My Look at the Solar Forcings over the Holocene - Eccentricity

More detail?
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Milankovitch Cycles and Their Influence

This series of slides focusses on the Milankovitch Cycles and their influence on the global temperatures. They, along with other solar forcings (directly and indirectly) have been driving the planet's climate for millions of years, are driving the climate now and will continue to do so in the future.
The slides will also tie-in the different influence that the Milankovitch Cycles have on our two hemispheres. The Northern Hemisphere (NH) is dominated by land mass, the Southern Hemisphere (SH) is dominated by ocean and they do react differently.

Note: The Arctic and Antarctic Temperature data I use in these slides is different from those I have used in the past. That previous data/analysis is still valid. The alternate data used here just gives a different perspective.

In Antarctica, Vostok Ice Core data was replaced with Dome C data. The difference, Vostok data does not show the temperature low at 8,000 years BP (like many of the other ice core data sets from around the continent).

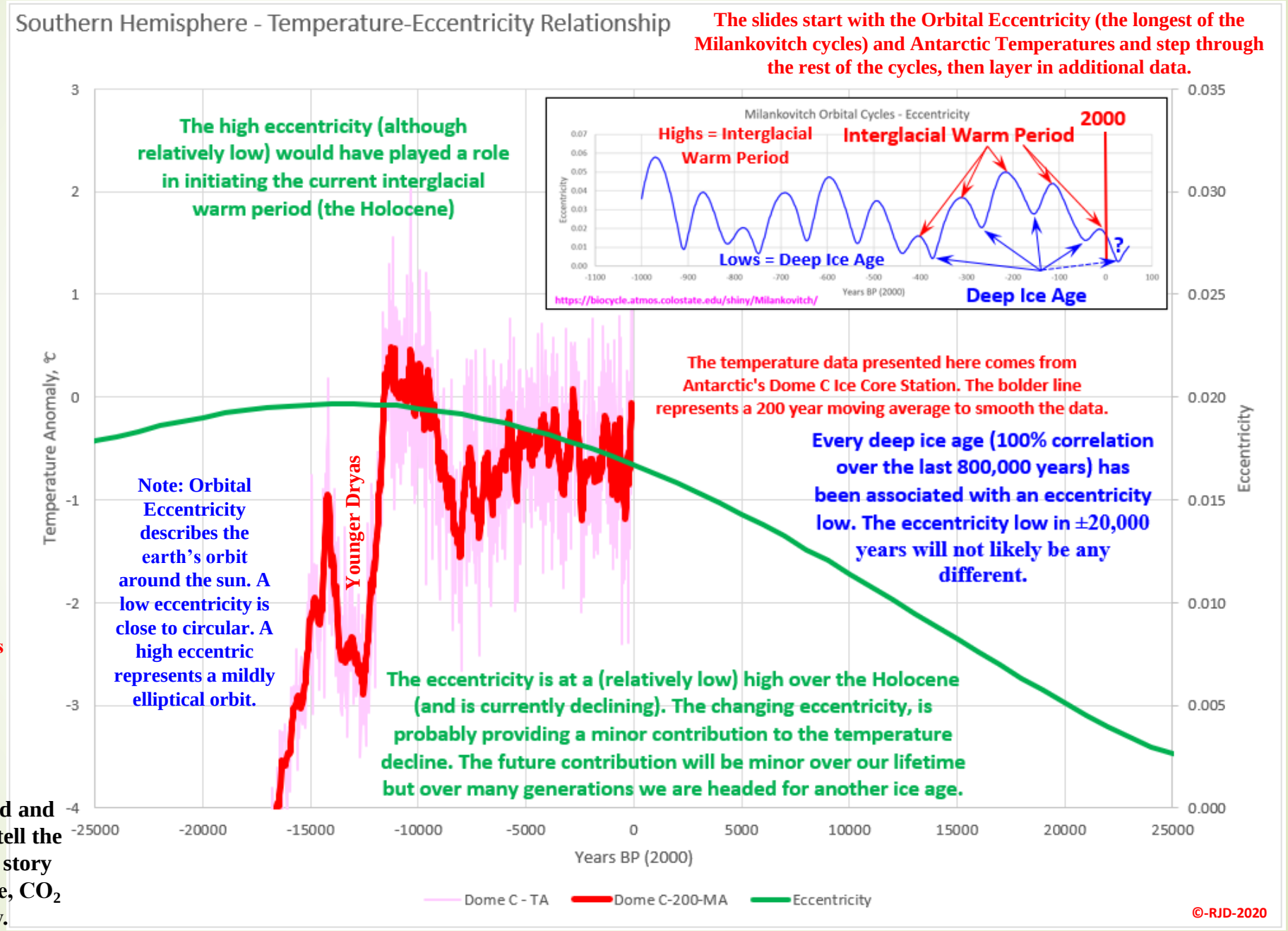
Milankovitch Eccentricity Antarctica

In the Arctic, The Greenland GISP2 temperature data was replaced with Vinther et al's 2009 Arctic temperature (which averages temperatures from a number of Arctic temperature data sets).

The sun, (not CO_2) is the primary climate driver!

Climate Change is complicated and this analysis does not begin to tell the whole story. What part of the story does it highlight? That's simple, CO_2 is "NOT" the whole story.

The slides start with the Orbital Eccentricity (the longest of the Milankovitch cycles) and Antarctic Temperatures and step through the rest of the cycles, then layer in additional data.



My Look at the Solar Forcings over the Holocene - Obliquity

More detail?
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Obliquity Cycle (Axial Tilt)

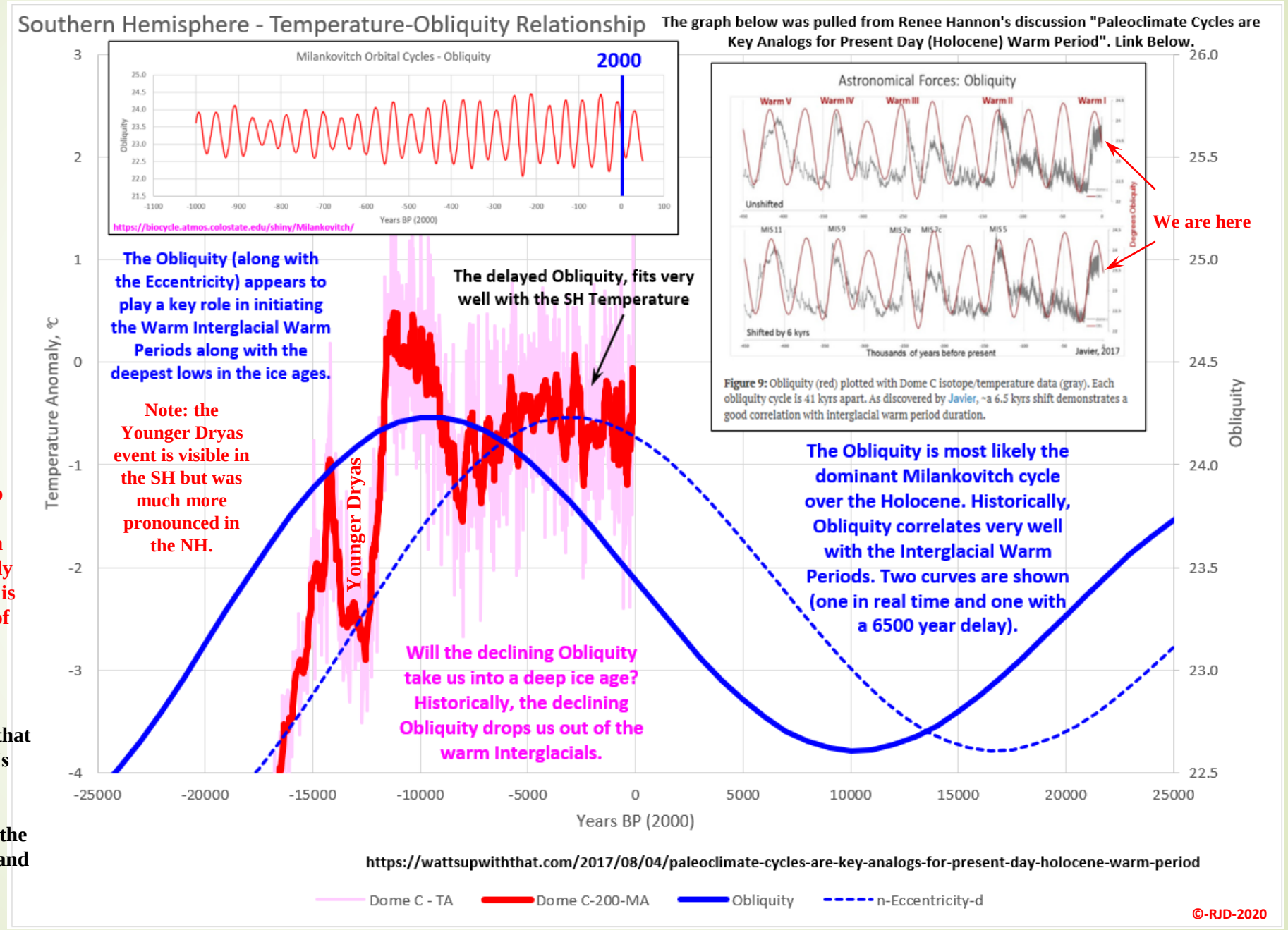
The Obliquity Cycle is the second longest Milankovitch Cycle at roughly 41,000 years. The Obliquity plays a significant role in the planet's climate. The peaks in Obliquity line up very well with the peaks in the Global Temperature (Antarctic Vostok Ice Cores data). That correlation tightens up nicely if a 6,000 year Obliquity delay is overlaid on the global temperature. The interglacial warm periods (like the Holocene we are living through) occur during Obliquity peaks. The deep ice ages and noticeable temperature dips occur during Obliquity lows.
More discussion on this delay can be found in Renee Hannon's discussion on Paleoclimate Cycles (reference and links included).

