



Nicolae Sfetcu

CLIMATE CHANGE GLOBAL WARMING

MultiMedia Publishing

Climate Change - Global Warming

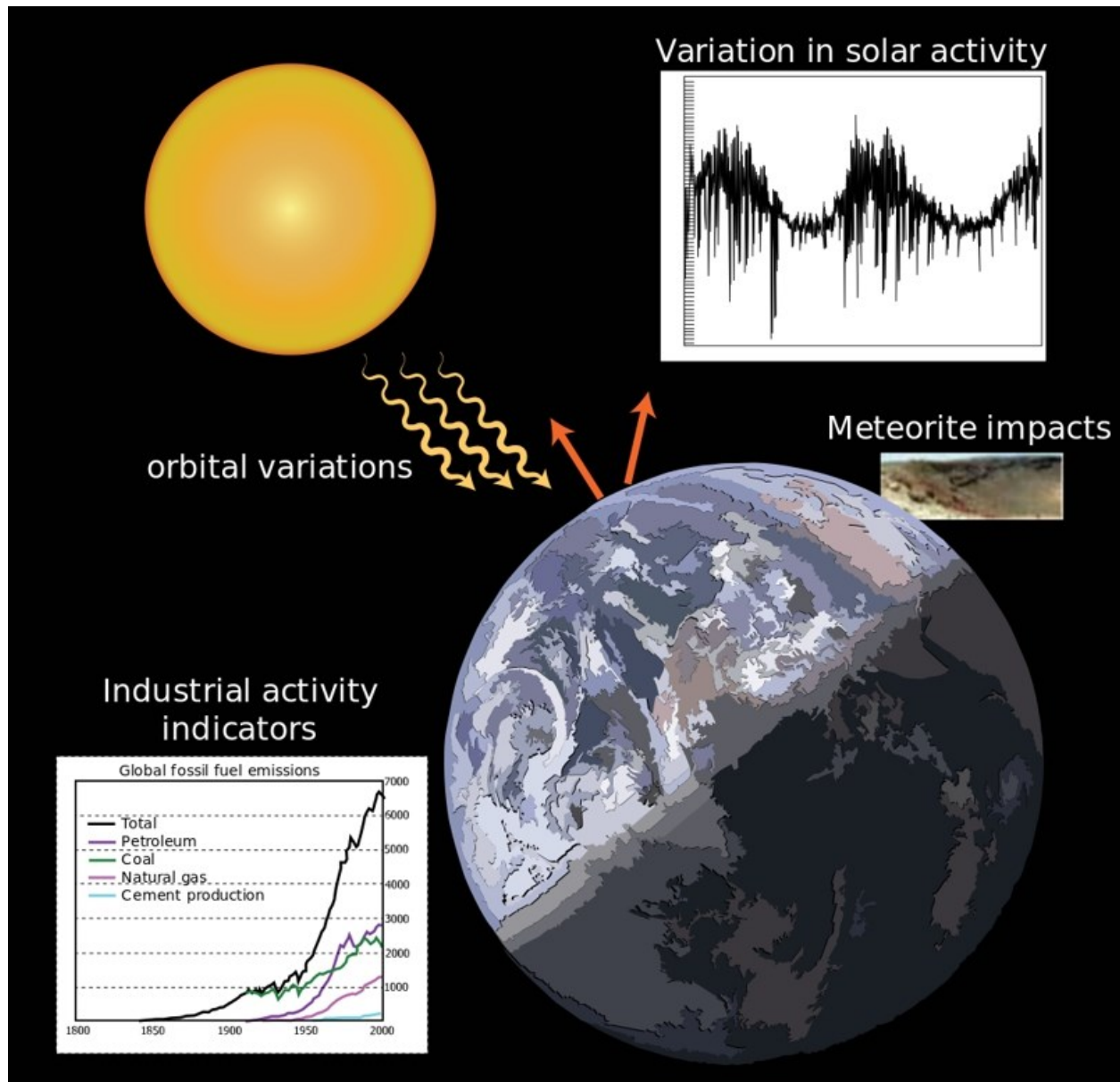
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Climate change

A **climate change** represents a lasting change (from decades to millions of years) of statistical parameters (mean parameters, variability) of the overall climate of the Earth or its various regional climates. These changes may be due to intrinsic process of the Earth, to outside influences or, more recently, to human activities.



