# Elbe flood 2002 – human sins or insufficient preparation?

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**Abstract**

The flooding events in Europe during the last decade, in particular the Elbe flooding in 2002, have often been interpreted as first manifestations of the anthropogenic climate change to come. In this paper, this claim is compared to the IPCC consensus reports on ongoing climate change and plausible perspectives of such change. More intense and/or more frequent intense rainfall events may possibly emerge in the decades to come. However, contemporary events are within the range of "normal" – even if rare and therefore extraordinary, and possibly exaggerated by inadequate land-use, planning and emergency preparation.

The paper argues for the implementation of efficient adaptation measures so that the vulnerabilities of populations, society, economy, and ecosystems are already now reduced. If the statistics of severe rainfall will indeed worsen in the decades to come, as envisaged in some of the IPCC scenarios, such a better preparedness to the vagaries of extreme weather will also help to mitigate the impacts of such adverse developments.

# 1. "Naturen slår tillbaka våldsamt" …[1]

... was the headline of an article in a Swedish newspaper with a report of the flooding of the Elbe in the Czech Republic and in Germany in 2002. In this article, it is first stated that there is no sound evidence for more frequent extreme weather events[2], but a few paragraphs later the confidence of climate scientists is described that the ongoing emissions of greenhouse gases into the atmosphere will cause just that, namely more frequent weather extremes[3]. Together with the headline of the article, the message is clear – there is no scientific evidence for the time being, but it is nevertheless clear that the human activities are causing changes in the atmospheric dynamics, followed by severe repercussions for societies, economy and ecosystems. These repercussions must be understood as a direct response to human action, to human sins – nature is striking back.

This presentation of extreme weather events is not uncommon. Historically, it was a major pattern of explaining the happening of disasters as God's punishment of sinful people.[4] Also in modern times we find the link of human guilt, sin and punishment – an example was printed in the Sächsische Zeitung in August 2002 during the disastrous Elbe flood: "Now, the flood is here, right at our door step. This is moving people, since this deluge is placing the question much more urgently to us – why, which sins, who are the perpetrators? We can now, even without scientific evidence, assume that global warming is not only related to the periodic cosmic variations, but also a consequence of our way of life."[5]

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[1] Nature strikes violently back. *Dagens Nyheter*, 14. August 2002

[2] "Det finns ingen statistik som visar att häftiga regn, stormar och andra extrema vädersituationer blivit vanligare, svarer man på SMHI". (SMHI is the Swedish weather Service.)

[3] „Men i praktiken är die fleste klimaforskare tämligen säkra ... att de här gaserna förstärker våldsamme regn, stormer, torkar och andra mer extrema vädersituationer med katstrophala följder för dem som drabbas."

[4] A detailed account for the case of storm surges along the German North Sea coast is provided by Jakubowski-Thiessen, M., 2003: Gotteszorn und Meereswüten. In D. Groh, M. Kempe and F. Mauelshagen (eds): *Naturkatastrophen*. Gunter Narr Verlag Tübingen, 101-118

[5] Sächsische Zeitung, 17. August 2002: „Nun ist die Flut also da, vor der eigenen Haustür. Das berührt, weil diese ‚Sintflut' so viel unerbittlicher als ferne Katastrophen die Frage nach dem Warum stellt, nach begangenen Sünden, nach deren Verursachern. Wir können heute auch ohne wissen-schaftlichen Beleg davon ausgehen: An der Erderwärmung sind nicht allein periodische kosmische Veränderungen schuld, (...) sie ist ebenso eine Folge unserer Le-

This is a recurring motive in the European discourse about climate and environmental change – the back cover of a book states "we shall be engulfed, quite literally, by the consequences of your greed and stupidity. Nearly two-thirds of our Earth could disappear under polar ice cap water. For this will be the inevitable outcome of industrialization, urbanization, over-population and the accompanying pollution."[6] summarizing this motive in a compact manner. In fact, the perception of wide parts in the public to the perspective of climate change and its adverse implications is displayed conveniently without a text digestible by westerners in Figure 1.

Undoubtedly, climate change, climate's adverse response to human action is a major issue today, at least in Europe. For example, Sir David King, the British government's chief scientific adviser, concludes: "I am sure that climate change is the biggest problem that civilisation has had to face in 5,000 years." A newspaper reports that "He [King] said that the realisation of the scale of the crisis was what prompted him to say in January that climate change was a bigger threat than global terrorism. … He said the heat wave of last summer in which 25,000 Europeans died had killed more people than terrorism, yet had not been given anything like the same level of attention. … He warned of the slow response of the climate system and said we were already doomed to 30 or 40 years of climate heating because of the carbon dioxide already in the atmosphere, hence the need to multiply effective flood defences such as the Thames barrier. … Sir David was backed up last night by Margaret Beckett, the environment secretary, speaking at the Green Alliance about the value of the EU's campaign to fight climate change. 'Climate change is the predominant global environmental issue where European leadership is vital,' she said."[7]

In the US the topic was a major issue in the 1990s as well, and played a major role in the US presidential campaign in 2002.[8] However, the interest has significantly de-

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bensweise." Further examples, see: Krauss, W. und M. Rulfs, 2003: *Bilder der Flut – Bilderfluten: Einschätzung der medialen Darstellung des Elbehochwassers im August 2002*. GKSS report 2003/9.

