



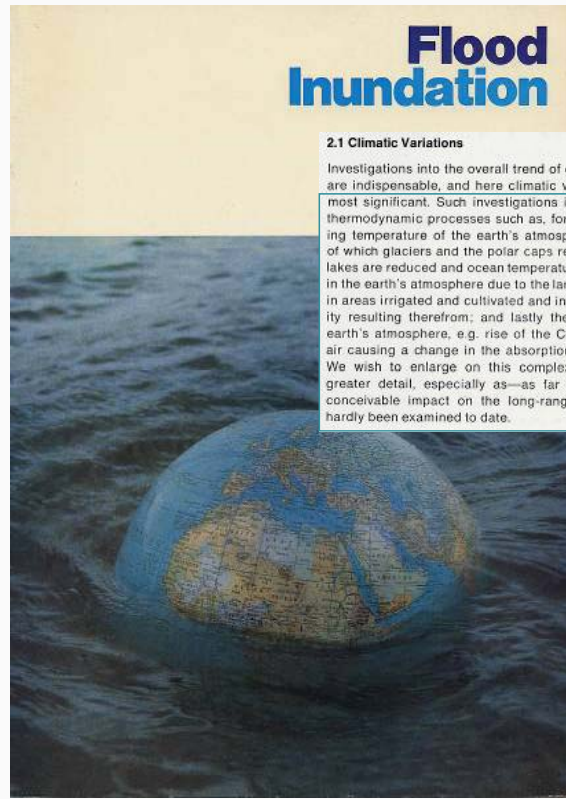
EXTREME WEATHER EVENTS: ARE THEIR FREQUENCY AND ECONOMIC IMPACT RISING?

Prof. Dr. Peter Hoeppe
Head Geo Risks Research/Corporate Climate Centre (GEO/CCC1)

Climate Change and Water Investment Conference, London, June 6, 2011



- Founded 1880
- Largest reinsurer
- Leading role in reinsurance of natural catastrophes
- 1973: Climate change identified as risk
- 1974: Foundation of Geo Risks Research Department
- 2007: Climate Change defined as one of two Strategic Topics for the whole Group



Flood Inundation

2.1 Climatic Variations

Investigations into the overall trend of claims experience are indispensable, and here climatic variations become most significant. Such investigations involve a study of thermodynamic processes such as, for example, the rising temperature of the earth's atmosphere (as a result of which glaciers and the polar caps recede, surfaces of lakes are reduced and ocean temperatures rise); changes in the earth's atmosphere due to the large-scale increase in areas irrigated and cultivated and increases in humidity resulting therefrom; and lastly the pollution of the air causing a change in the absorption of solar energy. We wish to enlarge on this complex of problems in greater detail, especially as—as far as we know—its conceivable impact on the long-range risk trend has hardly been examined to date.

most significant. Such investigations involve a study of thermodynamic processes such as, for example, the rising temperature of the earth's atmosphere (as a result of which glaciers and the polar caps recede, surfaces of lakes are reduced and ocean temperatures rise); changes

earth's atmosphere, e.g. rise of the CO₂ content of the air causing a change in the absorption of solar energy.

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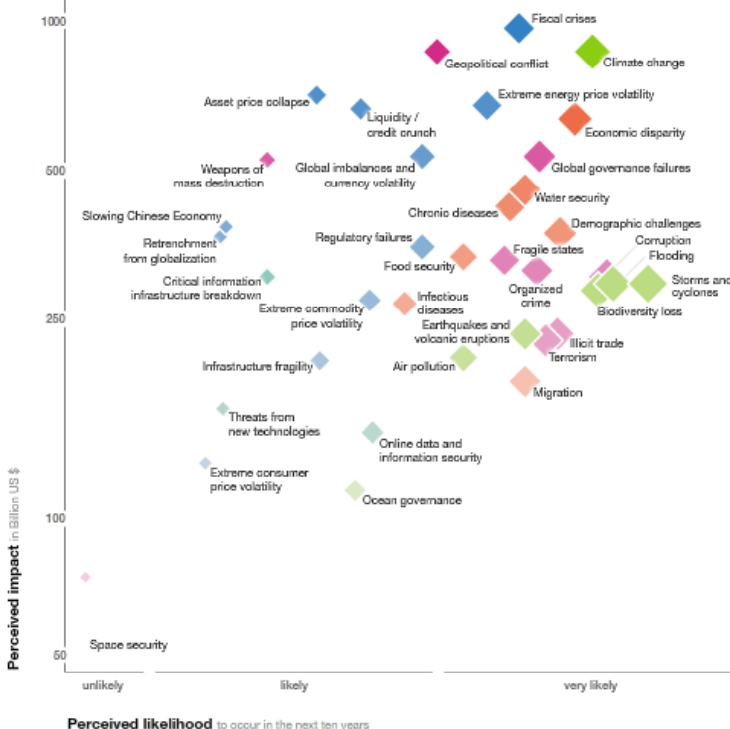
Munich Re Publication, 1973



