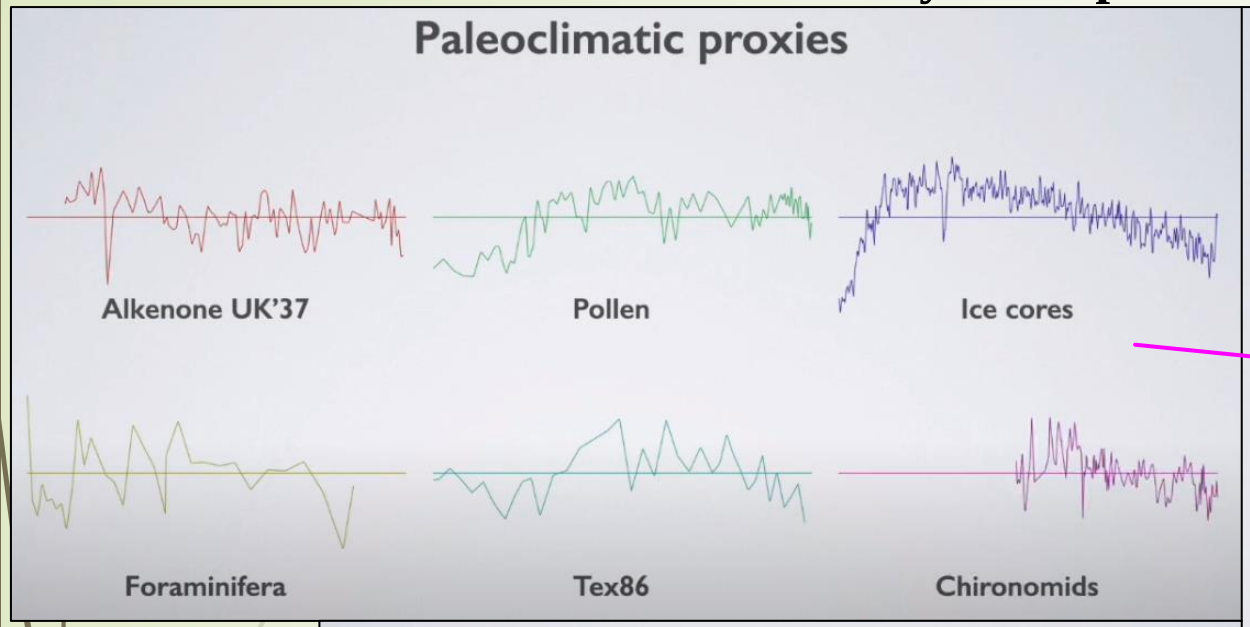
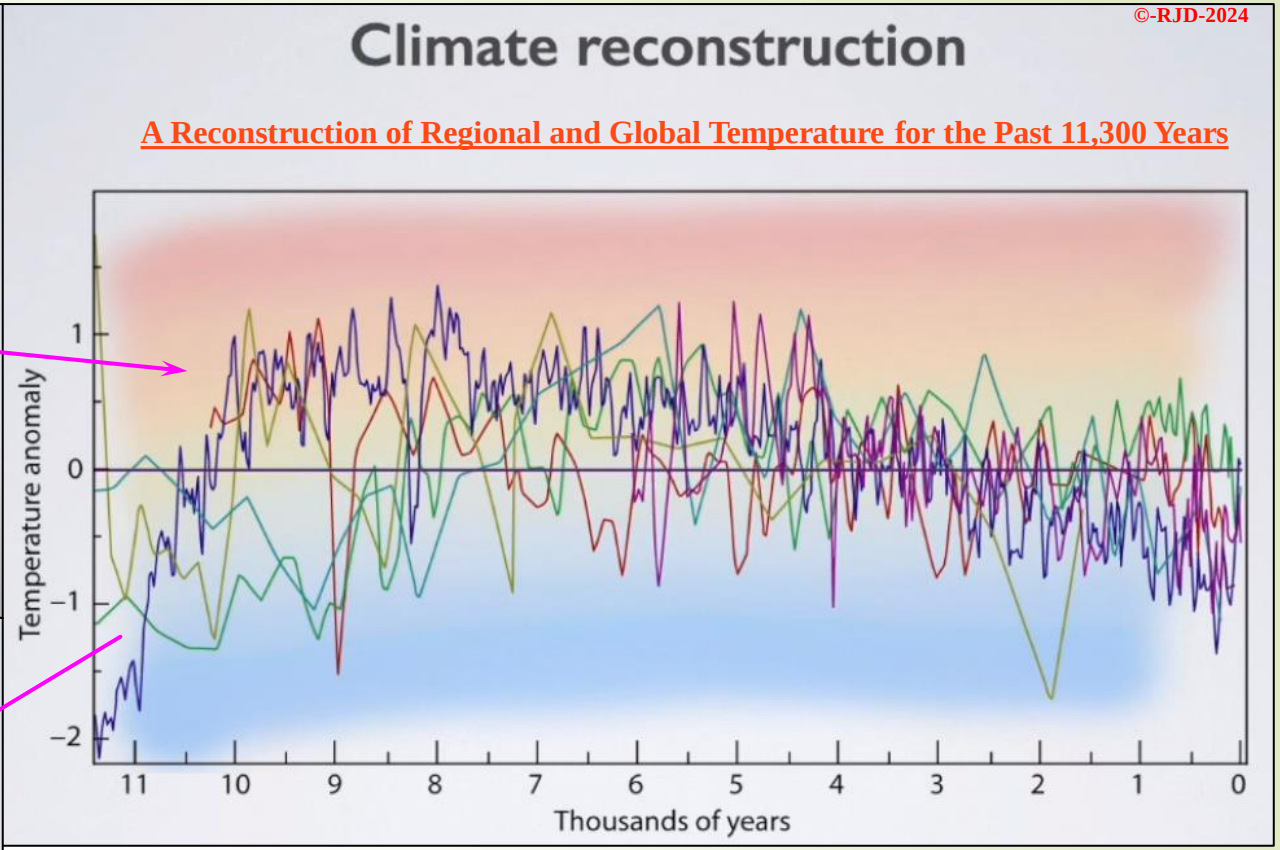
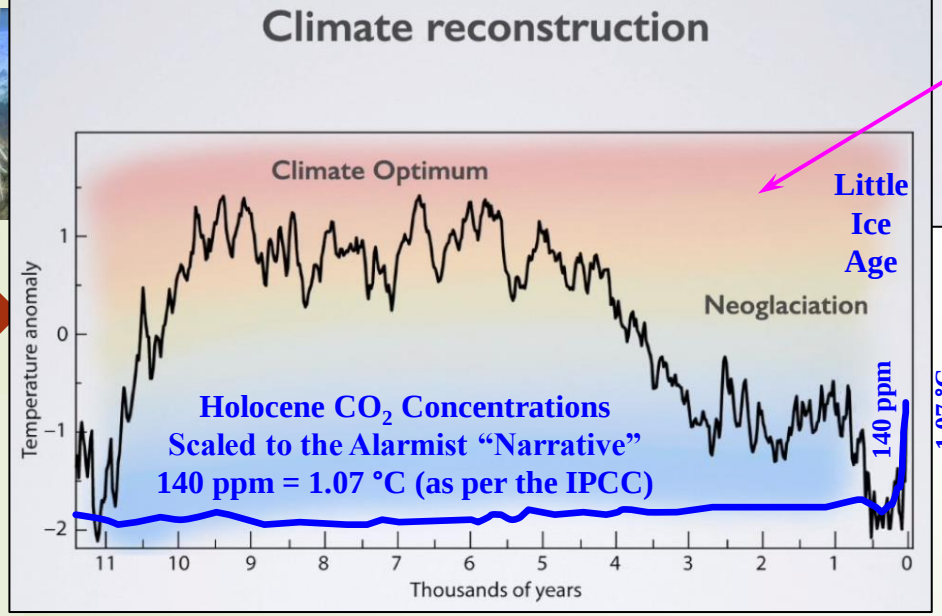
The Holocene & Solar Activity – Temperature Reconstruction





Holocene & TSI – Proxy Temperatures



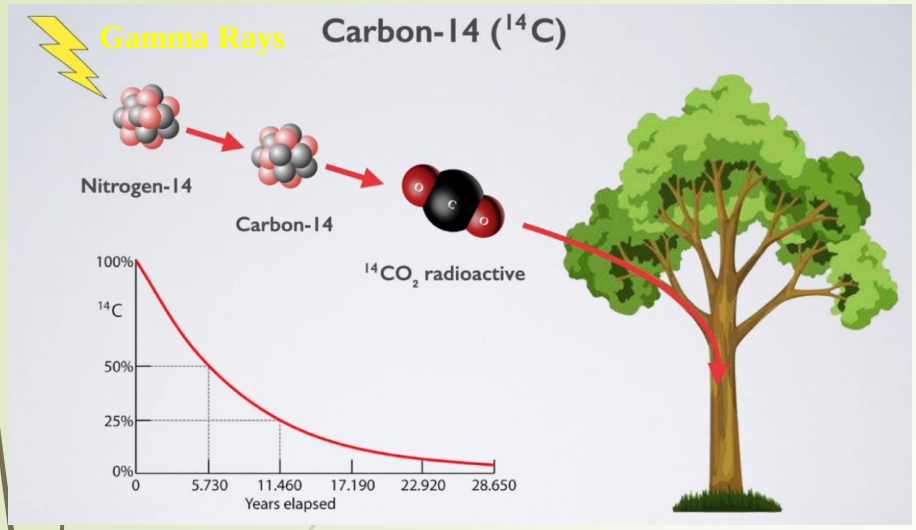
A Reconstruction of Regional and Global Temperature for the Past 11,300 Years

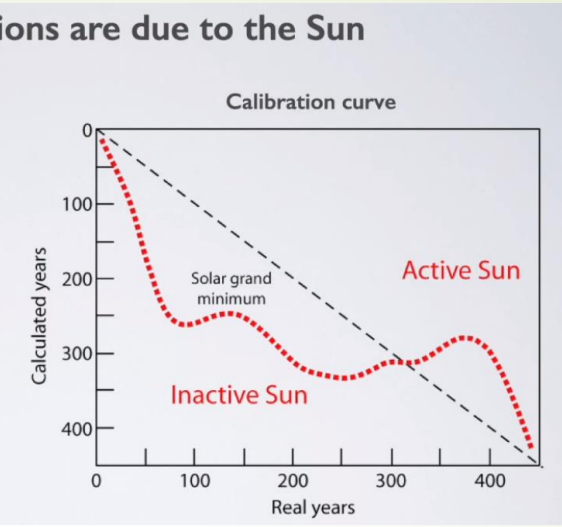
A video by Javier Vinós has been making the rounds recently, "How We Know the Sun Changes the Climate". The video touched on some unique interesting points that deserves a more detailed look (and some kudos for Javier). The alarmist community does not like to talk about the Holocene because temperatures fluctuated significantly despite a virtually flat CO_2 concentration. Somehow temperatures were able to change without CO_2's help? How is that possible given that CO_2 is the only significant climate driver (according to your favorite alarmist)? Obviously, there are natural forcings causing those fluctuations. And those natural forcings have not disappeared just because the computer models have decreed it so. Those models that have been self-acknowledged to run way too hot and use unrealistically high emission scenarios (RCP8.5)). More at OPS-55 – State of Climate Science.