[6] Anthony Milne, 1990: *Our drowning world*. Prism Press.

[7] *Guardian*, 14. July 2004, Paul Brown: "Melting ice: the threat to London's future"

[8] E.g., Michaels, P.J., and R.C. Balling, Jr., 2000: *The Satanic Gases*. Cato Institute, Washington D.C, ISBN 1-882577-92-2, 234 pp. and Gore, A., 1992: *Earth in the balance: ecology and the human spirit*. Boston, Houghton Mifflin.

creased since then:[9] A CBS poll from May 2003 lists no environmental problem, in particular not climate among the 5 most important problems "facing the country"[10]. When asked for the "top" environmental concerns in another survey, global warming ranged as only the 7th most important concern, behind water and air pollution, toxic waster, rain forest depletion, endangered species, and fisheries depletion. Interestingly, it seems to be rather uncommon in the US to relate Global Warming with recent extreme weather, in spite of the rhetoric of the former vice president Al Gore.

In the following two sections we contrast these culturally constructed views with what is considered consensus among climate scientists about present and possible future climate change.

[9] For an account of the „career" of global warming in the US as a public issue, refer to Ungar, S., 2003: Global warming versus ozone depletion: failure and success in North America. *Climate Research* 23:263-274; and Ungar, S., 1999: Is strange weather in the air? A study of U.S. national network news coverage of extreme weather events. *Climatic Change* 41: 133-159

[10] ... which are economy, war and terrorism, education, family values, health care and poverty.


***Figure 1*** Perceived implications of climate change in a Japanese comic: torrential rainfalls, sea level rise and violent windstorms, sands storms, and wider circulation of disease carrying vectors – and a dramatic call for actiob.

## 2. The assessment of global climate change by the IPCC

The Intergovernmental Panel on Climate Change (IPCC) is given the task to document contemporary knowledge about climate and climate change, and to advise the governments of the world. The IPCC does so by assembling large groups of scientists, who review the literature and prepare first scholarly assessments of various separate aspects of climate, such as the sensitivity of climate to increased greenhouse gas concentrations in the atmosphere, or the prospects for sea level change, or regional details of climate change, and much more. These detailed assessments are later condensed into summary reports, which are suitable for public consumption.[11]

The IPCC Assessment Reports are not free of critique, but a majority of scientists accepts these reports as representing a fair and balanced assessment of the present knowledge.[12] It thus makes sense to review the major findings of the IPCC and to compare them with the views discussed in Section 1.

The IPCC is first assessing the knowledge about recent climate change, and in a second step, it is providing scenarios[13] for possible future climatic development.

- Using an educated statistical detection and attribution concept, scientists have analysed the historical evolution of the globally distributed air temperature. They have found, and the IPCC concurs that this finding is accepted by most scientists, that the global air temperature has increased in the recent decades at a faster pace than what would be considered normal during historical times (Figure 2a; solid line;

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[11] So far three major „Assessment Reports" have been published. A report about the functioning of the IPCC is offered by Shackley, S., 1997: The Intergovernmental Panel in Climate Change: consensual knowledge and global politics. *Global Environ. Change* 7, 77-79

[12] In their 1996 survey among climate scientists, Bray and von Storch asked for an assessment of the statement "The IPCC reports accurately reflect the consensus of thought within the scientific community." – about 55% of all US respondents gave a positive answer and less than 20% a negative answer. For Germany, the rates were similar (more on the survey: Bray, D. and H. von Storch, 1999: Climate Science. An empirical example of postnormal science. *Bull. Amer. Met. Soc.* 80: 439-456.)

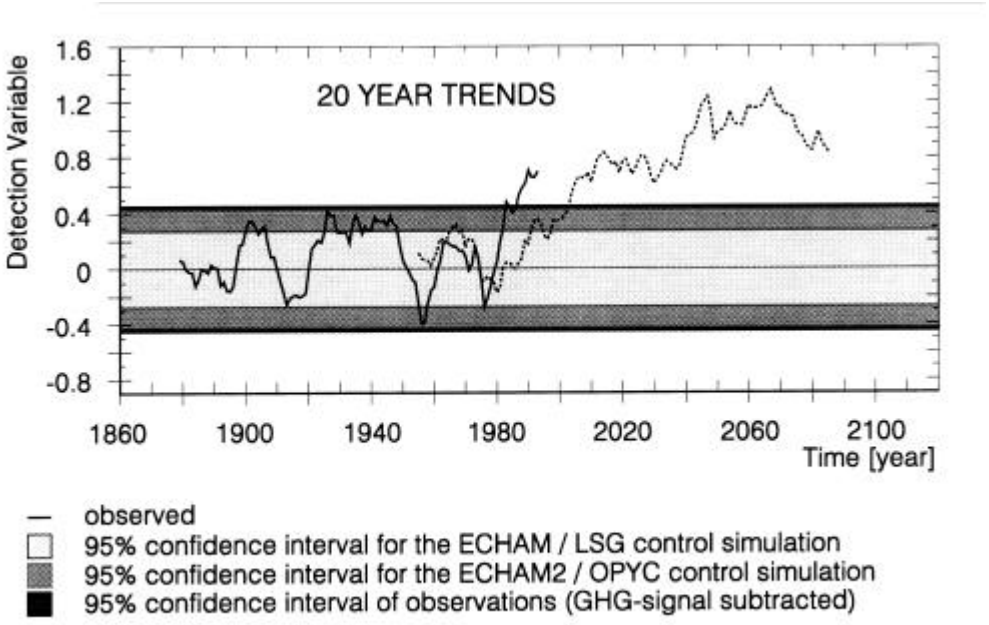
[13] Scenarios are not forecasts or prediction but consistent storylines about possible, plausible, but not necessarily probable futures. Whether the future will be as envisaged in a scenario depends strongly upon if certain preconditions, which are simply assumed for the scenarios, take place in reality or not. In case of climate, such key preconditions are the emission rates of radiatively active substances into the atmosphere. (See also, Schwartz, P., 1991: *The art of the long view*. John Wiley & Sons, 272 pp.)

