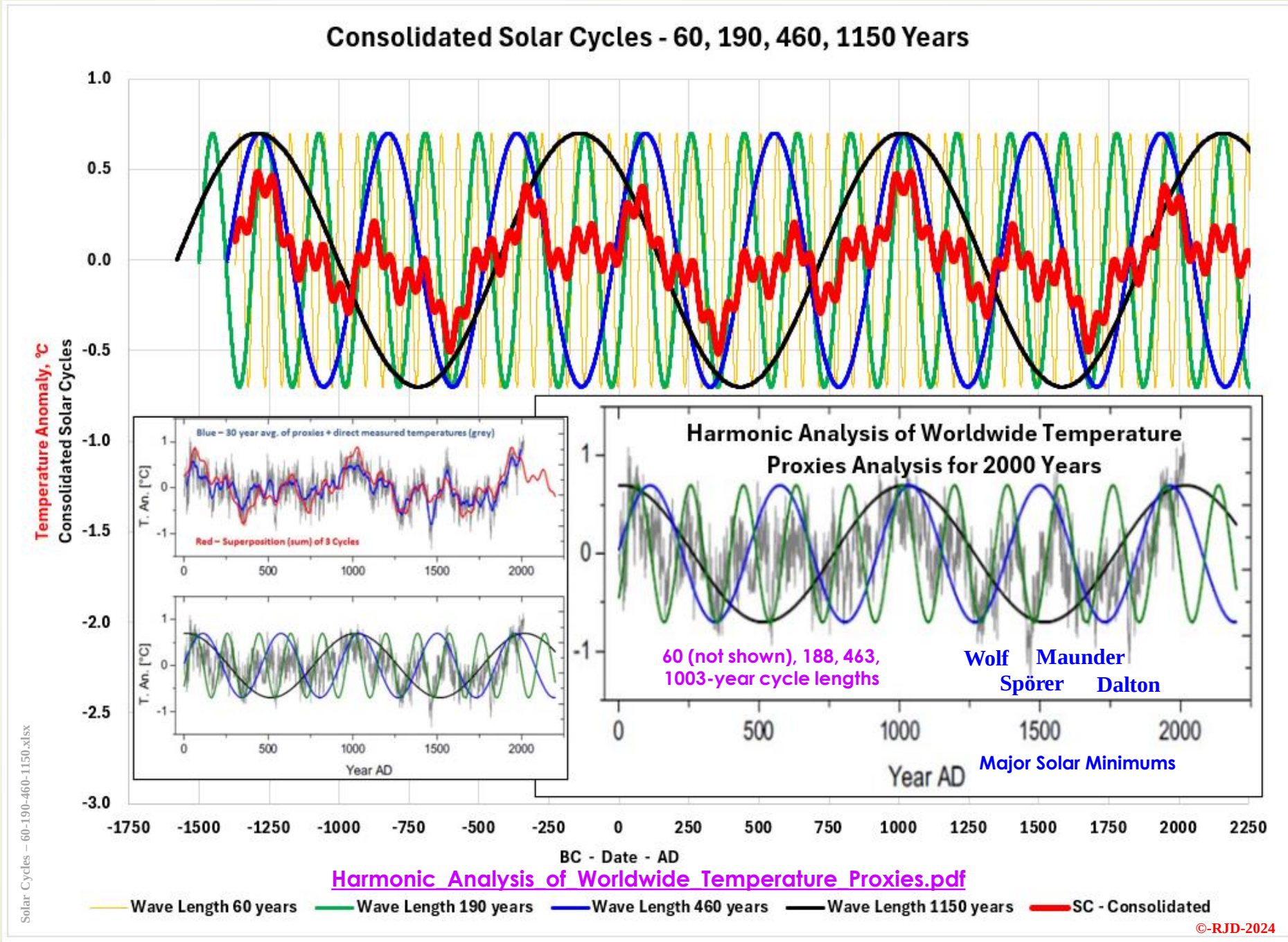
More Solar Cycles – Harmonic Analysis

A while back Joseph Fournier highlighted a 2017 H-J. Lüdecke, C-O. Weiss paper, *"Harmonic Analysis of Worldwide Temperature Proxies"*. Many thanks to Joseph for this and the many other papers, articles, etc. that he highlights and/or produces on his own. Lüdecke and Weiss looked at 4 different sinusoidal cycles and how those consolidated cycles compared to multi-proxy temperature reconstruction over the last 2,000 years. The authors used 60, 188, 463 and 1003-year cycles based on their Fourier analysis of the temperature reconstruction (input and results shown on the smaller inset graphs). There are many solar cycles that correspond to these sinusoidal curves. The ≈60-year cycle is visible in many climate parameters (the Atlantic Multi-decadal Oscillation (AMO) being a primary example). Joseph has put forward many more examples. Their 188-year cycle is likely a representation of the Suess-de Vries cycle.

More Solar Cycles - Harmonics

The 463-year cycle may be related to the 400-year Grand Solar Minimum cycle. Finally, the 1,003-year cycle might be corresponding to the Eddy Cycle. There are many other cycles in the historical literature. Andy May put together an interesting discussion on WUWT. The 4 sinusoidal curves at the top were prepared by myself to use with the GISP2 data.



