

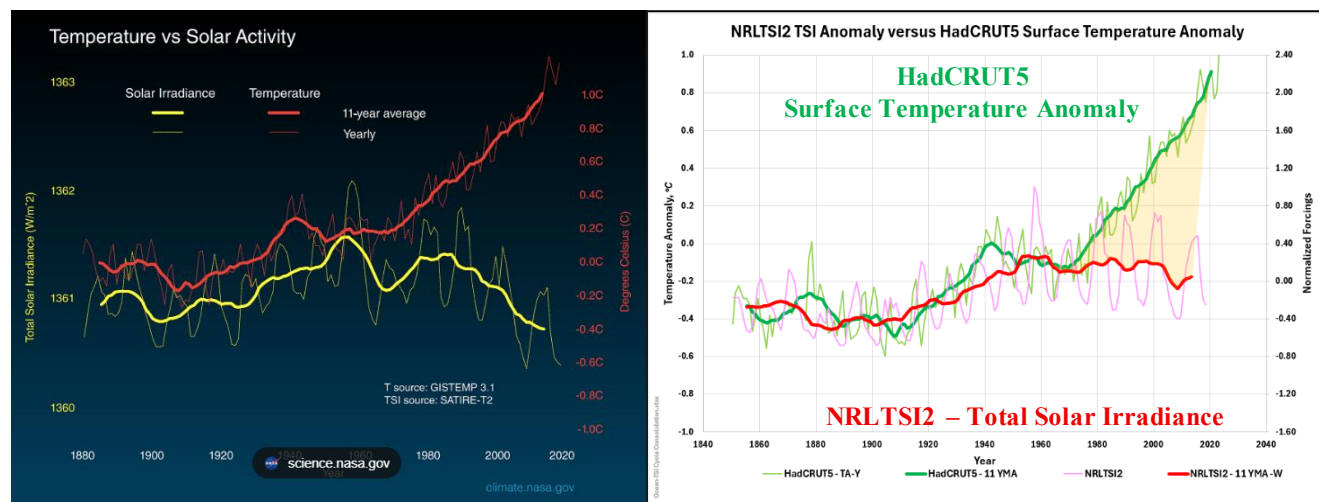
CSS-87 – TSI versus Global Temperature

<https://climatechangeandmusic.com/tsi-versus-global-temperature/>

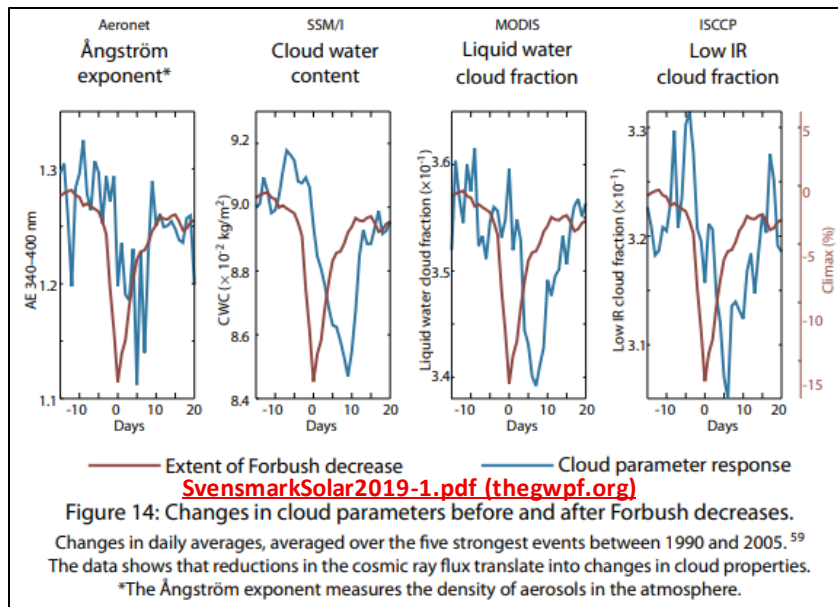
This post addresses one of the All CO₂, All the Time alarmists' favorite charts, Global Mean Temperature (GMT) and Total Solar Irradiance (TSI) over the Modern Temperature Record (MTR, 1850 to the present). Why is this chart a favorite? Around 1970, during the 'Ice Age is Coming Scare', the GMT and TSI data began diverging. GMT rose, TSI leveled out and began gradually declining more recently. These charts are often based on real data sets, but they lack a lot of context and display the lack of scientific knowledge/integrity of anyone posting a version of the plot.

[#climatechange](#) [#delaythegreen](#) [#globalwarming](#) [#showusthedata](#)

The chart below compares MTR GMT/TSI I pulled randomly from the internet and a chart I produced myself. The chart (bottom left) uses NASA's GISTEMP and the SATIRE-T2 TSI reconstruction. I used the HadCRUT5 surface temperature dataset and the Naval Research Laboratories' NRLTSI2 TSI reconstruction (chart, below right). The two plots are comparable. This post builds off the chart below right. There is so much more to 'climate change' than just anthropogenic forcings (despite what the alarmist community claims) and there is so much more to solar activity than just Total Solar Irradiance (TSI). And there is more to TSI than just SATIRE-T2 and NRLTSI2. A chart that shows just one temperature dataset and one TSI reconstruction is as simplistic and unscientific as the premise that anthropogenic forcings (focused on greenhouse gases, primarily CO₂) are virtually the only substantive climate driver. Both charts tell a similar story but neither one tells the whole story.



We can start with solar activity. Total Solar Irradiance (TSI) is just one of many solar forcings, and a minor one at that. There are many more solar related parameters that must be considered. Before we get into a detailed discussion, we should review a real-world example of the relationship between TSI and the energy the sun delivers to the earth and the amount of energy that actually makes it into the biosphere. Those real-world examples are called Forbush events. A Forbush event begins with a large Solar Flare (SF) and a Coronal Mass Ejection (CME). That enormous burst of energy is carried by the solar winds increasing both its speed and density. There are a lot of things that happen when that energy reaches the earth and virtually all of them are ignored. That includes the seemingly benign acceleration of auroral events (frequency, magnitude, and variety). A few examples are shown on the following two pages. The pink skirt under the green aurora indicates that the aurora energy is penetrating further into the atmosphere than normal. Unique auroral events like 'Steve' and red sprites have started making



more appearances. The May 2024 auroras (credit to a notable but not a particularly strong solar event) were easily visible even with the Calgary's light pollution.

