

# CSS-87a Total Solar Irradiance (TSI) versus GISTEMP 3.1 – Alarmist Meme

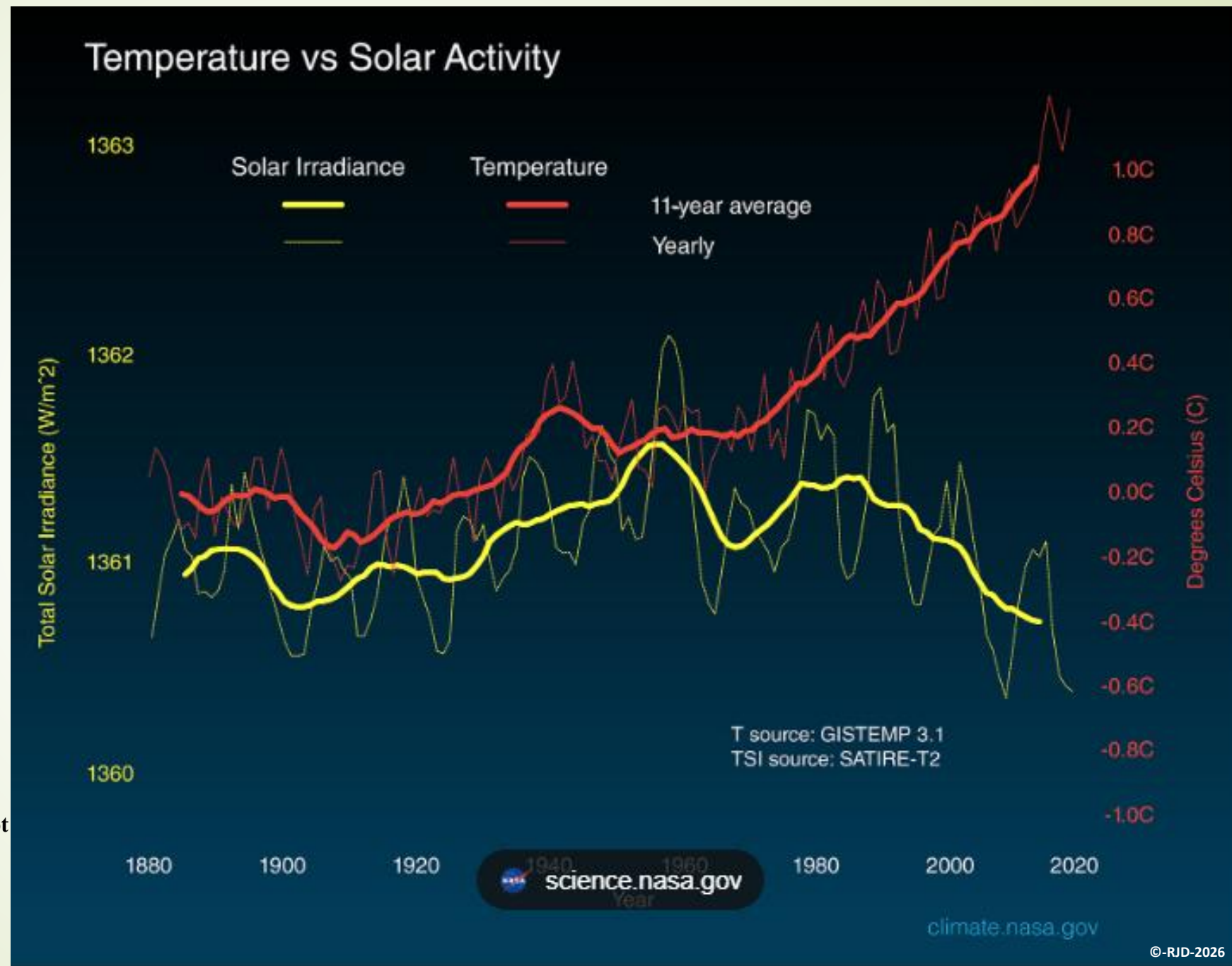
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You will see this image (or a version thereof) regularly on social media platforms and elsewhere with a note attached that declares the sun cannot possibly be driving the climate given that solar activity (represented here by the SATIRE-T2 Total Solar Irradiance (TSI) reconstruction) has been trending lower for the last few decades while global temperature (represented here by the GISTEMP 3.1 surface temperature data set) has been trending higher for the last several decades. What the alarmist community fails to recognize (knowingly or through ignorance) is that there are more direct and more powerful solar forcings than TSI alone. Those forcings would include (Cosmic Ray Flux (CRF) and High Energy Particles (HEP) which are included in the CMIP6 programming protocols but ignored), and magnetic field strength, UV radiation magnitudes, etc. And there are also indirect solar forcings such as ocean and atmospheric cycles, cloud cover/sunshine hours, submarine volcanic activity, etc. that are

also, NOT included in the climate models. All these natural forcing parameters play a role and should not be ignored to focus almost solely

on anthropogenic forcing, a decidedly unscientific position to take. The deviation between global temperature and TSI is real, but the magnitude is not “settled science” and the makeup of that deviation is not limited to just anthropogenic forcings. This post layers in many of the parameters (including CO<sub>2</sub>) discussed here, filling in the gap between temperature and TSI.

There is more to solar forcing than TSI and there is more to ‘climate change’ than anthropogenic forcings.

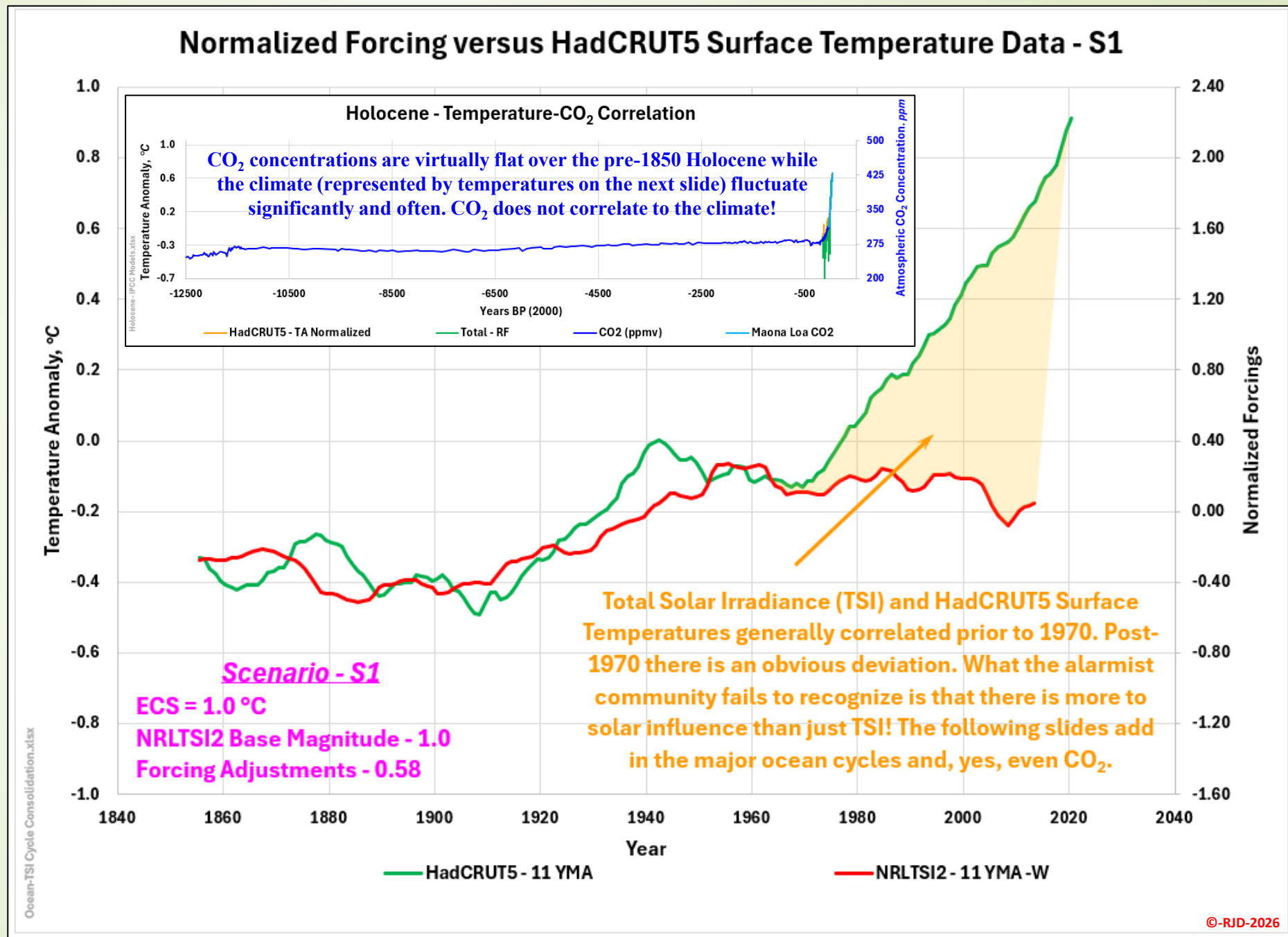


The chart shown here shows the same general profile using different data sets. The GISTEMP 3.1 surface temperature data set (the red curve on the previous slide) has been replaced with the HadCRUT5 dataset (the green curve to the right). The SATIRE-T2 TSI reconstruction has been replaced with the Naval Research Laboratory's (NRLTSI2) TSI reconstruction. There are some differences in the datasets, but they are not material to the discussion. The major difference between the HadCRUT5 and NRLTSI2 curves has been shaded yellow. This post will layer on a variety of natural parameters (well established datasets that are not included in the climate models), that build on the NRLTSI2 TSI reconstruction. There are two scenarios that will be evaluated.

