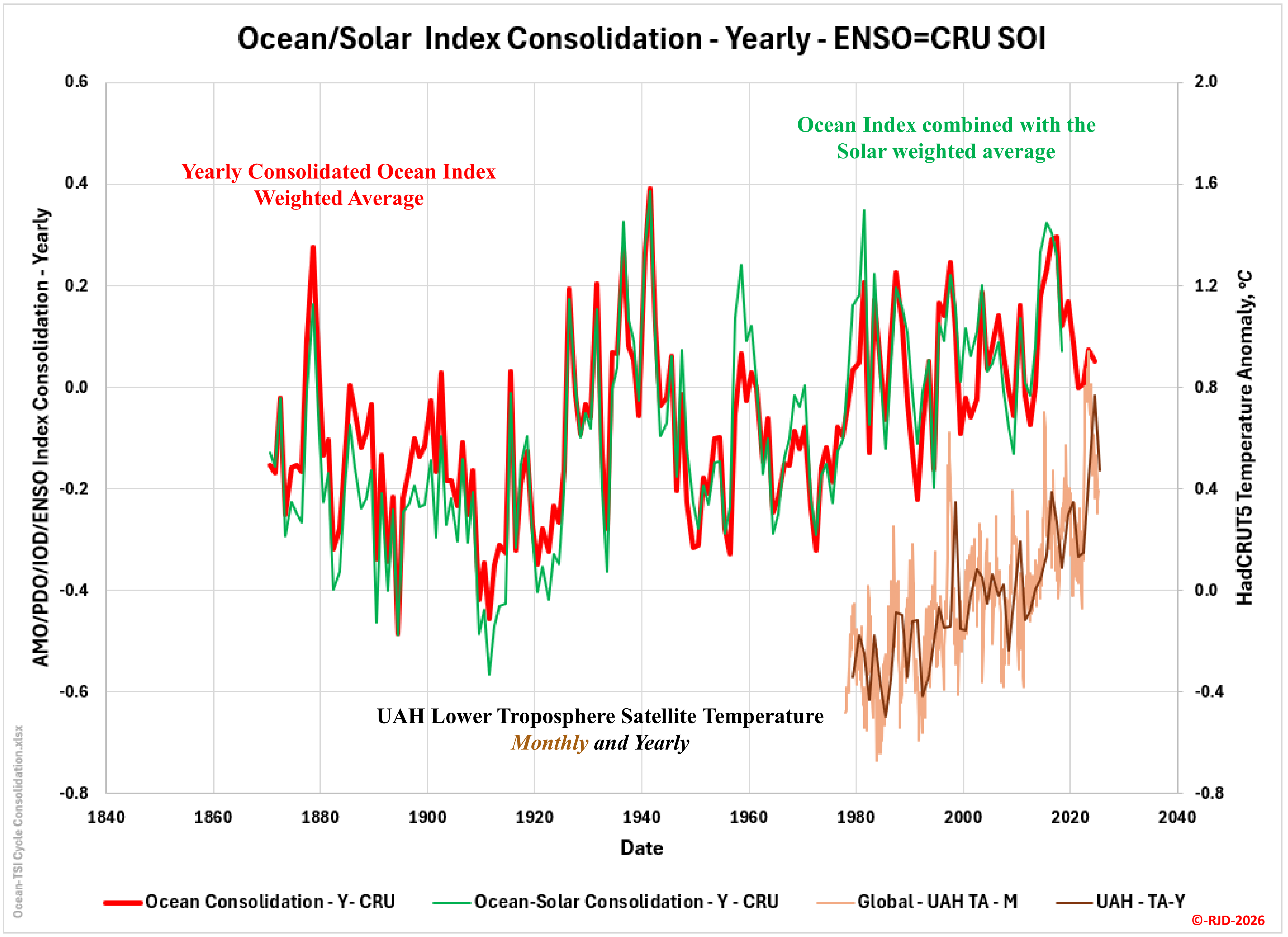
The yearly consolidated Ocean Index (weighted average) is plotted on its own here (the red curve). The green curve adds in the weighted solar activity component. Solar activity has a negative impact on the combined Ocean-Solar Index prior to 1950 and a net positive effect post-1950. Solar activity (as defined by the Total Solar Irradiance Momentum, TSI_M, the 20 Year Moving Average) peaked around 1950, remained relatively flat until ±2015, then began declining gradually. That decline will likely accelerate as we move further into a forecasted Grand Solar Minimum. But this exercise is about history matching not forecasting. The Burgess history match is focused on the UAH temperature dataset. That data set (December 1978 to March 2026) is shown below the Index curves. Both the monthly and yearly data has been included. Just to clarify before we move on, this Ocean Index used the Climate Research Unit's (CRU) estimate of ENSO (the Southern Oscillation Index, SOI). In a later slide, the CRU's SOI is swapped out for NOAA's Physical Sciences Laboratory (PSL) ENSO estimate (the Ocean Nino Index, ONI). There are noticeable differences to be discussed later. A discussion on solar activity (TSI) choices and the CO_2 component will take us to the final Climate Index.