World Economic Forum 2011



Global Risks Landscape 2011

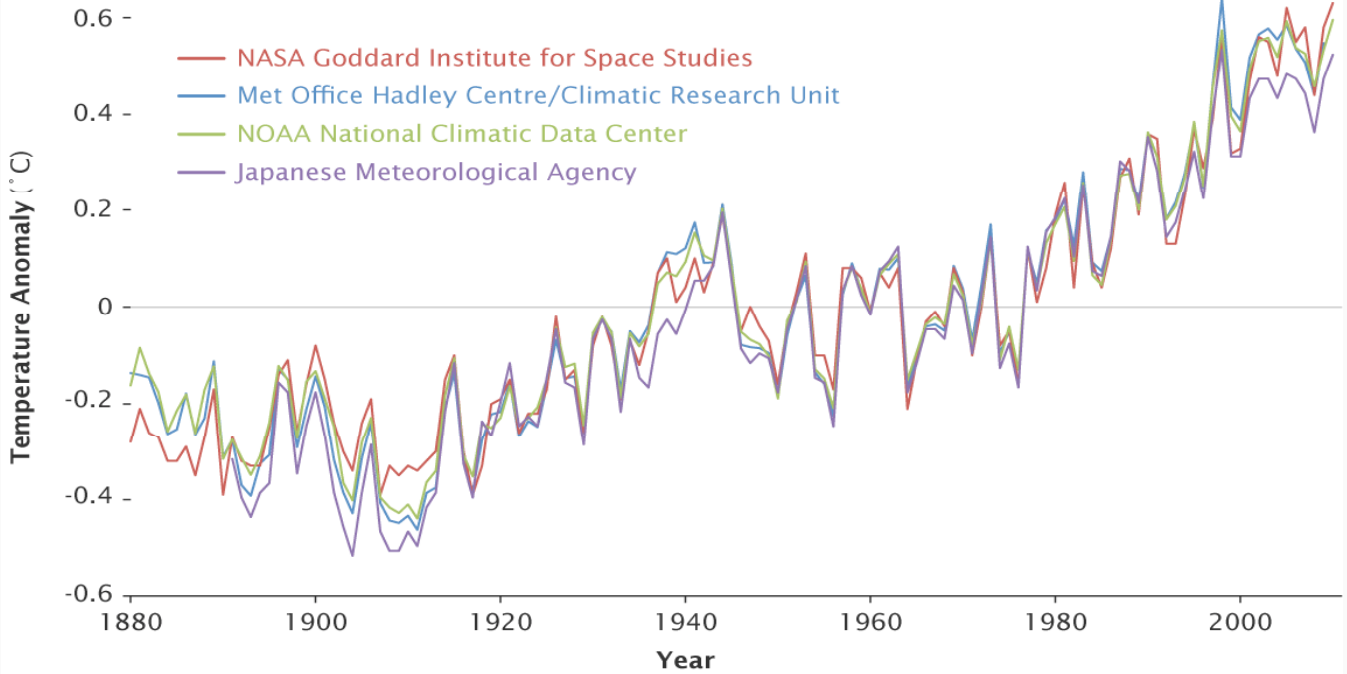


- Economic risks
- Geopolitical risks
- Environmental risks
- Societal risks
- Technological risks

- Survey of 580 leaders and decision makers across the globe
- Supported by 18 workshops
- Assessment of 37 global risks for the next 10 year period

Global Surface Temperatures

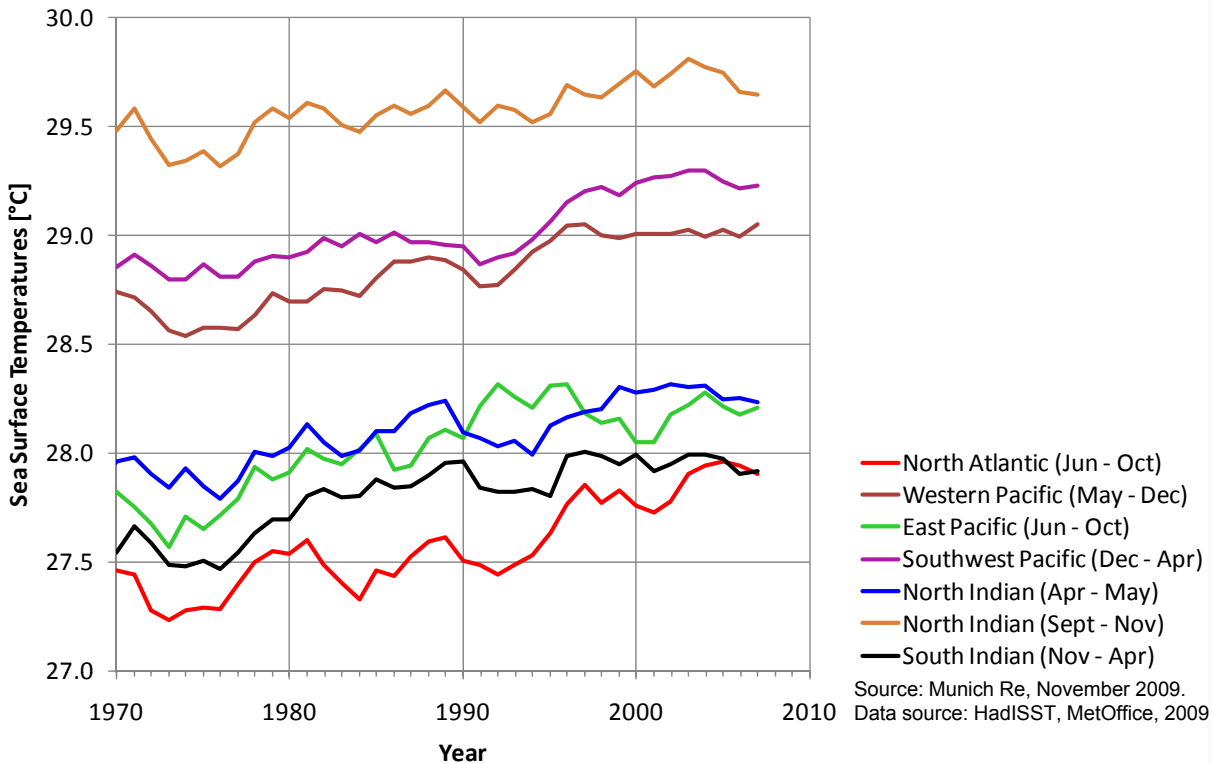
Four independent records show nearly identical long-term warming trends.



