EUREKA!
STARTLING INFORMATION FROM DEEP ICE

The 8200 Year Event

About 8,200 years ago our planet experienced its biggest and most abrupt climate change of the last 10,000 years. Ice cores from Summit, Greenland have shown scientists that the temperature had fallen almost 11 degrees and snow accumulation had decreased by 20%. The changes, which took just a few years to occur, affected most of the Northern Hemisphere. Tropical rainfall amounts decreased significantly. Forest fires increased 90% with a brief peak of 500%. Pacific ocean water temperature near Indonesia fell very rapidly by 5.4 degrees. The water in Lake Huron fell by 130 feet. Cold, dry, and windy conditions dominated the world during this period, similar to ice age climates. The changes persisted for 200 years before rising back to normal.

This abrupt climate change, like most abrupt climate changes is thought to have had multiple causes. A possible trigger, which is still debated in academic circles, is the failure of a great ice dam over Hudson Bay.

Lake Agassiz

The melting Canadian ice sheet had created a lake larger than any freshwater lake on the planet today. Called Lake Agassiz (Figure 6.1), this lake breached its ice dam and flowed into the North Atlantic through the Labrador Straits. The lake drained over the time span of a few years to a few decades. As it drained, the increased amount of fresh water in the North Atlantic affected the ocean currents there. It is a common theory that buoyant freshwater in large quantities can interrupt more dense saltwater ocean currents.

Figure 6.1 Lake Agassiz and the Laurentide Ice Sheet

Reference: Derived from Teller, et. al., 2005, Barber, et. al., Dyke, et. al., 2002, Holmes, et. al., 2004

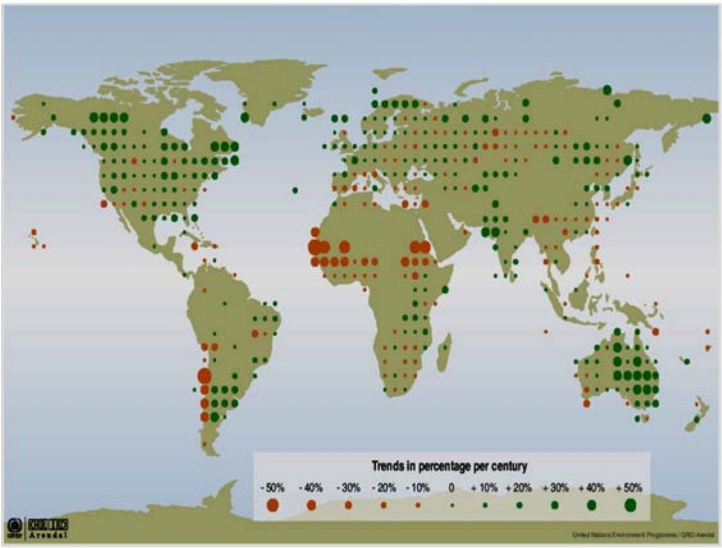
When this happens, the great ocean current can weaken or even reverse in the North Atlantic. (See the explanation of the great ocean current or thermohaline circulation in Chapter 9.) There is also evidence that the great ocean current, for other reasons, was already weakened at about this time – which would more easily allow the outflow from Lake Agassiz to further weaken or reverse the great ocean current. After the current was disturbed, feedback cooling rapidly cooled the northern hemisphere.

Oceanographic studies by Ruth and William Curry of the prestigious Woods Hole Institute show that the subpolar North Atlantic has recently become dramatically less salty, while the tropical oceans around the world become saltier. This increase in northern ocean fresh water is directly linked to global warming due to increases in rainfall and ice melt in northern latitudes (Figure 6.2). The saltier tropical waters have been caused by increased ocean evaporation also due to global warming. These ocean salinity changes, which help drive the great ocean currents, play a significant role in the ocean currents in the North Atlantic and are the primary suspect in the triggering of abrupt climate change.

North Atlantic Trigger

Richard Alley, Professor of Geosciences at Pennsylvania State University, one of the most published climate scientist of our time, predicted in 1997 that a similar fresh water inflow of this proportion might occur in the future. This freshwater inflow to the North Atlantic will, of course, not come from the bursting of an ice sheet dam of a gargantuan end-of-glaciation melt water lake.

Figure 6.2 Annual Precipitation Trends 1900 to 2000



Reference: United Nations Environment Programme / GRID Arendal

As is being seen today, and as has been described by the Curry's at Woods Hole, it could instead occur because of increased rainfall due to global warming. Alley says global warming of a little over 5 degrees, forecasted to happen in the relatively near future with a doubling of atmospheric carbon dioxide, "…could cause major climatic perturbations on the socially important time scales of decades or centuries."

The Little Ice Age and Medieval Warmth

The abrupt climate change of 8,200 years ago was one of the smaller, more recent changes documented in our new climate records. The Little Ice Age, the climate shift that wreaked havoc on the northern hemisphere between 1350 and 1850 is even smaller still. Figure 6.3 shows these two climate changes from our recent past and compares them to the new ice records.