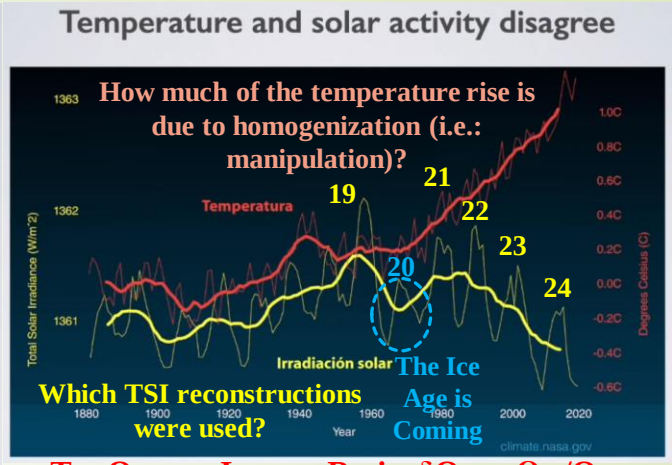
This temperature reconstruction is based on the Marcotte et al's 2013 paper, A Reconstruction of Regional and Global Temperature for the Past 11,300 Years. A variety of proxies were used to produce the Temperature Reconstruction on the bottom left. As shown, temperatures over most of the Holocene (the Climate Optimum) were significantly warmer than today's more moderate, cooler temperatures (the Neoglaciation). The Little Ice Age is prominently displayed. The CO_2 curve (scaled to reflect the alarmist narrative that the warming from the pre-industrial era is due to CO_2 increases), has been added to Javier Vinós' plot. Do you really believe CO_2 is the only significant climate driver?

The Holocene & Solar Activity – Carbon Dating

More detail? climatechangeandmusic.com





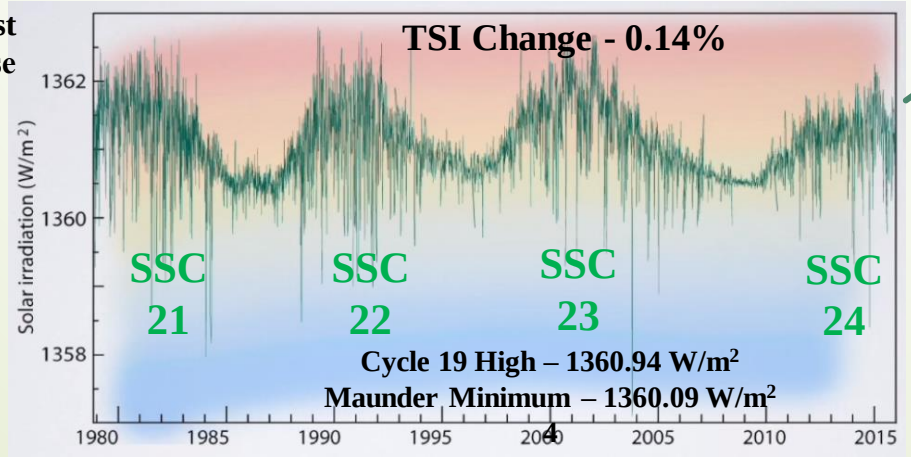


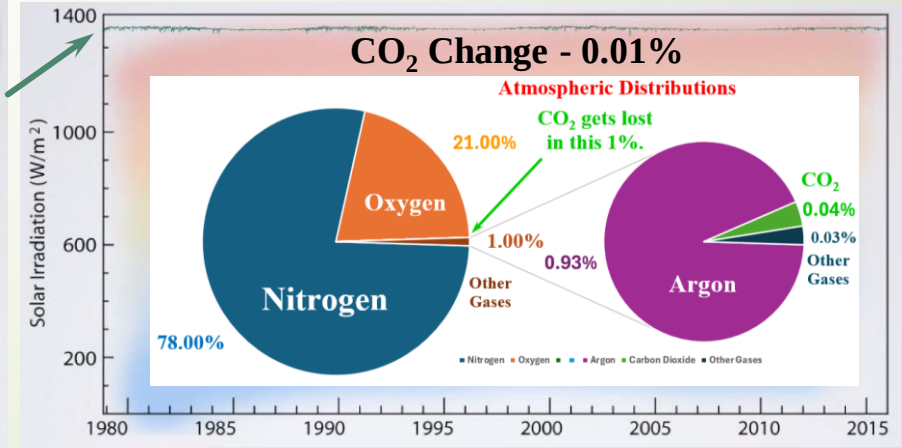
T_G: Oxygen Isotope Ratio, $\delta O_{18} \equiv O_{18}/O_{16}$

CO_2: Carbon Isotope Ratio, $\delta C_{13} \equiv C_{13}/C_{12}$

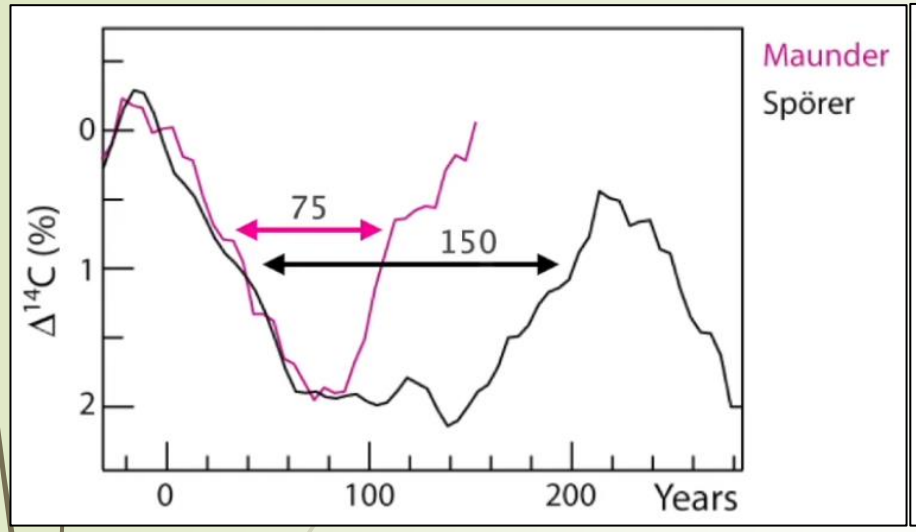
Javier outlined a few of the processes involved in producing proxies like those shown on the previous slide. Carbon and Oxygen Isotope Ratios can be used to estimate historical global carbon concentrations and temperatures (pre-direct measurement). The plot (top left) highlights the Carbon Dating process. Gamma Rays strike Nitrogen-14 molecules, producing a Carbon-14 (^{14}C) molecule that then combines with Oxygen to form a radioactive CO_2 molecule ($^{14}CO_2$). Those CO_2 molecules are taken up by trees and can be used to estimate the age of each tree ring based on $^{14}CO_2$'s radioactive decay rate. The general Carbon Dating correlation is shown below the process schematic. If only it were that easy. Cosmic Ray Flux (CRF) is not a constant. CRF moves up and down for a variety of reasons but is generally a function of the solar activity. When the sun is more active, the solar winds are stronger and deflect more of the CRF (producing less $^{14}CO_2$) and vice-versa. The middle chart above shows a calibration curve that adjusts for the CRF fluctuations. CRF is also important in driving global temperatures through cloud formation and albedo adjustments. That is a discussion for another day. The plot below left shows the Total Solar Irradiance (TSI) fluctuations over the 1980 to 2015 period. The TSI is rising and falling with the 11-year Schwab Solar Cycle (Active versus Inactive Sun). The plot to the bottom right shows the same data at full scale (look closely). This provides the alarmist argument that the change in TSI is too small to affect climate. That ignores the changes in CRF, albedo, high energy protons and a lot of other solar parameters, but sure the changes are too small. But wait, aren't the changes in CO_2 also small? The alarmist argument, a ≈0.01% increase in CO_2 has led to catastrophic Climate Change (extreme weather and temperature increases (1.07 °C according to the IPCC (?))) but a 14 times higher fluctuation in TSI (from the source of 99%+ of the energy that drives the planet's temperature) cannot possibly be contributing meaningfully to climate change? Sure! Note, extreme weather events are statistically flat to declining and 1.07 °C fluctuations are well within the climate variations. More on that later.

