# CSS-10a $CO_2$/Temperature – Cenozoic - Summary

More detail? climatechangeandmusic.com

I am starting this Climate Short Story (CSS) with the (spoiler alert) main take away. This plot summarizes the Cenozoic climate patterns fairly succinctly (more detail in further slides). The dominant features of this plot are outlined below.

1. The Cenozoic is roughly divided into six stable climate platforms typified by relatively stable temperatures despite wide ranges of $CO_2$ (FECKLESS indeed).
2. The platforms are separated by a variety of geological and catastrophic events that appear to initiate/transition the climate to the new platforms (celestial impacts, major volcanic intrusions, major oceanic current disruptions (whether new or shutting down).
3. The cooling from the Eocene Climate Optimum (Hothouse) to the Pleistocene Deep Ice Age (Coldhouse) is correlated directly to the rising Cosmic Ray Flux that underpins the general cooling.

**QUICK SUMMARY**

$CO_2$ is not playing a major role and is likely rising and falling with the changes in the detailed global temperatures. The main drivers are the major geological and catastrophic events combined with the continuous natural cooling associated with increasing cosmic ray flux.

1.3 Reference Bar Discussion (next page)- Virtually all $\delta C_{13}/CO_2$ is within the range of historical temperature influence throughout the Cenozoic.

Apart from $CO_2$ being a FECKLESS GreenHouse Gas (CSS-7), the historical information does not provide a lot of information that helps us predict our climate future. $CO_2$ is rising and will exert a warming effect (magnitude (?)). So, what parameters might push cooling?

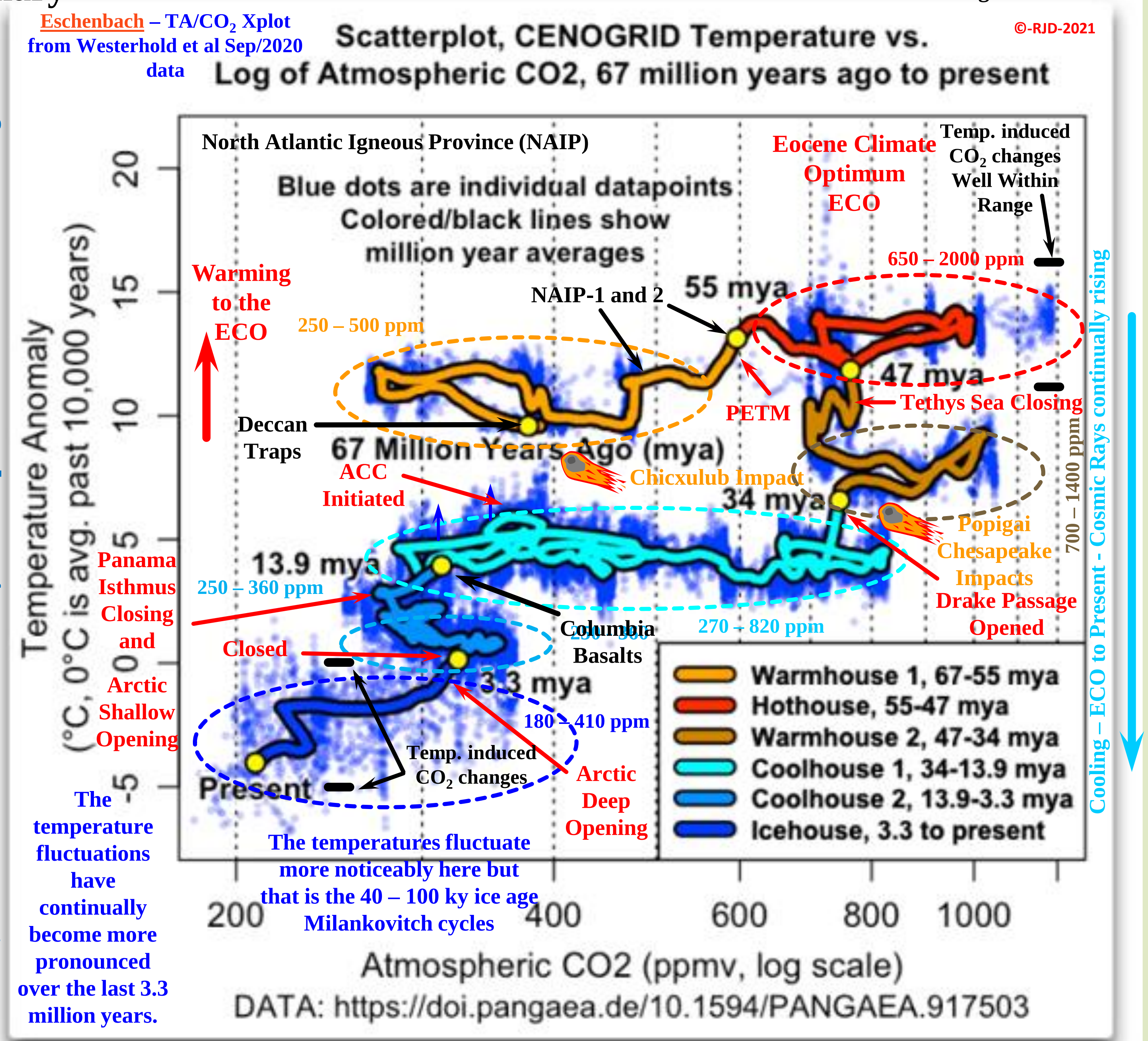
1. Milankovitch Cycles (eccentricity, obliquity and precession all headed cooler, Insolation, slightly cooler).
2. Ocean Cycles (AMO – cooling, PDO – cooling, ENSO – cooling)
3. Solar Activity (TSI decreasing and accelerating as we move further into the Modern GSM).
4. Volcanic Activity (increasing aerosols (i.e.: cooling), typical in GSMs)
5. Possible near-term catastrophic events (Beaufort Gyre release, lower latitude ice migration, solar micro-nova, Bill Gates geo-engineering)

**$CO_2$/Temperature Cenozoic**

3-4: Panama Isthmus, Arctic Deep
13-17: Panama Volcanics, Columbia Basalts, Glaciation, Arctic Shallow
30-40: Chesapeake, Popigai Impacts, Ethiopian Volcanics, Glaciation
34-47: Tethys Sea closing
54-56: NAIP-P2, PETM
58-62: NAIP-P1
66-67: Deccan Traps, Chicxulub Impact

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

But sure, we need to worry about $CO_2$, a, non-toxic, essential to life, trace gas!!



# CSS-10b $CO_2$/Temperature – Cenozoic

**1.3** Reference Bars - $\delta C_{13} \equiv C_{13}/C_{12}$ = 1.3 (carried throughout the CSS)

That $\delta C_{13}$ value represents the fluctuation that temperature causes in $\delta C_{13}/CO_2$ over the most recent million years. $\delta C_{13}$ through most of the Cenozoic fall within that range suggesting that the $\delta C_{13}/CO_2$ changes are driven by temperature (not the other way around).

More detail? climatechangeandmusic.com

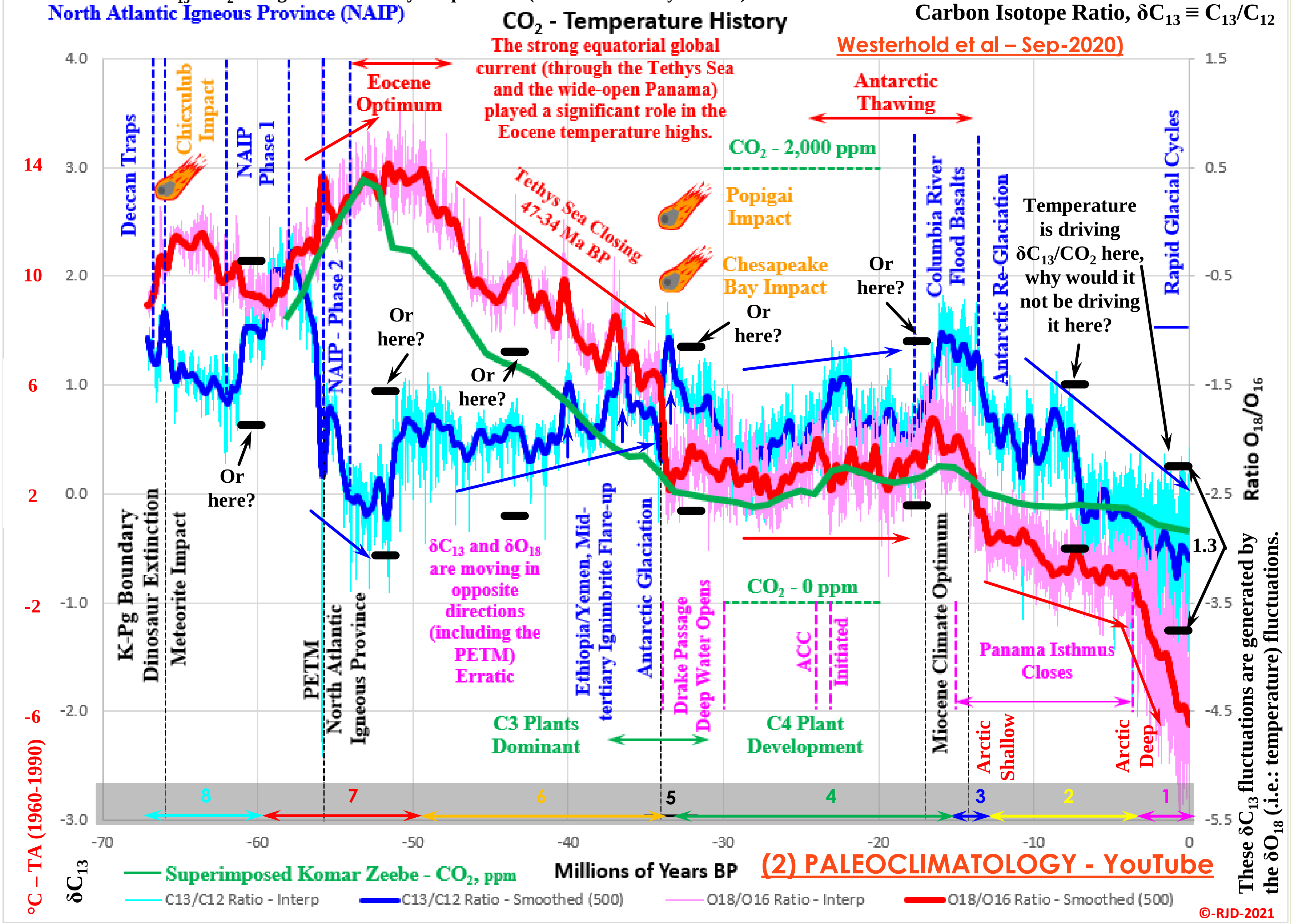
Oxygen Isotope Ratio, $\delta O_{18} \equiv O_{18}/O_{16}$

This slide highlights the relationship between $\delta C_{13}$ and $\delta O_{18}$ (Temperature) over a long period that catches the end of the Cretaceous (where the dinosaurs were wiped out by a large celestial body) and covers the many significant climate transitions up to the present. $\delta C_{13}$ and $\delta O_{18}$ (Temperature) are generally moving counter to one another during the 5, 6, 7 and 8 time periods. During Period 1, 2, 3 and 4 they are moving in the same general direction (up and down), but with different slopes/relationships. This period covers a wide variety of climatic environments. From the cyclic deep freezes during the Pleistocene and the essentially ice-free world of Eocene/Cretaceous. As with every other historical time period, $CO_2$ is not driving the climate on this historical time scale. There appears to be a break around the time the Antarctic froze over, 34 million years ago. Prior to that time, the $\delta C_{13}$ moved in opposite directions to the $\delta O_{18}$ (Temperatures) and then moves in the same direction post-glaciation. Why is there a change at 34 million years? The biggest change is the Antarctic glaciation. Was that changing ocean currents, continent interactions, ocean-atmosphere interactions, etc. Was there significant volcanic activity when $CO_2$ was going up unexpectedly (appears to be in some cases) or aggressive plant/sea life growth where $CO_2$ was going down unexpectedly? A lot of questions but $CO_2$ was not driving the temperature.

## $CO_2$/Temperature Cenozoic

The changes over the Cenozoic are complex and I am not going to explain them all in this one graph. A few of the highlights are shown here. The next slides will discuss more detail, but I do not pretend to know what the entire story is. I am presenting data, giving my opinion and am happy to have anyone provide additional information and interpretation. The Paleoclimatology Video referenced to the right provides more detail (Tom Gallagher).

- 3-4: Panama Isthmus
- 13-17: Panama Volcanics, Columbia Basalts, Glaciation
- 30-40: Chesapeake, Popigai Impacts, Ethiopian Volcanics, Glaciation
- 34-47: Tethys Sea closing
- 54-56: NAIP-P2, PETM
- 58-62: NAIP-P1
- 66-67: Deccan Traps, Chicxulub Impact






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

# $CO_2$/Temperature – Cenozoic

Geologic/Catastrophic Events are moving us from one climate regime to another. Temperature remains relatively stable in those regimes despite $CO_2$ changes!!!