More Solar Cycles – Individual Harmonic Cycles

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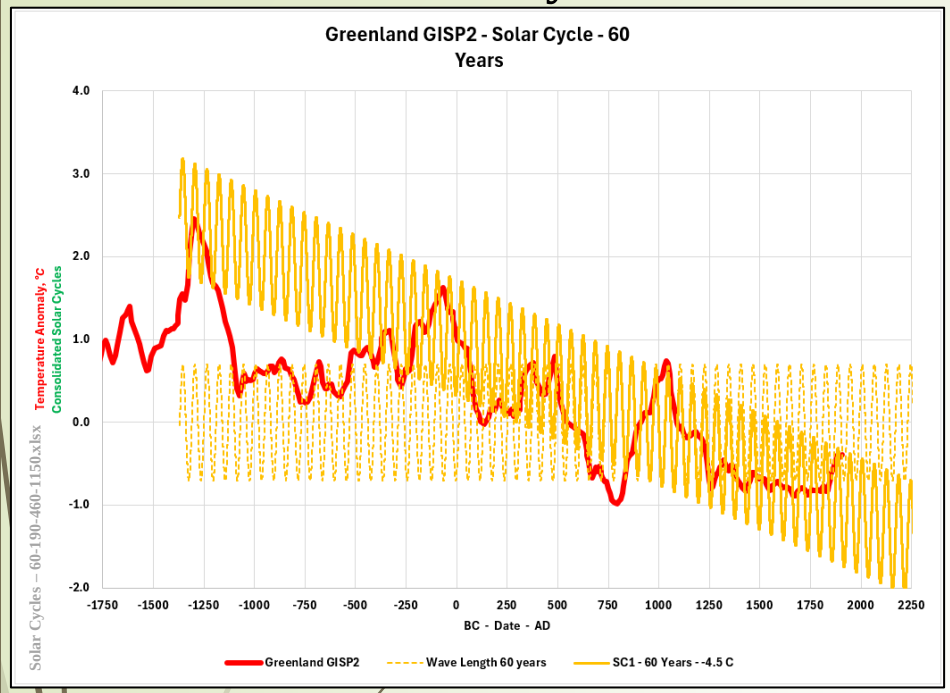
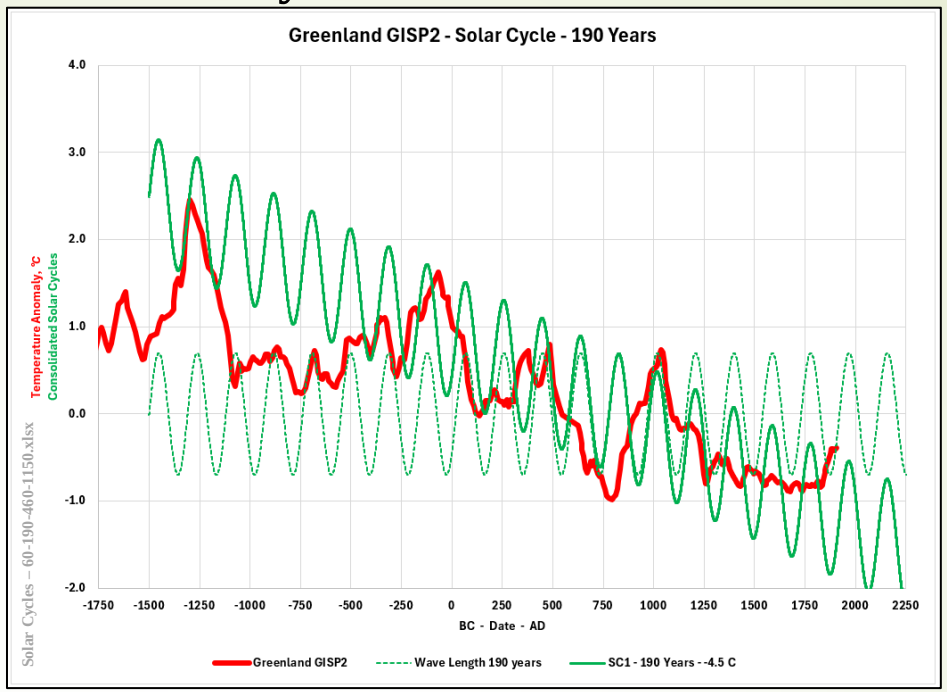


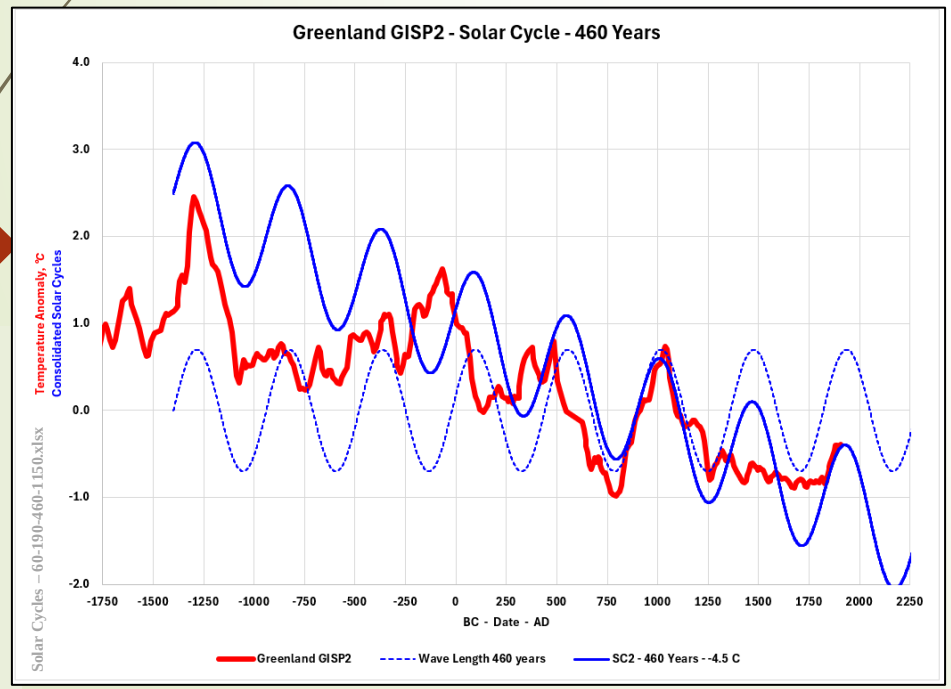


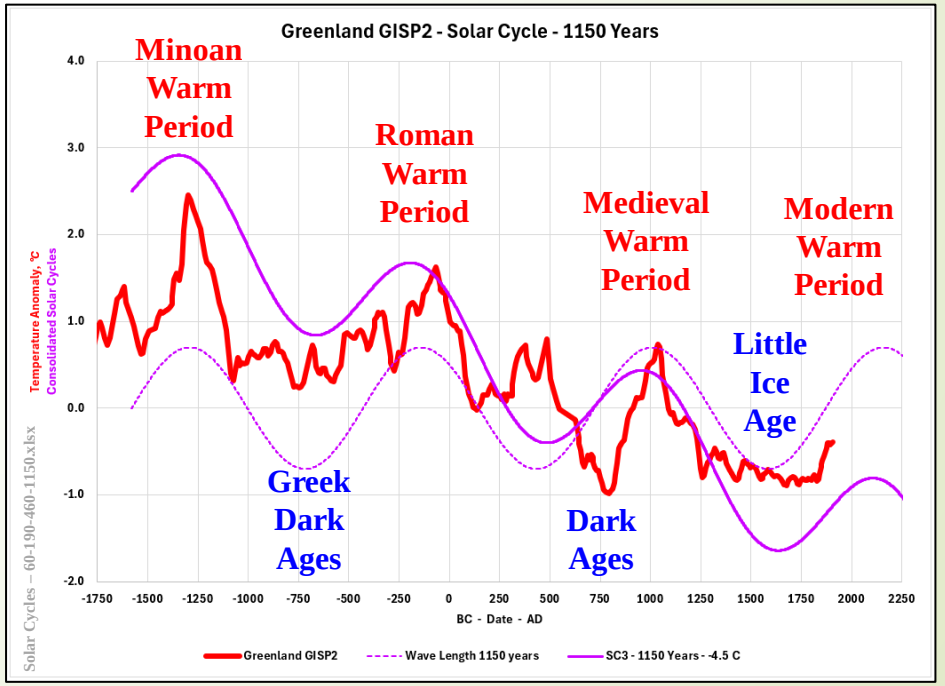
Given the very good solar activity, temperature correlation put forward by Lüdecke and Weiss, I was curious to see whether a similar sinusoidal curve consolidation could be used to represent the Greenland GISP2 ice core temperature reconstructions. As a general rule, solar activity is expressed very prominently in this dataset. The red curve in each plot is the GISP2 Temperature reconstruction. Each sinusoidal curve is shown horizontally and inclined (to correspond with the overall decline trend visible in the data). Lüdecke and Weiss looked at the last 2,000 years. The data shown here goes back another 1750 years (showing the long-term decline off the early Holocene Climate Optimum). I used cycle lengths of 60 (Orange), 190 (Green), 460 (Blue) and 1150 (Purple) years (which seem to fit closer with the GISP2 dataset). A shallower decline may be a slightly better fit. CO_2 concentrations were virtually flat over this period, yet somehow temperatures seem to fluctuate significantly.