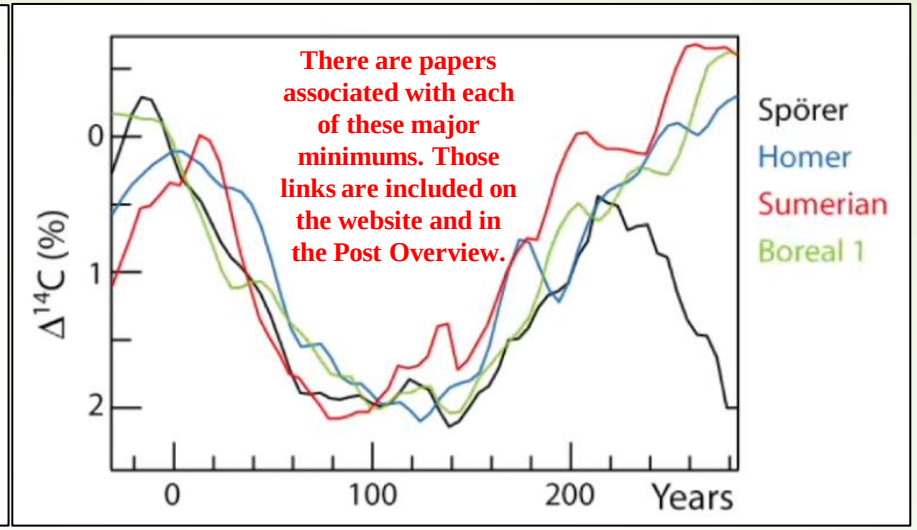
Holocene & TSI – Carbon Dating





The Holocene & Solar Activity – Solar Minimums





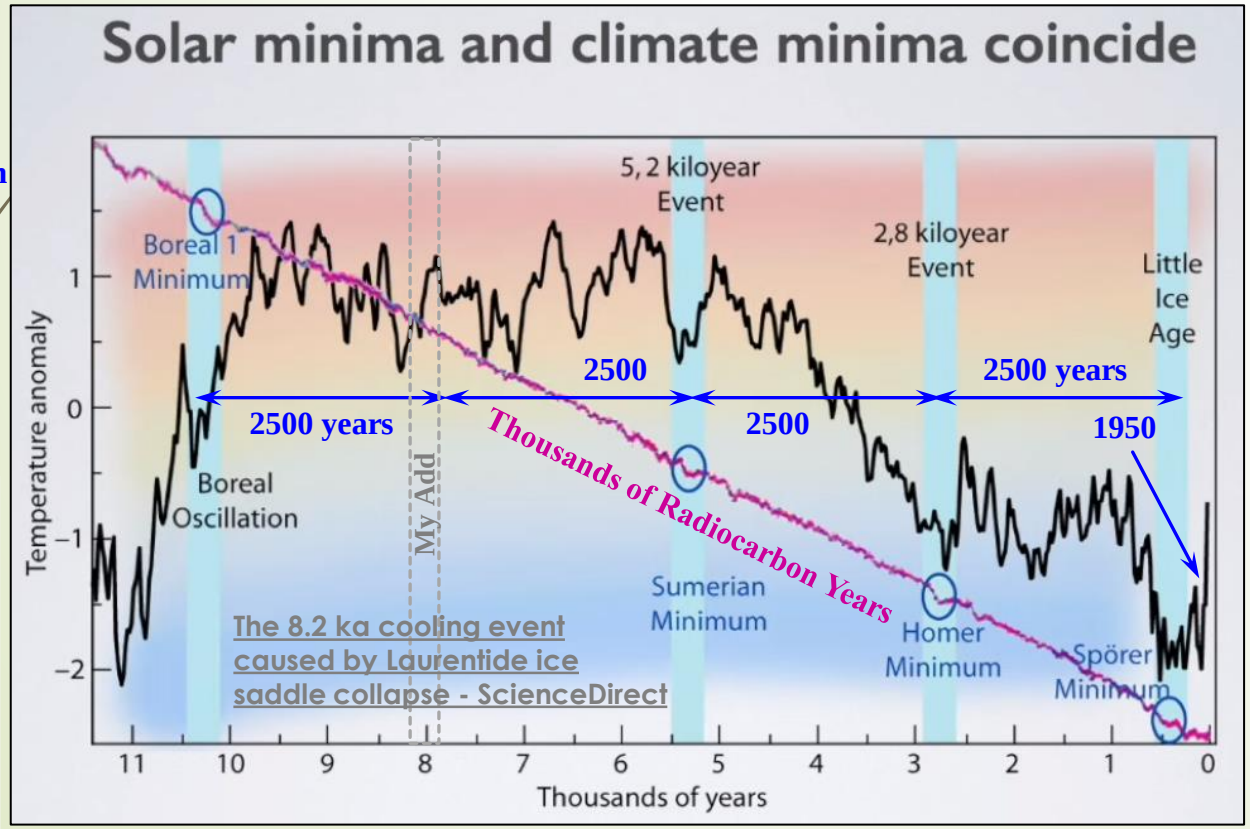
This was the information that caught my eye. I have looked at Solar Minimums back to the Oort Minimum but had not come across information prior to that time (≈1,000 years ago). What do all these Minimums have in common? Global temperatures dropped with no help from CO_2 (which was essentially flat throughout the Holocene). The bigger events (Spörer, Homer, Sumerian and Boreal) all coincide with obvious cold periods. The Spörer Minimum was just one of many minimums that produced the Little Ice Age (LIA, the coldest period of the entire Holocene, which happens to coincide with the lowest TSI levels of the Holocene). All with virtually no chance of CO_2 influence. As an aside, the highest TSI levels in the last 7,000 years coincide with the Modern Solar Maximum and many of those "HOTTEST YEARS EVER" you keep hearing about. Would anyone care to explain the temperature fluctuations shown here, given that 86%+ of our emissions occurred post-1950? Note, that temperatures began rising centuries before humanity could have had any meaningful/measurable impact (which is not that different from today). Slide CSS-56g includes additional Holocene temperature profiles that show similar profiles. And although the Northern and Southern Hemispheres experienced the Little Ice Age differently, they all experienced colder temperatures. The LIA began with the Wolf Minimum (1240) and lasted 573 years ending with the Dalton Minimum in 1843. Strange how the alarmists like to start their temperature discussions in the mid-1850s?. What is missing from Javier's chart? The 8,200-year event. A large event (i.e.: ripple) that is not visible in the Radiocarbon Year curve but is very visible in many of the temperature curves from around the world. Was there a large Minimum around 8,200 years ago? More than likely, but there was also very likely a large cooling component produced by the collapse of the large Agassiz and Ojibway Lakes into the North Atlantic (discussed here).

Holocene & TSI - Solar Minimums

Oort Minimum
1040-1080 AD
Medieval Minor
1150 – 1200 AD
LIA-Wolf Minimum
1280-1340 AD
Spörer Minimum
1400 – 1550 AD

Maunder Minimum
1640 – 1715 AD
Dalton Minimum
1787-1843 AD - LIA
Centennial Minimum
1875 – 1915 AD
Modern Minimum
???? - ????

Any guesses?



CSS-56d The Holocene & Solar Activity – Human Influences

More detail?
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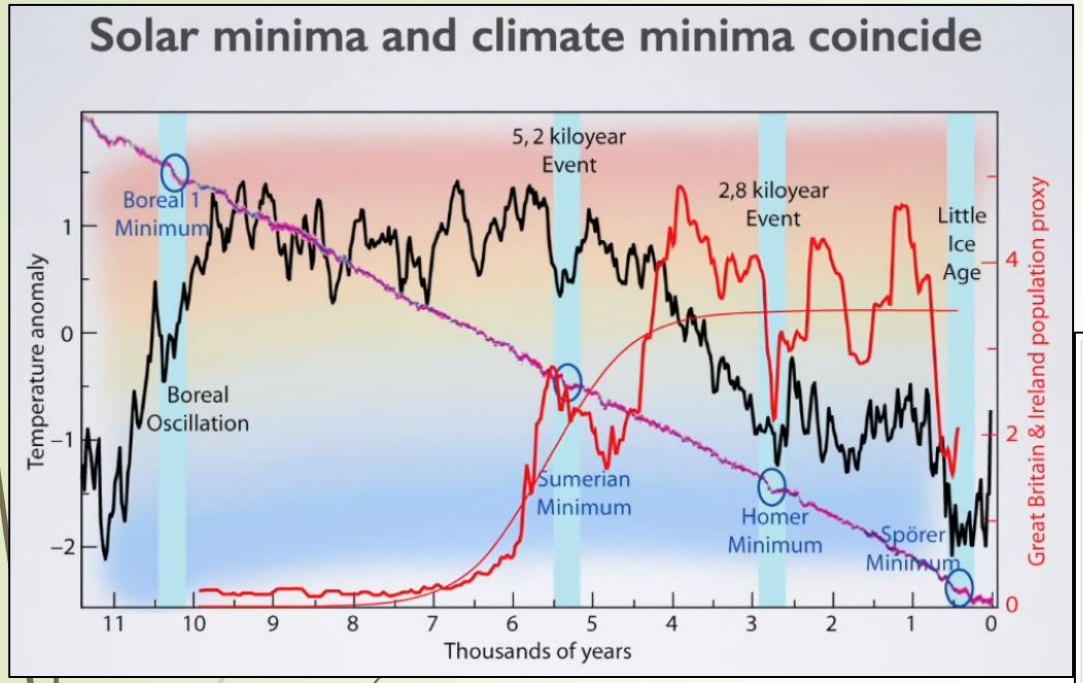
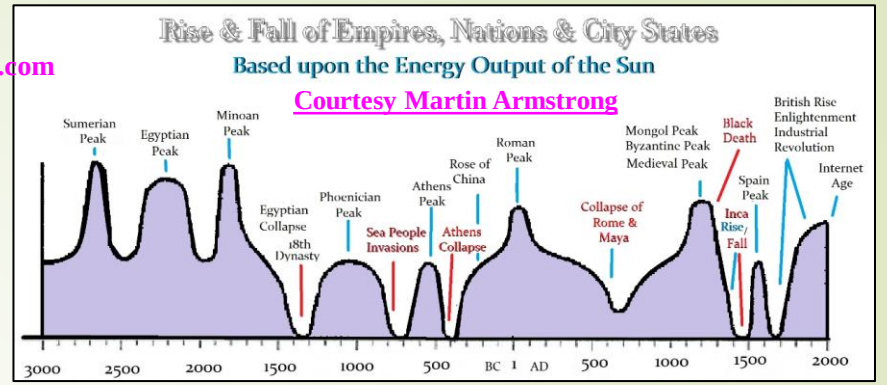
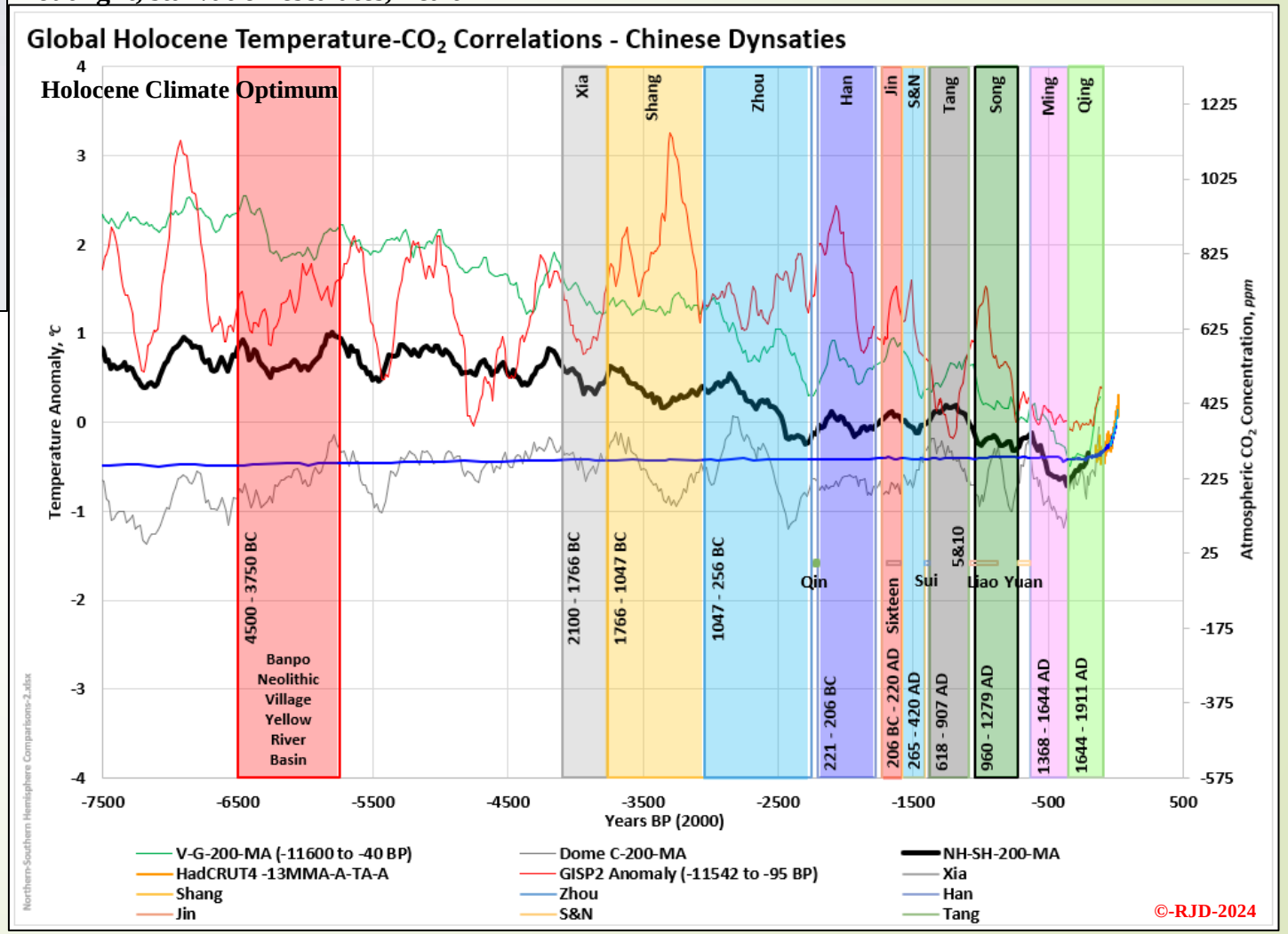