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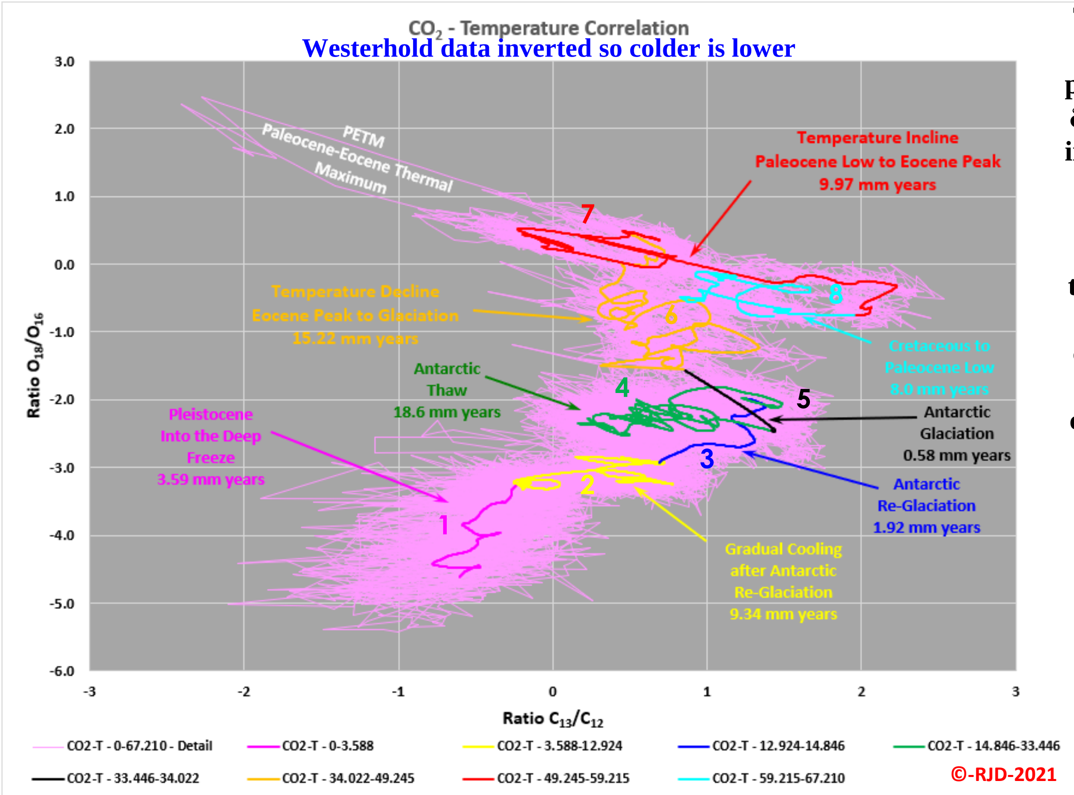
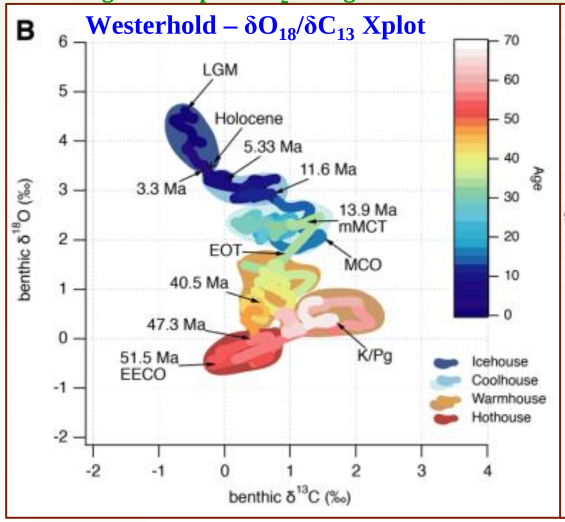
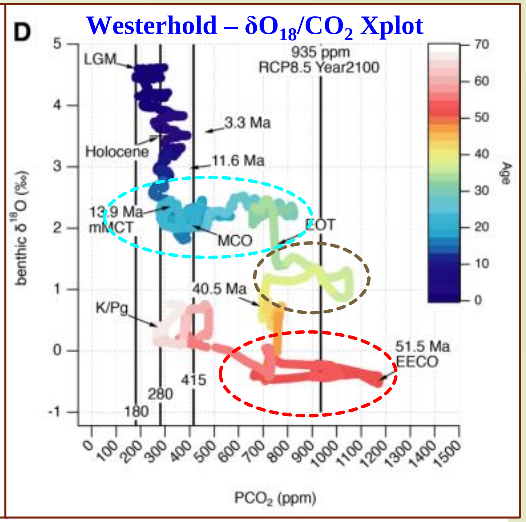
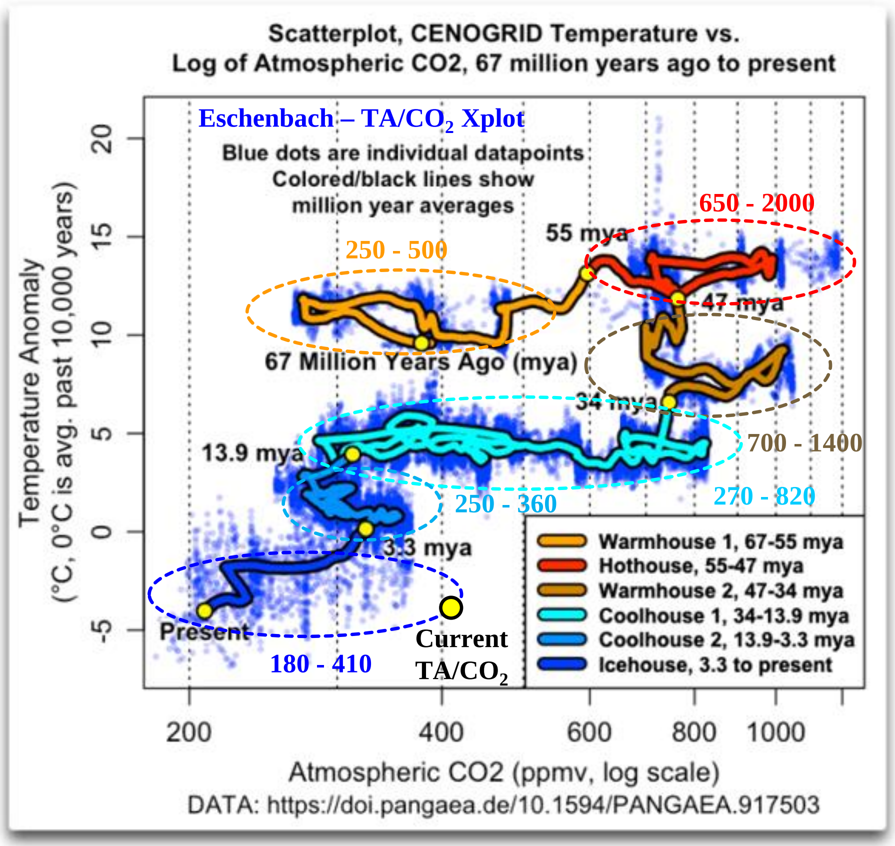



The Westerhold plots to the right are directly from the paper. $\delta O_{18}$ is plotted against $\delta C_{13}$ in the left plot and $CO_2$ in the right plot. Clearly $CO_2$ and temperature are not correlating over the Cenozoic. As will be shown, there are periods where $CO_2$ and temperature can be correlated with one another but that will just make the correlation that much worse when the entire Cenozoic is considered.




W. Eschenbach presented a slightly modified version (to the right, converting the $\delta O_{18}$ to a direct temperature and using a logarithmic scale for $CO_2$). The Cenozoic appears to be roughly broken up into six relatively stable temperature periods. Over each of these ranges the $CO_2$ concentrations vary considerably. Given that the historical $CO_2$ Climate Sensitivity (CCS) is roughly 1 °C, one would expect these temperature ranges would be tight and temperatures would, in general NOT be strongly influenced by $CO_2$. The $CO_2$ ranges are shown on the plot and generally show a doubling over the stable temperature grouping (i.e.: 1 °C of temperature forcing) That assumes CCS is still 1 °C at the higher $CO_2$ levels. As I discussed in CSS-7 – $CO_2$ – The FECKLESS GreenHouse Gas, CCS may decline as $CO_2$ concentrations increase. This is another of example of that FECKLESS GreenHouse Gas, $CO_2$.




## $CO_2$/Temperature Xplots

Temperature ($O_{18}/O_{16}$) is plotted against $C_{13}/C_{12}$ in the graph above. All this data is available from Westerhold et al's 2020 paper "*An astronomically dated record of Earth's climate and its predictability over the last 66 million years*". The pink floss is the entire data set, the colored coded lines are 500-point averages specific to the time periods indicated both graphically (in the chart on the previous page) and in the text legend above. You could argue for some correlation specific to the different periods, but there is no set correlation over the entire period. And as mentioned on the previous page, the two parameters move in opposite directions for the first half of this time period and move in unison the latter half. The rest of this Climate Short Story will break the data up into shorter periods and expand on what might be happening.

- 3-4: Panama Isthmus
- 13-17: Panama Volcanics, Columbia Basalts, Glaciation
- 30-40: Chesapeake, Popigai Impacts, Ethiopian Volcanics, Glaciation
- 34-47: Tethys Sea closing
- 54-56: NAIP-P2, PETM
- 58-62: NAIP-P1
- 66-67: Deccan Traps, Chicxulub Impact

The events listed to the far left, play significant roles in initiating the switch to the different periods of stable climate/temperatures.

