A History of

Perceived Anthropogenic Climate Changes

By Hans von Storch

For most people, the concept of anthropogenic climate change is of relatively recent origin. It is related expected climate changes associated with ongoing emissions of greenhouse gases and aerosols from burning fossil fuels. The scientific literature as well as the public media are full of analyses related to this issue, and the world's governments have established the *Intergovernmental Panel of Climate Change* (IPCC) to deal with the problem of anthropogenic climate change.

In the following we will demonstrate that the concept of anthropogenic climate change is by no means ne When we refer to "climate change" we do not mean changes of the local climate by the expansion of c clearing of single forests and other local modifications of land use. Instead we are referring to changes regional, continental and global scale climate. It has been around at least since the times of the enlightenment in the 18th century. It is plausible that it has been a religious element all through the history of mankind. Indeed, it seems reasonable to speak about a "history of anthropogenic climate changes". Most o the cases were not real; none of them proved to be associated with significant impacts related to the suggested dynamical link. But all cases went along with the perception of a change; in most case the perceived change was seen as a threat, only in rare cases the changes were welcome as a betterment affairs.

List of Cases

Our following list is not exhaustive. It features cases which we came upon more or less by chance. A systematic analysis by professional historians would almost certainly lead to even more cases. All items of the list have had a significant echo in the public.

1. Religious interpretations of climate anomalies, such as the prolonged wet period in England in the early 14th
   century, explained the adverse climatic conditions as the divine response to people's life-style. In medieval times, for instance, it was proposed that climatic anomalies, or extreme events, would be a punishments for parishes who would keep a too liberal stand against witches. Of courses, witches were perceived as being able to directly cause adverse weather. It would be interesting to learn what people thought about the extended cold period during the Maunder Minimum at the end of the 17th century.

2. Our oldest case documented by contemporary scientific writing refers to the climate of the North American colonies. The physician Williamson analyzed the changes of climate, and related them to the clearing of the landscape by the settlers. This is one of the few cases when human action was perceived as having a beneficial impact on climate.

3. The summer of 1816 was, presumably because of the eruption of the volcano Tambora, in many parts of Europe anomalously wet. Unaware of the real case, people ascribed the adverse conditions to the new practice of lightning conductors. The case is documented in two articles published in the newspaper *Neue Züricher Zeitung.*
   The authorities issued serious assessments, quoting the concern as unsubstantiated and issued grave warning to anybody acting violently and illegally against the conductors. Interestingly, it is mentioned that some years ago in Germany, people had blamed the conductors being responsible for a drought.

4. In the 19th
   century scientists, in Europe but also in North America, were confronted with the concept that the climate would be constant on historical time scales; on the other hand, scientists found significant differences between mean precipitation and temperature when averaged over different multi-year periods. Also, scientists claimed that the water levels of rivers would fall continuously. This lead to the hypotheses that either the assumption of constant climatic conditions would be false — in modern

terms: that there would be interdecadal natural variability — or that the observed changes would be caused by anthropogenic causes, mainly deforestation or reforestation. It seems that the majority adopted the concept of external causes over the natural variability hypothesis.

17. There are reports that both the extensive gun-fire during the first World War and the initiation of short wave trans-Atlantic radio communication was blamed to be responsible for wet summers in the 1910s and 20s.

18. In the first part of the 20th century a remarkable warming took place in large parts of the world. In 1933, this warming was documented, and the uneasy question "Is the climate changing ?" was put forward in *Monthly Weather Review*. Some years later, in 1938, Callendar related the warming to human emissions of carbon dioxide into the atmosphere, a mechanism described some 40 years earlier by Arrhenius. Also Flohn brought this line of reasoning into the scientific debate. The debate faded away when in the 1940s global mean temperatures began to fall – which eventually lead to claims that Earth would head towards a new Ice Age.
Today the risk associated with increasing concentrations of greenhouse gases such as carbon dioxide and methane is the overriding concern. There is no doubt about the increasing atmospheric concentrations. In a survey among 412 North American and German climate scientists a majority of scientists turned out to be convinced that "*global warming is a process already underway*". Interestingly the respondents had difficulties to specify the mostly negatively perceived impacts of expected climate change.

19. After World War II scientists noticed a cooling and speculated whether this cooling would be the first indication towards a new Ice Age, possibly supported by human actions, mostly emissions of dust and industrial pollution. It was speculated that human pollution would increase by a factor of as much as 8 which could increase the opacity of the atmosphere within hundred years by 400%.This would reduce the incoming sun light significantly so that the global mean temperature would sink by 3.5^{o}C – which would almost certainly be enough to force Earth into a new Ice Age. The prospect was illustrated in 1974 with the words: "Between 1880 and 1950, Earth's climate was the warmest it has been in five thousand years. ... It was a time of optimism. ... The optimism has shriveled in the first chill of the cooling. Since the 1940s winters have become subtly longer, rains less dependable, storms more frequent throughout the world."