Javier also threw in a little discussion on the population effects of these major Solar Minima (that just happen to coincide with climate minima). What happens when temperatures drop significantly? Growing seasons shorten, crop yields drop or fail outright, starvation escalates, health deteriorates (plagues and pestilence abound), civil strife rises and populations drop significantly. Does any of that sound familiar? Javier just shows us the population fluctuations associated with Great Britain and Ireland (above). The chart to the right lays out the various Chinese Dynasties over the temperature data. The Dynasties generally start and end when there are abrupt climate changes (cooling or warming). When temperatures are warmer, you can feed your armies and ambitions. When the temperatures cool and food is scarce, civil strife takes over and leads to consolidation where regimes/dynasties collapse and the most powerful ultimately dominate. The chart in the upper right is a schematic that highlights some of the major historical events that happen to coincide with solar fluctuations. The Solar Maximums (which coincide with the many warm periods over the Holocene) are good for humanity. Civilization advances during these warm periods (like the one we are currently living through). People are just more energetic and clearer headed when they are well fed and healthy. We are entering (or have just entered) the next forecasted GSM. What do you think is going to happen?

Holocene & TSI – Human Influences



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

The Holocene & Solar Activity – Glacier Advances (GA)

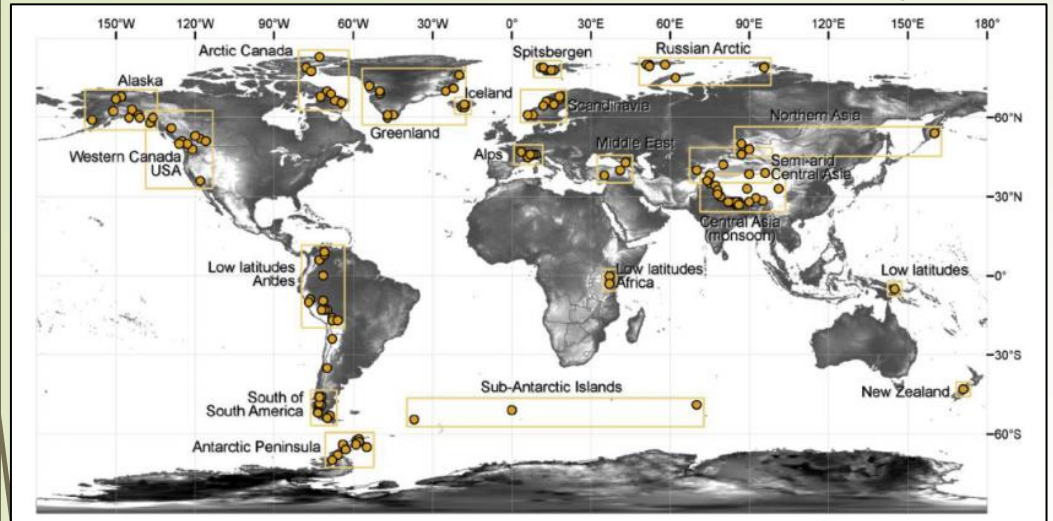
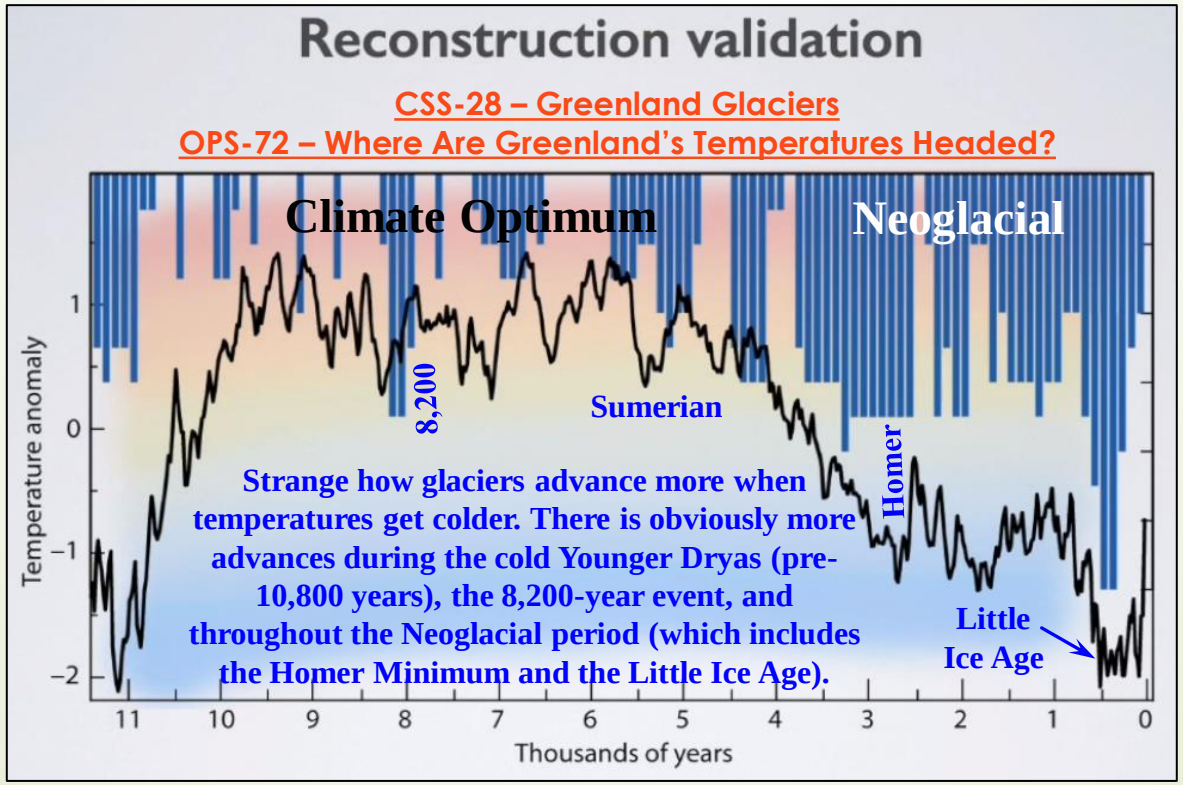


Fig. 1. Spatial distribution of time series used in this paper. Scale 1:150 000 000. 1. Alaska; 2. Western Canada and US; 3. Arctic Canada; 4. Greenland; 5. Iceland; 6. Svalbard; 7. Scandinavia; 8. Russian Arctic; 9. North Asia; 10. Central Europe; 11. Central Asia (semi-arid); 12. Central Asia (monsoon); 13. Low Latitudes; 14. South of South America; 15. New Zealand; 16. Sub-Antarctic Islands; 17 Antarctic Peninsula and Maritime Antarctic. For individual time series description see Table S2 in Supplementary Materials.

To validate his temperature reconstruction, Javier has plotted glacial advances against that reconstruction. The glacial fluctuation data is based on the 2015 paper "Holocene glacier fluctuations" by Solomina et al. The map to the left shows the regions included in the paper's analysis, from both hemispheres. The advances shown here are based on global totals. I have put together some plots that break out the hemisphere and tropical Andes data. That data is included in a later slide. The paper also includes a plot that shows how treelines varied over the Holocene. Treelines were higher during the early Holocene (i.e.: temperatures were warmer, and trees could grow at higher altitudes) and dropped along with temperatures through the Neoglacial (with their lowest levels in the Little Ice Age). Given that knowledge, you should not be surprised that old growth forests have been exposed as glaciers receded over the last half of the 20th century. The tree line was also much farther north during the Holocene Climate Optimum (thanks to temperatures that were around 2 °C warmer than today's "HOTTEST EVER TEMPERAURES".

Holocene & TSI - Glacier Advances (GA)

Glaciers have advanced and retreated for millennia. The most recent glacial retreats began long before human emissions were substantial (86%+ were post-1950) and are currently growing. The alarmist community loves to proclaim that the Little Ice Age (LIA) was only in the Northern Hemisphere. Sorry, not sorry, but the LIA was global, just experienced differently in each hemisphere.