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

# CSS-10d $CO_2$/Temperature – Early Paleocene

**Prior to Antarctic Glaciation at 34 Ma BP, the planet was essentially ice free including the north and south poles.**

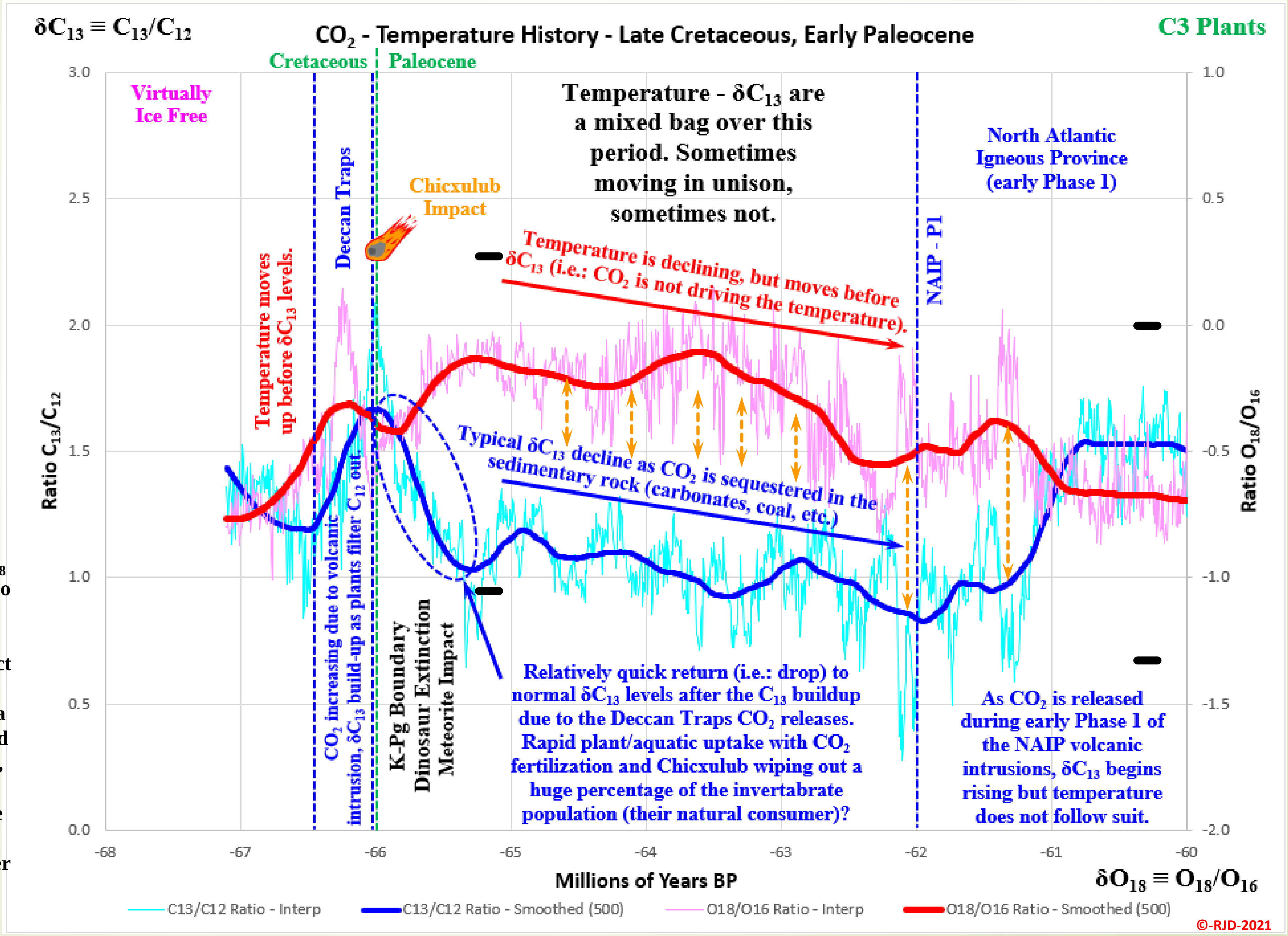
More detail? climatechangeandmusic.com

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

This slide focuses on the late Cretaceous and early Paleocene. I do not have a good high-definition $CO_2$ estimate for this period (67-60 Ma BP). The first notable events are the Deccan Traps (volcanic event) and the Chicxulub Impact event. Not a good time for the dinosaurs!!! $CO_2$ would have taken a spike up due to the volcanic activity, initiating some additional plant growth. The C3 plant types that dominated at the time, preferentially take up the $C_{12}$ isotope, causing the $C_{13}$ /$\delta C_{13}$ to rise. When $CO_2$ additions stop the $\delta C_{13}$ appear to drop quickly back to normal levels. After the initial adjustment, the $\delta C_{13}$ (and likely $CO_2$) begin their natural $CO_2$ sequestration decline though the early Paleocene. That $\delta C_{13}$/$CO_2$ decline abruptly ends as the North Atlantic Igneous Province opens up. Note that the Temperature continues to decline. As with most periods, the temperature and $\delta C_{13}$/$CO_2$ are not moving in unison. To be fair, on the scale of millions of years, the effect of instantaneous events and their interactions are not always readily visible.

**$CO_2$/Temperature Early Paleocene**

From 67 - 34 Ma BP, the $\delta O_{18}$ (temperature) and $\delta C_{13}$ tend to move in opposite directions. The C3 plant domination is likely responsible for this effect (as discussed above). After Antarctic Glaciation at 34 Ma BP dropped temperatures and $CO_2$ levels, C4 plants (grains, corn, sugarcane, weeds, etc.) began to evolve. They use the $\delta C_{13}$ isotope more efficiently and grow better under tougher conditions (like now).



# CSS-10e $CO_2$/Temperature – Late Paleocene, Early Eocene

More detail? climatechangeandmusic.com

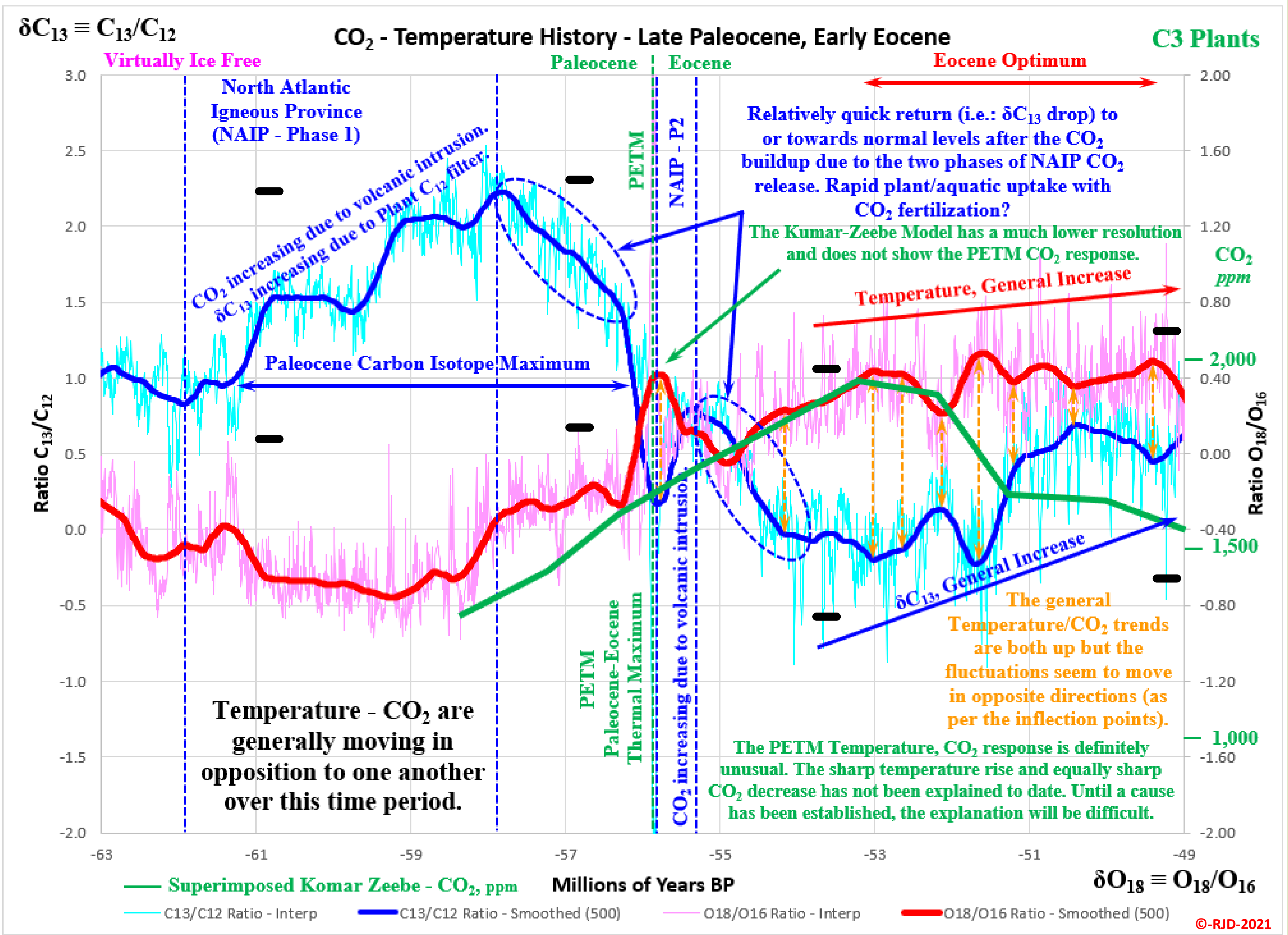
(PDF) Reconciling atmospheric CO2, weathering, and calcite compensation depth across the Cenozoic (researchgate.net)

This slide looks at the 63 – 49 Ma BP period. The full North Atlantic Igneous Province (NAIP, both Phase 1 and 2) and the Paleocene-Eocene Thermal Maximum (PETM) dominate the physical events over the late Paleocene and early Eocene. NAIP-P1 was a long period of volcanic activity. $\delta C_{13}$ rose as $CO_2$ levels increased during that period and as before quickly started the return to normal levels when new $CO_2$ additions stopped. NAIP-P2 had a similar but smaller response. As mentioned on the previous slide, C3 plants are dominant and the $\delta C_{13}$ and $\delta O_{18}$ (temperature) curves are moving in opposite directions (even on the averaged data).

The Eocene Climate Optimum (55 – 47 Ma BP) was a very warm period due in large part to the continental positions and the resulting ocean currents. Over this period, the Tethys Sea was wide open between Africa and India and North and South America were completely separated, allowing a global equatorial ocean current that kept the planet in a hothouse condition. Temperatures ($\delta O_{18}$) began rising around 59 Ma BP, long after $CO_2$/$\delta C_{13}$ began rising around 62 Ma BP. $CO_2$ continued to rise even after the NAIP-P2 ended.

**$CO_2$/Temperature Paleocene/Eocene**

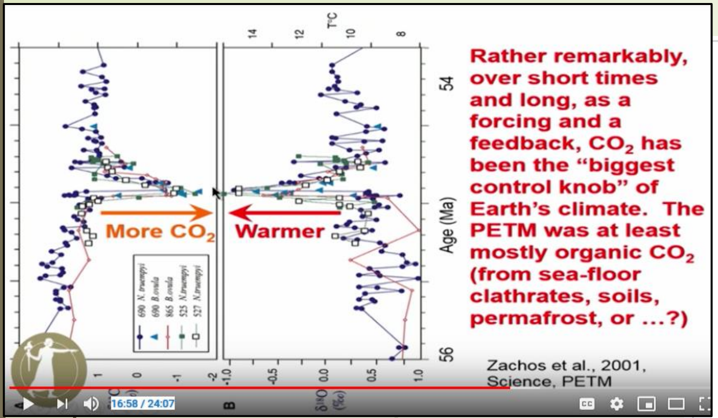
Once temperatures reached their peak, $CO_2$ levels began dropping fairly quickly despite a level temperature. This appears to be a normal $CO_2$ sequestration decline. The $\delta C_{13}$ incline most likely reflects the continued plant growth and filtering out the $C_{12}$ isotope. The Komar-Zeebe $CO_2$ estimate was used for comparison. The resolution is not as sharp as the $\delta C_{13}$/$\delta O_{18}$ data.



# $CO_2$/Temperature – PETM



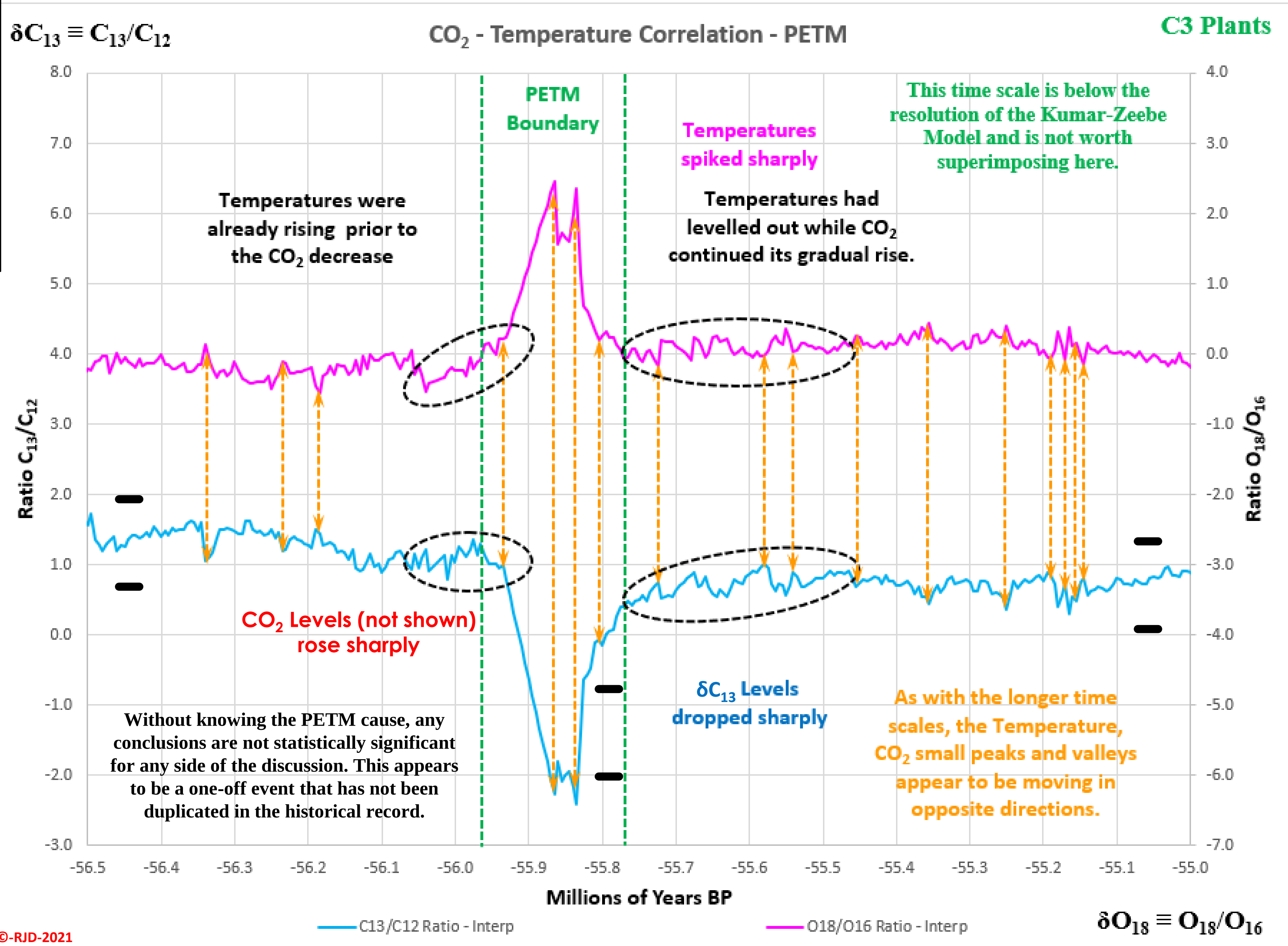





This slide focuses in on the Paleocene-Eocene Thermal Maximum (PETM, a relatively short period of time from a geological perspective). What caused this sharp spike in Temperature and $CO_2$ is still open for interpretation. The $\delta C_{13}$ spike went down moving in opposition to the $\delta O_{18}$ (Temperature) which is fairly typical for the pre-glaciation period (but on much shorter and lower magnitude intervals). This anomaly does not appear volcanic in nature since $\delta C_{13}$ tends to rise during the volcanic event, and then drop back to ambient levels. Whatever caused the PETM did precisely the opposite (quickly dropping the $\delta C_{13}$, and just as quickly rose back up to ambient levels).