There is a simple reason for the enhanced aurora activity without massive solar events. Our magnetic field strength has been weakening noticeably. I am not going to go into great detail on that subject in this post. That detail is provided in my [CSS-78 – Weakening Electromagnetic Field Strength](#)

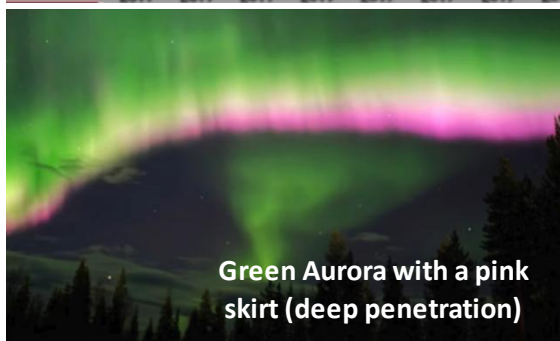
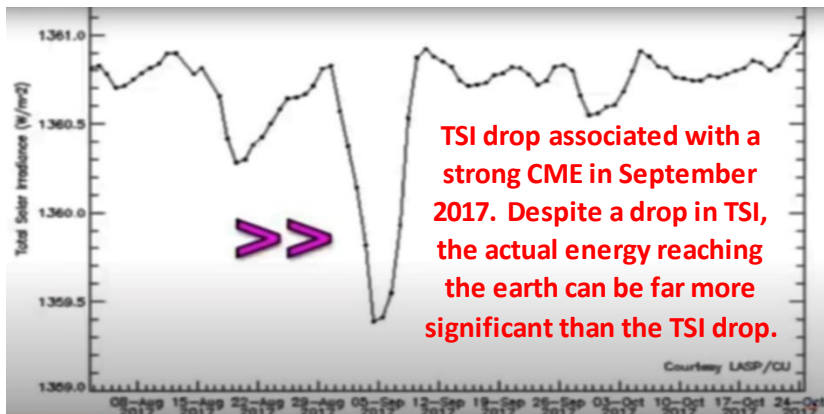
post. An important takeaway from that post is global temperatures/climate correlate with magnetic field strength; they do not correlate with CO₂ (as shown in the plot on the following page).

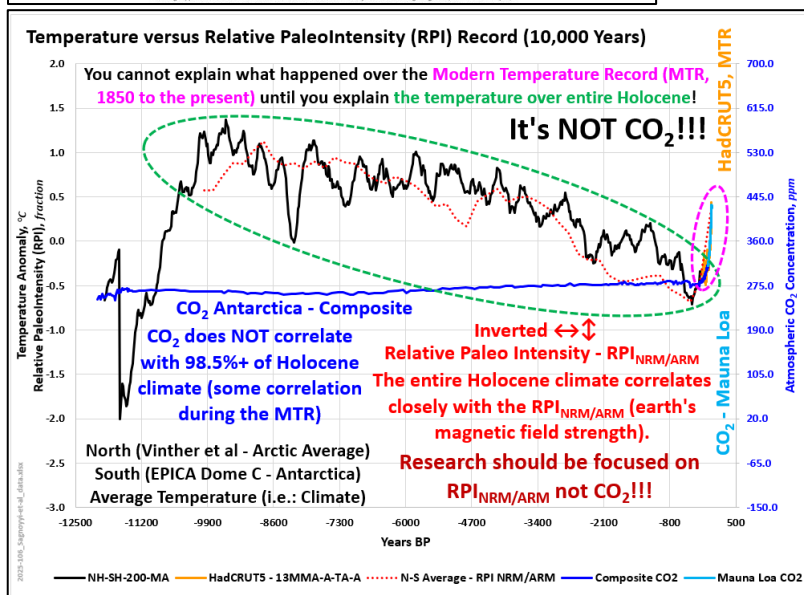
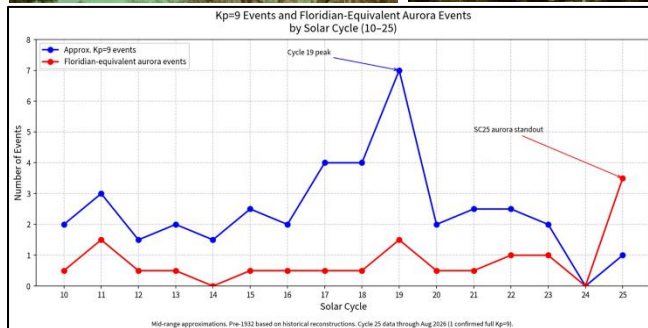
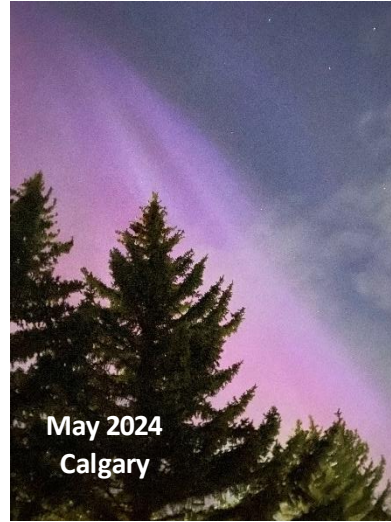
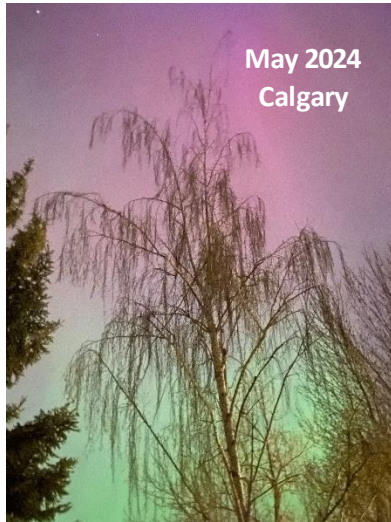
Back to the Forbush events. The upper chart shows the decrease in **Cosmic Ray Flux (CRF)** is followed by a drop in **cloud**

cover and its associated parameters. The enhanced solar winds mean fewer cosmic rays are entering the atmosphere, resulting in less cloud cover and more short wave (SW) solar energy entering the atmosphere, leading to more heating.