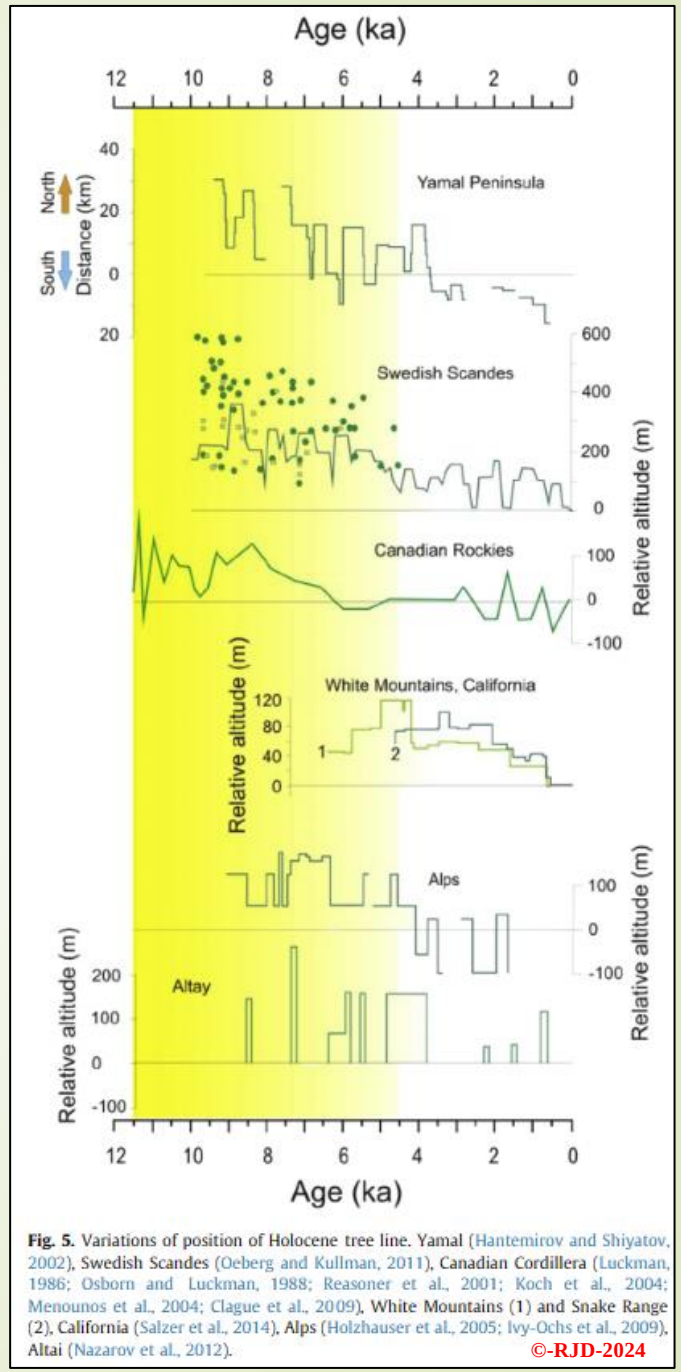


Fig. 5. Variations of position of Holocene tree line. Yamal (Hantemirov and Shiyatov, 2002), Swedish Scandes (Oeberg and Kullman, 2011), Canadian Cordillera (Luckman, 1986; Osborn and Luckman, 1988; Reasoner et al., 2001; Koch et al., 2004; Menounos et al., 2004; Clague et al., 2009), White Mountains (1) and Snake Range (2), California (Salzer et al., 2014), Alps (Holzhauser et al., 2005; Ivy-Ochs et al., 2009), Altai (Nazarov et al., 2012).

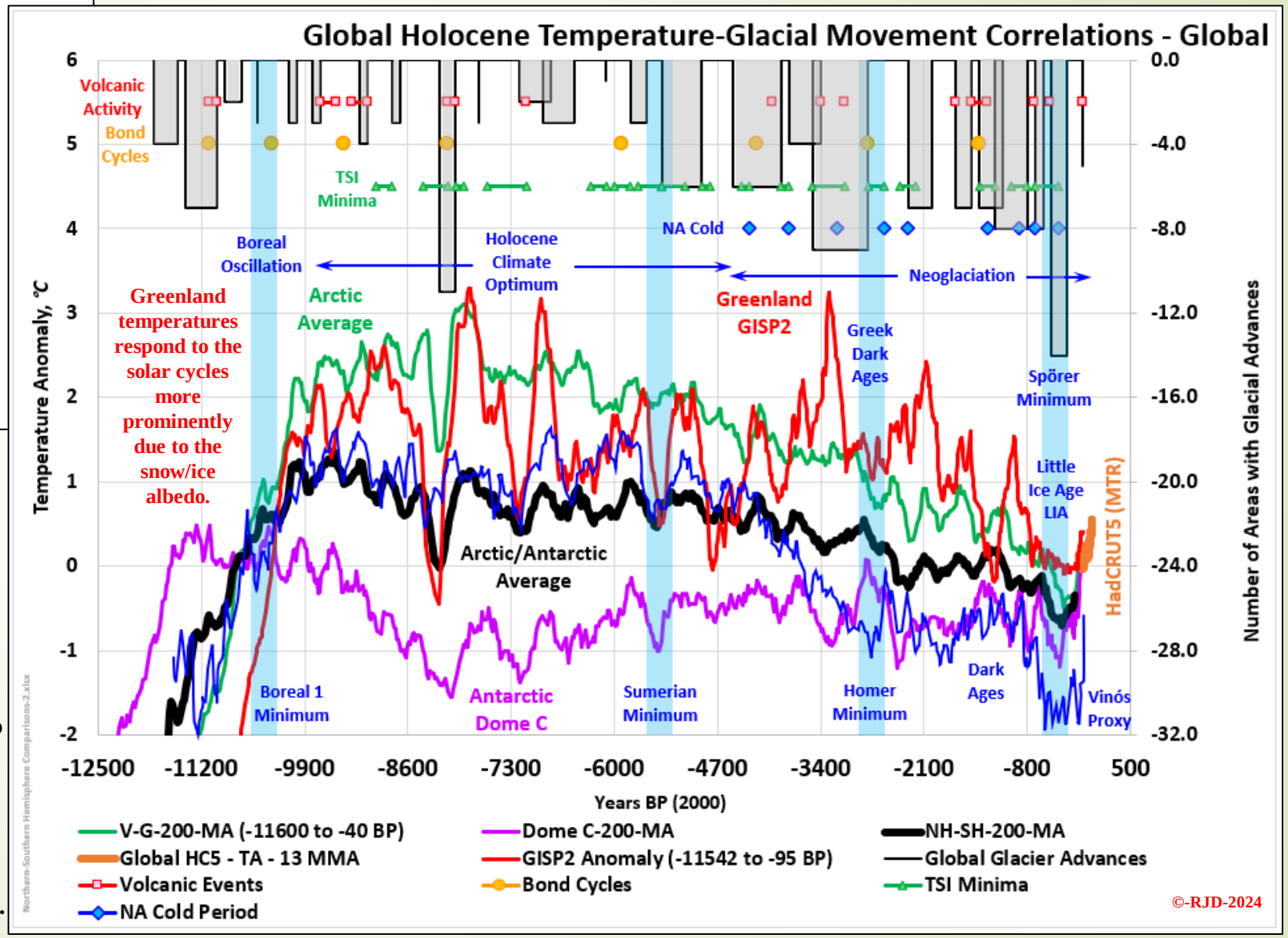
The Holocene & Solar Activity – GA - Detail

Table 2
Comparison of clusters of ages (ka) of glacier advances in the extra-tropical areas of the NH and SH and in low latitudes with major volcanic eruptions, solar activity, and Bond events. Advances that occurred in both hemispheres are marked by yellow, those occurring only in the NH are in blue. Numbers in brackets indicate the number of advances recorded, (N+?) means that a certain number of advances can possibly belong to the same group, but it onlymarginally corresponds to the interval of the dates. Solar forcings – by Renssen et al. (2006), strong climatically effective volcanic eruptions by Bay et al. (2006), Gao et al. (20 07), Sigl et al. (2013), the maxima in ice-rafted debris (IRD) in North Atlantic ocean cores (which are correlative with the solar activity) – by Bond et al. (2001).