Figure 6.3 1800-year Reconstructed Temperatures Compared to Greenland Ice Recoreds

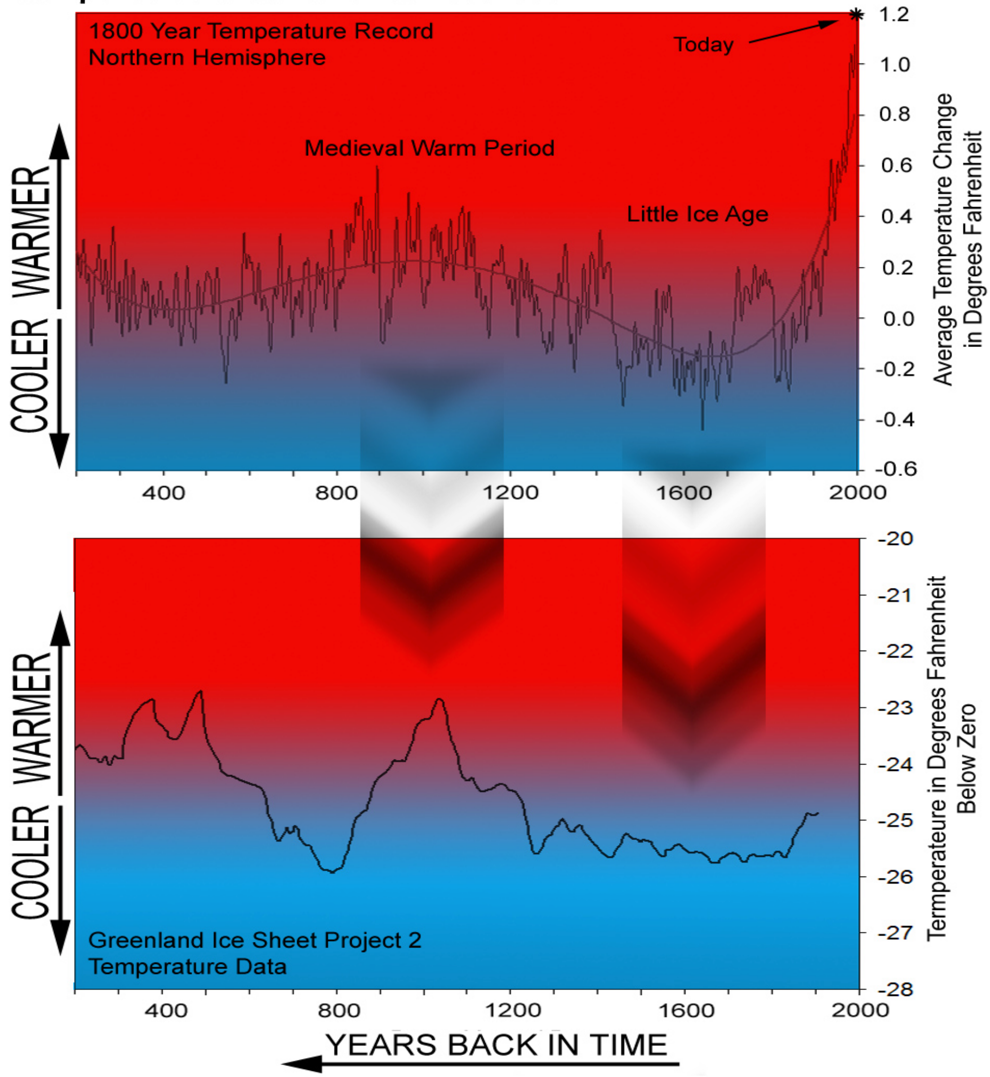


Figure 6.3 *These graphs show two sets of temperature records. The top is the temperature reconstruction from Jones and Mann that uses data from thermometers and physical temperature record constructions from growth rings from trees, corals and cave formations. The lower graph shows the ice record of temperature change from Greenland. The jagged lines represent the actual temperature. The smooth line in the upper graph represents the averaged temperature that more easily shows the Medieval Warm Period and the Little Ice Age. No average temperature line is shown in the lower graph because the peak of the Medieval Warm Period, and the general depression of the Little Ice Age are easily seen. These two climate periods had such small temperature changes from the normal global temperatures yet were responsible for regional and possibly global impacts. Data Source: Jones, P.D. and Mann, M.E., Climate over past millennia, Review of Geophysics 42, RG 2002, May 6, 2004. R. B. Alley, 2004, GISP 2 Ice Core Temperature and Accumulation Data, IGBP PAGES/World Data Center for Paleoclimatology, Data Contribution Series #2004-013, NOAA/NGDC Paleoclimatology Program, Boulder Colorado, USA.*

Yet, the Little Ice Age has been credited with disease of incredible proportions and agricultural failure that affected entire regional areas. Specifically, the Plague and the Irish Potato Famine may very well have had ties to this relatively minor climate change.

These two graphs show several important pieces of information. The first is that the two climate periods, the Little Ice Age and the Medieval Warm Period, are easily compared between the two graphs. The amount of warming and cooling during the two periods differ and the shapes of the graphs differ, but the general representation of a climate change is visible in both graphs. This is typical of the way that climate changes compare between the ice records and global temperatures. The ice record is a local image of past climate. The global temperature record or hemispheric record is an average. The ice record shows what the weather was doing at that one local point on the planet. The temperature record combines the weather record from many different regions and is less variable than the record from a single place.

Another major aspect of the comparison of global temperature record to arctic ice records is in the amount of temperature change shown in each record. During the Medieval Warm Period the Greenland ice record shows nearly 3 degrees of change while the global temperature record shows only 0.8 degrees of change. This difference is a result of averaging temperatures from many different regions that are affected differently by the climate change. For example: Parts of the southwestern United

States have recently recorded average annual temperature increases of 5.4 degrees that are directly attributable to global warming, while parts of Texas have seen about a 1 degree decrease in average annual temperature over the same period. The average is 2.2 degrees, which is not nearly so abrupt as the regionally specific temperature change of 5.4 degrees in the southwest U.S.

The Tip of the Iceberg

The final thing to remember about The Little Iced Age is that it represents only the smallest changes in climate from the ice records. Figure 6.4 shows 50,000 years of the new climate record. It is obvious from this graph how unstable the climate has been. The Little Ice Age in comparison to the 8,200 year event is quite small. And the 8,200 year event, compared to the rest of the ice record is small even though a temperature change like the one that occurred during the 8,200 year event would likely push the earth's climate into or near a quasi-glacial state.

