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Epidemics during Grand Solar Minima

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Epidemics during Grand Solar Minima

Alexey Ju. Retejum

Abstract- **Historical and geographical study of epidemics that affected the population of the Old World from the Stone Age to the present day shows that their development took place against the background of major anomalies in various geospheres. Obviously, an important role in the spread of pathogenic organisms was played by the situation of solar minima, which reveal a centuries-old cyclical repeatability. The last change in the periods of the 179-year and 1430-year cycles of the Solar system and the biosphere occurred in April 1990. The events of recent years and months follow a General pattern.**

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HighLights

- Major epidemics in the history of mankind over the past 3-5 thousand years, as a rule, developed against the background of global anomalies in different geospheres.
- A prerequisite for the spread of dangerous infectious diseases is the periodic weakening of solar activity.
- The epidemic process is one of the links in the chain reaction that the planet Earth responds to the disturbance from space.

I. Introduction

In 2017, the journal Astrobiology & Outreach published an article [1] in which a group of scientists from the UK, Sri Lanka, Australia, China and Japan draws our attention to the likely link between the onset of solar lows and pandemics, which can be used as a guide for closer scrutiny of circulating viruses, and monitoring their genetic variations. The question of the influence of space on diseases has a long history. The merit of the first comprehensive study of global conditions for the development of epidemics belongs to Alexander L. Chizhevsky. Generalization of materials on centuries-old observations of doctors allowed him to conclude that "epochs of natural disasters in nature coincide with the development of certain epidemic diseases", and these events "periodically repeat" depending on the state of the Sun. In relation to the mechanism of cosmic influence in those years, it was "all dark", "all unclear", but there was evidence of the role of electrical phenomena as a conductor.

In the 90 years since the publication of the book "Epidemic catastrophes and periodic activity of the Sun" (in Russian), the volume of relevant information has grown immeasurably. Important for solving the problems of the etiology of infectious diseases are information about the relationships of pathogenic organisms with bacteriophages, discovered by Felix d' Hérelle. Genetics made it possible to trace their origin and evolution. Paleoreconstructions opened the way to restore the solar climate and other elements of the human environment and its biocenosis since the Neolithic. The new data require certain adjustments to the existing understanding of the factors of the epidemic process. At the same time, Chizhevsky's approach to elucidating the associated consequences of a cosmos impact certainly retains its cognitive value. First of all, it is necessary to take into account the frequency of external pulses generated by variations in the activity of the Sun (Fig. 1) when it rotates around the barycenter of the Solar system, which is caused by the movement of planets in elliptical orbits.

With the synchronization of the movements of the heavenly bodies is the subordination of the solar cycles, their octal hierarchy: a 22-year cycle, repeated 8 times, forming a 179-year cycle, which, in turn, acts as one of the eight elements 1430-year cycle that is part of the cycle lasting about 11400 years, etc. Cyclical to be not only solar activity but also the speed of rotation of the Earth, as well as many natural processes in geospheres.

The end and beginning of a number of long-term and multi-century solar cycles falls on April 1990. It is important that the years of neighboring phases are usually marked by a decrease in solar activity (Fig. 2).

Taking into account the frequency of near-space impact on the habitat of living organisms, the destruction of cellular structures by ionizing galactic rays, as well as their probable mutagenic potential, it can be assumed that epidemics develop with a significant weakening of solar activity and violations in the functioning of geospheres. The results of testing this hypothesis are shown below.

II. Current Situation

The COVID-19 outbreak was preceded by two coronovirus epidemics – SARS-CoV (caused by the SARS-CoV strain, which in 2002-2004 sickened about 8 thousand people in 29 countries; the death rate was 9.6%) and middle East respiratory syndrome (when infected with the MERS-CoV strain, which infected 2,500 people in 27 countries in 2015-2020, of which about 35% died). In addition, in 2009-2010, humanity was struck by the swine flu pandemic, which affected from

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700 to 1400 million people in 168 countries (with a mortality rate of about 0.03%).

The extremely poor epidemiological situation in the first decades of the twenty-first century, based on the experience of previous centuries, indicates global shifts. Indeed, indicators of the state of many parts of the planetary system are currently characterized by maximum deviations from the norm for the entire period of instrumental observations.

Among the global anomalies, climate change draws particular attention. At the same time, it should be not only about an increase in temperature in the troposphere, but also a synchronous decrease in temperature in the stratosphere (Fig. 3).

The activity of the lithosphere has been unusually high in recent decades (Fig. 4).

The increase in earthquake energy is accompanied by an increase in the depth of the hypocenters (Fig. 5) and their redistribution (Fig. 6 and 7).

The level of the World's ocean is rising at an accelerated rate (Fig. 8).

The planetary scale shifts are indicated by an unprecedented decrease in the amplitude of variation of the Earth's axis (Fig. 9).

Global changes occur against the background of weakening solar activity (Fig. 10).

At the same time, the intensity of the UV radiation flux decreases (Fig. 11), which affects the life of organisms, especially viruses and bacteria.

Obviously, ionization of organic molecules and living matter should have serious environmental consequences for coenoses when the intensity of galactic cosmic rays increases (Fig. 12).

Before us is a situation similar to those that Professor Mikhail A. Bogolepov of Moscow State University once called perturbations of the planet. Regardless of what conclusion is received about the beginning of the circulation of the CAVID-19, we must recognize that the facts indicate the existence of prerequisites for the development of epidemic processes in modern extreme conditions.

III. Epidemics of the Ancient World and Later Analogues

The first epidemic in civilized Europe is known thanks to the book "History of the Peloponnesian War" by Thucydides - a witness to the events of 430-426 BC in Athens, who was infected, but miraculously survived. According to him, "the disease started in Ethiopia, over Egypt. From there it spread to Egypt, Libya, and most of the possessions of the Persian king. Quite suddenly, the disease also broke out in Athens; the first cases of the disease appeared among the population of Piraeus … Later, the disease also spread to the upper city, and many more people began to die... The singularity of this disease, which exceeds any means of expression, was shown not only in the fact that the disease affected people with a force that human nature could not bear, but also in the fact that, unlike everything previously observed, birds and quadrupeds that feed on human corpses did not touch the corpses at all (although many of the dead remained unburied) or, touching them, died… There were no other common diseases at that time. … The disease affected everyone, both strong and weak, without distinction in lifestyle. But the worst part of this disaster was the loss of spirit: as soon as any one felt ill, he was for the most part completely discouraged, and, no longer resisting, fell a victim to the disease; so people died like sheep, infected from one another. And this extreme contagion of the disease was just the main cause of widespread mortality. When people avoided visiting the sick for fear of infection, they died alone (and indeed, people died out in whole houses, since no one cared for them). And if someone visited the sick, he himself fell ill: there were still people who, out of a sense of honor, did not spare themselves, visited the sick, when even relatives, exhausted by the continuous mourning of the dying, at the end completely despaired and retreated before the terrible misfortune. The people who were most concerned with the sick and dying were those who had already suffered from the disease themselves, because they knew the course of the disease and considered themselves safe from secondary infection. Indeed, the disease did not affect anyone a second time… This calamity, which had befallen the Athenians, was aggravated by the influx of refugees from all over the country, and the new arrivals especially suffered from the disease. There were not enough dwellings: in the summer they had to live in stuffy temporary shacks, which caused people to die in complete disorder. The dying lay on top of each other, where they were found dead, or lay in the streets and by wells, half dead from thirst. The shrines themselves, along with the temple sites where refugees sought shelter, were full of corpses, as people died there as well... The disease spread mainly in Athens, and then in other densely populated places."

Among the dead were two adult sons of strategos Pericles, his sister and friends. The Athens epidemic, which lasted five years at a time, is estimated to have claimed between 30 and 100 thousand lives.

The nature of the infection is still unclear. There is no explanation for the unusual nature of the disease and its complete disappearance. The symptoms of the "Athens plague" are similar to Ebola hemorrhagic fever. It is impossible to exclude the case of a mutation of an imported ebolavirus or other pathogen from the filovirus family. The reason for this assumption is the phenomenon of a sharp weakening of solar activity in the years of the pestilence (Fig. 13), which, of course, was accompanied by an increase in the power of ionizing galactic radiation.

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The hypothesis of the mutagenic influence of a calm Sun on microorganisms can be verified by a mental critical experiment. If it is correct, the formation of new strains of a known pathogen should be timed to the next similar phase of weakening of solar activity. A positive test result will also confirm the reality of large solar periods. If we consider 1430-year cycles, we should expect that after the anomaly of the V-IV centuries BC, once again solar activity should have reached a minimum in the XI-XII centuries. At the same time, there was an increase in mutagenesis. The first part of the retrospection is fully justified (Fig. 14).

Materials on the evolution of pathogens help to test the hypothesis of mutagenesis periodicity. Confirmation was found in the results of an analysis of the genetics of Koch's wand (Mycobacterium tuberculosis), published by a team of Chinese scientists [3]. It was found that strains of the causative agent of the largest tuberculosis epidemic on the Earth were formed on the territory of China about 1000 years ago, in a "short window", when the living conditions probably changed. The authors assumption about the role of the environment corresponds to the facts, in particular, data on the annual growth of trees and the Grand eruption of the volcano Paektusan (on the border of China and Korea).

The second epidemic, of which there is historical information, broke out in Rome under Marcus Aurelius Antoninus in the mid-60s of the second century AD. There are conflicting opinions about its origin and scope, due to a lack of information. One source, the notes of doctor Galen, contains a brief description of the contagious disease. Another source – the testimony of the consul Dion Cassius - conveys rather a general impression. In book LXXIII of his work "Roman History "about the catastrophe, it is said literally only that " there was a pestilence, the greatest of all known to me: in one day two thousand people often died in Rome" (meanwhile, several pages are devoted to the acts of the Emperor Commodus on self-aggrandizement). Preserved documents of the Egyptian province indicate the simultaneous occurrence of other natural anomalies, in particular droughts and weak flooding of the Nile. They may be the consequences of a catastrophic eruption of mount Taupo in New Zealand – one of the most powerful in the last two thousand years.

In the third century AD, the Sun enters a phase of weakening activity (Fig. 15), the climate changes in the direction of cooling.

The middle of the solar minimum period of the third century AD coincides with the beginning of the third epidemic in the ancient world, known as the Cyprian plague. The disease originated in 249 on African soil, and in 251 it reached Europe. For 20 years, its victims were millions of people, which undermined the power of the Roman Empire. In many ways, the pathogen belonged to filoviruses.

We can assume that by analogy with the negative anomaly of the V-IV centuries BC, the minimum of the III century AD had a kind of double, younger than it by 1430 years. Again, the radiation reconstruction data demonstrate that a long periodicity of solar activity actually exists (Fig. 16).

It is quite natural that the relatively short period of the minimum of the XVII-XVIII centuries was marked by an unusually high frequency of epidemics: the Chinese plague (1641-1644), the Great plague of Seville (1647-1652), The Neapolitan plague (1656), the Great plague of London (1665-1666), the French plague (1668), the Maltese plague (1675-1676), the Great plague of Vienna (1679), the Canadian smallpox (1702-1703 years), the Icelandic smallpox (1707-1709), the Baltic plague (1710-1712), the Great plague of Marseilles (1720-1722), and others.

Thus, familiarity with the epidemics of antiquity reveals the parallelism and periodicity of solar and terrestrial anomalies.

IV. The End of Antiquity

In 559, the Sun approached the barycenter of the planetary system at the shortest distance in 1430 years. The movement of the sun with small deviations from the average position during the VI-VIII centuries entailed a long and very significant decrease in the power of its radiation (Fig. 17).

A sharp decrease in solar activity caused a cooling of the climate, which affected the biota of Eurasia (Fig. 18 and 19) and other continents.

Around 540, the first pandemic began, which went down in history as the Justinian plague. It is believed that the causative agent of the disease was of African origin, and its spread across Byzantium and the territories of neighboring countries led to a reduction in the population by 25-50%. In recent years, there has been evidence that the focus of infection was most likely located in the Asian steppes [4], and the idea of the devastating socio-economic consequences of its penetration into the Mediterranean is probably somewhat exaggerated [5].

