Introduction to Anthropology: Holistic and Applied Research on Being Human

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CONTENTS

MODULE 20: CLIMATE CHANGE AND HUMAN LIFEWAY ADAPTATION

What is Climate Change?

As you wake up every morning, you are experiencing weather. Is it cold or warm? Rainy or sunny? Windy or calm? Humans experience weather every day of their lives, and we react to changing weather by adding or removing layers of clothing or spending our time indoors or out. It's easy to recognize how we individually adapt to weather as a kind of natural backdrop to our daily lives. However, it can be harder to recognize how people adapt on a collective level for longer timeframes. It can also be harder to recognize how climate is not just a natural backdrop to human action: it is shaped by human action, society, and culture. To help make this phenomenon more visible, many scholars have proposed the term **Anthropocene** to refer to the current geologic era that is characterized by the profound and irreversible human impact on Earth's climate and ecosystems. Today, we need to adapt to environmental changes and confront the ways our society and culture produces environmental change.

Anthropologists look back in time and across cultures to better understand how they have developed ways to live sustainably, adapt to environmental change, and recover from disasters. Anthropologists also investigate the cultural and social dimensions of the climate crisis facing us. If these crises are socially produced, then solutions to these issues will require more than technological fixes. **Environmental anthropology** is a subfield that leverages anthropological questions, methods, and theories to better understand and find solutions to environmental problems and address issues of human survival.

This chapter will first explore the meaning and sources of climate change and global warming before looking back in time to better understand how people in the past adapted to climate change through technology, innovation, and migration patterns. Then, we will explore how contemporary societies are experiencing and making meaning of anthropogenic climate change. We also explore the ethical and human-rights implications of those on the front lines of climate change, and how they bear some of the greatest risks related to rising sea levels, water scarcity, and food shortages, but have contributed the least to creating these problems.

So, What is Global Warming?

If we average out the weather over specific time periods, we can see how climate has changed throughout that time. **Climate** is generally identified by the prevailing weather conditions of a region over a specific period, generally accepted to be over a 30-year period. **Weather** is broken down into temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and wind direction and speeds throughout the year. That general long-term trend in weather is **climate change**. Merriam-Wester online has defined climate change as "a change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels." Anthropologically, the effects of climate change are about people and power structures, the environmental costs of our actions and social justice, and the survival of cultural communities.

Video 20.1. Check out the video from *TED presenting Ilissa Ocko discussing how we can slow climate change now.*

Merriam-Webster online defines **global warming** as "an increase in the earth's atmospheric and oceanic temperatures widely predicted to occur due to an increase in the greenhouse effect resulting especially from pollution." Anthropologically, global warming is a great threat to the health and safety of the global population due to environmental and human health risks from industrial pollution entering the environment and changes in sea level. Global warming, however, is not the same as climate change because climate change examines the changes in temperature within the atmosphere and ocean, specifically. Global warming is the general trend of global temperature increase since approximately 1850 (see Figure 20.1). Since 1850, the general trend of atmospheric and oceanic temperatures has been rising (although not at a constant rate and sometimes falling). The long-term increasing temperature trend for the globe from 1880 to 2017 was +0.13°F per decade.

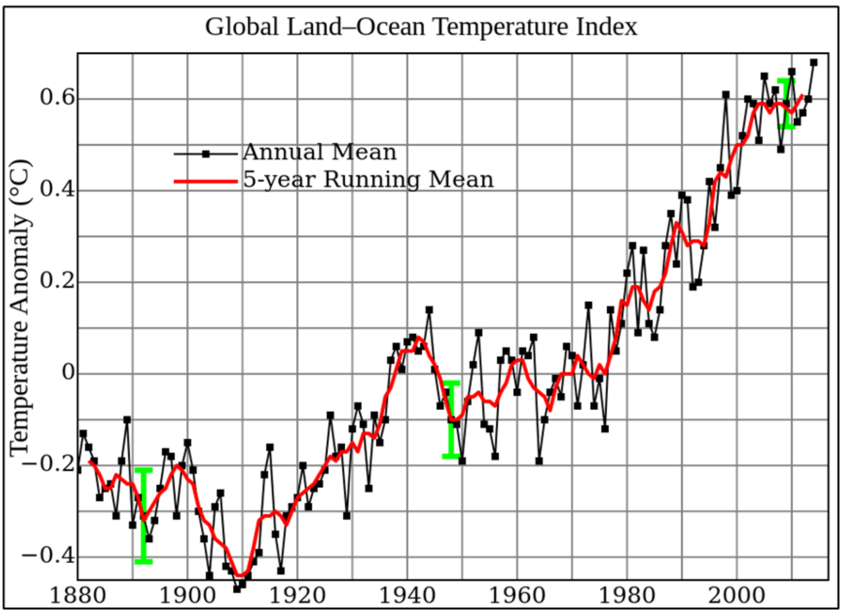

Figure 20.1. Temperature variation since 1880. Image modified from Climate Council.

Approximately 70% of the Earth's surface is covered by the oceans. Much of the heat retained in the ocean today is the result of increasing atmospheric greenhouse gas levels being absorbed by the ocean, which causes ocean temperatures to continue rising. Ocean temperature plays a major role in regulating Earth's climate system. The oceans of the Earth contain a circulation system that moves warm and cold water both horizontally and vertically in the oceans (see Figure 20.2). These circulation systems, called currents, move the warm waters of the Tropics into the cool waters of the high latitudes and move the cold waters of the Arctic regions towards lower latitudes.

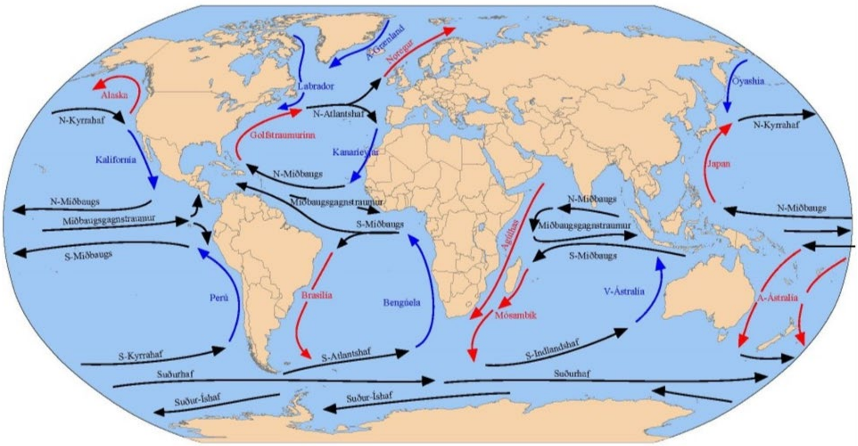

Figure 20.2. World Ocean currents. Red is warm and blue is cold water. Image modified from Coastal Wiki.