(Image composite illustrating main factors affecting climatic change. Source: https://commons.wikimedia.org/wiki/File:Climate_change-en.svg, CC Attribution-Share Alike 4.0 International license)

Anthropogenic climate change is the result of greenhouse gas emissions generated by human activities altering the atmospheric composition of the planet. To this are added the evolution of natural variations in climate.

In the work of the Intergovernmental Panel on Climate Change, the term "climate change" refers to any change in time, whether due to natural variability or human activity.

In contrast, in the United Nations Framework Convention on Climate Change, the term refers only to changes due to human activities. The Framework Convention uses the term "climate variability" to describe natural climate change.

Climatic variations

Historical record

The Greek philosopher Theophrastus, in his book *Winds*, writes that on the Cretan mountains we could already see the ruins of ancient cities, abandoned sites, formerly inhabited or cultivated land, depopulated long time ago for climatic reasons.

Another Greek philosopher, Plato, describes the effect of local climate change in Attica in his *Critias*:

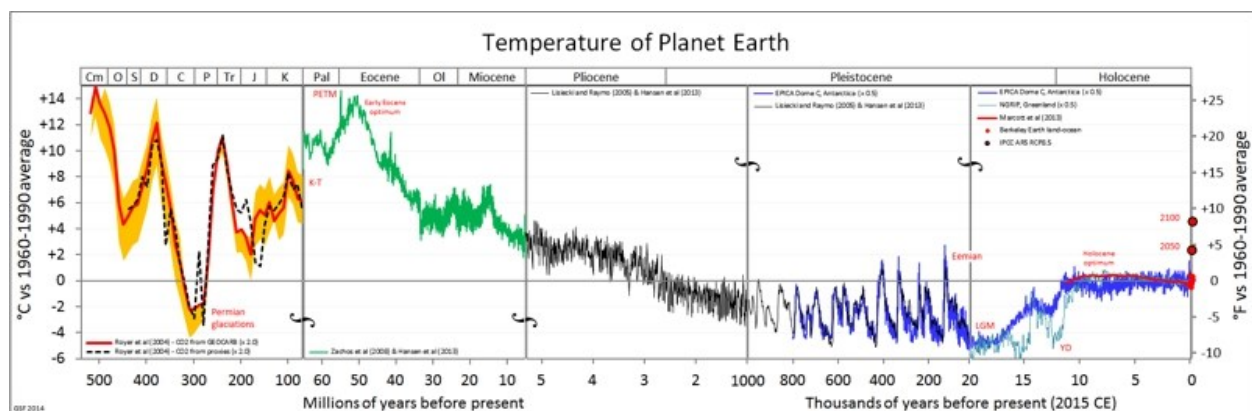
"The land was the best in the world, and was therefore able in those days to support a vast army, raised from the surrounding people. Even the remnant of Attica which now exists may compare with any region in the world for the variety and excellence of its fruits and the suitability of its pastures to every sort of animal, which proves what I am saying; but in those days the country was fair as now and yielded far more abundant produce. How shall I establish my words? and what part of it can be truly called a remnant of the land that then was? The whole country is only a long promontory extending far into the sea away from the rest of the continent, while the surrounding basin of the sea is everywhere deep in the neighbourhood of the shore. Many great deluges have taken place during the nine thousand years, for that is the number of years which have elapsed since the time of which I am speaking; and during all this time and through so many changes, there has never been any considerable accumulation of the soil coming down from the mountains, as in other places, but the earth has fallen away all round and sunk out of sight. The consequence is, that in comparison of what then was, there are remaining only the bones of the wasted body, as they may be called, as in the case of small islands, all the richer and softer parts of the soil having fallen away, and the mere skeleton of the land being left. But in the primitive state of the country, its mountains were high hills covered with soil, and the plains, as they are termed by us, of Phelleus were full of rich earth, and there was abundance of wood in the mountains. Of this last the traces still remain, for although some of the mountains now only afford sustenance to bees, not so very long ago there were still to be seen roofs of timber cut from trees growing there, which were of a size sufficient to cover the largest houses; and there were many other high trees, cultivated by man and bearing abundance of food for cattle. Moreover, the land reaped the benefit of the annual rainfall, not as now losing the water which flows off the bare earth into the sea, but, having an abundant supply in all places, and receiving it into herself and treasuring it up in the close clay soil, it let off into the hollows the streams which it absorbed from the heights, providing