It is important to emphasize that the duration of the plague was strictly limited by the epoch of the great solar minimum, which ended in 740. In addition to climatic anomalies, the VI century is characterized by high seismic activity: at that time, the number of strong earthquakes was greater than in three centuries combined (Fig. 20). Perhaps the increased degassing of the subsurface contributed to the deterioration of the environmental situation (so thought contemporaries of the events).

Natural prerequisites of the epidemic situation of the VI-VIII centuries. due to the rule of 1430-year periodicity, they must be reproduced again by the planetary system in the XXI-XXIII centuries (Fig. 21).

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In the era of the Justinian plague, due to its unique position in the 1430-year cycle, we see an exceptionally vivid manifestation of the relationship between the state of the biosphere and man with the dynamics of the planetary system.

V. The Plague of the Fourteenth Century

The medieval plague received an initial impulse in Mongolia in the 20s of the XIV century and in 1330-1360, it covered the areas of Asia and Europe, where it killed tens of millions of people. In terms of the scale of losses, the black death pandemic was obviously one of the worst natural disasters in human history.

The epidemic process developed 700 years ago in the conditions of a deep and extensive solar minimum (Fig. 22 and 23).

In the era of the Justinian plague, due to its unique position in the 1430-year cycle, we see an exceptionally vivid manifestation of the relationship between the state of the biosphere and man with the dynamics of the planetary system.

The events of the XIV century follow the general regularities of periodicity and range in our planetary system.

VI. The Minimum of Dalton

About 200 years ago, at the time limit of the penultimate and last periods of the 179-year cycle, there was a significant weakening of solar activity, now known as the Dalton minimum. In addition to reducing the area of sunspots (see Fig. 1), this era saw an intensification of volcanic activity, including the eruption of Tambora on one of the Lesser Sunda Islands, the most powerful in 800 years (after the above-mentioned Paektusan event). Climate cooling has had a negative impact on crop yields and forest growth in Europe (Fig. 24) and other regions.

It is not surprising that the solar minimum of the XIX century gave rise to the first and second largest pandemics of cholera – the deadliest disease of the century, with an area that includes Eurasia, Africa, Australia and North America, and the number of victims exceeding 200 thousand people (Fig. 25).

In addition, the list of major epidemics in the first decades of the nineteenth century includes yellow fever, plague, typhoid, and smallpox.

It can be stated that the XIX century gave new examples of direct and indirect dependence of pathogens on the space climate.

VII. Flu

Over the past 40 years, after the work of E.D. Kilbourne [6], there have been regular reports in the press about the discovery of a link between flu and solar activity [7-11]. However, an objective examination of the grounds for such a conclusion, performed by S. Towers [12], shows, that in all cases, the analyses either had mis-transcriptions of the dates of influenza pandemics listed in the literature, and/or made mistakes in the statistical analyses, and/or the analyses were not robust to arbitrary assumptions made to select the data, or the metrics used to assess the relationship between sunspot activity and the timing of influenza pandemic. This criticism is not shared by the author of a recent study [13] who claims that almost all recorded influenza pandemics have occurred in time frames corresponding to sunspot extremes, or +/- 1 year within such extremes.

The first documented flu epidemic dates back to 1889-1890, when 300 to 900 million people were infected worldwide, and about 1 million of them died. Cases of mass non-seasonal influenza diseases in the twentieth century occurred after the maximum (1918-1919) or during the maximum (1957-1958 and 1968-1969) of the 11-year cycle. How should the last three facts be considered? Most likely, they are not exceptions to the established rule, since we are talking about a multi-year period of increasing solar activity, which began in 1901. It is significant that the last epidemic, which was at the stage of a long-term decline in solar activity, like the flu of 1889-1890, developed just within the solar minimum (Fig. 26).

The epidemiology of influenza, which may have killed about 100 million people, remains largely unclear and requires in-depth study of the role of geophysical factors.

VIII. Prehistoric Events

Genetic and archaeological research in recent years has revealed evidence of the spread of plague across Europe during the Neolithic period [14]. Most often they are 5400-5700 years old. This was obviously a time of disasters, depopulation of settlements, and a change of management methods.

Interestingly, there is a time boundary between the two periods of the 1430-year cycle, which dates back to 3700 BC. Later, as usual, there was an era of rapid weakening of solar activity (Fig. 26). This process could trigger an epidemic.

Another set of facts sheds light on plague diseases in the Bronze Age. The age of the epidemic traces corresponds to the time limit of the later periods of the 1430-year cycle-2300 BC.

The found temporal order of events in the cosmos and the biosphere can be used in reconstructing events of the distant past.

IX. Conclusion

These facts allow us to get a general picture of the cause-and-effect relationships leading to destructive epidemic processes. They originate in the elliptical orbits of the outer planets, which control the activity of the Sun

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and through it determine the functioning of the Earth's system. Some links of this chain reaction have yet to be studied in detail, the main thing is to understand what exactly changes the rate of mutation of pathogenic organisms and the rate of their reproduction. In addition, the mechanism of energy transfer from near space, which causes perturbation of the Earth's body, remains unclear.

Available data on changes in the state of the biosphere and the spread of infectious diseases in the past relate mainly to the Old World. Individual facts from the history of epidemics on the American continents, for example, the development of three terrible epidemics of cocoliztli on the territory of present-day Mexico in the 16th century, do not contradict the general pattern. However, much more needs to be done to fill the gaps in our knowledge at the global level.

Acknowledgment

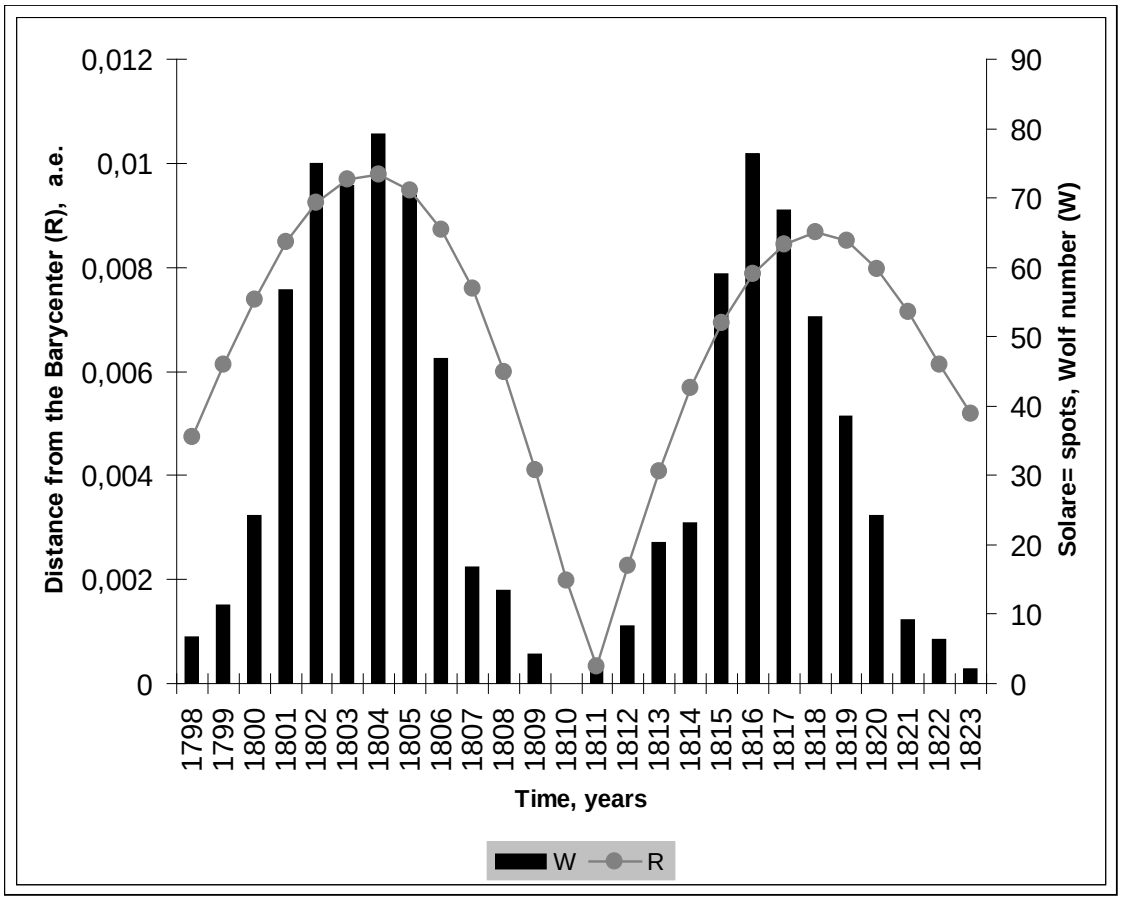
The author is grateful to Dr. A. Shapiro for kindly providing data on the reconstructed values of total solar radiation and to Prof. V. I. Bulatov for information about the performed epidemiological studies.

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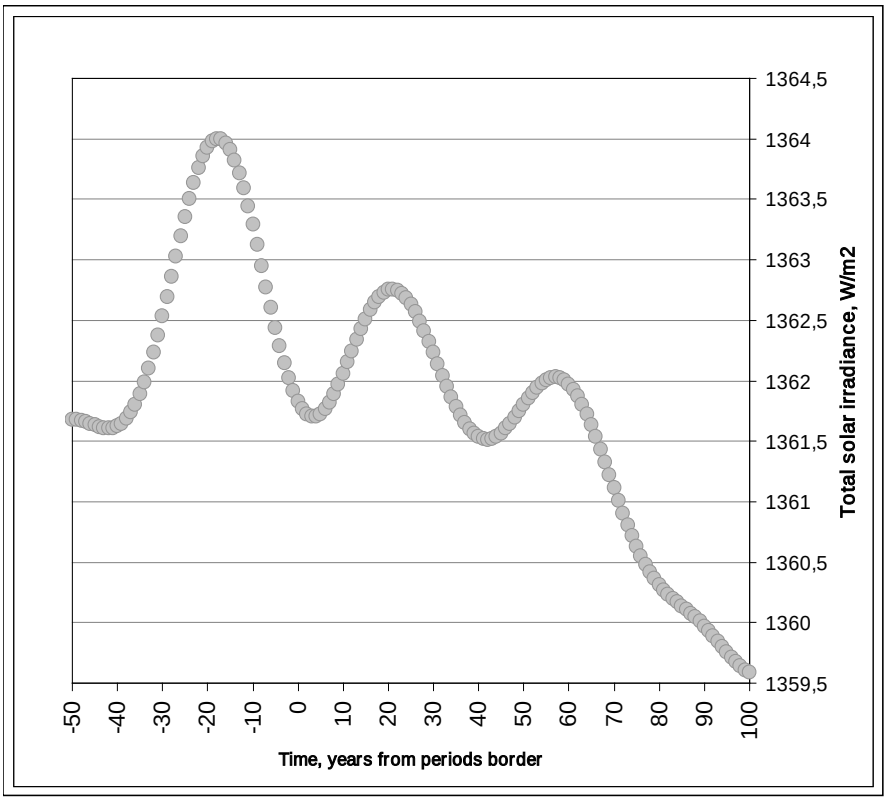
Figure captions



Source: according to the World Data Center for the production, preservation and dissemination of the international sunspot number (http://sidc.oma.be), calculation using the EPOS GAO program