Milankovitch Obliquity Antarctica

The Obliquity appears to play a significant role in ending interglacial warm periods. And unfortunately for all of us, the Obliquity is headed down regardless of whether the real time or delayed data is used.

Always keep in mind that "Climate Change" is complicated. The Obliquity is very influential but its not the only Climate Driver (and neither is CO_2)

The sun (not CO_2) is the primary climate driver!



My Look at the Solar Forcings over the Holocene - Precession

More detail?
climatechangeandmusic.com

Precession (Axial and Apsidal)

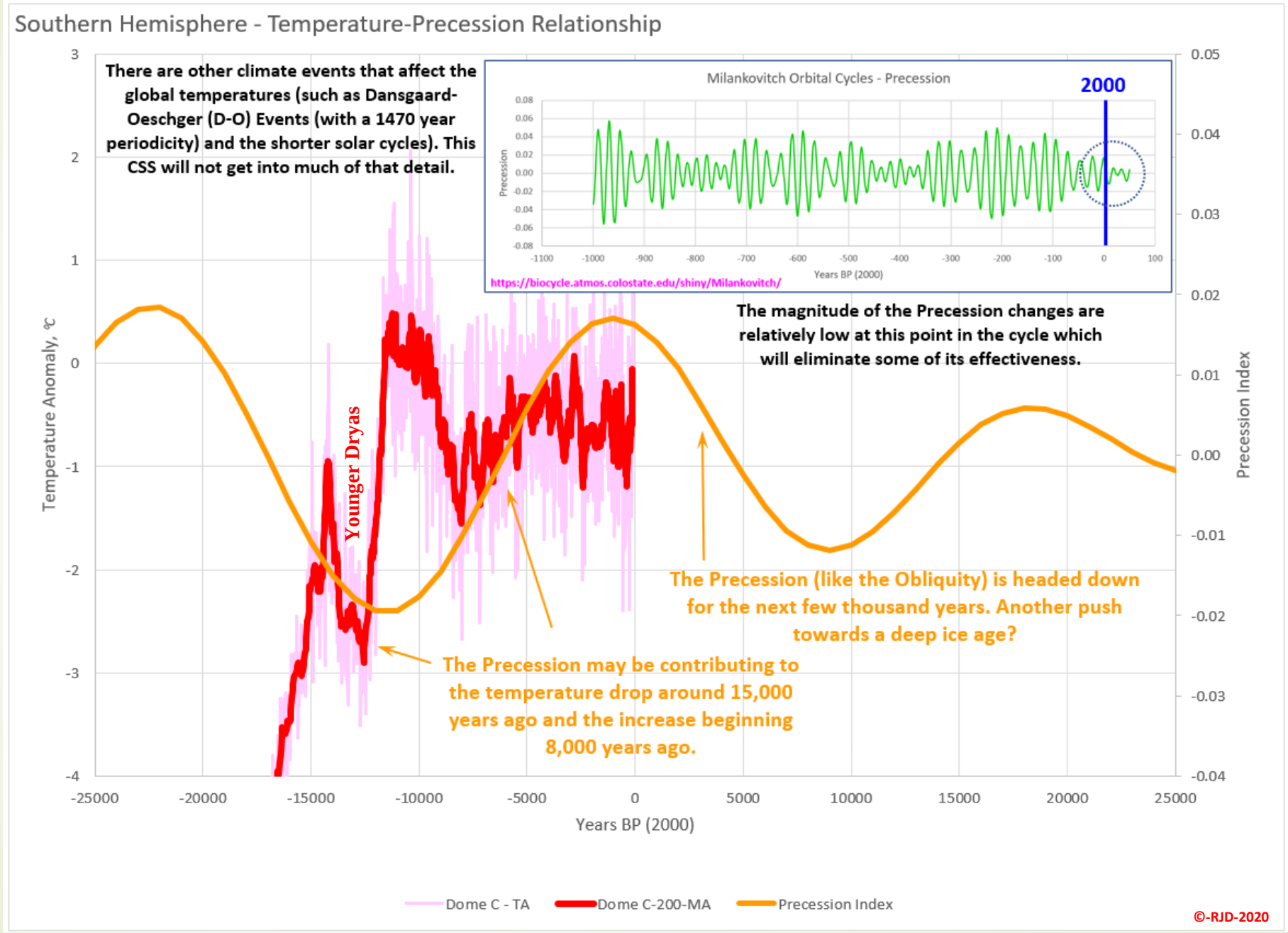
Precession cycles up and down roughly every 23,000 years (based on a combination of the Axial and Apsidal Precession). There are many sites that provide detailed information on Milankovitch cycles. I'm not going to get into that detail.

The Precession's magnitude is somewhat muted compared to historical cycles. That doesn't mean Precession is not playing a role in the planet's climate. The future Precession direction is down and that's not going to help our situation going forward.

Milankovitch Precession Antarctica

When CO_2 molecules absorb the earth's thermal radiation, they re-emit that energy, but they don't re-emit that energy unidirectionally. If the energy radiating out to space isn't changing much, the energy being re-emitted to the atmosphere is also not changing much.

The sun, (not CO_2) is the primary climate driver!



My Look at the Solar Forcings over the Holocene – Insolation 65° North

More detail?
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Insolation (65 ° North)

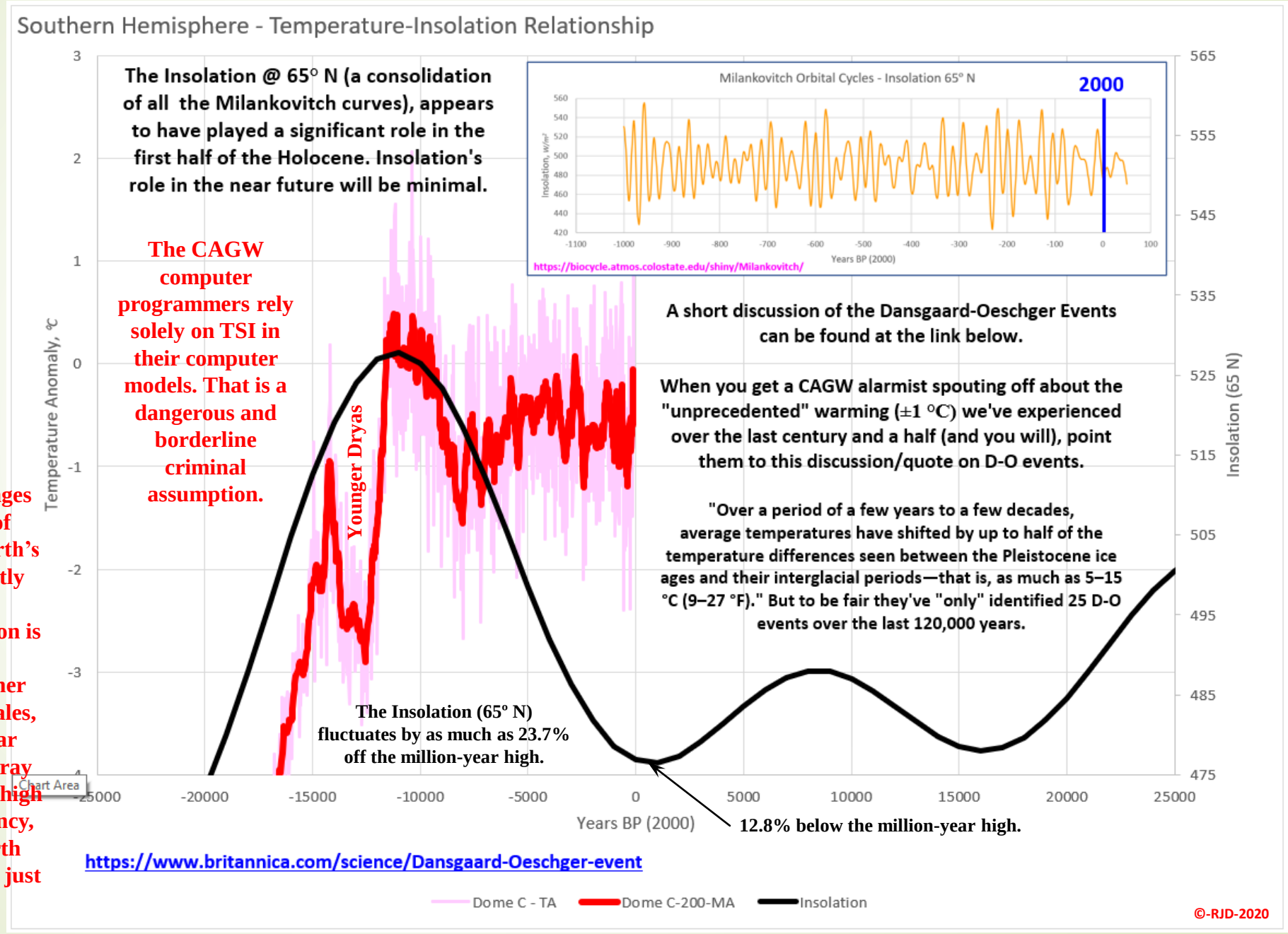
The Insolation at 65° latitude North is derived from the Milankovitch Cycles and plays a key role in the earth's climate. This represents the amount of energy that is reaching the earth's surface at 65° N. That latitude is important because that is where the continental ice sheets develop in the northern hemisphere. We are coming off an Insolation high and are currently 12.8% below the largest Insolation peak over the last one million years.