There are obvious highs and lows that correspond to

More Solar Cycles - Lone Harmonics

the historical highs and lows present throughout humanity's modern existence. CO_2 is NOT driving these historical temperatures.

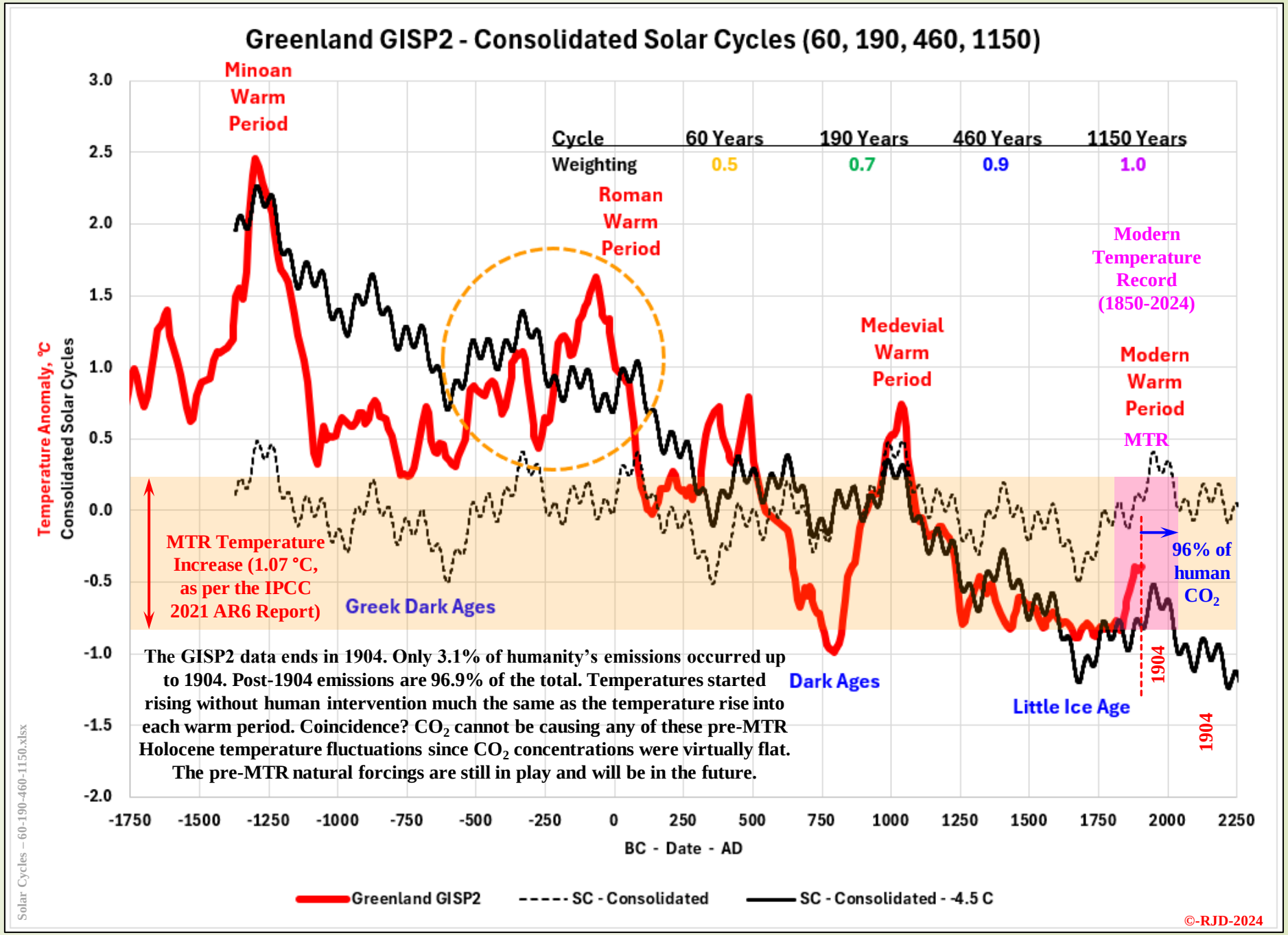




More Solar Cycles – Consolidated Harmonic Analysis – GISP2

More Solar Cycles -Full Harmonics

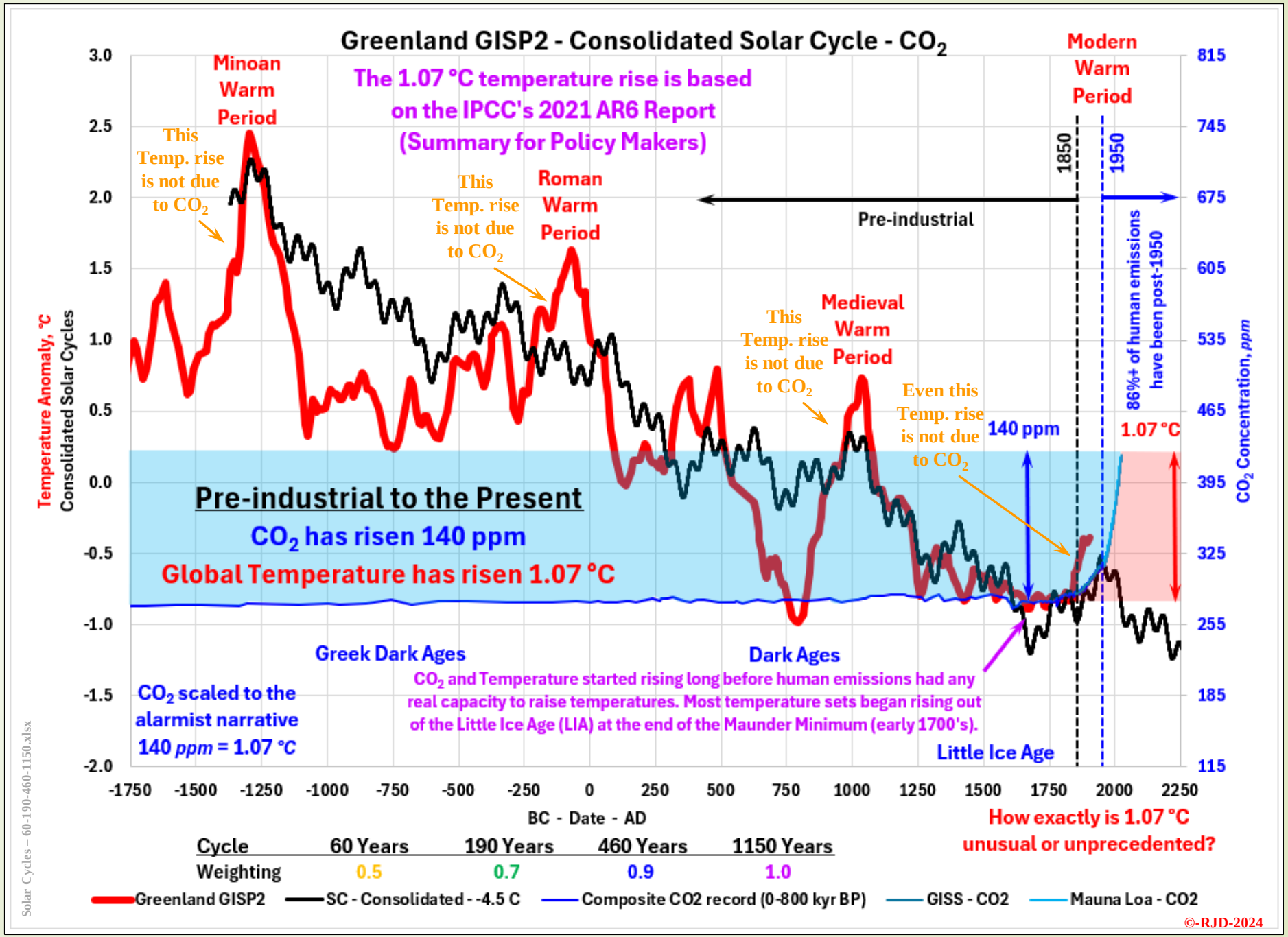
This plot shows the consolidated sinusoidal curve plotted against the Greenland GISP2 ice core temperature reconstruction. As before, there is detrended consolidation (dashed black line) and a declining consolidation (the solid black line). The match is not perfect, but the major historical warm and cold periods are all visible in the consolidated sinusoidal curve. I applied a different weighting to each of the cycles to tighten up the correlation. The Modern, Medieval and Minoan Warm Period peaks line up very well. The Roman Warm Period peak is off, but the broad longer term Roman Warm Period does line-up (highlighted in the Gold circle). The climate system is not as simple as these four sinusoidal curve representations, but they do provide a reasonable approximation. There are many factors acting on the climate (with CO_2 Being one small component). But, as mentioned earlier, over this period, CO_2 is virtually flat (starting to rise around 1850). Can CO_2 be responsible for some of the post 1850 temperature rise? Yes, but the natural forcings (primarily solar and solar related) that were active pre-1850, were still active post-1850 and will be into the future (i.e.: natural forcings also contributed to warming).



More Solar Cycles (MSC) – GISP2-CO_2 Neoglacial Correlations

MSC – GISP2 CO_2 Neoglacial Correlations

This slide layers in the atmospheric CO_2 concentration. The vertical CO_2 scale is chosen to reflect the alarmist viewpoint that virtually all the warming since the pre-industrial era (1.07 C, as per the IPCC AR6 – SPM report) is due to the ±140 ppm CO_2 increase. A significant portion of that warming began long before atmospheric CO_2 concentrations began rising or humanity's emissions became significant. Remember almost 97% of human emissions