CSS-44a

Global Temperature (GT) Distributions – Historical Stations

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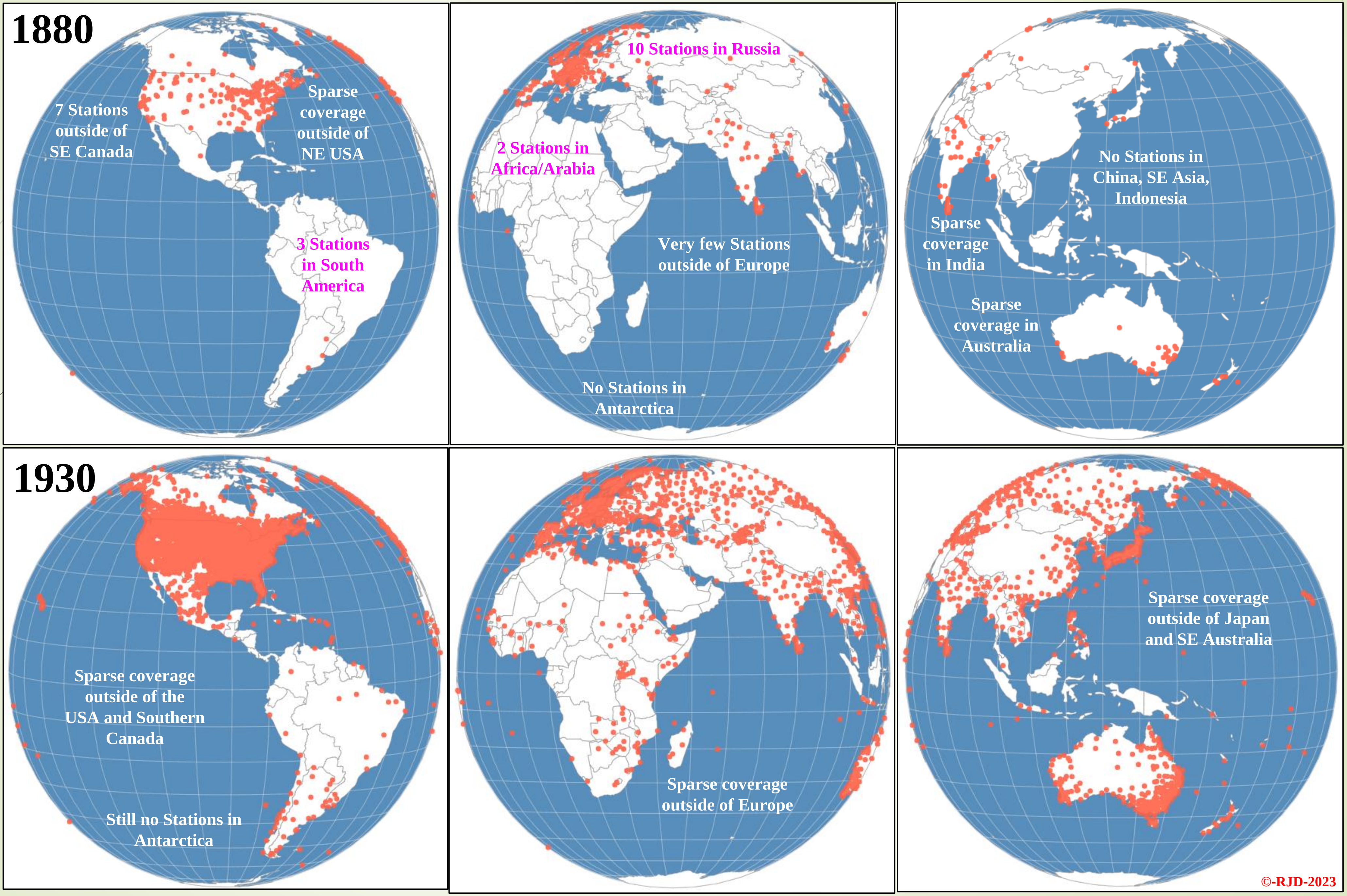
You should understand the limitations of the global temperature record. The global measured temperature record begins in 1850 (based on the HadCRUT5 surface data). The NASA/GISS surface temperature dataset (shown in this post) begins in 1880. A few points in the world (most notably the Central England Temperature (CET, with data back to 1659)) have longer datasets, but they do not realistically represent the entire globe. As shown here, the available data stations were pretty much limited to a portion of Europe and the NE USA. The average measured temperature is at best a crude estimate. The situation had not improved much by 1930. Outside the US, Europe, Japan, and SE Australia the station density is very sparse with minimal coverage in South America, Africa, Russia, Asia, and Arabia. There is little to no coverage in Northern Canada, the Arctic, Antarctica, and the oceans (covering 71% of the planet). US coverage in the Dirty 30s was very good. What happened to all those temperature records?