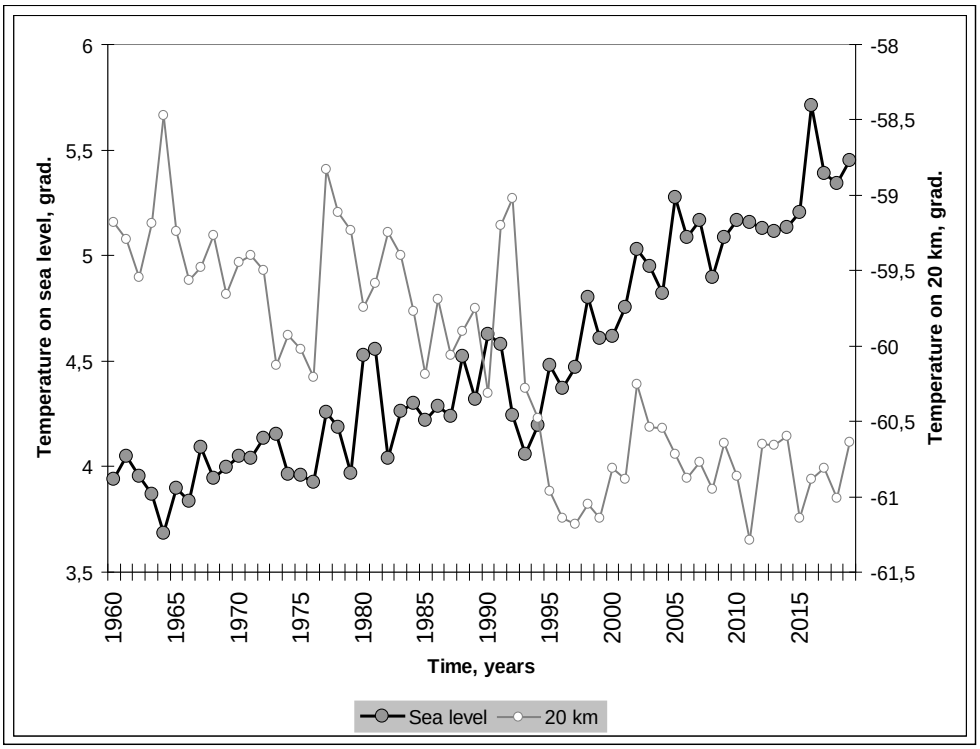
Fig. 1: The Long solar minimum of 1809-1811, due to the approach of the Sun's center to the barycenter of the Solar system by the shortest distance (which occurs once every 179 years)

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Source: calculation based on reconstruction data A. Shapiro et al., 2011 (https://arxiv.org/abs/1102.4763)

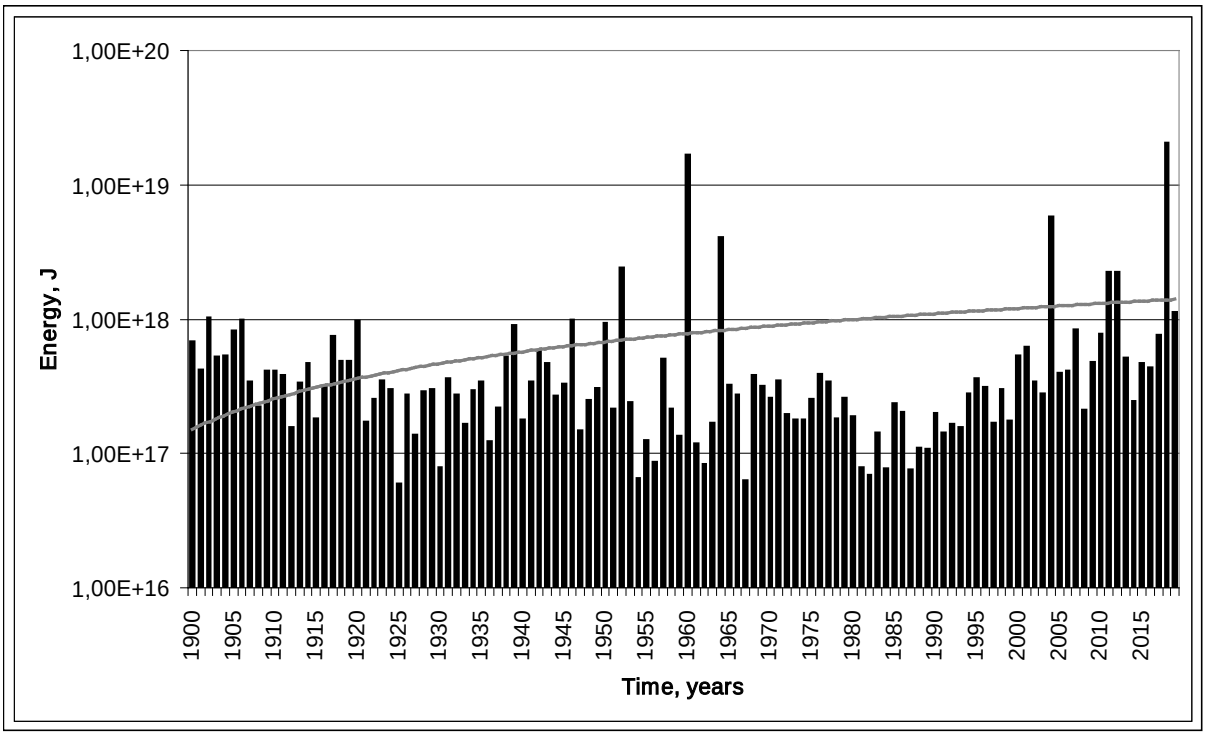
Fig. 2: Change in total solar irradiation at the time boundary of the 1430-year cycle periods (averaging over 9.5 thousand years)



Source: calculation based on Earth System Research Laboratory data (www.esrl.noaa.gov)

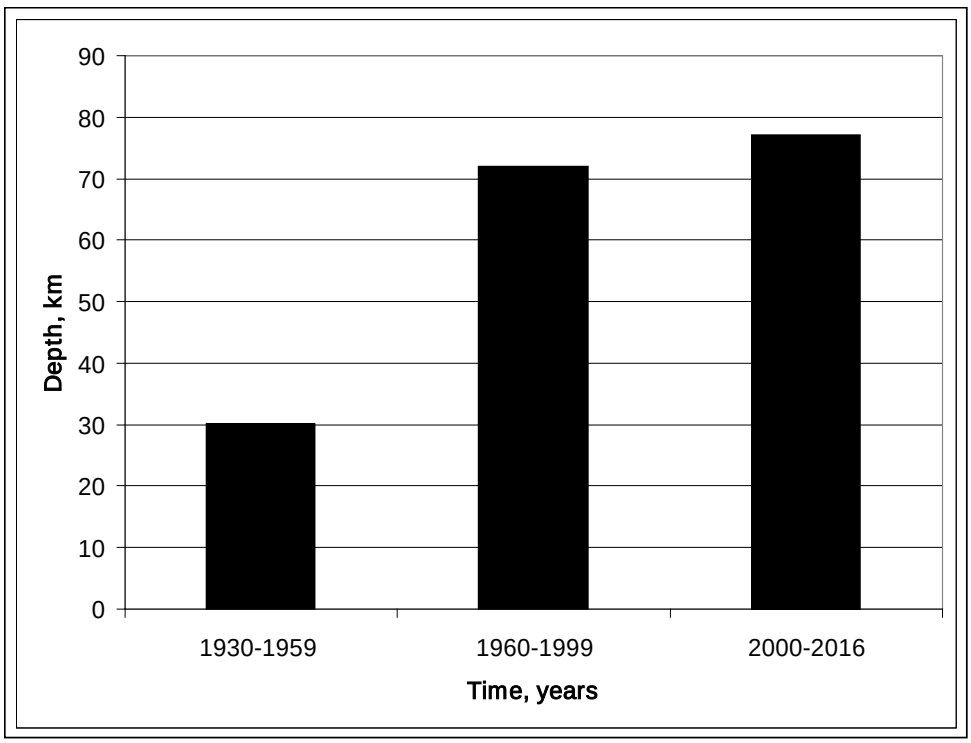
Fig. 3: Average annual air temperature on the globe in the surface layer of the troposphere and in the stratosphere at the surface level of 50 GPa

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Source: calculation according to the International Seismological Centre (http://www.isc.ac.uk/iscbulletin/search/catalogue/)

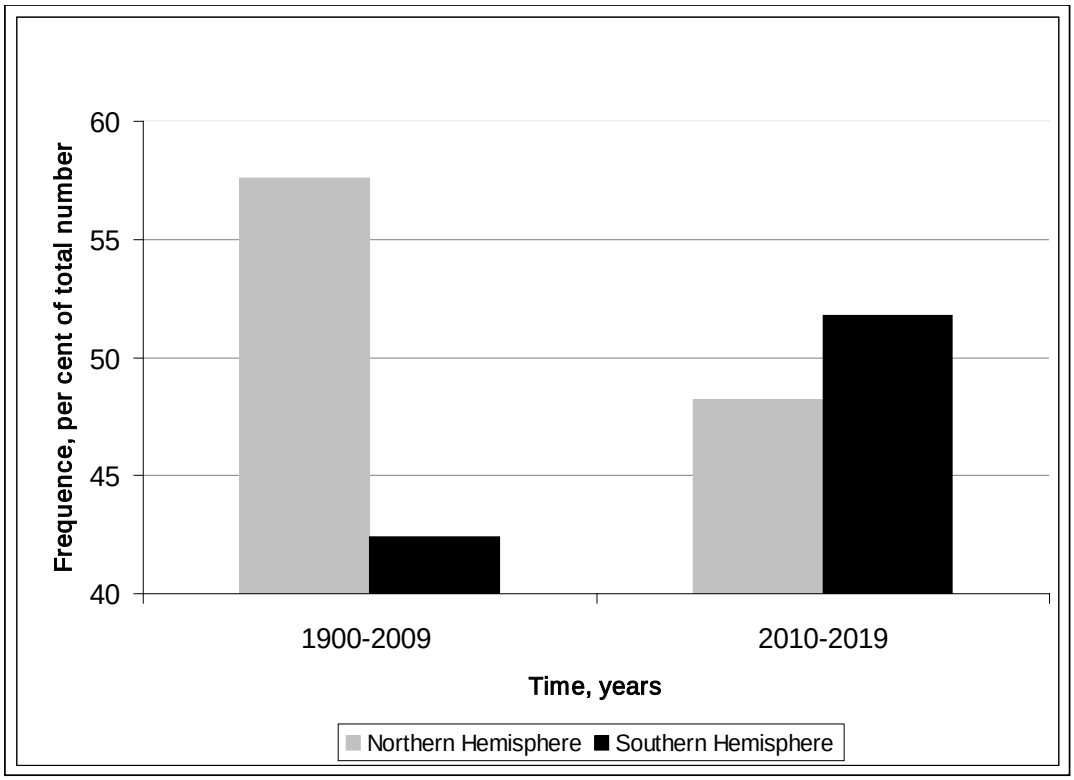
Fig. 4: Growth of the energy of strong earthquakes (Mw ≥ 5). Logarithmic scale



Source: Ibid.

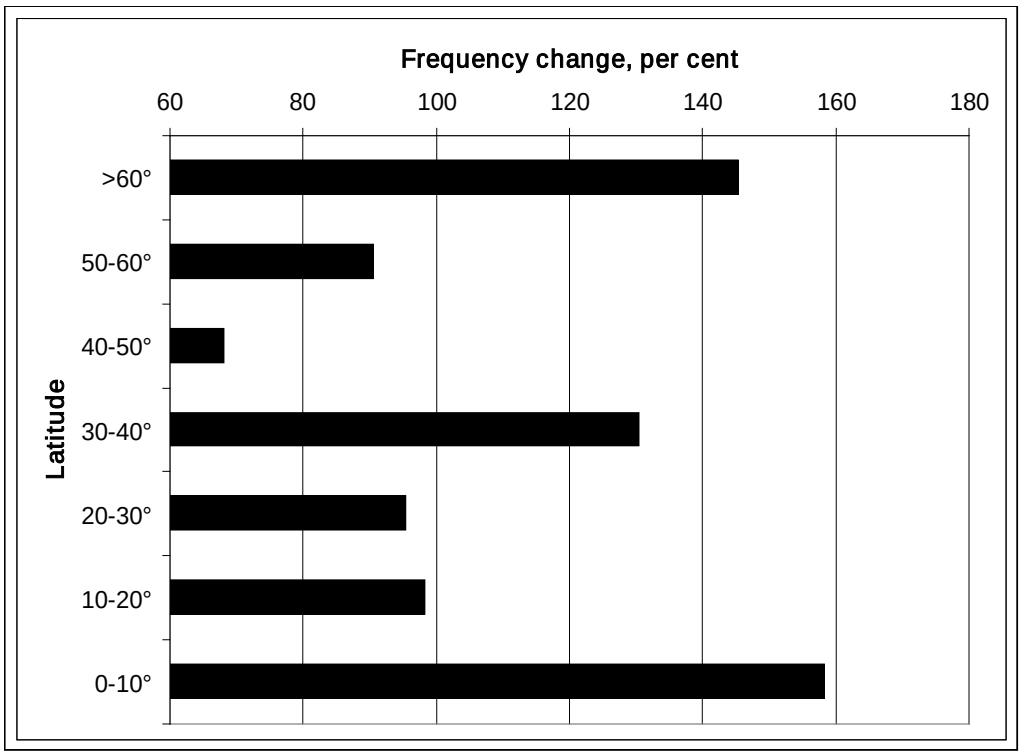
Fig. 5: Depth of hypocenters of strong earthquakes with Mw ≥ 5 in the Northern hemisphere

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Source: Ibid.