Ocean Index-TSI-CO_2 Index-UAH



AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – TSI

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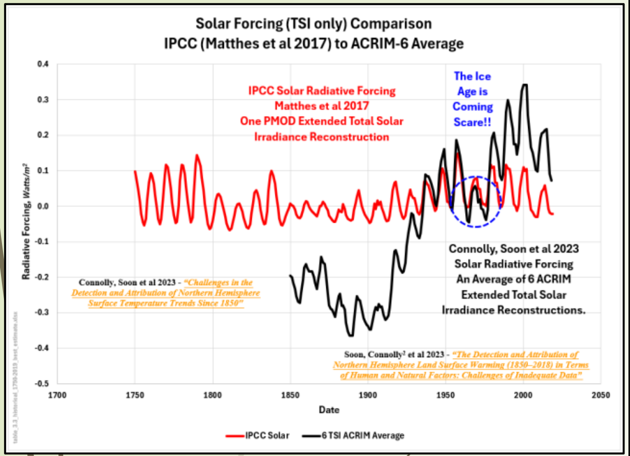
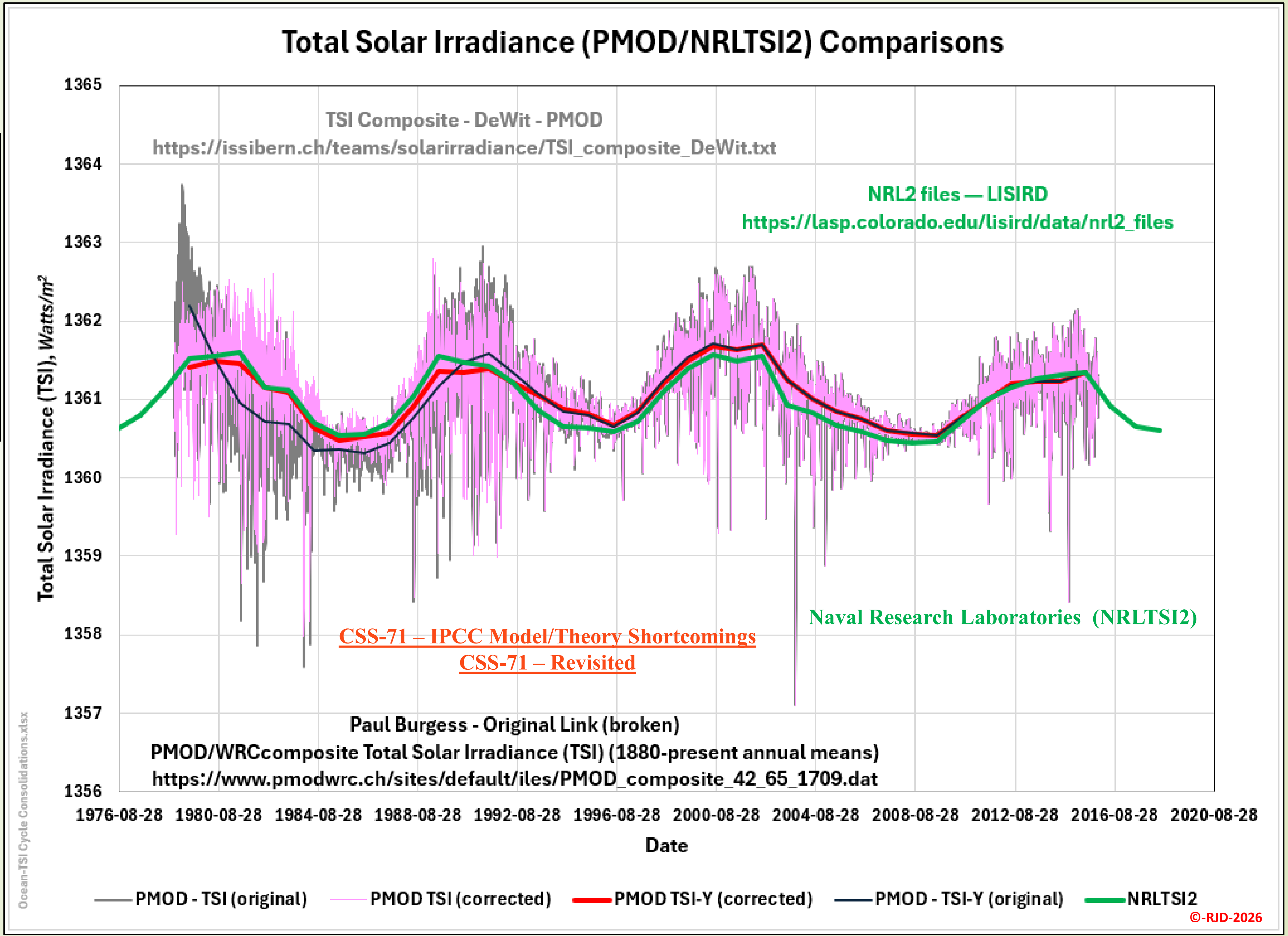
This slide focuses in on the solar activity (Total Solar Irradiance, TSI). The Burgess link to the PMOD/WRComposite TSI was broken. As an alternative, the DeWit PMOD TSI Composite was put forward.



This includes the original daily data and a "corrected" daily data along with Yearly averages for both of those curves. The NRL's TSI2 (a version I have routinely used) is also included.

Ocean Index-TSI-CO_2 TSI

The differences are not dramatic and either choice will produce similar results. However, this is not a representative look at solar activity. There are 40+ TSI reconstructions available and as shown above there are very different viewpoints. The IPCC's preferred TSI (Matthes 2017) is like the TSIs shown to the right. The black curve above (an average from an alternative method (ACRIM)) will produce very different results. There is also more to solar forcing than just TSI.