Scenario – S1 is correlated to the pre-Satellite period (pre-1979). Scenario – S2 is more closely correlated with the University of Alabama, Huntsville

(UAH) Lower Troposphere satellite temperature dataset. The small inset to the right shows the atmospheric CO<sub>2</sub> concentration profile over the Holocene (back to 12500 BP) correlated with the HadCRUT5 temperature data and the IPCC's 'best estimate' of Total Radiative Forcing. CO<sub>2</sub> levels are virtually flat, the Holocene climate is erratic (next slide).

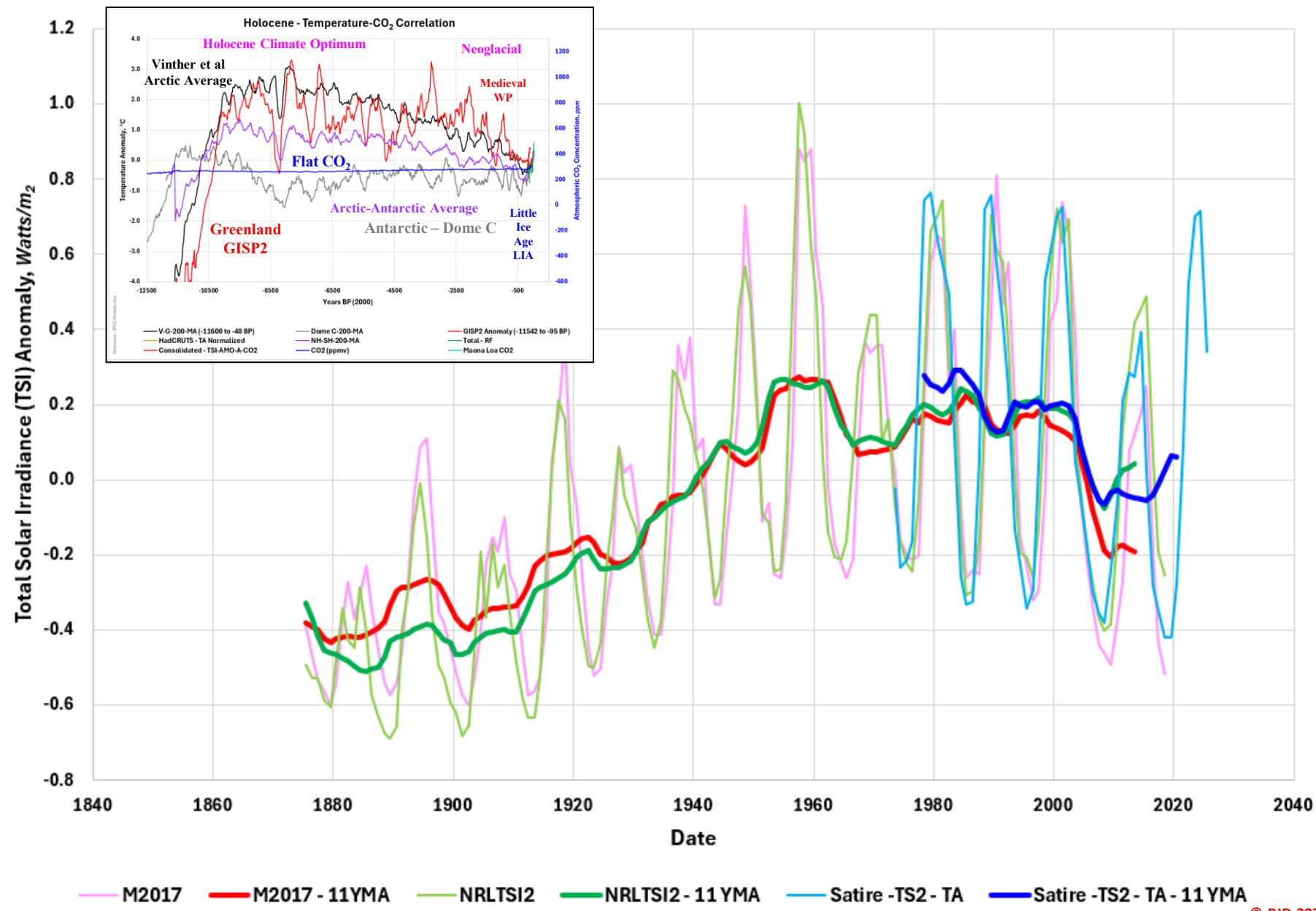
## TSI vs HadCRUT5 Meme Context



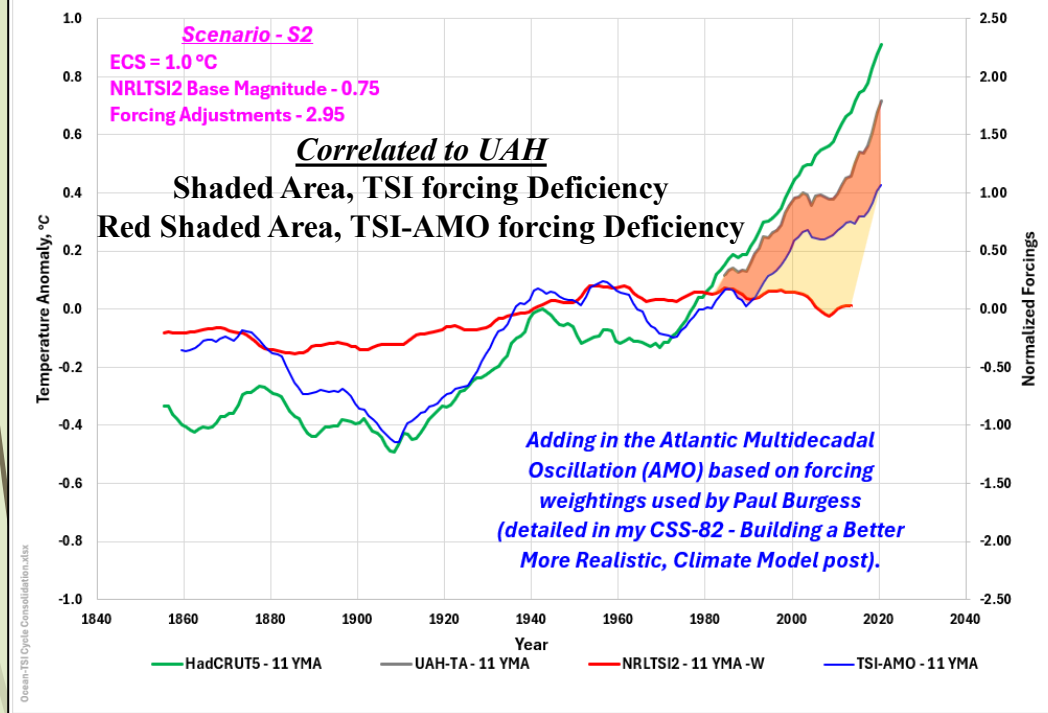
This slide compares the SATIRE-T2 TSI reconstruction (1973 to the present) with the NRLTSI2 TSI used in this analysis and the IPCC's 'best estimate' (Matthes et al 2017) TSI. Again, there are differences, but the differences are not material to the discussion. Note, there are many (40+) other TSI reconstructions that would be more material to the discussion. More detail on that topic is available in my [CSS-71 – IPCC Model/Theory Shortcomings](#) post. This discussion will stick with the NRLTSI2 TSI reconstruction. There is a longer SATIRE daily TSI dataset available but condensing the data down to monthly and yearly data is time consuming and will be dealt with later. The IPCC model programming minimizes the natural forcings (completely ignoring the ocean and atmospheric cycles and many of the solar forcings). Those natural forcings are visible in the pre-1850 Holocene temperature data (as shown in the small inset). Temperatures (climate in general (sea level change, glacial movement, etc.)) in the Northern and Southern Hemispheres fluctuated significantly and often despite a virtually flat CO<sub>2</sub> concentration (which is indicative of anthropogenic influence in general). The climate cannot be modeled with the current IPCC computer model ensemble, period!

