



Global Cooling?

Global cooling is a fundamental and natural part of climate change. It should be happening now without man's intervention. Climate scientists discovered these natural cycles back in the 60s in the earliest ice cores from Greenland when they were thought of as "noise" or unimportant information. In the 70s and 80, progressively more accurate ice cores began to dispel the previous assumptions and "modern" climate science was born. These natural cycles have happened maybe 25 times in the last 3 million years, almost every 100,000 years. They are caused by astronomical influences and amplified by natural climate feedback mechanisms like melting Arctic sea ice.

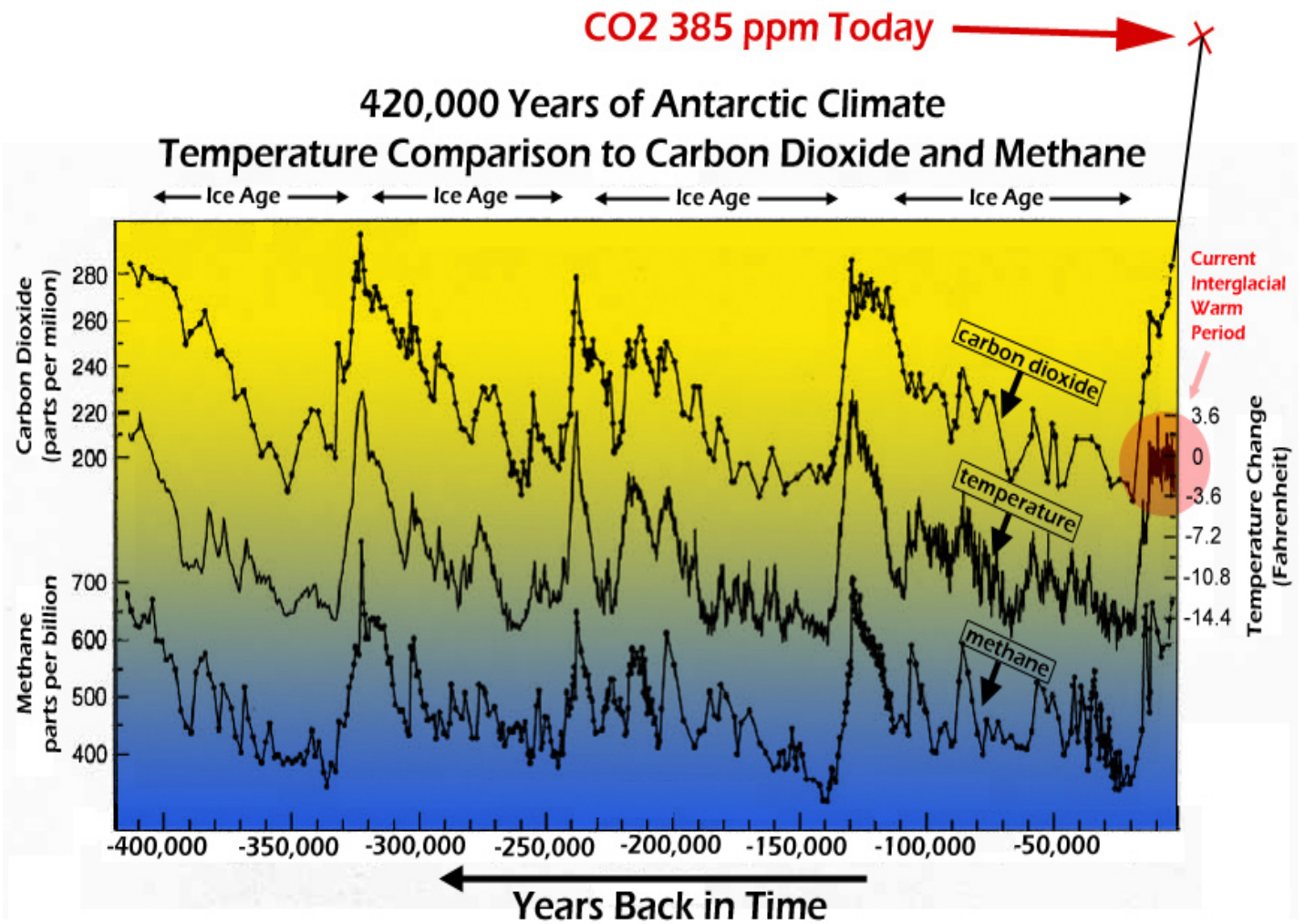
Each ice age is separated by a brief "interglacial warm period" that lasts no longer than a few thousand years. At least all of these interglacial warm periods last this long - except the one we are currently in. It seems that mankind's CO₂ has changed the normal pattern. Our current interglacial warm period is 10,000 years old and still warming - warming more rapidly than any previous interglacial warm period yet discovered. Today, if our CO₂ concentrations weren't higher than at any time, likely, in the last 20 million years, we would at this very instant in time be hurtling down the long icy slope into another ice age.