everywhere abundant fountains and rivers, of which there may still be observed sacred memorials in places where fountains once existed; and this proves the truth of what I am saying.

"Such was the natural state of the country, which was cultivated, as we may well believe, by true husbandmen, who made husbandry their business, and were lovers of honour, and of a noble nature, and had a soil the best in the world, and abundance of water, and in the heaven above an excellently attempered climate."

The idea of climatic variations became an important scientific theme in the 18th century, thanks in particular to the progress of paleontology, but it was only from the inter-war period that climatology became a true science.

Old variations



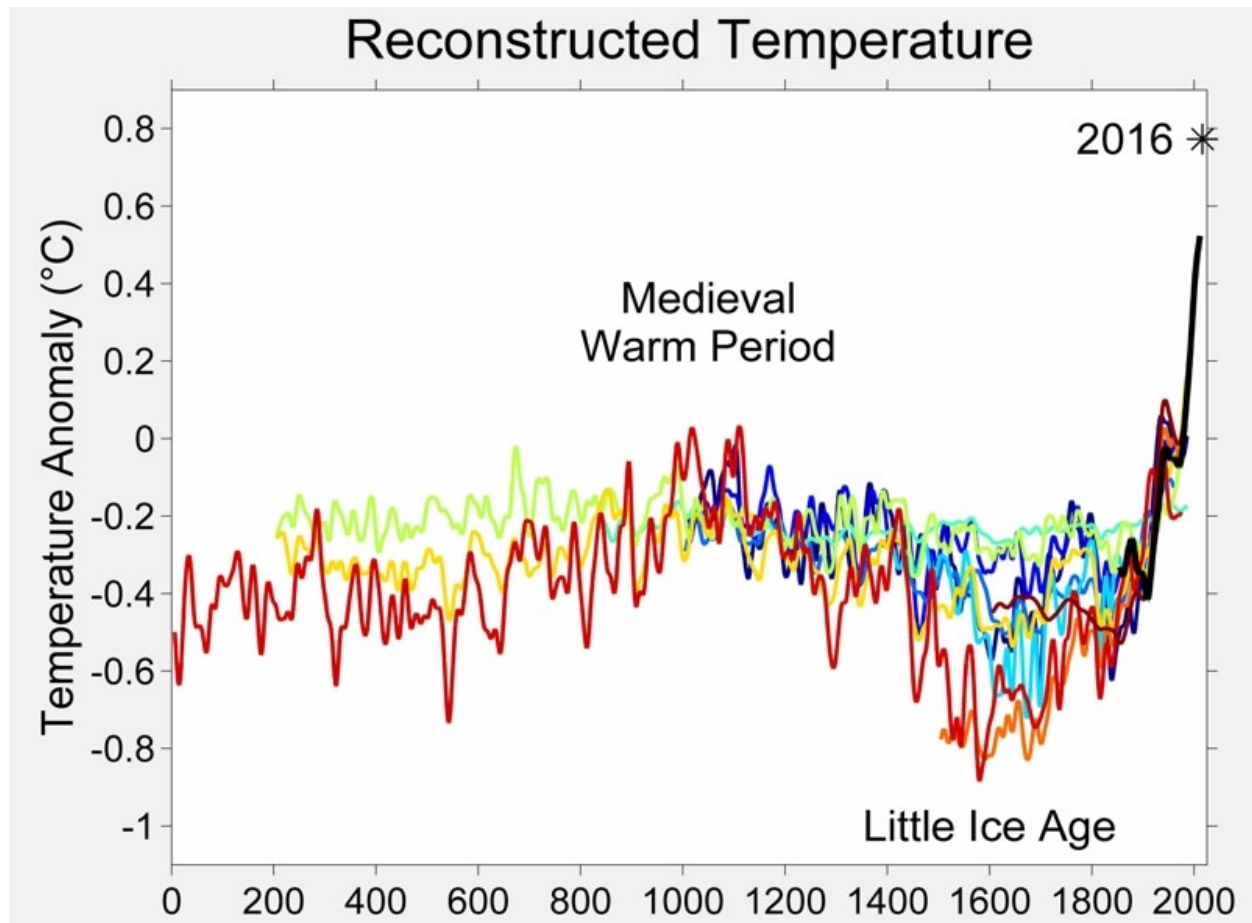
(Evolution of average global temperatures of 500 million years. Source: Glen Fergus, https://fr.wikipedia.org/wiki/Fichier:All_palaeotemps.png, CC Partage dans les Mêmes Conditions 3.0 (non transposée))