occurred after the temperature spike on the far right. This temperature data ended in 1904. The temperatures have fluctuated significantly over the last 3,774 years. The general decline trend has been down. This trend is very likely due to the Obliquity component (the earth's axial tilt) of the Milankovitch Cycles. The Obliquity peaked around 9,000 years ago and has been declining ever since. The Precession and Eccentricity components of the Milankovitch Cycles are also headed lower (i.e.: the temperatures will continue to decline all the way into a deep ice age over the next few millennia). The temperatures shown here are due to natural variability, certainly not the virtually flat CO_2 concentrations. CO_2 may have some small contribution to the post-1850 period, but CO_2 does not act alone



More Solar Cycles (MSC) – GISP2-CO_2 Little Ice Age (LIA) Correlations

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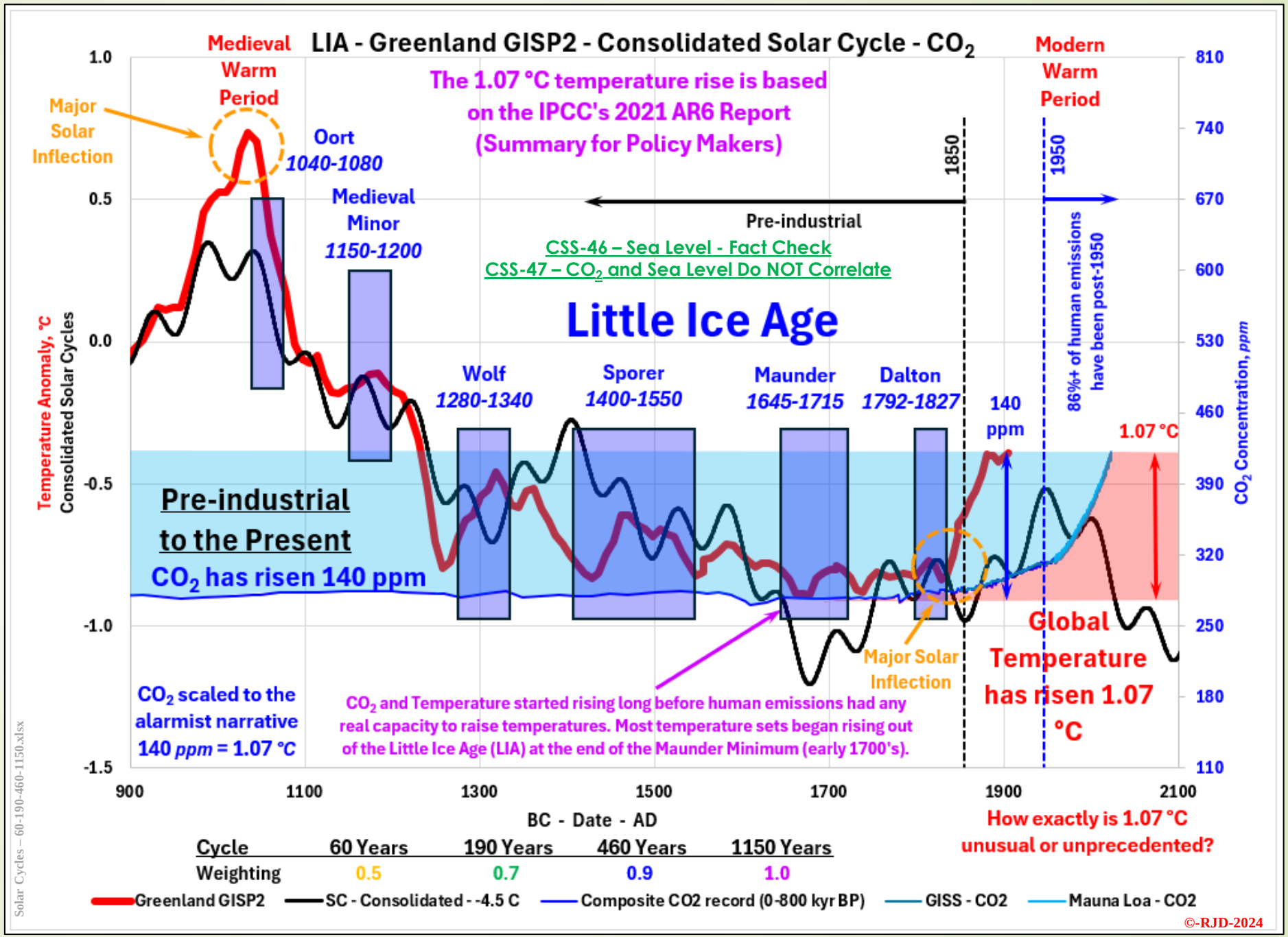
Interestingly, over the last 1,100 plus years, the temperature profile correlates very well with the consolidated four component sinusoidal curve. The Medieval Warm Period is very prominent in both ice core data (the red curve) and sinusoidal data (the black curve) ±1,000 years ago. The temperatures and the models both drop erratically into the depths of the Little Ice Age (the Maunder Minimum) for roughly six centuries. There were many solar minimums that dropped the planet into the Little Ice Age (all highlighted on the chart to the right). The Maunder Minimum (the coldest temperatures of the LIA) was the last Grand Solar Minimum (GSM). The GSMs occur roughly every 400 years. The modern GSM is forecasted to happen over the next few decades and will likely drop temperatures back to Maunder Minimum levels. Temperatures began rising out of the Maunder Minimum with a noticeable acceleration in the mid 1800s (which happens to correspond with a non-CO_2 induced change in Sea Level). Sea Levels were declining in the early 1800s and abruptly began a long-term linear rise that has lasted since the mid 1800s right up to the present. CO_2 is not driving Sea Level (CSS-46 and 47) nor these temperatures!