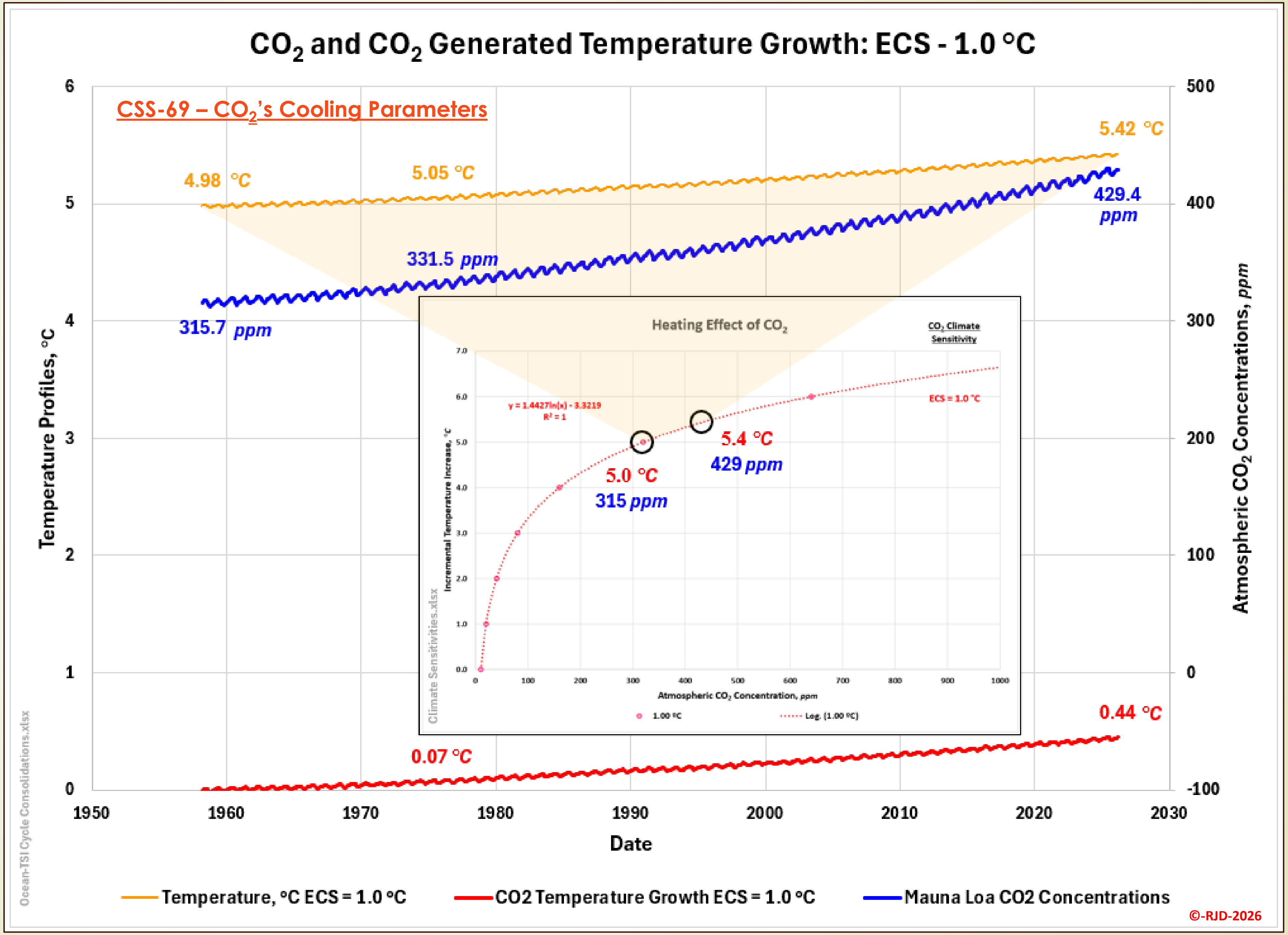


CSS-82j AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – CO_2 – 1.0 °C

The final component to the Climate Index is the atmospheric CO_2 concentrations. To properly account for CO_2 warming you need to establish its Equilibrium Climate Sensitivity (ECS). This is an area of unsettled science despite its obvious importance. The IPCC uses a range of 1.8 to 5.7 °C in their climate models. That is not settled science, and they have self-acknowledged that their models run too hot (i.e.: the models are wrong). CO_2's base radiative forcing is likely around 1.0 °C. The IPCC uses the higher numbers based on their unsubstantiated hypothesis that CO_2 warming causes more evaporation (i.e.: a positive water vapor feedback that keeps adding to the warming). They also ignore the two cooling components that rising CO_2 produces (additional leaf cover and co-aerosol production). Burgess uses a CO_2 ECS of 1.0 °C.

Ocean Index-TSI-CO_2 CO_2 – 1 °C

That will be the value used in my estimate for the Climate Index. As shown in the chart to the right, a CO_2 ECS of 1.0 °C will account for 0.44 °C of the roughly 1 °C temperature rise since 1958 (less than 50%). Estimates of CO_2 ECS approach zero. For a variety of reasons (discussed in my OPS-80 – CO_2 Affects Temperature but Does CO_2 Drive Climate? post) I have generally chosen to work with a CO_2 ECS of 0.8 °C. Note, an ECS of 2 or less is beneficial, not dangerous!



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AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – Model Results

