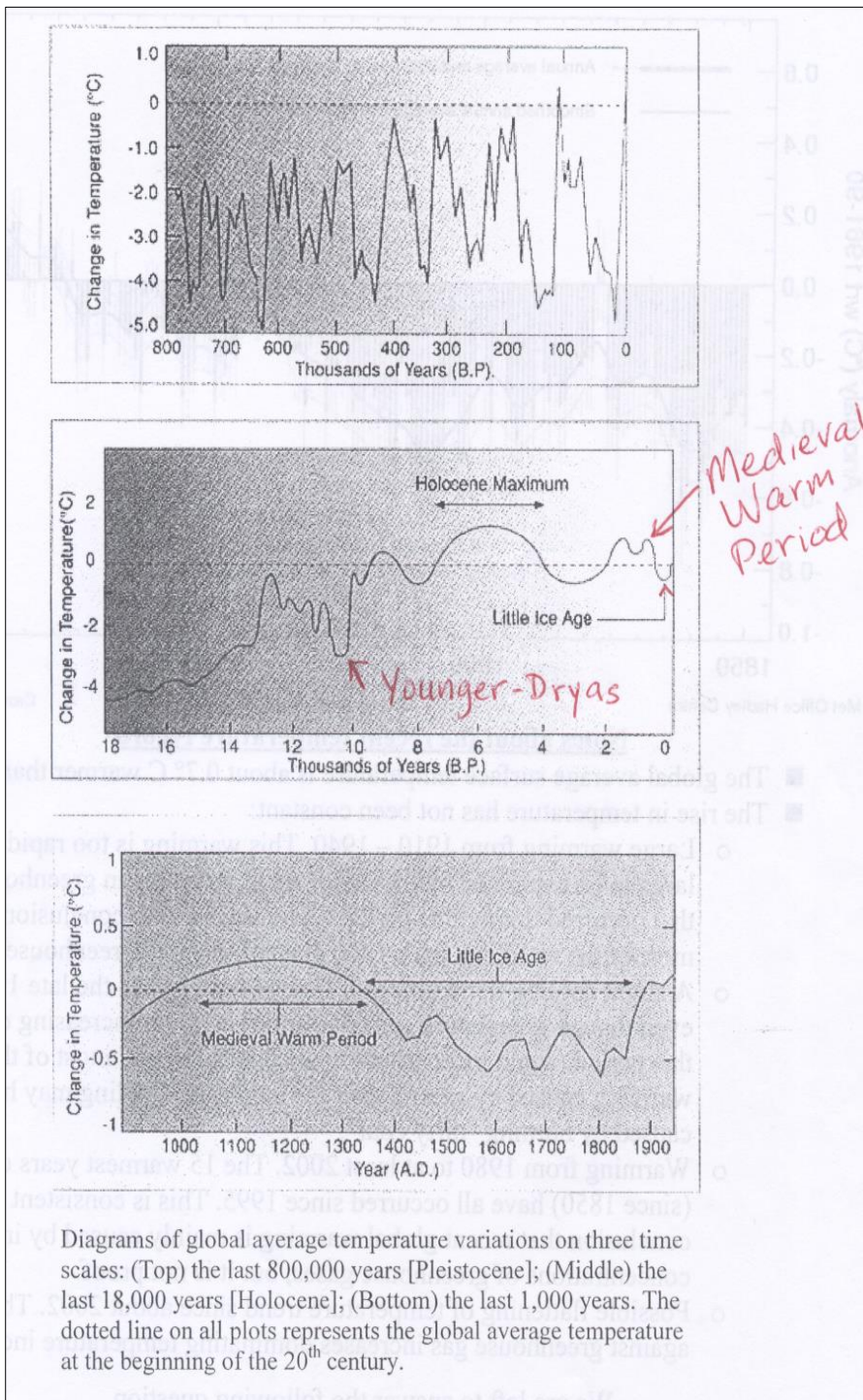


## Climatic trends in the Holocene

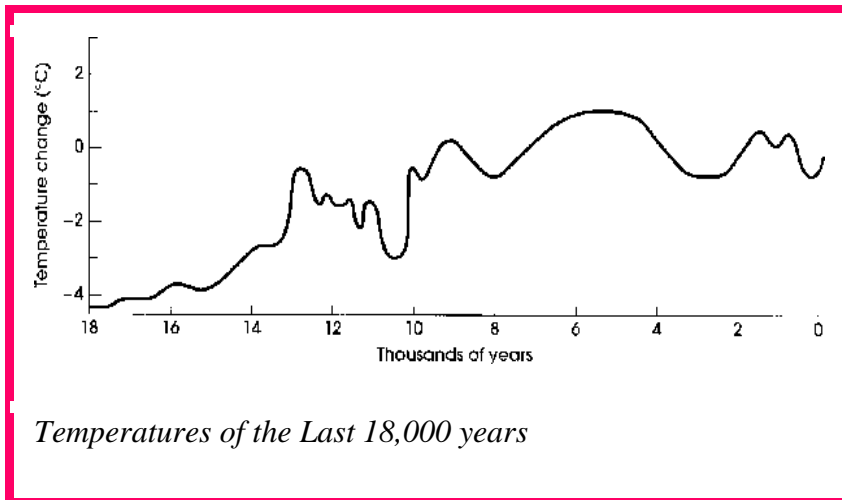
The last glacial maximum (Ice Age) ended about 15 thousand years ago. The most recent glacial retreat is still going on. We call the current period of glacial retreat the Holocene epoch and it continues until present. This page discusses the climate changes within the Holocene Epoch or the current interglacial period from its beginning up until about the year 1900. Prior to the year 1900 most climate changes are considered natural in that the changes could not have been caused by human activity. We will cover the temperature changes over the last 150 years on a separate page, since that is the period when human influence may have significantly impacted climate change. The four named periods within the Holocene: the Younger Dryas, the Holocene Maximum, the Medieval Warm Period, and the Little Ice Age.



The figure shows a common reconstruction (based on proxy records) of the global average temperature changes that have taken place on Earth over the last 800,000 years. On each of the three graphs, the dotted line (for 0 temperature change) is referenced to the global average temperature in the year 1900. Thus, plots show the estimated difference in global average temperature relative to the year 1900. The Ice Age cycles (alternating glacial / interglacial periods) are easily seen in the top graph, which covers the last half of the Pleistocene. The middle graph shows the Holocene Epoch and highlights the four periods mentioned above. The bottom graph

Diagrams of global average temperature variations on three time scales: (Top) the last 800,000 years [Pleistocene]; (Middle) the last 18,000 years [Holocene]; (Bottom) the last 1,000 years. The dotted line on all plots represents the global average temperature at the beginning of the 20<sup>th</sup> century.

shows that even in the last 1000 years there are significant natural fluctuations in global average temperature.



*Temperatures of the Last 18,000 years*

The figure shows that variations in the global average temperatures over the Holocene period have been relatively small compared to the ice age cycles, especially over the last 10,000 years. (Note that the vertical scale of temperature change is different for each of the graphs). However, even these relatively small variations in global average

temperature over the last 10,000 years have been significant in terms of their effects on human development and civilizations as described below.

Warming of Earth and glacial retreat began about 14,000 years ago (12,000 BC). The warming was shortly interrupted by a sudden cooling at about 10,000 - 8500 BC known as the **Younger-Dryas**. The warming resumed by 8500 BC. The younger-dryas event is significant because it shows that even during an otherwise tranquil period (the current interglacial), rapid climate shifts can still occur.