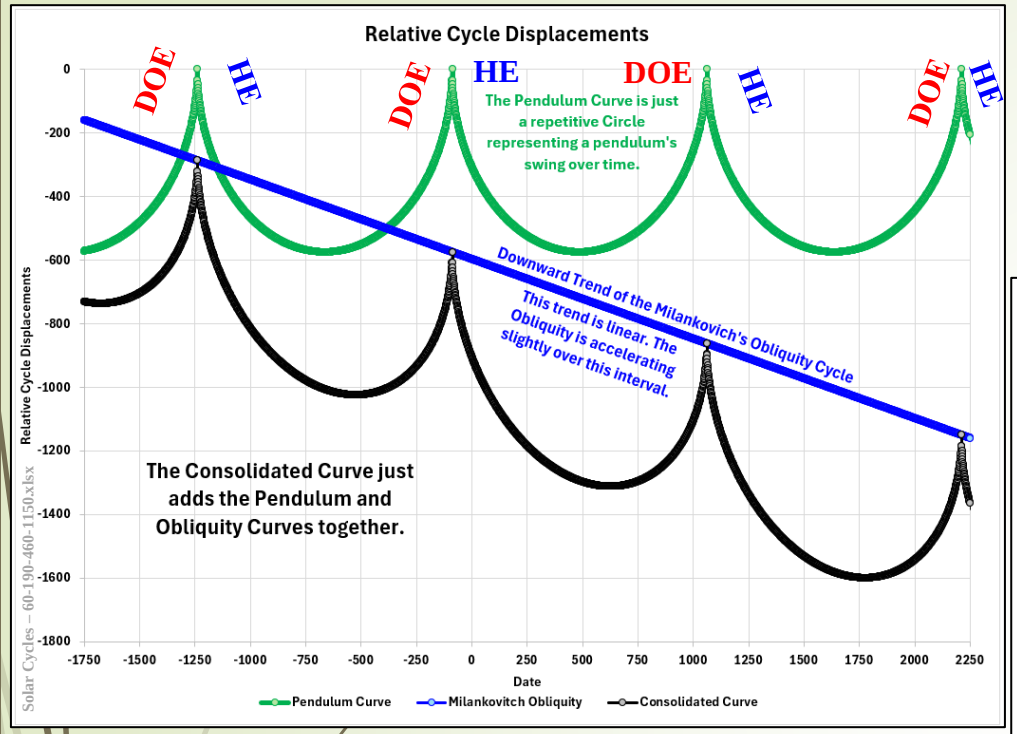
MSC – GISP2 CO_2 LIA Correlations



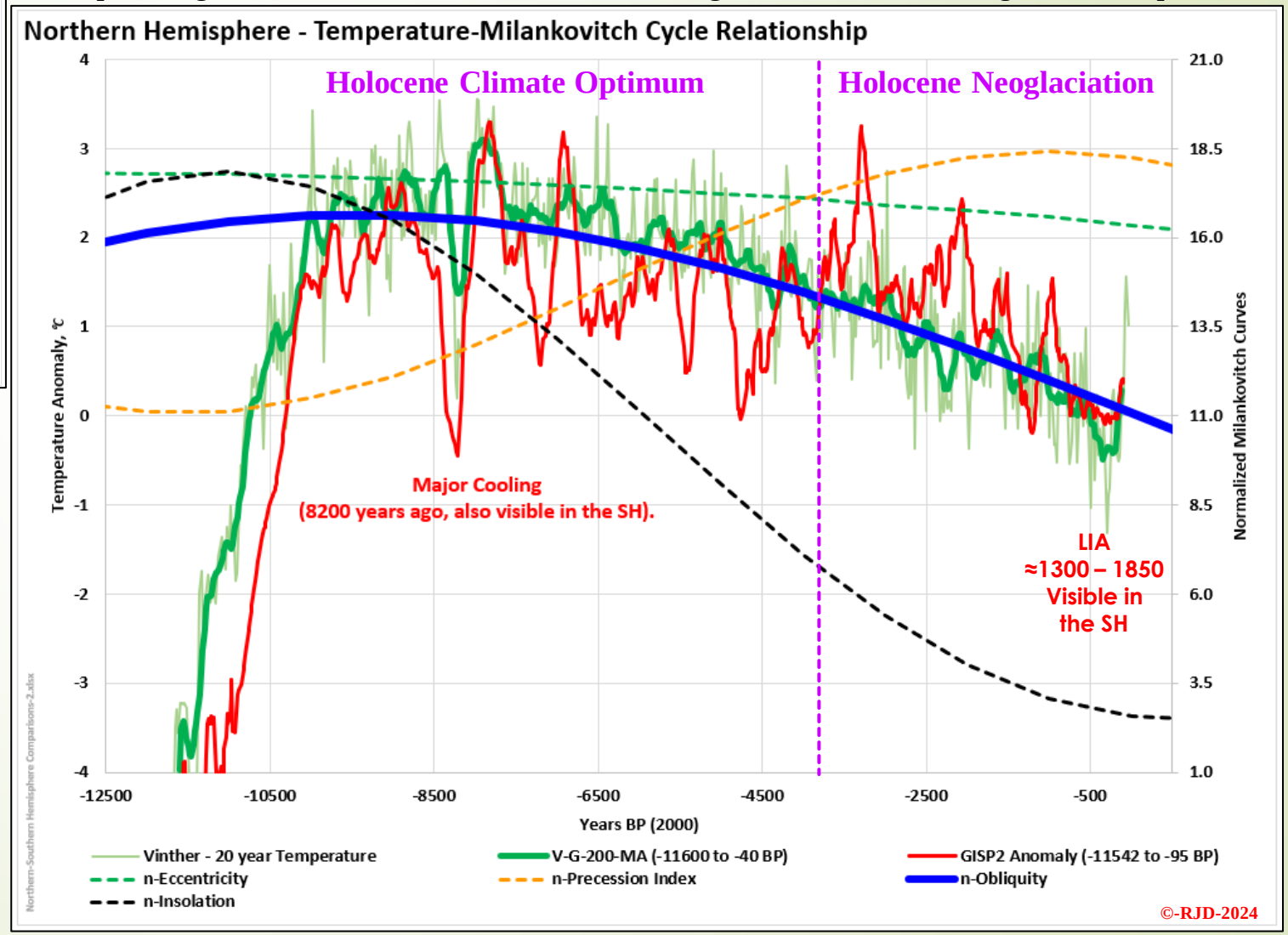
GSM – Grand Solar Minimum. The real "Climate Change" existential threat is right around the corner. Do the Research!