### TSI vs HadCRUT5 TSI Comps

## TSI Comparison - Matthes et al 2017, NRLTSI2, SATIRE-TS2



Normalized Forcing versus HadCRUT5 Surface Temperature Data - S2



CSS-87d

## TSI versus HadCRUT5 – Add in AMO

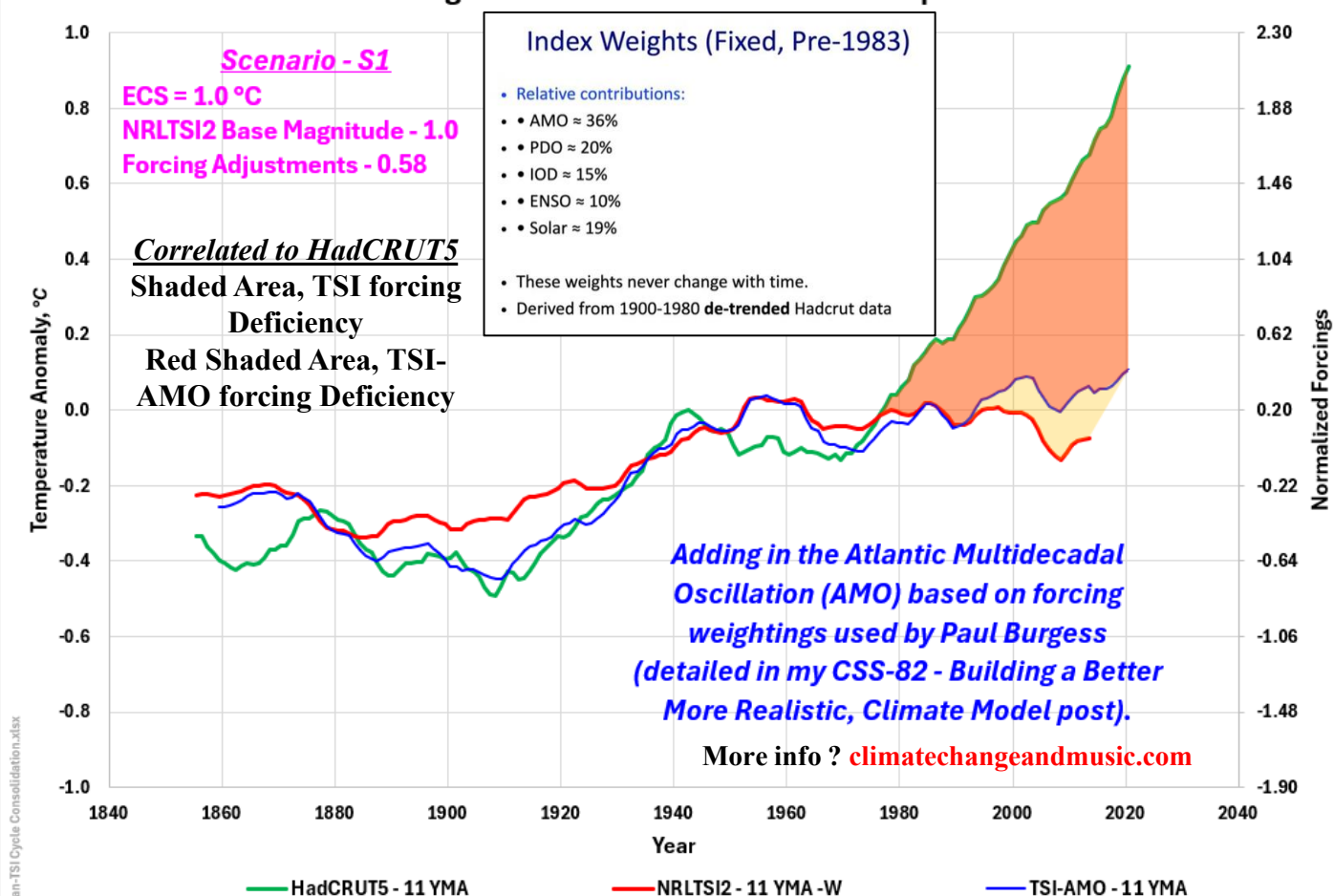
The first overlay is the Atlantic Multi-decadal Oscillation (AMO). In Scenario – S1 (below), adding the AMO forcing to the NRLTSI2 solar forcing produces a decent history match with the pre-1980 HadCRUT5 surface temperature data. Post 1980, there is still a deviation, but the NRLTSI2-HadCRUT5 difference has been reduced (i.e.: less CO<sub>2</sub> influence). The correlation is not surprising if you have read my [CSS-71 – IPCC Model/Theory Shortcomings](#) post. A TSI/AMO focused model with meaningful CO<sub>2</sub> and aerosol forcings included, produces a far better history match than the IPCC’s anthropogenic focused ‘best estimates’, especially pre-1850 as shown earlier. For this evaluation, each parameter has been assigned a weighting based on Paul Burgess’ work (outlined in my [CSS-82 -](#)

[Building a Better, More Realistic Climate Model](#) post). The small inset to the right lays out the forcing weightings that are used in this discussion. The AMO is the most influential with a 0.36 weighting.

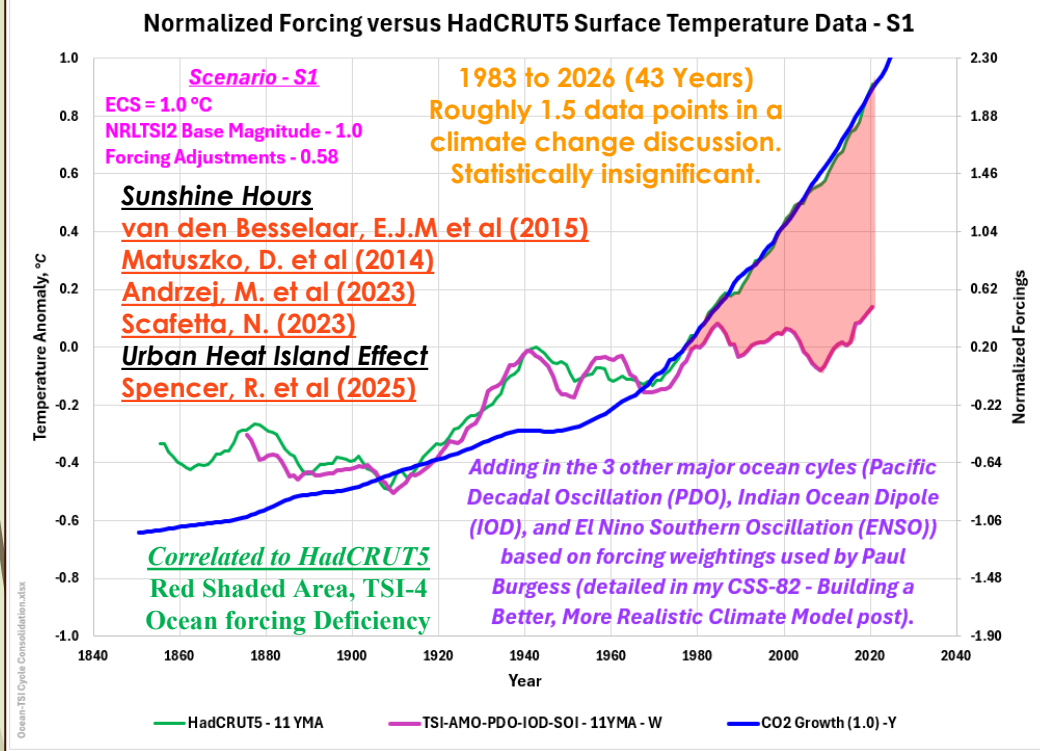
### TSI vs HadCRUT5 Add AMO

TSI is in the middle of the pack at 0.19. Scenario-S1 bumps up the TSI to 0.30 (to cover some of the ignored solar forcings) and keeps the TSI to ocean cycle ratios consistent with the inset. The chart above (Scenario-S2) is based on a final correlation with the UAH satellite temperature data (which has been roughly normalized to the HadCRUT5 data since 1979). In Scenario-S2 the TSI base was reduced by 25%, and the weighting was increased from 0.19 to 0.75. This produces a much stronger TSI/AMO response that now approaches the UAH temperature curve, noticeably reducing the deviation. The general profile is aligning with the HadCRUT5 data but that is mostly irrelevant because Scenario-S2 is focused on the UAH correlation. These are simple models that use a muted TSI (like the IPCC preferred reconstruction). The same evaluation could be done with an alternative TSI and different weightings.