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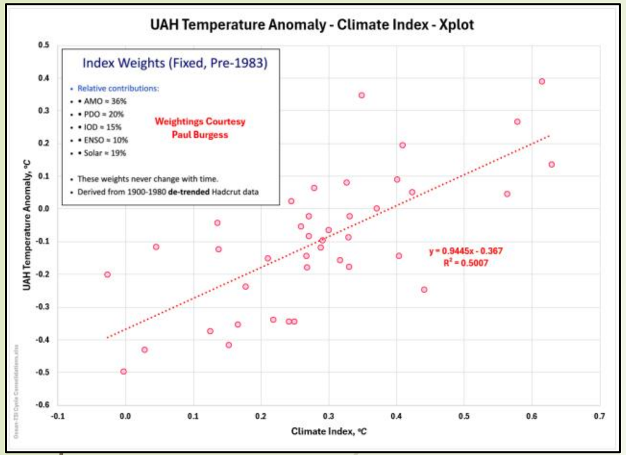
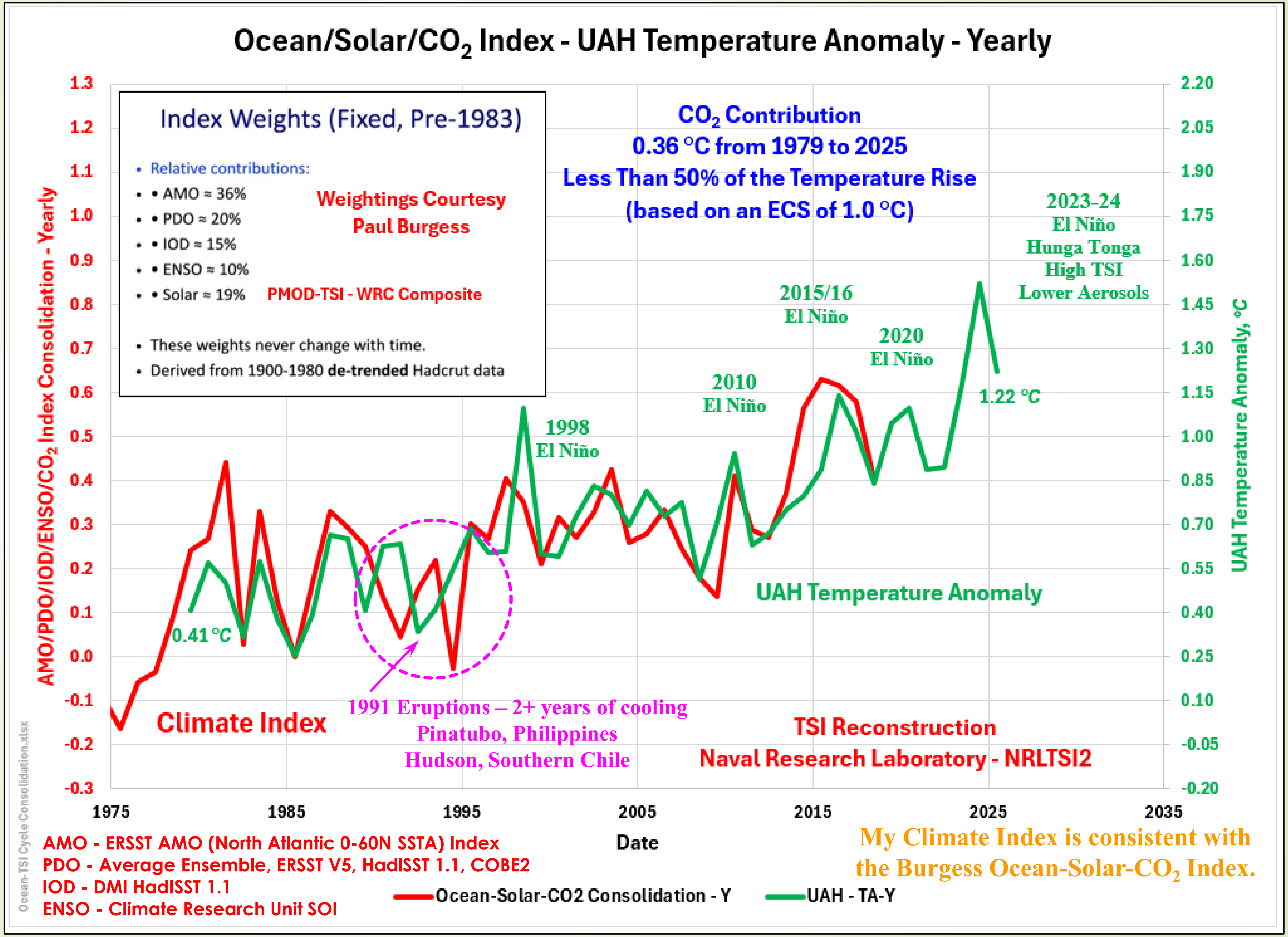


Taking all the previously discussed parameters and applying the weighting factors laid out by Burgess produce my version of his Climate Index (the red curve). The green curve shows the yearly average University of Alabama, Huntsville (UAH) Lower Troposphere Satellite temperatures (very slightly different than Burgess). There is an obvious correlation (R^2=0.50, but not as tight as the Burgess' 0.95+). Given that I had to an/or choose to use different datasets, there should be differences. Also, the Pinatubo/Hudson volcanic induced cooling after the 1991 eruptions likely contributed to the poorer correlation highlighted to the right. The 2020 temp bump should maintain correlation but additional forcings (not included in the index) contributing to the anomalously high temperatures of 2023 to 2025 should produce a poorer correlation.

Ocean Index-TSI-CO_2 Model Result



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AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – Model Comparison