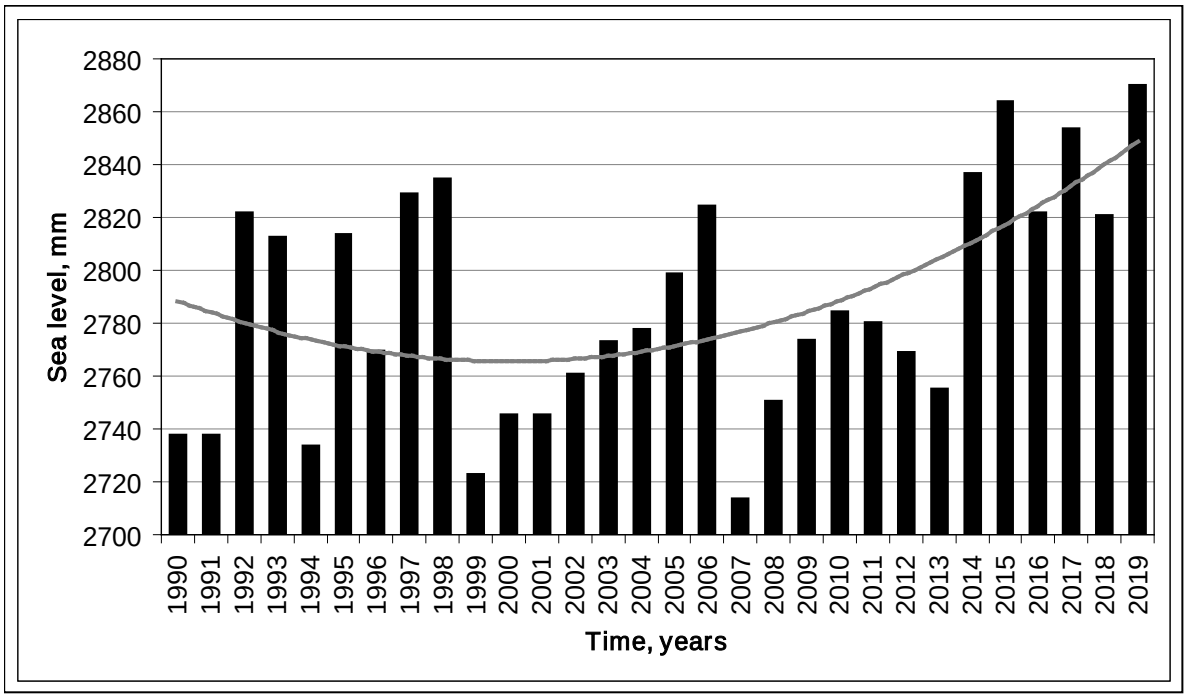
Fig. 6: Sharp changes in seismic activity of the Northern and southern hemispheres of the Earth in the last 10 years compared to the previous 110-year period (averaging events with M ≥ 5)



Source: Ibid.

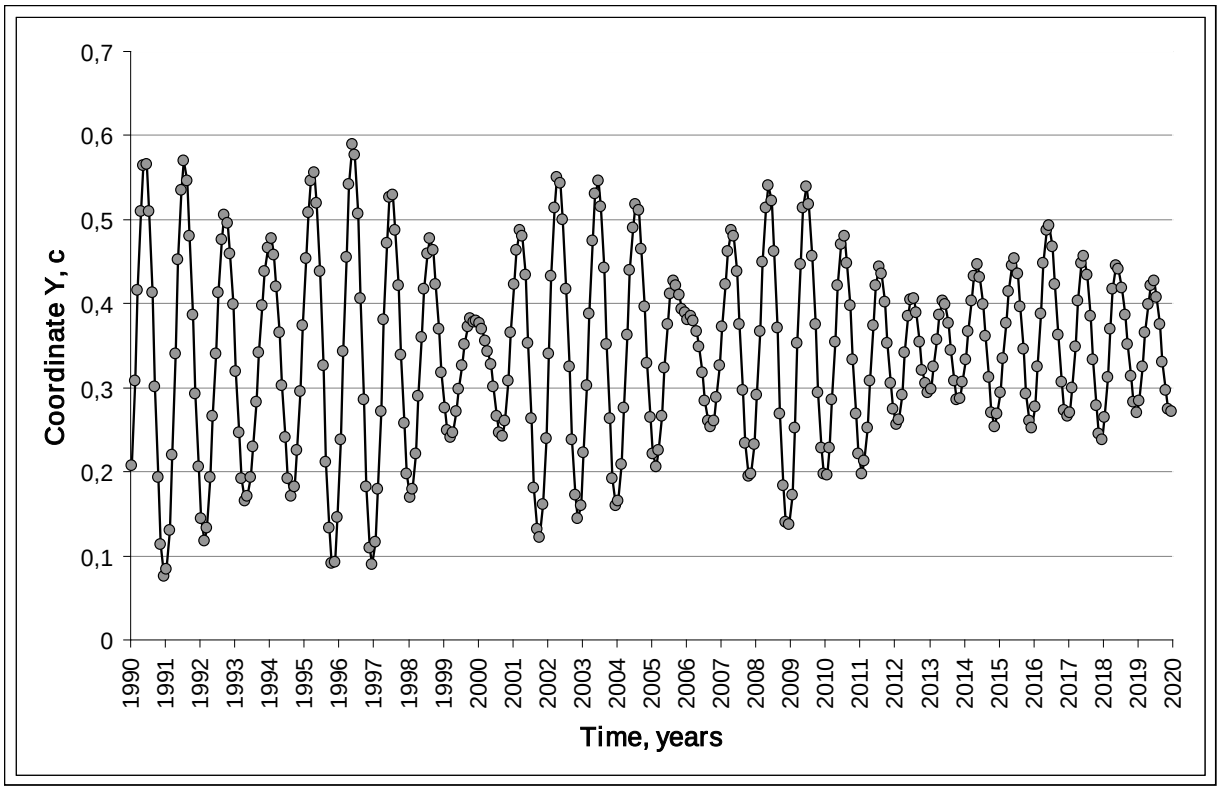
Fig. 7: Increase in the frequency of earthquakes (M ≥ 6) at the "critical" latitudes of the Northern hemisphere in 2000 - 2016 compared to 1904-1999 – at the equator, at the projection of The earth's liquid core and lower mantle at 60-70° and in the Veronnet EPI belt, about 35° (where, in particular, the territory of China is located)

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Source: according to Permanent Service for Mean Sea Level (https://www.psmsl.org/data/obtaining/stations/10.php)

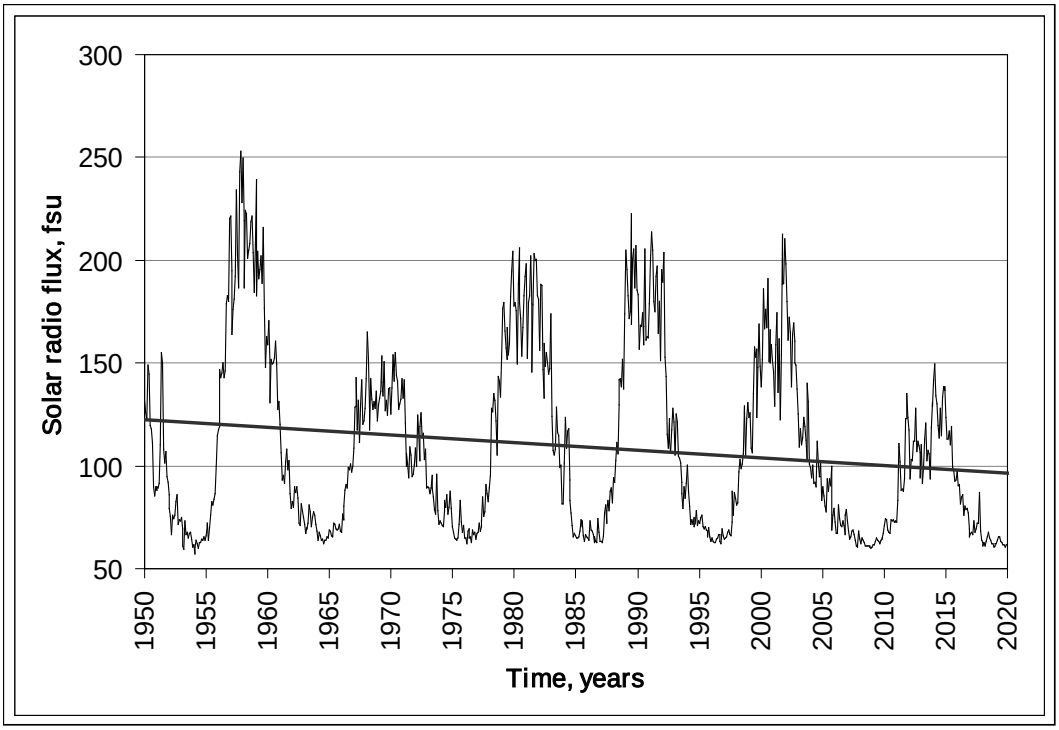
Fig. 8: The sea level rise acceleration (station San Francisco, USA). A polynomial trend is shown



Source: according to International Earth Rotation and Reference Systems Service (https://www.iers.org/IERS/EN/DataProducts/data.html)

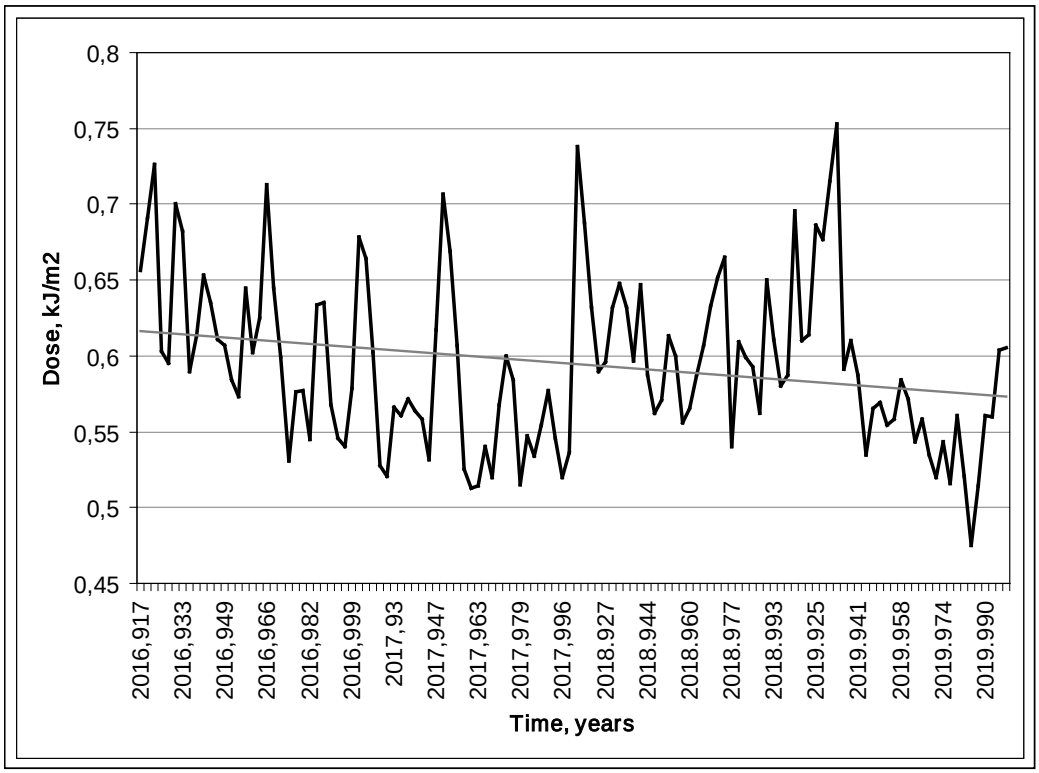
Fig. 9: Movement of the North Geographical Pole

