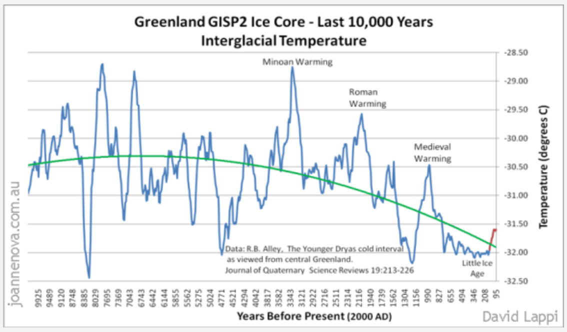
The big picture: 65 million years of temperature swings



Greenland Temperatures - last 10,000 years. Are we headed for an ice age? (See below for more detail.)

David Lappi is a geologist from Alaska who has sent in a set of beautiful graphs–including an especially prosaic one of the last 10,000 years in Greenland–that he put together himself (and which I've copied here at the top).

If you wonder where today's temperature fits in with the grand scheme of time on Earth since the dinosaurs were wiped out, here's the history. We start with the whole 65 million years, then zoom in, and zoom in again to the last 12,000 from both ends of the world. What's obvious is that in terms of *homo sapiens* history, things are warm now (because we're not in an ice age). But, in terms of *homo sapiens civilization*, things are cooler than usual, and appear to be cooling.

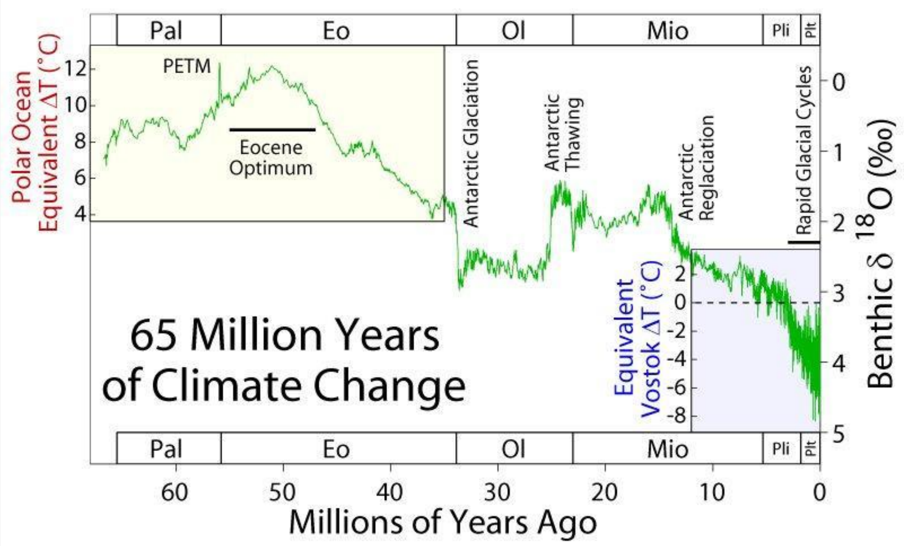
Then again, since T-rex & Co. vanished, it's been one long slide down the thermometer, and our current "record heatwave" is far cooler than normal. The dinosaurs would have scoffed at us: "What? You think *this* is warm?"

With so much volatility in the graphs, anyone could play "pick a trend" and depending on which dot you start from, *you can get any trend you want.* — Jo

GUEST POST by David Lappi

65 million years of cooling

The following two graphs (images created by Robert A. Rohde / Global Warming Art) are climate records based on oxygen isotope thermometry of deep-ocean sediment cores from many parts of the world [1]).   On both graphs, colder temperatures are toward the bottom, and warmer temperatures toward the top. Significant temperature events on the first graph show the start and end of Antarctic glaciation 34 and 25 million years ago, and the resumption of glaciation about 13 million years ago. It is obvious from the graph that we are now living in the coldest period of Earth's history for the last 65 million years. Despite recent rumors of global warming, we are actually in a deep freeze.