20. After World War II, the new practice of exploding nuclear bombs in the atmosphere caused wide spread concern about the climatic implications. According to Kempton's analysis, many lay-people are even nowadays concerned about this link.

21. In Russia, plans for rerouting Siberian rivers are discussed since the beginning of this century. The envisaged benefits of this planning was the supply of semi-arid regions with water, and to improve climate there. A byproduct was thought to be an ice-free Arctic ocean because of the reduced fresh water input from the rivers. This would shorten the winters and extend the growing season; the increase of evaporation from the open water would transform the Arctic climate into a maritime climate with moderate temperatures and busy harbors along the Soviet Union's North coast. Such plans were formally adopted in 1976 at the 25 Assembly of the Soviet Communist Party. Scientist, from the West as well as from the Soviet Union opposed these plans and warned that the formation of an ice-free Arctic could significantly affect the global ocean circulation and thus global climate. Later, the plans were abandoned, and more careful analyses indicated that the probability of melting the Arctic sea ice associated with a rerouting of the rivers was overestimated.

22. The idea of engineering with the climate system became popular in the first half of the 20th century. The rerouting of the Siberian rivers was one such example, another one was put forward by the New York engineer Riker, who in 1912 suggested to change the Gulf Stream with the purpose to improve the climate not only in North America but also the Arctic and Europe. Riker's idea was: "The Gulf Stream travels up along the American coast without any problem, ... but when it turns east to cross the Atlantic Ocean it collides with the icy Labrador Current coming down from the Arctic. This collision in relatively shallow water weakens the Gulf Stream ... But this would change ... if a simple jetty 200 miles long could be built from Cape Race on Newfoundland to a point just beyond the underwater Grand Banks. The jetty would keep the two currents apart ... Off the tip of Greenland ...the more powerful Gulf Stream would divide. Half would throw increased warmth against Northern Europe, and half would thrust into the Arctic... The benefits of this would be enormous .... Fog would disappear, ... all ice in the Arctic would melt. The melting of the Arctic would improve the world climate in two ways. ... Europe and North

America would be freed of chilling storms and icy ocean currents... And without the North Polar ice, the surviving ice pack at the South Pole would become the heaviest part of our planet. Centrifugal force would then tip the Earth ... With the Northern hemisphere tipped more towards the sun, Europe and North America could expect warmer climate." It is interesting to note that Riker thought of warming as an improvement of climate. The same view was put forward by H. Lamb.
Also later the idea of modifying the ocean currents was pursued by scientists from the USA, USSR and other nations. In most cases, the idea revolved around the building of a dam, which would for instance block the flow through the Bering Strait.

29. Close to the idea of climate engineering is the military use of climate modifications. The idea to change the course of the Gulf Stream was put forward already in the 18th century by Benjamin Franklin who envisaged a northward diversion of the Gulf Stream as a powerful weapon against the British Empire. An example of a perceived attack with a climate weapon is a purported Soviet plan in the 1950s to build a "jetty 50 miles or more long out from near the eastern tip of Siberia. The jetty would contain several atomic powered pumping stations that would push cold Arctic waters down through the Bering Strait. This would ... inject increasing amounts of icy waters into the ocean current that flows down the west coast of Canada and the United States. The result would be colder, more stormy weather throughout North America and enormous losses to the American economy in agriculture, work days and storm damage."
The concern about the development of climate weapons lead to a series of diplomatic discussions. For instance, on July 3, 1974 the United States and the Soviet Union issued during a summit meeting a Joint Draft Treaty: "Each State Party to this Convention undertakes not to engage in military or other hostile use of environmental modification techniques having widespread, long-lasting or severe affects as the means of destruction, damage or injury ... the term 'environmental modification techniques' refers to any technique for changing – through the deliberate manipulation of natural processes – the dynamics, composition of the Earth, including its biota, lithosphere, hydrosphere and atmosphere ... so as to cause such effects as ... changes in weather pattern, ...in climate patterns, or in ocean currents."

30. In the 1960s and 70s aircraft industries in the USA, Europe and Soviet Union designed supersonic civil air planes. These plans created substantial criticism because scientist argued that the exhaust of such planes would damage the ozone layer in the stratosphere and the climate in general. In the USA the plans were stopped, but in Europe the Concorde was built and in the Soviet Union the TU 144. Also, military supersonic air crafts are nowadays cruising the lower stratosphere. For many years, the discussion about the impact of air traffic on the climate ceased. In the early 1990s the topic re-entered the public debate, this time dealing high flying conventional jet liners. The focus of concern is the effect of contrails and exhaust gases on the radiative balance. Scientists assess the present effect as minor compared to other effects. However, some argue that with present best guesses of future passenger numbers and technology the effect may, or even: will, be significant.