Credit: NASA Earth Observatory/Robert Simmon

Observed changes in sea surface temperature in tropical ocean basins with TC activity

Sea surface temperatures of six ocean basins with TC activity Five-year running means (data: 1968 - 2009)

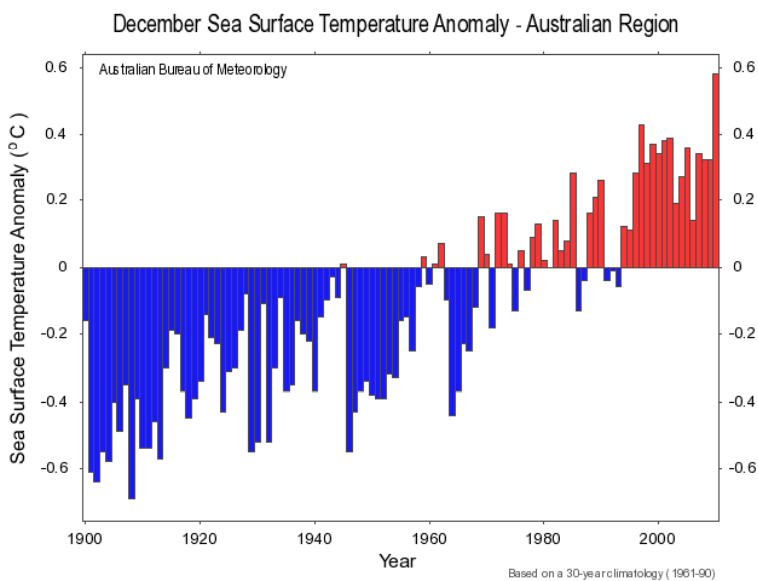


Source: Munich Re, November 2009.
Data source: HadISST, MetOffice, 2009

- May: Highest ever measured air temperature in Asia (Pakistan) 53.5°C
- July: Temperature record for Moscow 37.8°C, at other places in Russia more than 40°C
- August: Wettest August ever recorded in Germany
- September: 45°C (113 F) a new record temperature for Los Angeles
- December: Precipitation records in Queensland accompanied by records in sea surface temperatures
- Year with the second highest number of weather related disasters

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Queensland floods – is there a link to climate change?



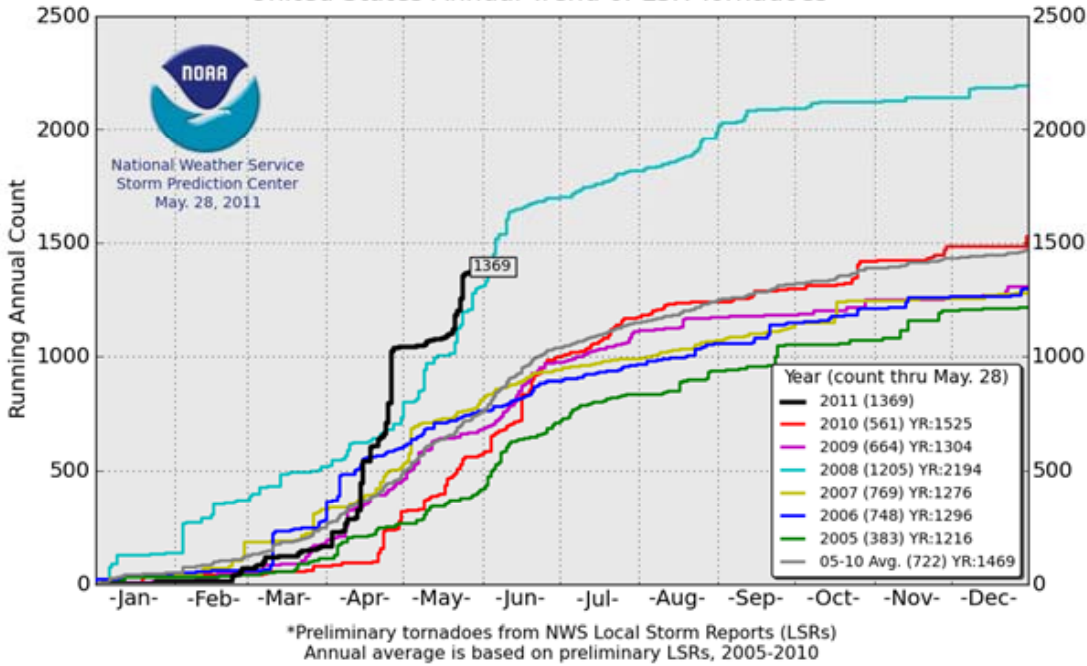
Source: Bureau of Meteorology (Australia)

- December sea surface temperature in the Australian region has been the highest on record
- There is a relation between precipitation and the sea surface temperature in Australia

Sea surface temperature is rising due to climate change

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United States Annual Trend of LSR Tornadoes*