The Little Ice Age and Medieval Warm Period are small changes in comparison to the repeated and abrupt changes our climate experienced during the last 110,000 years. The ice records show in great detail that abrupt changes of 20 to 25 degrees have occurred 37 times during this period. The climate abruptly warmed twenty four times and cooled thirteen times. Some of these changes occurred over the period of a human lifetime. Others occurred in only a decade or two. Mostly startlingly, some of these changes occurred in as little as a few years.

Highly accurate 110,000 year climate records from two identical ice cores, 20 miles apart – the European Greenland Ice Core Project (GRIP) and the American Greenland Ice Sheet Project (GISP), are widely accepted as the pivotal point in the reconstruction of earth's climate history.

These 10,000-foot deep ice cores were simultaneously drilled 20 miles apart for direct comparison in order to establish the highest possible accuracy of the data. This effort was very successful. From the present down to 110,000 years ago, direct comparison of the two cores shows almost identical climate patterns. The results of this work, published beginning in December 1993, began a new era of climate research. The results were so accurate and so highly detailed that abrupt climate change theories were then readily accepted as well established facts in the study of our ancient climate.

Figure 6.4 50,000 Year Temperature Record
Greenland Ice Sheet Project 2, 1997

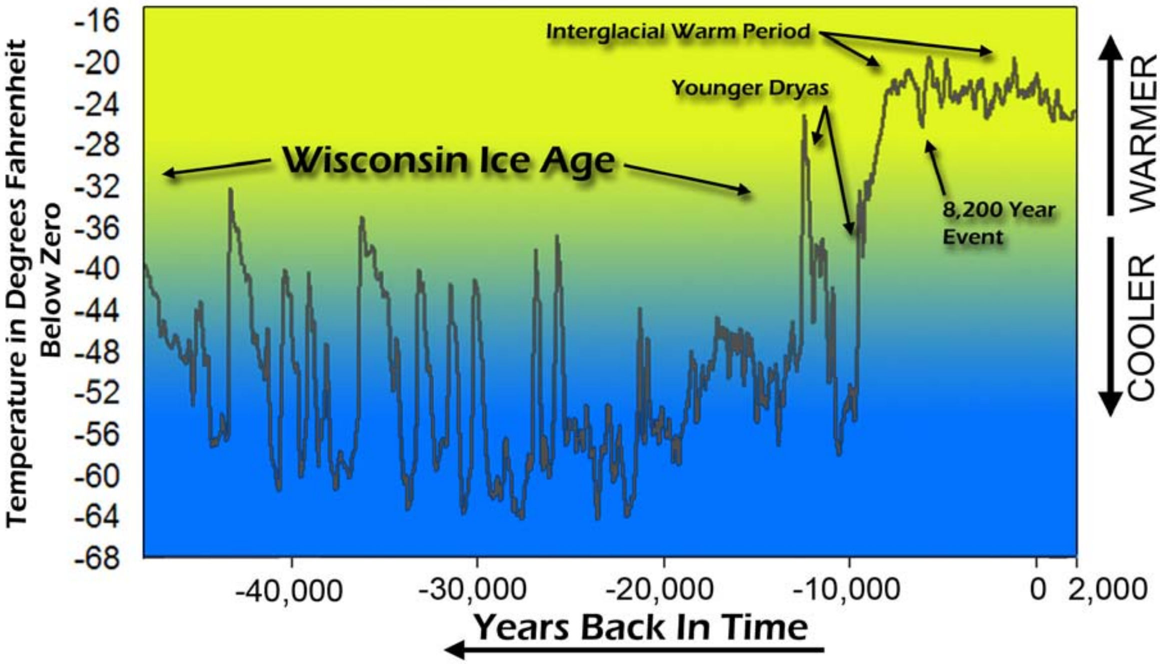


FIGURE 6.4 *This is what the temperature on the Greenland ice sheet looked like during the last 50,000 years. These temperatures were determined from laboratory techniques that analyze atmospheric gases preserved in the ice. The saw-tooth pattern of the graph shows rising and falling temperatures from left to right, over time, starting at about 50,000 years ago. The scale on the left shows the temperature spread ranging from the coldest of -68 degrees below zero to the warmest of -16 degrees below zero. Temperature changes worldwide during this period, in some cases were similar to the Greenland changes. These abrupt changes of temperature of 20 to 25 degrees generally took less than a human lifetime, and sometimes happened in only a single decade or even less. Data Source: R. B. Alley, 2004, GISP 2 Ice Core Temperature and Accumulation Data, IGBP PAGES/World Data Center for Paleoclimatology Data Contribution Series #2004-013, NOAA/NGDC Paleoclimatology Program, Boulder Colorado, USA8,200 year event would likely push the earth's climate into or near a quasi-glacial state.*

Eureka!

The flood of academic papers in 1993 following the discovery of the extraordinary ice data left few questions about the validity of the new climate record. This was the Eureka moment. Scientists like Richard Alley, William Dansgaard, Kendrick Taylor and Pieter Grootes worked tirelessly to introduce data from earth's new climate history to the world. After these papers were published the consensus regarding abrupt climate change was undeniable. The climate history of our planet was indeed far, far more volatile than almost all of the climate theories from the last century had led us to believe.

Huge changes in temperature were shown to have affected our planet in unimaginably short periods of time. These new ice records represented a fundamental shift in the understanding of our climate. Since the turn of the century it has been a relative certainty that our climate changed very, very slowly. But the climate scientists who taught us about the glacial pace of climate change had no idea of the degree of the true instability of our planet's climate.