GT Station Distribution 1880 & 1930



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

Global Temperature (GT) Distributions – Historical Stations

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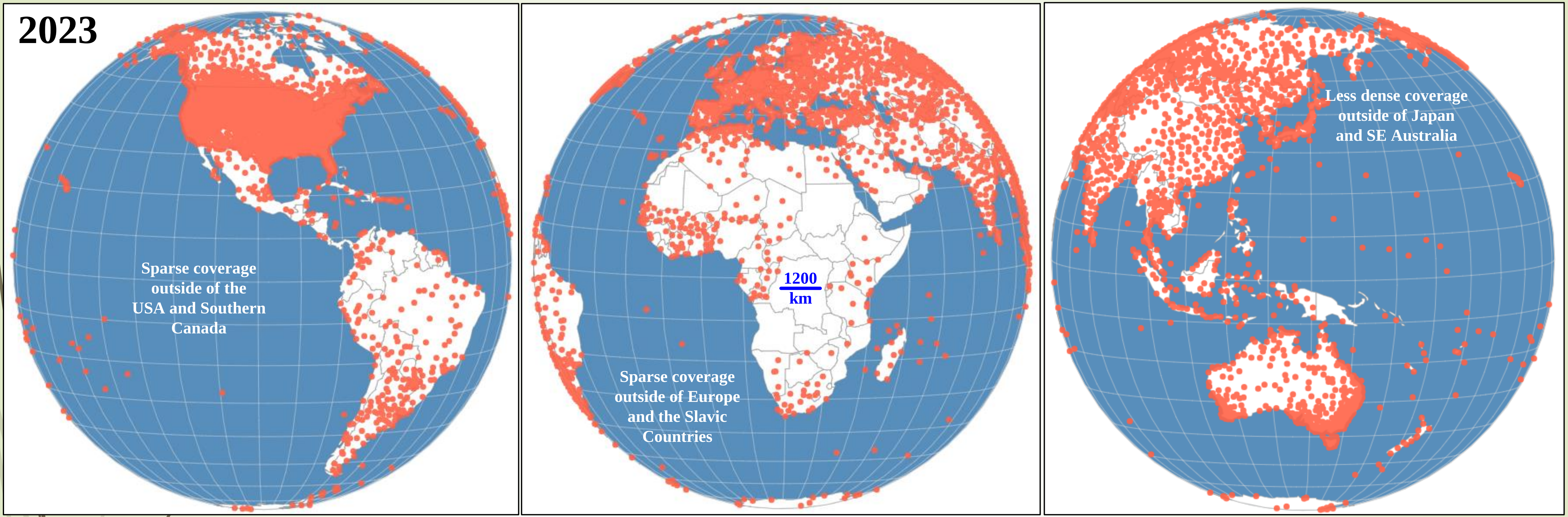
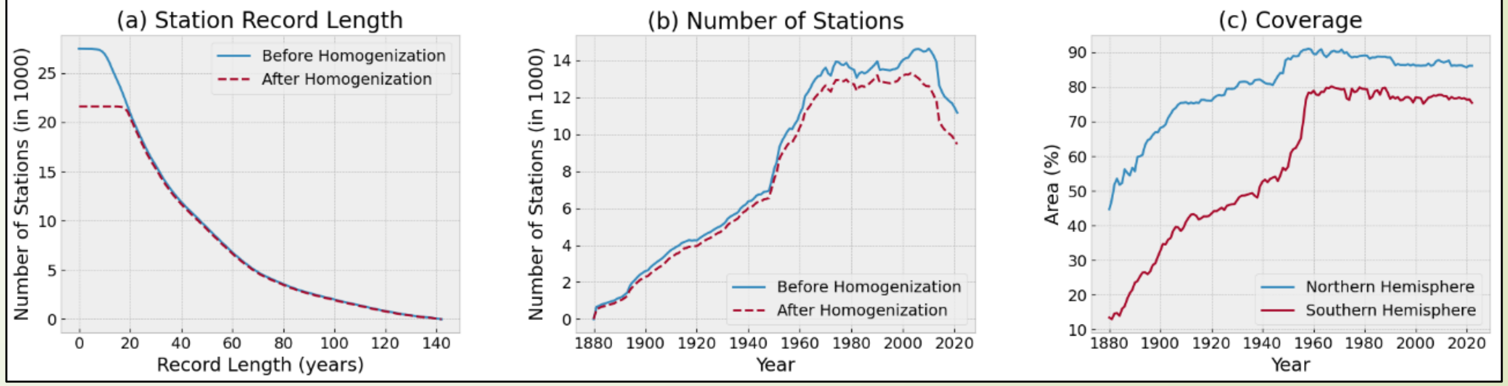


GT Station Distribution 2023

The answer to the question posed on the previous page is homogenization (i.e.: data manipulation). The people who died and suffered through that period can rest easy now knowing the measured temperatures they suffered through were not as hot as they thought it was. Out of curiosity, do you feel measured temperatures or homogenized temperatures? Coverage has improved since 1930 but there are still vast areas of land with sparse coverage. The chart to the far right gives an estimated coverage for the northern (≈87%) and southern (≈76%) hemispheres. But those stations could be 1,200 kilometers apart. Any chance the temperatures might vary significantly over that distance? Dense coverage is still pretty much limited to the US, Europe, Japan and SE Australia. And apparently that density is headed down given the information shown on the middle chart to the right. The number of stations has been reduced by almost 25% (with homogenization taking it to 35%). Most of our "official" temperature record is very likely generated by computer. Outside of Greenland and Antarctica, homogenization rules!

a. the number of stations with record length at least N years as a function of N ,
b. the number of reporting stations as a function of time,
c. the percent of hemispheric area located within 1200km of a reporting station.

Any chance the temperatures might be different 600 km away from any particular station?