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Source: according to Space Weather Canada (https://www.spaceweather.gc.ca/solarflux/sx-5-en.php)

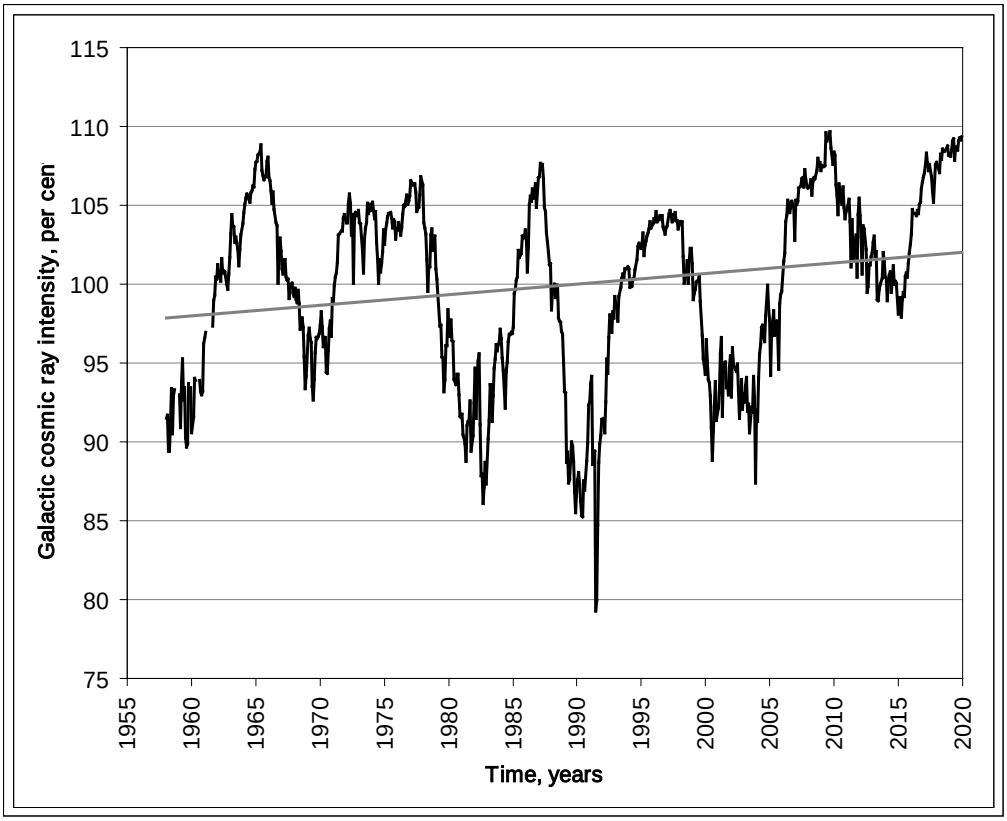
Fig. 10: A long-Term trend towards a decrease in the power of the Sun's radio emission at a wavelength of 10.7 cm (1 sfu = 10-22.m-2.Hz-1). A linear trend is shown



Source: according to Tropospheric Emission Monitoring Internet Service, UV index forecast and archives (http://www.temis.nl/uvradiation/archives/c.2.0/overpass/uv)

Fig. 11: Reduction of UV radiation doses from the Sun in December 2016-2019 (Tianjin, China). A linear trend is shown

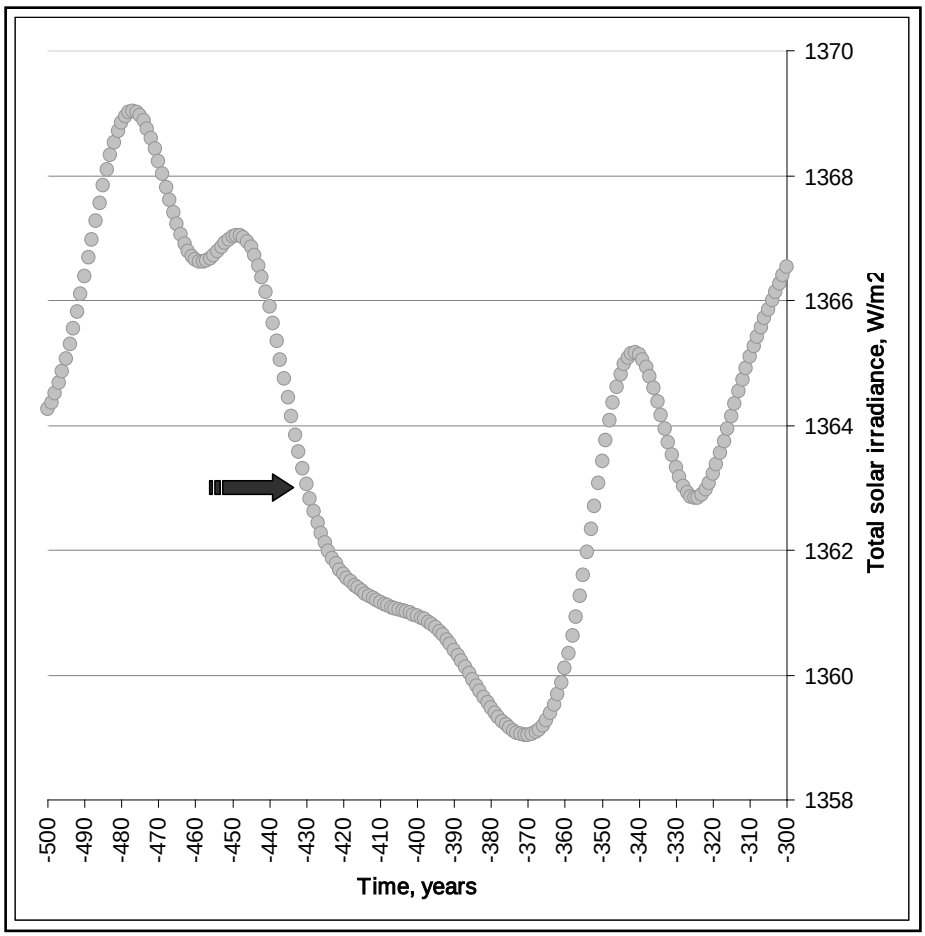
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Source: calculation based on Moscow Neutron Monitor data (http://cr0.izmiran.ru/mosc/)

Fig. 12: The Trend of increasing the intensity of galactic cosmic rays in the period 1958-2019 (Moscow neutron monitor). A linear trend is shown

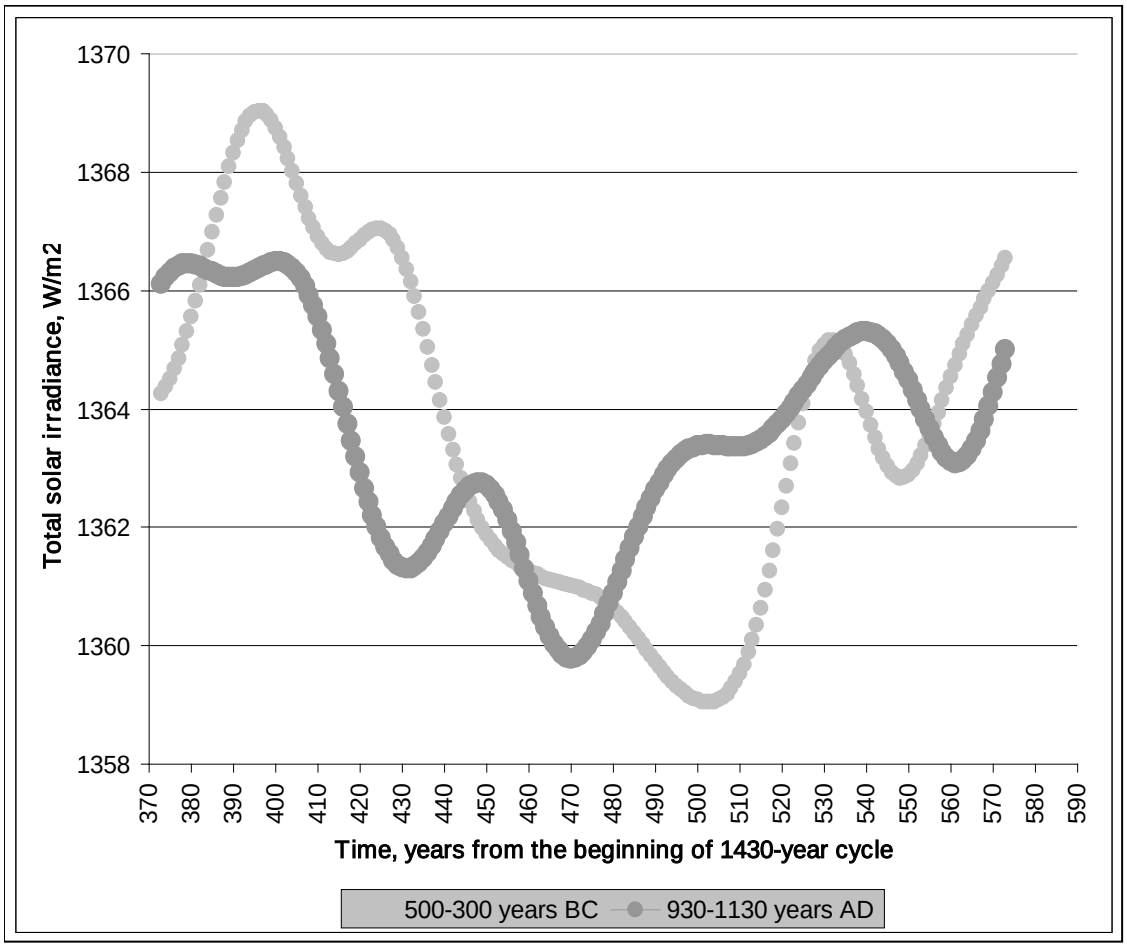
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Source: according to reconstruction data A. Shapiro et al., 2011 [2] (https://arxiv.org/abs/1102.4763)

Fig. 13: Large Sunny low V-IV centuries BC, the time of the Athenian epidemic is marked by an arrow