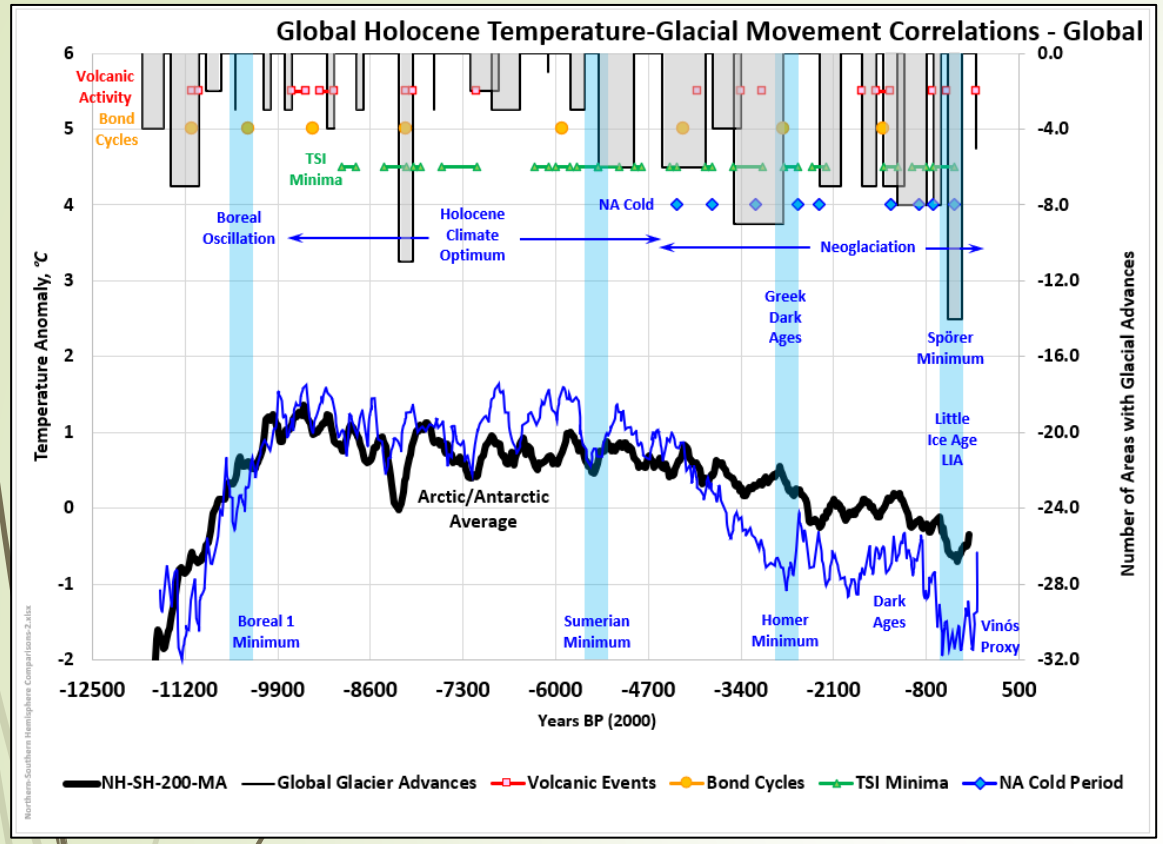
Glacial advances							
Northern Hemisphere	*Tropical Andes*	*Southern Hemisphere*	*Global*	*Volcanic events*	*Bond's cycles*	*TSI minima*	*Cold periods in the North Atlantic*
11.8-11.6 (2)	11.8	11.5 (1)	11.8-11.5 (4)				
11.4-11.0 (5)	11.3, 11.0		11.4-11.0 (7)	11.1-11.0	11.1		
	10.9	10.7 (1)	10.9-10.7(2)				
10.5 (3)			10.5 (3)				
10.1-10.0 (3)			10.1-10.0 (3)		10.3		
9.7 (2)		9.8 (1)	9.8-9.7 (3)	9.7-9.5			
9.2 (3)		9.1 (1)	9.2-9.1 (4)	9.3-9.1	9.4		
8.8 (2)		8.7 (1)	8.8-8.7 (3?)			9.0-8.8	
8.2-8.0 (5+2?)		8.0-8.2 (2+2?)	8.2-8.0 (7+4?)	8.1-8.0	8.1	8.4-8.1	
7.7 (3)			7.7 (3)			8.0-7.9	
7.2-6.8 (1)		7.2 (1)	7.2-6.8 (2)	7.1		7.6-7.1	
6.9-6.6 (2)		6.9-6.5 (1)	6.9-6.5 (3)				
6.1 (1)			6.1 (1)			6.3-6.1	
						6.0-5.8	
5.8-5.6 (3)			5.8-5.6 (3)		5.9	5.7-5.4	
5.4-4.9 (2)	5.2	5.4-4.9 (2+1?)	5.4-4.9 (5+1)			5.4-5.1	
						4.9-4.8	
4.5-4.2 (5)		4.3-3.9 (1)	4.5-3.9 (6)	4.0	4.2	4.4-4.3	4.3
3.8-3.4 (3)		3.6-3.2 (1)	3.8-3.4 (3+1?)	3.4		3.9-3.8	3.8
3.5-2.8 (9)			3.5-2.8 (9)	'3.1		3.5-3.1	3.2
					2.8	2.8-2.6	2.6
2.3-2.0 (5)		2.3-2.2 (2+1?)	2.3-2.0 (7)			2.4-2.2	2.3
1.7-1.5 (4+1?)		2.0-1.6 (2)	1.7-1.5 (4+3?)	1.7			
1.4-1.2 (4)	1.2	1.4-1.1 (2)	1.4-1.1 (7)	1.5-1.3 (3)	1.4	1.4-1.2	1.3
1.1-0.8 (4+1?)		1.2-0.9 (2+1?)	1.2-0.8 (6+2?)			1.0-0.8	0.9
0.7-0.6 (5)	0.6	0.6 (2)	0.7-0.6 (8)	0.7		0.7-0.4	0.7
0.5-0.3 (8)	0.5-0.4, 0.3	0.5-0.3 (3+1?)	0.5-0.3 (13+1?)	0.5			0.4
0.1 (4)		0.1 (1)	0.1 (5)	0.1			

The data for Javier's validation plot (previous slide) is included to the left. The table also includes some information on Volcanic Activity, Bond Cycles, TSI Minima, and North Atlantic Cold Periods. I have plotted that information below, along with several other Holocene temperature datasets. Javier's temperature reconstruction is the blue curve. Note, I do not have the Javier dataset. I just cloned the data and laid it over the other temperature curves. All the curves show the Holocene Climate Optimum, the 8,200-year event, and the Little Ice Age (to varying degrees). Antarctic temperatures are a little out of sync and will be discussed on a later slide. The 8,200-year event was not included in Javier's evaluation but probably should have been. The temperature response was much stronger in the Northern Hemisphere, but still visible in Antarctica and Javier's reconstruction. The reason that the two hemispheres respond differently is very likely related to the land/ocean distributions around the planet. The NH has a significantly higher percentage of the land mass on the planet. The oceans and land respond differently to solar input. That is why the Milankovitch cycles focus on insolation at a 65° N latitude (primarily land) that correlates to the long-term trends.

Holocene & TSI – GA Detail

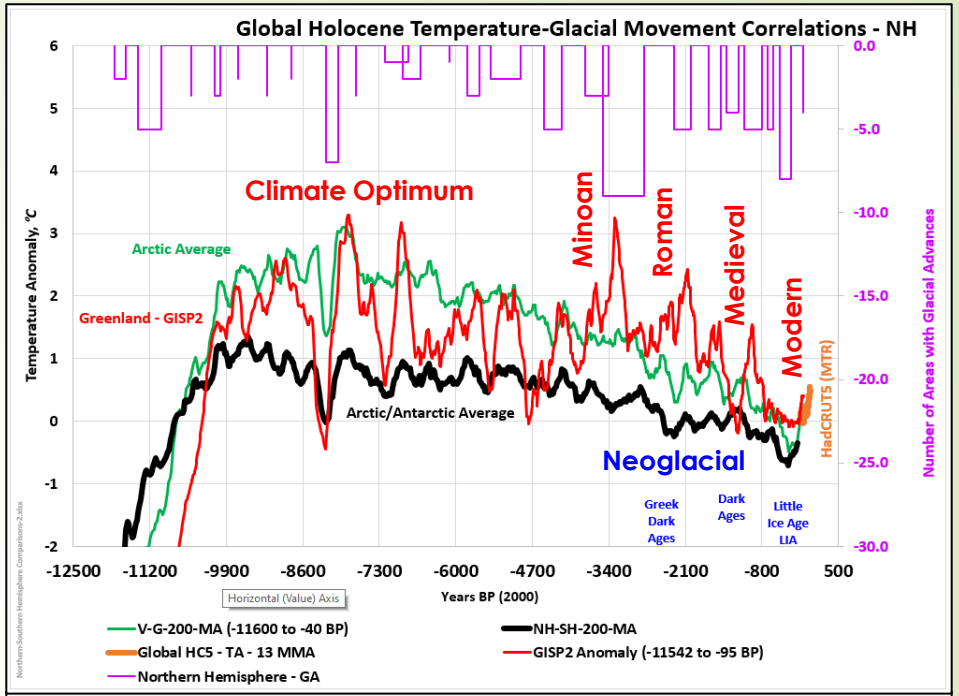


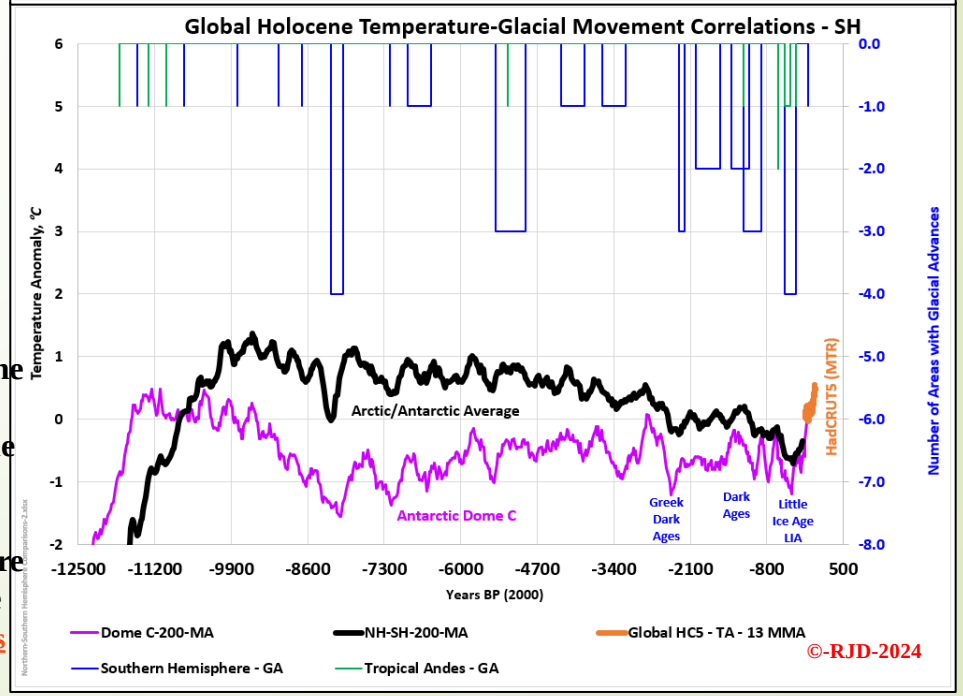
The Holocene & Solar Activity – GA Localized



The chart to the left has removed three of the temperature datasets, leaving just the Javier reconstruction and an average between Vinther et al Arctic Average and Antarctica's Dome C datasets. The two curves both show the Holocene Climate Optimum and the Neoglacial on a broad scale. On shorter time scales, both curves show the 8,200-year event, the Sumerian Minimum, and the Spörer Minimum (i.e.: the Little Ice Age). The Homer Minimum and Boreal Oscillation events are not as dominant on the Arctic/Antarctic Average curve. The Javier reconstruction has a much more pronounced distinction between the Holocene Climate Optimum and the Neoglacial. Based on glacial responses from all over the world, the Neoglacial is definitely a reality. Is the decline into the Neoglacial gradual or relatively sharp? That topic is open for discussion. The curves to the right show the Northern and Southern Hemispheres separately. Each of those hemispheres show the Holocene Climate Optimum and the Neoglacial. The Northern Hemisphere is more pronounced (as per the discussion on the previous slide). The Neoglacial glacier advances are significantly more frequent and prolonged than those over the Holocene Climate Optimum in both hemispheres. The Neoglacial was obviously colder than the Holocene Climate Optimum. The glacial advances during the 8,200-year event and the Little Ice Age standout against the background in both hemispheres and in both the major warm and cold halves of the Holocene. The Antarctic Dome C temperatures were suppressed during much of the middle Holocene and will be discussed in more detail on the next slide. There are many more datasets covering the Holocene. More detailed looks at the data are .included in my CSS-44 – Global Temperature Distributions and CSS-45 – Antarctic Average Consolidated Temperatures (AACT) posts. The two curves directly to the right are representative of the Global and Antarctic Temperatures.