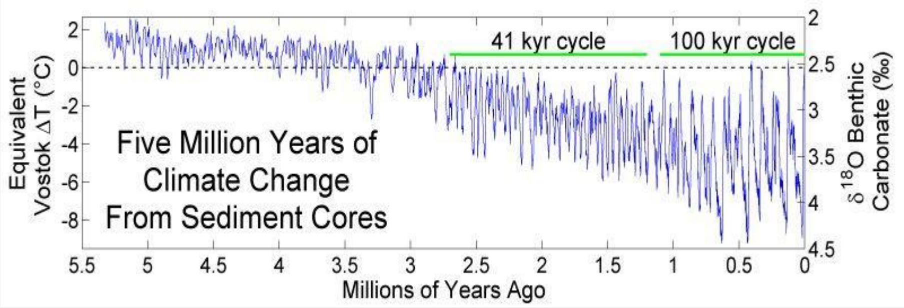


65 million years of global temperatures Image created by Robert A. Rohde / Global Warming Art

Image created by Robert A. Rohde / Global Warming Art

5 million years of cooling

The last five million years of climate change is shown in the next graph based on work by Lisiecki and Raymo in 2005 [2] . It shows our planet has a dynamic temperature history, and over the last three million years, we have had a continuous series of ice ages (now about 90,000 years each) and interglacial warm periods (about 10,000 years each). There are 13 (count 'em) ice ages on a 100,000 year cycle (from 1.25 million years ago to the present, and 33 ice ages on a 41,000 year cycle (between 2.6 million and 1.25 million years ago). Since Earth is on a multi-million-year cooling trend, we are currently lucky to be living during an interglacial warm period, but we are at the end of our normal 10,000 year warm interglacial period.



65 million years of global temperatures

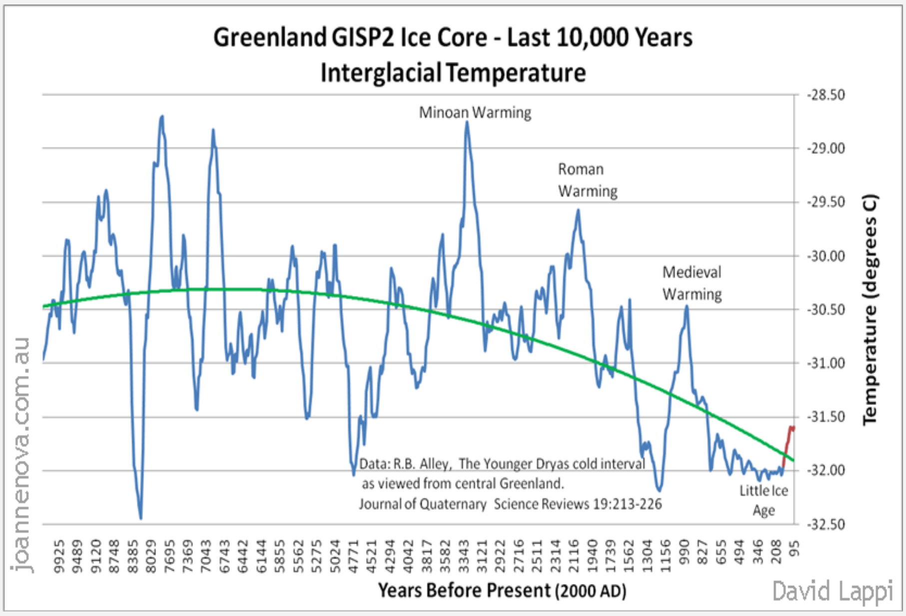
Image created by Robert A. Rohde / Global Warming Art

The last 10 millenia

To detail the more recent prehistoric temperature changes, scientists have drilled a number of ice cores in ancient glacial ice. Paleotemperature data from ice cores is considered to be our best continuous record of temperatures on the planet for time-spans up to about 420,000 years ago. Annual layering in undisturbed glacial ice allows us to precisely date the layers, and gives us a very accurate time and temperature sequence. The US government drilled the GISP 2 ice core in central Greenland over a five-year period, and the data is available here. This data set is useful because it reports temperatures (measured by oxygen isotopes) every 10 to 60 years — a good resolution. I sometimes see graphs of ice-core temperatures or greenhouse gasses that are based on measurements every 1,000 or 2,000 years: not nearly of close enough together for comparisons that are useful today. I downloaded and graphed these data in Excel myself. The following graphs have a time scale in years Before Present (BP).