31. A popular, but for natural scientists surprising, mechanism links space traffic to a deteriorating climate.

32. The ongoing deforestation of tropical forests is of great concern for many people, who are not only afraid of reduction of the variety of species but also about global climate. Model calculations indicate that these land use modifications cause significant local and regional changes whereas the global effect is in most model calculations marginal. Interestingly, similar results were obtained for the climatic implications of the transformation of the North American wilderness into agriculturally used land.

33. Also the potential of energy systems to influence climate by means of waste heat has been considered. While it was acknowledged that waste heat in principle may change global climate, it was found that present and foreseeable emissions of waste heat would be too small for a significant effect.
Hubert Lamb reports that there have been some concerns about the climatic impact of dumping nuclear waste into the deep ocean.

34. Anthropogenic aerosols are considered powerful agents for changing the global climate. One scenario deals with the emission of aerosols mainly from burning forests and fossil fuels. A dramatic version is that of "nuclear winter" – it was assumed that the explosion of a multitude of nuclear bombs in a future war would create a high flying veil of soot particles which would effectively shut off solar radiation causing a collapse of the biosphere.
Luckily, the nuclear winter experiment was never conducted, but the ignition of the Kuwait oil wells in the aftermath of the 1991 Gulf War was expected by some scientists as creating a minor nuclear winter, in particular with respect to the Indian Monsoon. It turned out that the effect was severe locally but insignificant on the global scale.

17. A new line of concern refers to the stability of the Gulf Stream in the Atlantic Ocean. Ocean models exhibit a markedly nonlinear behavior of the Atlantic circulation with two stable states, one with an active Gulf stream and another without such a northward transport moderating the European climate. Both states are stable within a certain range of conditions, but when the system is brought to the margins of these ranges, the systems switches abruptly to the other state.
Paleoclimatic reconstructions using evidence from ice cores and other indirect sources support the existence of such two stable states and frequent fast alterations within decades of years between the two states during the last glacial. During the present interglacial since about 10,000 years before present such rapid climate changes have not been detected and quasi-realistic climate models featuring interactive ocean and atmosphere models have not exhibited such behavior.
In the global warming debate the risk of a "collapse" of the gulf stream is put forward, with the paradox that while the globe is becoming warmer, Europe and Northeast America is entering significantly colder conditions with the possibility of a new ice age. In spite of this publicized view, most scientists consider such an evolution as unlikely, at least as long as carbon dioxide concentrations are not increased by a factor of four and more.
Not only global warming is presented as a human leverage for terminating the Gulf Stream. Another hypothesis was published by the Transactions of the American Geophysical Union *EOS* with a significant echo in the public media. This time the human culprit was the Assuan Dam in Egypt which would reduce the flow of fresh water into the Mediterranean Sea. This effect, together with enhanced evaporation caused by global warming would result in a more salty outflow from the Mediterranean Sea into the Atlantic which would eventually cause the Gulf Stream to flip over. Subsequent quantitative analysis revealed that the effect would be much too small.

Conclusion

It is interesting to speculate about the social processes which made and make the concept of anthropo climate change to a permanent issue challenging scientists and scaring lay people. It would also be interesting to find out why the concept was repeatedly forgotten and re-invented. Today such social processes may include the increasing need for scientists to frame their problems so that the solution fits his or her area of expertise, also ideological elements, genuine general concern about the state of the environment and the satisfaction of scientists to be heard and seen in the media may be part of the story. Also the economic needs of popular scientific journals such as *Nature* may introduce a certain bias towards more dramatic scenarios. On the other hand, one can hardly argue that the detection of a fragile global climate is entirely a scientific construction. The fact that the concern about the reliability of climate prevailed not only in the recent decades but for many centuries is indicative that people depend fundamentally o reliability of climate, and that professionals as well as lay people considered it at all times principally possible that this dependable condition of life and culture could suddenly disappear. Insofar, the concern is to larg extent a social construction.

In most cases of our list, the threat of anthropogenic climate change was either absent or oversold by scientific community to the public. Of course, in the present case of "Global Warming", we do not know at this time if it is a real threat or if the warnings are exaggerated as in earlier cases. The fact that the IPCC examining the scientific evidence with great care and articulated in 1995 its famous statement "*the balance of evidence suggests that there is a discernible human influence on global climate.*" and that other official bodies such as the Enquete Commission of the Deutscher Bundestag voiced grave concerns, may considered
as support of the reality of the envisaged threat. However, also some hundred years ago, parliame governments in Europe (.e.g. Prussia, Italy, and Russia) established committees which were asked to dea with the reality of anthropogenic climate change related to deforestation. And about 200 years ago th Parliament was discussing the climatic implications of human modifications in British tropical colonies.