More Solar Cycles – Milankovitch - Dansgaard-Oscheger – Heinrich Events

More detail? climatechangeandmusic.com



This slide focuses on the entire Holocene and shows the Milankovitch Cycles mentioned earlier. The earlier slides covered just the Holocene Neoglaciation period. This discussion adds in Dansgaard-Oeschger (DO) and Heinrich (HE) Events. DO "*climatic oscillations typically consist of a rapid warming episode that unfolds over decades and is followed by a gradual cooling interval that extends across centuries or millennia*". "Heinrich events are thought to be associated with sudden climate warming events…" (i.e.: DO events). There are a variety of potential causes for the HE (discussed in the link). That discussion focuses on the deeper ice age. The DO/HE are much more muted during the warmth of the interglacial warm period.



MSC DOE-HE Milankovitch Obliquity

This is speculation, but the warming is likely adding additional water vapor to the atmosphere, leading to more precipitation in Greenland and Antarctica. That additional mass leads to an increase in glacial calving. Those icebergs move to the lower latitudes, where they melt and cool those waters (the North Atlantic), upsetting the ocean salinity and weakening the thermohaline circulation. The result is a cyclical event that resembles a pendulum. Over the Holocene Neoglacial natural forcings are obviously in play. There are sharp increases in temperature (like the current warming), followed by a sharp cooling event. You can speculate on what caused the warming, but we know CO_2 was not the reason. The same goes for the cooling phase. I am going to go with the sun and its many direct and indirect influences. The green curve above is just a series of half circles. The blue curve is the Milankovitch obliquity curve (for simplicity presented as a straight line). The black curve is a consolidation of the two. That consolidation can now be compared to the Greenland data.

More Solar Cycles – MO-DOE-HE – GISP2 Correlation

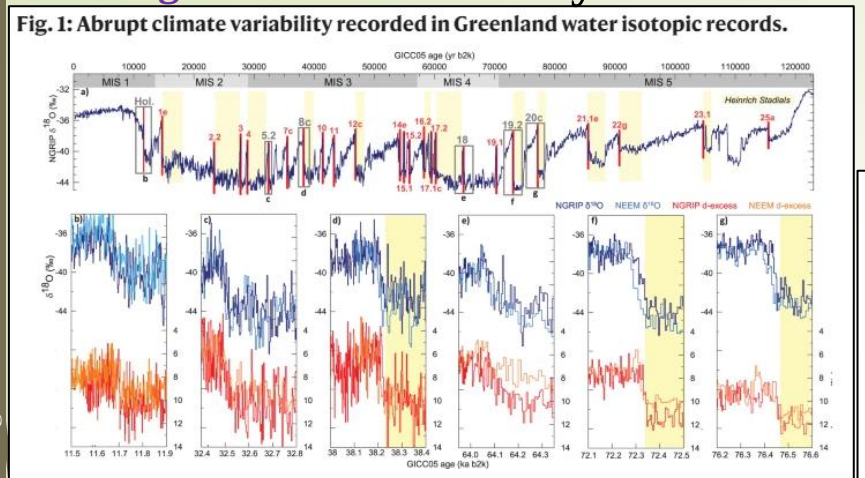
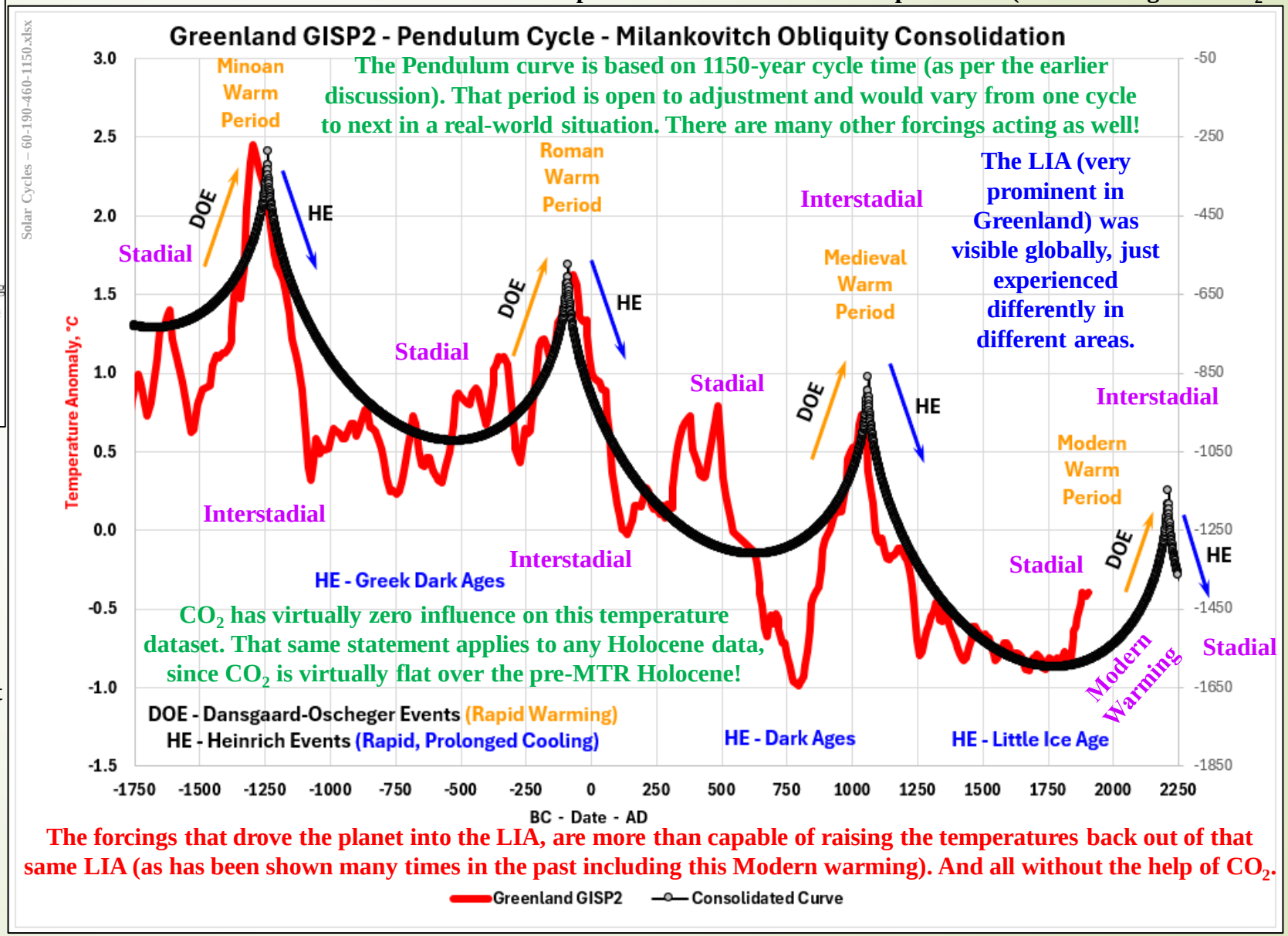


