

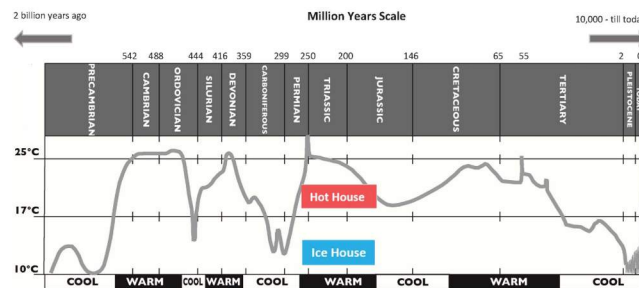
# 4. Climate on Earth and the anthropocene

## Objectives

- Know how to describe the evolution of the climate on Earth
- Understanding the influence of humans on the climate

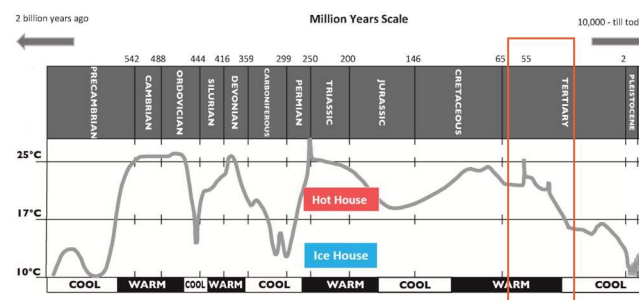
## 4.1. -2 billion years

Over the past 2 billion years, Earth's climate has alternated between “hot” periods and ice ages during which ice could cover the entire planet.



### -55 million years

The last transition between these phases occurred around 55 million years ago when the temperature reached a thermal maximum followed by a long period of cooling, which we are now experiencing.



### -500,000 to -100,000 years

500,000 to 100,000 years ago, a period of fluctuation between hot and cold temperatures occurred. Arctic ice samples show that over a period of several hundred thousand years, the large ice caps that covered parts of North America and Europe melted in a series of surges of temperature, each occurring approximately every 100,000 years.

### -10,000 to today

The last 10,000 years are known as the Holocene. Sea level stabilized at its current level about 7,000 years ago. This period of stable temperatures allowed human civilization to develop.

## Cause of climate change

The Earth's climate does not change without reason. Many factors can influence it over long periods of time. These factors are known as “climate forcings”. The 3 main climate forcing factors are: 1) solar variability, 2) volcanic activity and 3) changes in the carbon cycle

### 4.1.1. Human influence on the climate

#### Definition

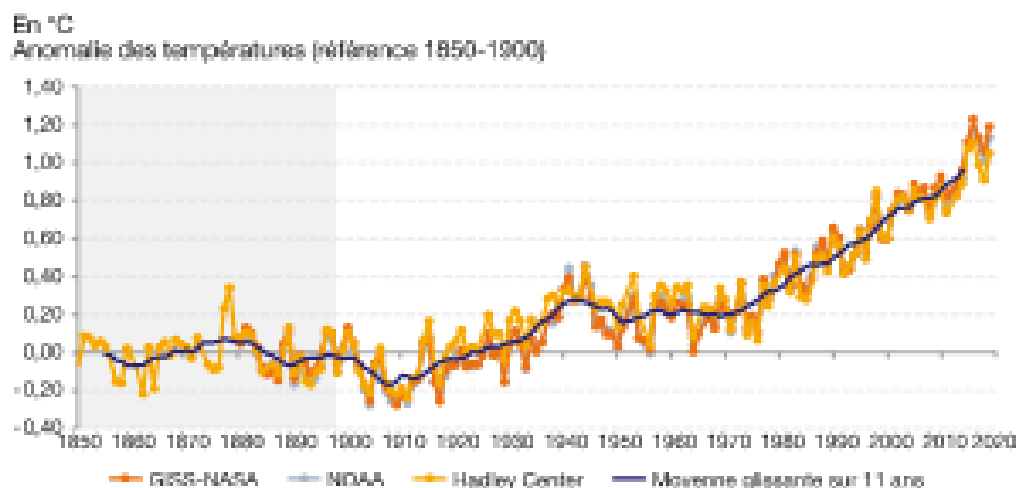
Anthropocene (“Human Age”): Geological period following the Holocene and characterizing all the geological events that have occurred since human activities have a significant global impact on the Earth's ecosystem.

Popularized at the end of the twentieth century Paul Josef Crutzen and Eugene Stoermer, it would have started according to them at the end of the eighteenth century with the industrial revolution.

#### Impact of human activities and carbon sinks

Almost all human activities emit GHGs. Whether it is for the production of heat, electricity or other energies, agriculture and animal husbandry, industry, buildings and transport, every major sector of the world economy contributes to CO<sub>2</sub> emissions. Current CO<sub>2</sub> emissions will have an impact on the temperature of the globe for more than a century. On the other hand, certain activities reduce the capacity of ecosystems to absorb these gases. Indeed, certain natural environments (forests, peat bogs, ocean) are called “carbon sinks” because of their ability to filter CO<sub>2</sub> from the atmosphere and transform it into organic carbon. Their degradation (deforestation, urbanization, pollution, agriculture, etc.) thus considerably reduces the capacity of these environments to absorb CO<sub>2</sub>.

#### Evolution of the annual average temperature



#### WORLDWIDE ANNUAL AVERAGE TEMPERATURE EVOLUTION FROM 1850 TO 2019

Since the early 1980s, the global average temperature of land surface air and ocean surface water has warmed markedly.

The decade 2010-2019 (with a temperature 0.66 ° C above the 1961-1990 average) was 0.19 ° C warmer than the decade 2000-2009 (0.47 ° C above the 1961-1990 average). The last five years are the five warmest since 1850. The year 2016, with a temperature 0.86 ° C higher than the 1961-1990 average, ranks first among the warmest years since 1850, the year 2019 ranking second. Since the end of the 19th century, the global average temperature has increased by almost 1 ° C (2010-2019 ten-year average of 0.97 ° C).

source: NASA; NOAA; Hadley Center

<https://www.statistiques.developpement-durable.gouv.fr/edition-numerique/chiffres-cles-du-climat/1-observations-du-changement-climatique>