The lower chart shows that the TSI actually drops during a significant Solar Flare/CME event despite energy levels that are orders of magnitude higher than

our more normal bombardment (i.e.: TSI is not the only solar forcing and its impact is significantly smaller than CRF and the High Energy Particles (HEP) associated with





SF/CME events). More detail is provided in my [CSS-36 – Solar Flares and CMEs](#) post. The middle chart below left shows that the number of lower latitude auroral events (think Florida) have been increasing in recent years. Very small solar events have been producing major auroral events that were normally only produced by very strong events (think the 1859 Carrington event, an $\pm X100$ solar flare that would fry our grids if we were to experience one with today's

electric technologies. I would be far more worried about our grid integrity, than the minor, beneficial warming that we will experience from greenhouse gas (primarily CO_2) emissions. The billions/trillions wasted on unnecessary, expensive emissions reductions would be far better spent on hardening our grids to withstand as big a solar

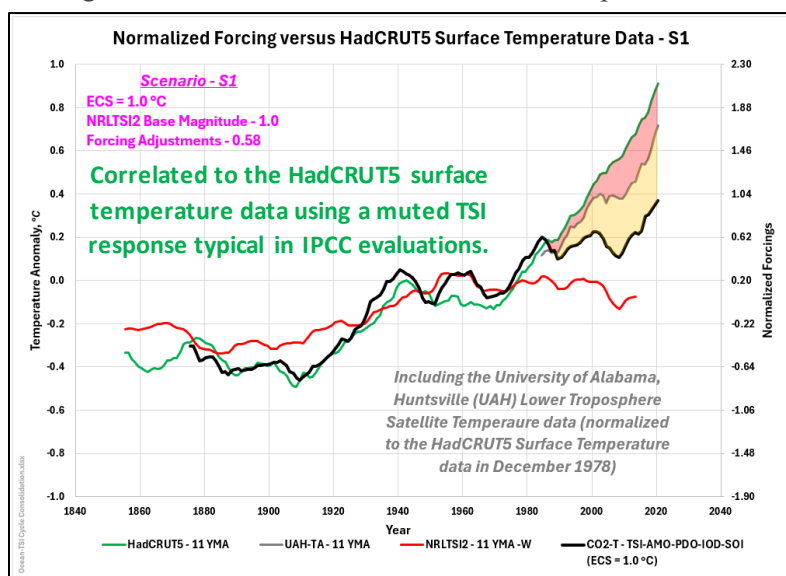
shot as possible. Given the risks associated with violent solar events in a weakening magnetic field scenario, the push to electrify 'everything' is ill advised and ultimately dangerous. Stupid also comes to mind given those wasted billions/trillions will have no measurable impact on future temperatures.

Additional discussion can be found in my [OPPS-20 – Why Are We Putting All Our Eggs in One Basket?](#) and [OPPS-33 – What Happens After Net Zero?](#) posts.

As mentioned earlier, the chart above provides some historical context to the discussion. The earth's magnetic field strength has a general correlation to the earth's Holocene climate (i.e.: expressed here as temperature). Temperatures are warmer with a weak magnetic field (i.e.: more of the sun's energy enters our biosphere) and colder with a stronger magnetic field (i.e.: less energy enters our biosphere). Does the Relative Paleo Intensity (RPI, magnetic strength indicator) correlation indicate that our magnetic field strength is driving the Holocene climate? Not necessarily. The more logical scenario

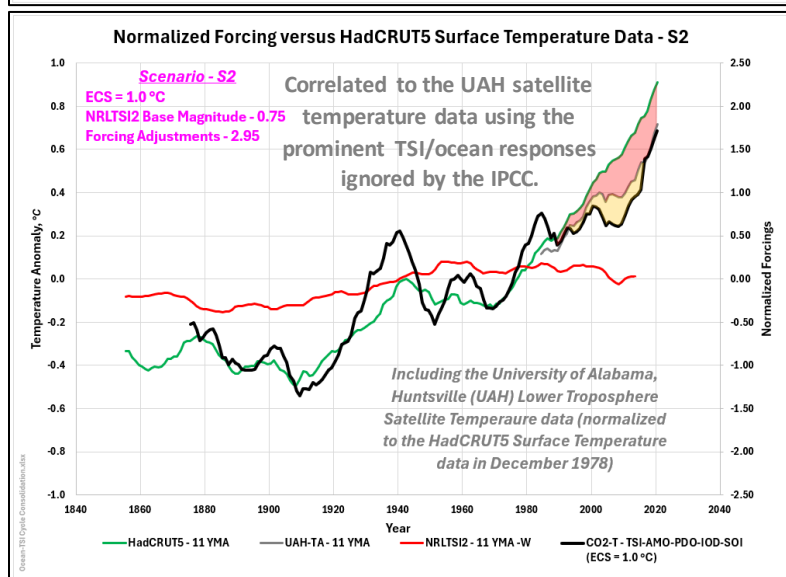
would suggest that there is some contribution from the magnetic field, but there are likely other natural forcings contributing that are driving the magnetic field strength. Note, we can confidently say that CO₂ is not driving the Holocene climate, given CO₂ concentrations were virtually flat for 10,000+ years. Those natural forcings are primarily related to orbital dynamics and the electromagnetic and gravitational interactions within our solar system and beyond. You can find more detail in my [CSS-79 – A Common Sense Look at ‘Climate Change’](#) post. The TSI should be used as a proxy

We have touched on a few of the solar forcings (Cosmic Ray Flux and its effect on cloud albedo, solar wind and magnetic field strength) that are ignored by the alarmist community. There are many other solar forcings (direct and indirect) that can be used to erase or significantly minimize the deviation presented in the first two charts in this discussion. This post goes through many of the options and builds incrementally towards a consolidated (solar, ocean, and CO₂) history match. Solar forcings are far more than just TSI (especially the muted reconstructions used by the IPCC). When other solar forcings are factored in, the deviation in the temperature/solar history graph diminishes significantly.