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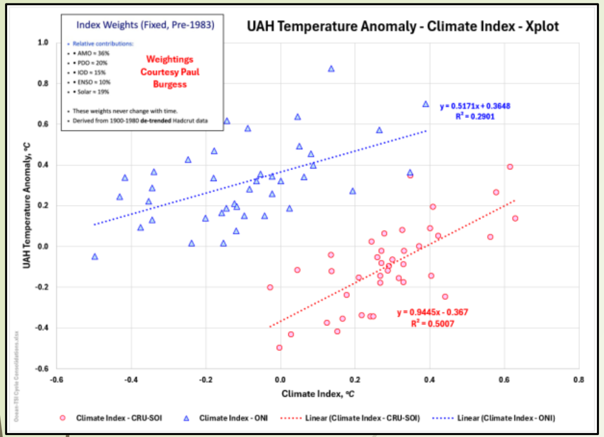
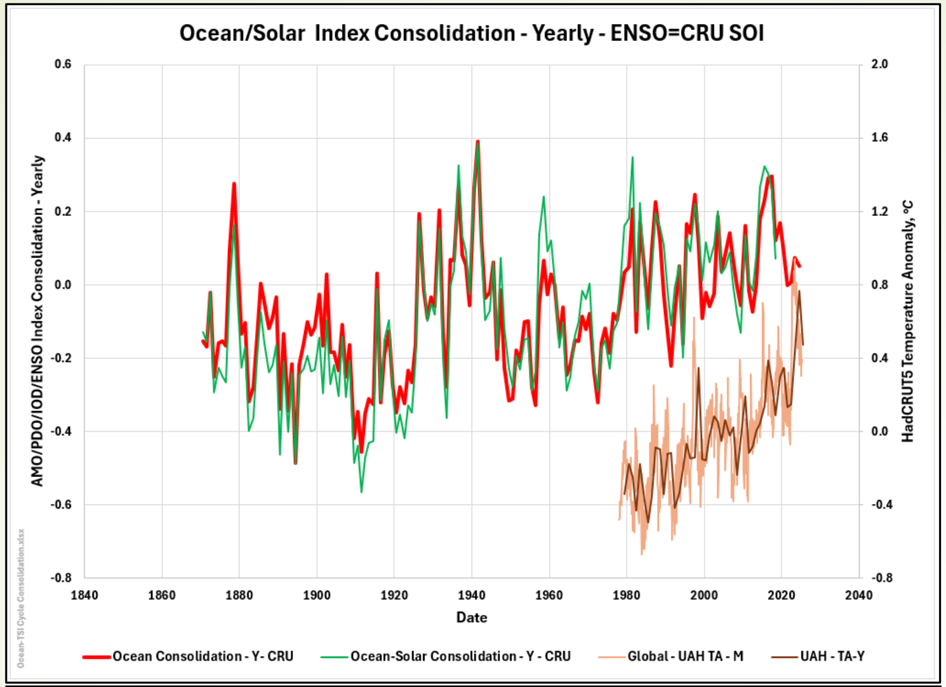
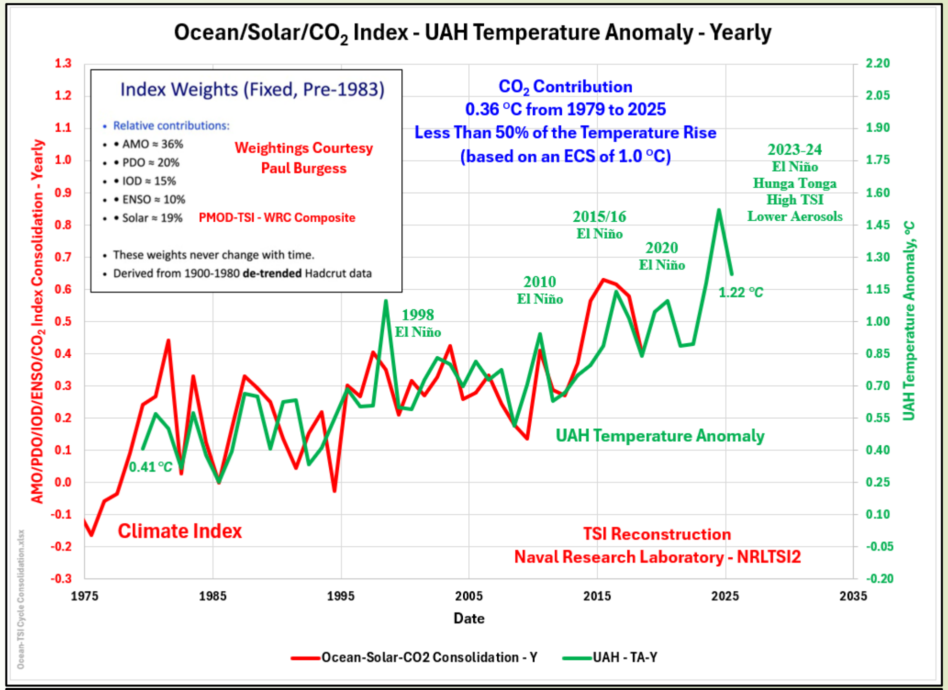
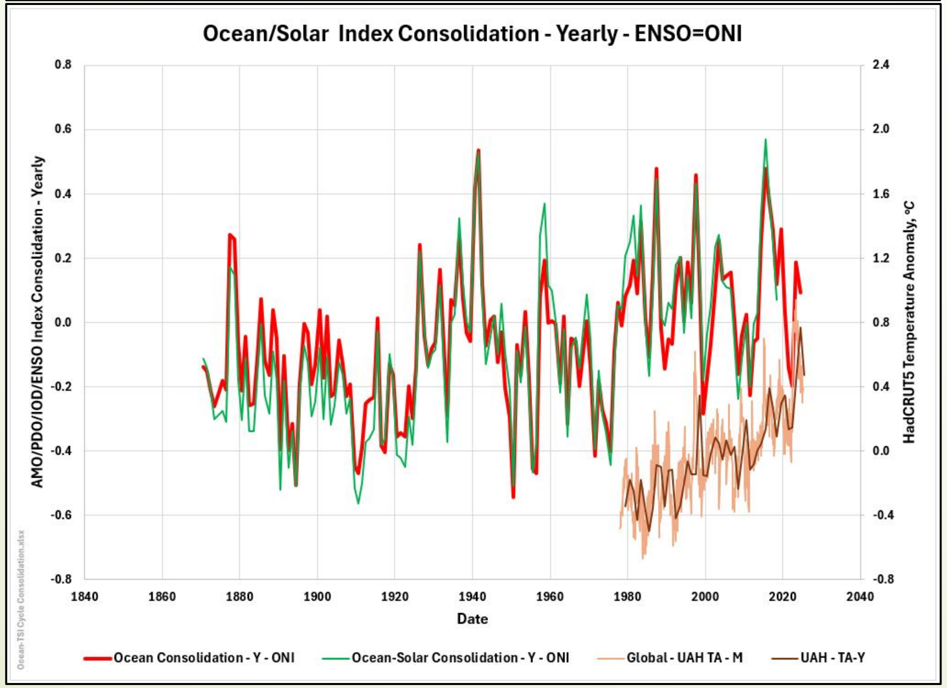