the dashed line indicates that the observed evolution is consistent with what a model envisages as response to an ongoing increase of greenhouse gas concentrations in the atmosphere). At the end of the record, the trend is clearly beyond the limit of "normal variations", no matter how these limits have been determined. Theory advises us that we should expect no or only a weak "signal" in the earlier part of the record, but an increasing signal, emerging from the "sea of noise" of natural variations, in most recent times – this is exactly what we see in Figure 2. From that finding, it is concluded that "non-natural factors" are at work.

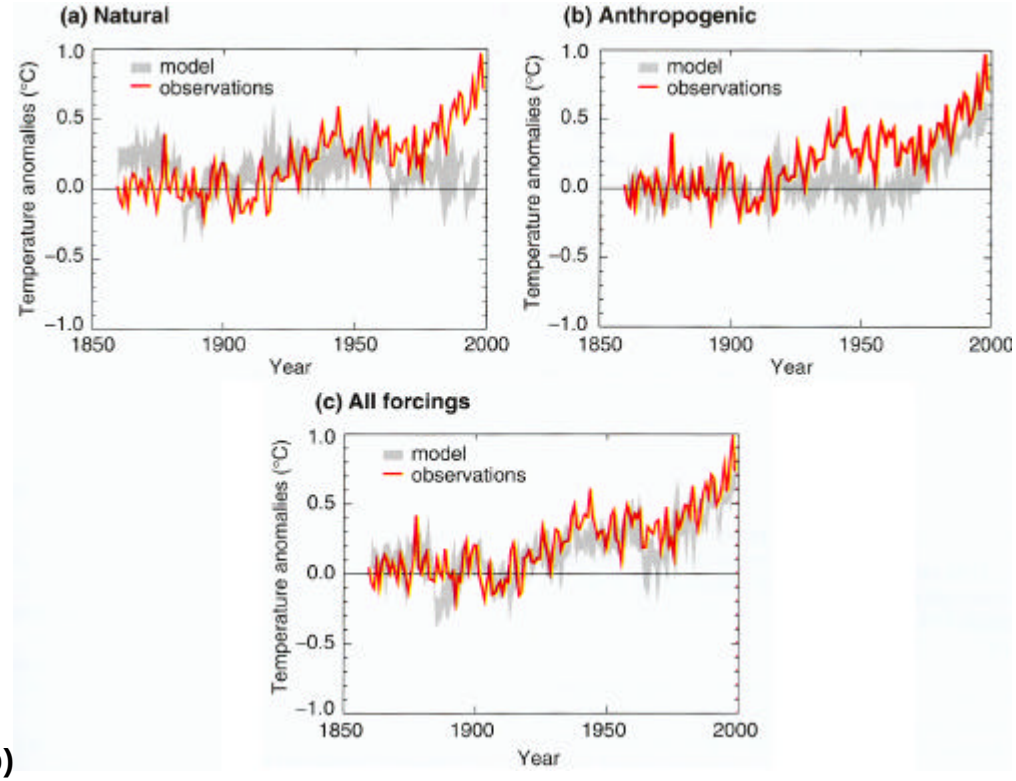
- Another argument links this "non natural factors" to greenhouse gases. A climate model is repeatedly run with different sets of forcing factors. One simulation is done with the historical variations of solar output and volcanic aerosols; a second with enhanced greenhouse gases and industrial aerosols; a third one with all factors (Figure 2b). Neither the natural factors nor the anthropogenic factors alone can reproduce the observed evolution, but when all factors are included then most of the observed evolution can be recovered. About 2/3 of the recent warming since about 1970 can be explained only through elevated greenhouse gases.

This conclusion is relevant insofar as it is the "smoking gun" proving the validity of the anthropogenic climate change argument. On the other hand, something as abstract as global or hemispheric air temperature is not really going along with significant impact. Therefore, the IPCC has also assessed regional changes – and concluded that maximum and minimum daily temperatures have "likely" increased in most land areas. The diurnal temperature range has "very likely" decreased. Heavy rainfall events have "likely" become more frequent in some areas.[14] Continental drought has "likely" increased in a few areas. However, insufficient evidence would prevent making statements about changing wind speeds and intense rainfall amounts in hurricanes. No assessment was given on changing statistics of wind storms at mid-latitude – the evidence was insufficient for such an assessment.

[14] As far as I know, Central Europe was not among the "some areas".