In 2003, a fellow named Ruddiman started publishing research that says that mankind started warming the planet, not during the industrial revolution, but 5,000 to 6,000 years earlier during the *agricultural* revolution. His theories were not widely accepted at first, but today there have been several more articles published that confirm his findings. It is beginning to look very much like man has been causing global warming for the last 5,000 or 6,000 years.

The graph below shows several chemical trace records from two miles of Antarctic ice core. Different ratios of different chemical isotopes can very accurately show CO₂, methane, Temperature and many more indicators of past climate (dust, pH, metals concentrations, sulfur concentrations, etc.) Only the last four ice ages are shown in this image.

The pattern is virtually identical back to 1 million years BP (before present). The previous 3 million years are very similar. Prior to 3 million years ago, the Isthmus of Panama did not exist, Greenland ice did not exist and the planet was a different place, generally a warmer place.

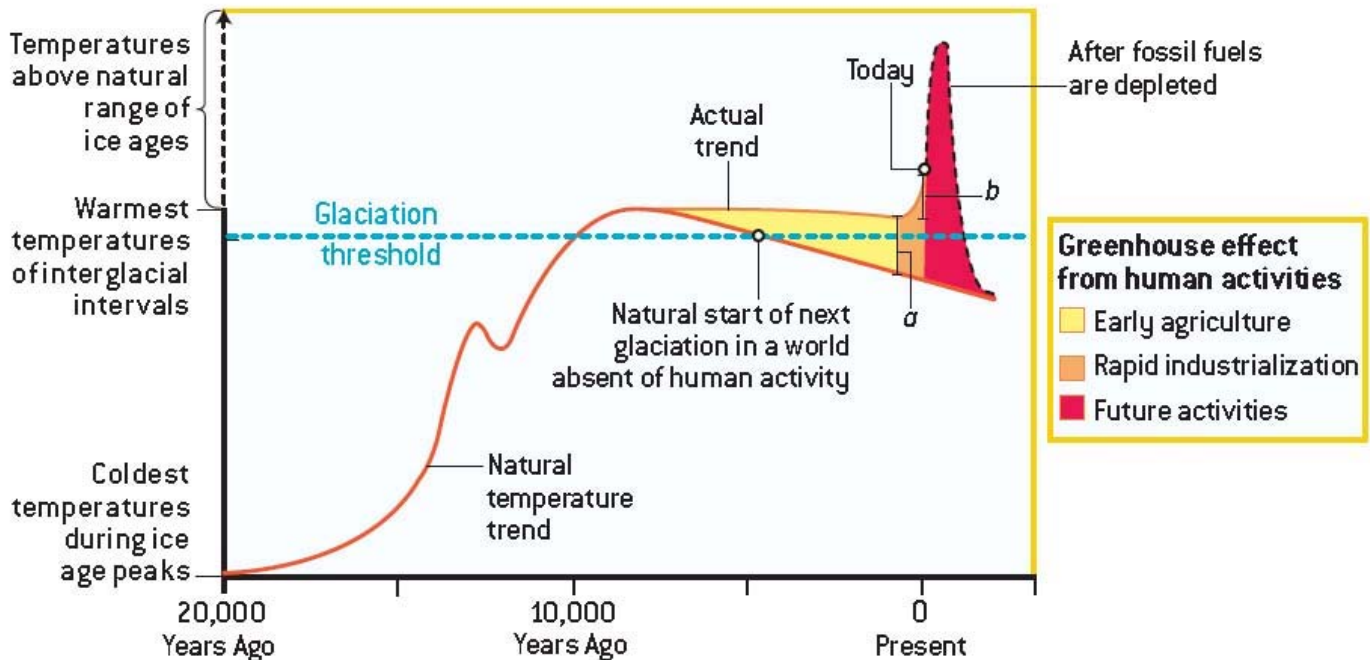
But CO₂ and CH₄ levels were far below where they are today. Also note while CO₂ concentrations at today's 385 ppm is 33% or more above anything in the last 800,000 years, it is also likely to be higher than anything seen in the last 20 million years, even though the planet was a warmer place just three million years ago, and that methane concentrations today (not shown) are at 1,700 ppm which is 130% higher than the average methane concentration for at least the last 800,000 years and quite likely the last three million years.