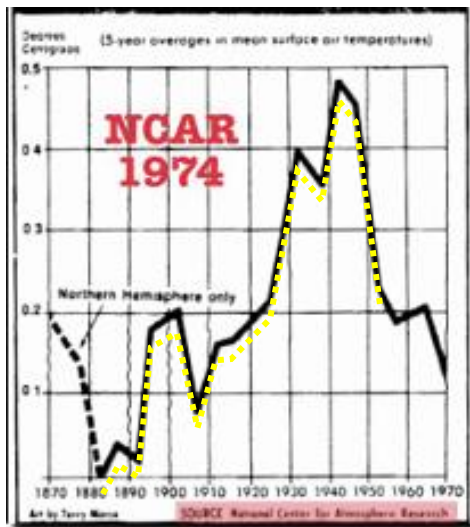


Adding in the major ocean cycles (the Atlantic Multi-decadal Oscillation (AMO), Pacific Decadal Oscillation (PDO), Indian Ocean Dipole (IOD), El Niño Southern Oscillation (ENSO)) cuts the HadCRUT5 Temperature/TSI deviation roughly in half in the upper chart to the left and almost eliminate the UAH/TSI deviation in the lower chart to the left.

The shaded areas (yellow and red combined) represent the residual deviation after accounting for the selected TSI reconstruction, the four major ocean cycles, and a CO₂ contribution based on an Equilibrium Climate Sensitivity (ECS) equal to 1.0 °C. The TSI in the upper chart has been muted a little and the consolidations use the TSI/ocean weightings laid out by Paul Burgess in my [CSS-82 – Building a Better, More Realistic Climate Model](#) post. The consolidation shown in the upper chart is correlated with the post-1978 HadCRUT5 surface temperature data. The yellow shaded area represents the residual deviation after accounting for the same forces listed above. The lower chart (previous page) weightings



deviation after accounting for the same forces listed above. The lower chart (previous page) weightings



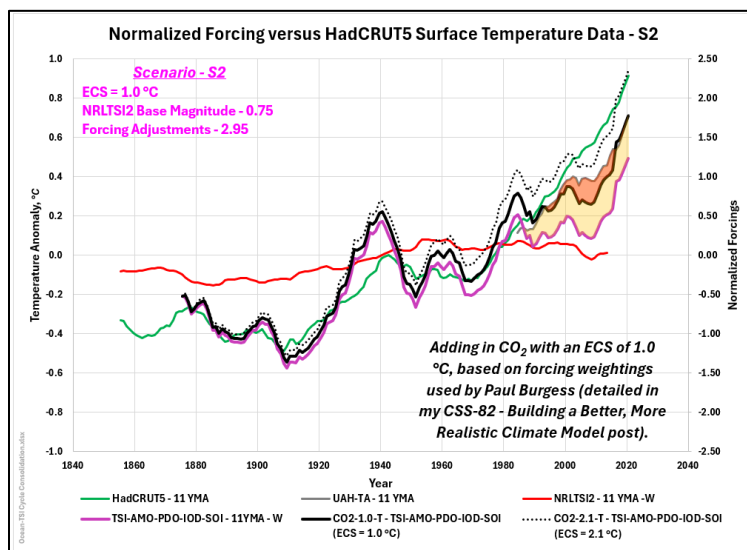
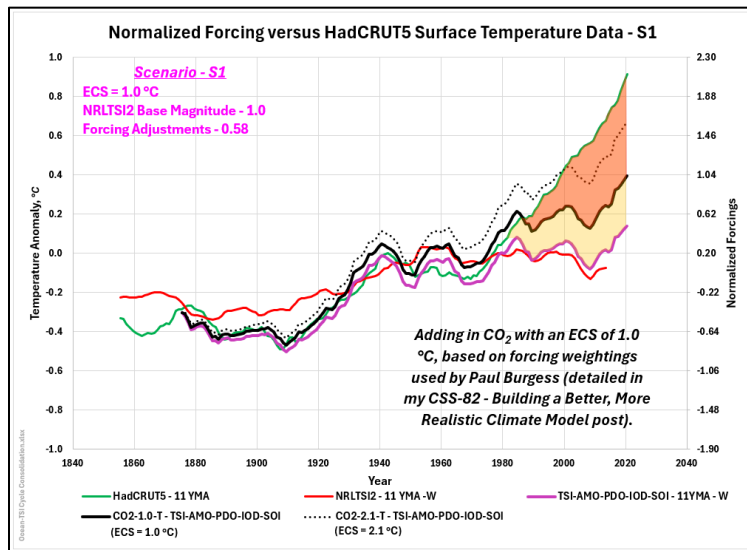
are the same, but the TSI has been amplified by a factor of three. This amplification produces a **consolidated curve** that has a general correlation with **HadCRUT5**, but that peaks and valleys fluctuate above and below the smoothed-out **temperature**. The amplified curve looks very much like the earlier global temperature estimates (to the left) before our ‘climate’ scientists got homogenization happy.