**a)**




**b)**

***Figure 2*** Hemispheric air temperature development.
a) 20-year running trends derived from the observational record (solid) and from a model simulation extending into the future (dashed). The range of "normal" variations derived from different estimates is given by the horizontal lines. From Hegerl et al (1995).
b) the observed record of Northern hemisphere air temperature (red line) and simulations of air temperature with a climate model forced with only natural factors, only anthropogenic factors and with all factors. (IPCC, TAR)

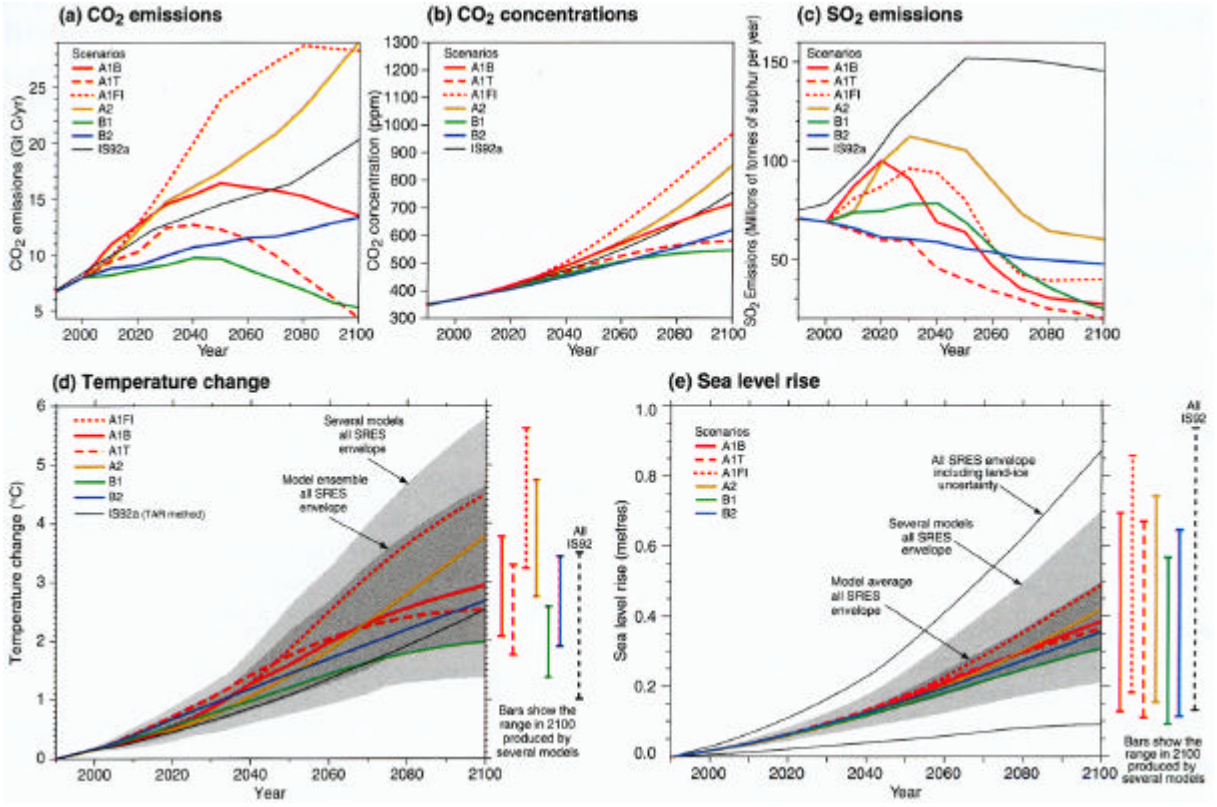



***Figure 3*** The set of IPCC scenarios of $CO_2$ and $SO_2$ emissions, with resulting $CO_2$ atmospheric concentrations, air temperature change, and sea level change. Note that to none of the scenarios is assigned a probability – they are all plausible, consistent but not necessarily probable. (IPCC, TAR)

- The argument just presented in Figure 2b supports the view that climate models are a suitable and reliable tool to envisage future climate changes, given changes in natural and anthropogenic forcings. The IPCC has developed a number of plausible and possible scenarios of future emissions of gases and particles into the atmosphere (Figure 3). These emissions are used to determine consistent atmospheric concentrations and fed into climate models, which respond with changing temperatures, sea level, and other meteorological and oceanographic variables. The different scenarios envisage very different futures, some with unabated and even increasing emissions of carbon dioxide, and others with reducing emissions in the later part of the 21st century. These emissions lead al to elevated carbon dioxide concentrations, but the levels at the end of the 21st century vary strongly among the scenarios. The aerosol ($SO_2$) emissions diminish in all scenarios, some of which after a few decades of increased emissions. The climatic implications of these emissions are elevated temperatures and sea levels – with the famous lower and upper bounds

of 1.5 to 6 K and 10 to 90 cm's for the end of the 21st century.[15] The diagrams show very clearly that temperature and sea level will not attain new equilibria, but will continue to rise well into the 22nd century.

The regional implications of the global changes are not that clear, but the IPCC has assessed that it would be "very likely" that maximum and minimum regional temperatures would rise and diurnal range of temperature would shrink almost everywhere. The frequency of heavy rainfall events will "very likely" rise in these scenarios. It is also "very likely" that droughts will be more frequent in many continental mid-latitude areas. Wind speeds and rainfall amounts associated with hurricanes are also with "high likelihood" increasing. Note that these expectations refer to the end of the 21st century.