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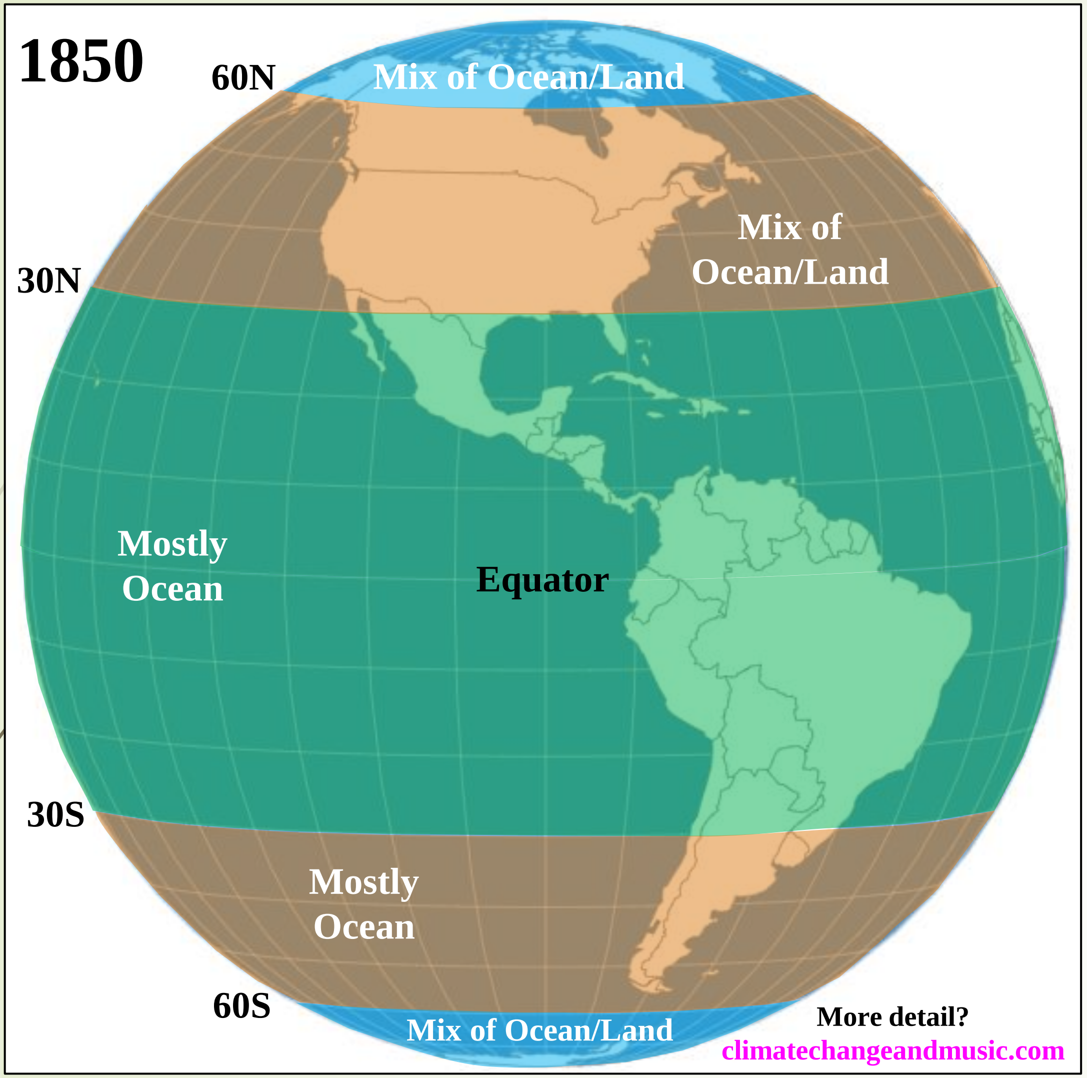
Global Temperature (GT) Distributions – Latitude Bands

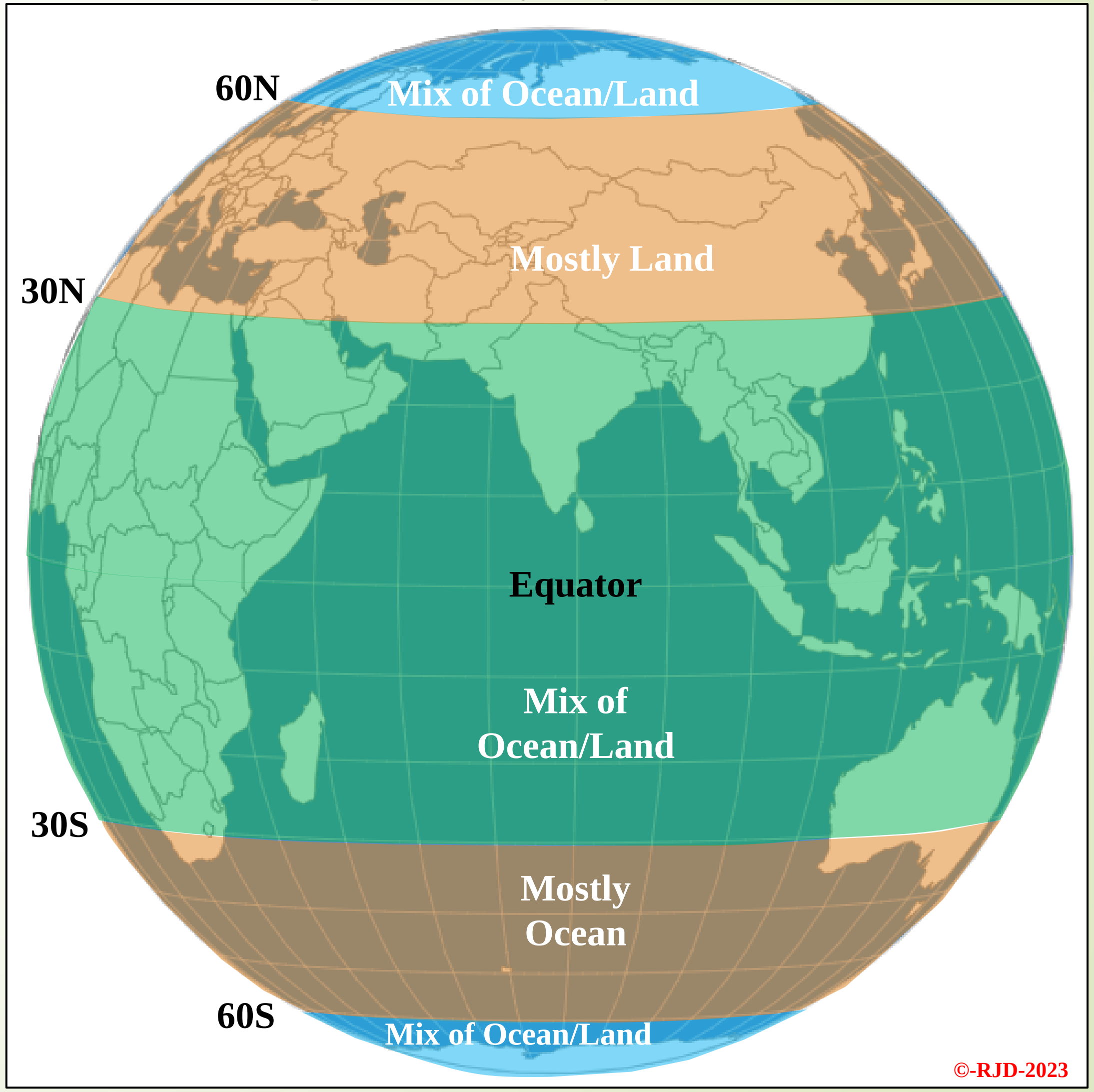
The polar ice cores (Greenland and Antarctica) are generally used to show longer term temperature data sets. In 2020, Kaufmann et al put together Holocene temperature reconstructions for the six 30° bands shown to the right. A detailed discussion is available in their *"Holocene global mean surface temperature, a multi-method reconstruction approach"* paper. Keep in mind the ocean and land mix over each of these bands. Just in general, temperatures will react more over the land than the ocean. And the temperatures will generally move more in the polar regions. Given that the southern hemisphere is mostly ocean, we can expect less temperature response than the land dominated northern hemisphere. Antarctica is a special case. Although the Antarctica is a significant percentage of the 60S to 90S area, that land mass is effectively isolated by the Antarctic Circumpolar Current (ACC, established over 20 million years ago). The ACC combined with high albedo (primarily ice) and low insolation have kept the southern polar temperatures colder (and less responsive) than northern polar temperatures. Antarctica temperature measurements are sparse at best. The satellite record (the best option) shows very little temperature change since 1978 (statistically flat). Not great for the narrative!