Fig. 1: Abrupt climate variability recorded in Greenland water isotopic records.

a NGRIP $\delta^{18}O$ record[5]. Studied abrupt warming transitions are highlighted with red vertical bars and Greenland Interstadials (GI) are numbered[38]. Gray boxes indicate intervals shown in (**b**–**g**), illustrating the variety of abrupt GS–GI transitions across the Last Glacial; stadials containing Heinrich events are indicated in yellow following refs. [53,85], and Marine Isotope Stages (MIS) are indicated in gray. **b**–**g** High-resolution $\delta^{18}O$ from NGRIP (dark blue) and NEEM (light blue) and d-excess from NGRIP (red) and NEEM (orange) over 400 yr time intervals centered on the Holocene abrupt onset (**b**) and the abrupt transitions into GI-5.2 (**c**), GI-8c (**d**), GI-18 (**e**), GI-19.2 (**f**), and GI-20c (**g**).

"*Stadials are periods of colder climate, and interstadials are periods of warmer climate*". DO and HE combine to form the warm and cool periods throughout the deep ice age (the chart to the left). The general pattern continues throughout the Holocene interglacial warm period (but is far more muted). The consolidated Pendulum/Obliquity curve is laid over the Greenland GISP2 ice core temperature data. What does this plot tell us (remembering that CO_2 was virtually flat over this entire period)? There are natural forcings controlling the temperature in Greenland and CO_2 is playing NO role in the very obvious temperature fluctuations. Those natural forcings have not stopped acting on the planet just because CO_2 concentrations have increased by 0.01%. Given that temperatures started rising prior to CO_2 and any significant human emissions, we likely entered the most recent interstadial and are very likely in the throes of a DO event. And what follows a DO event? A sharp, cooling HE (i.e.: we are likely headed into a stadial (i.e.: colder temperatures). The Holocene's fluctuating temperatures (and not just in Greenland) need to be explained before the All CO_2, All the Time statement can even be considered scientific. A DO-HE event (whatever the cause) is more likely than CO_2..

MO-DO-HE GISP2 Correlation

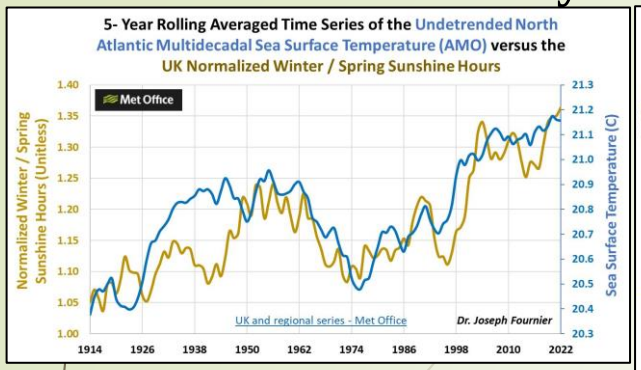


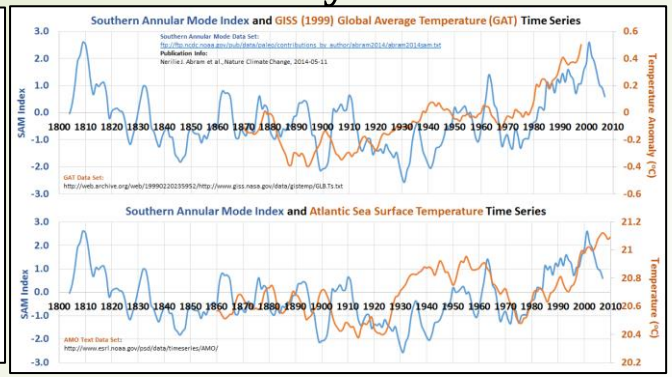
The forcings that drove the planet into the LIA, are more than capable of raising the temperatures back out of that same LIA (as has been shown many times in the past including this Modern warming). And all without the help of CO_2.

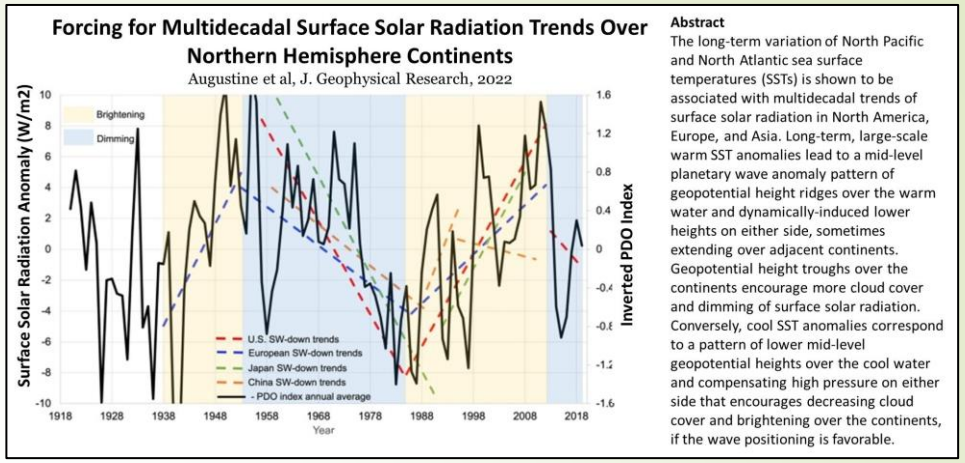
More Solar Cycles – 60-Year Cycles

More detail? climatechangeandmusic.com

The 60-year cycles are visible in a wide variety of climate parameters. These references are courtesy Joseph Fournier, Senior Scientist.