This exchange of water regulates, or balances, the global temperatures. As warmer waters move to higher latitudes, average temperatures rise in the higher latitudes. Hotter temperatures in the ocean and atmosphere cause glaciers to melt, sea levels to rise, and greater evaporation. This affects the climate, which can be seen by an increase or decrease of rainfall in different regions, the increase in average temperatures around the globe, changing wind patterns, and storm severity (hurricanes, monsoons, etc.). These changes are what we call climate change.

Thus, today's evidence of climate change begins with global temperatures continuing to rise coupled with increasing ocean temperatures. This, in turn, results in the number of record high temperature events increasing, while the number of record low events decreased since 1950 around the Earth. Yearly snow cover, on average, is melting earlier each year which results in less snow being added to glaciers. Therefore, glaciers are melting and retreating at accelerated rates. Due to this increase, the rate of global sea level rise in the last two decades is nearly double that of the last century, and it continues to accelerate slightly every year. Increased sea levels and higher global temperatures coupled with increased evaporation and altered wind patterns has caused the number and severity of storm events to rise. These are the effects of climate change that we are dealing with today.

Has Climate Changed on the Earth in the Past?

The Earth's climate has gone through cycles of hot and cold, wet and dry for at least the past five million years based on the geologic record. Milutin Milanković (anglicized as Milankovitch) was a Serbian mathematician, astronomer, climatologist, geophysicist, and civil engineer who examined the patterns in Earth's climate in the early 20th century. In the 1920s, he developed the explanation for Earth's long-term climate changes being caused by variations in the position of the Earth in comparison to the Sun. These variations are based on its path as it orbits around the Sun (**Eccentricity**), the changing tilt direction of its rotational axis (**Precession of the Equinox**), and the tilt of its axis (**Obliquity**). These three natural cycles of the Earth are now known as **Milankovitch Cycles**.

Video 20.2. Check out the video from *It's Just Astronomical discussing Milankovitch Cycles and how ice ages happen.*

Eccentricity is an approximately 100,000-year cycle (first suggested by Johannes Kepler in 1609) related to the distance from the Earth to the Sun at different times of the yearly orbit of the Earth around the Sun (see Figure 20.3). The symmetry of the cycle ranges from a near circle where the Earth is centered to an oblong pattern where the Earth is located off center. This change in symmetry results in differing distances between the Sun and Earth resulting in greater or less solar radiation that the Earth receives through a yearly cycle.

Obliquity, or tilt, (first suggested by Ludwig Pilgrim in 1904) is an approximately 41,000-year cycle related to the angle of tilt of the Earth on its axis (see Figure 20.3). The angle of tilt determines how much solar radiation the higher latitudes of the Earth receive from the Sun during its yearly cycle. This results in angles of tilt ranging from 22° and as large as 24.5°. Today, the Obliquity of the Earth is approximately 23°27', but it is not fixed.

The Precession (first identified by Hipparchus in 130 BC) of the Equinoxes is approximately 26,000 years and describes the direction in which the Earth is tilted through the yearly cycle in relation to the Sun (see Figure 20.3). At different times throughout the cycle, the Earth is either tilted towards, parallel, or away from the Sun. The direction of tilt determines the seasons. At the Summer Equinox, the Earth is tilted towards the Sun, but during the Fall and Spring Equinox. it is titled parallel to the Sun, and during the Winter Equinox, the Earth is tilted away from the Sun. The amount of solar radiation that the Earth receives during the cycle of the Earth around the Sun impacts the temperature of the atmosphere and oceans.

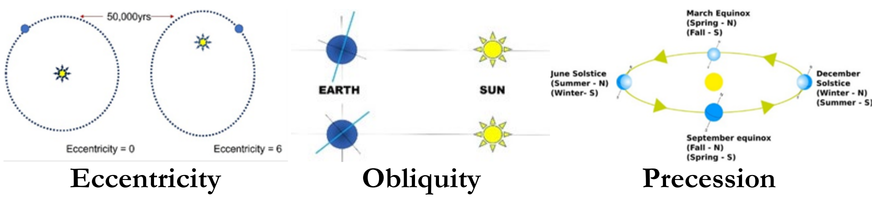

Figure 20.3. Milankovitch Cycle, depicting eccentricity, obliquity, and precession cycles.

Today, the Earth is closer to the Sun in the Northern Hemisphere's Winter and further away from the Sun in Summer (see Figure 20.4). Thus, the amount of solar radiation that the Earth receives from the Sun in Winter is greater than what it receives in Summer. However, the Earth's movement around the Sun today is at High Eccentricity (oblong pattern), meaning the Earth is closest to the Sun in Winter and furthest away in the Summer. At the same time, the tilt of the Northern Hemisphere of the Earth is towards the Sun at the Summer Equinox and away during the Winter Equinox. Today, this combination of the Eccentricity and the tilt direction and angle of the Earth during the yearly cycle results in a Summer that is long, with direct solar radiation in the Northern Hemisphere, and a short Winter with less solar radiation. This variation in solar radiation results in the snow that falls in the Winter to be melted in Summer.