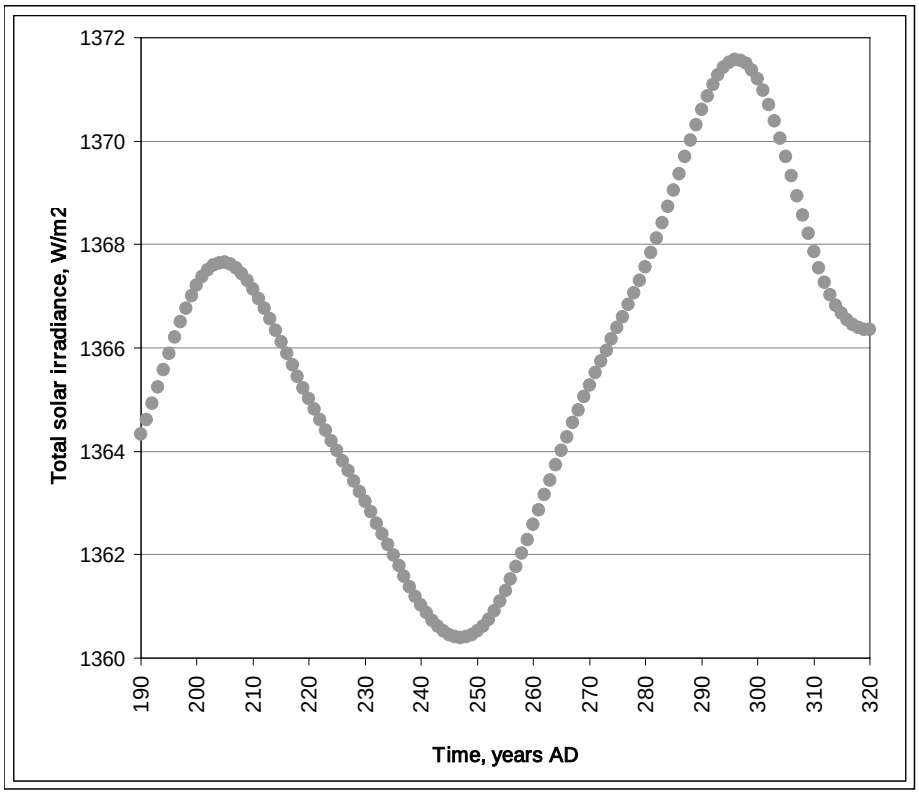
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Source: Ibid., calculation under the EPOS GAO program

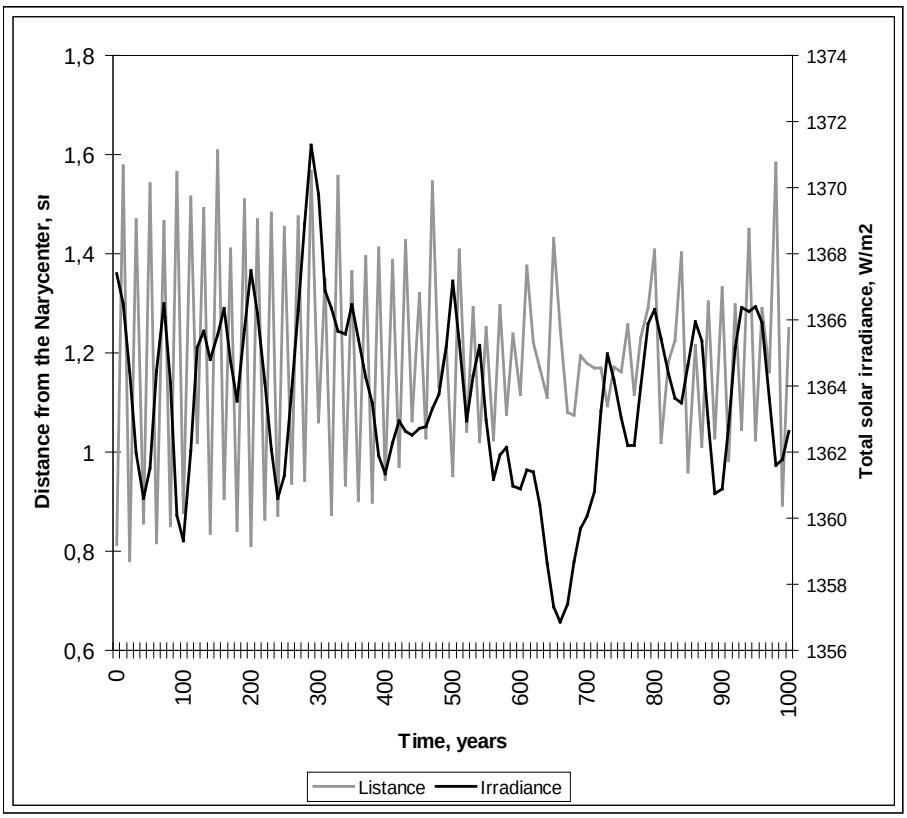
Fig. 14: Similarity of large solar minima separated by a 1430-year interval. The correlation coefficient of the total radiation values for 200 years is 0.57

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Source: Ibid.

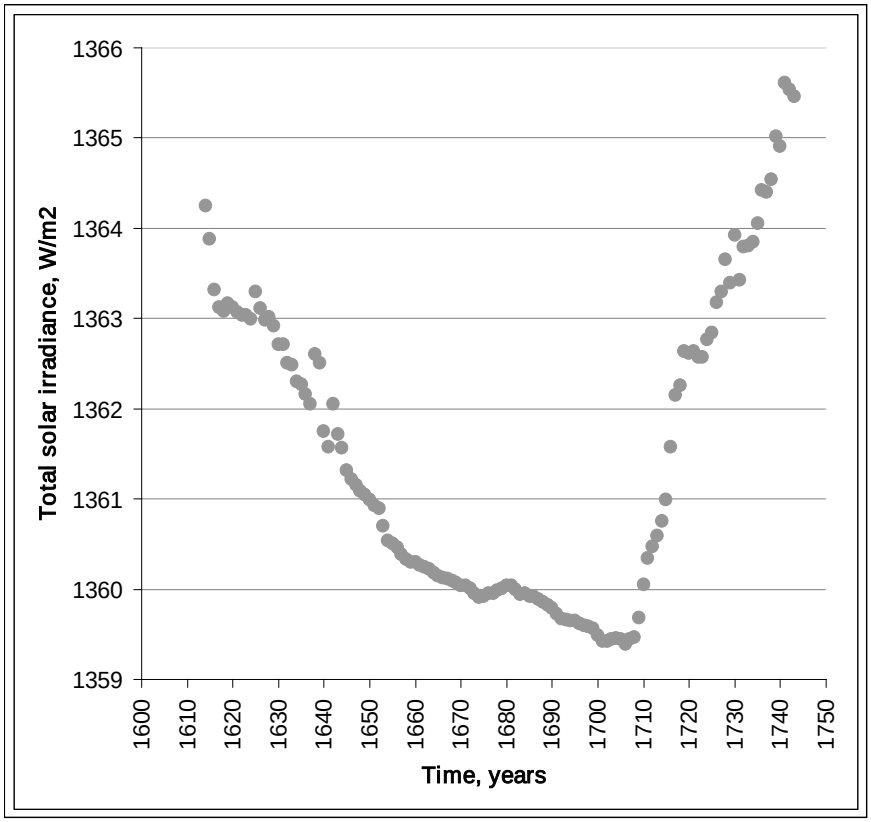
Fig. 15: The solar minimum of the III century AD



Source: Ibid

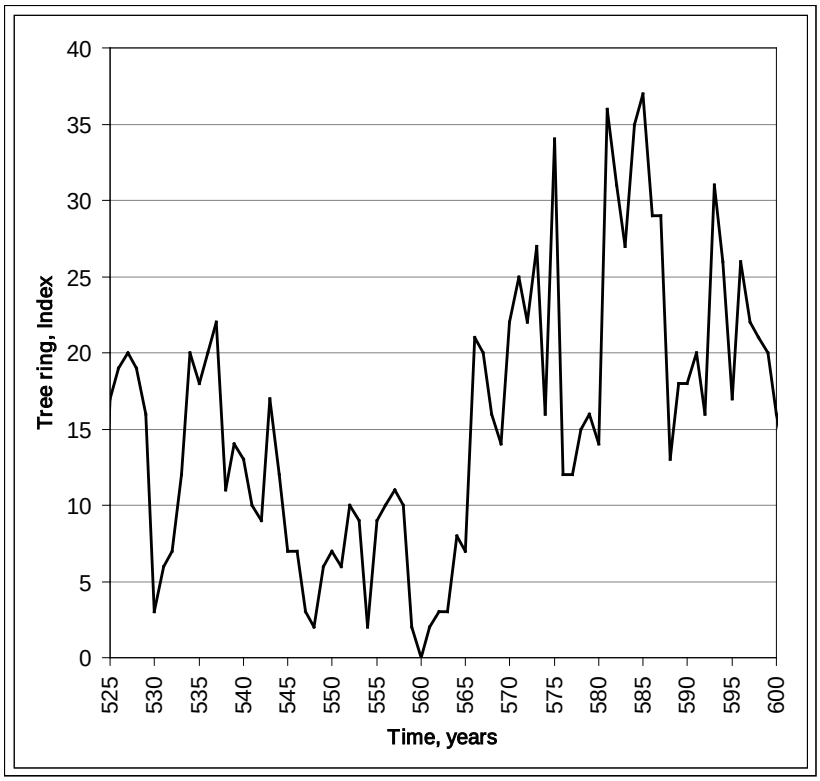
Fig. 16: Minimum solar activity of the XVII-XVIII centuries, which occurred exactly 1430 years after the minimum of the III century AD.

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Source: Ibid., calculation under the EPOS GAO program

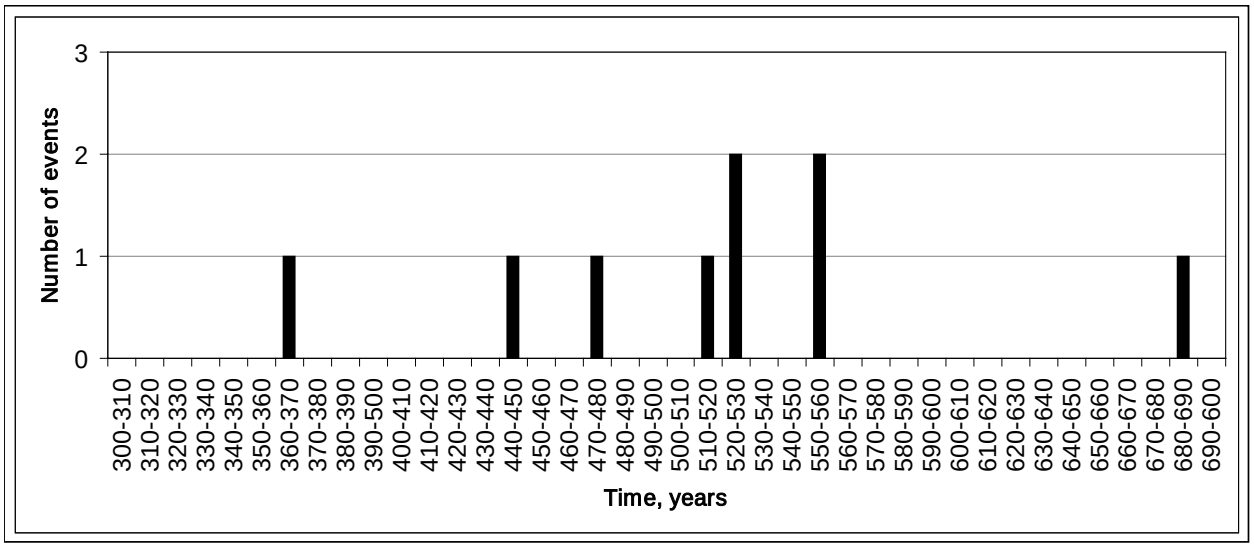
Fig. 17: The movement of the Sun relative to the barycenter of the planetary system and its total irradiation at the border of two periods of the 1430-year cycle (averaging over 10 years)



Source: according to P.Sheppard and L.J.Graumlich (https://www.ncdc.noaa.gov/paleo-search/?dataTypeId=18)