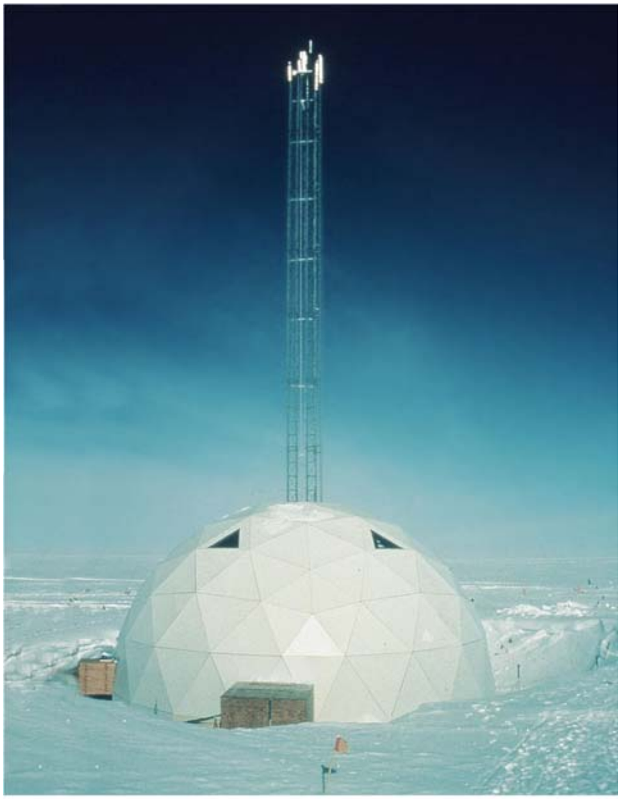


Figure 6.5 Ice Drilling Shelter, Greenland Ice Sheet Project 2 (GISP2)
Photo Source: Mark Twickler, University of New Hampshire

They believed, as we all did, that climate changes progressed on a geologic timescale, that our earth had a nearly limitless buffering capacity, and that there was nothing that man could do that could impact our world's weather.

The most alarming reality of the new climate record is the extreme magnitude of these abrupt change events and the very short amount of time that it took for these changes to happen. The saw-tooth shaped graph in Figure 6.4 showing temperatures across time is drawn from central Greenland ice core research. Since the Greenland research was done, these same abrupt climate changes have been identified across the globe and have been dated to exactly compare to the ice records of Greenland.

Glacial periods, or ice ages, last for about 100,000 years and are separated by interglacial warm periods which each last about 10,000 years. Our most recent ice age is called the Wisconsin Ice Age and we are currently at about the end of the 10,000 year long warm period following the Wisconsin.

The interglacial warm period that controls our climate right now is shown in the above graph as the smaller less radically shaped saw-tooth line high on the right side of the graph. The interglacial warm periods are significantly more stable than the ice ages. Even so, many abrupt changes with global impacts can be seen in the stable interglacial period. The 8,200 year event, Little Ice Age and Medieval Warm Period all occurred during the interglacial warm period. The climate changes of typically three to five degrees have been associated with major regional catastrophes and even the fall and or disappearance of entire civilizations.

For instance, the Dust Bowl during the Great Depression is now being associated with global climate change. Many of the great civilization disappearances of the past can be linked to global climate changes caused by relatively minor fluctuations in global temperature. These great disappearances include the Anasazi civilization of the American Southwest, the Inca and Mayan civilizations, the Egyptians and the Acadians.

This type of climate change is not supposed to happen in this world with the climate history that we recognize. Yet, we have known since the 1960s that the ice has shown these incredible changes. Like other scientific breakthroughs of extraordinary significance, the acceptance of the new knowledge will be difficult to achieve.

A Hard Theory to Swallow

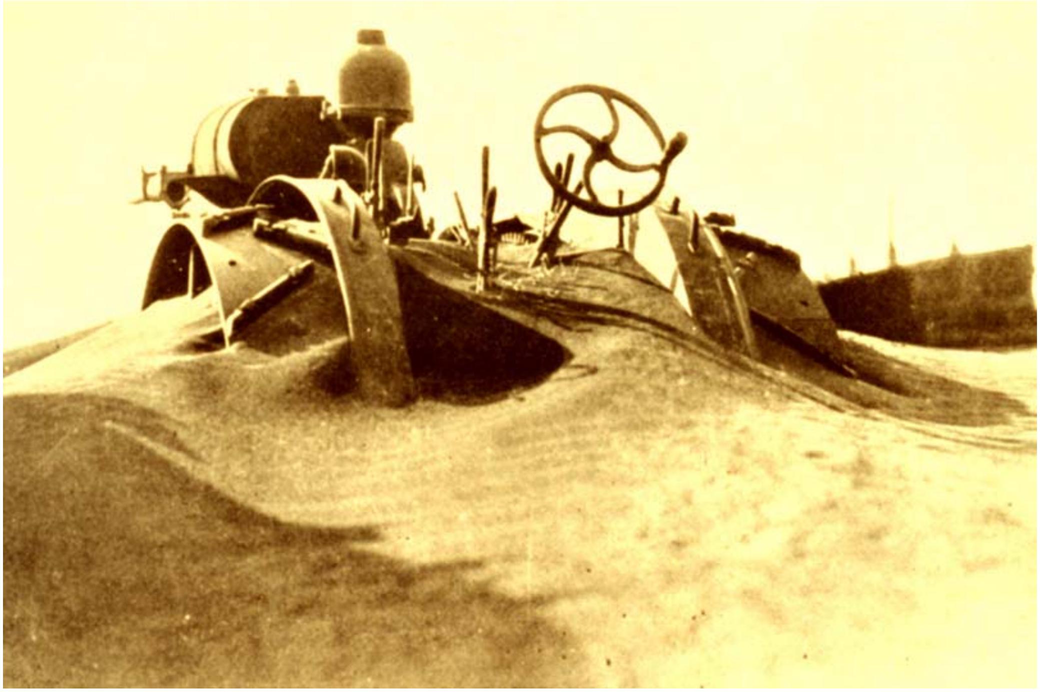
When continental drift and the theories of plate tectonics were first revealed in the early part of the twentieth century, they were basically dismissed as hypothetical. It took 50 years for the reality of these theories to become accepted as valid. The same thing has happened with global warming. Although global warming theories have been around since the 1920s, global warming has only recently become accepted as a reality across the planet.