Those shaded areas are not explained by the consolidations shown here. What factors could be put forward to explain the unresolved deviation? CO₂ is one of those potential factors. The chart, directly below, has added in a dashed curve that shows the effect of CO₂ based on an ECS of 2.1 °C (Scenario – S1). There is a problem with using a higher ECS. The

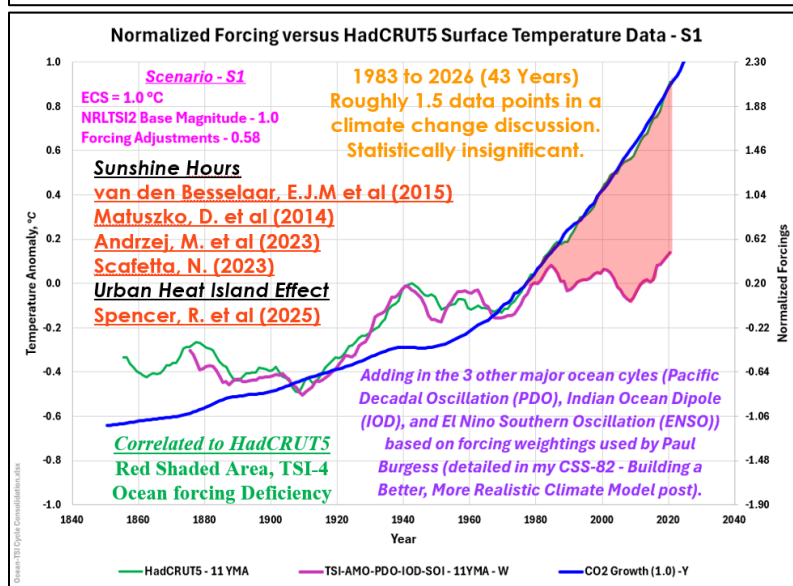
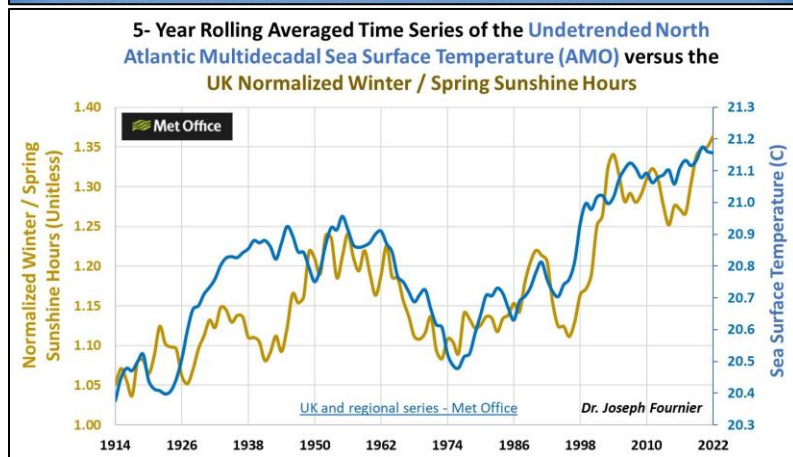
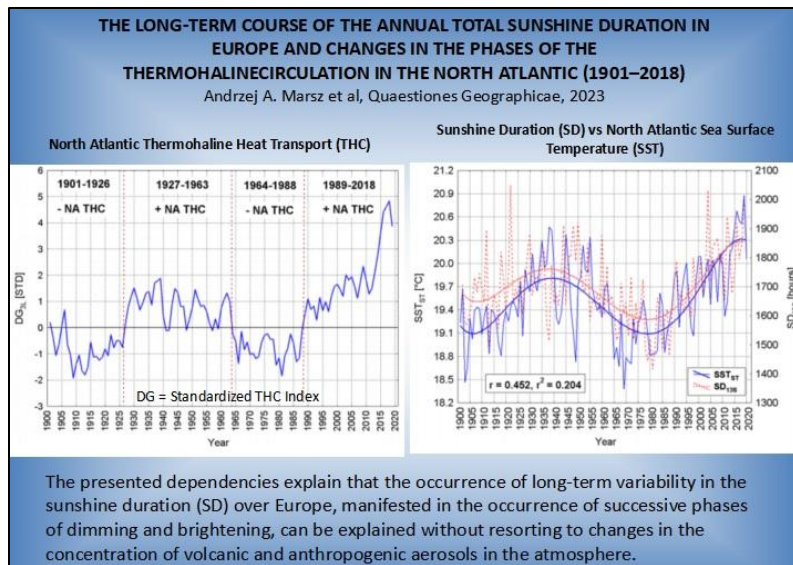
correlation with the HadCRUT5 temperature data gets worse as the ECS is increased.

The Scenario – S2 consolidation (chart below) generally correlates with the HadCRUT5 temperature data since the mid-19th century based on an ECS of 2.1 °C. Note that 87%+ of humanity’s CO₂ emissions have occurred since 1950.

But those same shaded areas can also be explained by giving more credit to solar activity and ocean cycles. The Urban Heat Island Effect (UHIE) and homogenization can be used to explain a portion of the deviation. More recently there have been several studies that have shown that most of the warming since 1980 can be explained by less cloud cover (i.e.: more sunshine hours). An example paper is the Marsz, A. et al 2023 paper, [*“The Long-Term Course of the Annual Total Sunshine Duration in Europe and Changes in the Phases of the Thermohaline Circulation in the North Atlantic \(1901–2018\)”*](#). As shown, on the following page, Sunshine Duration (SD) correlates very well with the North Atlantic Sea