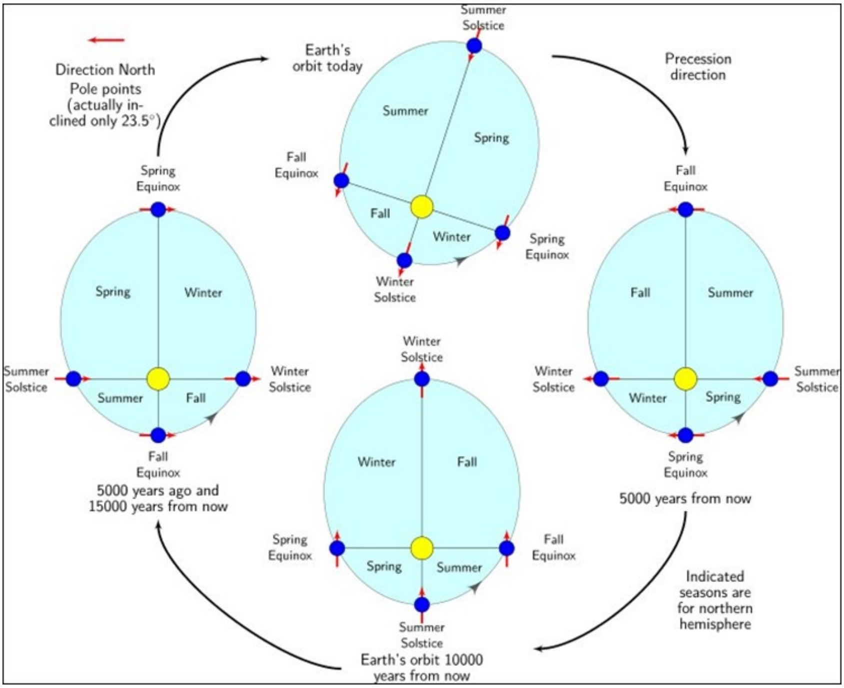

Figure 20.4. Illustration of the earth's movement during the year. Image modified from Wikimedia Commons.

Approximately 15,000 years ago, the tilt of the Earth was the opposite, so the Earth was at the maximum of the **Wisconsin Glacial Period** (Figure 20.5). During the Wisconsin Glacial Period maximum, the tilt of the Earth was towards the Sun when Earth was closest to the Sun and away from the Sun when the Earth was furthest away from the Sun, thus the winters where long and the summers short, so the snow that fell every Winter did not melt every summer and slowly built up, ice, and forming into glaciers, primarily in the Northern Hemisphere, that covered the land.

Since glacial maximum approximately 23,000 years ago, the transition of the Precession of the Equinoxes to today's pattern has resulted in the Earth getting warmer, the glaciers melting, and the sea level rising over 300 ft. Over the past 420,000 years, the Earth has gone through this process based on ice core data from Vostok, Antarctica (see Figure 20.5).

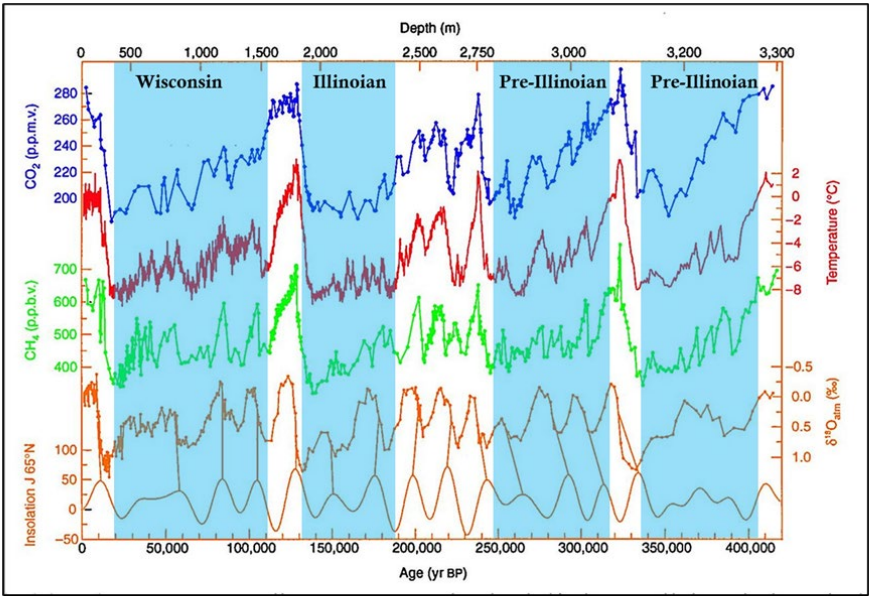

Figure 20.5. Climate change based on Glacial ice from Vostok, Antarctica. Blue highlighted areas are periods of glaciation. Image modified from Wikiwand.

Earth's climate can also change based on tectonic activities such as the movement of the Earth's tectonic plates, volcanic activity, and mountain building. There are several tectonic plates that make up the lithosphere of the Earth, and they move in relation to one another: sometimes passing each other, sometimes colliding, and sometimes one subducts below another.

When the movement is away from one another, new lithosphere is created, and existing mountains move away from each other on the different plates. When the movement is past one another, existing terrains (e.g., mountains) may get closer or move further apart. When the movement is towards one another, they collide and create mountains or build existing mountains even higher. Conversely, when moving together, one tectonic plate can subduct below another. The subducted tectonic plate begins to melt as it moves into the mantle, and the magma slowly rises through the lithosphere and comes out and forms volcanic mountains.

All this movement in so many directions effects climate in different ways. When the tectonic plates move into each other, they typically build mountains, including volcanoes. Mountains are important to weather and climate patterns because they are barriers to airflow. Air is what carries moisture (humidity) that has evaporated from the oceans, lakes, and rivers. Rain clouds are formed by the condensation of warm, humid air as it rises in the atmosphere and the air gets cooler. Mountainous terrain enhances this process and accelerates the formation of clouds and eventual precipitation as rain or snow depending on the air temperature (see Figure 20.6).

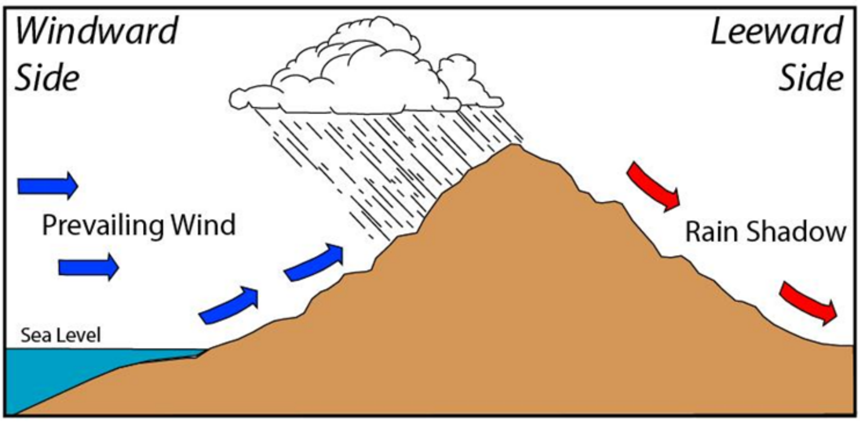

Figure 20.6. The process of creating a rain (snow) shadow. Image from Wikimedia Commons.