GTD Latitude Bands



Kaufmann et al (2020) Abstract

"An extensive new multi-proxy database of paleo-temperature time series (Temperature 12k) enables a more robust analysis of global mean surface temperature (GMST) and associated uncertainties than was previously available. We applied five different statistical methods to reconstruct the GMST of the past 12,000 years (Holocene). Each method used different approaches to averaging the globally distributed time series and to characterizing various sources of uncertainty, including proxy temperature, chronology and methodological choices. The results were aggregated to generate a multi-method ensemble of plausible GMST and latitudinal-zone temperature reconstructions with a realistic range of uncertainties. The warmest 200-year-long interval took place around 6500 years ago when GMST was 0.7 °C."



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CSS-44d

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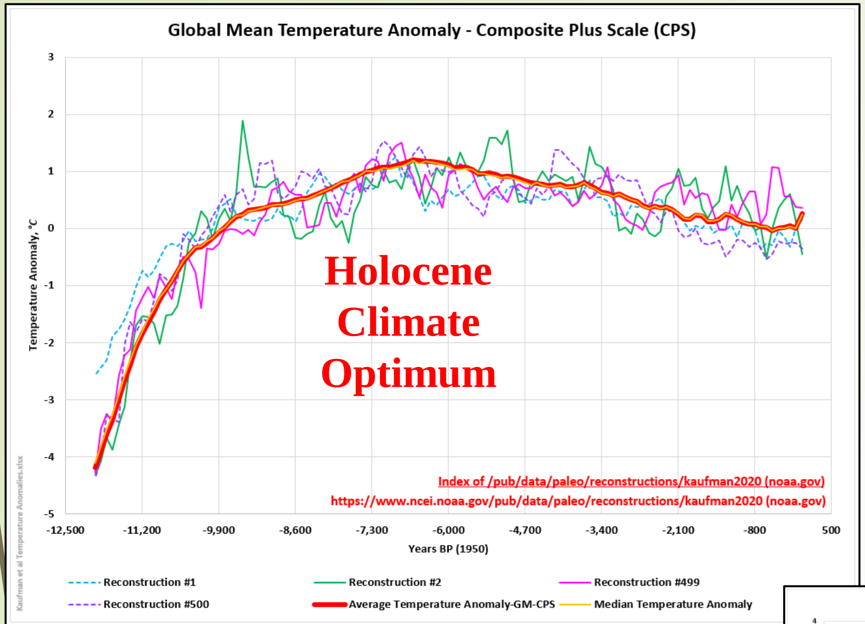
Global Temperature (GT) Distributions – CPS Reconstructions

The Kaufmann et al analysis used 5 different statistical techniques to produce their Paleo reconstructions (CPS, DCC, SCC, GAM, and PAI (description to the left) with more detail in their data description file. Each of these data files have 500 different data sets. I have chosen to look at just one statistical technique (CPS) in detail and I have only plotted the first two and the last two individual datasets with the average for each 30° band. As will be shown later, the CPS technique produces a much more pronounced temperature response than the four other statistical methods used. The northern hemisphere has more pronounced temperature changes and is noticeably less erratic than the southern hemisphere. The consolidations for each latitude band are quite smooth (apart from the recent increase that shows up in the 0N to 30N and 60S to 90S bands). And no, that increase is not our fault. Remember, 86%+ of our emissions have occurred post-1950. These datasets end in 1950. Some form of natural forcing must be in play from 1750 to 1950 (the point where Antarctic temperatures started rising). Since 1950, Antarctic temperatures have been relatively flat. The first weather stations were established in the 1940s on the Antarctic Peninsula. The first long term surface stations on the main continent were added in the 1950s, with satellite measurements beginning in December 1978. The long-term surface stations are summarized in my CSS-13 – Homogenization post. The satellite temperature is summarized in my CSS-32 – UAH-LT Temperature – November 2022 post. The Holocene Climate Optimum (HCO) is visible in all the latitude bands except the southern pole region (60S to 90S). The HCO is more pronounced in the Northern Hemisphere. Remember CO_2 is virtually flat over this time period. The temperature changes (for the averages and/or individual runs) is due to natural forcings (likely solar or solar related).