The Catastrophic Anthropogenic Global Warming (CAGW) alarmist crowd like to portray the solar effects as minimal because the Total Solar Irradiance (TSI) changes are very small.

Despite the small changes in TSI, the amount of energy reaching the earth's surface can vary greatly depending on the circumstances. Insolation is just one of those circumstances. On other short and long-time scales, other factors like solar wind strength, cosmic ray intensity (cloud cover), high energy particle frequency, etc. can affect the earth significantly more than just TSI alone.

Milankovitch Insolation Antarctica

The sun, (not CO_2) is the primary climate driver!



My Look at the Solar Forcings over the Holocene – Milankovitch Cycle Overlay

More detail?
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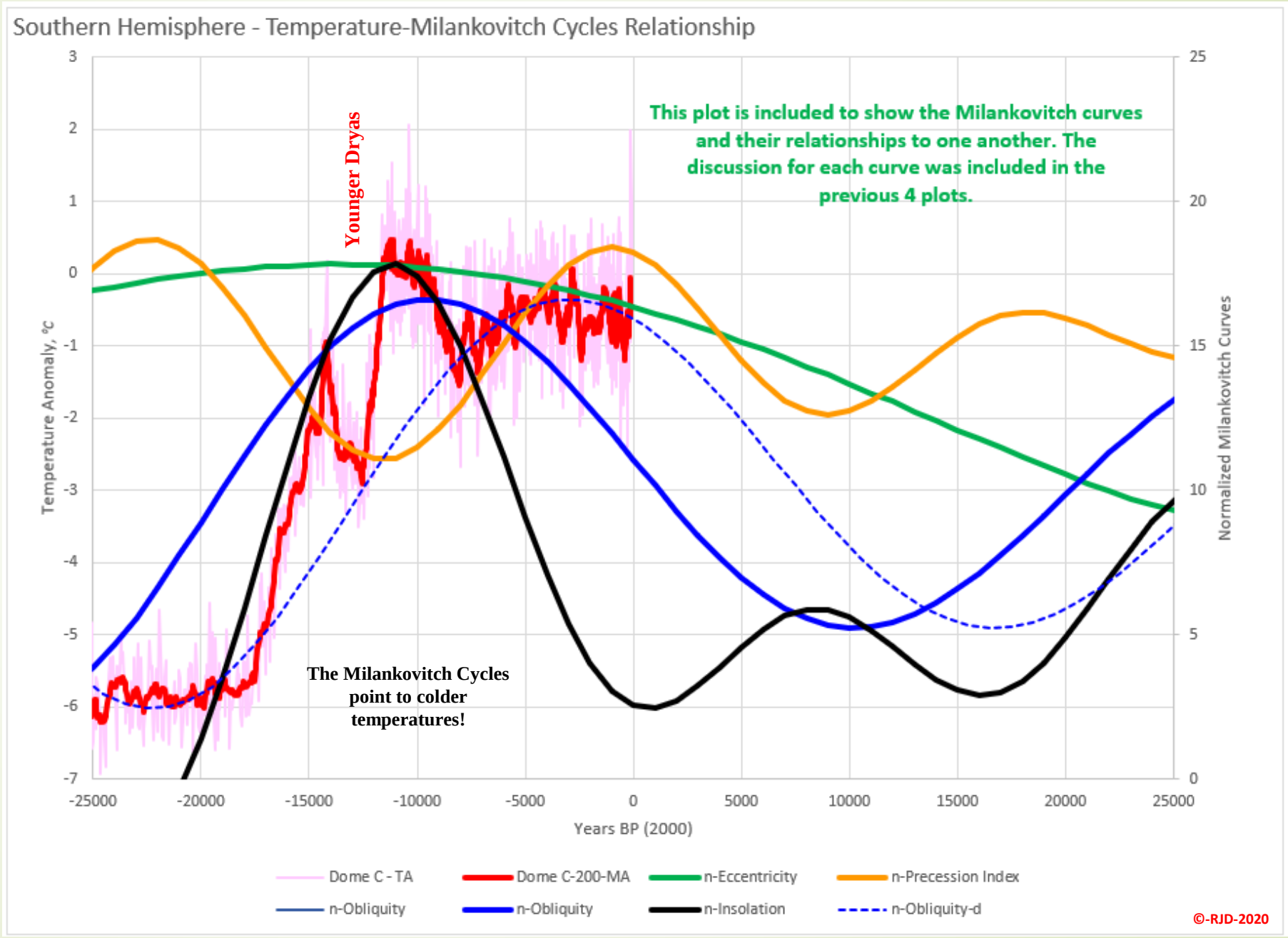
Milankovitch Cycle Overlay

This slide overlays all of the various cycles on one plot. They have all been normalized so that they can be plotted together (i.e.: the plotted values do not represent (directly) the value of each parameter. Go back to the previous slides to see the true values. The temperature and time scales have also been expanded to include the temperatures through the most recent deep ice age.

The individual Milankovitch Cycle influences can be seen in the Antarctica temperature data. The most important take away from this plot is the downward trend in the Eccentricity, the Obliquity (regardless whether the real time or delayed data is used) and the Precession. The Insolation (65° N) is generally flat right now.

Milankovitch Overlay Antarctica

The sun, (not CO_2) is the primary climate driver!



My Look at the Solar Forcings over the Holocene – Milankovitch Cycles - Focussed

More detail?
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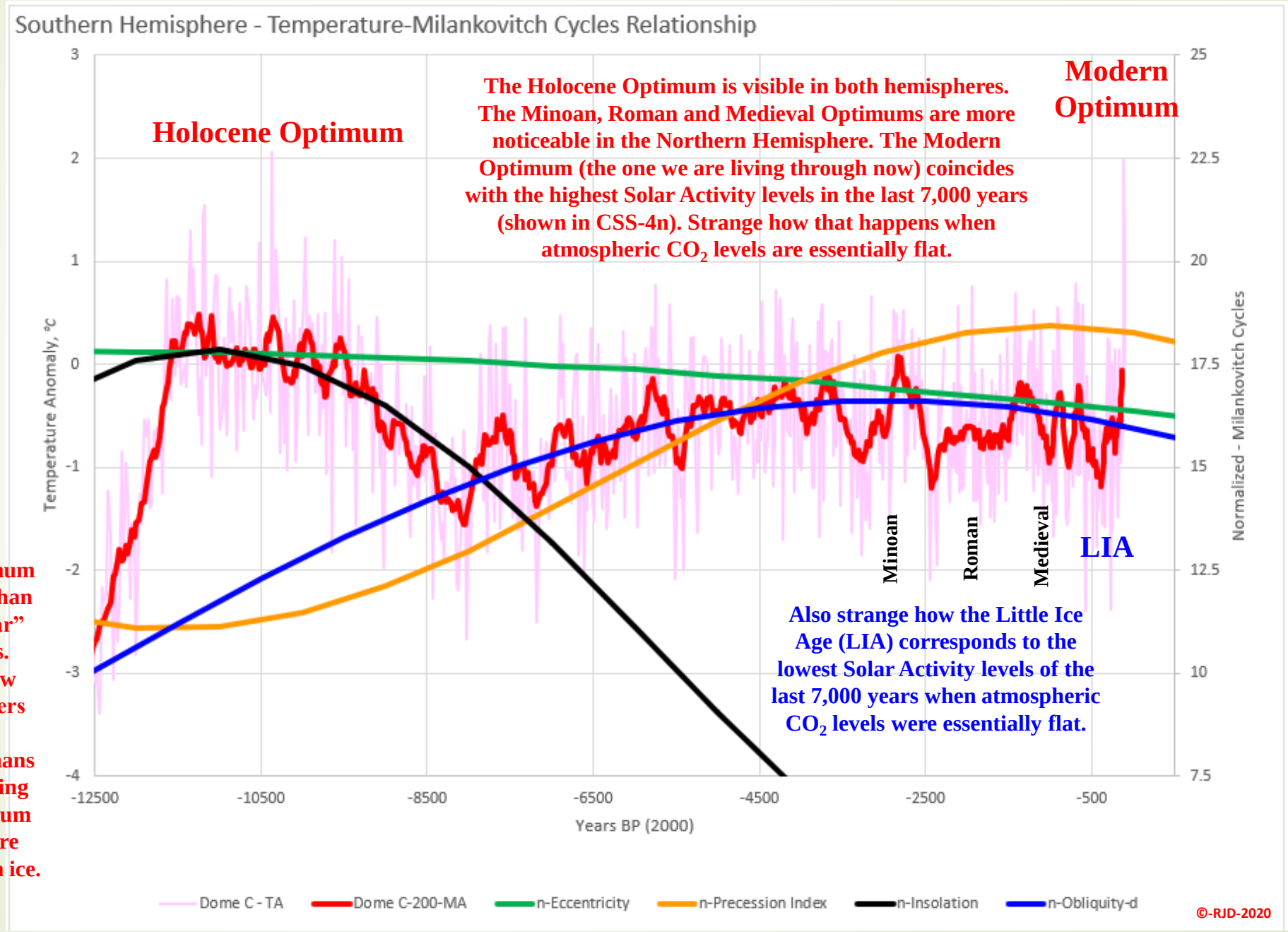
Milankovitch Cycle Overlay