Now, one of the most well-established and basic concepts of earth science has been found to be in need of significant revisions. The ice age theories of the 20th century are no longer accepted fact. The old theories have been replaced by new theories that are more reliable, with better confirmation and higher accuracy. The geologically paced theories have been radically altered. Our climate is affected by extreme and abrupt temperature changes and this trait extends back 900,000 years, to the oldest ice recovered from the Antarctic ice cap.

Stable Ecosystems

So why is our climate so much more variable than was thought for the last 100 years? Why is our climate so volatile? The basic reason is that earth is an ecosystem. Ecosystems are stable as long as they don't include too much or too little of any number of given ecological ingredients that work together to make up the whole ecosystem.

The sand hills ecosystem on the Great Plains of North America easily illustrates a stable ecosystem that looses its stability. When there is enough rainfall,



the grass on the Great Plains is fine. But kill the sea of grass in a great drought, blow away the topsoil, and only sand dunes and cactus are left.

In other words, the grassland ecosystem collapses and is replaced by a desert. A big portion of the Great Plains, from the Panhandle of Texas to the Great Plains of Alberta, from the Mississippi River to the Rocky Mountains, over the millennia, has routinely changed back and forth between blowing sand and grasslands.

The giant ecosystem that is our earth works similarly. It can only absorb so much of a change in its ecological ingredients before a threshold is crossed and the stable ecosystem is abruptly replaced by something else. The following is a small part of the Greenland ice record that dates back 50,000 years before 1950:

Figure 6.6 Temperature Record, 31,000 to 37,000 Years Before Present
Greenland Ice Sheet Project 2, 1997

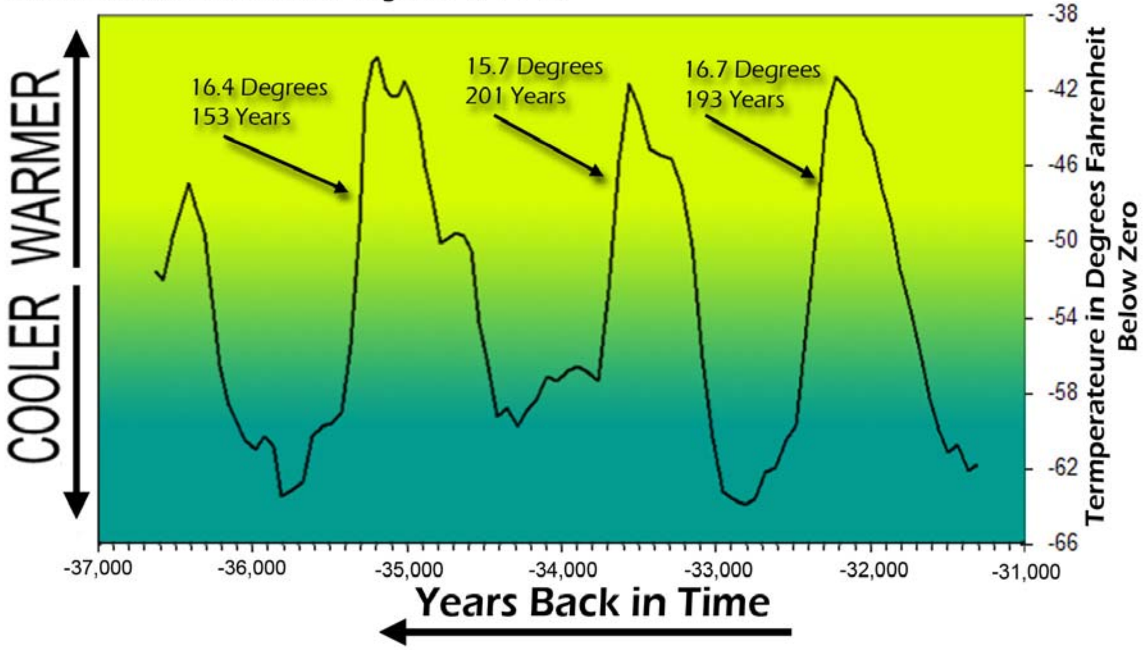


Figure 6.6 *This figure shows three abrupt climate changes from Figure 6.4. Data Source: R. B. Alley, 2004, GISP 2 Ice Core Temperature and Accumulation Data, IGBP PAGES/World Data Center for Paleoclimatology, Data Contribution Series #2004-013, NOAA/NGDC Paleoclimatology Program, Boulder Colorado, USA*

This graph shows a 6,000 year section of Figure 6.4. The three peaks in this graph represent three abrupt changes, each cycle taking about 1,000 years. The average of the temperature changes is 16.2 degrees in 182 years. This temperature change equals about 0.9 degrees per decade, or 10 times faster than climate change today. These 23 to 24 degree temperature changes, that are even larger elsewhere in the record, represent swings in and out of an ice age climate. Changes like these would change the climate in Houston, Texas to one like Minneapolis, Minnesota. And sometimes, the temperature changed even more and even faster than is shown.

The Younger Dryas – An Ice Age Flower

One much-studied abrupt climate change is called the Younger Dryas. This name refers to a tiny flowering tundra plant called dryas octopetala common during ice age periods. The pollen of the dryas flower shows up as a common and significant marker for ice age environments in ocean and lake sediments. Younger refers to the last period of glaciation from which this pollen is found.

Dryas octopetala - the glacial environment marker for ice age conditions. Peteet, D. 1995 (rights unsecured)

The amazing thing about the Younger Dryas is the extreme temperature change that happened during this period. Richard Alley thinks that the Younger Dryas could have had one big temperature rise of about 20 degrees that occurred in as little as 15 years.