Paleo Reconstruction Methods

CPS – Composite Plus Scale

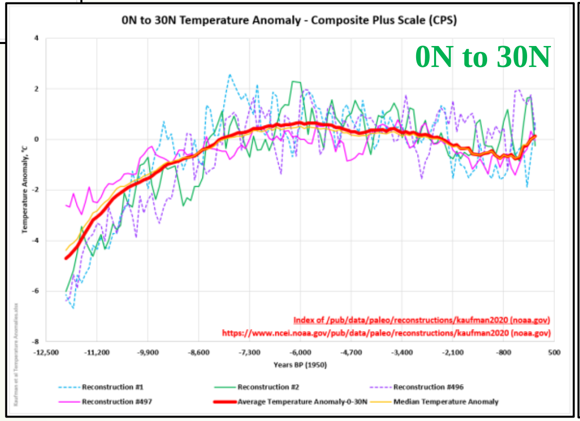
DCC – Dynamic Calibrated Composite

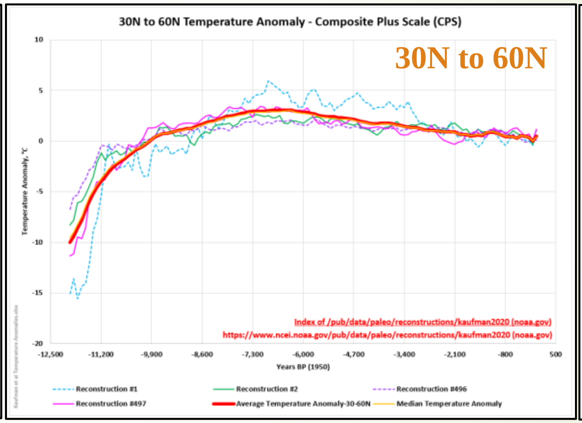
SCC – Standard Calibrated Composite

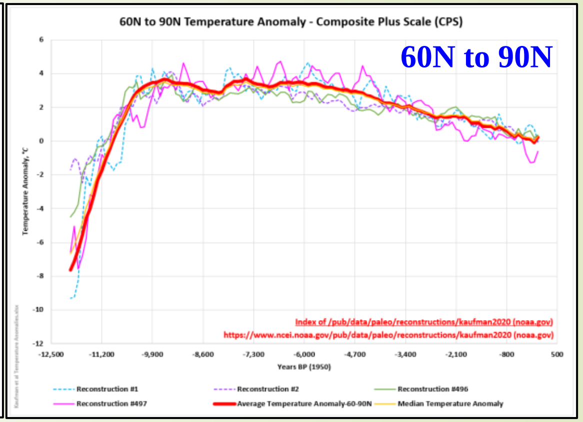
GAM – Generalized Additive Model

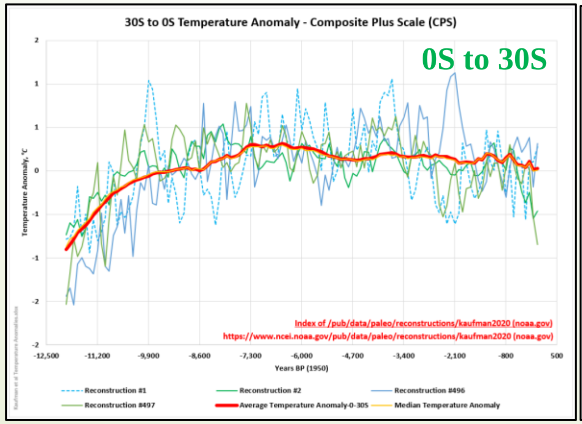
PAI – Pairwise Comparison

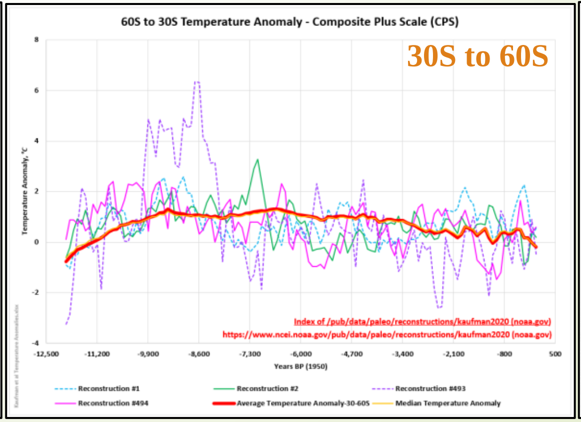
GTD Reconstructions CPS

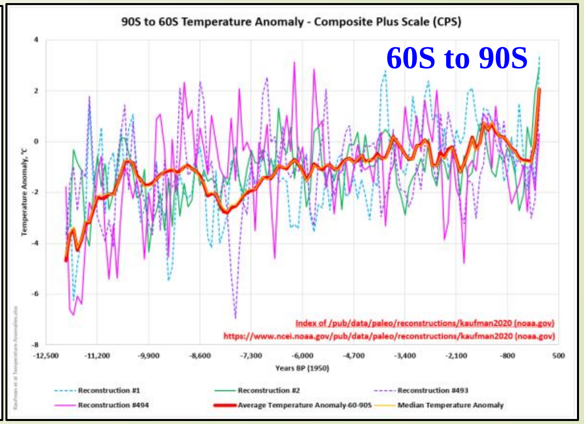












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Global Temperature (GT) Distributions – CPS Latitude Reconstructions