As air flows over mountains, it is forced higher into the atmosphere. As the warm humid air moves beyond the bottom of a large hill or mountain, it moves up and over the mountain. The air temperature drops as it rises because there is less pressure in the atmosphere at higher altitudes, and the air can expand. The decrease in air pressure causes water vapor within the air to condense and, under the right conditions and oversaturation, can result in precipitation. Thus, depending on which direction the air is moving, it can create a situation where one side (the windward side) of a mountain gets a high amount of precipitation while the opposite side (the leeward side) gets very little.

The side where precipitation occurs is the side from which the air is blowing towards the mountain. The side of the mountain that gets little rain is called the area in the **rain/snow shadow** and is typically a drier region (see Figure 20.6). As mountains move or build through plate tectonics, the effects of the wind and the rain/snow shadow can alter the weather and, ultimately, the climate of a region. This change can either make an area wetter or dryer.

The interplay of these changes can be seen in the alteration in the monsoon patterns related to the Indian tectonic plate and the Harrapan civilization. As the Indian plate continued to collide with the Asian tectonic plate, the Himalayan mountains to the North and the Sulaiman Range to the west of the Indus Valley continued to build during the time of the Harappan civilization. This resulted in a directional change in the flow of the upper Sutlej River and changed the pattern of the winds effecting the winter monsoon pattern. The monsoon slowly moved further East, resulting in the Ganges River Valley receiving greater rainfall and more river water from the Himalayan mountains while the Indus Valley received less water (see Figure 20.7). This is suggested to be a partial cause of the decline in the Harrapan civilization around 1,500 years ago as archaeological evidence suggests the amount of groundwater within the Indus Valley slowly reduced and salts within the farm fields increased and caused a decline in food production.

Figure 20.7. Image depicting the location of the Indus, Ganges, and Sutlej Rivers. Image modified from Flickr/GRID-Arendal.

What have Humans and their Ancestors Done to Adapt to Climate Changes?

Based on the evidence of natural global cycles, there have likely been hundreds of glacial periods throughout the history of the Earth and humans and their ancestors have lived through many of these glacial periods and corresponding climate changes (see Figure 20.8). For humans and their ancestors to live through climate change, they must adapt by changing physically or morphologically, by migrating to new places on the Earth, and/or by developing new technologies to survive the changes.

Based on the existing record of the development of humans and their ancestors, they physically adapt over very long timespans. Conversely, changes in human lifeways and technologies can be relatively rapid compared to physical changes. Because climate changes are relatively fast (200-100,000 years) in Earth's history but humans and their ancestor's physical adaptation has been relatively slow (hundreds of thousands of years), the ability for humans to rapidly change lifeways and technology have allowed them to survive climate change.

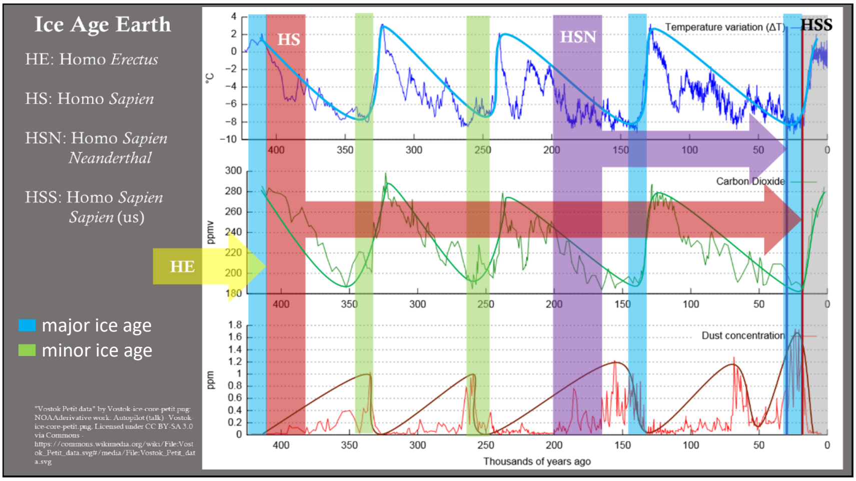

Figure 20.8. Relationship between human origins and climate change. Image modified from Wikimedia Commons.

Prior to the human concepts of property and state societies since **Last Glacial Maximum** (approximately 21,500 years ago), as climates changed and tectonic plates moved and sea levels adjusted accordingly, areas would become deserts while other areas became rainforests, and humans and their ancestors would migrate accordingly to seek mild climates and abundant resources. Today, we can watch sea level rise due to the ongoing deglaciation of the Earth; the shorelines of the continents are slowly being transgressed by rising waters, shorelines are slowly moving inland from their current positions, oceanic islands are disappearing, and the landscapes we live on is slowly being submerged.

During the Last Glacial Maximum, the landscapes within the higher latitudes of the Northern Hemisphere and the highest elevations on mountains throughout the Earth were covered with glaciers (see Module 8: Upper Paleolithic and Ice Age). Because glaciers are ice, and ice is frozen water, where did the water come from? The water that became locked up in the glaciers came from evaporated oceanic water. As snow (frozen water) fell during the winter and didn't melt through the summer (related to the Milankovitch Cycles), the snow slowly became thicker and turned to ice. As the ice built up through time and glaciers formed, sea level fell. This fall in sea level resulted in the exposure of landscapes that are now up to 300 feet below present sea level (see Figure 20.9). Some of these exposed landscapes became "land bridges" between islands and continents that, today, are separated by the oceans. These landscapes also became places where our ancestors could live. The existence of these landscapes also allowed our ancestors and land animals to migrate from one region or continent to another in search of resources.