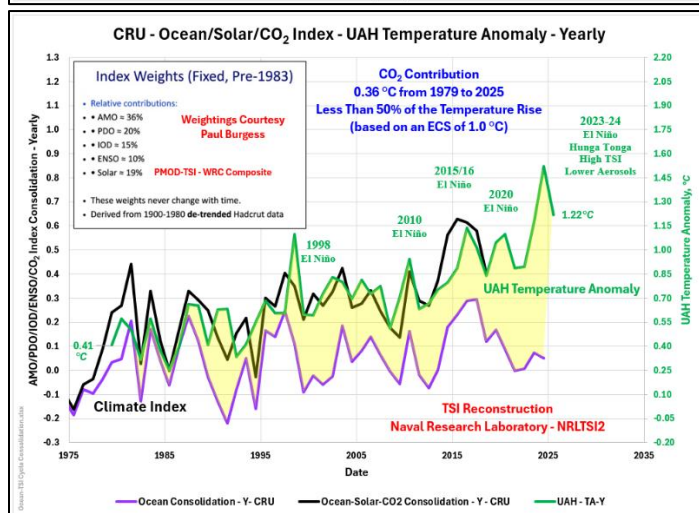
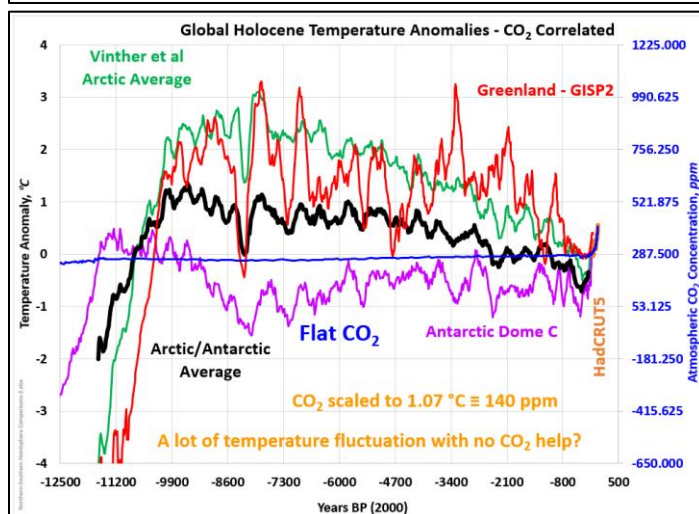
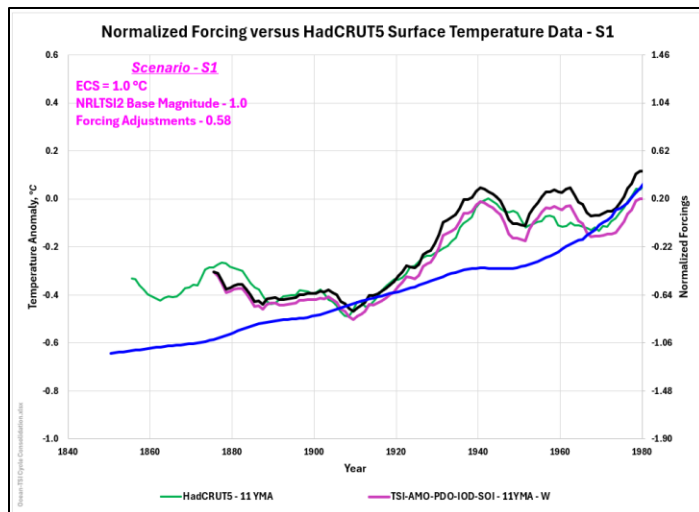
Surface Temperatures, the Thermohaline Heat Transport (THC), and the Undetrended North Atlantic



Sea Surface Temperatures (SST, i.e.: the AMO). The concept is relatively simple. Declining cloud cover since 1980 means that more of the sun's energy has reached the earth's surface and the earth has warmed as a result. The concept is simple; the process is not. Cloud formation is very complicated and poorly understood and the IPCC models are effectively guessing at cloud impacts. Note that the North Atlantic SST and the Sunshine Duration (SD, to the left) generally rise and fall in unison. The AMO and the North Atlantic Thermohaline Heat Transport (THC) follow the same cycle. What does not follow the global temperature cycle is CO₂, as shown in the chart below. Does CO₂ correlate well with the post-1975 "homogenized" temperature rise? Yes, but the correlation ends there.

Can you argue that CO₂ has contributed to the warming during the deviation (1975 to the present)? Sure, but you have to ignore the fact that CO₂ contributed very little to the pre-1975 temperature (when CO₂'s warming capacity was stronger). Solar activity (TSI) and the four major ocean cycles history match the temperature record very well pre-1975 (minimal CO₂ influence) and also account for a significant portion of the post-1975 period as shown earlier. The history match is very dependent on CO₂'s Equilibrium Climate Sensitivity

(ECS) and the magnitude of the solar activity. Neither of which is even close to "settled science". More detail on that in my [CSS-86 – Is "the Science" Settled?](#) post. And for a deeper dive on CO₂'s ECS check out my [OPS-80 – CO₂ Drives Temperature but Does CO₂ Drive Climate?](#) post. Then follow that