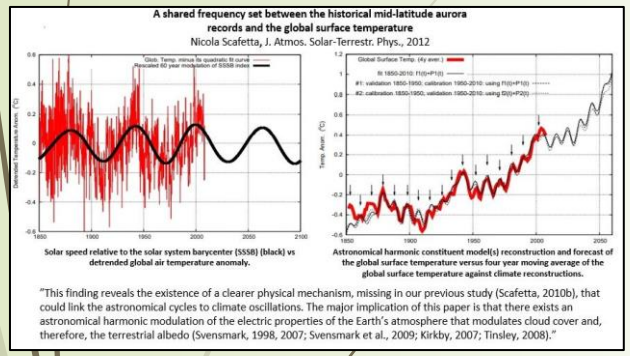




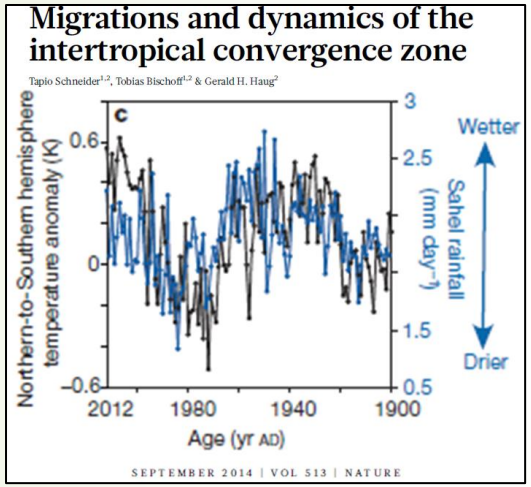


Abstract

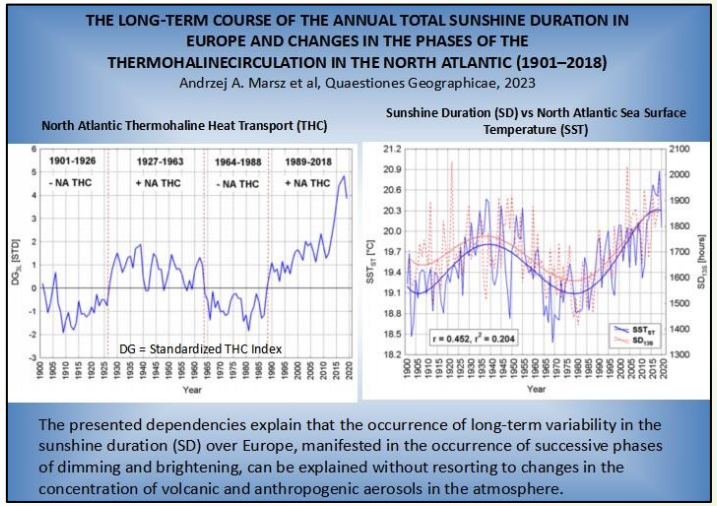
The long-term variation of North Pacific and North Atlantic sea surface temperatures (SSTs) is shown to be associated with multidecadal trends of surface solar radiation in North America, Europe, and Asia. Long-term, large-scale warm SST anomalies lead to a mid-level planetary wave anomaly pattern of geopotential height ridges over the warm water and dynamically-induced lower heights on either side, sometimes extending over adjacent continents. Geopotential height troughs over the continents encourage more cloud cover and dimming of surface solar radiation. Conversely, cool SST anomalies correspond to a pattern of lower mid-level geopotential heights over the cool water and compensating high pressure on either side that encourages decreasing cloud cover and brightening over the continents, if the wave positioning is favorable.



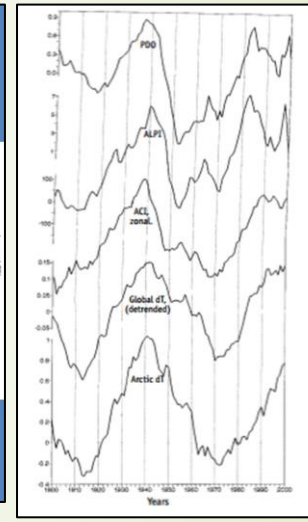
"This finding reveals the existence of a clearer physical mechanism, missing in our previous study (Scafetta, 2010b), that could link the astronomical cycles to climate oscillations. The major implication of this paper is that there exists an astronomical harmonic modulation of the electric properties of the Earth's atmosphere that modulates cloud cover and, therefore, the terrestrial albedo (Svensmark, 1998, 2007; Svensmark et al., 2009; Kirkby, 2007; Tinsley, 2008)."



All these cycles are solar or solar related (primarily ocean cycles). Very little to do with CO_2.



The presented dependencies explain that the occurrence of long-term variability in the sunshine duration (SD) over Europe, manifested in the occurrence of successive phases of dimming and brightening, can be explained without resorting to changes in the concentration of volcanic and anthropogenic aerosols in the atmosphere.



Cyclic Climatic Change and Fish Productivity

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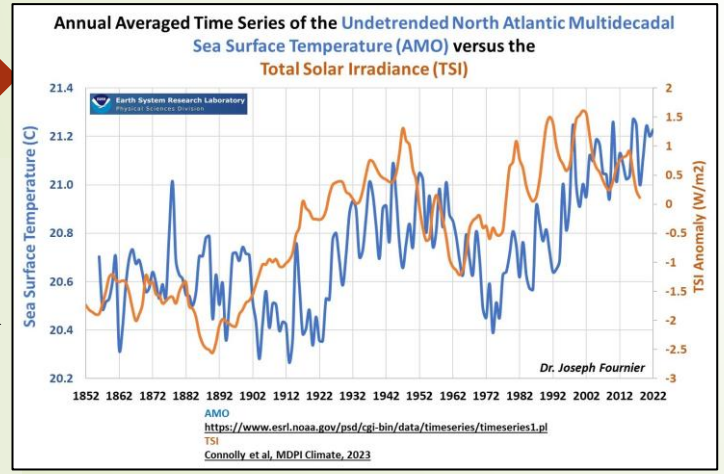
Comparative dynamics of several climatic indices for 1900–2000:

Pacific Decadal Oscillation (PDO)
Aleutian Atmospheric Pressure Index (ALPI)
Zonal Atmospheric Circulation Index (ACI)
Detrended Global dT
Arctic Temperature Anomaly (Arctic dT).

Smoothed by 13-year moving averaging

More Solar Cycles 60-Years



Atmospheric CO_2 concentrations have been rising steadily unlike the erratic and rather obvious cyclic temperature and temperature related changes. CO_2 is a minor player at best! The alarmist narrative is simplistic & unscientific!