This slide just focusses in on the interglacial warm period to show the temperature in a little more detail. The Eccentricity has been on a shallow but steady decline throughout the Holocene. The real time Obliquity peaked during the Holocene Optimum (not shown here, refer back to CSS-4b). The delayed Obliquity peaked around 3,000 years ago and has begun its decline (which will accelerate over the next few millennia). The Precession peaked around 1,000 years ago and is beginning its descent. The Insolation (65° N) also peaked during the Holocene Optimum and may be responsible for the temperature low at 8,000 years BP. The Obliquity (delayed) and Precession may have combined to reverse the Insolation (65° N) induced temperature decline.

Milankovitch Focussed Overlay Antarctica

The Holocene Optimum was much warmer than today's "hottest year" ever temperatures. Mature forests grew where today's glaciers are receding and exposing them. Humans inhabited areas during the Holocene Optimum that are now or were recently covered with ice.

The sun, (not CO_2) is the primary climate driver!



CSS-4g

My Look at the Solar Forcings over the Holocene – Primary Responsibility

More detail?
climatechangeandmusic.com

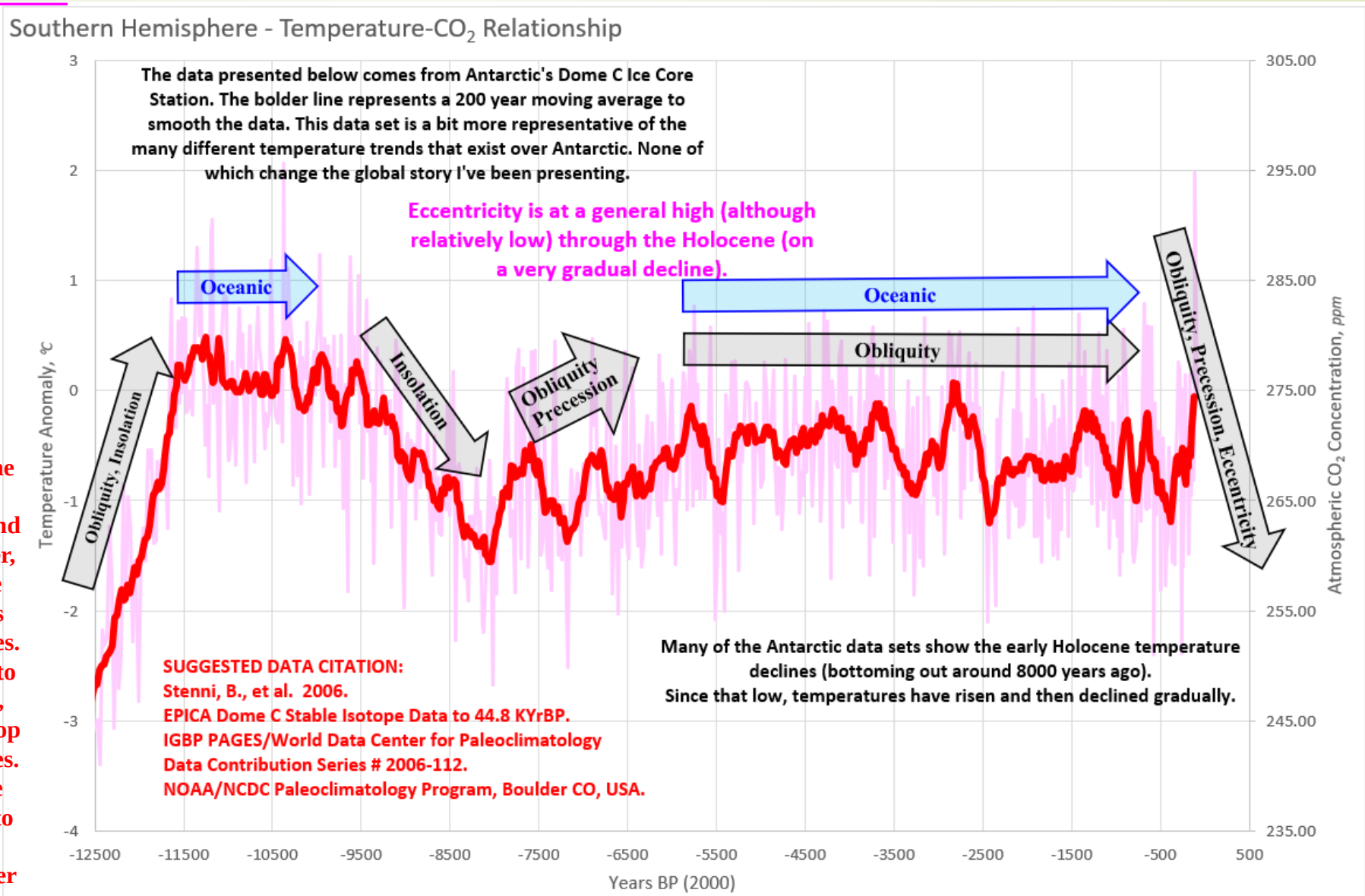
A Quantitative Look at the Temperature Drivers

This slide drops the various Milankovitch curves and lays out the general temperature drivers using word descriptors. The Milankovitch Cycle drivers are shown in grey, the Oceanic Cycles in blue. The Oceanic Cycles are discussed in Renee Hannon's Paleoclimate Cycle discussion (referenced earlier in CSS-4b and linked below in blue). During the flatter temperature periods, ocean processes are dominating, giving the shorter and lower magnitude temperature changes (that are also present when Milankovitch Cycles are dominating).

The concern again is the continued decline in Obliquity, Precession and Eccentricity. Remember, cold temperatures are much more dangerous than warm temperatures. CO_2, although it helps to warm the atmosphere, will not be enough to stop the temperature declines. The shorter time scale solar cycles also point to lower temperatures (refer to my Open Letter and OPS-21).

Milankovitch Responsibility Antarctica

The sun, (not CO_2) is the primary climate driver!



https://wattsupwiththat.com/2017/08/04/paleoclimate-cycles-are-key-analogs-for-present-day-holocene-warm-period

We should not be ignoring the SUN!!!