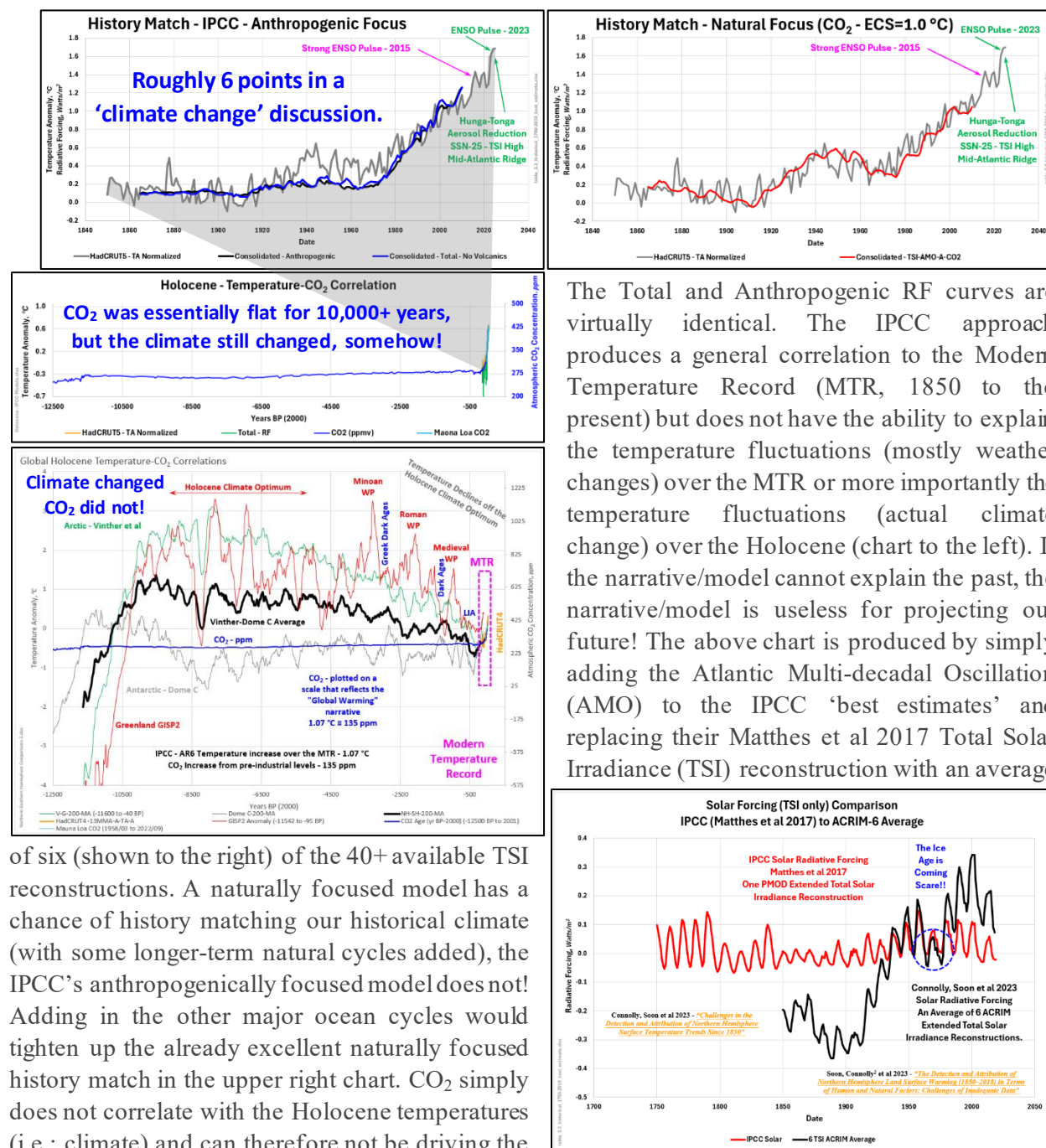
with my [CSS-51 – Soon-Connolly – Solar Forcing](#) post. Anyone that cares to commit to deep dive into the empirical data will find that CO₂ has little to no effect on the climate. CO₂ has a limited impact on the climate from 1850 to 1980 (as shown in the chart directly to the left). Going back further in time, CO₂'s impact is virtually non-existent during the pre-1850 Holocene, as shown in the chart below left. We could play this game further, but if you have read the OPS-80 post (linked on the previous page) you will find that CO₂'s contribution to the warming is beneficial, but minor at best. As shown in the Holocene chart to the left, the climate can change significantly and often, without the help of that all powerful, climate alarmist demon molecule, CO₂. Those natural forcings present pre-1850 were still acting post-1850 (just not in the models or the alarmists' simplistic, unscientific view on solar activity). There is a deviation between TSI and the over-homogenized surface temperature datasets, but much if not all the TSI/temperature deviation can be explained with more prominent TSI reconstructions, neglected solar forcings, ocean cycles, aerosols, volcanic activity, etc. Even CO₂ has a role, the magnitude of which is ultimately dependent on its ECS.

Unfortunately for the alarmist community, a comprehensive set of parameters (including CO₂) produce the best history matches. The chart to the left is one of those history matches. The forcings used are TSI and the four major ocean cycles (AMO, PDO, IOD and ENSO) and CO₂ (with an ECS = 1.0 °C). The weightings used for each parameter are based on Paul Burgess's work (discussed in CSS-82,

linked earlier). The same forcing weightings used in the upper chart (history matched with the 1850 to 1980 HadCRUT5 surface temperature data) were used for the UAH satellite temperature history match above. Adding in some cooling from the 1991 Pinatubo eruption, warming from the 2022 Hunga-

Tonga stratospheric water injection eruption, and some tighter shipping emission regulations in the last decade will just tighten that history match up further.

An excellent alternative history match can be developed by starting with the IPCC's 'best estimates' of forcing. The detail is provided in my [CSS-71 – IPCC Model/Theory Shortcomings](#) and [CSS-71 – Revisited](#) posts. The quick summary, the IPCC's anthropogenic focused history match can be easily transformed into a much more accurate naturally focused history match using readily available peer reviewed published empirical data. The starting point is the IPCC's **Total Radiative Forcing (RF)** 'best estimate' shown in the chart below. How do we know the IPCC model is anthropogenically focused?



of six (shown to the right) of the 40+ available TSI reconstructions. A naturally focused model has a chance of history matching our historical climate (with some longer-term natural cycles added), the IPCC's anthropogenically focused model does not! Adding in the other major ocean cycles would tighten up the already excellent naturally focused history match in the upper right chart. CO_2 simply does not correlate with the Holocene temperatures (i.e.: climate) and can therefore not be driving the

Holocene climate. The IPCC's questionable anthropogenic focused (primarily CO₂) MTR correlation does not prove that CO₂ is a primary climate driver. The natural forcings active pre-MTR were still active during the MTR and will still be active in the future (just not in the climate models). CO₂ has contributed to that warming, but as laid out earlier, that contribution is NOT 'settled science' and is very likely minor with net positive benefits.

To summarize, there is a lot more to solar forcing than Total Solar Irradiance (TSI)! The deviation between surface temperature data sets and some choices of solar activity (as represented by just Total Solar Irradiance (TSI)) are real possibilities. But those options do not begin to reflect all the possibilities. There are also questions attached to the surface temperature data (i.e.: homogenized (data manipulation) versus valid measured temperatures, satellite versus surface temperature data, the Urban Heat Island Effect, quality of data, etc.). But we do not need to delve into those uncertainties in detail here. Most if not all the deviations can be explained by NOT ignoring the many solar forcings (direct and indirect) over and above the TSI reconstructions used in these simplistic memes.

We can start with more powerful TSI reconstructions and add in Cosmic Ray Flux/Cloud Albedo/Sunshine Hours, solar wind and magnetic field strength, High Energy Particles (HEP), Solar Flares/Coronal Mass Ejections (CME), etc. We can then follow up with indirect solar forcings, the many atmospheric and oceanic cycles (discussed by [Dr. Joseph Fournier in his informative SubStack](#)) that produce our weather. None of these forcings are handled properly (if at all) in the IPCC climate models. Those very same models that have been self-acknowledged to run too hot and regularly use implausible emission scenarios as their business-as-usual case (RCP7.0/ssp3-7.0 and RCP8.5/ssp5-8.5, officially retired). Taking these emission scenarios out also takes out the Climate Emergency/Crisis/Apocalypse/Next Scary Descriptor scenarios.