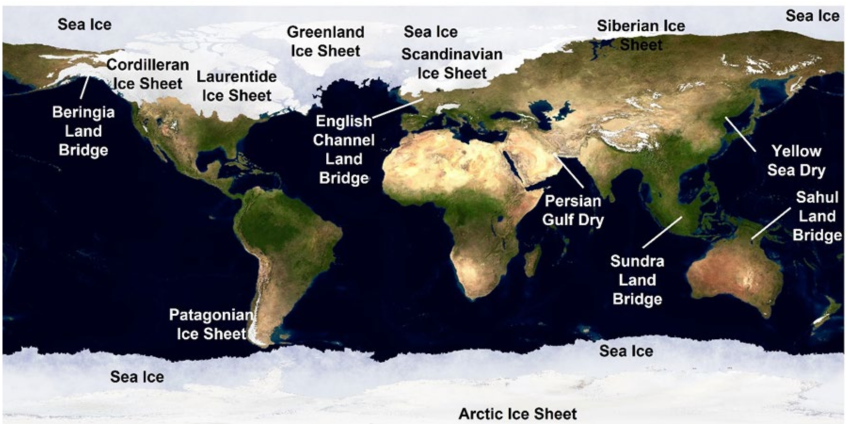

Figure 20.9. Earth at Last Glacial Maximum showing locations of major exposed landscapes. Image modified from Reddit.

Therefore, as the Earth's sea level rose and fell over hundreds of thousands of years, humans and their ancestors would have the ability to migrate to new places with mild climates (not too warm or cold and not to wet or dry) and abundant resources. Over time and after many climate changes, humans and their ancestors eventually migrated to the moment of inhabiting all the continents, except Antarctica, by the end of the Last Glacial Maximum approximately 21,500 years ago.

In addition to migrating, the archaeological record shows that humans and their ancestors adapted relatively quickly to these recurring changes in climate. The use of fire, the invention of clothing and shelter, and the domestication of plants and animals have all been adaptations to changing climates. The use of fire provided heat when it was cold and light during short daylight hours in winter. Fire also provided protection from predators. The earliest evidence for fire associated with humans in the archaeological record is approximately 1.8 million years old in what is now the country of Georgia, between the Black Sea and the Caspian Sea (see Module 7: Genus Homo and First Cultures).

The invention of clothing, or simply any kind of covering over the body, provided protection from inclement weather and adjusted personal warmth based on changing climate conditions. The earliest direct evidence of clothing from the archaeological record is from approximately 20,000 years ago and discovered in Guitarrero Cave in Peru. However, while the archaeological record yields no direct evidence of older clothing, it does hold evidence of artifacts used to manufacture clothing (notably bone eyed needles, stone fur scrapers, bone and antler auls, etc.) approximately 100,000 years ago. In addition, there are depictions of clothed humans in cave paintings and related items such as buttons and beads. Moreover, archaeological evidence includes the increase hunting of fur-bearing species such as wolves, bears, and Arctic foxes which can be used as a proxy for clothing manufacturing (see Module 8: Upper Paleolithic and Ice Age).

Before humans began to build freestanding shelters, they used caves and rock overhangs to protect themselves from the weather. These shelters were expedient and provided protection against inclement weather, though offering little protection against wild animals. The earliest evidence of hominins intentionally occupying a cave is found at the Wonderwerk Cave, Northern Cape Province, South Africa. The age of that oldest occupation is approximately 1.96 million years ago. This date is based on a small lithic assemblage related to the Oldowan lithic technology from strata over a meter below the level of the current cave floor (see Module 7: Genus Homo and First Cultures).

The invention of free-standing shelters also provided protection from inclement weather and increased warmth due to restricting the diffusion of heat into a smaller area. The earliest evidence of the building of a free-standing structure comes from the site of Terra Amata (Italian for "Beloved Land") on the slopes of Mount Boron in Nice, Italy. Excavations found 21 oval-shaped living floors that ranged in size from 26-49 ft. long and 13-20 ft. wide at their largest axis. These floors were surrounded by imprints of a series of stakes (approximately three inches in diameter) that appear to have been driven into the ground as vertical supports of the structure. Beyond these stakes, a line of stones is found paralleling the pattern of stakes, which are interpreted as braces for the walls of the structure. In addition, there was evidence for several posts (approximately 1 ft. in diameter) placed down the long axis of each of the structures. Another feature of these structures were pebble-paved fire hearths dug into the sand floors that were 1-2 ft. in diameter. These identified structures are interpreted to be between approximately 380,000 and 230,000 years old based on two **thermoluminescence (TL) dates** on burnt flints and an **electron spin resonance (ESR) date** on quartz grains in relation to the burnt flints.

So, as we look back into the archaeological record, we see that humans have developed methods/technologies to protect themselves from the weather and, ultimately, climate changes. These developments, when placed onto a figure that depicts human development and the known ice ages dating back over 400,000 years, you can see that humans have survived several past climate changes and thrived by developing new methods and technologies to improve their lifeways (see Figure 20.10). However, many of the new lifeways and technologies have affected climate change.

Since humans began to control fire and began to domesticate plants and animals, the amount of the greenhouse gasses such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) in the atmosphere has increased. For example, the burning of wood releases CO_2 into the atmosphere. Some of the fires were not for warmth or cooking but intentionally set to develop fields for growing plants. Unlike today, where we fertilize agricultural fields, the fields in marginal lands would lose nutrients over time. This loss of nutrients would precipitate the need to open new fields in the forests where the soil's nutrients were not depleted. This process over time reduced the number of forests in any given region.

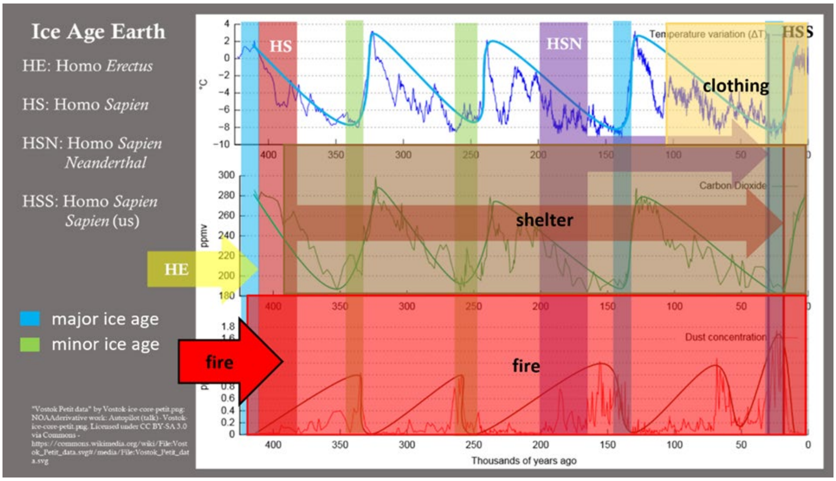

Figure 20.10. Past climates overlain by human origins and technologies. Image modified from Wikimedia Commons.