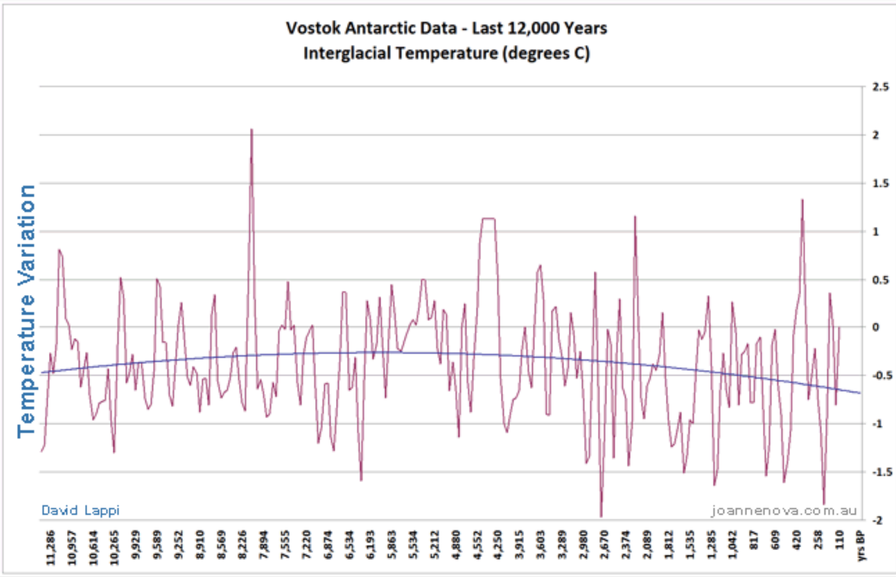
The next graph of temperature from the ice core for the last 10,000 years (the current interglacial period) shows that Greenland is now colder than for most of that period (vertical scale in degrees C below zero). We can see the Medieval Warm Period 800 to 1,000 years ago was not particularly warm, and the Little Ice Age 150 to 650 years ago was one of the longest sustained cold periods during this interglacial. We are now recovering from this abnormal cold period, and the recovery started long before anthropogenic greenhouse gases were produced in any quantity. The curved trend line in green shows that we have been experiencing declining temperatures for the past 3,000 years, and are likely to be heading down toward the next ice age. Temperatures are only considered to be increasing if viewed for the last 150 years, from 1850 onward, which is roughly when thermometers began collecting global data, and is also the period of time the UN’s Intergovernmental Panel on Climate Change (IPCC) has chosen for its review. The red portion of the curve is the recovery from the Little Ice Age. The amount of 20th century warming is unknown, since it was recently revealed that unknown portions of the international temperature databases have been tampered with, and the amount and extent of the tampering has not been publicly documented. It is likely that some warming has continued into the 20th century, but it is also likely that the amount of warming is not as great as the 0.6 degrees C that the global warming advocates would lead us to believe.

Our current warming is well within natural variation, and in view of the general decline in temperatures during the last half of this interglacial, is probably beneficial for mankind and most plants and animals. The graph clearly shows the Minoan Warming (about 3200 years ago), the Roman Warming (about 2000 years ago), and the Medieval Warm Period (about 900 years ago). Great advances in government, art, architecture, and science were made during these warmer times.



Greenland Temperatures - last 10,000 years

Long-term, temperatures are now declining (for the last 3,000 years), and we appear to be headed for the next 90,000 year ice age, right on schedule at the end of our current 10,000 year warm period. We have repeated this cycle 46 times in succession over the last 2.6 million years. And in case you are wondering, the previous Antarctic ice cores tell a broadly similar story.   The following graph of ice core data from Vostok (vertical scale in degrees C variation from present) shows that Antarctica is also experiencing a long-term (4,000 year) cooling trend mirroring the Greenland GISP2 cooling trend. Though the individual temperature spikes and dips are different than in Greenland, the long-term temperature trend on the planet appears to be down, not up. And since it is so late in our current interglacial period, we could be concerned about global *cooling*.



Vostok Antarctica, last 12,000 years

The US is currently drilling a new ice core (see here), already at 1,512 meters where it is 7,700 years old, that is dated absolutely by counting annual ice layers, and each layer will be analyzed for temperature, greenhouse gases, and other constituents. This will give us the best Antarctic record yet. I believe the results will confirm the above. We geologists owe it to policy-makers to give them the benefit of our longer-term perspective. I believe we will regret regulating CO2, since doing so will not produce any measurable climate control, and may actually cause great harm to world economies. If we want to promote renewable energy sources (and I do), let us not penalize fossil fuel production and use. We may soon need all the energy we can produce, if the long-term cooling continues.