The earlier phases of human history show the paleoclimatology. It can track, over continental drift and periods of successive glaciations, changes related to climate change that affected the soil and species.

- ...
- + Upto 450 000 years ago: Waalian Interglacial
- - Until 400,000 years ago: Günz or Nébraskien
- + Upto 350 000 years ago: Cromer or Aftonian Interglacial
- - Until 320,000 years ago: Mindel , Elster or Kansien Glaciation + until 270,000 years ago: Holstein or Yamouthien Interglacial
- - Until 200,000 years ago: Riss, Saal, or Illinoien Glaciation
- + Upto 125 000 years ago: Eem, Eemian or Sangamonian Interglacial
- - Until 70 000 years ago: Würm, Wisconsin or Weichselian Glaciation
- + Upto 11,625 years ago: the Holocene Interglacial (Holocene climatic optimum) sometimes referred to as the Holocene "new warming"

... Beginning of written human history and observation of climate changes by chroniclers.

- - Climate Change between 535-536 observed by the Byzantine Procopius.
- + From the tenth century to the fourteenth century, the Medieval Warm Period is a localized heating to Europe and North America.
- - The 1550s to the 1850s remains the Little Ice Age.
- + The last phase is contemporary and attempts to describe the multiple effects of global warming. It is separate from the rest because of the constant anthropogenic interference with the climate balance since the advent of the industrial revolution and control of polluting energy sources by mankind.



(Graph of temperatures of 2 past millennia highlighting the medieval climate optimum, the Little Ice Age, which follows the breakdown of global warming. Source: Robert A. Rohde, https://fr.wikipedia.org/wiki/Fichier:2000_Year_Temperature_Comparison.png, licence CC Attribution – Partage dans les Mêmes Conditions 3.0 (non transposée))