Normalized Forcing versus HadCRUT5 Surface Temperature Data - S1



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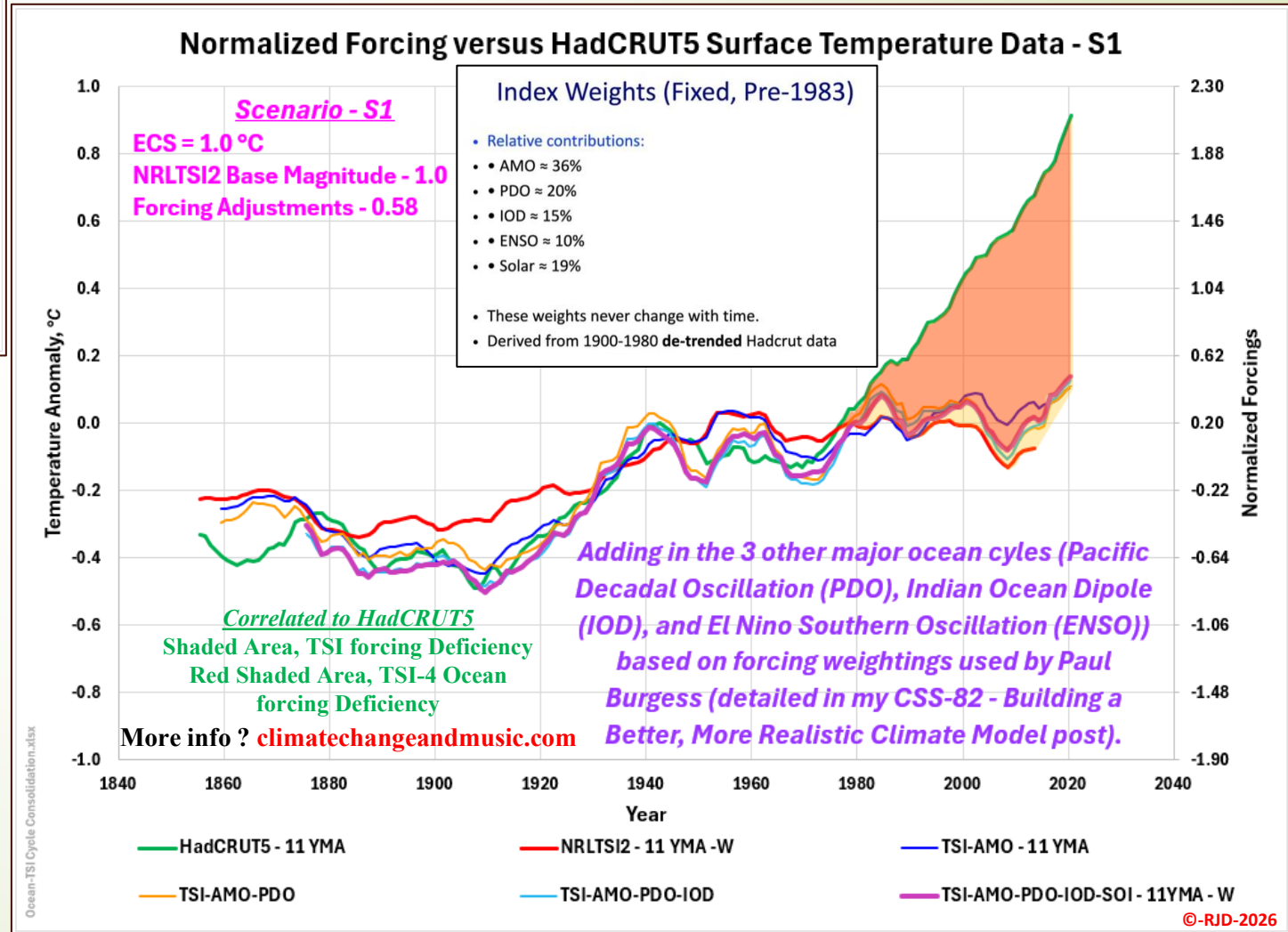


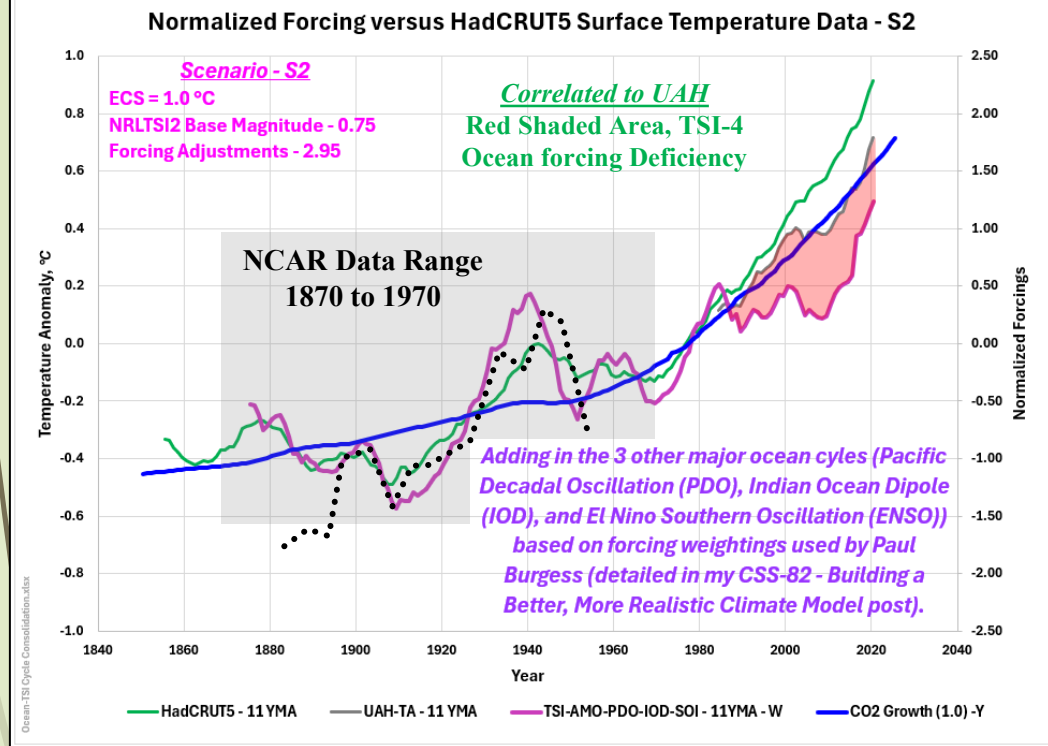
add in the area between the **consolidated natural forcings** and the **TSI solar forcing** curves to the right. What they refuse to factor into the discussion is realistic Urban Heat Island Effects (UHIE) and sunshine hours/cloud cover along with solar forcings over and above TSI, magnetic field strength, etc. If CO<sub>2</sub> was responsible for all the post-1970 warming, CO<sub>2</sub>'s warming contribution would be based on a CO<sub>2</sub> Equilibrium Climate Sensitivity (ECS) of roughly 2.0

°C. That ECS provides minor warming that would be beneficial, not dangerous. Based on the many papers (a few authors listed above) that show most of the warming since 1980 can be attributed to lower sunshine hours/duration (i.e.: less cloud cover) there may not be much room left for CO<sub>2</sub>. The UHIE mentioned earlier affects the Global Mean Temperature (GMT, for what that number even means) through the process of homogenization (i.e.: data manipulation). Recent work by Roy Spencer ([link above](#)) estimates that 22% of the GMT is based on UHIE (as compared to the IPCC estimate in the 10% range). CO<sub>2</sub> has competition for the shaded area.

## CSS-87e S1 - TSI versus HadCRUT5 – Add in PDO, IOD, ENSO

Adding in the other 3 remaining ocean cycles tightens up the correlation between the natural forcings included to this point in the evaluation (TSI, AMO, PDO, IOD, and ENSO) and the HadCRUT5 temperature anomaly curve pre-1983. The plot below shows each of the ocean cycles progressive contributions to the **overall natural forcing curve**. The chart to the left isolates the overall natural forcing curve with the HadCRUT5 temperature anomaly curve. That is a very good correlation pre-1983. The CO<sub>2</sub> forcing (correlated/normalized with the post-1970 HadCRUT5 data) has also been added. The All CO<sub>2</sub>, All the Time alarmist community would have you believe that the shaded area to the left is all due to human activity with a focus on greenhouse gases (primarily CO<sub>2</sub>). You can also

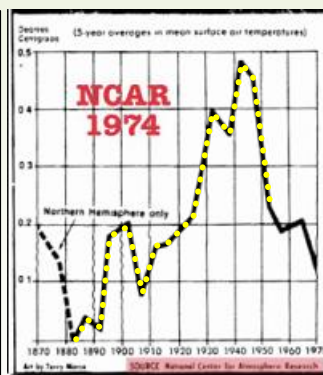




CO<sub>2</sub>. Note, the chart to the right has all four of the major ocean cycles (plus TSI) plotted in succession. The chart above just has the TSI/ocean cycle consolidation plotted. The black dotted line (NCAR's 1974

temperature estimates, yellow dots highlight above right) was overlain on the above chart. The NCAR (a pre-homogenization dataset) and consolidated forcing correlate well from 1896 to 1953. And I suspect that the pre-homogenized (i.e.: measured) HadCRUT5 temperature data would not look much different. Whether the correlation is with the HadCRUT5 or UAH, the natural forcing correlation is a better match than the CO<sub>2</sub> correlation (at least pre-1983). Post-1983 there certainly could be more than just the IPCC's muted, but preferred TSI and the ocean cycles that they ignore in their models. The TSI (as a proxy) and/or other solar forcings can easily be weighted to explain much of the warming since the pre-industrial (1850) period. But before we discuss those options, we should roll in some CO<sub>2</sub> influence. The next slide adds in a CO<sub>2</sub> forcing based on an ECS of 1.0 °C. Remember the max ECS is only ≈2.0 °C!