My Look at the Solar Forcings over the Holocene – Antarctic Temperature/CO_2

More detail?
climatechangeandmusic.com

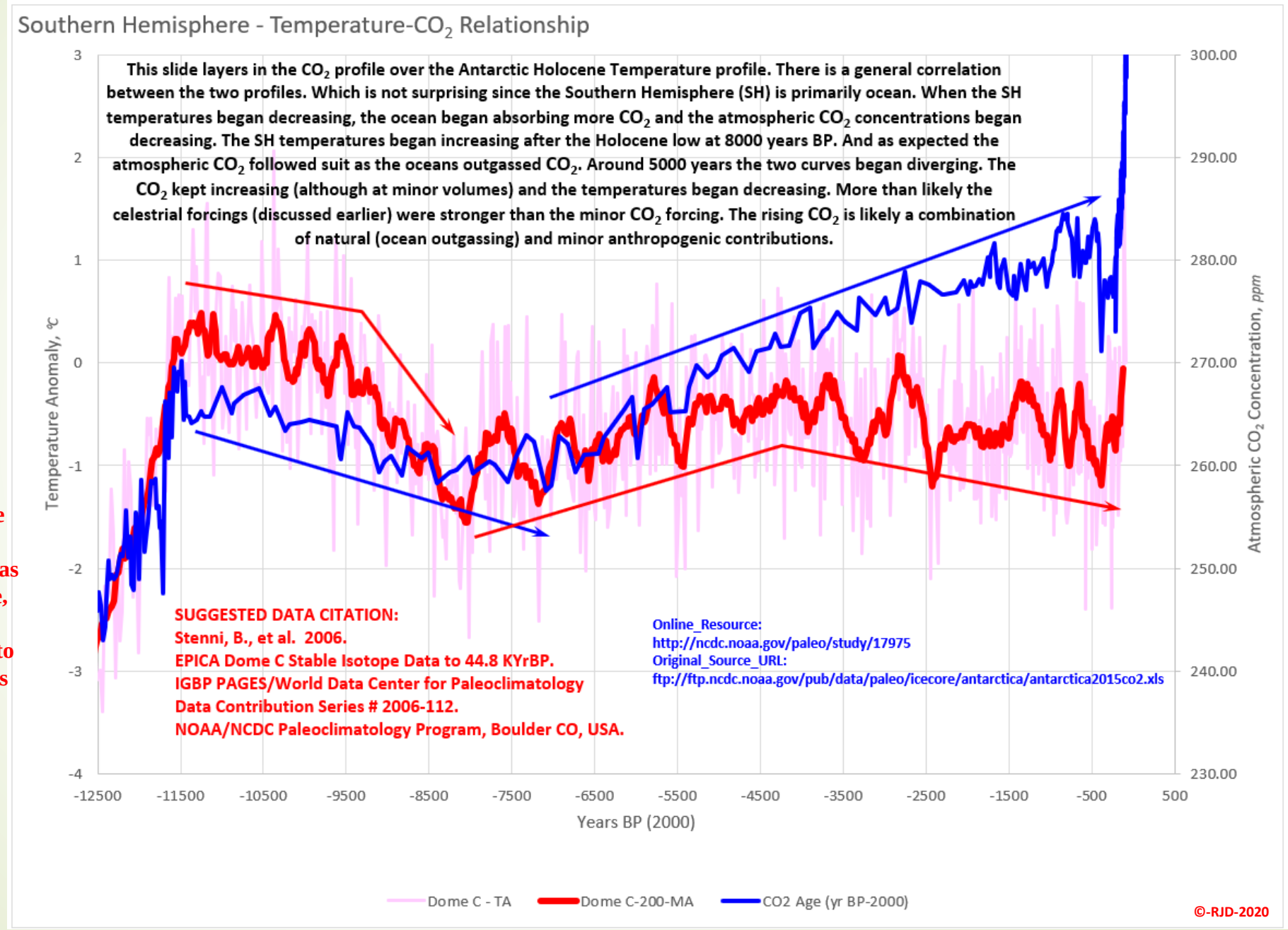
Bringing CO_2 into the Discussion

This slide begins to address atmospheric CO_2 levels. Over the Holocene, CO_2 levels do correlate to the Dome C temperatures (to some degree). A couple of key points need to be addressed here. Firstly, the CO_2 level changes are greatly exaggerated by the scales that are used. The natural (solar) cycles are driving the temperature changes. And like the last million years, the solar induced temperature changes are driving the CO_2 changes. Additional discussion has been included on the graph.

Holocene Temperature/CO_2 Antarctica

The CO_2-Temperature correlation in the Northern Hemisphere (as shown in the next slide, CSS-4i) is a reverse correlation. The Land to Ocean ratio differences lead to the different correlations.

The sun, (not CO_2) is the primary climate driver!



My Look at the Solar Forcings over the Holocene – Arctic Temperature-CO_2

More detail?
climatechangeandmusic.com

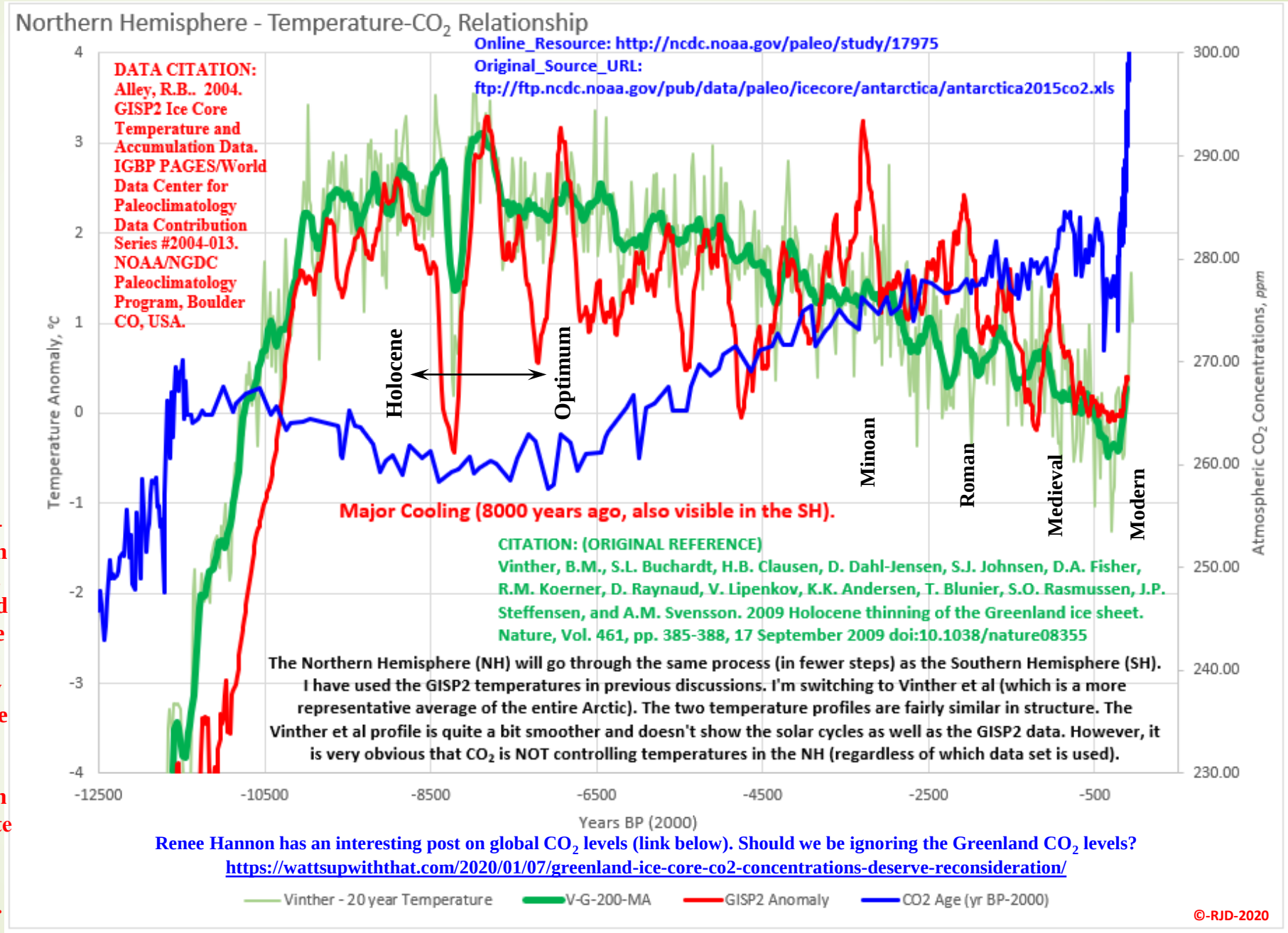
Switching the Discussion to the Arctic

This slide will shift the discussion to the Northern Hemisphere (NH) to develop a more global twist to the discussion. I've plotted both the Greenland GISP2 temperature data (Alley et al, 2004) and the Arctic temperature data (Vinther et al, 2009). The general profile is the same for both data sets. The Vinther et al data is smoother due to the data averaging and multiple data sources. I've retained the GISP2 data to show that small changes in natural (solar/oceanic) cycles can still cause major changes in global temperatures. Those natural processes did not shut off just because the CAGW alarmist (IPCC et al) computer programmers have decreed it to be so!!!

Holocene Temperature/CO_2 Arctic

As mentioned in the previous slide, the CO_2-Temperature correlation is a reverse correlation. Having said that I would like to point out that the Antarctic CO_2 levels (used here) are the only readily available ice core data set. There is data available in Greenland cores but they have been put aside (by the "climate change" community) since they don't agree with the Antarctic data.

The sun, (not CO_2) is the primary climate driver!