**$CO_2$/Temperature PETM Boundary**

The image above was forwarded to me as "proof" that $CO_2$ was driving the climate. There are a lot of problems with this "proof". The resolution makes it hard to determine cause and effect (but it looks like the Temperature moves first). Without a $CO_2$ source, the simpler option is a rising temperature, that releases the oceanic $CO_2$ reserves and reabsorbs them as temperatures drop again. That also fits with the smaller moves.



# CSS-10g $CO_2$/Temperature – Late Eocene

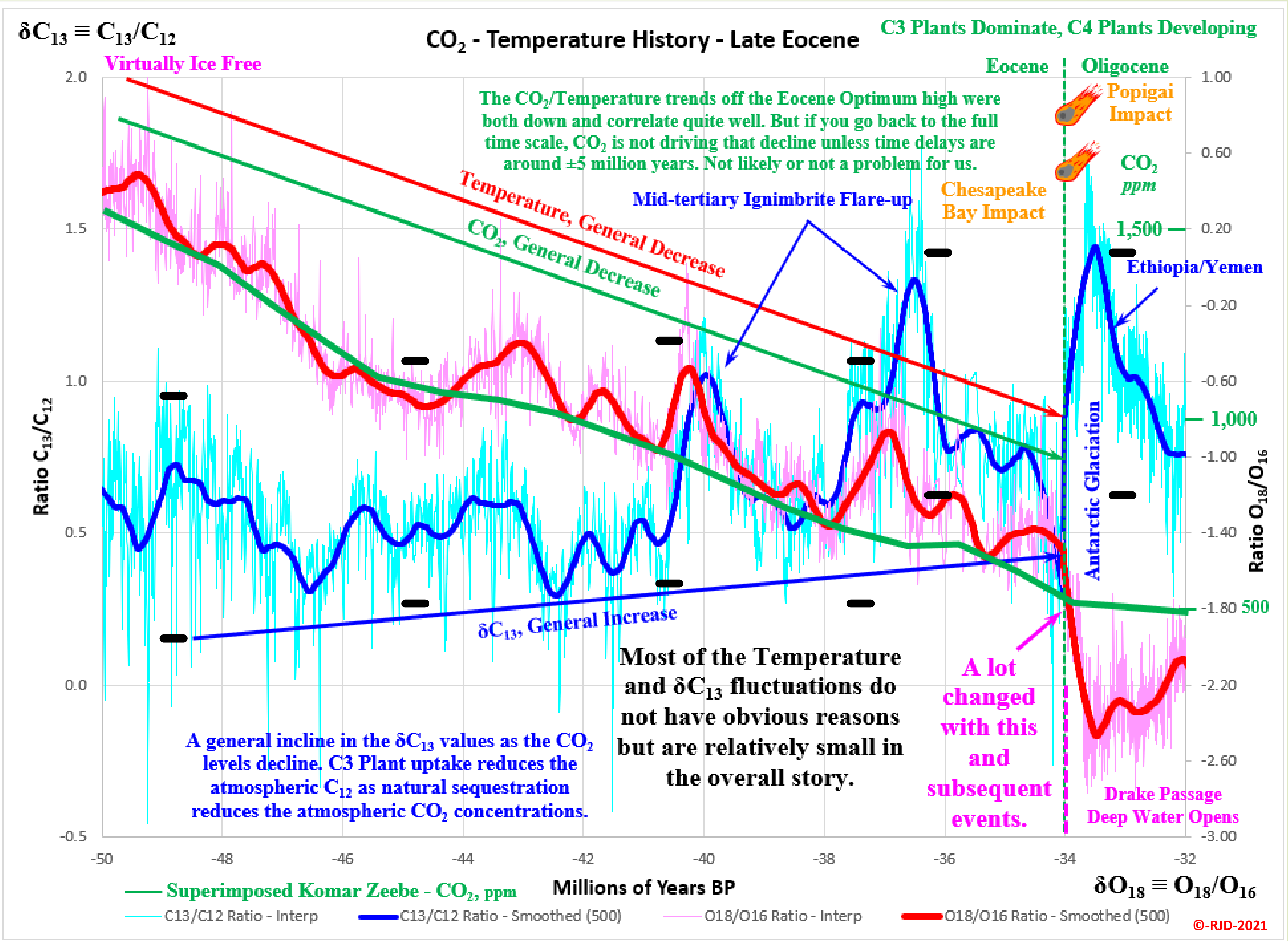


Prior to the Eocene/Oligocene boundary, the Temperatures and $CO_2$ both moved down in general unison, suggesting the normal longer-term natural $CO_2$ sequestration process was in play. The $\delta C_{13}$ was generally trending upwards (similar to previous stable periods), with a few smaller volcanic intrusions (the Mid-Tertiary Ignimbrite Flare-ups and some Ethiopia/Yemen Intrusions). As mentioned previously, the Komar-Zeebe $CO_2$ estimate does not have the resolution to show the $CO_2$ upticks from those volcanic intrusions. Despite the $CO_2$/Temperature correlation over this period, $CO_2$ is not driving that downtrend. $CO_2$ started that downtrend millions of years prior to the temperature coming off the Eocene Climate Optimum High (refer to CSS-10e). While delays in portions of the climate system are common, they do not stretch into the millions of years. That steady downtrend ended very abruptly at the Eocene/Oligocene boundary. The planet was hammered with a couple of substantial impacts (Chesapeake Bay and Popigai) with a little volcanic action (probably in Ethiopia and Yemen).

## $CO_2$/Temperature Late Eocene

Those events combined to drop the planet into an ice age with Antarctica quickly glaciating over. In addition to those short-term events, a slower term geologic process was conspiring to keep Antarctica in the deep freeze (the Drake Passage was opening between South America and Antarctica. Australia was also pulling away).

Another transition from C3 Plants to C4 plants was also occurring. As $CO_2$ dropped, C4 plants began to evolve (since they are more efficient in low temperature $CO_2$ conditions. The $\delta C_{13}$ and $\delta O_{18}$ seem to be coming into sync over the Late Eocene decline.



# CSS-10h $CO_2$/Temperature – Oligocene/Miocene

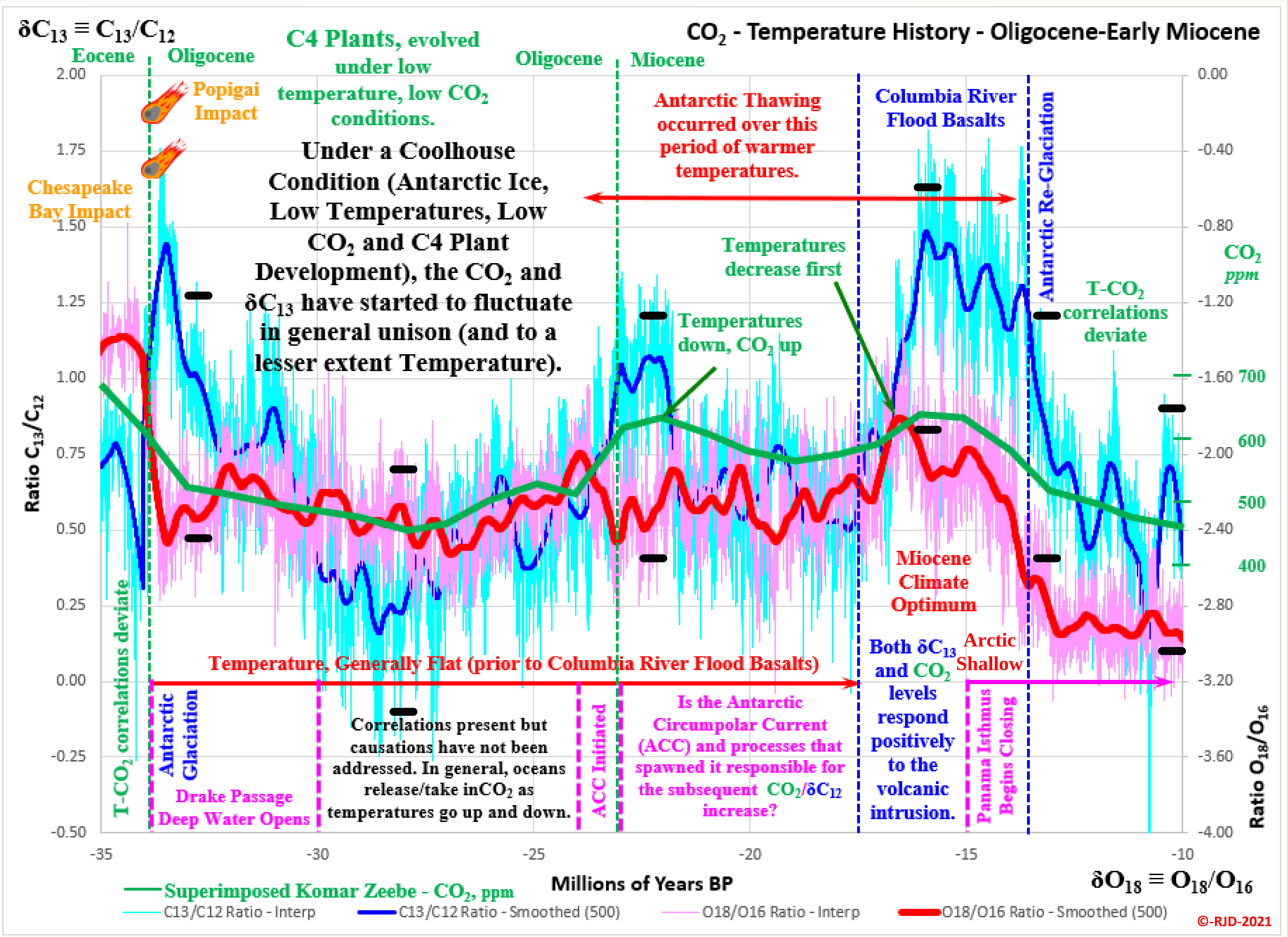
More detail? climatechangeandmusic.com

After the abrupt initial drop into glaciation, the temperatures appeared to stabilize for the rest of the Oligocene and into the early Miocene. The $\delta C_{13}$, $\delta O_{18}$ and $CO_2$ all seem to move in general unison over this period. The scale is more exaggerated on the $\delta C_{13}$ data. The $\delta C_{13}$ bump at the start of the Miocene looks like an undefined volcanic intrusion or is it related to the Antarctic Circumpolar Current (ACC)? The end of the Oligocene and early Miocene were a bit warmer and there was some thawing in the Antarctic. The $\delta C_{13}$, $\delta O_{18}$ and $CO_2$ all bumped up around the Oligocene/Miocene Boundary (although temperature did not respond strongly) and again during the Miocene Climate Optimum (which overlapped the Columbia River Flood Basalts). These are relatively minor moves but still interesting. The geological influences are strong over this period. The Drake Passage Deep Water opened and Australia split off Antarctica, eventually leading to the ACC. The next major events affecting the global climate (the Panama Isthmus closing and the Arctic/North Atlantic shallow opening) began during the Miocene Climate Optimum. This change dropped global temperatures to a noticeably lower level resulting in Antarctic Re-Glaciation.

## $CO_2$/Temperature Oligocene Miocene

Moving forward from the Eocene/Oligocene boundary, the $\delta O_{18}$ and $\delta C_{13}$ curves moved in general unison (as per the C4 plant influence discussed earlier).

As the Panama Isthmus closed, the ocean currents between the Atlantic and Pacific oceans continually weakened, disrupting the heat transport around the planet. Temperatures dropped quicker and sooner than $CO_2$ and much sooner than the $\delta C_{13}$. As mentioned on the previous slide, the C4 plants are playing a continually stronger role in the planet's carbon cycle leading to stronger $\delta C_{13}$ and $\delta O_{18}$ correlations.