The **domestication** of animals has also influenced climate change (see agriculture module). The domestication of animals resulted in the need for fodder which, in turn, resulted in more forests being cleared. At the same time, domestication resulted in an increase in the number of animals being supported. These animals release CO_2, CH_4, and N_2O into the atmosphere. The trend of overall increases in these gasses can be seen for the past 2,000 years (see Figure 20.11).

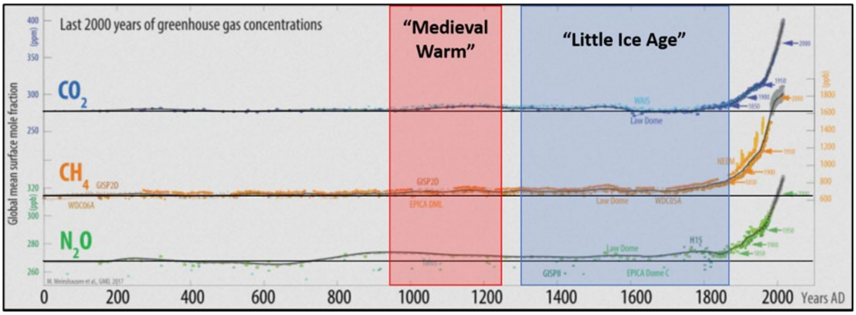

Figure 20.11. Increase in greenhouse gasses over 2000 years. Image modified from University of Melbourne's *Pursuit.*

Over the past hundred years, industrialization and the spread of global capitalism has intensified human impact on the Earth and climate. Industrialized systems of agricultural, meat production, and transportation are fossil-fuel intensive and have caused expansive clearing of forested lands. Since the beginning of the industrial revolution in 1750, 566 billion metric tons of CO_2 emissions have been added to the atmosphere. As of 2007, the farm animal sector annually accounts for 9% of the emissions of CO_2, 37% of the CH_4, and 65% of N_2O worldwide. Today, the use of fossil fuels and the rate at which greenhouse gasses have entered the atmosphere has increased exponentially since the early adaptations previously discussed. The release of these greenhouse gasses at increasing rates has compounded the effect of natural cycles of climate change (see Figure 20.12).

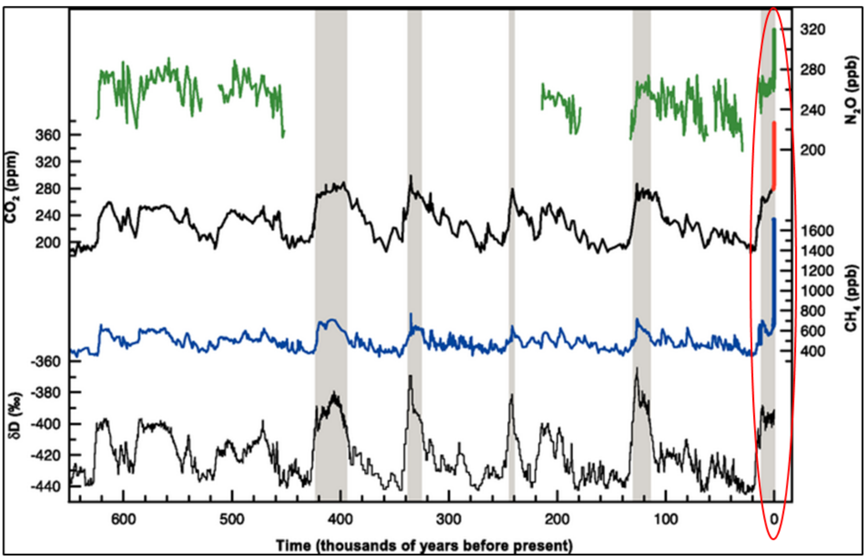

Figure 20.12. Natural cycle of climate change in relation to greenhouse gasses versus today circled in red. Image modified from van der Laan (1978).

Video 20.3. Check out the video from *It's Just Astronomical* discussing why we have diverged from the Milankovitch cycles.

Without humans continued ability to adapt to changing climates, we wouldn't have built the ability to live in the extreme climates nor be able to extend our reach into space. Our ability to adapt in the past indicates a capacity for resilience in the face of environmental changes and challenges. **Resilience** refers to the ability to bounce back after a disaster to maintain a society's "function, structure, and identity." Resilience depends on our collective knowledge, skills, and resources. Looking across cultures today, we consider what factors facilitate and constrain the ability of societies to adapt and be resilient.

Resilience and Risk: Climate Change Today

The **Intergovernmental Panel on Climate Change (IPCC)**, a United Nations body that assesses and reports on the science related to climate change, reports "it is unequivocal that human influence has warmed the atmosphere, oceans and land." This human influence includes industrialization and the burning of fossil fuels, resource depletion, environmental degradation, and consumer lifestyles.

As mentioned in the introduction to this module, scholars have proposed the term 'Anthropocene' to refer to the current geologic era marked by a profound human-impact on our planetary systems. Climate change is having serious social, economic, political, and health consequences for human societies. However, these consequences will not be experienced equally. Anthropocene is a term that usefully highlights the role of human society and culture in shaping our planet, but it also obscures the fact that not all societies have contributed equally to the causes of climate change, nor do they bear the risks equally.

Indigenous communities in the Arctic are already observing the effects of climate change. **Polar amplification** describes the processes through which the Arctic is warming faster than any other region of the Earth. The Arctic is 2-3 degrees Celsius warmer today than it was in the 1950s and may be completely ice-free in summer by 2050. This poses a global risk because Arctic ice reflects the sun, which creates a cooling effect that helps stabilize global jet streams. The largest share of human activities contributing to climate change originate in places far from the Arctic, but the effects are disproportionately felt there. Disappearing sea ice impacts critical habitats, and the thawing of permafrost makes travel more difficult and undermines buildings and roads. Indigenous communities face a loss of traditional food sources and displacement from homes and communities with rapid ecological changes. In addition to the present erosion of lifeways, the archaeological record, the historic record of the ancestors of these communities, is being eroded and lost.

