Weather catastrophes and climate change
Is there still hope for us?

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“Now that there is firm evidence of man’s influence on the climate, society is faced with a decision-making problem of global proportions that goes far beyond the realms of basic scientific research: What future climatic development do we as humankind want to set ourselves as a target?”

Prof. Dr. Hans-Joachim Schellnhuber
Director of the Potsdam Institute for Climate Impact Research (PIK) and Research Director at the Tyndall Centre for Climate Change Research, Norwich, UK

The standard work on climate change

The ten warmest years ever recorded have all occurred since 1991. Extreme weather conditions are increasing throughout the world, climate change is advancing. This conclusion is undisputed today, but the causes are the subject of contentious discussion.

An overview of the current state of research and the effects of climate change is given in a new book: “Weather catastrophes and climate change – Is there still hope for us?”. This publication by Munich Re’s Geo Risks Research takes a comprehensive and knowledgeable look at all aspects of climate change without any ideological bias and has all the makings of a standard work.

Twenty-two renowned experts from the fields of science, research, and economics outline the present situation and analyse the effects of climate change on nature, human beings, and the economy. A critical look is also taken at the ideas of the so-called climate sceptics. The result is a state-of-the-art view of climate change which explains the relationships between all the different aspects and gives an indication of the options for action.

Weather catastrophes and climate change – Is there still hope for us?

The answer to this question in the book is an unequivocal "yes". The reason is that we all contribute to climate change by our own behaviour – and that is something we can change. The more we know, the greater our prospects of exerting a positive influence on climate change. This new work creates the basis for action – and raises awareness of the measures that are required.

Internationally recognised experts shed light on the causes and effects of climate change from a variety of perspectives. The list of authors reads like a "Who's Who?" of climate research. It includes Hartmut Graßl, Director of the Max Planck Institute for Meteorology, who outlines the general history of climate change. The very special phenomenon of El Niño is discussed by Mojib Latif, who heads the Ocean Circulation and Climate Dynamics research division at the Leibniz Institute of Marine Sciences in Kiel. The opportunities and limits of modern climate models are identified by climate researcher Ulrich Cubasch, while the oceanographer Stefan Rahmstorf talks about abrupt climate change and presents an appraisal of the arguments put forward by the climate sceptics.

This is followed by a look into the future provided by such renowned scientists as Hans-Joachim Schellnhuber and Hans von Storch, to name but two. In short, with this book Munich Re covers all facets of climate change and draws together the findings of current climate research into a single volume.

In the space of just a few years – 1983, 1993, 1995 – the old city of Cologne was submerged no fewer than three times.


Düsseldorfer

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Earth's climate and its changes

Climate is a central natural resource and the basis of all life. But man's treatment of this valuable asset is both reckless and ruthless. The consequence is that the climate is gradually becoming a risk.

Hartmut Graßl

Many countries operate scientific research bases in the Antarctic all the year round. Continuous meteorological observations are part of their standard programme and provide important information on the current state of the climate.

Climate factors

The size of the earth and its mean distance from the sun are the main factors determining the planet's climate. The earth is big enough to retain an atmosphere and warm enough to possess water in all three phases. This fact paved the way for life, and life gave rise to an unusual composition of the atmosphere, in which trace substances have a stronger effect on the climate than its main components.

If we take the size of earth and its mean distance from the sun as given and constant, we are left with the following chief influences on the climate at any location around the globe:

– Brightness of the sun
– Variations in the earth's orbit around the sun
– Composition of the atmosphere
– Positions of the continents
– Interactions between ocean, atmosphere and land surfaces, including vegetation and inland ice
– Volcanism
– Celestial bodies impacting on the earth
– Human activities

All of these determinants have typical timescales which, in total, range from billions of years (e.g. for a complete relocation of the continents) all the way to minutes (e.g. for the life cycle of fair-weather cumulus clouds). This being so, the climate cannot be stable and has in fact always been subject to change. As it will continue to be. The central question here is: how fast? Mankind's response – depending on the pace of change – has been adaptation or migration. Where the pace of change was too rapid, whole populations died out, while moderate climatic changes, e.g. more precipitation coupled with a slight rise in temperature, can even ease living conditions.

What is climate?

The World Meteorological Organisation (WMO) defines climate as the synthesis of the weather and recommends an averaging of weather data over at least 30 years. So the climate of a location is deemed described if we know, in addition to the mean values of all weather variables, the probability of a deviation from the mean value as well as very rare events and weather extremes for several decades.

Since the atmosphere is able to communicate weather anomalies occurring in one region to an entire hemisphere within a few weeks, certain large-area anomaly patterns in the atmospheric circulation can reach hemispheric proportions. The best-known is the warm tropical eastern Pacific (El Niño), which leads to droughts in Indonesia and northeast Brazil but often produces floods in California, Peru, and parts of Central and South America. It even has an impact on parts of Europe. Meteorologists refer to these relationships as teleconnection patterns.

Most of these and other deviations from the mean value are due to atmosphere-ocean interaction. This is what can make a July day in Hamburg with a maximum temperature of 12°C as chilly as one of the mildest days in January. What follows is an attempt to show the footprint mankind has left – unconsciously as a rule – in impacting not only the regional but also the global climate.

Impact of mankind

In physics, it is usual to start by assessing the magnitude of a potential determinant. If we do this for the three main climate-changing effects of human activity, viz. the production of waste heat, changes in land use, and alterations in the composition of the atmosphere, we must compare the mean global changes in the radiation flux density with natural change, and we must do so – an often-overlooked factor – using the same timescales. Table 1 compares energy change per unit of time and area in watts per square metre (Wm^{-2}) for various time intervals. A mere glance is enough to make the following clear:

– Waste heat is not a global problem but a local one, e.g. in metropolitan regions.
– A volcanic eruption changes the climate for only a few years.
– The driver behind climatic changes due to different land use is small compared with the impact of the anthropogenic greenhouse effect.
– Changes in insolation were only one climatic factor among several and by no means dominant in the 20th century.
– The consequences of changes in air turbidity have been assessed only roughly so far, but measures taken very soon show visible results.
– The factor which has had the strongest impact on clima change since the start of industrialisation is the grow greenhouse gas concentrations (with CO_2 contrib roughly more than one half).

Thirty years of geo risks research at Munich Re

Extreme windstorms and flood catastrophes are increasing steeply worldwide. The overall loss to the economy from weather-related natural hazard events between 1980 and 2004 alone came to around US$ 1,000bn. Climate is therefore an economic factor that directly affects not only the insurance industry.

This was recognised at an early stage by Munich Re, a company with global operations and the world's largest reinsurer. Consequently, more than 30 years ago now, it set up a special unit to handle geo risks research and successfully built up a worldwide network of experts.

The company now employs specialists from all relevant disciplines, including meteorologists, geologists, geophysicists, geographers, hydrologists, and environmental scientists. This broad spectrum permits a sound assessment of natural hazard risks and the effects of climate change. Experts from Geo Risks Research are active members of numerous scientific bodies and share their knowledge with Munich Re's clients and decision-makers throughout the world.

Hurricane Andrew, which devastated the south of Florida in August 1992, produced the largest insured loss to date from a natural catastrophe (US$ 17bn).

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Questions on the content should be addressed to:
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http://www.munichre.com

Responsible for content
Geo Risiko Forschung

Person to contact
Angelika Wirtz
Tel.: +49 (0) 89/38 91-34 53
Fax: +49 (0) 89/39 90 56
E-mail: awirtz@munichre.com

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