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

# $CO_2$/Temperature – Miocene to the Present

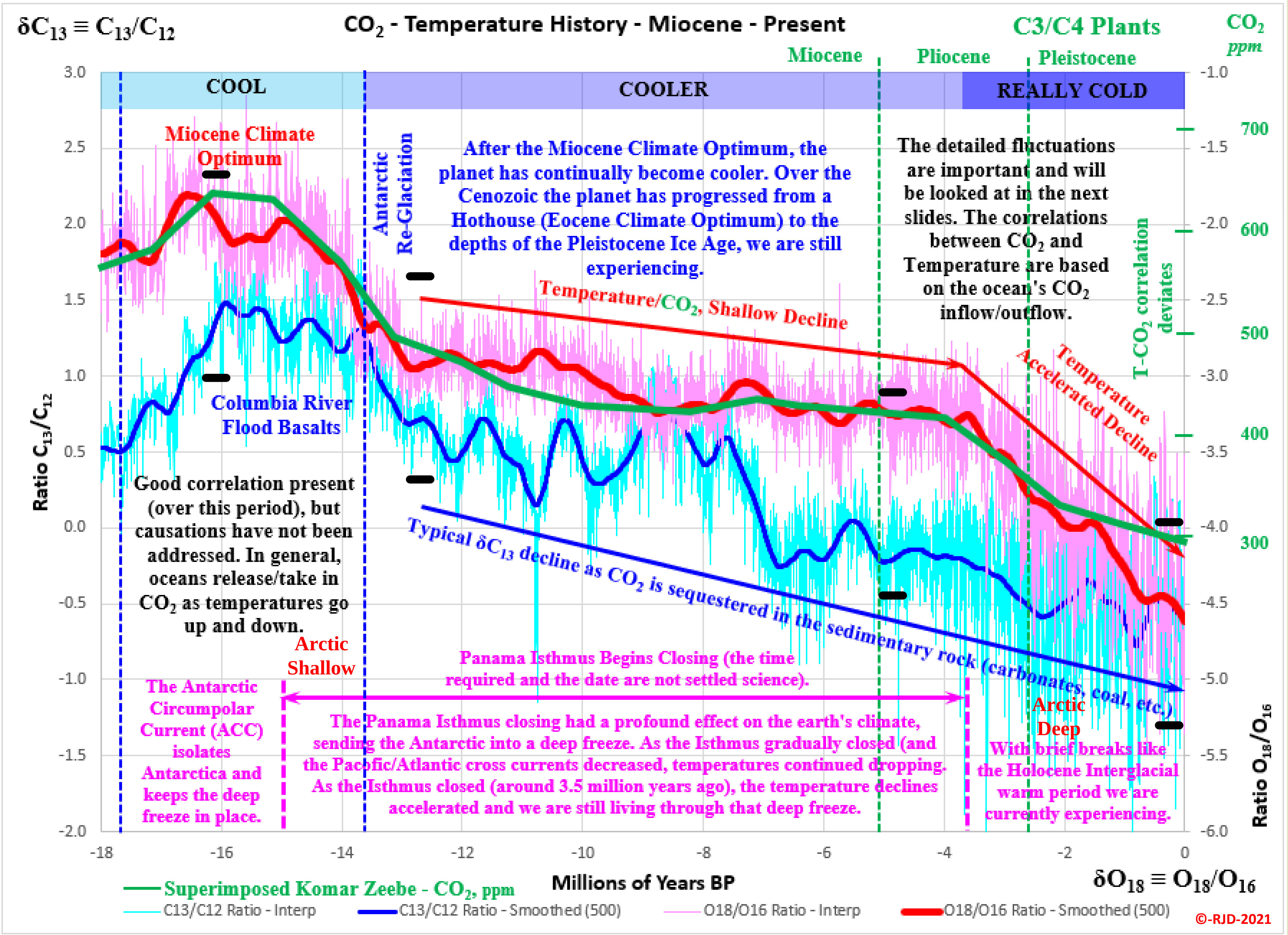


This slide takes us home for the bigger picture Cenozoic. We will zero on some detail on the last few slides but the big climate shifts that took us into the Pleistocene Ice Age have already happened. The $\delta O_{18}$ and $\delta C_{13}/CO_2$ curves have some correlation over this period (but not when viewed over the full Cenozoic, refer back to CSS-10b and/or CSS-10h). The $\delta O_{18}$ and $CO_2$ track fairly well until the last 1.5 million years where $CO_2$ levels off and temperatures continue their plunge. The $\delta O_{18}$ (temperature) hinge point at 3.5 million years ago lines up with the Panama Isthmus closure and the Arctic/North Atlantic Deep Water opening. That change in ocean circulation had a dramatic effect on the climate (which we and our humanoid predecessors have had to live through). After the typical $\delta C_{13}$ volcanic induced rise, the $\delta C_{13}$ declined quickly to more ambient levels and stayed there for roughly 5 million years. The $\delta C_{13}$ curve did not react to the Panama Isthmus final Closure (although there was a step drop between 8 and 7 million years ago that is quite noticeable).

## $CO_2$/Temperature Miocene to Now

Moving forward from the Eocene/Oligocene boundary, the $\delta O_{18}$ and $\delta C_{13}$ curves moved in general unison (as per the C4 plant influence discussed earlier).

After that tour of the Cenozoic, the big takeaway would be the relatively FECKLESS $CO_2$ response (more detail in CSS-7 – $CO_2$ – The FECKLESS GreenHouse Gas). Several very important geological processes were responsible for moving the planet through the various stable climatic periods (as shown in CSS-10c). During those stable periods, $CO_2$ varied significantly but temperatures remained generally level.



# $CO_2$/Temperature – Pleistocene



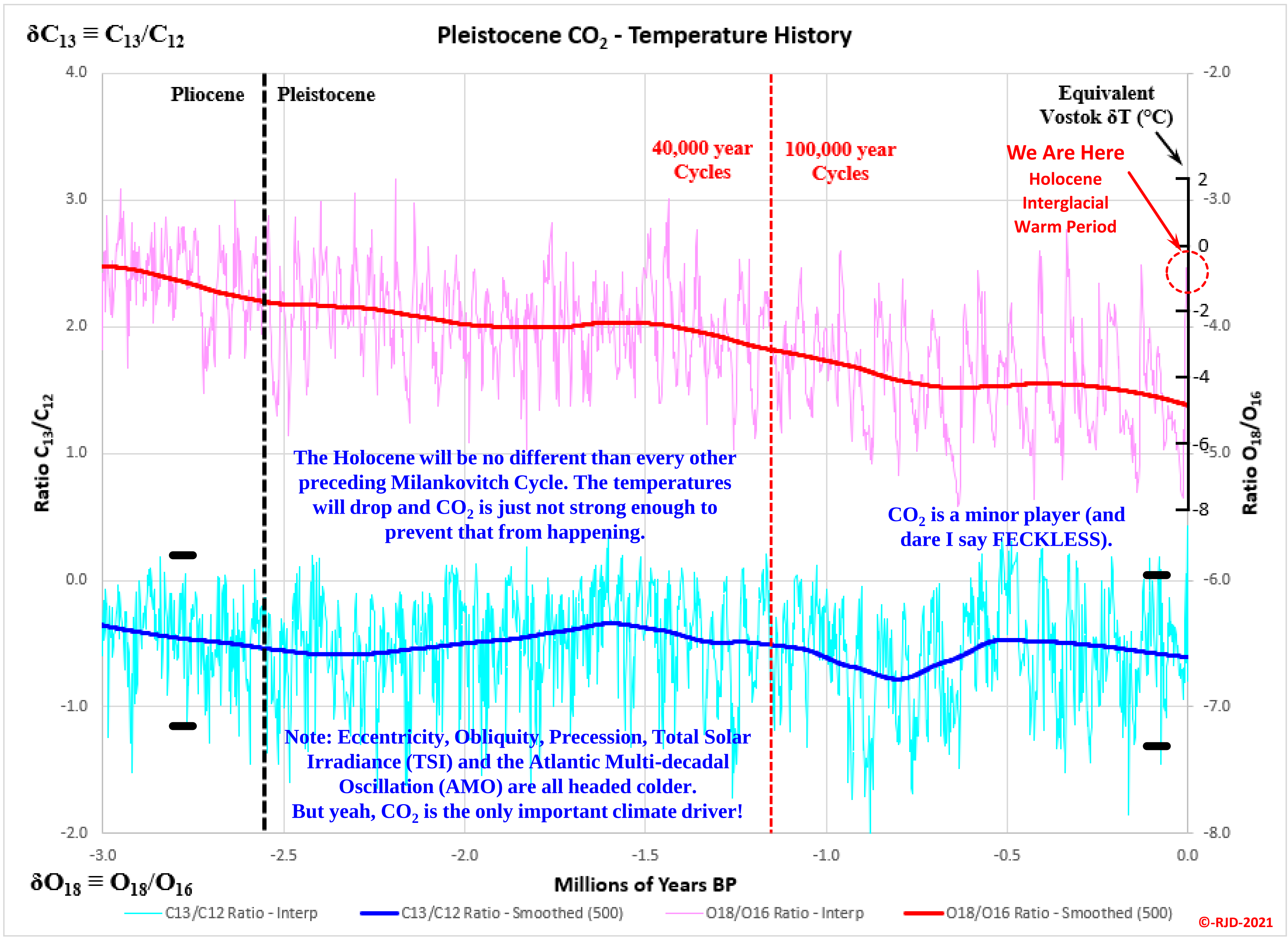
We are thankfully living through an interglacial warm period (the Holocene) but that warm period will end sometime over the next few millennia dropping us back into the deep freeze. Our ancestors will likely see the freeze and thaw cycles continue for millions of years before a real climate driver (geological or solar) kicks in and moves us to another new stable climate period. At this time scale, we can finally see the detail showing the Milankovitch cycles. More detail is available in my CSS-4 – Milankovitch Cycle post. The eccentricity is currently operating on a 100,000-year cycle, the Obliquity on a 41,000-year cycle and the Precession is on a 23,000-year cycle. The 3-cycle combination is driving the 100,000-year glacial cycles (90% deep ice age, 10% warm interglacial). Earlier in the Pleistocene, the glacial cycles were only 40,000 years long. I suspect the Milankovitch cycles were active throughout the Cenozoic (given the erratic characteristics of the detail).

The $\delta O_{18}$ (temperature) and $\delta C_{13}$ are generally moving in unison throughout the Pleistocene. That will be shown in more detail on the next slide. This is the climatic environment that mankind evolved through. And despite the narrative that we are moving into a new epoch (the Anthropocene), there is NO scientific evidence that indicates the Pleistocene is about to come to an end.

**$CO_2$/Temperature Pleistocene**

The Modern Solar Maximum is coming to an end (solar activity peaked in 1950 and has remained relatively flat, now headed down) and the Holocene Interglacial will end. Will this GSM be the tipping point or do have a few thousand years more?