Island and coastal nations are also at particular risk from rising sea levels that submerge land and contaminate sources of fresh water. Bangladesh, because of its high population density and low elevation, is at risk from rising sea levels that could displace coastal farming communities and cause widespread food insecurity. Researchers are racing to find solutions to increased flooding from seasonal monsoons that submerged one quarter of Bangladesh in 2020, damaging nearly 1.3 million homes. The combination of extreme weather events associated with climate change (flooding, drought, or storm surges) and longer-term processes of **coastal erosion** and **salinization** threaten to decrease arable lands and potable water availability, deepen poverty, and increase the displacement of populations. In Bangladesh, poorer farmers are less likely to have the resources to adapt to seasonal flooding by planting varieties of rice at different elevations, and female headed households are even more constrained, in part because of higher levels of poverty and poorer health.

This example illuminates how higher degrees of inequality make certain groups of people more vulnerable to disaster. While we think of natural disasters as being caused by forces outside of our control like earthquakes, flooding, or droughts, the outcomes of natural disasters are shaped by social and political forces. For example, socio-political dynamics determine the quality of infrastructure built to withstand disaster, or the ability of aid to reach those who need it, when they need it. Climate change exacerbates existing inequalities that already hamper people's ability to adapt. Examining power relationships, anthropologists consider the role of social inequality in shaping the impacts of disasters while also investigating how disparities take shape along the lines of social class, race, ethnicity, or gender as people are variably impacted by polluting industries. We also investigate how people work to create alternatives to these systems.

Culture and Climate Change

What does "**community**" mean? Brainstorm a word web of all the things that are part of a "community." Then, consider your list of ideas alongside the peers in your class. In doing so, you are illuminating a cultural domain, which is part of a cognitive map of categories that we use to order our reality. In many college classrooms in the U.S., "community" often centers on people and human-social relationships. What if "community" also included human-environmental relationships: waterways, animals, or plant life? Indeed, our health, individual and communal, depends on being part of a healthy ecosystem of social-environmental relationships. In Western culture, it is often common to think of people as standing outside of or above nature, which is often understood as untouched wilderness, but this isn't a universal way of thinking. In other cultures, including many indigenous societies, social-environmental relations are understood differently.

One way to research the relationship between culture and climate change is to consider the systems of meaning that people use to relate to the environment. This means investigating a culture of consumerism that is straining the capacity of the Earth's resources to meet demands for consumer items that we associate with quality of life, status, or happiness (see Module 13: Economics, Politics, and Inequality). When we look across cultures, we can recognize how the idea of a good life, or what it means to thrive, takes many forms. How do people create a meaningful world, and draw on cultural systems to configure socio-environmental relationships that may foster **biodiversity**?

Biodiversity is critical for human wellbeing. When climate change impacts biodiversity, it has major implications for human health. Some scientists argue that we are facing a mass extinction event, in which the loss of some species can have a cascading effect that destabilizes entire ecosystems. There have been five in Earth's history, each caused by catastrophic alterations of the Earth's environment. Loss of biodiversity includes loss of agro-biodiversity and medicinal plants that are critical to food and health security. As habitats shift, emerging infectious diseases also pose a risk to human health.

Looking across cultures can illuminate the ways people steward and create biodiversity. Indigenous communities nurture a diversity of native crops, such as in Peru's Potato Park, Quechua speaking communities grow 1,367 varieties of potato adapted to different elevation (see Figure 20.13 and Module 9: Development of Agriculture).

Rather than focusing on 'wilderness' conservation, the park focusses on protection of **biocultural landscapes** as indigenous agricultural practices, language, and culture continue to steward and generate genetically diverse plants that may enable resilience and adaptation in the face of climate change. This project is even more important considering that an estimated 75% of crop diversity, globally, has been lost since 1900. The wild relatives of food crops are also at risk from a changing climate. Cross cultural research shows that human beings are not inherently destructive. It also shows the important role that diversity plays in building resilience. This doesn't just mean biodiversity, but it also involves biocultural diversity.

Figure 20.13. Example of Peruvian potato varieties. Image from Flickr/Miraglia.

Traditional environmental knowledge involves dynamic knowledge about the environment that indigenous communities develop through long-term connection and experience in places. Research on traditional ecological knowledge often considers culture as adaptive: including the knowledge, values, behaviors, and mental maps that shape how people relate to, steward, and adapt to the environment. This research also works to bring biologically diverse landscapes and relationships into being. Traditional environmental knowledge can also track the local and regional impacts of climate change. A focus on culture as adaptive can also help us investigate how people use their knowledge and culture to face new risks.

Summary

Environmental anthropology uses tools and concepts from anthropology to better understand and potentially find solutions for the challenges related to climate change. Anthropology is focused on fieldwork and involves a comparative perspective that considers the scope of human culture throughout time and across cultures. Consequently, we explore and document how communities around the world are experiencing and responding to climate change. We also consider the long history of human adaptation to changing climates for insight into current and future practices. Anthropology's holistic approach helps us to examine the cultural values, practices, and power relationships that contribute to vulnerability or resilience. Thinking holistically also involves examining complicated systems and problems that are social, political, economic, and environmental.

Review Questions

- **T/F.** The Milankovitch Cycle impacts the Earth's climate through eccentricity, processual, and lunar changes.

- **T/F.** Humans have adapted to climate change through the development of clothing, control of fire, and the domestication of plants and animals.

- **T/F.** Climate change has impacted human populations through decreased natural disasters and increases in available drinking water.

- **T/F.** The loss of world biodiversity does not affect agro-biodiversity. Thus, medicinal plants are continuing to be available for food and health security through agro-biodiversity.

- **T/F**. Although Climate Change and Global Warming are different, they are both affected by pollution related to human activity on the Earth.

Discussion Questions

- The most important thing we should do NOW to address climate change is ____________________.

- Globally: How is climate change impacting people's lives?

- Closer to home, what are the impacts projected to be where you live?

- Are people near you experiencing climate change already?

- Watch https://www.nbcnews.com/news/world/thin-ice-inuit-way-life-vanishing-arctic-n152806. What changes are the Kanak Inuit experiencing in the traditional lifeways? Ironically, how is the strategy they've been forced to adopt for survival perpetuating the problem created by outsiders?

Activities

1. **Ecological Footprint**
   - Calculate your ecological footprint(opens in a new tab) and describe your results.
   - Can we change our footprint? How?