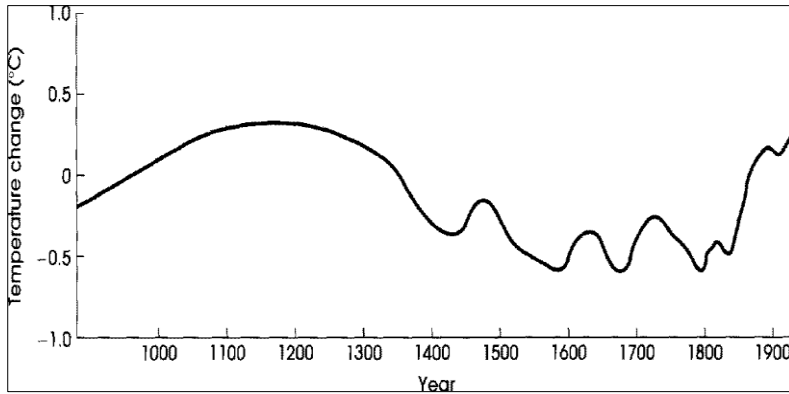
By 5000 to 3000 BC average global temperatures reached their maximum level during the Holocene and were 1 to 2 degrees Celsius warmer than they are today. Climatologists call this period either the Climatic Optimum or the Holocene Optimum.

During the climatic optimum many of the Earth's great ancient civilizations began and flourished. In Africa, the Nile River had three times its present volume, indicating a much larger tropical region.

From 3000 to 2000 BC a cooling trend occurred. This cooling caused large drops in sea level and the emergence of many islands (Bahamas) and coastal areas that are still above sea level today.

A short warming trend took place from 2000 to 1500 BC, followed once again by colder conditions. Colder temperatures from 1500 - 750 BC caused renewed ice growth in continental glaciers and alpine glaciers, and a sea level drop of between 2 to 3 meters below present day levels.

The period from 750 BC - 800 AD saw warming up to 150 BC. Temperatures, however, did not get as warm as the Climatic Optimum. During the time of Roman Empire (150 BC - 300 AD) a cooling began that lasted until about 900 AD, although Global average temperature remained relatively warm until about 600 AD. From 600-900 AD (The "Dark Ages"), global average temperatures were significantly colder than today. At its height, the cooling caused the Nile River (829 AD) and the Black Sea (800-801 AD) to freeze.



The period 1100 - 1300 AD has been called either the **Little Climatic Optimum** or the **Medieval Warm Period**. It represents the warmest climate since the Climatic Optimum.

From 1550 to 1850 AD global temperatures were at their coldest since the beginning of the Holocene. Scientists call this period the **Little Ice Age**.

During the Little Ice Age, the average annual temperature of the Northern Hemisphere was about 1 degree Celsius lower than today.

Summary of distinct climatic periods during the Holocene epoch		
Period	Name	Climate conditions
14,000 years ago	Holocene warming	Slow warming from the last ice age; large ice melt
10,000 - 8500 BC	Younger-Dryas	Rapid cooling, prolonged cold period, then Rapid warming
5000 - 3000 BC	Climatic optimum	Warm conditions; temperatures were perhaps 1 to 2 degrees Celsius warmer than they are today. Great ancient civilizations began and flourished.
3000 - 2000 BC		Cooling trend; drops in sea level and the emergence of many islands.
2000 - 1500 BC		Short warming trend
1500 - 750 BC		Colder temperatures and renewed ice growth, sea level drop of between 2 to 3 meters below present day levels.

750 BC - 150 BC		Slight warming not as warm as the Climatic Optimum.
150 BC - 900 AD		Cooling trend; Nile River (829 AD) and Black Sea (800-801 AD) froze
1100 - 1300 AD	Little Climatic Optimum or Medieval Optimum	Warm; warmest climate since the Climatic Optimum, Vikings established settlements on Greenland and Iceland.
1300 - 1550 AD		Cool and more extreme weather; abandonment of settlements in the Southwest United States,
1550 to 1850 AD	Little Ice Age	Coldest temperatures since the beginning of the Holocene. Populations die from crop failure and famine in Europe.
1850 AD - present	Contemporary climate	Warming trend