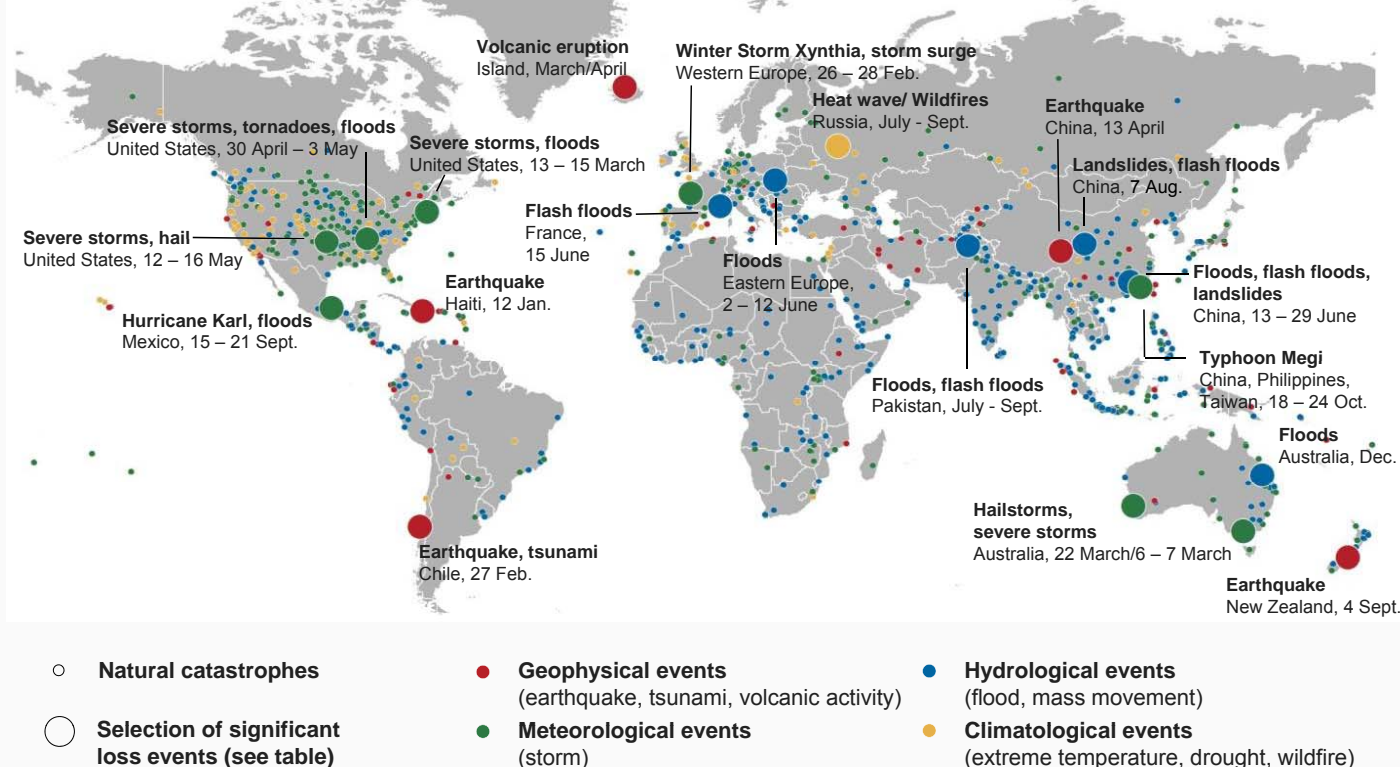


Region	Overall losses	Insured losses	Fatalities
Several States in the US (PCS Cat 44, 46, 48)	US\$ >10,000m* * Loss estimation in progress	>US\$ 7,000m* * Loss estimation in progress	566

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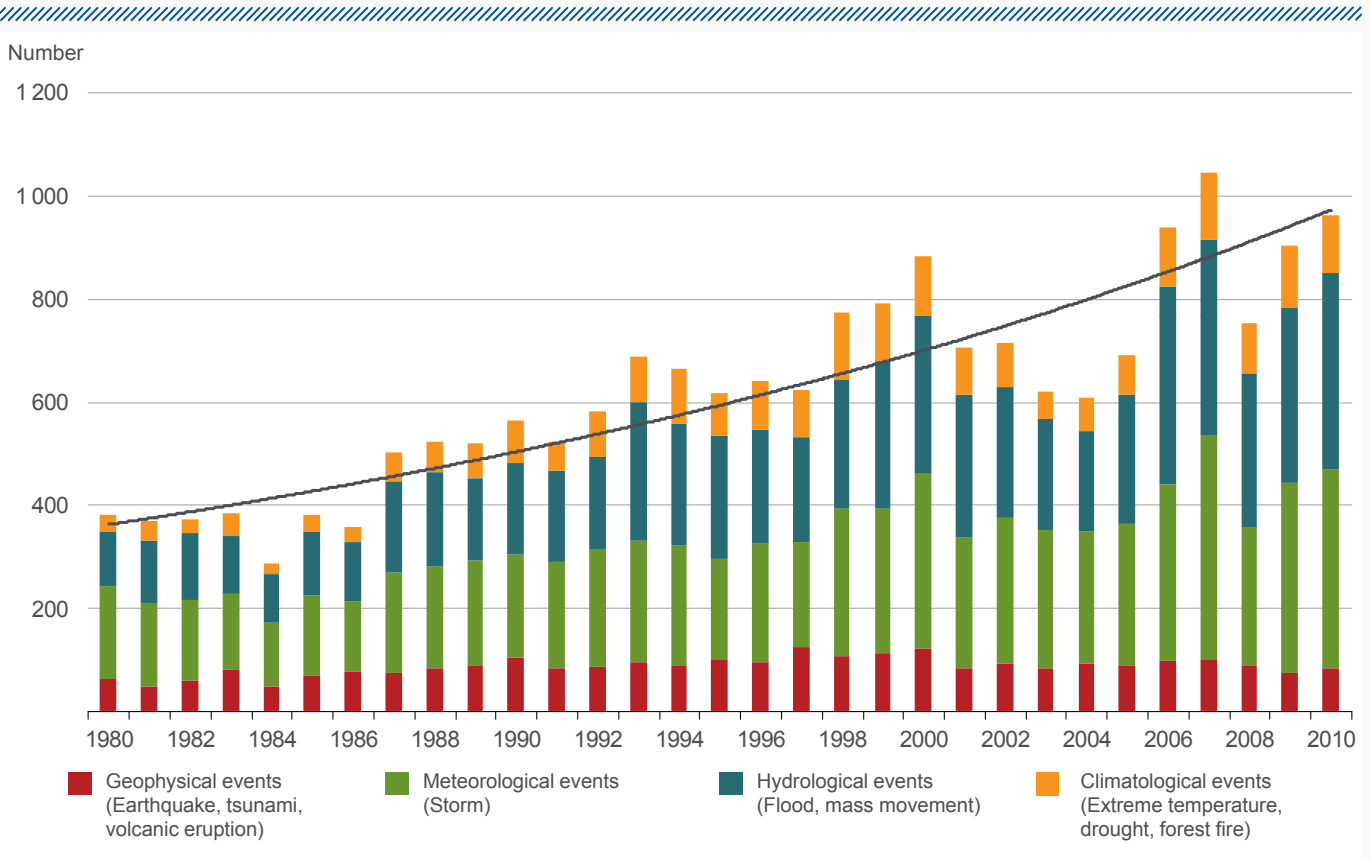
Munich Re NatCatSERVICE – the world's largest database on natural catastrophes (>29.000 events)