Recent global warming

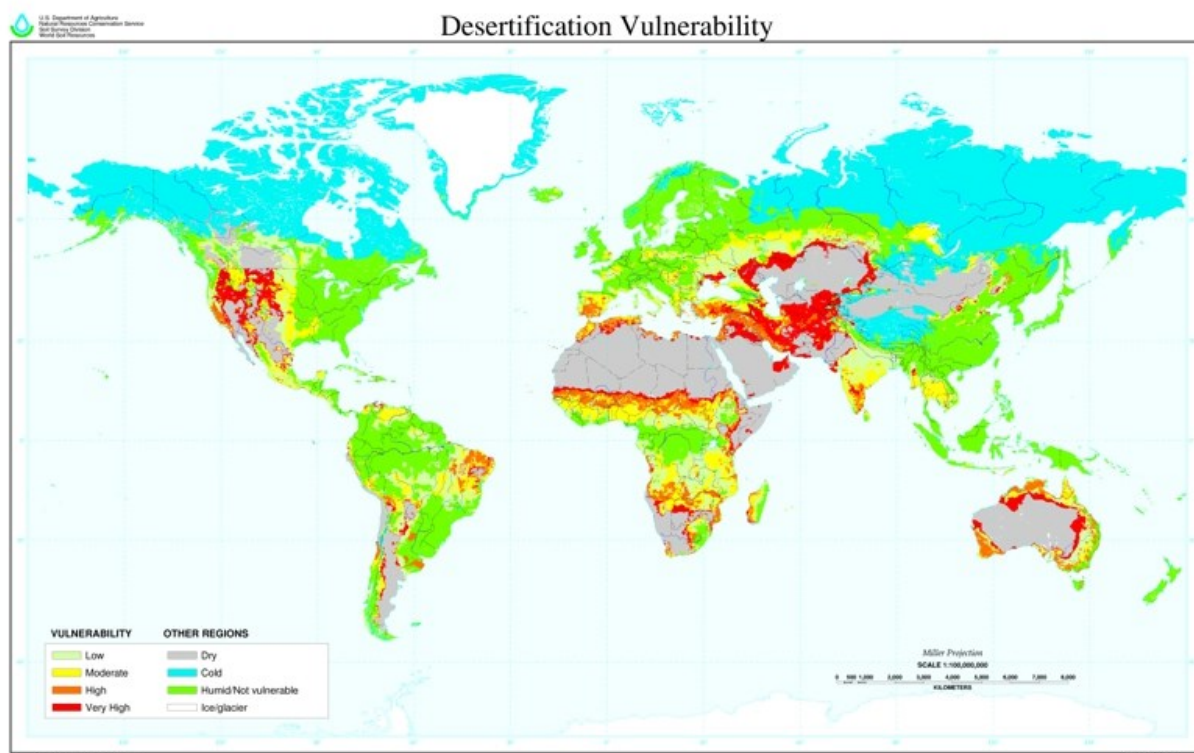
Global warming was first mentioned by several authors, and modeled by Svante Arrhenius in 1896. The English-language original term *global warming* was coined by the climatologist Wallace Broecker in the journal *Science* on August 8 1975. Since, the Intergovernmental Panel on Climate Change says that global warming tends to increase and the classic cycles and climate regulation processes are outdated since 1950, including thawing of permafrost containing methane (CH₄), whose action on the greenhouse effect is 25 times greater than carbon dioxide (CO₂) and the

melting of polar ice and glaciers increases the uptake by soils and oceans solar radiation. During the more frequent heat waves, vegetation slows its growth and thus its ability to remove carbon from the atmosphere. It would be a shift towards a strong global imbalance magnitude, without already know if a point of no return is reached.

The Intergovernmental Panel on Climate Change does not conduct research in its own name but has the task of evaluating the information scientific, technical and socio-economic information relevant to understanding the scientific basis of the risks linked to climate change of human origin, identify the possible consequences of this change and consider possible adaptation and mitigation strategies. The ten warmest years since 1850 are all subsequent to 1998.

The ten warmest years since 1850 are all after 1998

Drought and desertification



(Areas vulnerable to desertification. Source: Public domain)