Figure 4 shows an example – changing precipitation on average and in extreme events for the last 30 years of the 21st century according to the rather severe A2 scenario. In most of Europe, there will be on average less rainfall, according to this scenario, but more intense extreme events. The changes in extreme events in Figure 4 amount to 40% in some regions.[16] If we assume a linear change from now until the end of the century[17], then we may expect an increase of at most 4% of extreme events in central Europe until today – a signal much too weak to be detected in a record of strong interannnual, intercecadal and even intercentennial variability.

Thus, Figure 4 is not a valid evidence to argue for a causal link of the Elbe flood in 2002 and anthropogenic climate change. However, it indicates that in a worst-case scenario, extreme rainfall events may become more intense in a few decades to come. For the public, it is difficult to discriminate between contemporary floofings being not related to global Warming, whereas in future such events may be come worse in the course of Global Warming.

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[15] Unfortunately, the upper bounds are often falsely reported in the media as forecast, i.e., most probable future developments. In fact, the upper bounds are not responses to the most dramatic emission scenarios as simulated by climate models, but estimated of most adverse effects of, for instance, melting ice sheets not accounted for in the climate models.

[16] Certainly, one should not assign to much significance to spatial scales of about 100 km's and less, as this would stretch the skill of regional climate models too far.

[17] Figure 3 indicates hat the development may be exponential so that a linear interpolation would overestimate present signals.

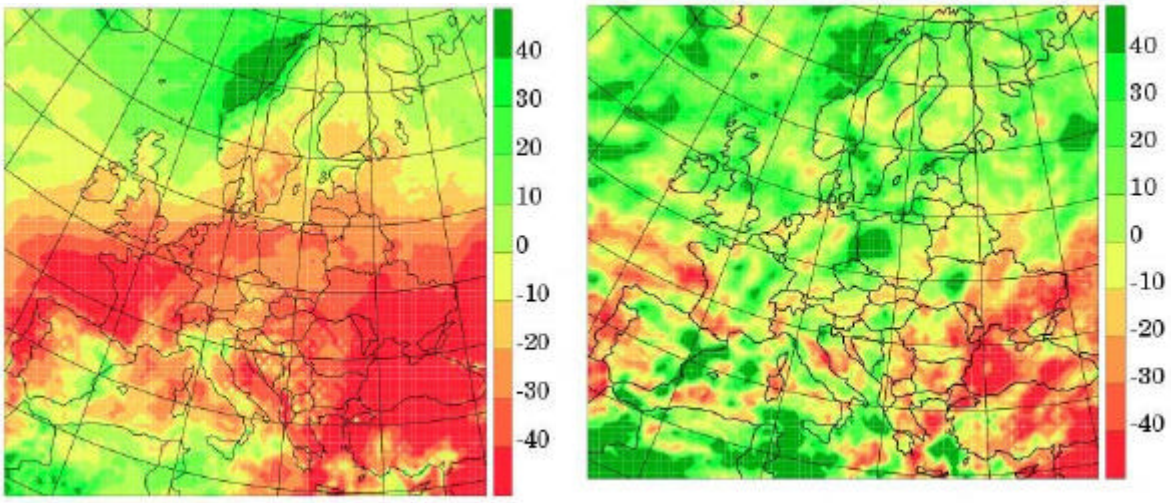


***Figure 4*** Simulated changes in summer rainfall amounts (left) and extreme rainfall events (right) for the end of the 21st century (Christensen and Christensen, 2003) in the A2 scenario.

## 3. Extreme events – rare and clustering events

The Elbe flood was perceived by the contemporaries as unprecedented, but it was not, as we will see later. However, it was an extraordinary event. The degree of "extraordinariness" is usually described by a statistical approach named "extreme value analysis". This approach characterizes events as "1 in X years". This "1 in X years" means that if we have a very long record and select arbitrary chunks of X year length, we will find one such event in each chunk *on average*. An equivalent statement is that we find equally often none or two events in such a chunk.[18] Extreme value analysis is applied to the observational record at one location; if applied to another location, different X's are determined – since a flooding is represented by many different observations throughout the affected area, it is hard to assign a specific X to a flooding. For the time being it may be sufficient to mention that X is of the order of one to two hundred years in case of the Elbe flooding.[19]

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[18] This statement is not exactly equivalent to "expectation is 1", as the expectation is a weighted sum. However, for the explanatory purpose of this article, namely to demonstrate that it is not so that each chunk contains exactly one event, this simplification may be justifiable.

[19] According to Uwe Grünewald, the expected return interval for a flood event like the one in 2002 has been assessed to be 150 to 200 years in the "Umweltatlas der Stadt Dresden von 2002" as well as in the DKKV-Studie "Hochwasservorsorge in Deutschland - Lernen aus der Katastrophe 2002 im Elbegebiet" (www.dkkv.org).