What happened during this period is that the Wisconsin Ice Age suddenly ended with an enormous temperature spike of about 25 degrees, and then the climate just as suddenly fell back to ice age cold. The climate remained in the deep freeze for another 1,000 years before abruptly rising to nearly the warmth of today. This final sudden end to the Wisconsin happened over only a few decades. Jonathan Adams, another very prominent climate scientist, says that this event occurred with a speed that is probably representative of similar but less well-studied climate transitions during the last few hundred thousand years.

Figure 6.7 shows The Younger Dryas period of the Greenland temperature record:

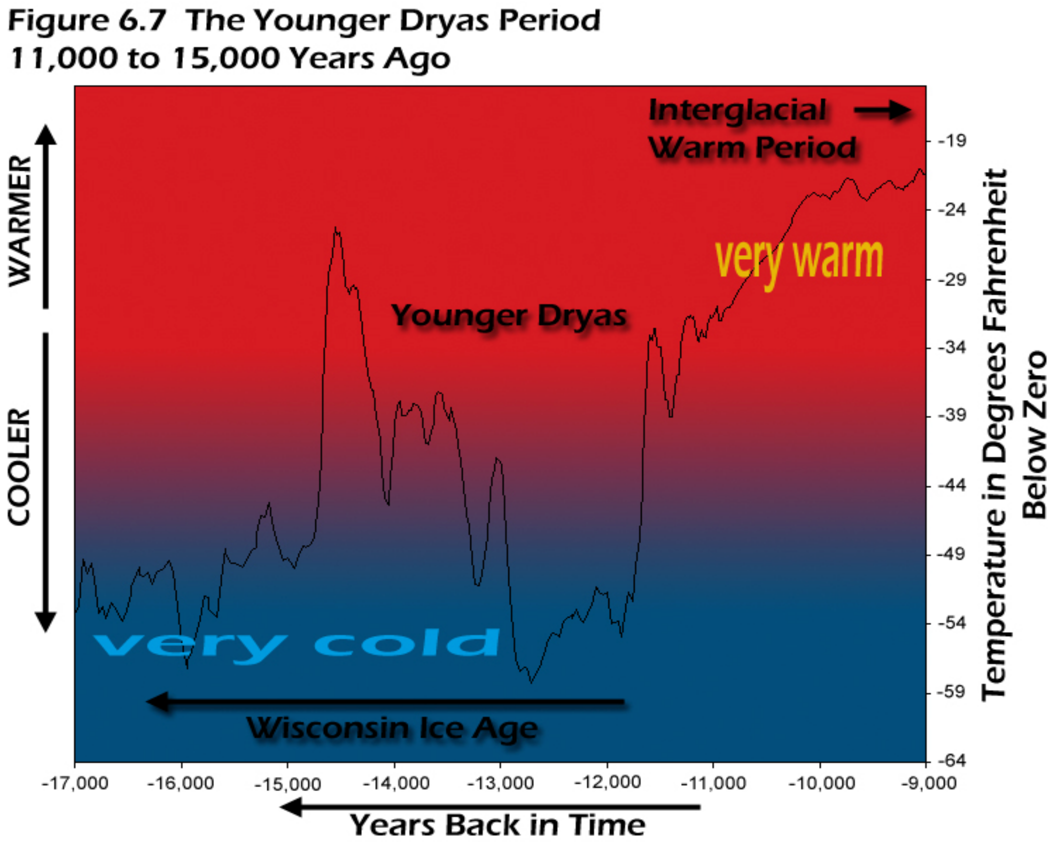


Figure 6.7 *This graphic shows a period called the Younger Dryas. This name refers to a tiny flowering plant common during glacial periods of the species dryas. The pollen of the dryas flower shows up as a common and significant marker for glacial environments in ocean and lake sediments. Younger refers to the last period of glaciation from which this pollen is found. The big temperature rise is approximately 25 degrees occurring in 15 years. Source: R. B. Alley, 2004, GISP 2 Ice Core Temperature and Accumulation Data, IGBP PAGES/World Data Center for Paleoclimatology, Data Contribution Series #2004-013, NOAA/NGDC Paleoclimatology Program, Boulder Colorado, USA.*

Remember, these temperature records must not be confused with worst-case scenario climate modeling. These temperature records ARE the record of our climate from the past. These climate patterns have repeated themselves many times in the past and they will continue repeat themselves in the future. This planet's climate will repeat itself with us or without us.

Remnant Ice Cap – Baffin Island, Canada

Same Ice Story at the South Pole

Figure 6.8 shows over 400,000 years of climate records from deep ice in Antarctica. This graph shows four ice age periods separated by what are called interglacial warm periods. The warm periods are the four spikes that reach towards the top of the three graphs. Notice how they align so that increases in temperature, carbon dioxide and methane occur at the same time. The far right side of the temperature graph, where the temperature line does not rapidly fall after it reached its warmest temperature, shows that we are currently in one of the longest interglacial warm periods ever seen.