Renee Hannon has an interesting post on global CO_2 levels (link below). Should we be ignoring the Greenland CO_2 levels?
https://wattsupwiththat.com/2020/01/07/greenland-ice-core-co2-concentrations-deserve-reconsideration/

My Look at the Solar Forcings over the Holocene – NH-SH Temp/CO_2

More detail?
climatechangeandmusic.com

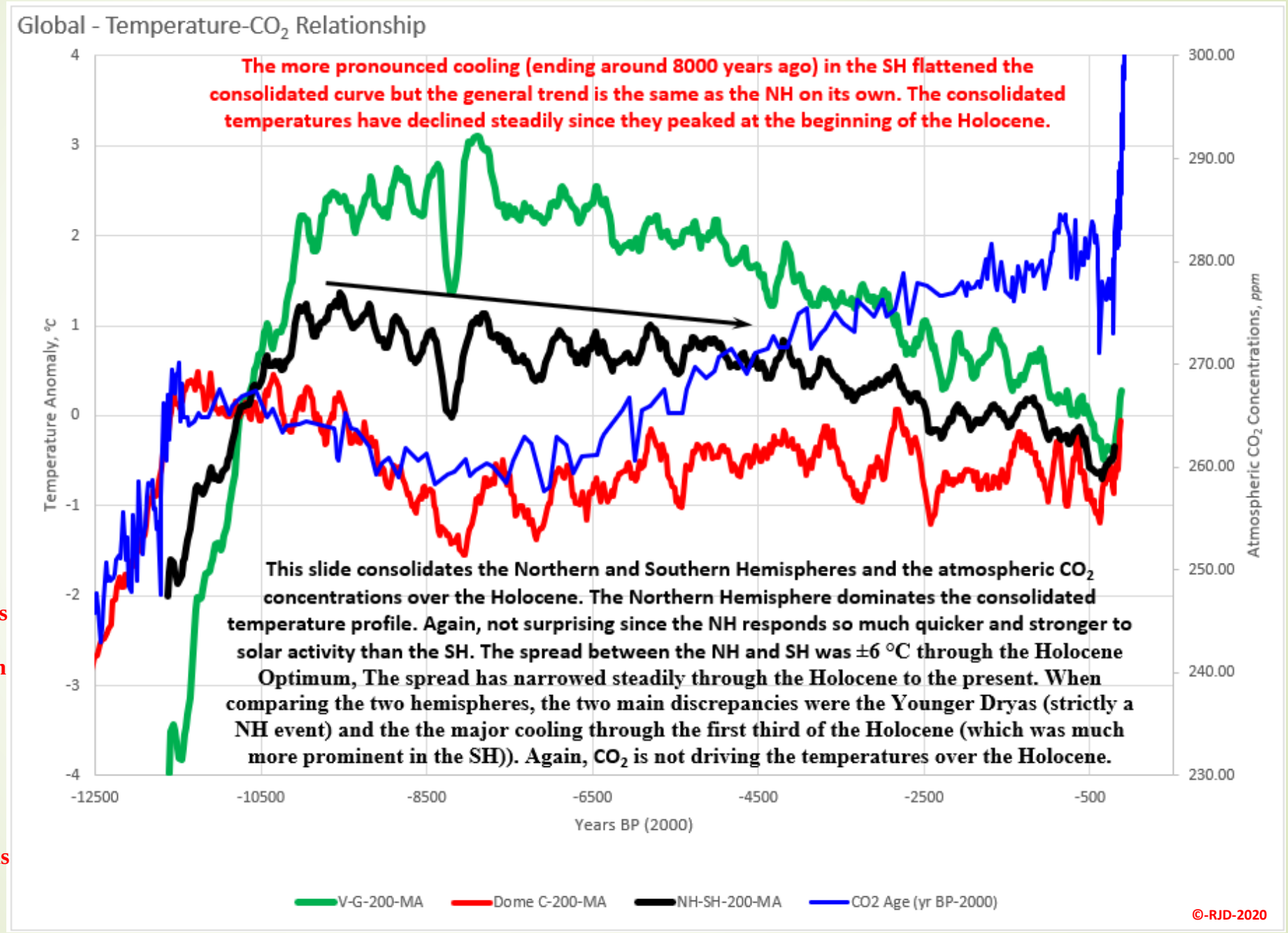
Tying the NH and SH Together

This slide produces the Global Temperature curve that I will use for the rest of this Holocene CSS. Averaging the Northern and Southern Hemispheres gives us the middle black curve, with a general profile that is similar to the NH temperature profile. Not surprising since the NH has much more dominant temperature changes than the SH. Note, the SH has significantly more ocean surface area. The heat goes into the ocean and can be tied up there for centuries/millennia. The temperature anomaly in the NH is much higher because land surface heats up with higher solar energy but quickly releases that energy (night versus day). The NH temperature anomaly is obviously going to be higher going from bare land (interglacial warm period) to ice covered land (deep ice age) versus the SH temperature anomaly where you go from cold ice to colder ice.

Holocene Arctic and Antarctica

As shown in the previous slide, the NH CO_2-Temperature correlation is a reverse correlation. Given that the NH dominates the Global Temperature anomaly profile, the correlation for the Global Temperature-CO_2 data is also a reverse correlation.

The sun, (not CO_2) is the primary climate driver!



My Look at the Solar Forcings over the Holocene – Arctic – Milankovitch Overlay

More detail?
climatechangeandmusic.com

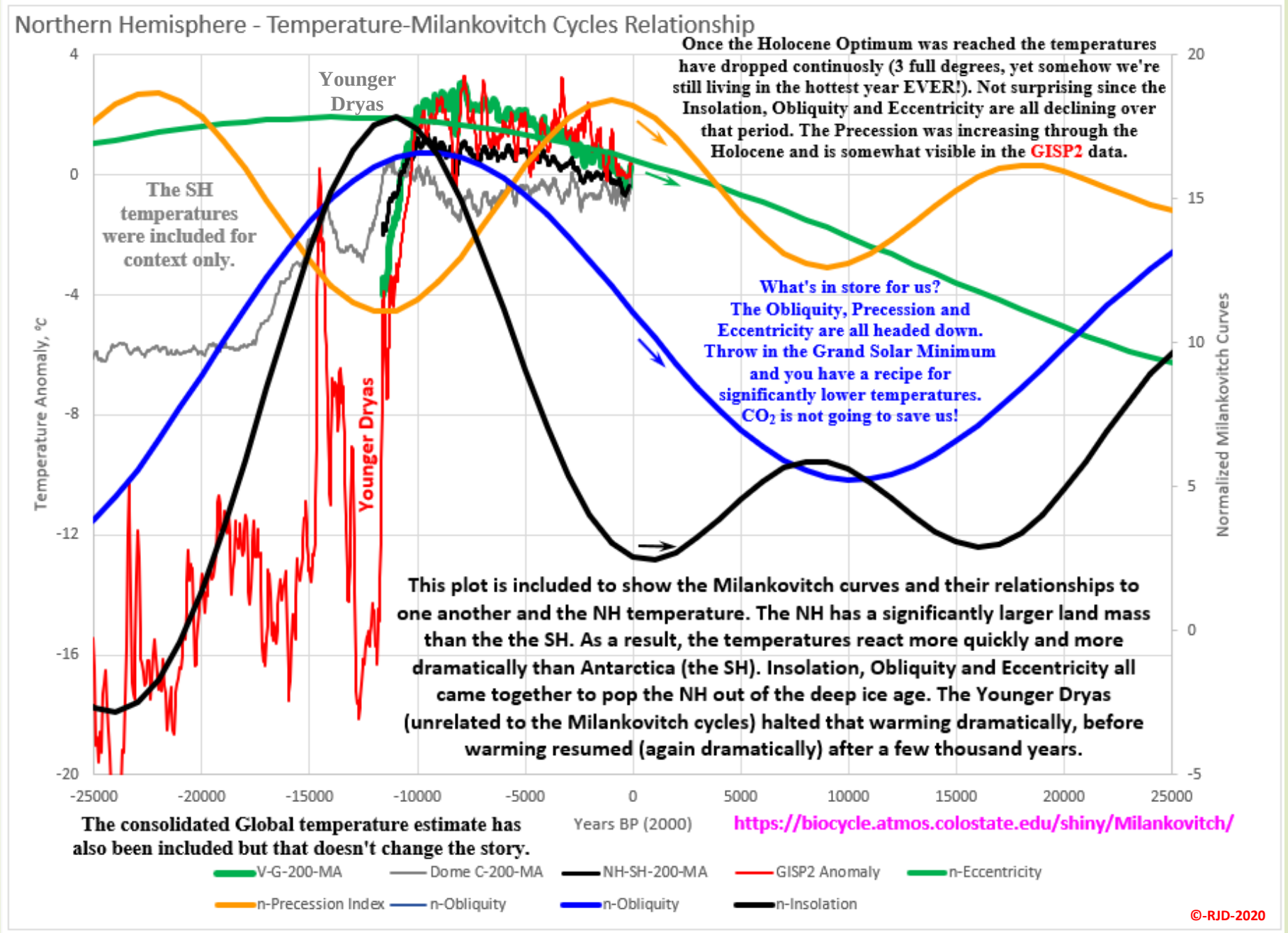
Arctic et al Milankovitch Overlay

This slide is somewhat complicated and could be broken out as I did with the Antarctic data. The Eccentricity peaked during the Younger Dryas and has declined steadily along with the Arctic temperatures. The Insolation (65° N) peaked right at the end of the Younger Dryas and has also declined steadily with the Arctic temperatures. The Obliquity peaked during the early Holocene Optimum and has been declining steadily with the Arctic temperatures. With a delayed Obliquity the peak would have been at the end of the Holocene Optimum. Good thing the Precession was increasing throughout the Holocene or we (in Calgary) may have been living under a mile or two of ice by now!

Milankovitch Overlay Arctic

The sun, (not CO_2) is the primary climate driver!

Again the correlations aren't perfect, but CO_2 is not responsible for the 3 °C NH (or the 1 °C SH) temperature drop over the Holocene (unless you believe that rising CO_2 is responsible for declining temperatures).