960 loss relevant events in 2010



Natural catastrophes worldwide, 1980 – 2010

Number of events with trend



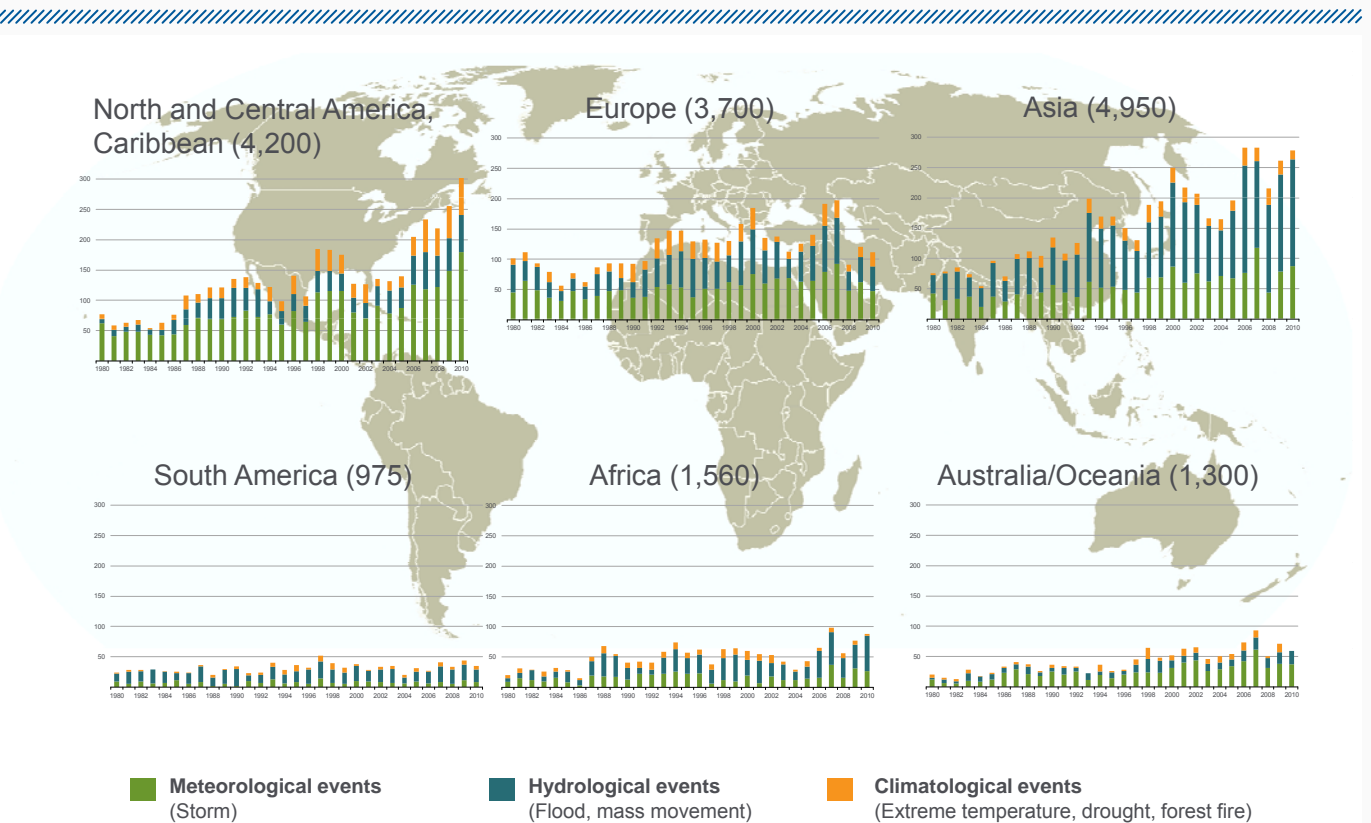
Source: Geo Risks Research, NatCatSERVICE

© 2011 Munich Re

NatCatSERVICE

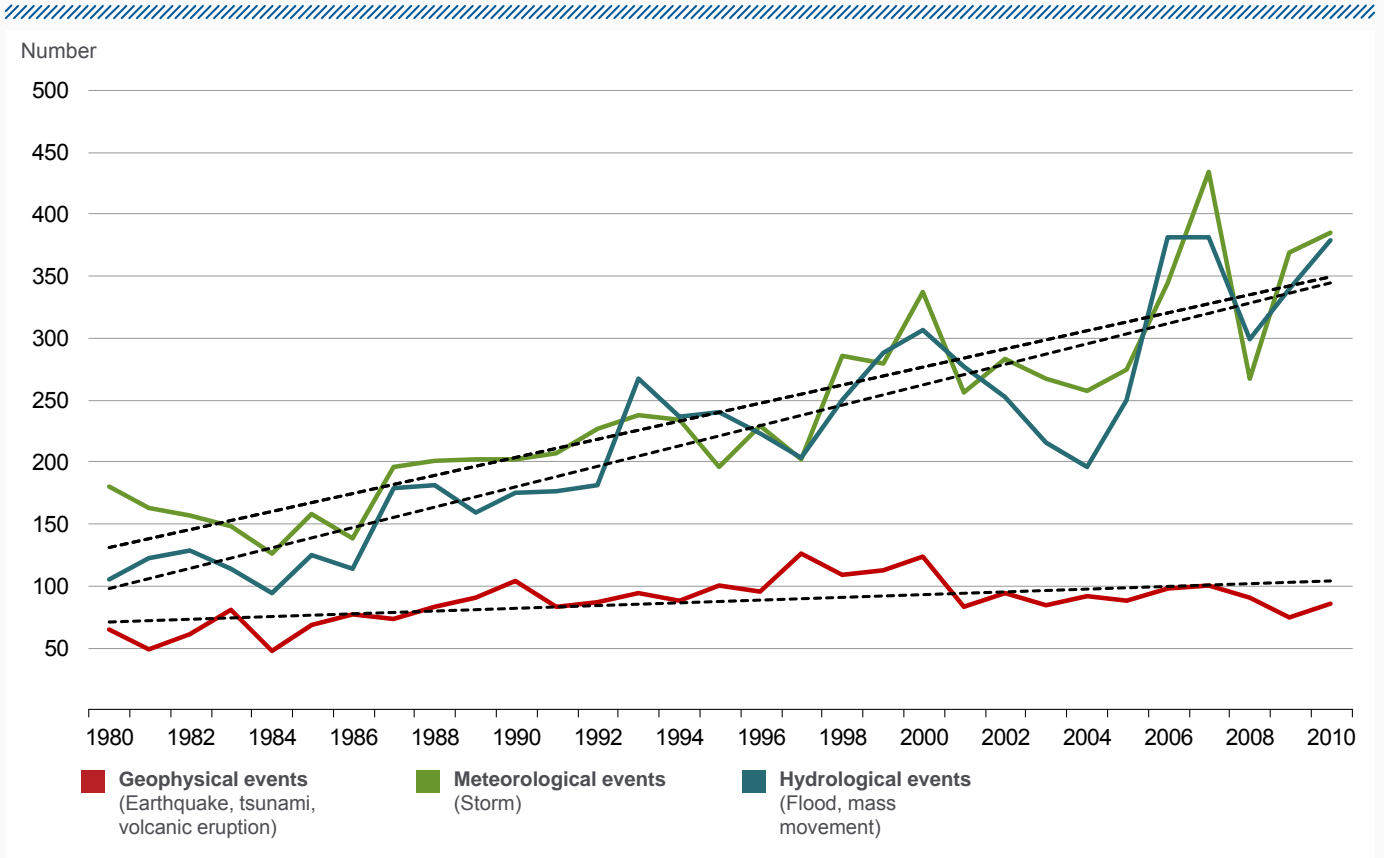
Weather catastrophes worldwide, 1980 – 2010