Holocene & TSI – GA Localized

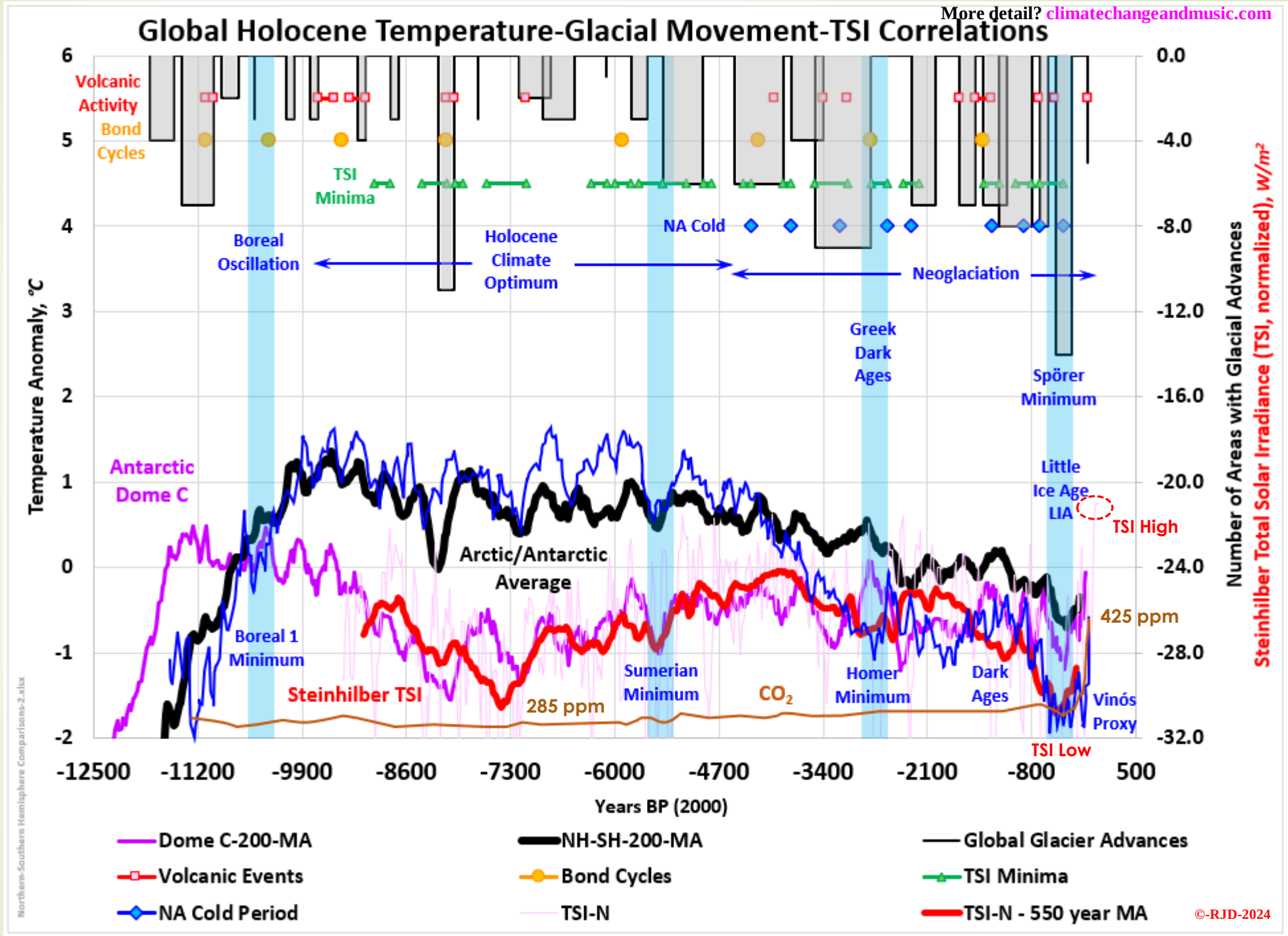




The Holocene & Solar Activity – Steinhilber Total Solar Irradiance

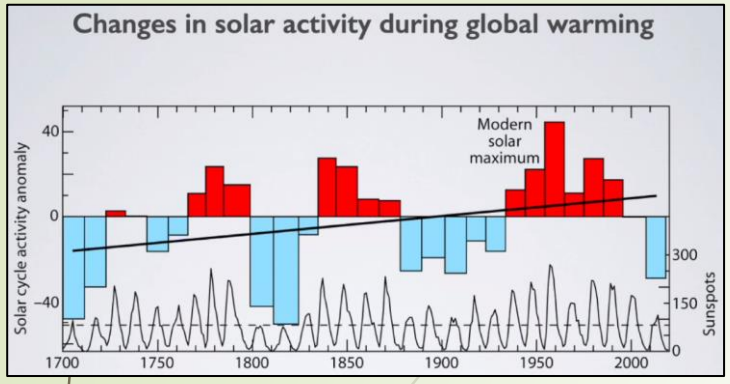
Holocene & TSI Steinhilber

The Antarctic temperature profile is a bit of an outlier with the mid-Holocene temperature suppression. What caused that suppression? Certainly not CO_2, since CO_2 was virtually flat over most of the Holocene. And somehow temperatures still fluctuated significantly. Note, CO_2 is scaled to reflect the alarmist narrative (140 ppm ≡ 1.07 °C) and normalized to the Javier reconstruction. Any chance the general Antarctic temperature profile is related to the Total Solar Irradiance (TSI) as represented by the Steinhilber et al TSI reconstruction? Any chance that the Little Ice Age (LIA) is cold because TSIs were at their lowest levels in the last 7,000+ years? Any chance that the Modern Warm Period may be due to the highest TSIs in the last 7,000+ years? More prominent plots and discussion are included in my CSS-10 – A Ride Through the Cenozoic post (CSS-10n, 10o & 10P) for those that are interested. Yes, it is complicated!



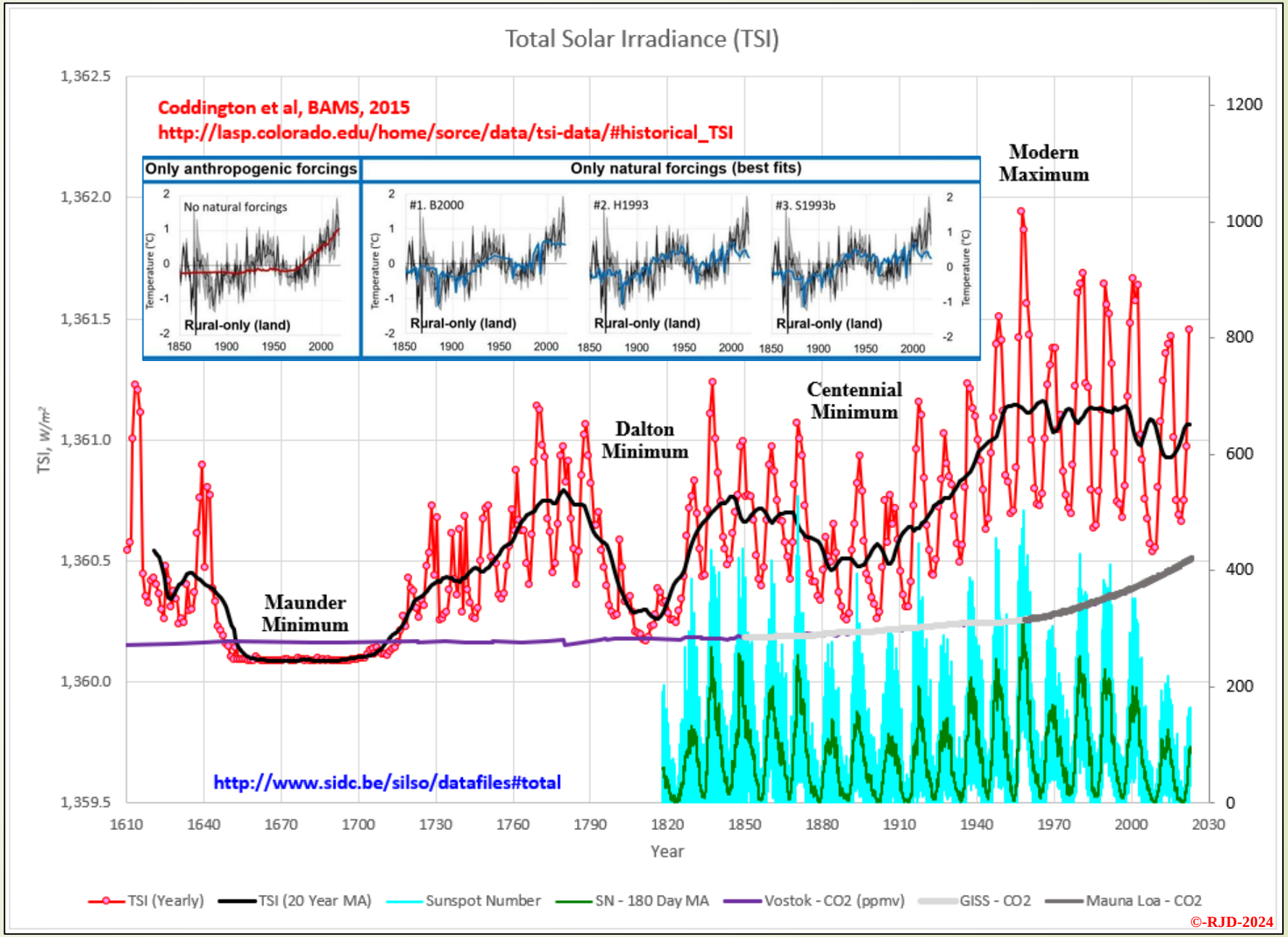
The Holocene & Solar Activity – Temperature Reconstruction