My Look at the Solar Forcings over the Holocene – Global Average Temperature/CO_2

More detail?
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Global Average Temperature/CO_2

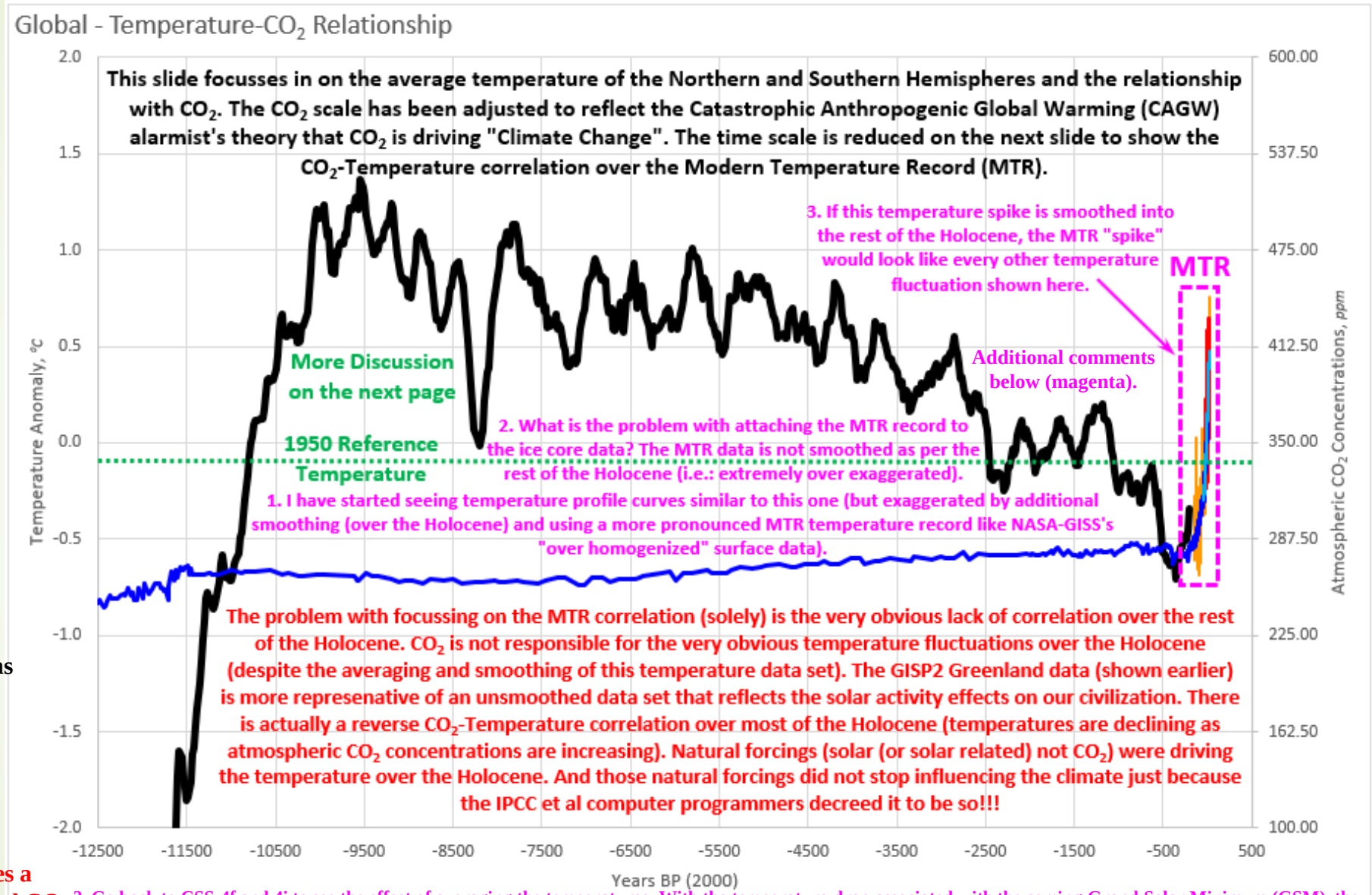
This slide lays the CO_2 plot (Modern Temperature Record (MTR) data included) over the Global Average Temperature. The CO_2 rise (over the MTR) is correlated to the MTR temperature rise based on the Catastrophic Anthropogenic Global Warming (CAGW) alarmist viewpoint that the MTR temperature rise is due almost entirely to human activity (as laid out in the IPCC computer programming OPS-22). As in my Holocene analysis using just GISP2 data (OPS-26 & 27 and CSS-1 & 2), natural processes are the dominant temperature driver in the Global Average Temperature. CO_2 is not responsible for any of the pre-MTR temperature fluctuations.

Is there any reason to believe that the MTR spike has no natural (solar) component?
NO, there is a solar component!!!

Holocene Temperature/CO_2 Global Average

Is there any reason to believe that future temperature fluctuations will have no natural (solar) component?
NO, there is a solar component, we should not be ignoring!!!!

The sun, (not CO_2) is the primary climate driver!



The MTR temperature includes a combination of solar (pre-1950) and CO_2 (post 1950, 80%+ of human emissions were post 1950). There was also ocean cycle contribution post-1950 (refer to my Open Letter Addendum). Natural (Solar) forces will be much more important and dangerous than CO_2 in the future!!!

3. Go back to CSS-4f and 4i to see the effect of averaging the temperatures. With the temperature drop associated with the coming Grand Solar Minimum (GSM), the MTR temperature spike could be unnoticeable on the Holocene time scale. There are many temperature spikes similar to the MTR that do not show up in the average data. The best examples occur at -1600 and -2040 BP where the spike is followed immediately by a comparable temperature drop (i.e.: GSM).

My Look at the Solar Forcings over the Holocene – MTR Activity

More detail?
climatechangeandmusic.com

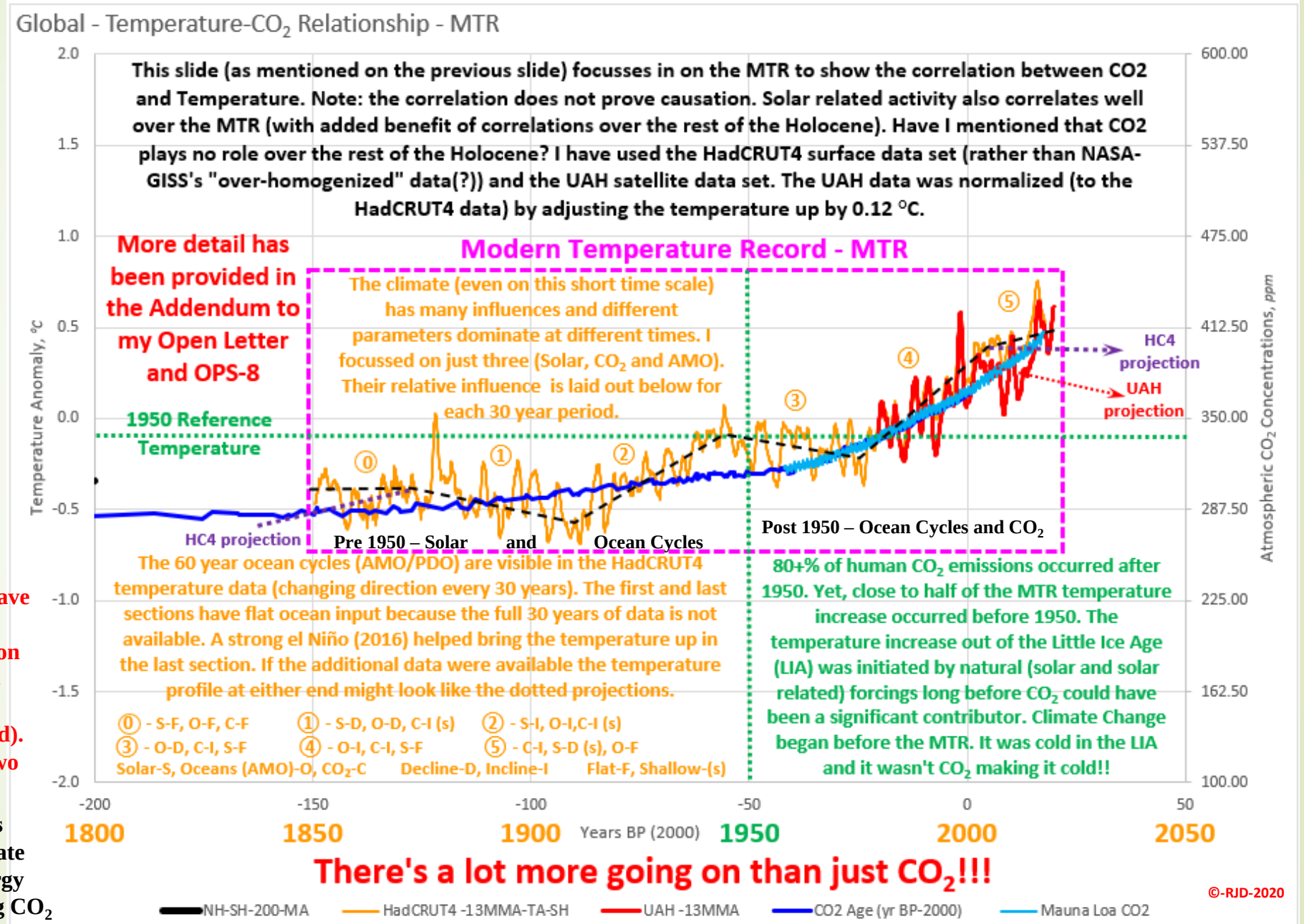
Modern Temperature Record Activity

This slide focusses in on the Modern Temperature Record (MTR). Obviously, the detail gets lost on the Holocene time scale. Additional discussion on the MTR period has been included in my other Holocene discussions (OPS-26 & 27 and CSS-1 & 2). As with everything in "Climate Science", it's complicated. To simplify this plot, pre-1950 was dominated by solar activity and ocean cycles (an indirect solar forcing). Post 1950 was a combination of Ocean Cycles and CO_2. The CO_2 contribution is subject to CO_2's climate sensitivity. And that subject (a very important one) is not settled science. CO_2 could be responsible for roughly 40% of the MTR warming (significant but not dangerous) based on its theoretical heating capacity (Transient Climate Response (TCR) of roughly 1 °C per CO_2 doubling).

