

Annex 2

Some examples of climate change in history:

***Early Bronze Age.** The climate was warm in Europe at altitudes now beyond cultivation, such as Dartmoor, Exmoor, the Lake district and the Pennines in Great Britain. The climate appears to have deteriorated towards the Late Bronze Age, with a period of unusually cold climate in the North Atlantic region 1800-1500 BC.

Source: BROWN Tony, *The Bronze Age climate and environment of Britain*, 2008

***Prehistoric Central North Africa.** Climate cooler and wetter, some parts of the present Saharan desert may have been populated, judging by cave art and other signs of settlement in the area.

Source: *Historical climatology*, Wikipedia

***Roman Warm Empire.** The first known global pandemic struck in 451 AD and recurred until 750 AD leading to the premature death of up to a quarter of the human population in the Eastern Mediterranean region. The plague of Justinian (536-750 AD) coincided with a period of major climate change in the Eastern Mediterranean. The largest dry to wet climatic shift of the last 11,000 years occurred in the 6th century AD. This was briefly interrupted (535-536 AD) by a climatic reversal and failure of harvests which may have been caused by a major volcanic eruption. The climatic instability created the environmental condition to allow the plague to spread exceptionally quickly with devastating consequences for human mortality.

The Justinian plague era came to an end when the climate became drier once again. The wetter climate would have increased the number of rats and other rodents which carry fleas, which in turn carry the plague bacterium.

Source: *Climate change and the Plague of Justinian*, University of Plymouth

***Warm Period in Middle Ages.** There was a warm period between about 800-1300 AD. During this period some parts of the globe may have been warmer than they are today, such as the North Atlantic. The effects of the warm period were particularly evident in Europe, where grain crops flourished, many new cities arose, and the population more than doubled. During this period, the Vikings colonised southern Greenland because the milder climates allowed favourable open-ocean conditions for navigating. The Greenland settlement lasted until 1300 AD when the little Ice Age ended the possibility of farming.

Source: *Why Greenland Viking vanished*, Smithsonian, 2019, *Medieval warm period*, Skeptical Science

***1046 Cold winter** in the middle of the Warm Period. As it appears in the Anglo-Saxon Chronicle (1046): “And in this same year after the 2nd of February came the severe winter with frost and snow and with all kinds of bad weather, so that there was no man alive who could remember so severe winter as that, both through mortality of men and disease of cattle; both birds and fishes perished through the great cold and hunger.”

Source: *The Little Ice Age Was Not So Little*, Alternate history, ASB-Environmental

***Medieval Little Ice Age.** In 1300, temperatures dropped dramatically in parts of Europe and North America. The Little Ice Age was not a time of continuous cold climate, but rather repeated periods of cooling and warming, each of which occurred during times of solar minima, that lasted until 1800.

With the colder climate, early snows, violent storms, and recurrent flooding massive crop failures occurred, resulting in famine and disease. Glaciers began advancing and pack ice extended southward in the North Atlantic, blocking ports and affecting fishing.

The change from the warm to the cold period was abrupt and devastating, leading to the Great Famine from 1310 to 1322. Continuous rain impeded the sowing of grain crops, and harvests failed once and again. Diseases increased, people died of starvation, and many farms were abandoned. 1316 was the worst year for cereal crops in the entire Middle Ages. Cattle could not be fed, hay wouldn't dry and couldn't be moved so it just rotted.

Sources: *Medieval Warm Period*, Science direct, EASTERBROOK, D, *Evidence Based Climate Science*, HUHTAMAA, H, *Climate and the Crises of the Early Fourteenth Century in Northeastern Europe*

***Europe's 'bleak midwinter' of 1430-1440** made dramatic changes in response to food shortages and famine caused by exceptional cold. Crops failed, food and fuel prices rose. Malnutrition and famine struck many parts of Europe. Weakened populations fell prey to disease and pestilence, worsened by environmental and living conditions. Authorities responded by changing trade policy, banning food exports and introducing new approaches to protect people from hunger, such as communal granaries for storage. Norse colonies in Greenland starved and vanished as crops failed and livestock could not be maintained through increasingly harsh winters.

Source: What can a Medieval Climate crisis teach us about Modern day warming,
The Guardian, 2016

***17th century Little Ice Age.** The coldest temperatures in Northwestern Europe and southeastern North America. This Ice Age is well documented by paintings, diaries, and events held on frozen lakes and rivers in the 17th and 18th centuries. The most serious period was from 1645 to 1715, during which sunspots became exceedingly rare. Temperatures in Europe decreased, snow and ground frost became frequent, glaciers in the Swiss Alps reached farms and buried villages. Sea ports were blocked in Iceland and Holland and cereal grain harvests failed, leading to mass famines. The Thames River and canals and rivers of the Netherlands froze over during the winter. The population of Iceland decreased by about half.



Jan Griffier – *The Great Frost* – 1663
(Thames River, London)

In parts of China, warm-weather crops that had been grown for centuries were abandoned. In North America, early European settlers experienced exceptionally severe winters.

Source: Environmental History Resources

***Europe's Little Ice Age in 1790-1830.** Cold weather, cool temperatures, low sunspot activity; it was a time of intense cooling and great hardship. Widespread famines due to crop failures spread across Europe. Several notable events occurred during this period, including the French Revolution and Napoleon's defeat in Russia because of a bitterly cold winter. The 1794-95 winter was particularly harsh, which concluded in bad harvests and food shortage.

***1815, the year without a summer,** due to volcanic dust, happened in the middle of the Little Ice Age from 1790 to 1830. Evidence suggests that this phenomenon was caused by the 1815 eruption of Mount Tambora in April in the Dutch East Indies (now Indonesia). This eruption was the world's largest eruption in at least 1,300 years. The result was a further reduction in solar irradiance that brought record cold to much of the world during the summer.

The unusual cold caused crop failure, an increase in food prices, widespread famine, and epidemics of cholera and other diseases.

Source: *Blast of the Past*. Smithsonian magazine

***Beginning of the Industrial era.** Some studies reveal that warming in some regions actually began in the 1830s, as an immediate effect of burning fossil fuel. That warming did not develop at the same time across the planet. The tropical oceans and the Arctic were the first regions to begin warming in the 1830s. Europe, North America and Asia followed two decades later.

With the dawn of the Industrial age and the burning of fossil fuels such as coal, natural gas and oil, humans began to significantly add to the amounts of carbon dioxide and other greenhouse gases in the atmosphere, enhancing the planet's natural greenhouse effect and causing higher temperatures.

Source: *The industrial revolution kick started global warming much earlier than we realised*, The conversation.