More detail? climatechangeandmusic.com

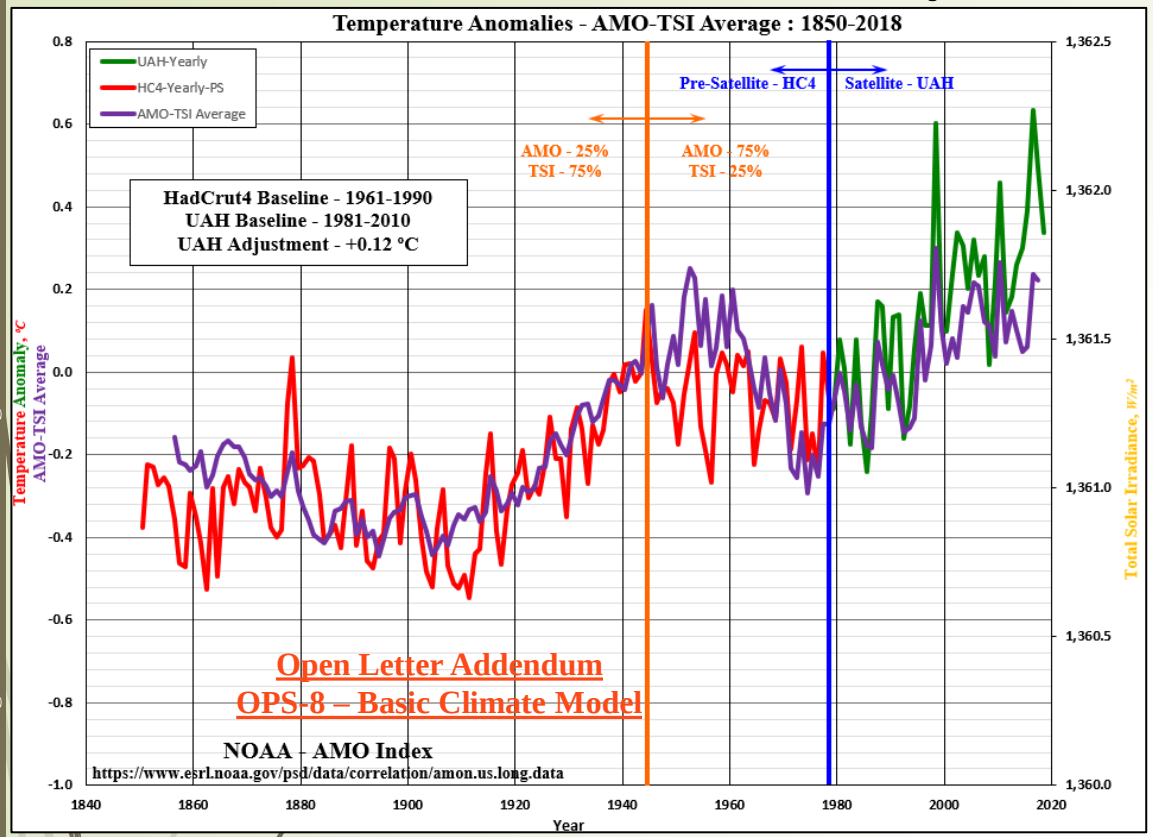


The plot to the left shows the general trend of Solar Activity over the "Global Warming" (GW≡Climate Change≡CO_2) era from Javier's presentation. The plot below is a more detailed TSI profile based on the Naval Research Lab's NRLTSI2 TSI reconstruction. There are many TSI reconstructions. The NRLTSI2 TSI is close to the visual average as discussed in my CSS-42 – The Role of the Sun – Scafetta 2023 and CSS-51- Soon-Connolly – Solar Forcings posts. Those two posts show that TSI (as a proxy) can model the Modern Temperature Record (MTR, 1850 to the Present) far better than the CO_2 focused models currently being used (those models that are self-acknowledged to run too hot). One example is shown to the right, but many more are available. As shown on the Holocene curves, CO_2 cannot begin to model the pre-MTR temperatures correctly since CO_2 is effectively flat. CO_2 can be forced to correlate with homogenized (i.e.: manipulated) temperatures beginning around 1975, but that is not statistically significant. Do CO_2 concentration changes affect temperature? Yes, but that influence is minor and lost in the much more powerful ocean and solar cycles! CO_2 is not a major climate driver, and these so-called climate models are ignoring the very real and dangerous potential for colder temperatures over the next few decades. Wake up people!

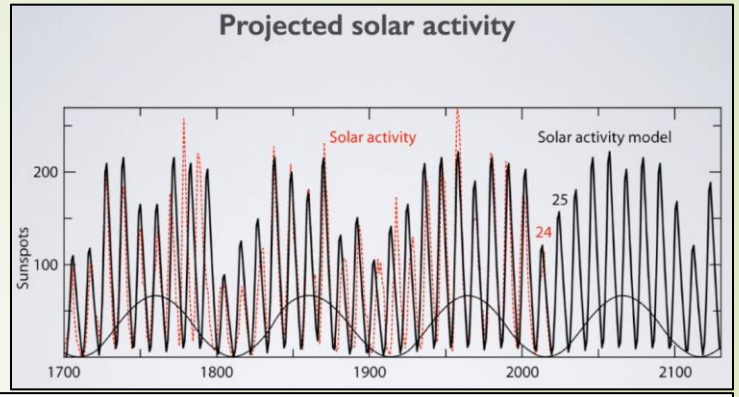
Holocene & TSI Profiles

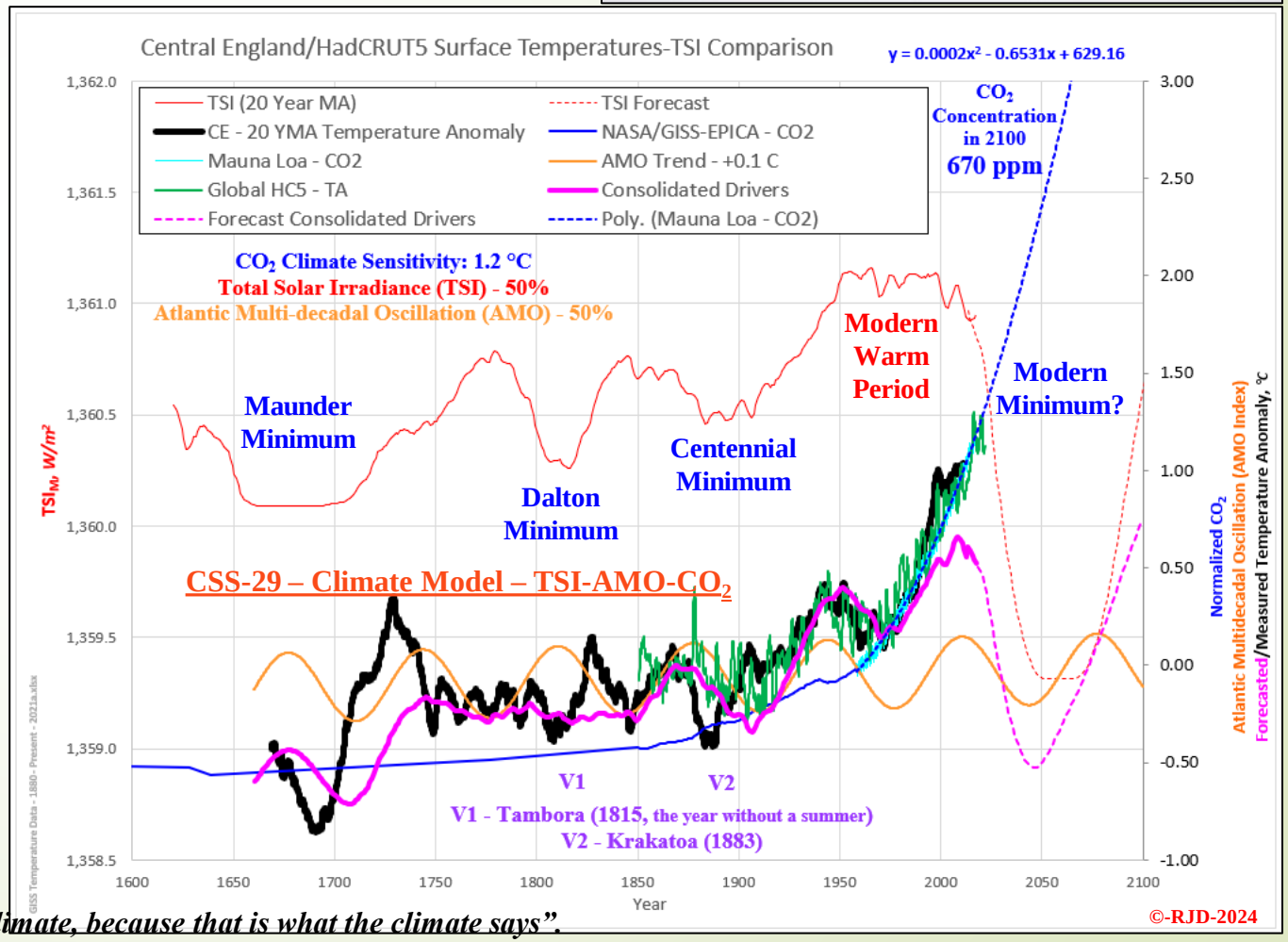


The Holocene & Solar Activity – Models



The last point I will address is Javier's presentation is his solar activity forecast. The model is interesting, and he correctly forecasted that Cycle 25 would have higher Sunspot Numbers (SSN) than Cycle 24. However, the sinusoidal curve will not represent the absence of Sunspots during the Maunder Grand Solar Minimum or the forecasted absence of Sunspots in Cycle 26.





Holocene & TSI Models

We have just entered (or about to enter) the Modern Grand Solar Minimum according to many forecasts. In my opinion, the TSI is a better proxy for changes in solar activity and its associated temperature influences than SSNs on their own. I have put together two "simple" spreadsheet models. The first model (above) uses just TSI (as a proxy) and the Atlantic Multi-decadal Oscillation (AMO) to recreate the MTR temperatures (1850 to the present). The second model (to the right) uses TSI (as a proxy), the AMO and CO_2 to recreate the Central England Temperatures (CET, 1659 to the present). The history matches are not perfect, but they are much closer to reality than the IPCC's simplistic, unscientific, ideological CO_2 focussed models. Remember, those models are self-acknowledged to run way too hot and use implausibly to impossibly high emission scenarios (like RCP8.5). Javier is correct when he says *"we can state emphatically that changes in solar activity affects the climate, because that is what the climate says".*