Number of weather-related events per continent



Natural catastrophes worldwide, 1980 – 2010

Number of events by peril with trend



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Climate change and extreme weather events (IPCC, 2007)

Phenomenon ^a and direction of trend	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood of a human contribution to observed trend ^b	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	<i>Very likely^c</i>	<i>Likely^d</i>	<i>Virtually certain^d</i>
Warmer and more frequent hot days and nights over most land areas	<i>Very likely^e</i>	<i>Likely (nights)^d</i>	<i>Virtually certain^d</i>
Warm spells/heat waves. Frequency increases over most land areas	<i>Likely</i>	<i>More likely than not^f</i>	<i>Very likely</i>
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	<i>Likely</i>	<i>More likely than not^f</i>	<i>Very likely</i>
Area affected by droughts increases	<i>Likely in many regions since 1970s</i>	<i>More likely than not</i>	<i>Likely</i>
Intense tropical cyclone activity increases	<i>Likely in some regions since 1970</i>	<i>More likely than not^f</i>	<i>Likely</i>
Increased incidence of extreme high sea level (excludes tsunamis) ^g	<i>Likely</i>	<i>More likely than not^{f,h}</i>	<i>Likelyⁱ</i>

very likely > 90%
likely >66%
more likely than not > 50%

Science 22 January 2010:
Vol. 327. no. 5964, pp. 454 - 458
DOI: 10.1126/science.1180568

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REPORTS

Modeled Impact of Anthropogenic Warming on the Frequency of Intense Atlantic Hurricanes

Morris A. Bender,^{1,*} Thomas R. Knutson,¹ Robert E. Tuleya,² Joseph J. Sirutis,¹ Gabriel A. Vecchi,¹ Stephen T. Garner,¹ Isaac M. Held¹

Several recent models suggest that the frequency of Atlantic tropical cyclones could decrease as the climate warms. However, these models are unable to reproduce storms of category 3 or higher intensity. We explored the influence of future global warming on Atlantic hurricanes with a downscaling strategy by using an operational hurricane-prediction model that produces a realistic distribution of intense hurricane activity for present-day conditions. The model projects nearly a doubling of the frequency of category 4 and 5 storms by the end of the 21st century, despite a decrease in the overall frequency of tropical cyclones, when the downscaling is based on the ensemble mean of 18 global climate-change projections. The largest increase is projected to occur in the Western Atlantic, north of 20°N.

¹ National Oceanic and Atmospheric Administration/Geophysical Fluid Dynamics Laboratory, 201 Forrestal Road, Princeton, NJ, 08540, USA.

² Center for Coastal Physical Oceanography, Old Dominion University, 4111 Monarch Way, Norfolk, VA 23508, USA.

New study shows causal association between climate change and weather extremes

Human contribution to more-intense precipitation extremes

Seung-Ki Min, Xuebin Zhang, Francis W. Zwiers & Gabriele C. Hegerl

[Affiliations](#) | [Contributions](#) | [Corresponding authors](#)

Nature 470, 378–381 (17 February 2011) | doi:10.1038/nature09763

Received 15 March 2010 | Accepted 17 December 2010 | Published online 16 February 2011

Published online 16 February 2011 | Nature 470, 316 (2011) | doi:10.1038/470316a

News

Increased flood risk linked to global warming

Likelihood of extreme rainfall may have been doubled by rising greenhouse-gas levels.

Quirin Schiermeier

Climate change may be hitting home. Rises in global average temperature are remote from most people's experience, but two studies in this week's *Nature*^{1,2} conclude that climate warming is already causing extreme weather events that affect the lives of millions. The research directly links rising greenhouse-gas levels with the growing intensity of rain and snow in the Northern Hemisphere, and the increased risk of flooding in the United Kingdom.