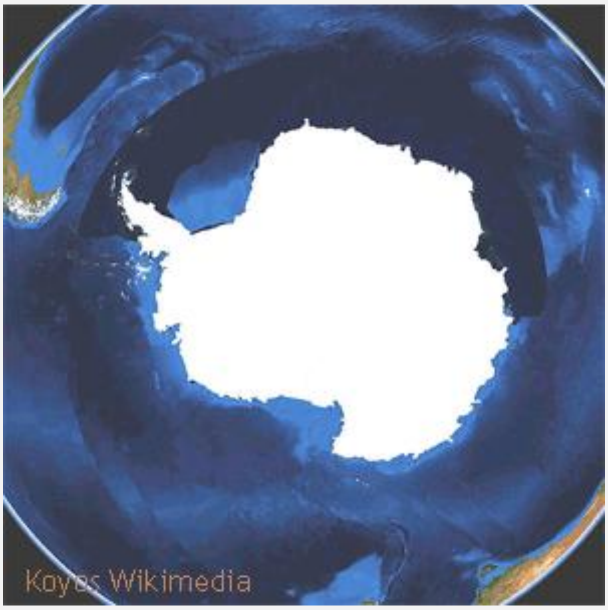
My main point is that natural variation is so large, even if we cease all emissions completely, the climate will still change (just look at the graphs). The cost of (possibly) slightly influencing this change is so great, why not spend a lot less adapting to it? Since we don’t know if the long-term climate is cooling or warming (I bet on cooling long-term), we could spend trillions to cut emissions, only to have the climate cool catastrophically on its own. What then? Pump as much CO2 into the air as possible?

Warming is not a killer, but global cooling is. It would only take a few years of global crop failures from cold weather to put populations at serious risk. Both the Antarctic and Greenland ice sheets are thickening: Leave anything on the ice, and it gets buried pretty fast (for example: the US South Pole Base was recently reconstructed because the old base was being crushed by snow and ice, and WWII planes lost on Greenland’s southeast coast, were *covered by 264 feet of ice* in 50 years: see the image below). This is not rocket science. Sure, the sea-level edges are retreating (that is why we call them the ablation zones of a glacier), but they represent a minute portion of the continent-scale ice mass.

"Glacier girl" crashed on Greenland and became buried under 264 ft of ice.

Joanne adds a few thoughts…

Antarctica: whiter than white, and its own separate system



Antarctica -- whiter than white

Greenland and the GISP cores are just one point on the globe. It's hard to know what temperatures in the tropics were by drilling in the Arctic Circle. However, we do have hundreds of studies regarding the Medieval Warm Period about 1,000 years ago, and, clearly, the higher temperatures affected most of the globe (as I discuss in my post on why the Hockey Stick is audaciously wrong).

But, the Vostok graph is not mirroring the detail in GISP. Why should we rely on Greenland as a better climate guide for the planet? Svensmark suggests that Antarctica responds uniquely. Because it is covered in Earth's most reflective ice and snow, it has a very high albedo, sending most of the incident sunlight right back to space. The Arctic is not as white, and neither is Greenland. Greenland is also tied to local water and wind patterns, whereas the Antarctic is more isolated, and completely surrounded by vast oceans. The result is that cloud cover changes have a different effect on Antarctica. The theory goes that if the world becomes cloudier, most places cool, but Antarctica *warms*. The cloud tops are actually *less* reflective than Antarctic snow, and they re-radiate the heat they absorb. They also trap heat from below, preventing it from escaping into space. An effect like this means that while Antarctica is a good indicator of big climate movements, it may not be so good for smaller changes on smaller time scales. Hence, Greenland may be a better indicator of planetary climatic trends over the past 10,000 years.

Not *another* IPCC-gate?

Fitting with this is the trend of the last few decades where most of the world warmed, but Antarctica *cooled* and its sea ice *increased.* And as it happens, just today comes word of another cringeworthy error in AR4: They managed to whitewash the steady growth in Antarctic sea ice, and underestimate it by 50%. (When the facts don't fit your theory, *change the facts…*)

Joanne Nova

http://joannenova.com.au/2010/02/the-big-picture-65-million-years-of-temperature-swings/

References:

1 J. Zachos, et al (2001) – *Trends, Rhythms, and Aberrations in Global Climate 65 Ma to Present*, *Science* 292 (5517), 686–693

2 L. E. Lisiecki and M. E. Raymo (2005) – *A Pliocene-Pleistocene stack of 57 globally distributed benthic δ18O records,* Paleoceanography 20, 1003

UPDATE: Sunday Feb 21, 2010 – The Gisp graph of the last 10,000 years has been updated to improve it. The old graph is here.