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



# $CO_2$/Temperature – Ice Core Comparison



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

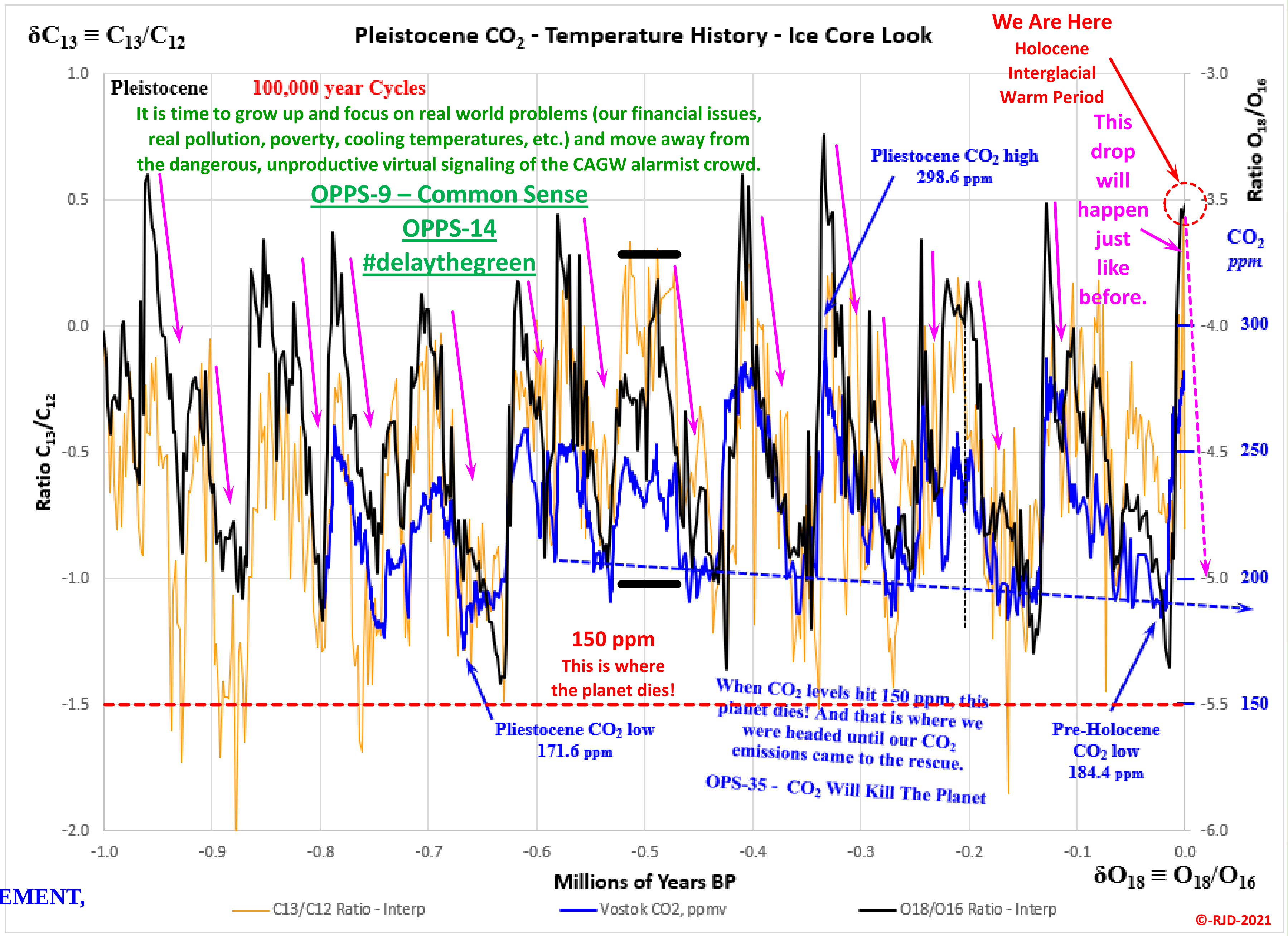
This slide zooms in to the last 1.0 million years. As shown, in our recent history, the $\delta C_{13}$ and $\delta O_{18}$ have been moving in general unison. The magnitudes may differ, but the peaks and the valleys are lining up very well. This period allows a quick comparison between the $\delta C_{13}$ and $\delta O_{18}$ curves and the ice core data ($CO_2$ specifically). The $CO_2$ curves could be expanded (with a scale adjustment) to match the $\delta C_{13}$ curves more closely. The main point being that the $\delta C_{13}$ and $\delta O_{18}$ data is good quality data that can be used to represent large periods of time. (67 million years in this case). The data is available with Westerhold et al's September 2020 paper. In Westerhold's words, "Much of our understanding of Earth's past climate comes from the measurement of oxygen and carbon isotope variations in deep-sea benthic foraminifera". All the slides to this point use the Westerhold data. Again, do not be fooled by the Anthropocene narrative (which is just as phony as the Catastrophic Anthropogenic Global Warming Narrative (CAGW)). We are already dropping into a new Little Ice Age (LIA) with the next step being the inevitable plunge into the deep ice age. And that plunge is directly caused by short term solar influences (Solar Activity (we have just entered a Grand Solar Minimum (GSM)), Ocean Cycles (the AMO is entering a 30-year cool cycle) and long-term cycles like the Milankovitch cycles (the eccentricity, obliquity and precession are all headed down). This plot gives us the opportunity to reflect on $CO_2$'s role on planet earth. Without $CO_2$, this would be a lifeless planet. Plants would die at 150 ppm and take all other life with them. We reached 184.4 ppm in the last deep ice age and would have dropped lower every subsequent ice age (if not for our timely and beneficial $CO_2$ emissions). Even at 400 ppm, plant life is severely stressed.

**$CO_2$/Temperature Ice Core Look**

**WE NEED MORE $CO_2$, NOT LESS.**

**$CO_2$ IS A MINOR CLIMATE DRIVER AT BEST!**

I really wish $CO_2$ had the ability to prevent the temperature drop into the next Little Ice Age or deep ice age but that is not reality.






**$CO_2$ IS A BASIC LIFE REQUIREMENT, NOT A POLLUTANT!**

# CSS-10l Temperature, Solar, Cosmic Rays, Clouds

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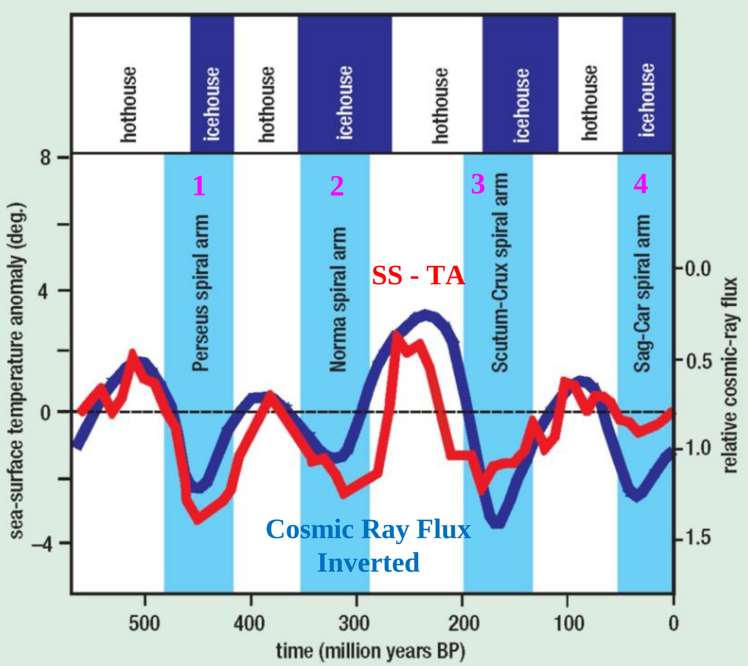
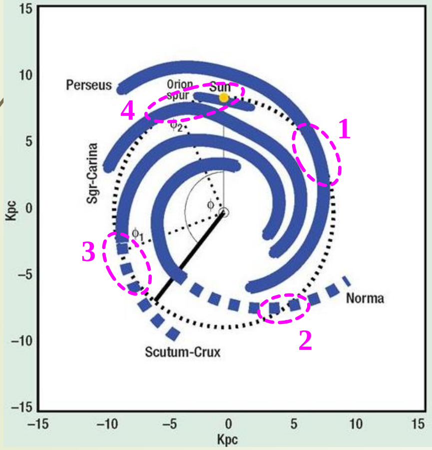
GSM – Grand Solar Minimum. The real "Climate Change" existential threat is right around the corner. Do the Research!



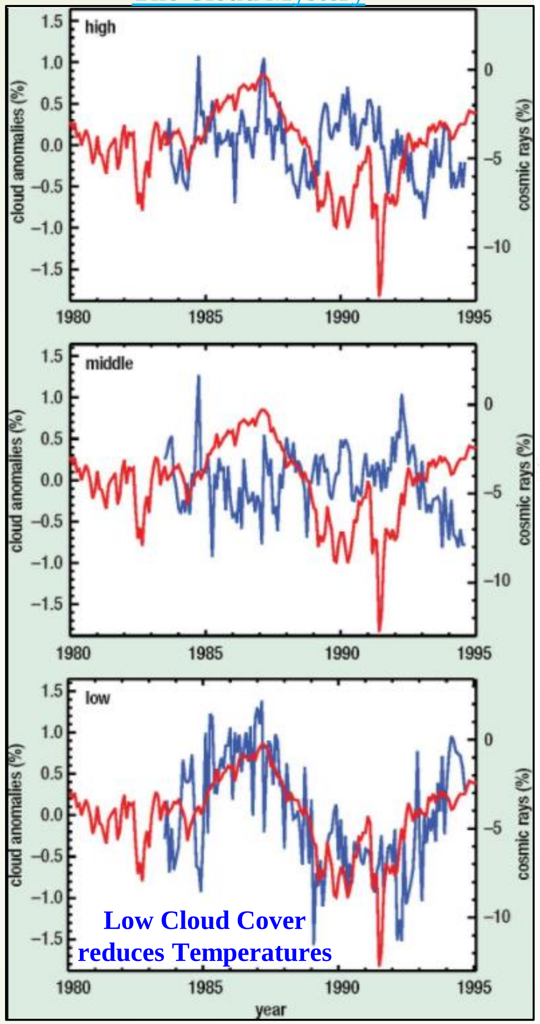

As the earth moves in and out of the Milky Way Galaxy's spiral arms, Temperatures appear to move up and down with the Cosmic Rays flux.




**Temperature/Solar Cosmic Rays/Clouds**

Cosmic Rays increase when the earth passes through the spiral arms (more stars), initiating the big ice ages (1, 2, 3 and 4 in three of the figures) roughly every 150 million years.

[Henrik Svensmark](#)
[The Cloud Mystery](#)

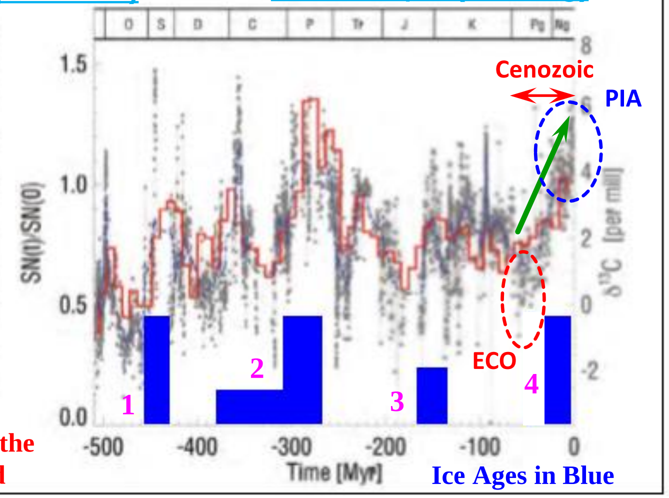



[Cosmoclimatology: a new theory emerges | Astronomy & Geophysics | Oxford Academic (oup.com)](#)

Solar Activity has not been discussed up to this point. The work done by Henrik Svensmark and others has shown the connections between solar activity, cosmic rays and clouds on the planet's temperature. The topic has been deferred to the end because I have not found a comprehensive data set that accurately represents the Cenozoic time period (longer and shorter periods (from Svensmark's work) are shown here). Solar Activity is present throughout the climate history. The cycles that will affect us are on much shorter time cycles. The vertical text to the left was included on every slide because that is the solar cycle that will affect us immediately and dangerously!

[svensmarkepn_46-2-2_2015.pdf (wordpress.com)](#) [1210.2963.pdf (arxiv.org)](#)

▸ FIG. 2: Red curve is the variation in the local supernova rate, and therefore also the variation in cosmic ray flux during the last 500 Myr. The colored band indicates climatic periods: warm periods (red), cold periods (blue), glacial periods (white and blue hatched bars) and finally peak glaciations (black and white hatched bars). The proportions of carbon-13 in sediments ($d^{13}C$ in parts per mill) over the past 500 Myr, shown in the scattered points, reflect changes in the carbon cycle. $d^{13}C$ carries information on the burial of organic material in sediments, and is therefore a record of bio-productivity. Blue dashed curve is smoothed $d^{13}C$. Circles are $d^{13}C$ from marine carbonates, open circles with a star symbol, Jurassic to Neogene, are a carbon isotopic record of organic matter. Note that there are three brief gaps in the $d^{13}C$ data (end-Silurian, mid-Carboniferous and mid Jurassic). Abbreviations for geological periods are Cm – Cambrian, O – Ordovician, S – Silurian, D – Devonian, C – Carboniferous, P – Permian, Tr – Triassic, J – Jurassic, K – Cretaceous, Pg – Palaeogene, Ng – Neogene. Figure based on Ref. [9].




Cosmic Ray Flux generally increasing over the Cenozoic, more Cosmic Rays, more cloud cover, more cooling/glaciation.

Eocene Climate Optimum (ECO), a low cosmic ray flux
Pleistocene Ice Age (PIA), a high cosmic ray flux

Just a coincidence, move along, nothing to see here folks!!