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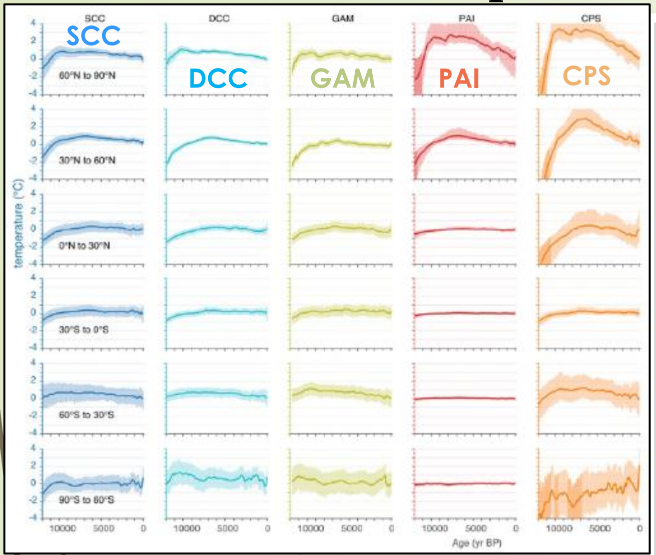
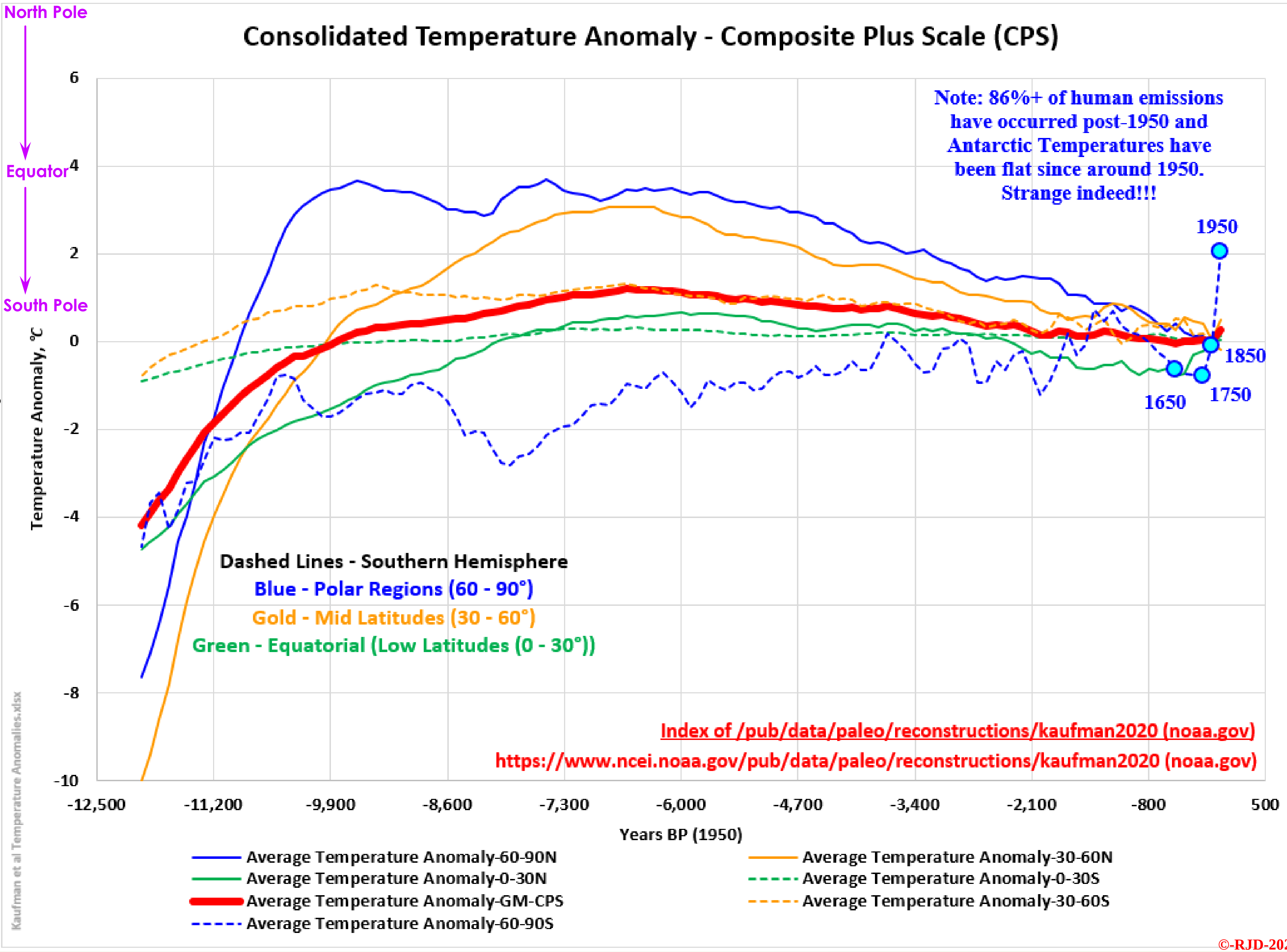


This slide plots the six CPS latitude bands together (to the right). The southern latitude bands have much less relief than the northern latitude bands. What you do not see clearly in this averaged data is the well documented Minoan, Roman and Medieval warm periods and the cold Dark Ages and Little Ice Age. Surprisingly, the southern pole shows the Medieval Warm Period and the Little Ice Age quite well. Most of the evidence for these disparate temperature regimes is normally found in the Northern Hemisphere. The chart above was pulled from the Kaufmann et al paper and shows the other Paleo Reconstruction profiles. As mentioned earlier, the other reconstructions are not as pronounced as the CPS reconstruction detailed here.