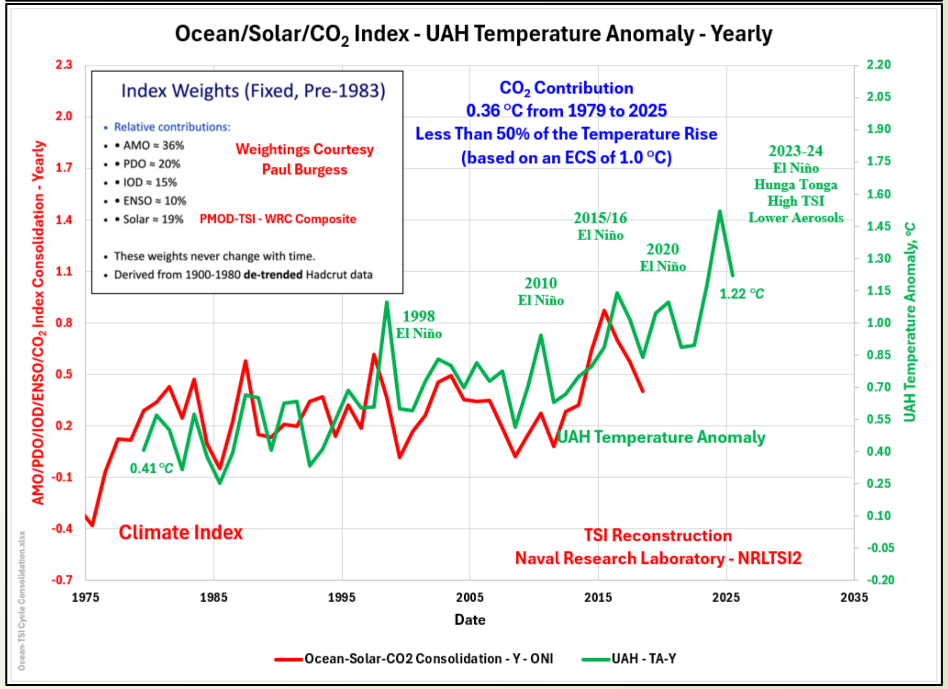
As an exercise, I have substituted out the CRU-SOI ENSO data for the NOAA PSL – ONI ENSO data. The result is a poorer correlation (R^2=0.29 (ONI) versus 0.50 (SOI)) using the same weighting factors. Those weighting factors could be adjusted to tighten up the correlation (for both the CRU-SOI and PSL-ONI Indices). There are a lot of factors in in play that will affect the correlation. For example, using the ACRIM based TSI reconstruction (a more realistic representation of solar activity, in my opinion) would require some significant weighting adjustments. My look at the Burgess Ocean-Solar-CO_2 Index did not produce exactly the same results, but the general concept is in line with my thought processes and is more than reasonable.

Ocean Index-TSI-CO_2 Comparison









CSS-82m AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – Anthropogenic Focus

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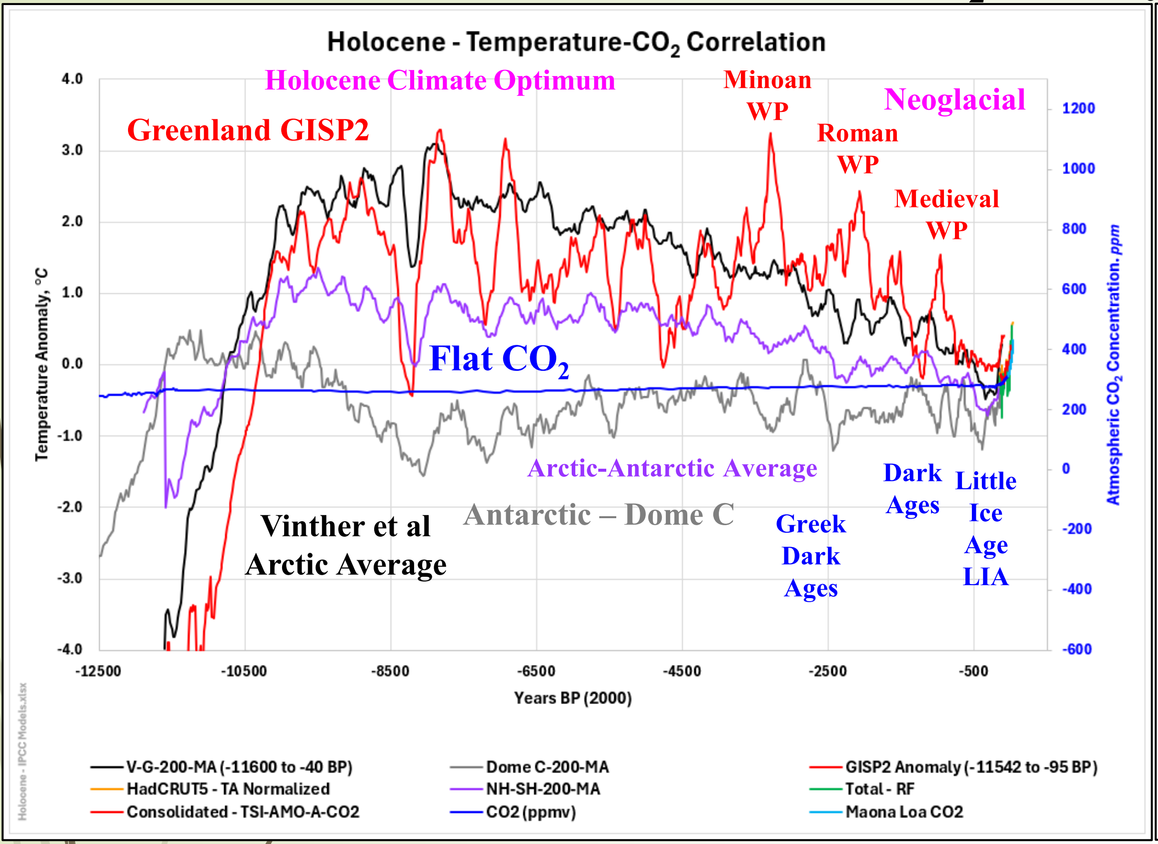
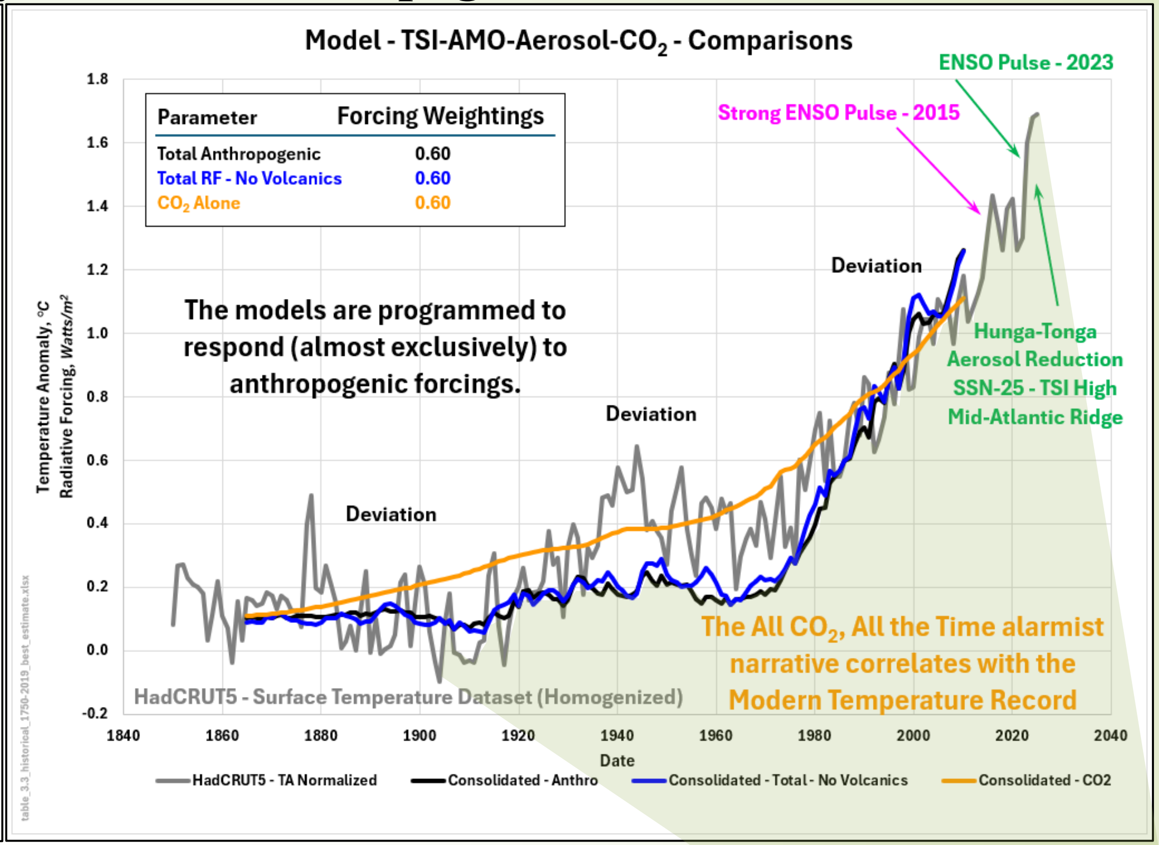