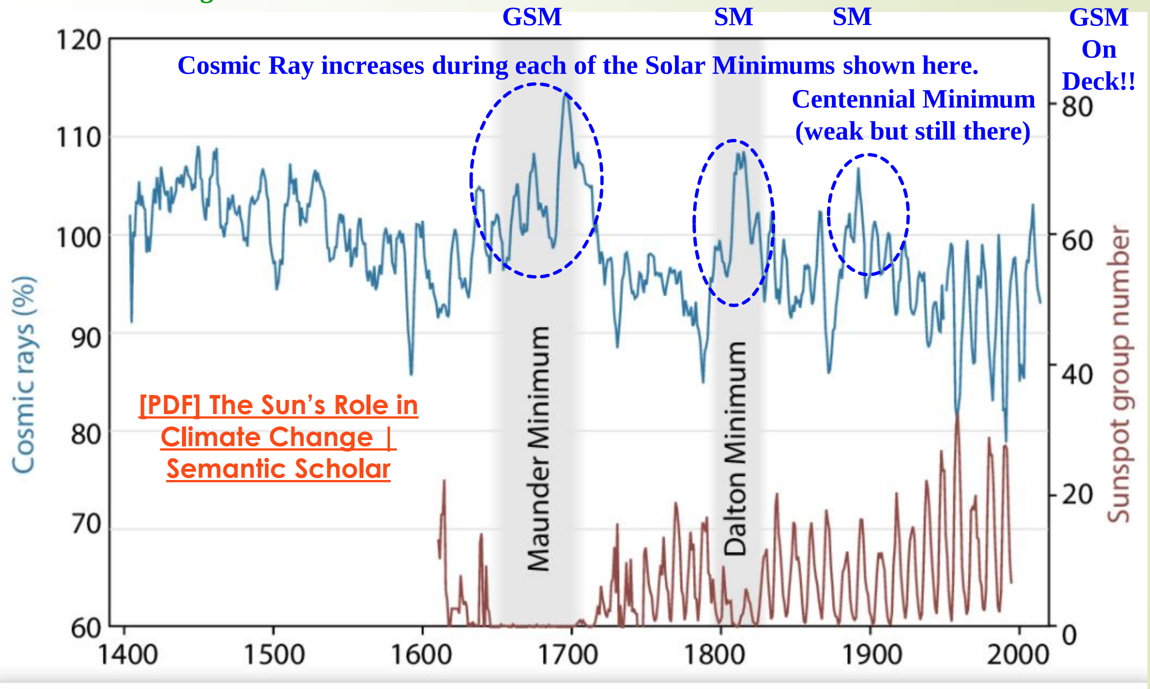
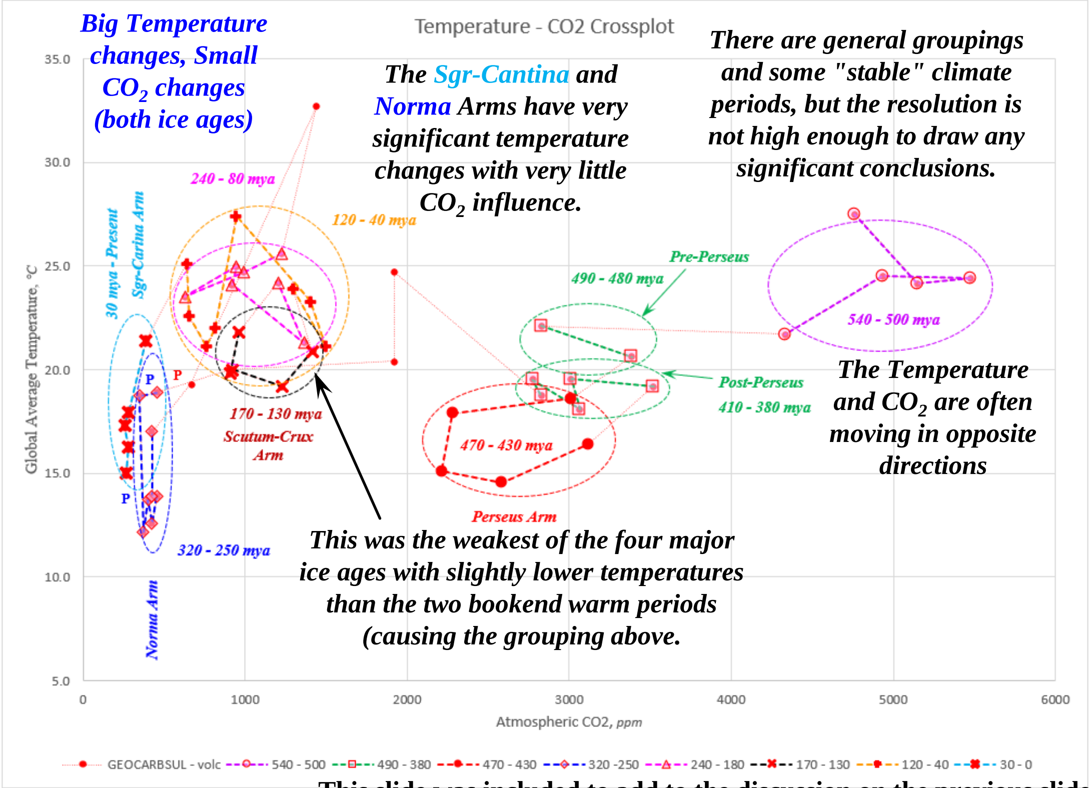



Figure 4: 10Be reconstruction of cosmic ray variation since 1391.

# CSS-10m Phanerozoic Data Analysis

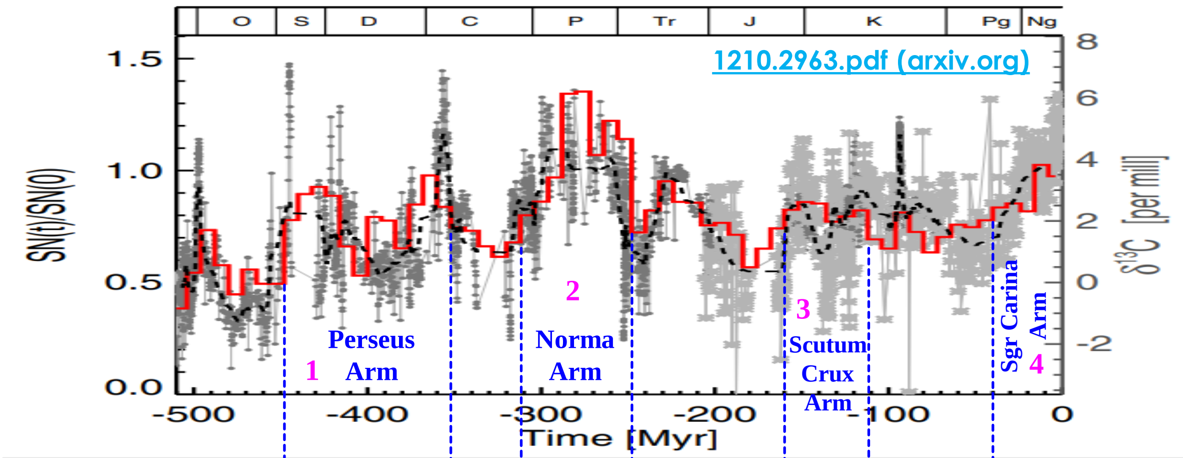


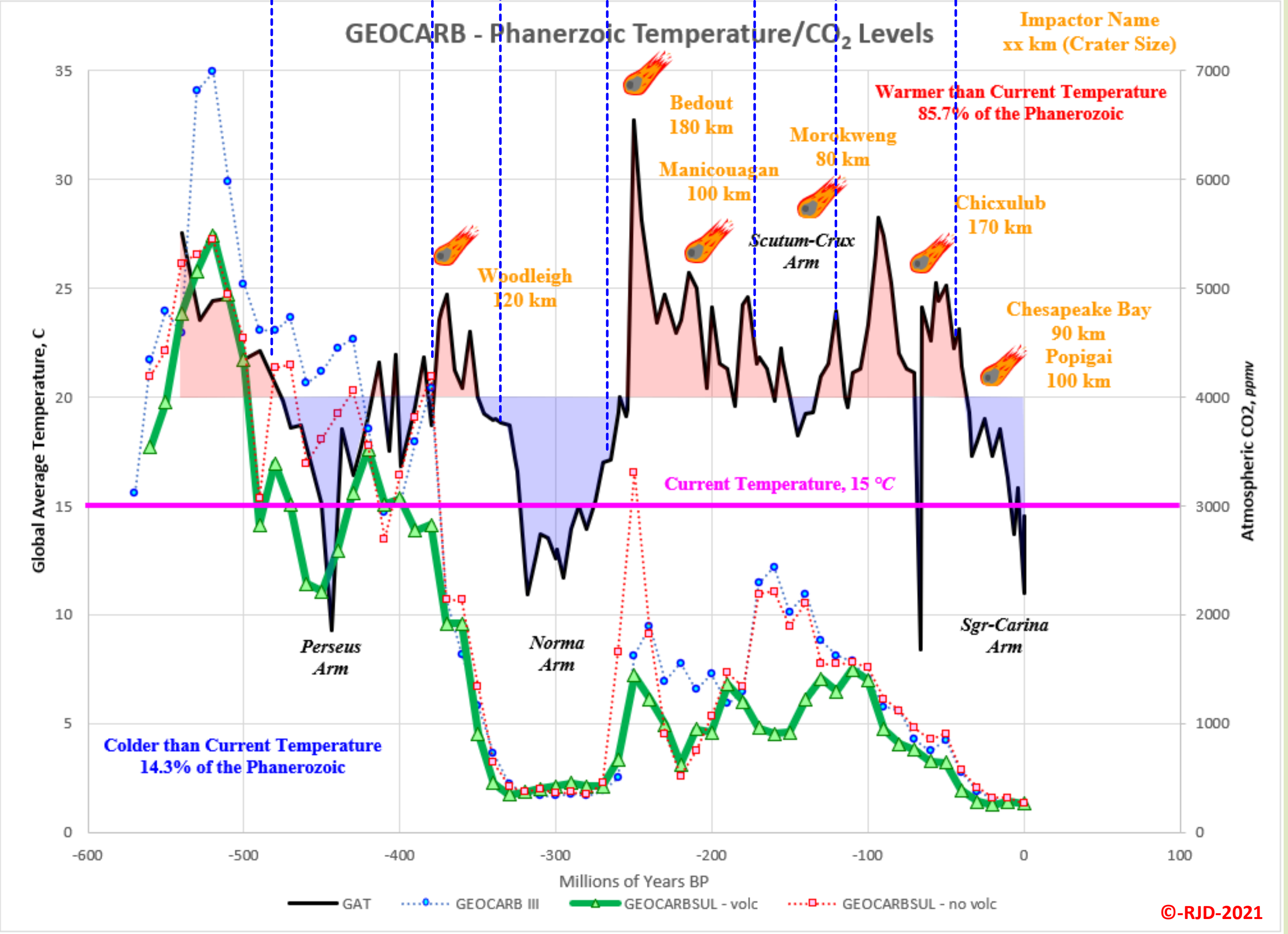

## Temperature/Solar Cosmic Rays/Clouds

This slide was included to add to the discussion on the previous slide. And my engineering predilection to data is front and center here. I was able to find the updated electronic data sets and no longer have to rely on screenshots from the internet for this time period. I had been using GEOCARB III and a temperature image from Dr. Scotese's website. Both the GEOCARB (2005) and Scotese (2021) data are updated here. The cosmic ray flux (CRF) from Svensmark's work was overlain above the Temperature/$CO_2$ plot showing the correlation between CRF and Temperature. Note that CRF correlates much better to temperature than the $CO_2$ levels. I plotted the 570 million year Temperature/$CO_2$ crossplot above to see how this time frame compares to Westerhold et al's Cenozoic data. Generally, more data points would have helped improve the resolution. The major ups and downs are present giving some stable climate zones (as per the Cenozoic), but the temperature ranges tend to be wider. Much wider than the theoretical $CO_2$ Climate Sensitivity (even if the $CO_2$ absorption band is not saturated (CSS-7 – $CO_2$ – The FECKLESS GreenHouse Gas).

Cosmic Rays increase when the earth passes through the spiral arms (more stars), initiating the big ice ages (1, 2, 3 and 4 in three of the figures) roughly every 150 million years.