Figure 6.8 Temperature Comparison to Carbon Dioxide and Methane

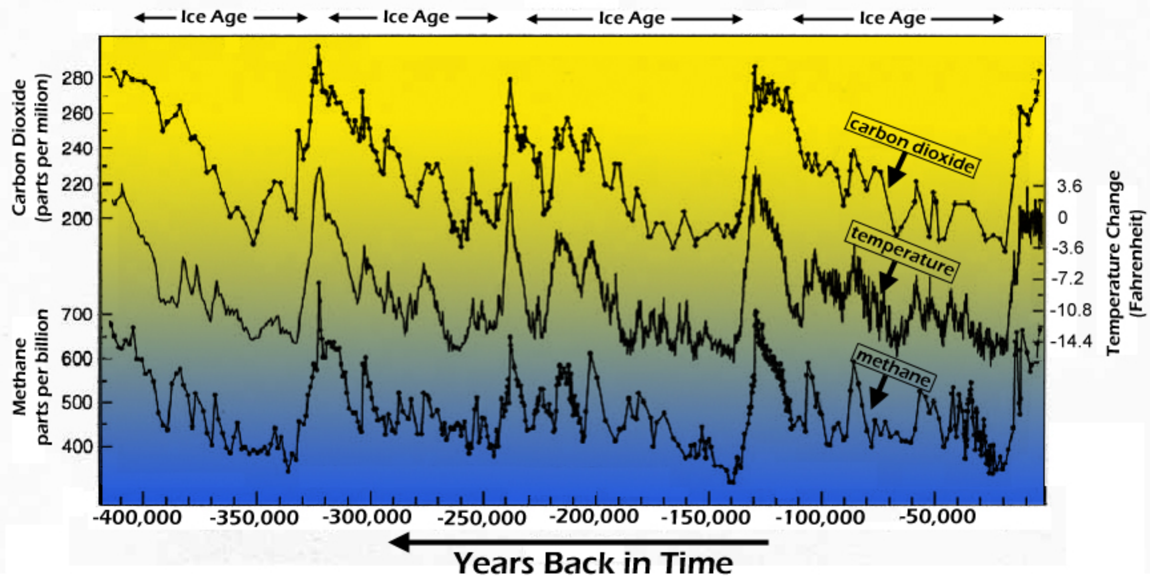


Figure 6.8 *This graph shows several relationships from Antarctic ice. Carbon Dioxide (CO_2) is the top saw-tooth shaped data set with it's legend from 220 to 280 parts per million located on the top left side of the graphic. Temperature is the next line down with its legend in degrees Fahrenheit on the top right. Methane is the next jagged line down with a legend on the left from 400 to 700 parts per billion. Reference: CO2 and Temperature over the Last 420,000 Years: Present and Projected Climate Changes in Perspective, USGCRP Seminar, 30 September 1999.*

After every interglacial period there is another 100,000 yearlong ice age. This pattern has been repeating itself for about the last 900,000 years. It is now fairly well understood that we are due for the transition to the next ice age to begin.

The last interglacial warm period ended with a gradual decline over several thousand years culminated by a 25 degree drop in 70 years. The 100,000 year ice age periods separated by the relatively short interglacial warm periods are generally believed to be the result of the Milankovitch cycles discussed in Chapter 8.

Milankovitch cycles however, cannot be responsible for climate changes below time spans of about 17,000 years. As the ice records clearly show, abrupt climate changes occur much more often than every 17,000 years. Some other climate trigger must be responsible for these changes that occur so regularly through the ice record at periods of 2,000 to 4,000 years. Forecasting the future climate however, is even more difficult than forecasting the daily weather. To improve these forecasts, or climate models, we need to continue to look to our climate history and to plan for a future based on information from the past.

The most important thing that this graph shows us is that the changes in carbon dioxide and methane concentrations happen at the same time as the temperature changes. There is still some debate about which comes first, climate change or increases in carbon dioxide or methane, and the amount of influence that these gases and other things have on abrupt climate change, but that is not the point of this discussion. The big picture shows us that these changes happen, they happen quickly, they happen often, they generally happen across the planet, and the effects of these climate changes are far more significant than global warming as we know it.

Out-of-Control Global Warming

Our planet has warmed about 1 degree in the last 100 years because of global warming. Mankind has so altered this planet that we have reached the point where it is affecting the weather.

Back in the 1960’s and 70’s, theoretical climate researchers told us that someday this time would come. Someday the burden of our civilization would become so large that it would begin to affect the planet as a whole. There is no longer any speculation about when this time will come. It is here today, and carbon dioxide is a big part of this burden. Evidence of mankind’s burden on the planet is shown in the changing carbon dioxide concentrations preserved in air bubbles in glacial ice.

Figure 6.9: Carbon Dioxide Concentrations Obtained From Mauna Loa, Hawaii, and Ice Cores from Taylor and Law Domes, Antarctica