## TSI vs HadCRUT5 – S2 Ocean Cycles



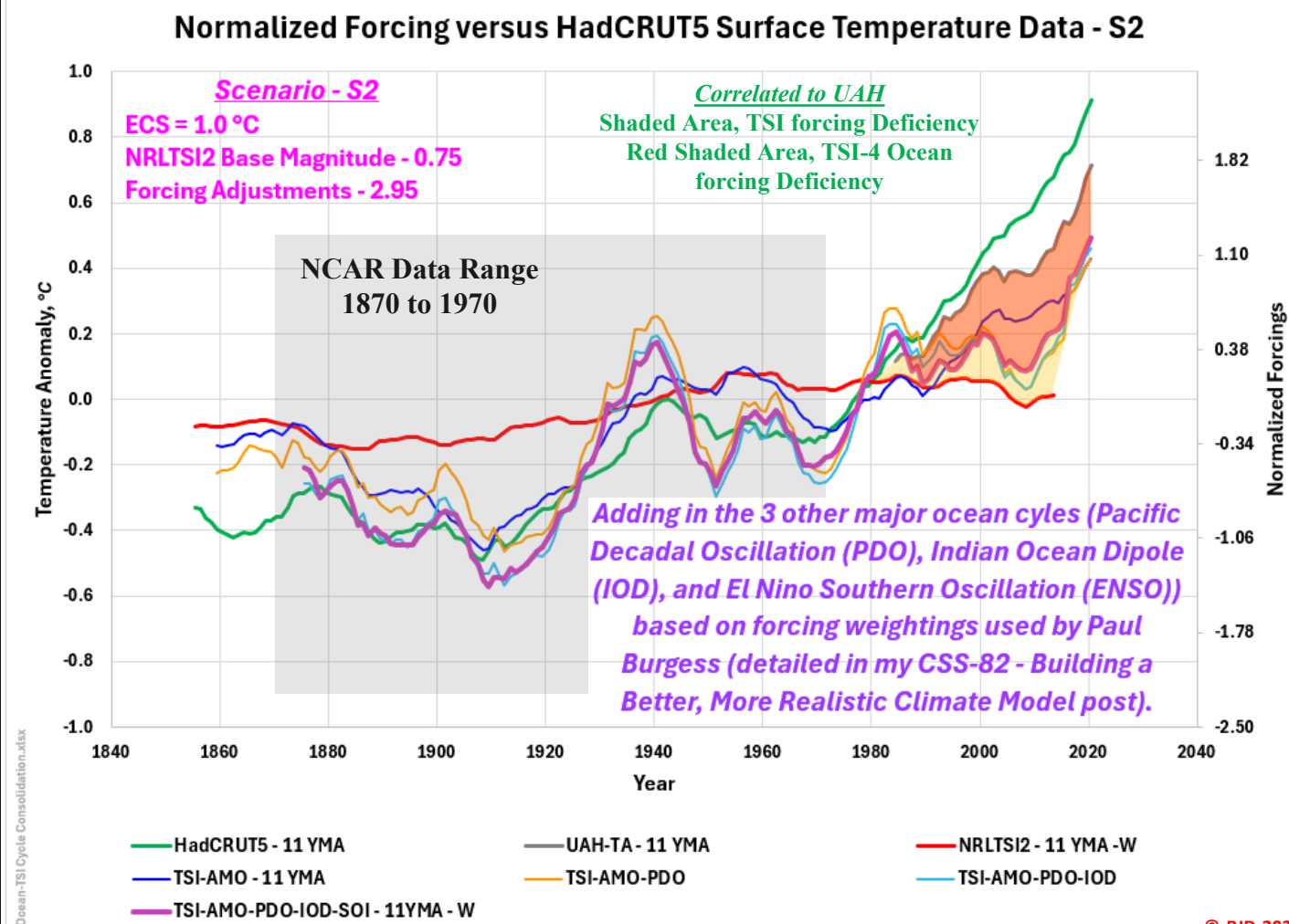
CSS-87f

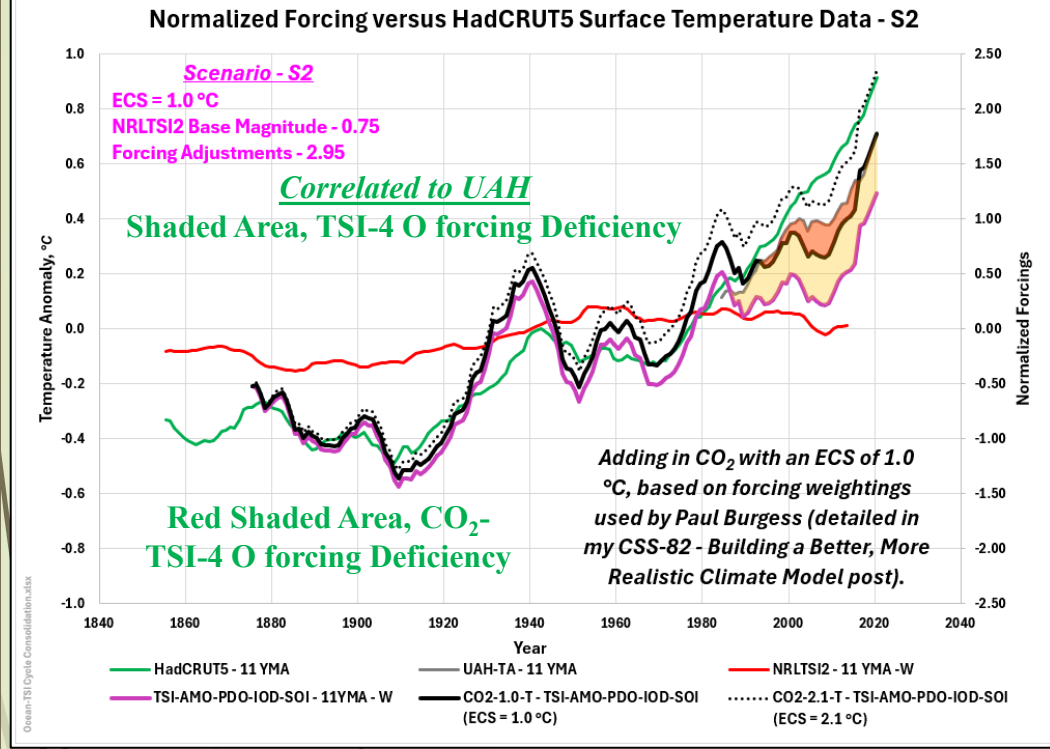
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## S2 - TSI versus HadCRUT5 Add Ocean Cycles

Shifting to Scenario – S2 produces a wider forcing range than Scenario – S1.

So, the correlation is not as tight as the correlations on the previous page. Remember these charts are correlated to the UAH satellite temperature data set. There is still a difference between, and the temperature data sets (HadCRUT5 and UAH) and the TSI/ocean cycle consolidation, but that difference has narrowed (especially as compared to the UAH curve). There are still many parameters that could be responsible for that difference, including