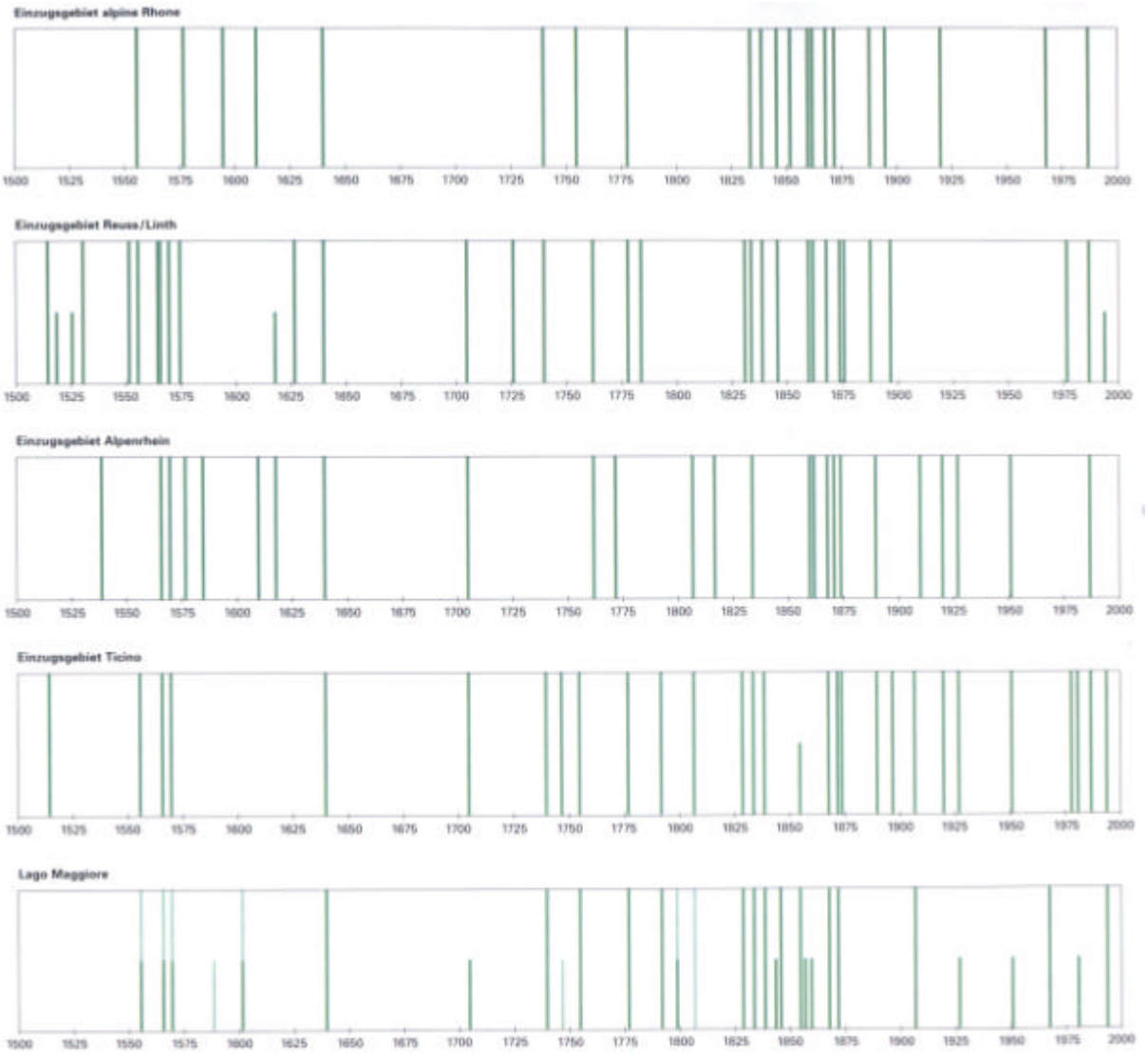


***Figure 5*** Pfister's analysis of flooding events in Alpine river catchments since 1500. The height and breadth of the lines represents the intensity of the events. (Pfister C (1999) *Wetternachhersage. 500 Jahre Klimavariationen und Naturkatastrophen 1496-1995*. Haupt, Bern Stuttgart Wien, pp 304)

Thus, the emergence of such events is "normal" albeit seldom, possibly very seldom. But, nevertheless, extreme events are part of the range of events, the natural environment is regularly (but very rarely) generating. The question is if the frequency of intensity of such events is changing. To detect changes in mean values is not an

easy task; it needs many data. To detect changes in high percentiles or extreme values is very demanding and requires very many data.[20]

The public, as well as populist scientists, likes to argue that clustering of uncommon events would be proof of ongoing change. This argument fails to acknowledge a number of caveats, namely changing media coverage, insufficient personal and public memory and a possibly invalid assumption required for conventional extreme value analysis. A further problem is that data about river discharge and river levels is almost all case affected by river regulation activities, so that data from a few decades earlier can hardly be compared to recent ones.

- *Changing media coverage*. In times, when the attention of the public is not caught by other problems, like conflict, technological development and economic change, environmental problems gets better coverage. The ubiquitous "normal" background of weather-related disasters appears as unprecedented wave of bad news. Of course, when other problems dominate the public agenda, as the "war against terrorism" in the US, weather related disasters become less visible.[21] Another problem with media coverage is that often not the meteorological or hydrological forces are addressed but the monetary damages. Because of the ever increasing affluence of modern societies, the affected properties are getting more and more valuable so that even a steep rise in monetary damage in many cases does not imply a more severe damage-creating event.
- *Insufficient memory*. It seems to be all too human to memorize the past weather as a smooth flow of events with regular seasons.[22] Thus, the presence appears always as less smooth, less regular, and thus less predictable than the past. Figure 5 provides a good example. Dates of severe flood events for several river catchments in the Alpine regions are displayed. In the middle of the 19th century Switzerland suffered from a cluster of several very severe flooding events, which were perceived as unprecedented and used as a key argument for the institution of

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[20] See, for instance, Frei, C. and C. Schär, 2001: Detection probability of trends in rare events: Theory and applications to heavy precipitation in the Alpine Alps. *J. Climate* 14, 1568-1584
Benestad R. E.,2004: How often can we expect a record event? *Climate Research*

[21] More research is certainly needed; a case supporting this motion is the US survey mentioned above, which lists the gravest problems faxing the nation.