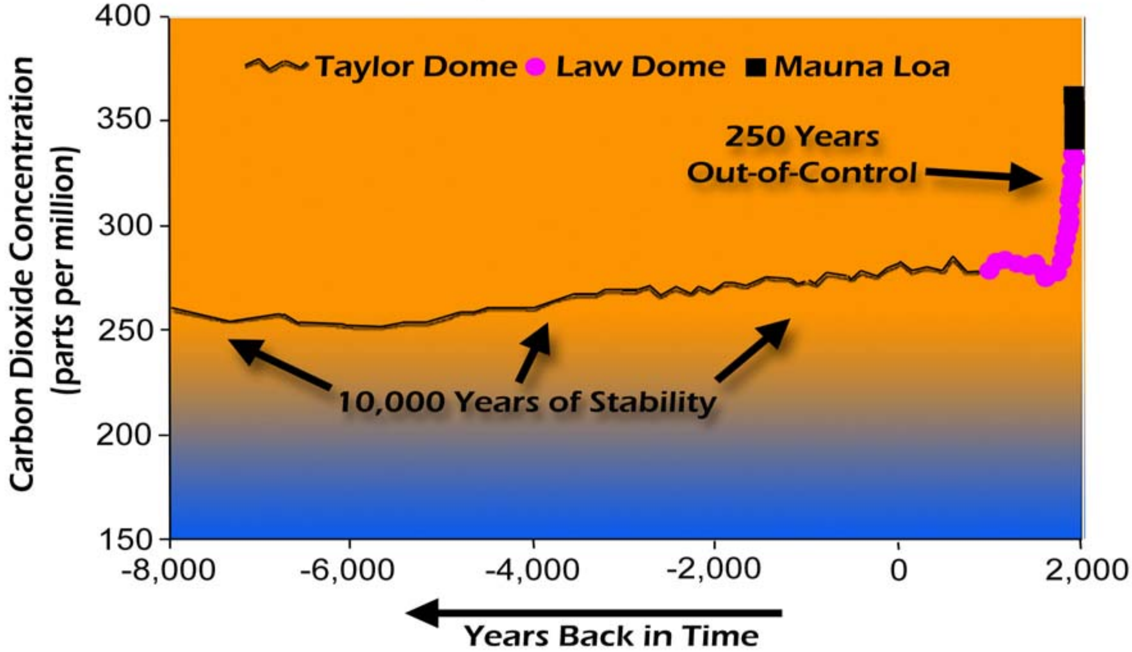


Figure 6.9 *This graphic shows the graph from Chapter 10 that represents the credible increase of man-made carbon dioxide in our atmosphere. Data Source: Vostok – Indermühle, A., et. al., Holocene Carbon-cycle Dynamics Based on CO2 Trapped in Ice at Taylor Dome, Antarctica, Nature, Vol. 398, March 11, 1999, Law Dome: Ethridge, D. M., et. al., Historical CO2 record derived from a spline fit (75 year cutoff) of the Law Dome DSS, DE08, and DE08-2 ice cores, Division of Atmospheric Research, CSIRO, Aspendale, Victoria, Australia, June 1998, Mauna Loa: Keeling, C. D., Atmospheric CO2 concentrations (ppmv) derived from situ air samples collected at Mauna Loa Observatory, Hawaii, T. P. Whorf and the Carbon Dioxide Research Group, Scripps Institution of Oceanography, June 2004.*

The recent extraordinary increase in our atmosphere's carbon dioxide concentration is a stark reminder of discussions of climate triggers from Chapter 9, and our current atmospheric greenhouse gas dilemma presentation from Chapter 10. This reminder is that we are facing great risks of abrupt climate change because of the significant alterations that mankind has made to this planet. The ice records are real and they show a very stable planet up until recently. The preserved atmosphere and other climate signals from the archive of deep ice are accurate to an extent never before seen in climate science.

What is being realized is that our ancient climate reacted violently to massive changes in the atmosphere. Carbon dioxide in our atmosphere has increased 165 times faster in the last 250 years than it did in the previous 10,000 years. We have had a 37% increase in carbon dioxide in our atmosphere in the last 250 years. Even more impressive, in the last 46 years the carbon dioxide concentration has increased 20%. The Intergovernmental Panel on Climate Change estimates that concentrations will double to over 700 parts per million (ppm) by the end of the century. They also warn that there is a threshold of about 550 ppm that we as a civilization do not want to exceed.

Today's carbon dioxide concentration is about 380 ppm. If we continue to produce this dangerous greenhouse gas at this rate we will cross the threshold in about 60 years. But by 2050 there should be 12.2 billion people on the planet, and many many more people in China and India will have massive carbon producing lifestyles like those of us in the U.S., so it is likely that that the threshold will be crossed much sooner.

In-fact, There are an increasing number of well respected scientists today that fear we may even cross this threshold within the next decade. The chair of the Woods Hole Oceanographic Institutes Oceanography Department said in 2004 "It could happen in ten years… Once it does, it can take hundreds of years to reverse".

Climate Lag

One of the most important aspects of our weather, and our climate, is that weather and climate lag change, or that the climate change follows the change in conditions. Our atmospheric greenhouse gas concentrations have been rising for centuries, yet it is only recently that temperature change has been enough to see and feel. This may be easier to understand if it is compared to the weather.

The winter solstice occurs on December 21st every year, the shortest day of the year in the northern hemisphere. The earth is tilted to its maximum on this day, allowing the least amount of sunlight to hit the northern hemisphere with the corresponding smallest amount of warmth. So this day should be the coldest day of the year, right? Everyone knows that it is much colder in January and early February than at Christmas. However, the depths of winter do not come on the winter solstice however because of the climate lag.

This is iceberg B-15A. It broke away from the Ross Ice Shelf in March 2000. The iceberg is 170 miles long and 25 miles wide and is probably the largest recorded in the last 100 years.

One condition that causes the lag is the cooling of the oceans. Our oceans cool slowly throughout the winter. As long as the air temperature is cooler than the water temperature, the ocean continues to cool. So, even though the days are getting longer after the Winter Solstice, they continue to become colder. When the air temperature warms above the water temperature in the spring, the climate starts to warm again. This is another feedback loop like those discussed in Chapter 8 and 9.

Other conditions help shift the coldest period further away from the Solstice as well. Snow cover is the biggest of these. Snow reflects light and heat back into space. So, the further into the winter we get, the more snow is on the ground and the greater is the amount of heat that is reflected back into space. Again this is a feedback loop that continues until the area of snow cover decreases enough or the progression of spring allows warming to take over.

Understanding the importance of climate lag has never been more important. We know through atmospheric measurements over the past 50 to 100 years that we are actively modifying this great ecosystem called Earth. Through the startling facts revealed by the new climate records, we know that these changes are real and that they could lead to significant changes in our climate. The world's seasonal climate changes lag behind the heat of the sun each year. Why would the world's climate not lag another important piece of our planet's ecosystem like warming global temperatures?

The changes that our atmosphere is experiencing have never been seen before during mankind's stay on this planet. In fact, as can be seen in the deep ice record from Antarctica (Figure 6.9), carbon dioxide levels have not been anywhere near as high as they are now for 420,000 years and likely not in the last 20 million years. The changes that man has brought are unprecedented.

In the preserved ice records, when the carbon dioxide concentration changed 40% in 250 years, so did the temperature. The temperature went up with increasing carbon dioxide and down with decreasing carbon dioxide. The two moved together like a dog and its tail. Scientists still debate whether or not the carbon dioxide wags the climate's tail or the climate wags carbon dioxide's tail. But today carbon dioxide has increased nearly 40% in 250 years and the climate has only changed a degree.

The position of our planet's climate has now become unbalanced. It is not known what happens to an unbalanced climate, but most natural systems tend to balance themselves automatically, such as the way a hurricane removes excess heat from the tropics – dramatically.

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Chapter Six: Eureka - The Startling Facts of Ice Records

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