2. **Dendrochronology Exercise**
   Imagine you have recently excavated five Pueblo house structures at an archaeological site in Arizona and found that the structural beams are well preserved. You want to know how old each structure is and the order in which the houses were built. You select one beam from each house to match up to a Master Sequence for the region to determine the specific cutting date of each beam. Assuming the inhabitants immediately used the cut beams when constructing their house, you will be able to determine the age of each house structure using dendrochronology.
   - Working off the Master Sequence initially, match up the five wooden beams, A-E, which represent five Pueblo house structures. You will need to cut them out with scissors and then tape them together once you have matched them correctly.
   - Once they are matched, determine the cutting date for each wooden beam, and the age of each house structure by counting the rings. What might be some problems with applying dendrochronology to archaeological sites? (HINT: Think about climate change, tree species, and how people collected house beams).

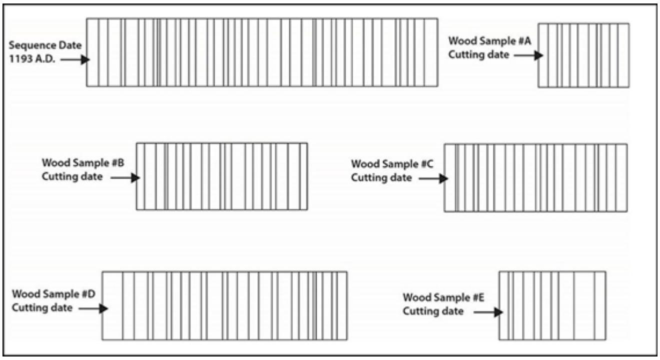

Figure 20.14. Example of tree-ring dating. Image from Homsey-Messer et al. 2020.

Activities for Instructors

1. **Tree of Life**
   If you are an instructor, an activity you might consider embedding in your class discussion of climate change, especially if you are looking for an archaeological perspective, is Homsey Messer et al.'s "Tree of Life" activity published in *Experiencing Archaeology: a Laboratory Manual of Classroom Activities, Demonstrations and Mini-labs for Introductory Archaeology* in 2019. This activity introduces students to the dendrochronology and the study of past climate as it affects prehistoric societal change (i.e., archaeoclimatology). While living trees hold records of climate dating back no more than a few hundred years, tree trunks from archaeological sites allow scientists to determine what climate was like a few *thousand* years ago. Like the dendrochronology exercise above, this activity uses tree ring cut-outs. Students count the rings but rather than simply cross-dating them, they also analyze the nature and appearance of the tree rings to infer paleoclimatic data and contextualize historical events.

Key Terms

Anthropocene: Current geologic era characterized by profound and irreversible human impact on the Earth's climate and ecosystems.

Biocultural landscapes: The spatial relationship between people and their natural environment and biological resources.

Biodiversity: The variability and variety of living organisms on Earth.

Climate: Prevailing weather conditions of a region over a specific period of time.

Climate change: A change in global or regional climate patterns, in particular a change apparent from the mid-to-late 20th century onwards and attributed largely to increased levels of atmospheric carbon dioxide produced by using fossil fuels.

Coastal erosion: The process by which local sea level rise, strong waves and currents, and coastal flooding wear down or displace soils, rocks, and/or sands along the coast.

Community: An interacting group of various species sharing a common habitat at the same time.

Currents: Ocean water circulation systems.

Domestication: A slow biological process where wild plants and animals are adapted for human use.

Eccentricity: The deviation of a planet's orbit from circularity (i.e., the shape of earth's path as it orbits around the sun).

Electron Spin Resonance (ESR) Dating: A radiation exposure method based on radiation dosimetry, which causes a charge to become trapped at defects in the crystal lattice of certain minerals like aragonite, calcite, and quartz. The trapped charges from pragmatic centers can be detected by the rise of a ESR signal, used for absolute dating of some archaeological materials.

Environmental anthropology: A subfield that uses anthropological questions, methods, and theories to understand and find solutions to environmental problems and address issues of human survival.

Global warming: An increase in the earth's atmospheric and oceanic temperatures, largely since 1850, widely predicted to occur due to an increase in the greenhouse effect resulting especially from pollution.

Greenhouse effect: The trapping of the sun's warmth in a planet's lower atmosphere, due to gases like carbon dioxide and chlorofluorocarbons that absorb infrared radiation.

Intergovernmental Panel on Climate Change (IPCC): A United Nations body that assesses and reports on the science related to climate change.

Last glacial maximum: Approximately 21,000 years ago when massive sheets of ice (glaciers) locked away water on land, lowering the sea level, exposing continental shelves, joining land masses together, and creating extensive coastal plains.

Milankovitch cycles: The three natural cycles or movements of the Earth; eccentricity, precession, and obliquity.

Obliquity: The angle between a planet's axis of rotation and a line perpendicular to its orbit plane (i.e., the tilt of the earth's axis).

Polar amplification: The phenomenon where the effects of global climate change (ice melting reveals more darker land or ocean surfaces which absorb more energy from the sun, causing additional ice loss) disproportionately impact the Arctic and polar regions, which has warmed at nearly twice the rate of the rest of the world in the past 30 years.

Precession of the equinox: The motion of the equinoxes along the plane of earth's orbit (the ecliptic) caused by the cyclic precession or wobbling in the orientation of earth's axis of rotation (i.e., the changing tilt direction of the earth's rotational axis). A full precession takes 25,772 years.

Rain/Snow shadow: The side of the mountain that gets little rain or snow, becoming a drier or desert region because mountain ranges block the rainy, plant-growing weather from reaching that area of land.

Resilience: The ability to bounce back after a disaster to maintain a society or culture.

Salinization: The process by which a non-saline soil becomes built up with salt, as by the irrigation of land with brackish water, hindering the growth of crops and plants.

Thermoluminescence (TL) dating: A method used to date certain materials that store accumulated energy by measuring the amount of light released when an object is heated, such as ceramics, lava, or sediments that were exposed to substantial sunlight.

Traditional environmental knowledge: Long-term experience with and knowledge of environments that indigenous communities develop in connection to places.

Weather: Temperature, air pressure, humidity, precipitation, and wind conditions throughout the year.

Wisconsin Glacial Period: The most recent major division or cycle of Pleistocene time and deposits, with climate cooling and glacier expansion, in North America, beginning between 100,000 or 75,000 years ago and ending around 11,000 years ago.

Suggested Readings

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