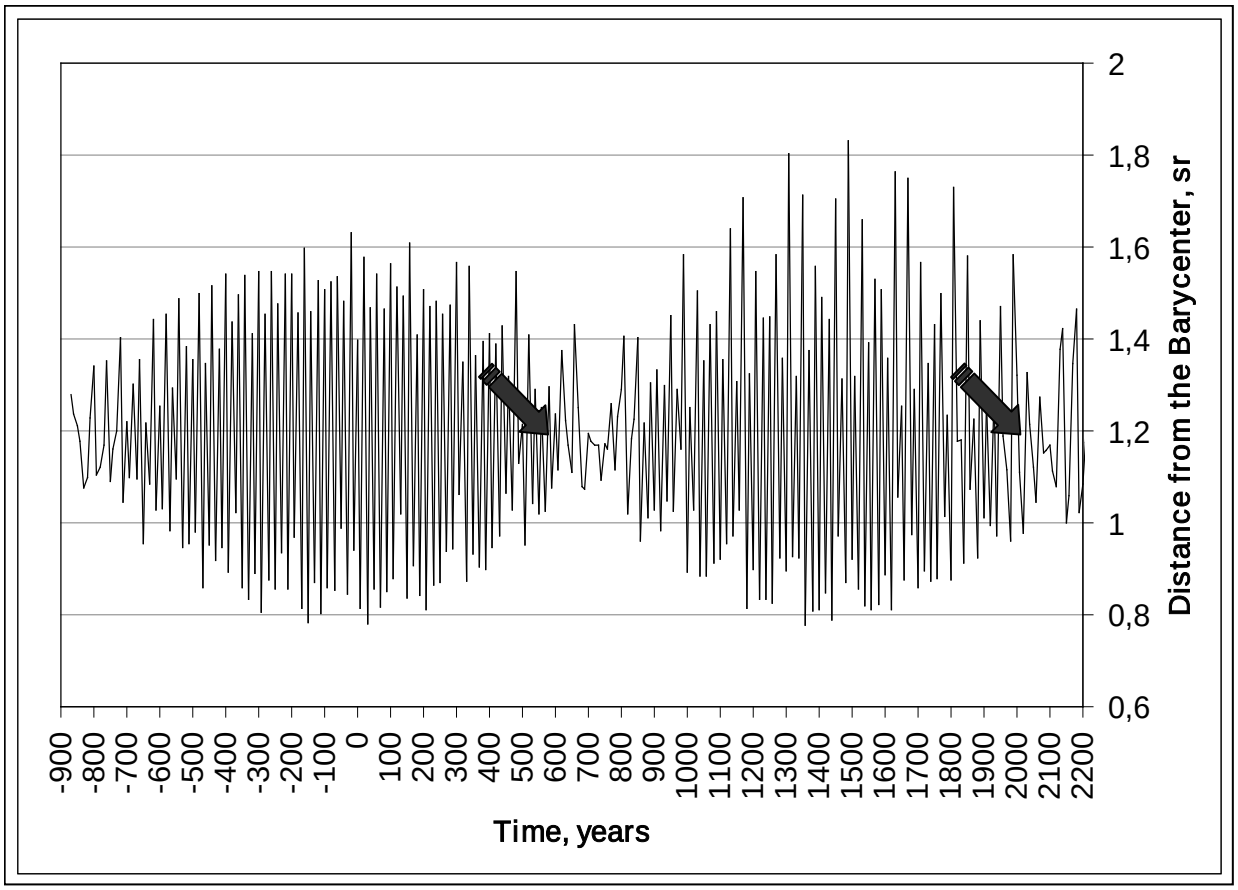
Fig. 18: Deterioration of juniper growth in the middle of the VI century in China (Qianshan mountains)

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Source: according to H. Grudd et al. (https://www.ncdc.noaa.gov/paleo-search/?dataTypeId=18)

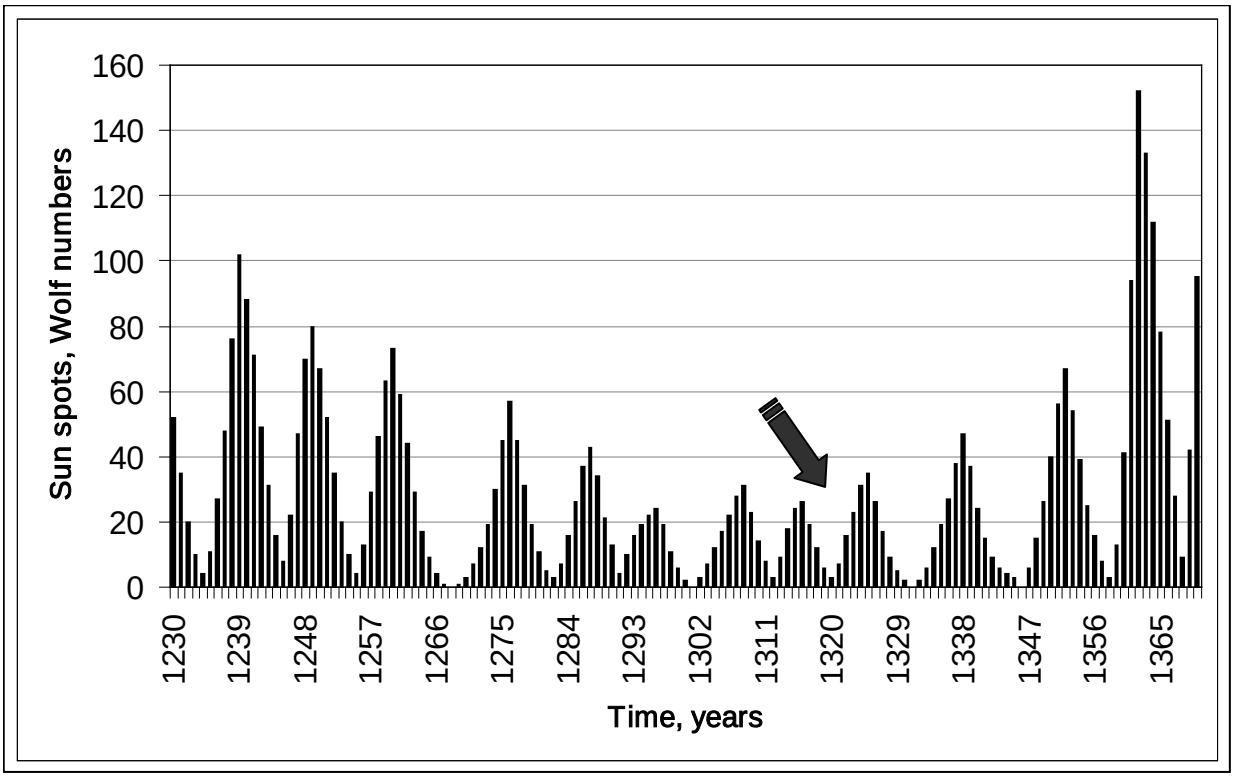
Fig. 19: Decrease in annual growth of pine trees in the middle of the VI century in Scandinavia



Source: according to The Significant Earthquake Database (http://www.ngdc.noaa.gov/nndc/struts/form?t=101650&s=1&d=1)

Fig. 20: Strong earthquakes (M ≥ 7) in the IV-VII centuries.

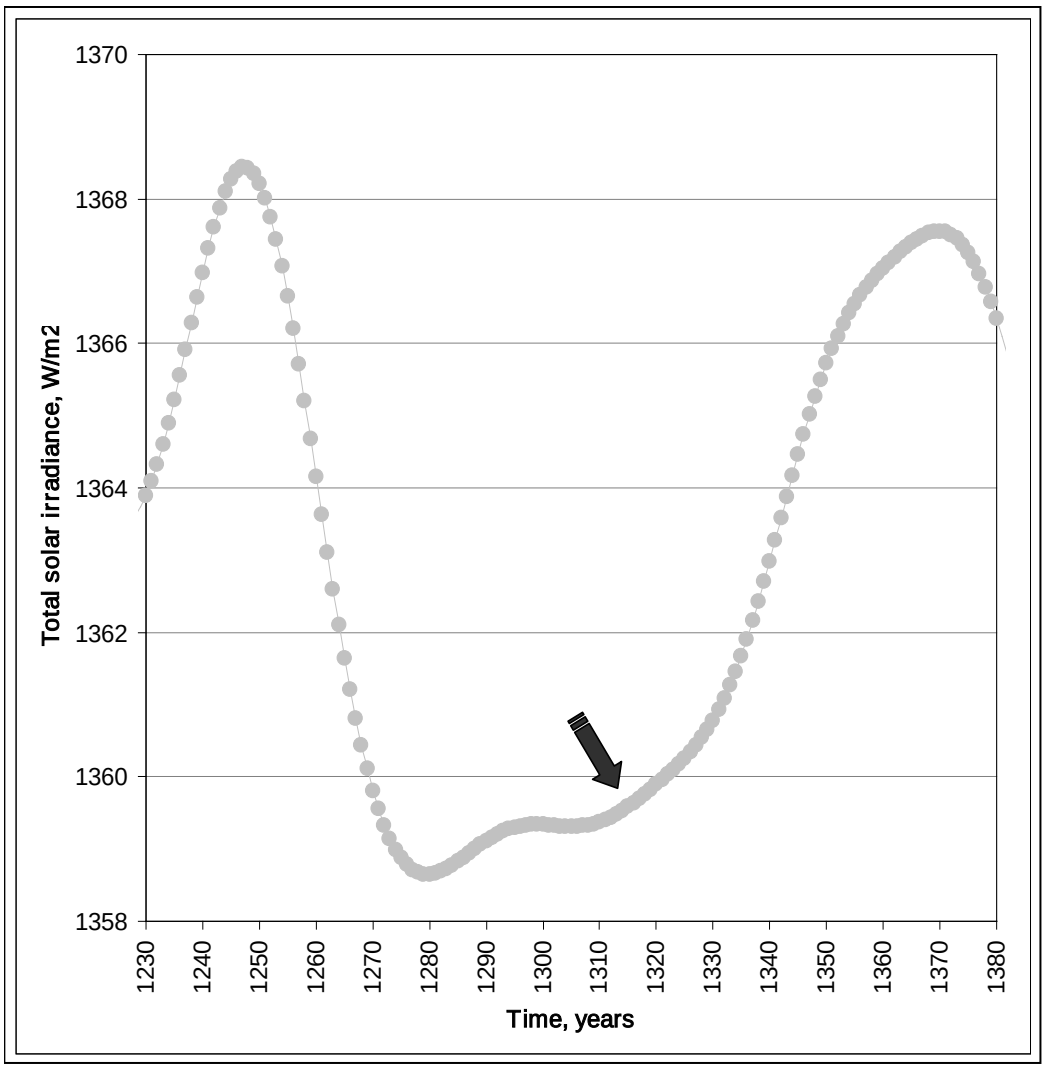
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Source: calculation under the EPOS GAO program

Fig. 21: 1430-year cycle in the movement of the Sun relative to the barycenter of the planetary system (time limits of periods are marked with arrows)

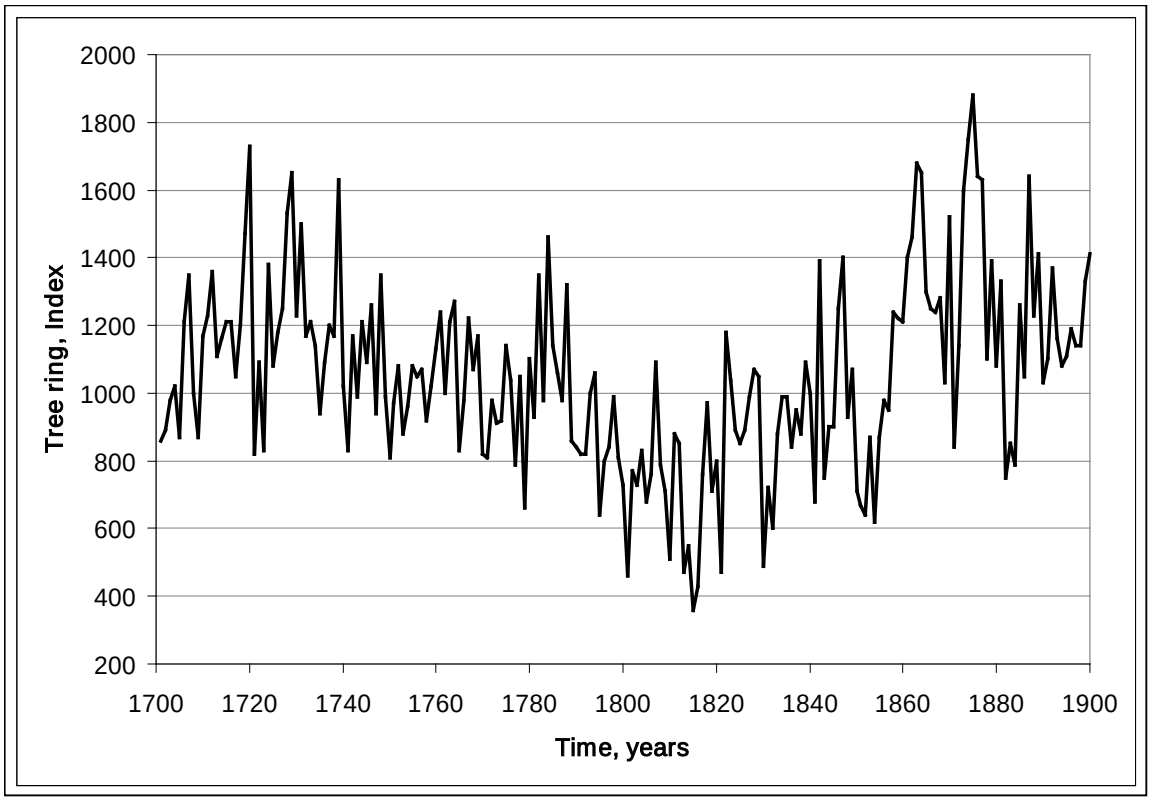
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Source: according to Yu. a. Nagovitsyn (http://www.gao.spb.ru/database/esai/yr_wom.txt)