GTD Reconstructions CPS-Latitude



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CSS-44f Global Temperature (GT) Distributions – Ice Cores

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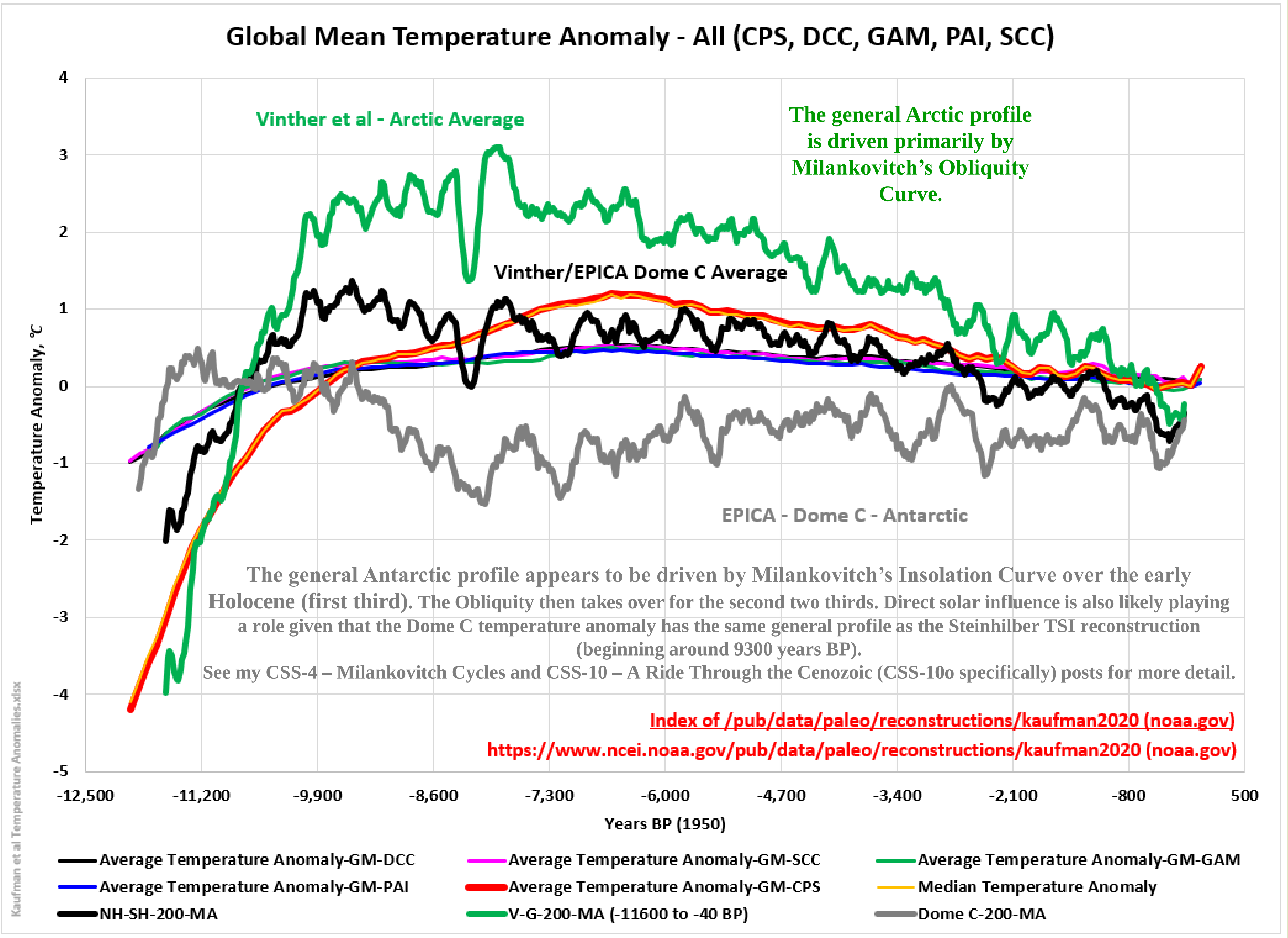
This slide compares the Kaufmann et al average Paleo Reconstructions to the Vinther et al Arctic Average Temperature Anomaly, the EPICA Dome C Antarctic Temperature Anomaly, and the average of those two curves. Neither the Vinther et al nor the EPICA Dome C temperatures represent a global temperature. But they do represent the general temperature changes for their respective hemispheres, since most of the long-term temperature changes on the planet occur in the polar regions. In the north, the temperatures were high (higher than today) during the Holocene Climate Optimum. Temperatures began dropping around 5,000 to 6,000 years ago, declining steadily reaching a 10,000 year low during the Little Ice Age (LIA). The Greenland GISP2 ice core data (not shown here) has a similar profile to the Vinther et al Arctic data with much more pronounced temperature fluctuations highlighting the warm and cold periods mentioned earlier. The southern pole is reacting differently but still shows the Little Ice Age. The general profile of these polar temperature reconstructions is driven by the Milankovitch cycles. The shorter-term temperature fluctuations are driven by natural forcings (solar and solar related), not CO_2 (which was virtually flat).