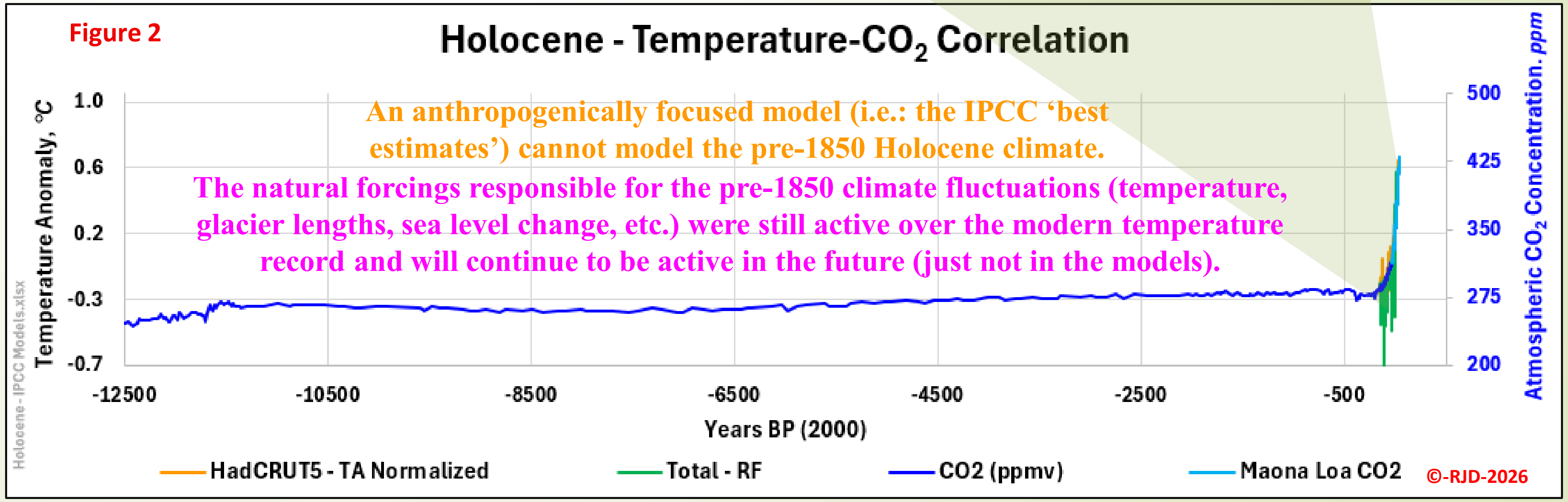


History began before we started making satellite measurements and before we routinely took surface measurements. The chart directly to the left shows the CO2 and HadCRUT5 surface temperature correlations along with the IPCC 'best estimates' for anthropogenic and Total

Ocean Index-TSI-CO_2 Anthro Focus

radiative forcings. Note, the IPCC models are obviously focused on anthropogenic forcings given the anthropogenic and Total Radiative forcings are almost identical. This CO_2/temperature correlation is combined with the IPCC models to justify the All CO_2, All the Time alarmist narrative. But correlation is not proof of causation. And extending the analysis back in time (chart to the right) shows that anthropogenic forcings (CO_2 highlighted) over the pre-1850 Holocene were effectively negligible. Yet the temperatures fluctuated significantly and often over that same period. An index that has those natural forcings built in will produce far better history matches than the human focused IPCC option.