MTR Activity Global Average

Conversely, CO_2 may have negligible warming capacity if its absorption band is saturated (as many very qualified scientists have proposed). CSS-3 looks at these two scenarios.

The sun, (not CO_2) is the primary climate driver!



The University of Chicago's MODTRAN model can simulate satellite measured global energy emissions very accurately. Rising CO_2 at current levels (400 ppm) has very little effect on the energy being radiated back to space. CO_2 was very effective at levels below 100 ppm (just not now).

My Look at the Solar Forcings over the Holocene – TSI Overlay

More detail?
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Total Solar Irradiance (TSI) Overlay

Layering the solar activity on the global average temperature has some interesting implications. The lowest solar activity over the last 7,000 years occurs in conjunction with the Little Ice Age and the highest solar activity in the last 7,000 years occurs in conjunction with the MTR temperature spike (the current Modern Optimum).

Is CO_2 driving the Holocene temperatures? NO!!!

Is Solar activity driving the temperature over the Holocene?

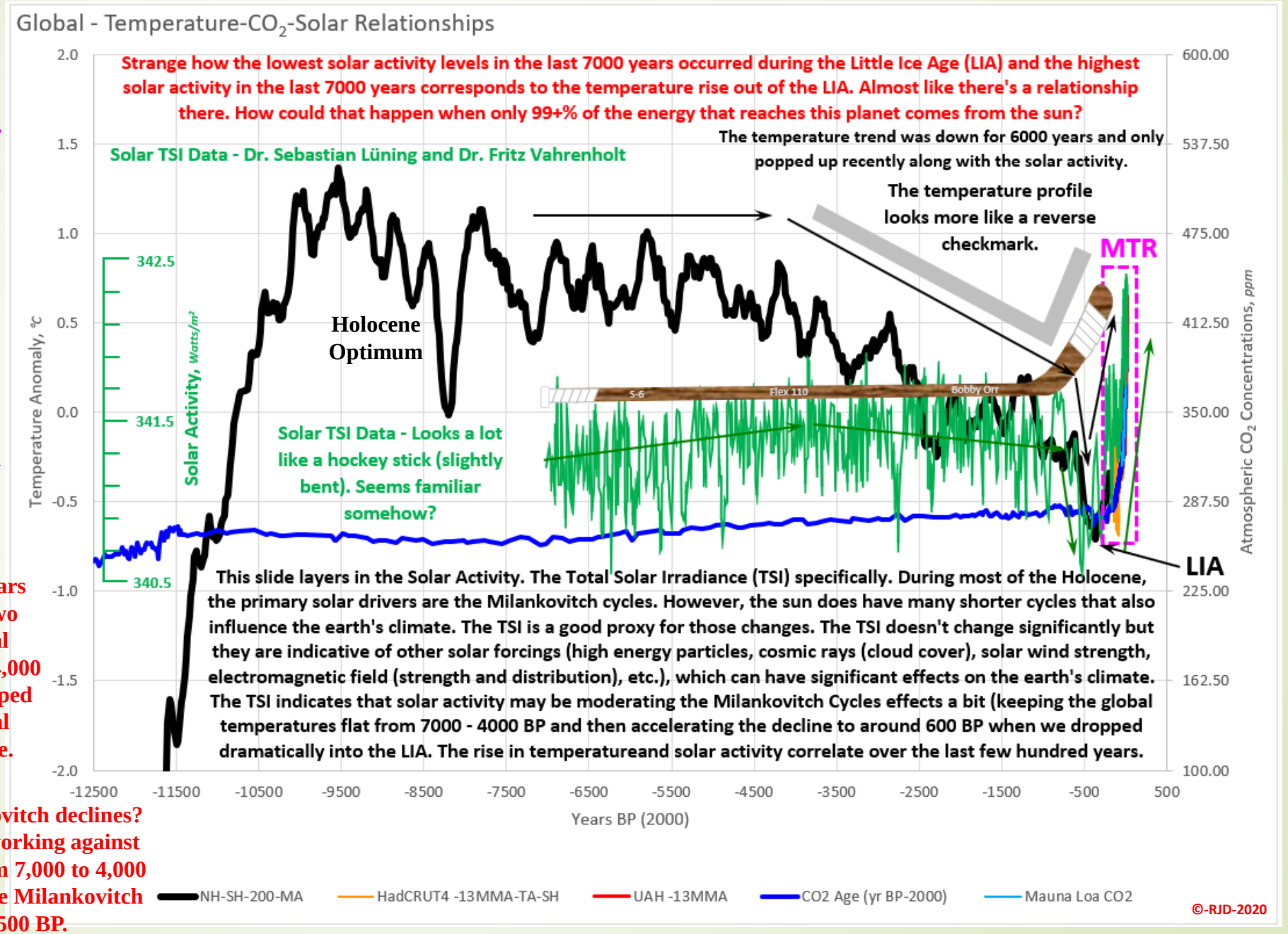
Yes but it is a combination of many factors. The Milankovitch Cycles are acting throughout the Holocene and have been taking the temperatures down steadily from the Holocene Optimum. The TSI (as a proxy) has been very active in the last 500 years or so (giving us the LIA (cold) and Modern Solar Maximum (warming)).

Holocene Solar Overlay Arctic

The previous 6,500 years can be divided into two sections. The gradual increase from 7,000 to 4,000 years BP may have helped flatten out the Global Average Temperature.

The sun, (not CO_2) is the primary climate driver!

Did the TSI arrest the Milankovitch declines? Hard to say, but the sun was working against the Milankovitch forcings (from 7,000 to 4,000 years BP) and working with the Milankovitch forcings from 4,000 to 500 BP.



CSS-4o

My Look at the Solar Forcings over the Holocene – Sliding into the Deep Ice Age

More detail?
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Are We Headed for a Deep Ice Age?

For the last 6,000 years the temperatures have been headed down (as per the Milankovitch Cycles). That is not changing despite the rhetoric put out by the CAGW alarmist crowd. The planet will definitely end up in deep ice age soon enough. Let's hope that layering on the Grand Solar Minimum (GSM) does not push us over the edge and into that deep ice age. Any contribution from CO_2 warming will help but won't stop the global cooling that has already been initiated (Milankovitch cooling) and is currently accelerating (with the onset of the current GSM).

Temperature Slide Into A Deep Ice Age?

The temperature drops associated with GSMs have been devastating for humanity and there is no reason to believe that the current GSM will be any different. You don't have to look much further than the current weekly forecast (for North America and Australia). We are in for brutal/record cold and snow that will affect crop yield. And we're just starting the drop into the GSM.

The sun, (not CO_2) is the primary climate driver!

Adapt 2030 Video (09/06/20) : https://youtu.be/3eKMhDgnU_g

My Look at the Solar Forcings over the Holocene – Shorter Cycle Influence

More detail?
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Looking at the Shorter Cycles

This CSS was set up to look at the long term cycles (focussed on the Milankovitch Cycles). We don't actually live on those time scales. The shorter term cycles were touched on but not dealt with in much detail. The GSM (sorry, not CO_2) will be the most important "Climate" event in our near future (1 to 2 decades). Solar activity has been the primary climate driver throughout this planet's existence and that is not changing in the future. CO_2 has a role but it's small and ultimately unimportant.

And to underline that statement and bring this discussion back to our time scale, I've included this plot from my Open Letter. I expanded on that plot in my Open Letter Addendum and OPS-8.

Shorter Cycle Influence

The plot clearly shows that CO_2 is not the primary climate driver over our and our recent ancestor's lives. CO_2 is likely contributing to the warming post-1950 (even though temperatures have not been continuously rising since 1950).

CO_2 increases lead to higher (but not dangerous) temperatures!!!

To close, I'm still waiting for anyone (scientist or not) to provide any empirical proof that realistic CO_2 increases can lead to dangerous temperature levels and any empirical temperature/CO_2 data set that shows CO_2 driving the climate on any statistically significant historical time scale.

Computer Models and/or Unvalidated Theories are not proof!!!