Data Source: Petit, et.al., Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica, Nature Volume 399, June 1999, NOAA, National Climatic Data Center, Department of Commerce.

These dramatic and likely, entirely unprecedented, increases in these two very important greenhouse gases have occurred during and after mankind's industrial revolution.

Ruddiman's Theory – Agriculture, not Industrialization Started Global Warming This is Ruddiman's Theory (it used to be Ruddiman's Hypothesis, but because it is becoming more widely accepted, it can now be rightly called a "theory"). This theory looks at the last 20,000 years of temperature on the planet. In the image on the following page, you can see the spike in temperatures that started in the 1800's in orange - the red is projected warming. The yellow is warming caused by the agricultural revolution. The orange line is the cooling that should have happened naturally, like in the past 25 ice age interglacial events, three of which are shown in the above graph.



GREENHOUSE EFFECT from human activities has warded off a glaciation that otherwise would have begun about 5,000 years ago. Early human agricultural activities produced enough greenhouse gases to offset most of the natural cooling trend during preindustrial times (yellow), warming the planet by an average of almost 0.8 degree Celsius. That early warming effect (a) rivals the 0.6 degree Celsius (b) warming measured in the past century of rapid industrialization (orange). Once most fossil fuels are depleted and the temperature rise caused by greenhouse gases peaks, the earth will cool toward the next glaciation—now thousands of years overdue.

Ruddiman Hypothesis: Scientific American , March 2005

Abrupt Climate Changes happens all the Time There are many scenarios where different explosively accelerating feedback loops could plunge the world into ice age, or just the opposite, into runaway global warming. Abrupt climate changes could be explosive warming that might or might not stop at some yet never-encountered warm climate state of our planet's ecosystem. In our current continental configuration - after the closure of the Isthmus of Panama three million years ago, we have never been significantly warmer than we are today, and likely the planet's temperature has been no more than 1 degree C warmer than it is now, and possible no warmer at all. In time spans that matter – to the present day Earth, in our current tectonic configuration with our current solar radiation - It could very well be that today is as warm as it has ever been, in relevant climate terms, on this planet.

You see, before the Isthmus of Panama, ocean circulation was vastly different. The pacific loop current came into the Atlantic - much, much differently than today. Today it is the Atlantic current that drives world climate - because it is able to develop significant currents at high latitudes because of lower latitude warming and higher latitude cooling: it's all about the Gulf Stream. The warmth of the tropics evaporates an incredible amount of water from the Atlantic current on its way north. The further north the Gulf Stream flows, the cooler of course - losing its warmth to Europe because the Coriolis effect spins it east. As it cools it gets heavier, finally, somewhere north of Iceland it starts sinking. (Together this effect - the increasing salt content because of evaporation and cooling because of latitude is called the thermohaline

circulation).