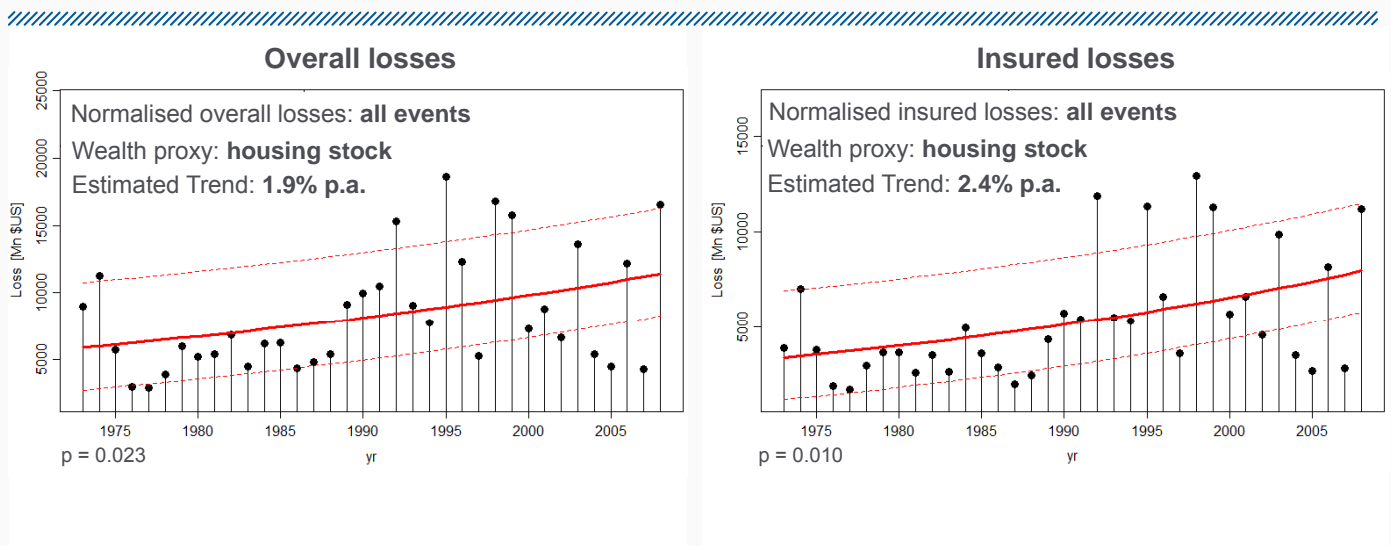


The effects of severe weather — such as these floods in Albania — take a huge human and financial toll. REUTERS/A. CELI

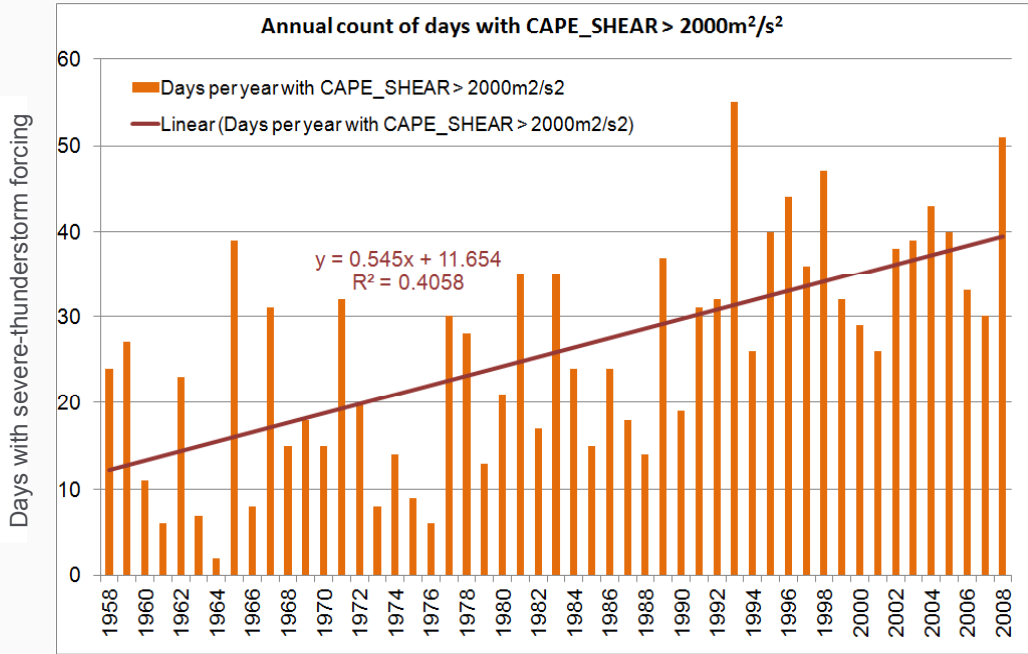
“... Here we show that human-induced increases in greenhouse gases have contributed to the observed intensification of heavy precipitation events found over approximately two-thirds of data-covered parts of Northern Hemisphere land areas. ..Changes in extreme precipitation projected by models and thus the impacts of future changes in extreme precipitation, may be underestimated because models seem to underestimate the observed increase in heavy precipitation with warming”.

- Normalisation accounts for the fact that population and wealth per capita increases over time and that past disasters would have caused more damage if they occurred nowadays
- Increasing trend of normalised damages could point in the direction that anthropogenic climatic changes may be the driving force