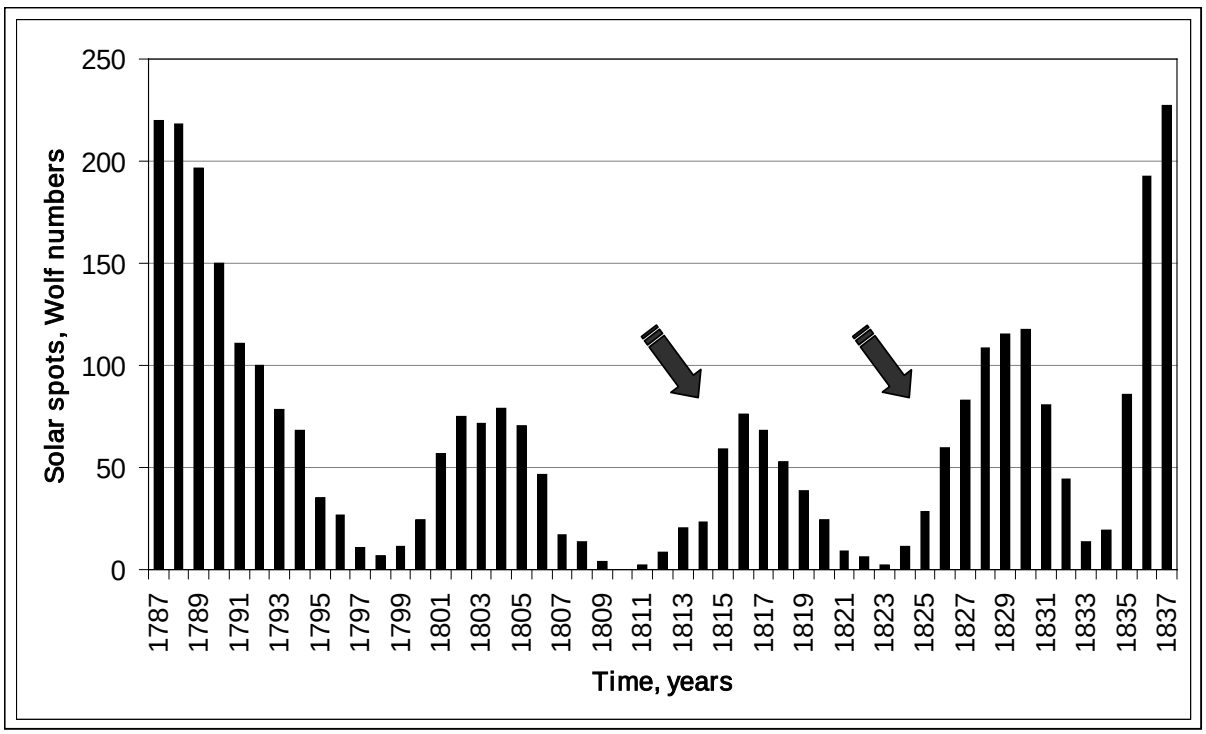
Fig. 22: Solar activity in the XIII-XIV centuries. The moment when the plague started is marked with an arrow.

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Source: according to reconstruction data A. Shapiro et al., 2011 (https://arxiv.org/abs/1102.4763)

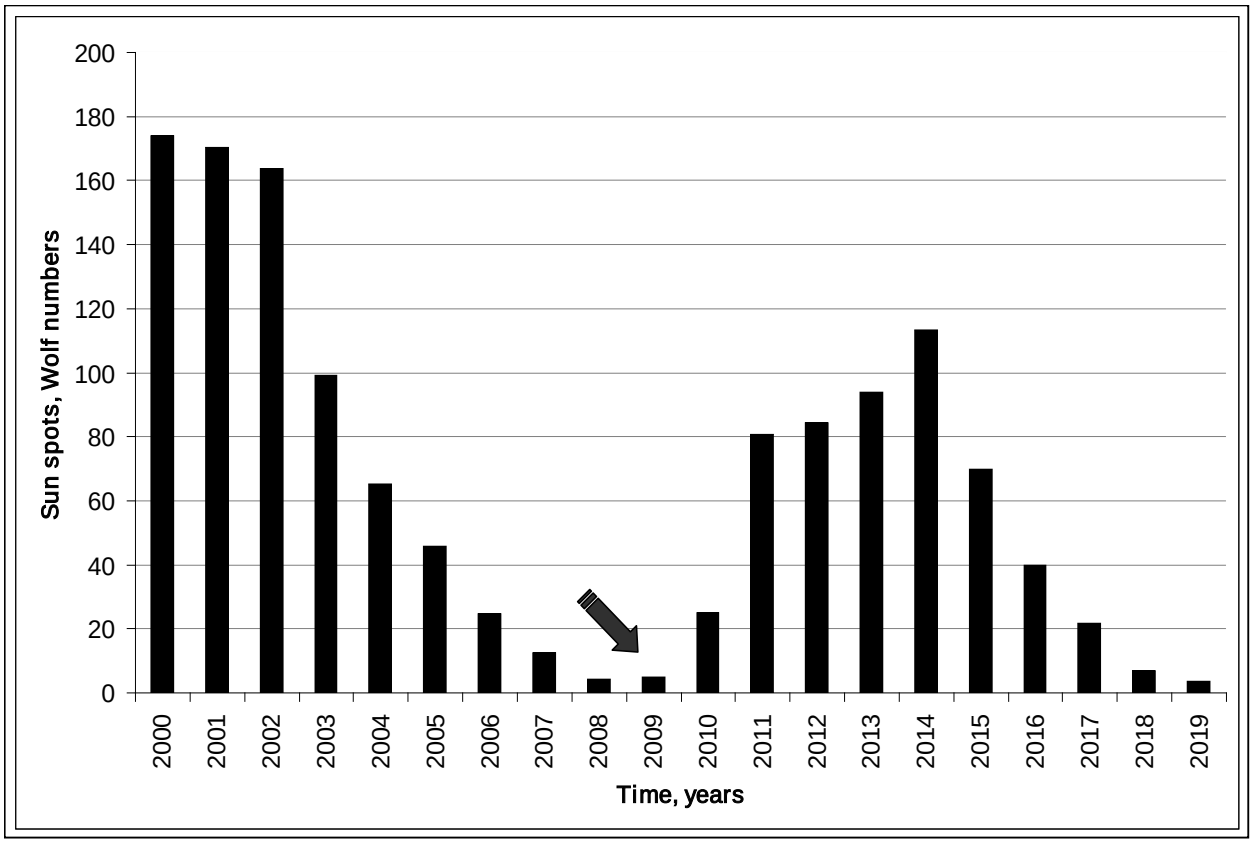
Fig. 23: Negative anomaly of total solar radiation in the XIV century. The Moment of the beginning of the plague epidemic is marked with an arrow



Source: according to W. Huesken (ncdc.noaa.gov/paleo-search/?dataTypeId=18)

Fig. 24: Weakened growth of larch trees in the Italian mountains during the Dalton minimum years

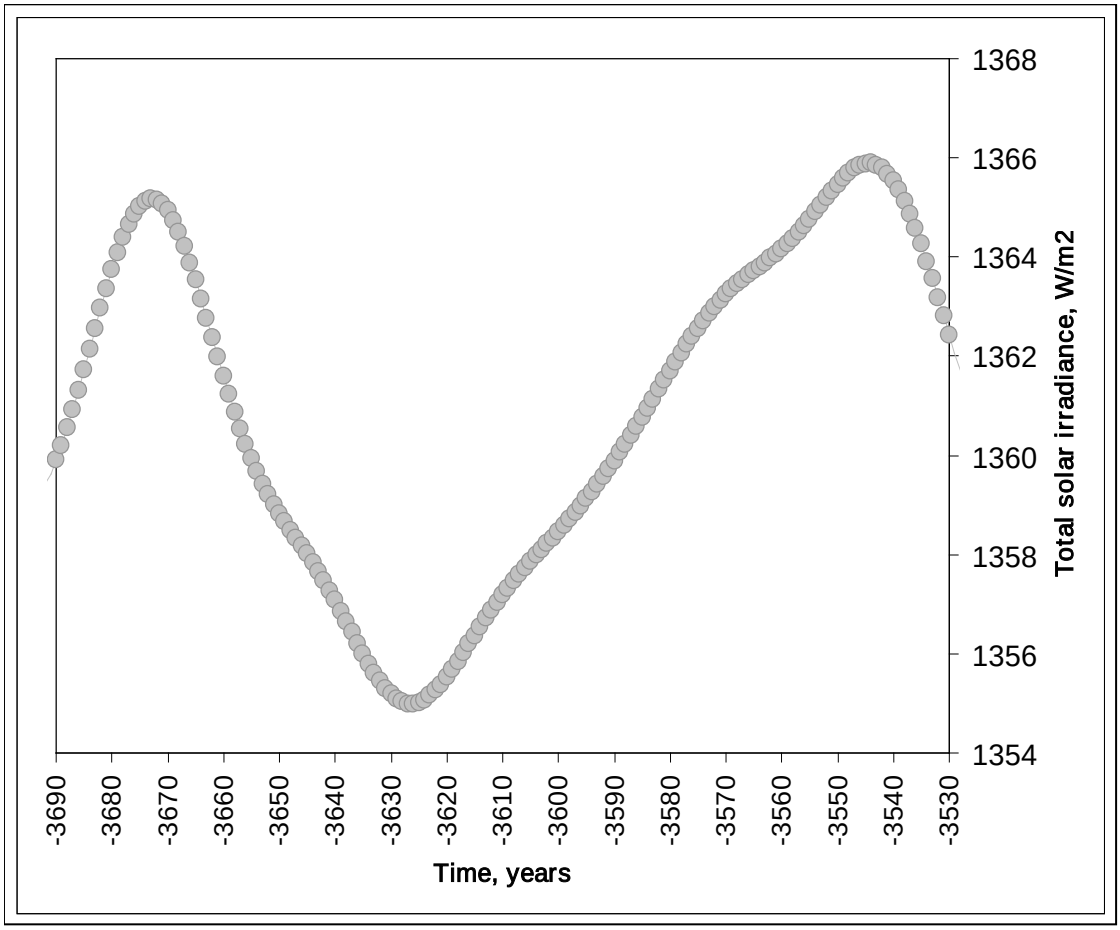
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Source: according to the World Data Center for the production, preservation and dissemination of the international sunspot number (http://sidc.oma.be/silso/datafiles)

Fig. 25: Weakening of solar activity in the first third of the XIX century. The Moments of the beginning of the cholera pandemic are marked with arrows

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Source: Ibid.

Fig. 26: Solar activity in 2000-2019. The moment of the beginning of the flu epidemic is marked with an arrow

Source: according to reconstruction data A. Shapiro et al., 2011 (https://arxiv.org/abs/1102.4763)

Fig. 27: The solar minimum is the time of the Neolithic at the border of two periods 1430-year cycle, which corresponds to the boundary between the stages of the warmer Atlantic and cold climate of Subboreal (scheme Blitt-Sernander)

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