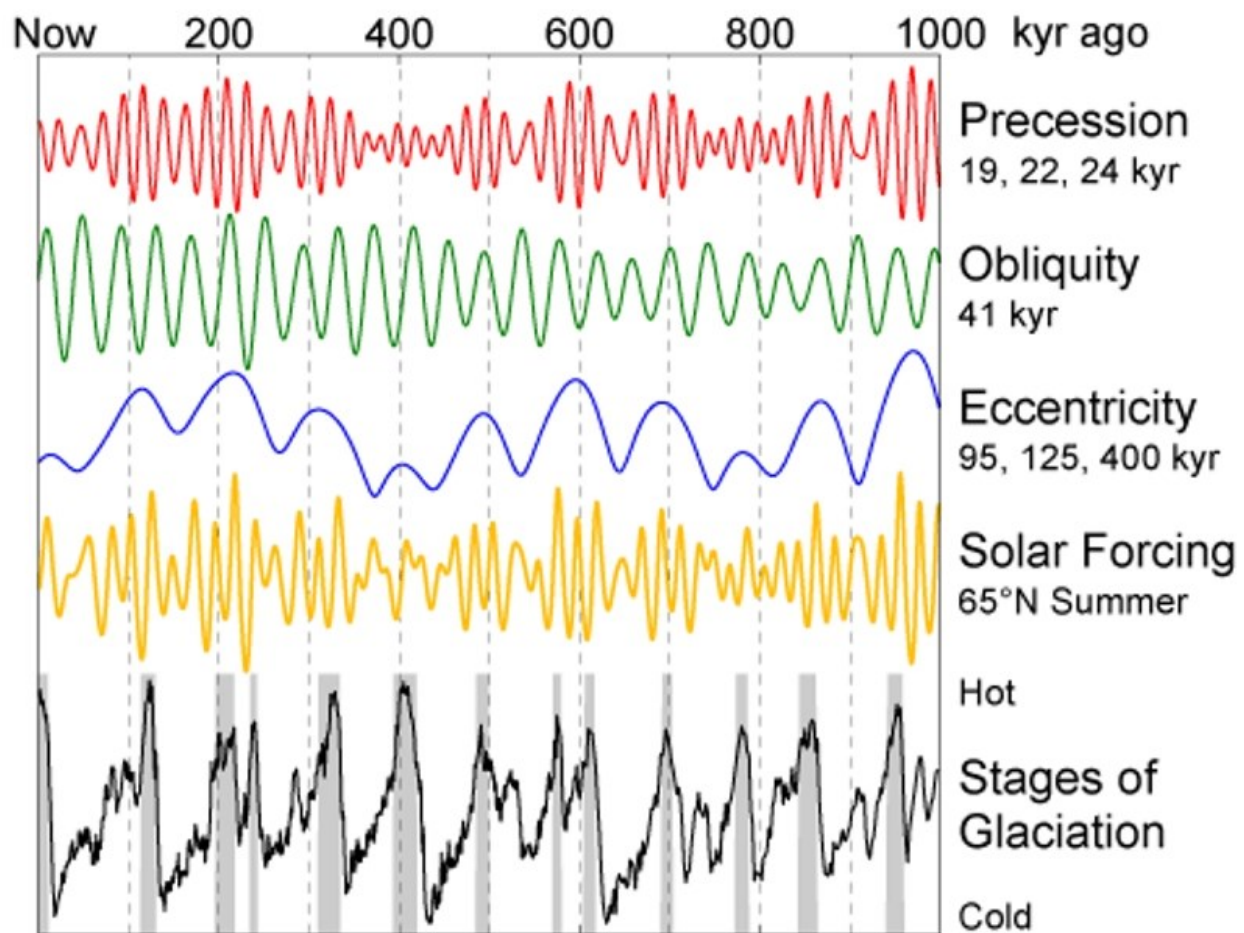
Drought phenomena, salinization and desertification may be aggravated by climate change, particularly in the Sahel and the Gobi Desert that stretch. Desertification can itself contribute to local and global changes in climate, such as through the burning of savannahs or steppes, being a major source of dust (aerosols that can affect rainfall) and albedo (more important than a vegetated areas).

Factors

Currently, the phenomenon of so-called natural climate change (or "climate variations") is not fully understood, but there are several hypotheses that attempt to explain them.