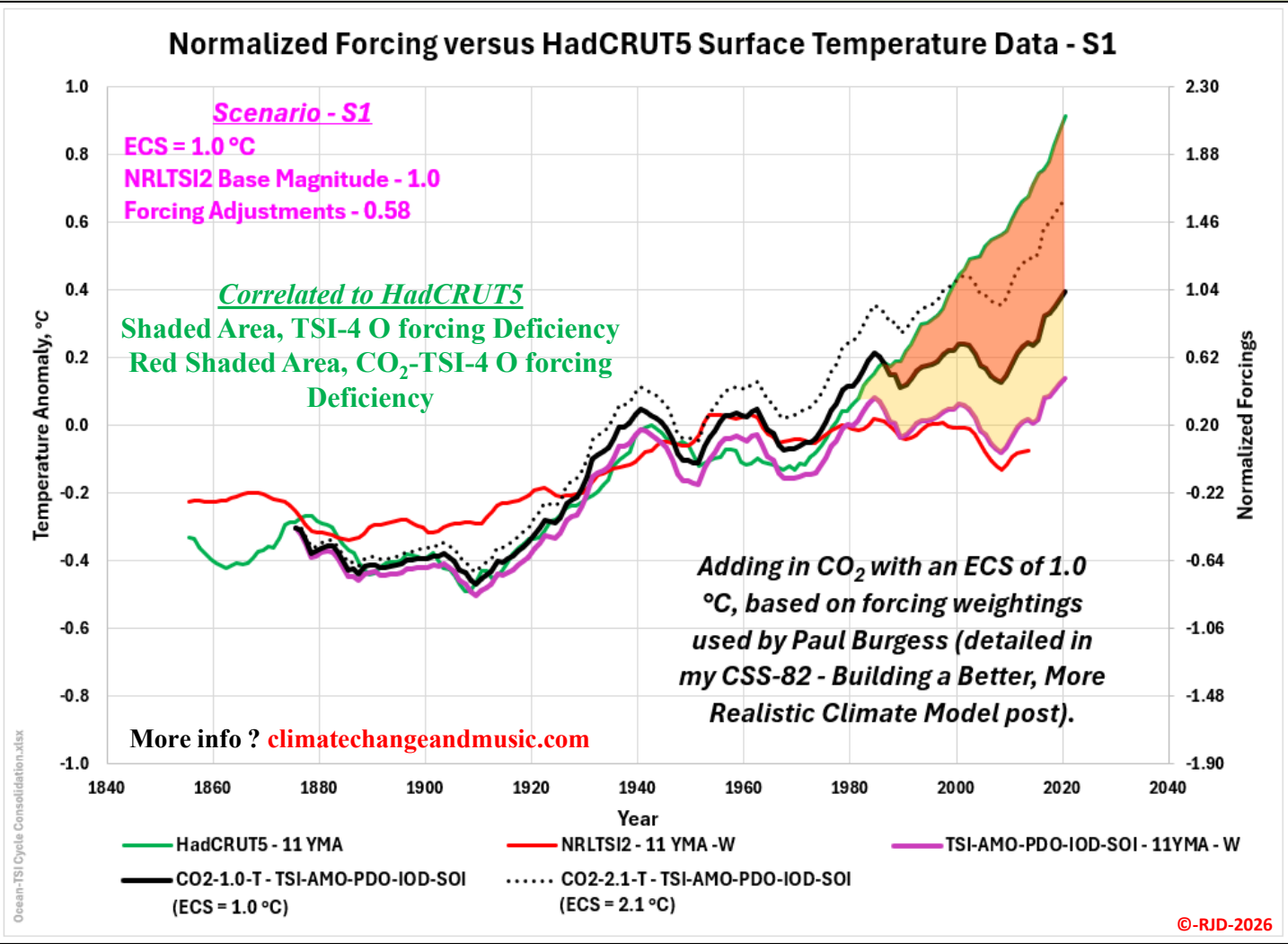


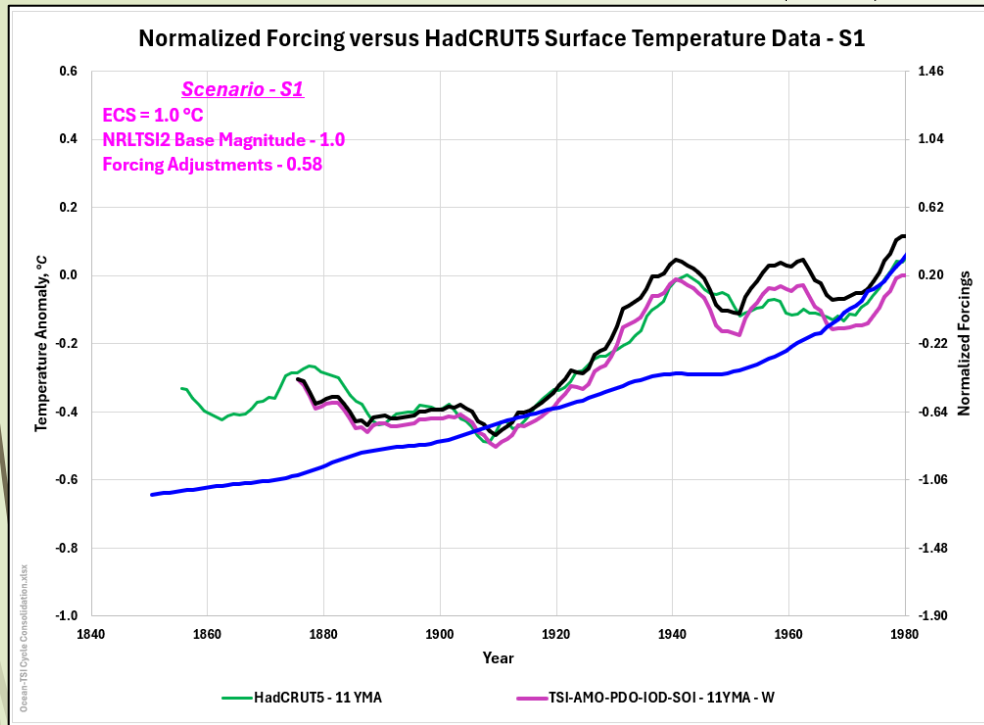
SATIRE-T2 and the IPCC Matthes et al 2017 ‘best estimate”, compared earlier on CSS-87c). Using a less muted TSI reconstruction would tighten up that post-1980 correlation. The Scenario-S2 version (above) focuses more heavily on the natural forcings and is correlated to the UAH satellite data. In this scenario, CO<sub>2</sub>’s warming (based on an ECS of 1.0 °C) is enough to roughly match the warming that is observed in the UAH satellite temperature data. The “over-homogenized”, pre-satellite HadCRUT5 surface temperature data does not correlate well to the natural forcings plotted above. But as shown earlier, the correlation is much better with the older measured data. As discussed in my recent post (CSS-86 – Is “the Science” Settled?), the science is obviously NOT settled. The All CO<sub>2</sub>, All the Time alarmist narrative is woefully deficient at history matching the Modern Temperature Record (MTR, 1850 to the present) and is simply useless for history matching the pre-1850 Holocene temperature/climate data. A natural forcing weighted approach (solar and ocean) produces far superior history matches!

## TSI vs HadCRUT5 Add CO<sub>2</sub>

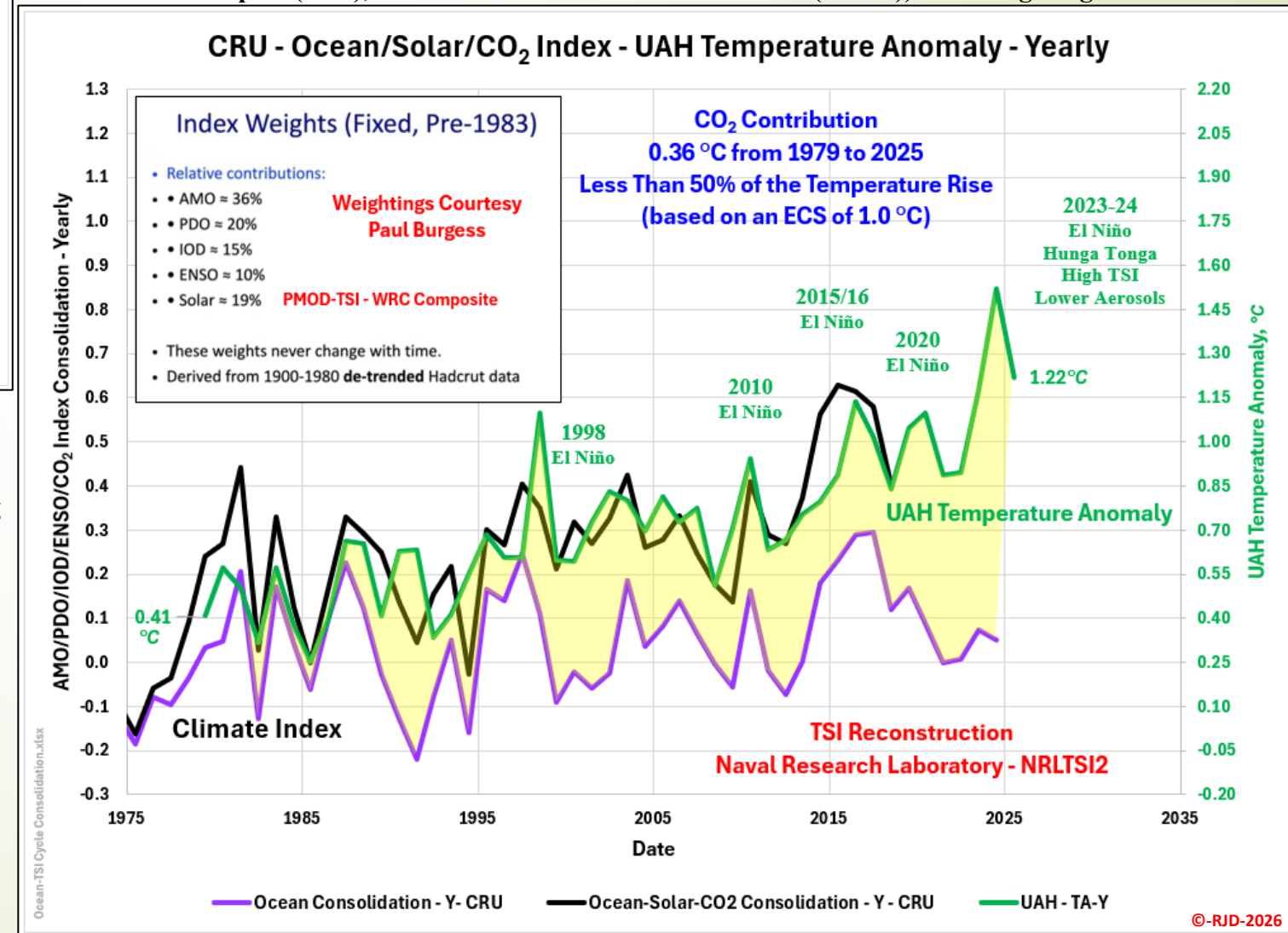
## CSS-87g TSI versus HadCRUT5 – Add CO<sub>2</sub> (ECS = 1.0 °C)

This slide adds in the CO<sub>2</sub> component with an ECS of 1.0 °C (bold black line) and for some additional perspective 2.0 °C (dotted black line). In Scenario-S1 (below), CO<sub>2</sub> at an ECS of 1.0 °C, accounts for a little less than half of the warming from the early 1980s. As discussed earlier, there are peer reviewed published papers that show significant post-1980 warming contributions from sunshine hours/cloud albedo, Urban Heat Island effects, and potentially the warming biases in the homogenization process. Additional CO<sub>2</sub> warming is also a possibility and is represented here as the 2.0 °C ECS case. At an ECS of 2.0 °C, most of the additional (minor and beneficial) warming would be accounted for. Note that the TSI used in this scenario (NRLTSI2) is a muted TSI reconstruction (like the original meme





This slide breaks the MTR up into two periods (satellite (December 1978 to the present, below) and primarily pre-satellite (1850 to 1980, to the left)). The reason for reviewing the two periods separately begins with work done by Paul Burgess which I discussed in my [CSS-82 – Building a Better, More Realistic Climate Model](#) post. Burgess showed that he could model the University of Alabama, Huntsville’s satellite temperature dataset very closely using a CO<sub>2</sub> ECS of 1.0 °C combined with Solar (TSI), and the four major ocean cycles (the Atlantic Multi-decadal Oscillation (AMO), the Pacific Decadal Oscillation (PDO), the Indian Ocean Dipole (IOD), and the El Niño Southern Oscillation (ENSO)). The weightings of each of the