Figure 2

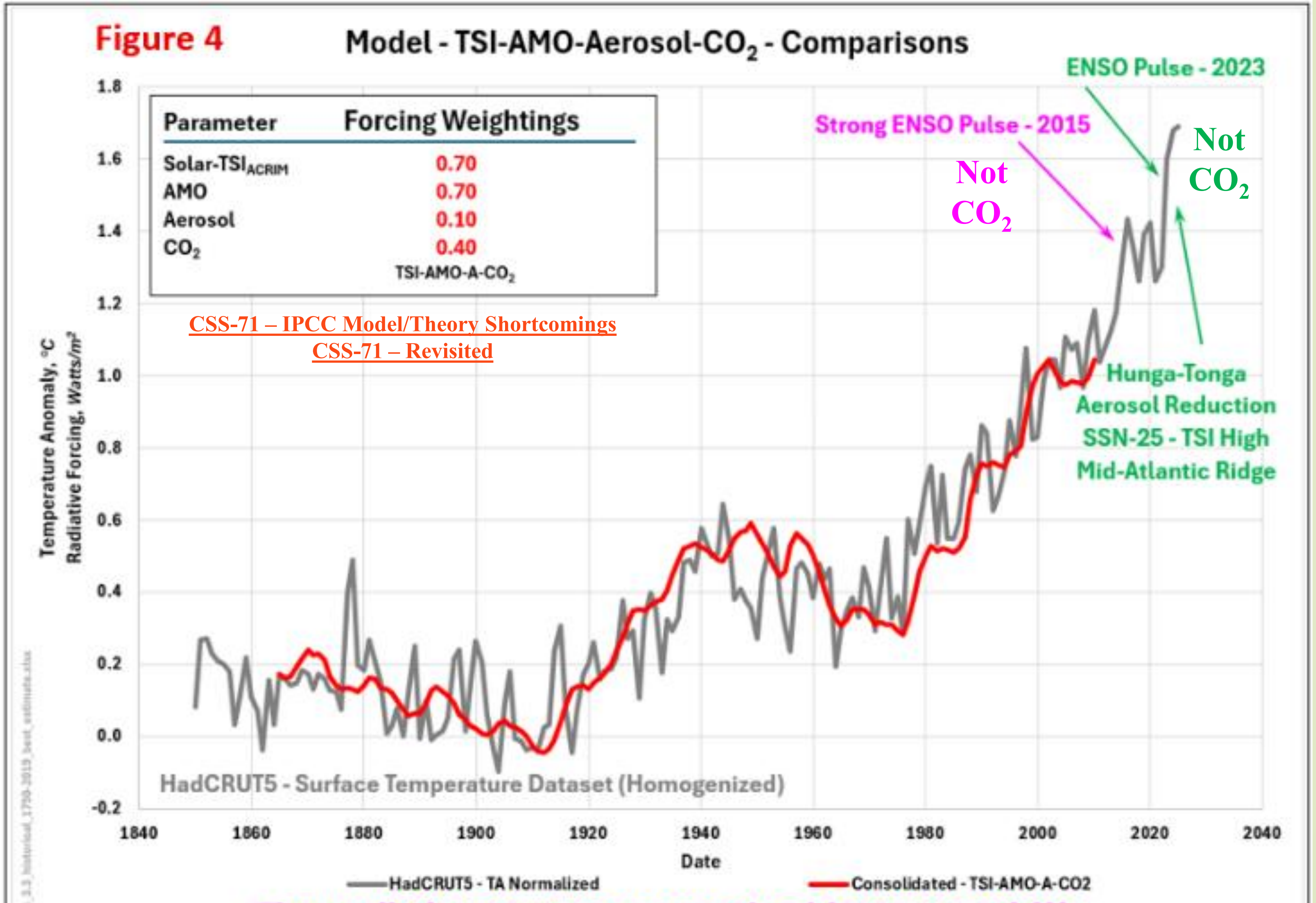


CSS-82n AMO-PDO-IOD-ENSO-TSI-CO_2 History Match – Solar Focused HM

More info ? climatechangeandmusic.com

Starting with the same IPCC 'best estimates' a much better history match can be obtained by just adding in the ocean cycles and substituting out the IPCC's 'best estimate' TSI reconstruction (Matthes et al 2017, a PMOD based estimate) for any one or a combination of the other 40+ available reconstructions. This would include ACRIM based analyses or treating the TSI reconstructions as a proxy to account for the solar forcing parameters that TSI does not represent. The history match shown here accounts for just the Atlantic Multi-decadal Oscillation (AMO) and uses an average of six of the ACRIM based TSI reconstructions. Adding in the other ocean cycles (PDO, IOD and ENSO) should tighten up the correlation. An exercise for the future that should be considered by the IPCC if they want to bring themselves closer to reality. The AMO has a well-established sinusoidal pattern that lends itself to future projections. The PDO, IOD, and ENSO have more erratic cyclical patterns that are less predictable. There are obviously other natural forcings that are not that predictable at all (volcanic eruptions, seismic activity along the tectonic plate edges, solar flares/CMEs, etc.). A combined Solar-Ocean focused model is just superior to an anthropogenic focused model!

Ocean Index-TSI-CO_2 Solar Focus



CSS-71 – IPCC Model/Theory Shortcomings
CSS-71 – Revisited

The realistic, more encompassing history match!!!