Astronomical causes

This theory proposed by Milutin Milanković between 1911 and 1941, confirmed by the study of oxygen-18, and broadly endorsed by the scientific community, explains the glacial/interglacial climate cycles by variations of eccentricity, obliquity and precession of Earth. According to this theory, without anthropogenic forcing the planet would enter a new cooling era, or enter an exceptionally long and stable interglacial phase (another 50 000 years).



(Variations of parameters and temperature. Source: Robert A. Rohde, https://commons.wikimedia.org/wiki/File:Milankovitch_Variations.png, CC Attribution-Share Alike 3.0 Unported license)

Another theory, compatible with the others, is that of solar cycles, developed by the German Heinrich Schwabe in 1840, and then by the American George Hale in 1906. It explains the low climatological changes that take place every 11 years, cycle corresponding to that of sunspots which have a periodicity of 11 years; when the number of sunspots is important, the Sun emits

more energy (Earth receives more so) and therefore a change in temperature occurs. This radiation influences in a complex way the cloud (see physical principle of the cloud chamber) and therefore both the planetary albedo and the greenhouse effect due to clouds and water vapor. These spots are cooler (4500 K) than the surface of the Sun (5800 K approximately), but they correspond to an increase in radiation by X-rays which can increase to 1000 times to 1% in the visible light in the periods of intense activity. The little ice age observed between the years 1645 to 1715 is an illustration of the theory of the influence of temperature variations due to sunspot cycle. An unusually low number of sunspots were observed there.

Interstellar dust clouds

This theory is the most controversial. For some scientists, when the solar system passes through an interstellar cloud of dust, some of the light energy is absorbed; this affects the amount of heat that reaches Earth and thus on climate.

Movements of continents near the poles

To understand the influence of the movements of continents, we must first know that ocean currents have a major influence on climate change, the continents have really no direct influence on the climate but they allow by moving the training or stopping currents.

The example of the Antarctic: before the breakup of the Gondwana super-continent, the Antarctic climate was hot and humid; since Australia, Africa and South America have migrated north, the various straits were opened and a circular ocean current (called Circumpolar Current) began. In some time, the climate changed to meet current one with a huge ice cap that was put into place on the Antarctic continent, despite its aridity (this is the driest area in the world), but all the snow accumulates the ground, at -45°C average, the sublimation pressure is negligible; the cause of ablation is from wind and coasts, calving glaciers. On the other hand, the "treadmill" oceanic is running in about 2000 years. If the thermohaline circulation were to be disrupted, the climate would be significantly disrupted.

The two computer models of climate (US and European) give fairly similar results but are largely dependent on human factors.

The Book

A brutal and catastrophic warming could put humanity in short-term risk, a climate hypothesis that was first presented as highly speculative and subject to more science fiction than a serious prospective, before taking consistency by the scientists from the Rio Summit, and the difficulties of implementing the Kyoto Protocol. This possibility is beginning to be considered by the futurists, including the Intergovernmental Panel on Climate Change (IPCC), under the aegis of the UN, then a university report synthesis and evaluation that a large and abrupt changes may jeopardize all or part of humanity, biodiversity or societies and ecosystems to adapt capacities. The large press is gradually echoed, referring to the international climate negotiations "more difficult than on nuclear disarmament" and risking "the future of humanity".

Tens of thousands of deaths are attributed to heat waves. Floods are expected to increase. The Arctic is warming faster than other European regions, resulting in a doubling of melting of the Greenland ice cap. The sea has risen, with local isostatic variations. Impacts are expected on the flora (flowering, tree diseases..., but also on wildlife: zoonoses, range change) and diseases (ticks, some mosquitoes and sandflies go back further north and at altitude). The pollen season is longer. The plankton is changing and - outside marine environments - the migration/adaptation speed of many species is insufficient compared to the speed of biological and geoclimatic disturbances, which aggravates the risk of extinction. Agricultural yields are expected to decrease to the south and perhaps increase to the north.

The reality of risk and the phenomenon is now almost consensus. Faced with the problem, three approaches complement each other: fight against greenhouse gas emissions, carbon sinks, and adaptation.



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