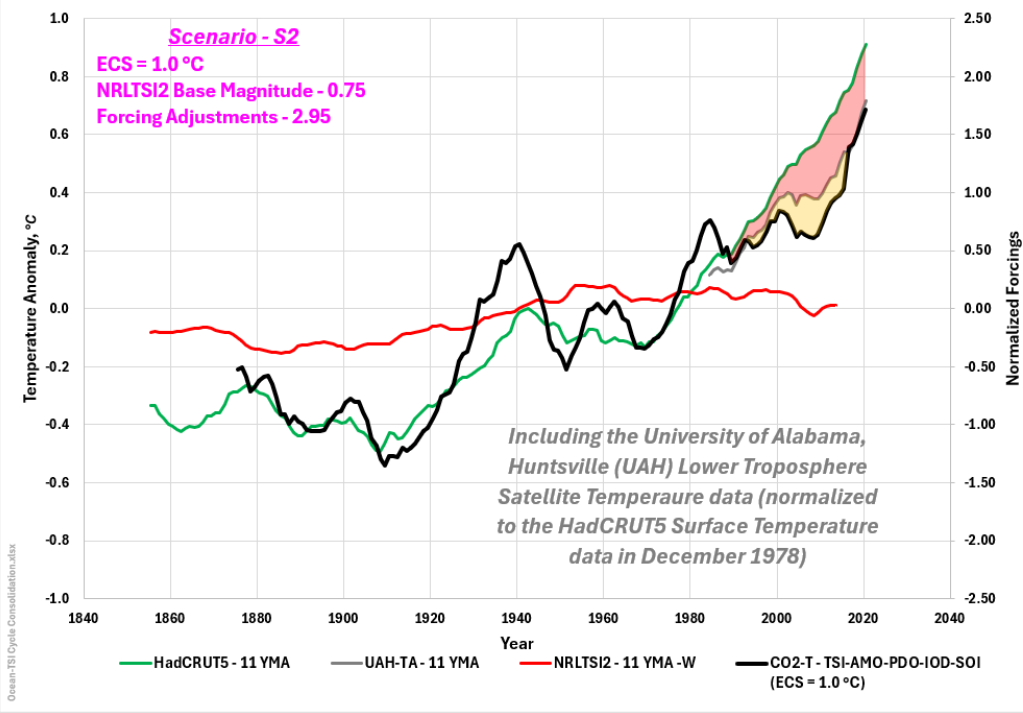


Natural forcings is laid out in the inset to the right. The chart to the right is my attempt to duplicate Burgess’s work. The datasets I had to use were slightly different, but the results provided confirmation to Burgess’ work. The same forcing weightings were applied to the pre-satellite data above and not surprisingly, the HadCRUT5 temperatures correlate very well with the **consolidated natural forcings**. Adding in the CO<sub>2</sub>

influence (ECS=1.0 °C) also produces a good correlation but the natural forcings are obviously driving the temperatures, not CO<sub>2</sub>! A realistically higher CO<sub>2</sub> ECS will make very little difference in the pre-satellite period. During the satellite period, CO<sub>2</sub> played a more prominent role (i.e.; the shaded period post-1986). That also assumes that warming the shaded area was not due to sunshine hours, cloud albedo, UHIE, etc. Note, the natural forcing weightings could potentially be finetuned to produce a slightly better history match (i.e.: a more prominent ENSO influence appears to be required).

**TSI vs UAH  
Burgess History  
Match**

Normalized Forcing versus HadCRUT5 Surface Temperature Data - S2



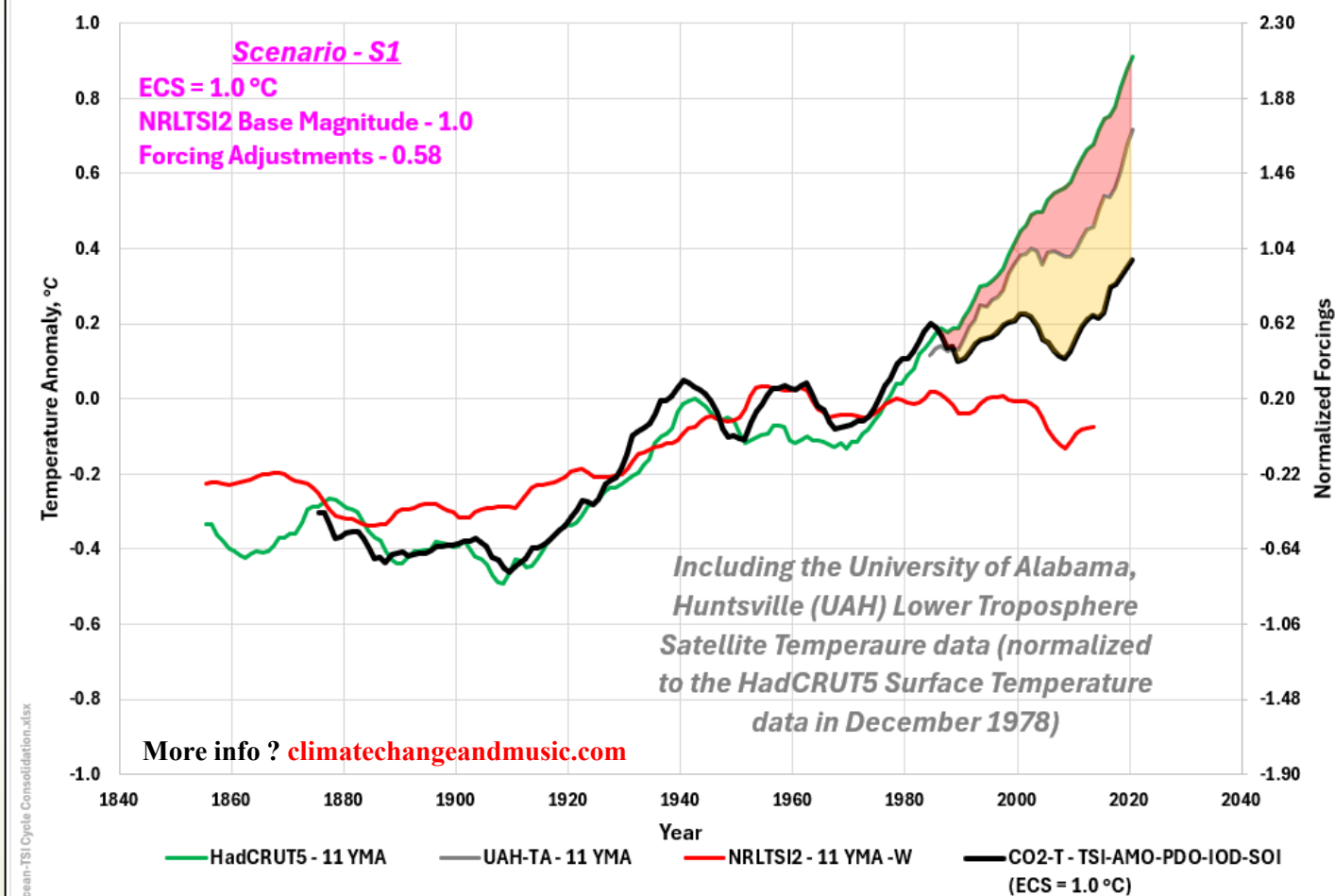
Huntsville's (UAH) data and have used that data in this post. I could have used NOAA's STAR product with the same results. Satellite (Lower Troposphere) and surface (2 meters above the ground) data sets cannot be compared directly. But we can history match whichever datasets we choose. The UAH and HadCRUT5 datasets are normalized to the December 1978 start date of the satellite period. The satellite data has lower temperatures and a shallower incline. Scenario-S1 post-1987 has a much more noticeable deviation than Scenario-S2. But does that matter? CO<sub>2</sub> (as shown earlier, CSS-87e) only correlates with the post-1970 period HadCRUT5 data. The post-1970 CO<sub>2</sub> correlation cannot be improved. But the overall natural forcings can be easily adjusted (with well established TSI reconstructions and ocean cycles) to produce far better history matches than those shown here. The known ocean cycles and solar activity drove the climate pre-1970. They did stop acting on the planet suddenly. And CO<sub>2</sub> may correlate but its influence must be separated from sunshine hours, ocean cycles, submarine volcanics, aerosols, biases, etc.!