Volcanism is also overlooked or downplayed. The IPCC 'best estimates' include the aerosol induced cooling associated with volcanic eruptions. But they do not include the warming associated with submarine volcanoes (like Hunga-Tonga-Hunga) that inject large volumes of water into the stratosphere producing a warming effect. Nor do they include the additional heat injection associated with the increased seismicity and associated volcanism along the Pacific Ring of Fire and the Mid-Atlantic Ridge. There are many peer reviewed, published papers/studies that link solar activity to the ENSO Ocean cycle. And there is [empirical data](#) that shows a correlation between global seismicity and global temperatures. These volcanic forcings are indirectly related to the sun through the gravitational and electromagnetic interactions present throughout the solar system and beyond. This post does not cover all the solar forcings given my lack of resources. But given the billions of dollars and time our climate scientists have wasted you would think they could have put more effort into studying solar activity's potential effects rather than just dismissing them.

For more perspective and more detailed analysis, you can also check out some of the following posts which are back up for the points discussed in this post.

[Shifting Plates, Shifting Poles, Shifting Paradigms – Arthur Viterito](#)

<https://www.omicsonline.org/open-access-pdfs/shifting-plates-shifting-poles-shifting-paradigms-2573-458X-1000130.pdf>

[IPCC Working Group 1 \(WG1\) Sixth Assessment Report \(AR6\) Annex III Extended Data](#)

<https://zenodo.org/records/5705391>

“Burgess Oceanic-Solar-CO₂ Index Follow-Up” | Tom Nelson Pod #375

<https://www.youtube.com/watch?v=JziUjnXLdJw>

Explaining Every Temperature Change from 1983 to 2025 – Burgess paper

<https://substack.com/home/post/p-182701114>

Solar Forcing of ENSO on Century Timescales – Wilcox et al 2023

<https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2023GL105201>

ENSO Index Variations and Links with Solar and Volcanic Activity – Zharkova et al 2024

https://www.scirp.org/pdf/ns2024164_18303679.pdf

The Long-Term Course of the Annual Total Sunshine Duration in Europe and Changes in the Phases of the Thermohaline Circulation in the North Atlantic (1901–2018) - Marsz, A. et al 2023

<https://www.researchgate.net/publication/374982179> The long-term course of the annual total sunshine duration in Europe and changes in the phases of the thermohaline circulation in the North Atlantic 1901-2018

Challenges in the Detection and Attribution of Northern Hemisphere Surface Temperature Trends Since 1850 – Connolly Soon et al 2023 (CSS-51)

<https://iopscience.iop.org/article/10.1088/1674-4527/acf18e>

Relationship between sunshine duration and temperature trends across Europe since the second half of the twentieth century – van den Besselaar, E.J.M. et al 2015

<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2015JD023640>

Relationship between sunshine duration and air temperature and contemporary global warming – Matuszko, D. et al 2014

<https://www.researchgate.net/publication/269727866> Relationship between sunshine duration and air temperature and contemporary global warming

The long-term course of the annual total sunshine duration in Europe and changes in the phases of the thermohaline circulation in the North Atlantic (1901–2018). – Andrzej, M. et al 2023

<https://www.researchgate.net/publication/374982179> The long-term course of the annual total sunshine duration in Europe and changes in the phases of the thermohaline circulation in the North Atlantic 1901-2018

Empirical assessment of the role of the Sun in climate change using balanced multi-proxy solar records – Scafetta, N. 2023

<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2015JD023640>

Urban Heat Island Effects in U.S. Summer Surface Temperature Data, 1895–2023 – Spencer, R. et al 2025

<https://www.researchgate.net/publication/391311079> Urban Heat Island Effects in US Summer Surface Temperature Data 1895-2023

The Total Greenhouse Effect: Clouds plus Clear Sky Greenhouse Gases – Dr. Joseph Fournier

<https://josephfournier.substack.com/p/the-total-greenhouse-effect-clouds>

When the Tropics Stretch Poleward: The Hidden Mechanism Behind a Warming North and a Greening Sahel – Dr. Joseph Fournier

<https://josephfournier.substack.com/p/when-the-tropics-stretch-poleward>

Climate Short Story (CSS)

CSS-36 – Solar Flares and CMEs

<https://climatechangeandmusic.com/solar-flares-and-cmes/>

CSS-51 – Soon-Connolly – Solar Forcings

<https://climatechangeandmusic.com/soon-connolly-solar-forcings/>

CSS-69 – CO₂'s Cooling Parameters

<https://climatechangeandmusic.com/css-71-ipcc-model-theory-shortcomings-revisited/>

CSS-71 – IPCC's Model/Theory Shortcomings

<https://climatechangeandmusic.com/ipcc-model-theory-shortcomings/>

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

<https://climatechangeandmusic.com/css-71-ipcc-model-theory-shortcomings-revisited/>

CSS-74 – Climate Tipping Points

<https://climatechangeandmusic.com/climate-tipping-points/>

CSS-75 – Solar Forcing Discussion

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CSS-78 – Weakening Electromagnetic Field

<https://climatechangeandmusic.com/weakening-electromagnetic-field/>

CSS-79 – A Common Sense Look at 'Climate Change'

<https://climatechangeandmusic.com/a-common-sense-look-at-climate-change/>

CSS-82 – A Better, More Realistic Climate Model

<https://climatechangeandmusic.com/building-a-better-more-realistic-climate-model/>

One Page Political Summary (OPPS)

OPPS-20 – Why Are We Putting All of Our Eggs in One Basket?

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OPPS-33 – What Happens After Net Zero?

<https://climatechangeandmusic.com/what-happens-after-net-zero/>

One Page Summary (OPS)

OPS-80 – CO₂ Affects Temperature but Does CO₂ Drive Climate?

<https://climatechangeandmusic.com/co2-affects-temperature-but-does-co2-drive-climate/>

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