[22] A good empirical example is given by Rebetez, M., 1996: Public expectation as an element of human perception of climate change. *Climatic Change* 32, 495-509

the progressive Swiss Forest Law[23]. At that time, no reliable historical account was available – but Figure 5 demonstrates that similar clustering has happened 300 years earlier and was just forgotten.

In Saxony, where most of the German damage took place in 2002, in the past hundred years at least every 30 years severe floods happened, namely in July 1897, 1927[24] and 1957. Obviously these events were forgotten in the public and were hardly mentioned in the media (cf. Krauß and Rulfs, op .cit.). The public was also no longer aware of a rule of thumb provided by the East German government after another severe event in 1954, according to which "in almost every third year at least one summer month will be extremely wet, and in every tenth year two summer months."[25]

- *Extreme value analysis*. This approach is based on the assumption that the "waiting time" between any two events is independent of the waiting times before and after. However, in environmental systems this assumption is often not satisfied, be it because of long-frequency variability (i.e., variations of climate on scales of decades and longer due to natural reasons) or a phenomenon described as "long memory"[26]. Both properties, low-frequency variability and long memory cause extreme values to cluster, and the analysis of historical data (which are long enough for such an analysis) show that the waiting time between extreme events is not independent from the waiting time before and after. Instead a short waiting time is usually preceded by a

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[23] The events were considered as proof for ongoing climate change, provoked by irresponsible logging in the high mountains; for further details, refer to Pfister, C., and D. Brändli, 1999: Rodungen im Gebirge - Überschwemmungen im Vorland: Ein Deutungsmuster macht Karriere. In R.P. Sieferle and H. Greunigener (Hrsg.) *Natur-Bilder. Wahrnehmungen von Natur und Umwelt in der Geschichte* Campus Verlag Frankfurt/ New York, ISBN 3-593-36327-5, 371 pp, 9-18

[24] According to U. Grünewald, Technical University of Cottbus, in 1927 110 bridges were destroyed and 160 bridges damaged; 188 buildings were destroyed, 152 people lost their life. The total monetary damage was 70 million Reichsmark.

[25] „Fast in jedem dritten Jahr ist also in einem der Sommermonate mit extrem hohen Monatssummen des Niederschlages ... zu rechnen. In jedem zehnten Jahr sind sogar zwei der Sommermonate durch solche hohen Niederschläge ausgezeichnet". A summer month was considered extremely wet when the amount of rainfall passed the 200 mm threshold. After Böer W., H. Schubert, O. Wilser, 1959: *Das Sommerhochwasser der Elbe im Juli 1954*. Quoted after U. Grünwald, pers. comm.

[26] Bunde, A., J.F. Eichner, S. Havlin, and J.W. Kantelhardt, 2004: Return intervals of rare events in records with long term persistence: stretched exponentials and clustering. submitted

short waiting time, whereas a longer waiting time is, on average, followed by a longer waiting time.

Another example of clustering is provided in Figure 6 – which displays the occurrence of so-called Vb-weather types. These weather types, first characterized by von Ficker in the 1880s, are often associated with severe rainfall and flooding events. It has been claimed that these events would have become more frequent in recent years, but a comparison with the full record since the beginning of analysis in the late 19th century concludes that so far we just see clustering effects but no systematic change towards more such events.

Obviously, these caveats greatly limit the evidence of recent extreme events as harbinger of ongoing climate change.