More detail? climatechangeandmusic.com



# CSS-10n $CO_2$ – Holocene Solar

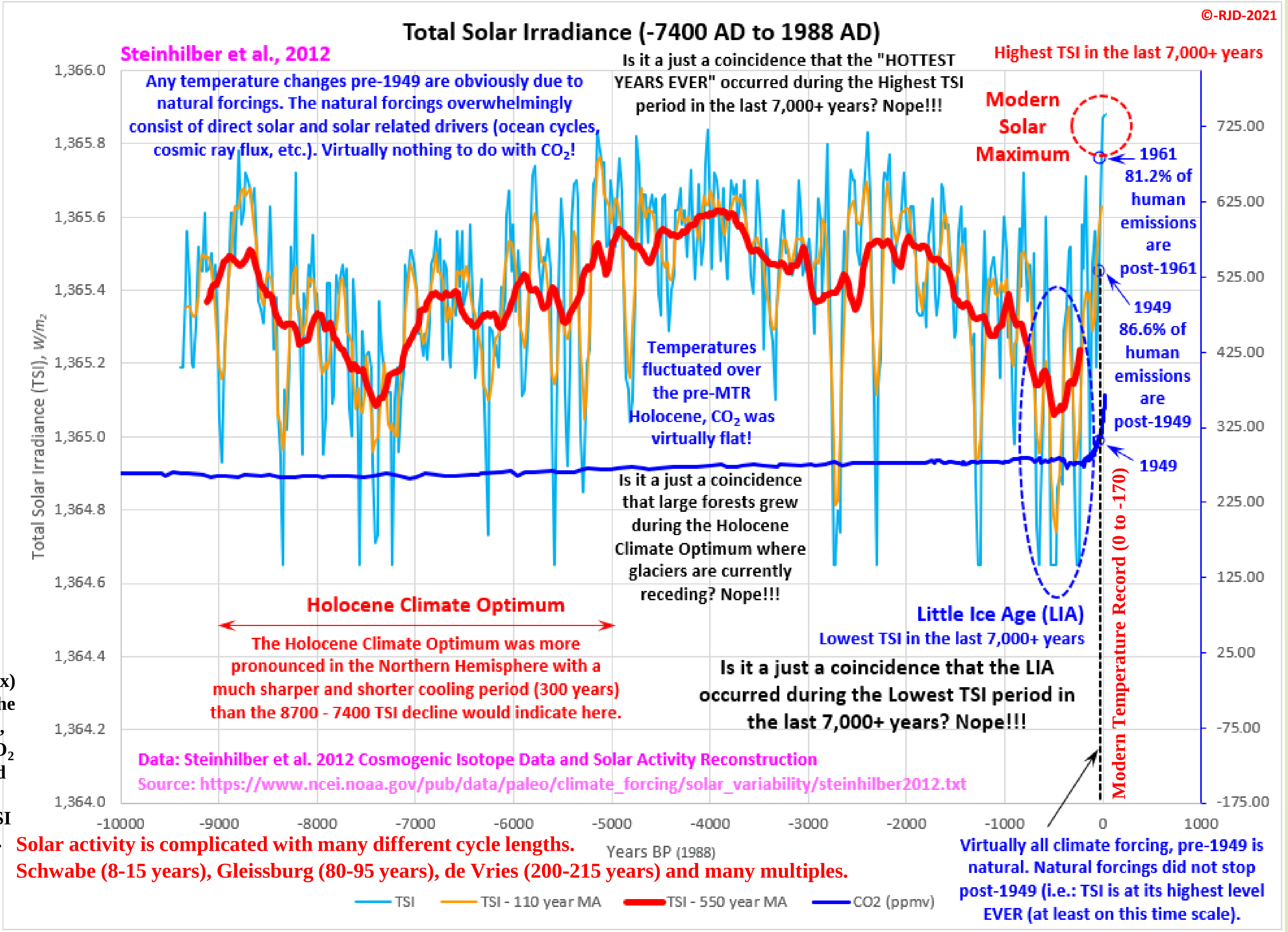
The trip through the Cenozoic was interesting but the real climate drivers that will affect humanity occur on much shorter time intervals. Moving from the Eocene Climate Optimum to the Pleistocene Ice Age we witnessed a series of geological and catastrophic events that had a profound effect on our planet's climate history. A more subtle but continuous driver (the cosmic ray flux) was also present. High cosmic ray flux was present in each of the four Cenozoic ice ages. As mentioned, $CO_2$ played only a minor role (with maybe (I repeat maybe) 1 °C or so of movement, assuming the $CO_2$ change was not temperature induced to begin with). Until we exit the current Milky Way spiral arm, we will most likely remain in that Pleistocene Ice Age. As we shrink the time scale, the parameters that affect our lifetime start coming into focus. This slide introduces the solar activity fluctuations over most of the Holocene and compares that to the ice core atmospheric $CO_2$ levels. The $CO_2$ vertical scale was chosen to reflect the CAGW alarmist narrative that $CO_2$ is responsible for virtually all the Modern Temperature Record (MTR) warming. More detail to follow and significantly more detail in my Holocene Logic posts (OPS-26, 27, 36, 44 and CSS-1, 2, 4). The Total Solar Irradiance (TSI) fluctuates significantly. The magnitude of that fluctuation is quite small, but the changes are a good proxy for the overall solar forcings.

## $CO_2$/TSI Holocene

The IPCC only uses the TSI in their computer models (even though they have the option of using additional solar forcings (high energy particles and cosmic ray flux) in the new CMIP6 computer protocol. The TSI and $CO_2$ do not tell the whole story, but the plot does show that the rise in $CO_2$ (especially the human emissions that did not really kick in until 1950) and the Modern Solar Maximum (the highest TSI level over the last 9,000 years) coincide. Any chance the "HOTTEST YEARS EVER" might be related to that pesky little solar maximum?

**Key Takeaways – TSI is the highest in 9,000 years, 86.6 % of human emissions occurred post-1949, the coldest period in the last 9,000 years (the LIA) aligned with the lowest TSI and $CO_2$ has virtually nothing to do with any pre-MTR (1850-Present, Modern Temperature Record) events and not much influence over the MTR.**

More detail? climatechangeandmusic.com




Solar activity is complicated with many different cycle lengths. Schwabe (8-15 years), Gleissburg (80-95 years), de Vries (200-215 years) and many multiples.

Virtually all climate forcing, pre-1949 is natural. Natural forcings did not stop post-1949 (i.e.: TSI is at its highest level EVER (at least on this time scale).

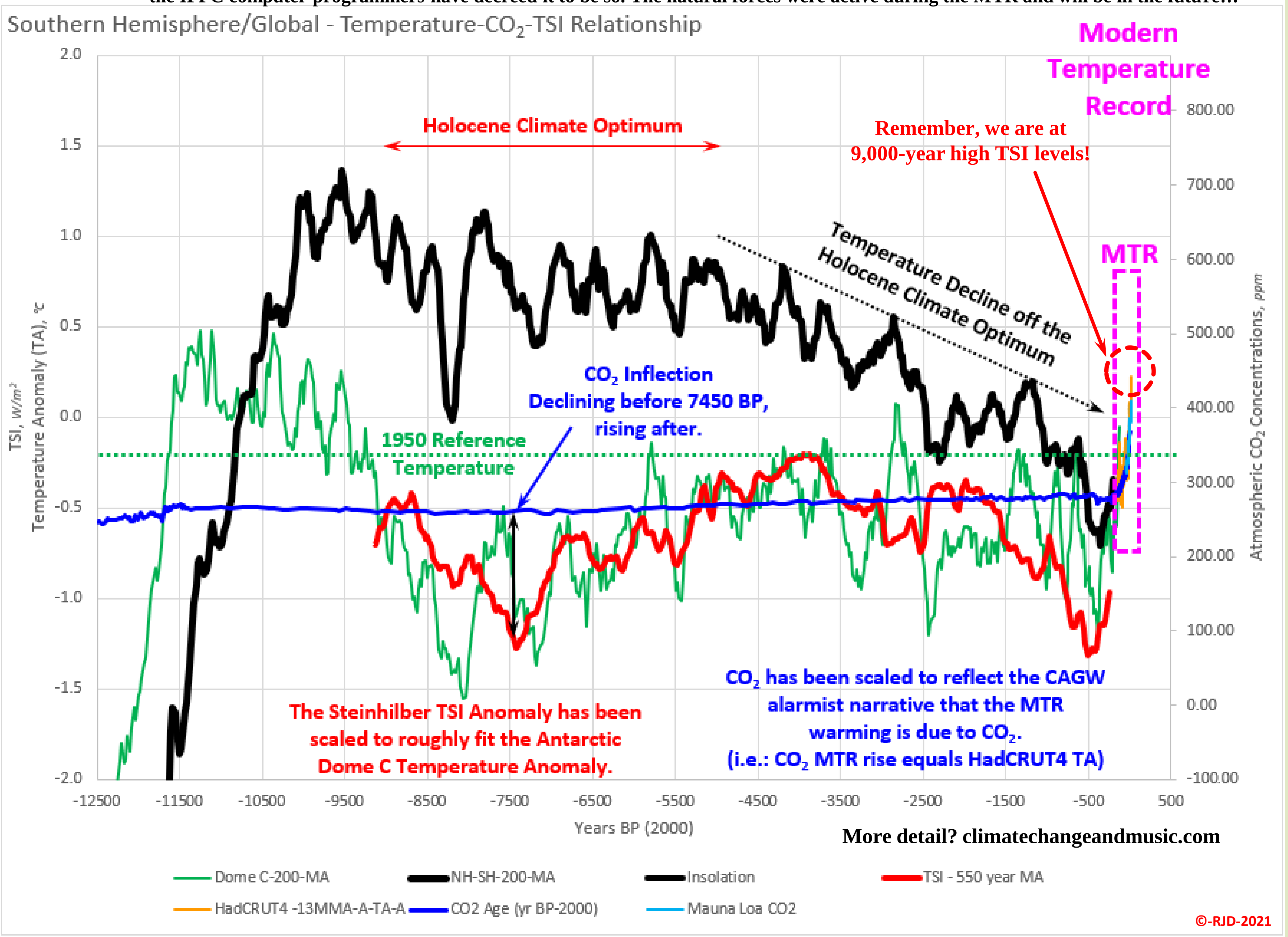
# CSS-10o $CO_2$/Temperature/TSI – Holocene

Natural forces (solar or solar related), not $CO_2$, were obviously causing the pre-MTR Temperature fluctuations on the planet. The $CO_2$ may have risen noticeably and faster over the MTR, but the temperature rises over the MTR were no more dramatic than any previous Holocene fluctuations and the temperature started rising long before (±400 years) than $CO_2$ levels. The natural forces did not cease to exist just because the IPPC computer programmers have decreed it to be so. The natural forces were active during the MTR and will be in the future!!!

To see the way all the main parameters intertwine we need to bring the temperatures back into the discussion. Through the pre-MTR Holocene, $CO_2$ is essentially flat (i.e.: a climate non-entity). Temperatures fluctuate continually on the same general scale as the supposedly scary MTR temperature rises the CAGW alarmist crowd are so worried about. I have only shown the Law Dome C Antarctic and an average of the Vinther et al (Arctic average) and the Law Dome C temperatures. The Vinther et al and Greenland GISP2 ice core temperature estimates are included in my CSS-4 – Milankovitch post for more perspective. Remember $CO_2$ is scaled to fit the MTR temperature rise (as per the CAGW alarmist narrative). On that scale we cannot easily see the small $CO_2$ decline pre-7450 BP and the small rise post-7450 BP. Having now seen the Steinhilber TSI estimate, that pre-MTR $CO_2$ movement makes sense. Solar Activity was declining in the early Holocene, reducing temperatures and subsequently $CO_2$ levels. When Solar Activity reversed direction the temperature and $CO_2$ followed suit and moved higher (as should be expected).

**$CO_2$/Temperature TSI - Holocene**

When $CO_2$ began to rise over the late MTR (remember 86.6% of human $CO_2$ emissions occurred post-1949), you can expect that there would be some warming contribution from $CO_2$. But there would also be a warming contribution from the TSI maximum (mostly pre-1949 MTR), the post-1975 AMO warming and the 2015 – 2018 ENSO warming. Again, $CO_2$ is at best a minor player.




More detail? climatechangeandmusic.com

# CSS-10p CO$_2$/Temperature/TSI – Holocene

The general public needs to wake and recognize that CO$_2$ is a FECKLESS GreenHouse Gas (CSS-7). We need to #delaythegreen (OPPS-14) and fix our country (soon) or move on to other options!!!

More detail? climatechangeandmusic.com

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

This slide was added to highlight one more piece of the extremely complicated climate change puzzle. Solar Activity may be driving the temperatures and pre-MTR CO$_2$ levels, but something must be driving the Solar Activity. When I posted CSS-4 – the Milankovitch Cycles, I did not have the TSI data. The TSI correlates nicely with the Milankovitch cycles (falling with the Insolation until 7450 BP, then rising and falling with the Delayed Obliquity). For those of us alive now and for the next few decades, the shorter solar cycles will play more dramatic roles (i.e.: we have just started into a Grand Solar Minimum, (GSM)). The implications of GSMs have never been positive for humankind and this one will be no different. The GSM poses a real and immediate existential climate threat but our self indulging, virtue signaling leadership (and their sheep) are ignoring that threat to pursue their useless, idiotological UN Agendas/Great Resets, etc. We have much bigger, real problems that deserve to be focussed on.

Just a quick statement to tie back into the initial slide. CO$_2$ will provide some minor, beneficial warming, but the negative forcings listed below will easily and dangerously overpower any CO$_2$ effect.

**CO$_2$/Temp/TSI Milankovitch**

1. Milankovitch Cycles (eccentricity, obliquity and precession all headed cooler, Insolation, slightly cooler).
2. Ocean Cycles (AMO – cooling, PDO – Cooling, ENSO – cooling)
3. Solar Activity (TSI decreasing and accelerating as we move further into the Modern GSM).
4. Volcanic Activity (increasing aerosols (i.e.: cooling), typical in GSMs)
5. Possible near-term catastrophic events (Beaufort Gyre release, lower latitude ice migration, solar micro-nova, Bill Gates geo-engineering)

But sure, we need to worry about CO$_2$, a, non-toxic, essential to life, trace gas!!