This sinking water is the actual drive for the entire current system. It sinks to the bottom of the ocean and because it has nowhere left to go, flows south along the bottom of the Atlantic underneath the northward flowing Gulf Stream, all the way to the tip of Africa. It then proceeds, on the bottom of the ocean, around Australia and through the great rifts of Indonesia into the Pacific where it finally warms and becomes diluted enough (the saltier water is heavier than less salty water) to rise to the surface in the North Pacific, in the general area between Hawaii and Japan. It then is forced back southward and westward, by other smaller currents, on the surface, and eventually finds its way back to the southern tip of Africa and starts the journey up the Atlantic to the Gulf Stream all over again (warming all the way). This trip takes 1,000 years. It is one of the main reasons why there is a big climate lag (30 to 200 years or more). This is why our climate reacts slowly to changes in greenhouse gas concentrations.

It's not the time to complete the loop makes the lag, but the time it takes for the surface waters, that are rising in the Pacific to become saturated with CO₂, the amount of sea ice on the planet, which regulates the atmospheric ocean contact, which directly influences the ability of the ocean to absorb CO₂. There is a reason why climate science is the most complicated science ever known. Besides for it being directly associated with virtually every known field of science, like say solar physics, it is speculative. We have never seen it occur. We have records that show it has occurred in the past, but the only way we know how it might occur in the future is through hypothesis and computer modeling.

So, the Atlantic current did not behave like it does today prior to the closing of the Isthmus of Panama. It had input before from the much less saline Pacific Ocean, changing its characteristics. Back then, climate was distributed across the globe in a very different manner from today.

Abrupt Cooling Today – Thermohaline Circulation Shutdown The most likely, and very well studied abrupt climate change that has happened many times in the past is the shutdown of the Gulf Stream, or the thermohaline circulation. It can be caused by at least two different mechanisms that probably work together in most cases. Records show that many of Earth's abrupt climate changes have occurred simultaneously with a thermohaline circulation shutdown. Great freshwater influx from a melting or disintegrating ice cap can cause the circulation to be less salty. This “freshening “ of the ocean waters creates much less dense water than would have otherwise sank to the ocean floor naturally. The less dense water does not sink and the ocean current slows or stops because the sinking water is the driver, or the engine that runs the current.

The other method involves increased sea ice cover that does not allow the ocean water to cool as rapidly. Ice is a great insulator and not only keeps the water below warm through its insulative properties, but also keeps the winds from stirring up the water's surface layers and allowing even more cooling. The warmer water is less likely to sink, and the current is slowed or shuts down.

The results are that there is less warm water in the north, more cooling downwind (Europe and Scandinavia and Russia). More sea ice forms and then there is less warming of the ocean waters in a feedback effect that amplifies the relatively local cooling (Europe through Russia). So, the more it cools, the more sea ice forms cooling the climate even more.

We are currently seeing a rapid melt in Greenland, but the computer models indicate that so far, and as projected, the inflow of fresh melt water is not enough to affect ocean circulation and will likely not be a factor. Even so, some recent studies have shown a decisive freshening of northern Atlantic waters and even a significant slowing sinking in the far north Atlantic and slowing of surface and subsurface currents in the Atlantic. But a new study, albeit only with a small amount of data, has shown no changes that are relevant.

The reality is that the Gulf Stream runs at a rate of about 3 cubic miles of water a minute or about 300 billion gallons per second. Small changes could cause a great change given the conservative nature of the climate models. Or maybe not, the data is conflicting and sparse. But what we do know is Gulf Stream shutdown has occurred simultaneously, likely most of the time, with abrupt climate changes in the past. We know that we are overdue for the cooling to begin in the next glacial cycle. Still our climate is warming in contradiction to the all of the natural changes that have occurred in the past.

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