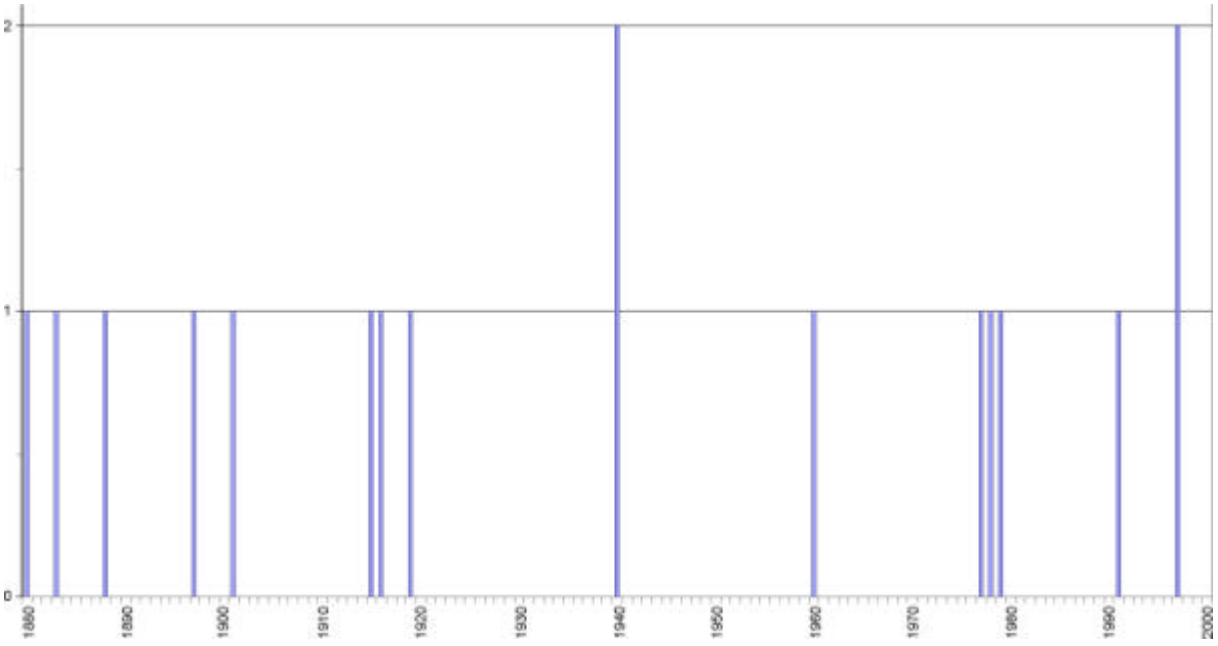


***Figure 6*** Annual number of so-called "Vb" weather situations, which are regularly associated with severe flooding events in Central Europe (after Brà zdil, pers. communication)

## 4. Need for better adaptation

From the discussion so far, the following main conclusions may be drawn:

1. Anthropogenic climate change is real, and it will accelerate in future.
2. Societies are vulnerable to weather extremes.

3. Contemporary weather extremes (in particular floods and rain storms) are falsely attributed to climate change.

In principle, there are two strategies to respond to anthropogenic climate change:

- Adaptation – to existing and changing weather patterns. This means to reduce contemporary and future vulnerability to weather extremes.
- Mitigation of anthropogenic climate change – by reducing the emission of radiatively active gases and substances (greenhouse gases and aerosols)

A robust expectation is: If no effective emission regulations are implemented, then we will have a quadrupling of greenhouse gas concentrations in the atmosphere at the end of the 21st century, with severe repercussions of the climate system. If a regulation is adopted, then we may end up at the end of the 21st century with a doubling of greenhouse gas concentrations, with less significant changes in the weather patterns. In both cases significant efforts to deal with adaptations are needed.

In fact, reducing the contemporary vulnerability of societies to weather extremes is a win-win strategy. First, it reduces contemporary risks. Second, if some extremes are really getting worse in future because of ongoing unabated or only weakly regulated greenhouse gas emissions into the atmosphere, it helps to alleviate some of the dangers of a possible future climate.

Thus, a meaningful climate policy should address both aspects, reduction of emissions and reduction of vulnerability.

In a number of European countries (such as Germany, Denmark and Sweden) almost only the option of „mitigation" is considered. It is widely believed that the implementation of the Kyoto-protocol would lead to a significant mitigation. However, Kyoto will at best cause a symbolic reduction of emissions.[27]

One may wonder why mitigation is strongly favored over adaptation, even if it is rather obvious that any reasonable policy will adopt a blending of the two approaches. Possibly there are cultural and political reasons. In terms of morality, adaptation means managing the consequences of the evil (anthropogenic climate change)

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[27] The real significance of the Kyoto protocol is that it leads to acceptance of an agenda, which will enforce implement serious and significant reductions of greenhouse gas emissions in the future.

– but the morally only acceptable effort is to fight against the evil, i.e., to reduce the emissions. Also, talk about adaptation will cause people to believe that anthropogenic climate change is not that bad, that it can be dealt with. Thus, talk about adaptation is not "good". On the political side, it is to be mentioned that in developing countries, adaptation measures can hardly be separated from general development. [28]Also, adaptation in the Third World means investment in local industries and not technological development of developed countries.

The bias towards mitigation, leads to an increase of vulnerability. This is because weather extremes are not understood as something one has to be prepared for, but as something being caused by somebody. Thus, the adequate response is to policy the perpetrator, not to guard oneself against the real dangers of weather extremes. Previously, in 1953and 1962, the disastrous storm surges in the Netherlands and in Germany were understood as a signal to improve coastal defense; this was done successfully, and the even higher storm surge of 1976 in Hamburg did not cause significant damages. The present perception, and interpretation by politicians and advocate scientists in the media, causes people to no longer follow the 1953/1962 example, but to simply continue as before while requesting financial help for rebuilding and an active Klimaschutzpolitik[29] to be paid for by others. Thus, the disregard of measures to reduce the vulnerability, to better adapt to the risks of weather extremes, is not only unreasonable but has significant adverse effects for people living today.

My answer to the question raised in the title of this paper is – insufficient preparation. Reference to human sins has in our history rarely been a good advice in setting up a rational and reasonable approach for solving problems.

**Acknowledgement**

I am thankful to Martin Döring, who persuaded me to complete this article, to Beate Gardeike for preparing skillfully the diagrams, to Christoph Matulla for critically commented on the manuscript and to Ulf Grünewald, who provided me with relevant material on the Elbe flood in 2002.

[28] The urgent need for modernization and making infrastructure more efficient can, and will be combined with measures to reduce vulnerability, and vice versa.
[29] Not really translatable term - climate protection policy.