GTD Reconstructions + Ice Cores



Global Temperature (GT) Distributions – Arctic-Antarctic Average

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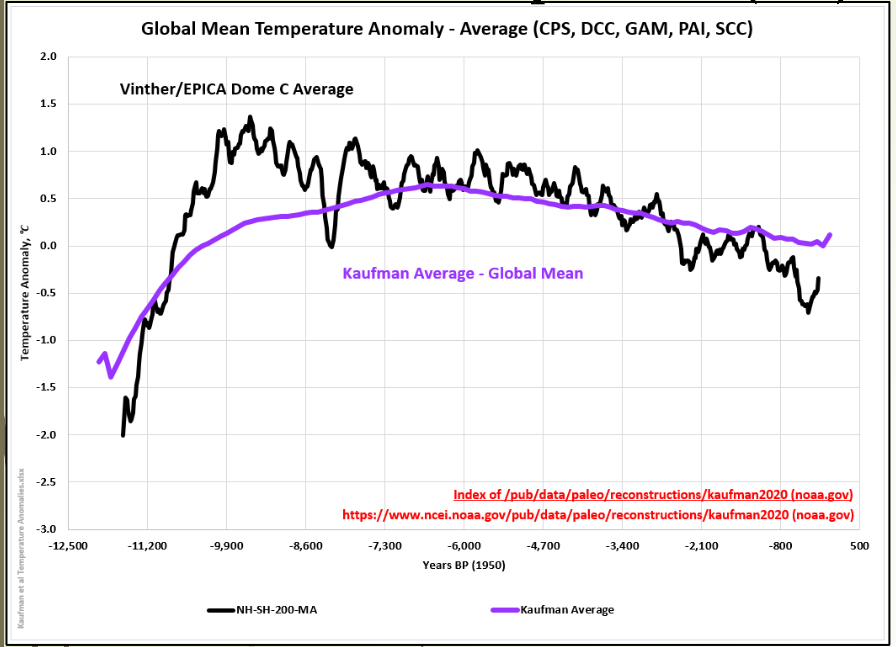
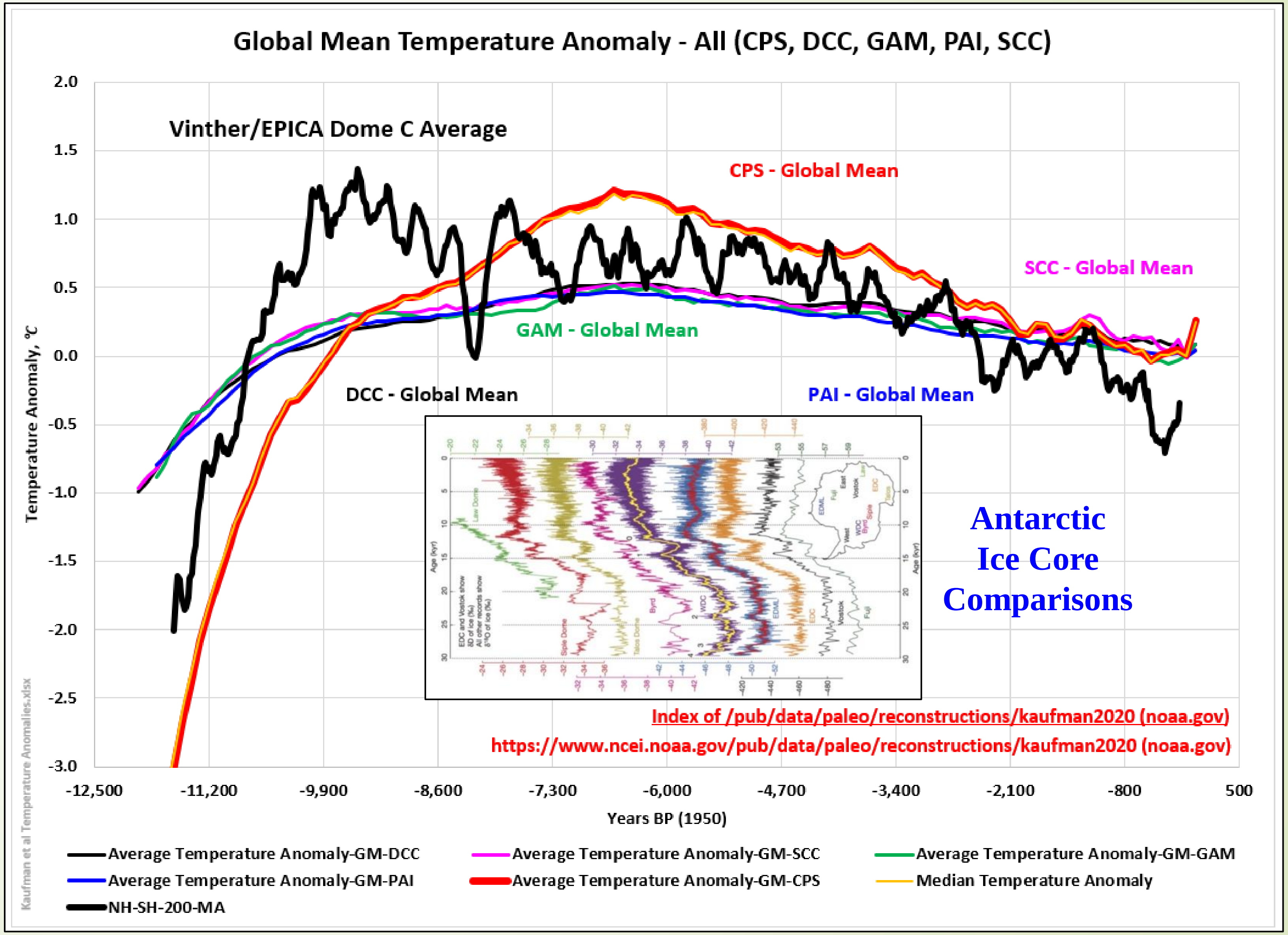


This slide looks at the average of the Vinther et al Arctic and EPICA Dome C temperature anomalies and how that average compares to the Kaufmann et al averages. The plot below shows each of the individual Kaufmann et al Global Mean Paleo Reconstructions. The plot to the left just shows the average of the five individual Paleo Reconstructions. The polar average curve and the Kaufmann averages appear to be in the same ballpark. The polar average is higher in the early Holocene and a bit lower in the late Holocene, but through most of the Holocene, the curves lay over one another. Is one curve better than the other? That is obviously open for discussion. In my opinion, the polar average provides more information. The early Holocene had the warmest temperatures at both poles (although somewhat offset).



GTD Polar Averages

And both polar regions show the same temperature decline over the last millennia, finalizing in the Little Ice Age. Given the comparisons shown here, I will continue to use the polar average as a general representation of the global average. The shorter-term fluctuations are also important to recognize. They are lost in the Kaufmann et al evaluation. I suspect that much of the current 1.07 °C temperature rise out of the Little Ice Age would also be averaged out of existence using the Kaufmann averaging parameters. The small inset to the right is a compilation of the Antarctic Ice Cores. I used the EPICA Dome C temperature profile for this evaluation. The other curves would produce similar results (to be discussed further).

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