## TSI vs HadCRUT5 Add UAH

## CSS-87i TSI versus HadCRUT5 – Add UAH Temperatures

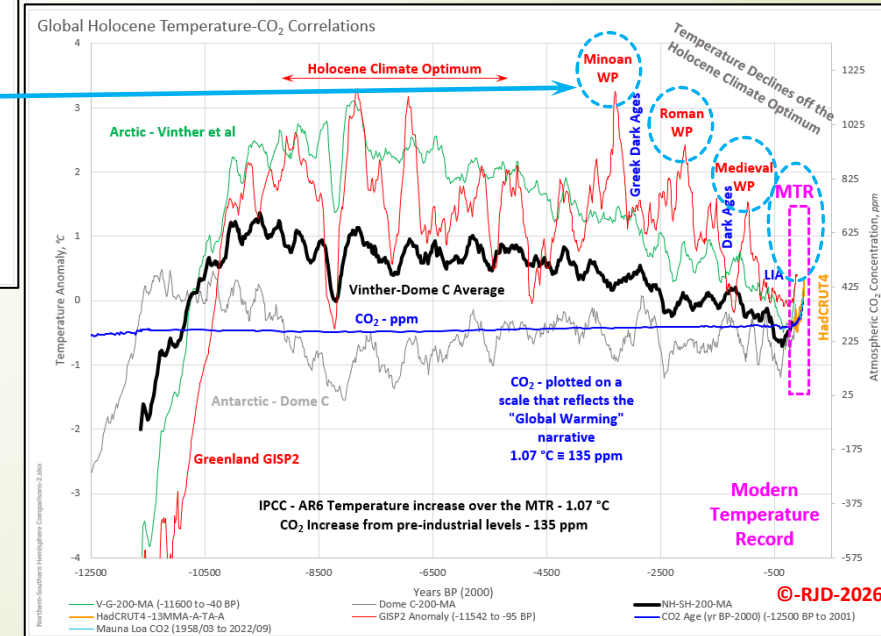
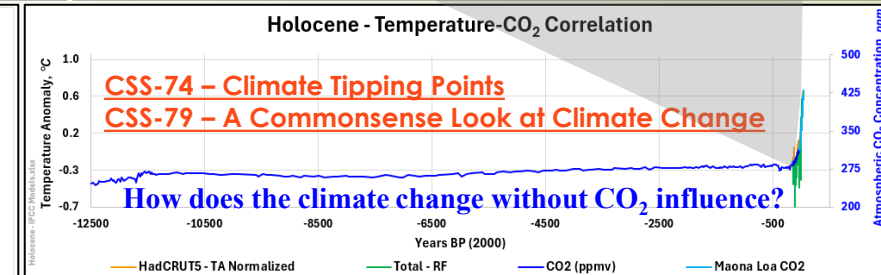
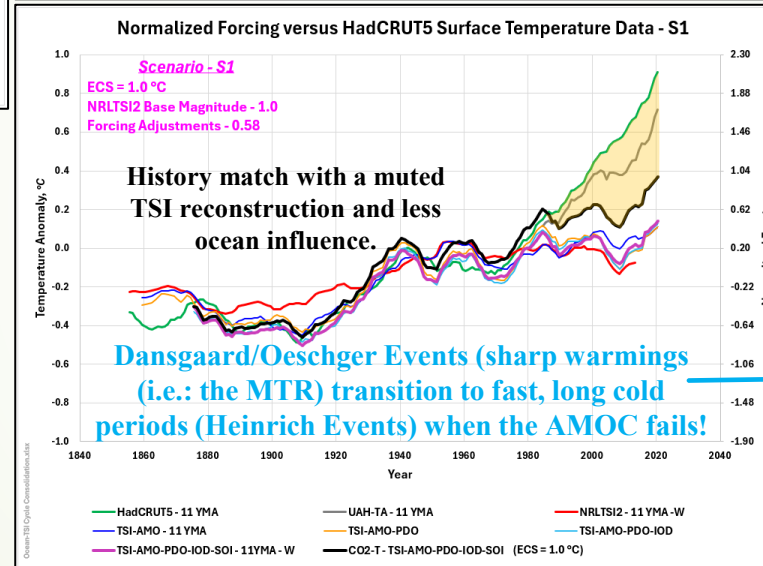
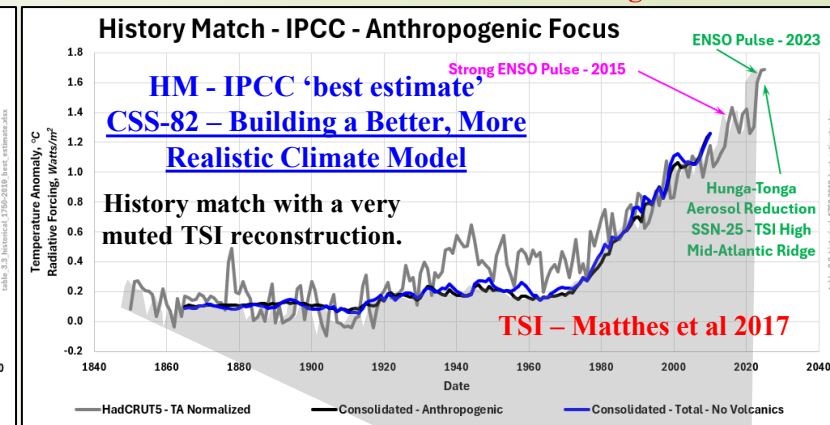
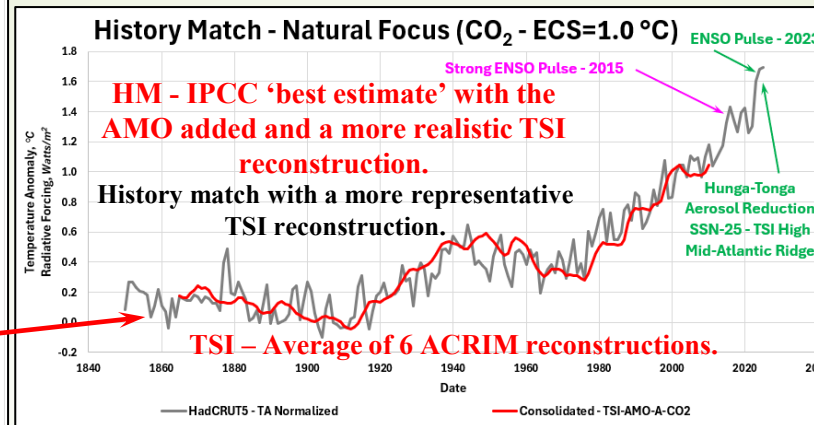
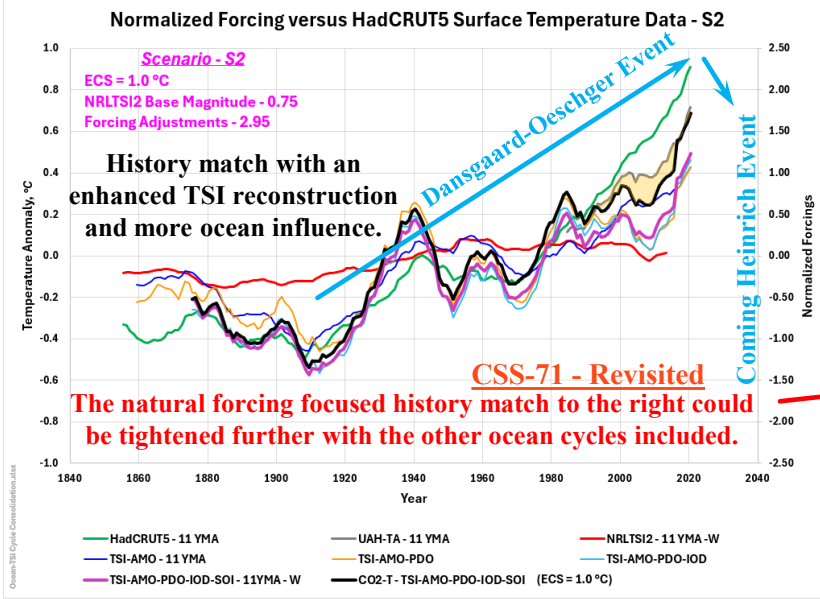
There are two temperature datasets used in this post. A “properly” trained alarmist will always go with one version or another of the many “aggressively homogenized” surface temperature datasets. This post started with an image that used the NASA-GISS dataset (the traditional leader in aggression). I prefer the HadCRUT5 surface temperature dataset which I have used throughout the post. Slightly less “homogenized” but not materially different. There are serious issues with the accuracy of the surface datasets (over-homogenization, UHIE influence, ghost stations, poor station quality, station density (past and present), etc.). But we must work with what we've got. The satellite data sets are more accurate and have far better coverage than any surface dataset. I prefer the University of Alabama,

Normalized Forcing versus HadCRUT5 Surface Temperature Data - S1



# CSS-87j Total Solar Irradiance (TSI) versus HadCRUT5 – IPCC Model

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As I showed in my **CSS-71 – IPCC Model/Theory Shortcomings** posts, the IPCC and its alarmist minions could easily produce a far better history match with existing peer reviewed information. Their anthropogenic focused 'best estimates' produced a **questionable correlation (upper right chart)** that is limited to the Modern Temperature Record (MTR, 1850 to the present). Pre-1850, these climate models are useless for history matching and/or making climate predictions. As shown in the two charts to the right, CO<sub>2</sub> is virtually

**TSI vs HadCRUT5 IPCC Model**

flat while the pre-1850 Holocene climate (represented here with temperatures) fluctuates significantly and regularly. Simply adding in the AMO and replacing the IPCC's 'best estimate' TSI reconstruction with a more representative average produces the **far better history match shown above (center chart)**. The IPCC and their alarmist minions regularly ignore the empirical data and interpretations that do not fit with their narrative. But you cannot ignore the fact that CO<sub>2</sub> does not generally correlate with the global climate. But when that correlation happens to occur, that does not provide proof that CO<sub>2</sub> is driving the climate on its own. Interestingly, the alarmist community has chosen to begin pushing an Atlantic Meridional Overturning Circulation (AMOC) collapse, that will plunge our planet into a noticeably colder phase. So much for "Global Warming". And they may be correct, but their rationale remains focused on anthropogenic causes when the empirical data shows the natural forcings regularly initiating **the events**.