Normalised overall and insured losses from US thunderstorms All events



Meteorology: Observed changes in US severe thunderstorm parameters

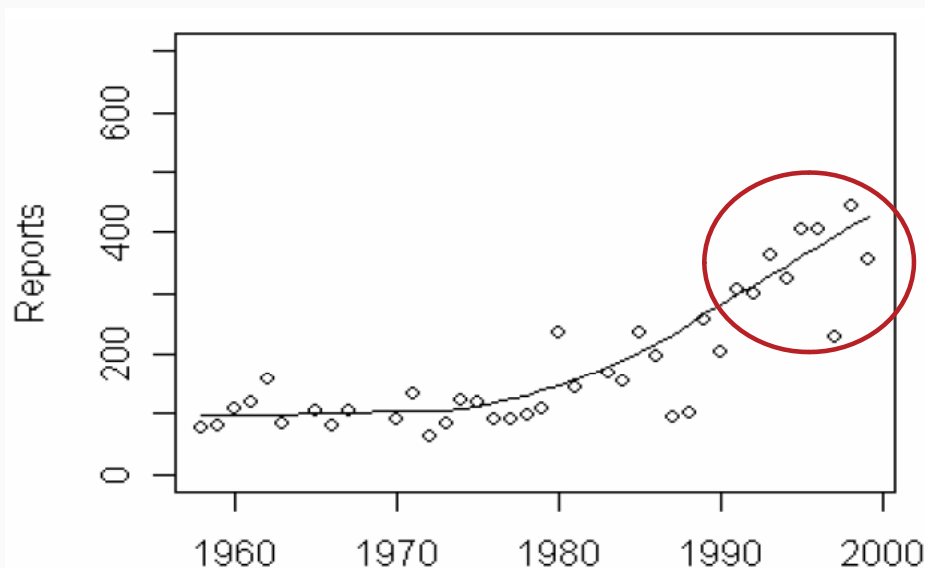


CAPE = Convective Available Potential Energy (f(atmospheric stability, humidity))
SHEAR = Change of wind direction and wind speed with height

NCAR/NCEP Reanalysis data processed in order to calculate CAPE and vertical shear by J. Sander, German Aerospace Centre, 2010

Meteorology: Observed changes in US severe thunderstorm parameters

Annual number of US hail reports (hail ≥ 7 cm in diameter)



Evaluating the economics of climate risks & opportunities in the insurance sector

Collaboration between Munich Re and the London School of Economics



Trend analysis of normalised insured damage from natural disasters

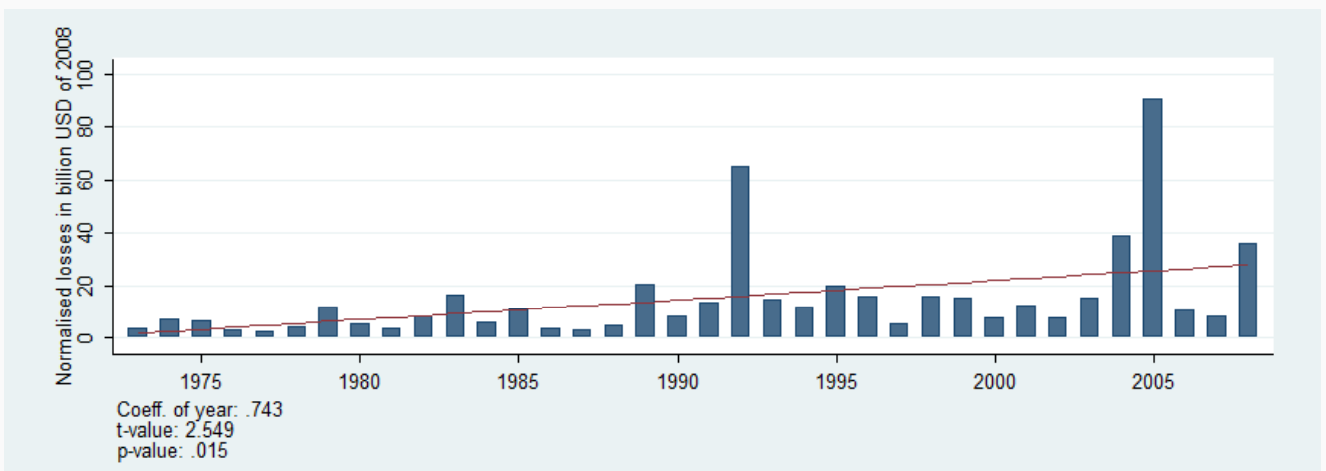
First study of this kind!

Paper submitted to „Climatic Change“ by Fabian Barthel and Eric Neumayer, LSE, London

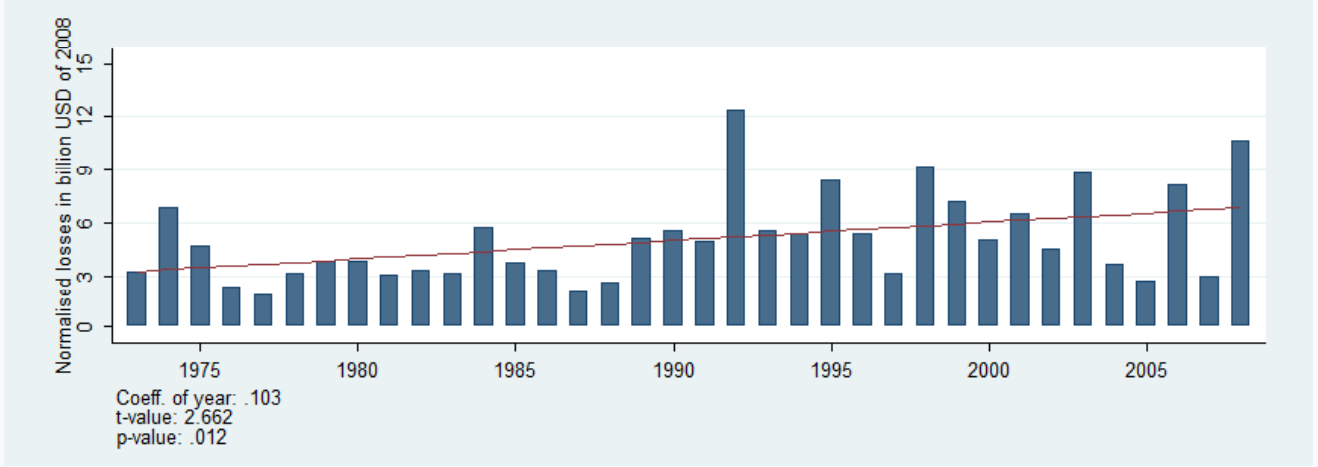
Normalisation by insurance premiums

Insurance premiums used: subset of property and engineering premiums plus motor physical damage, which are affected by natural disasters

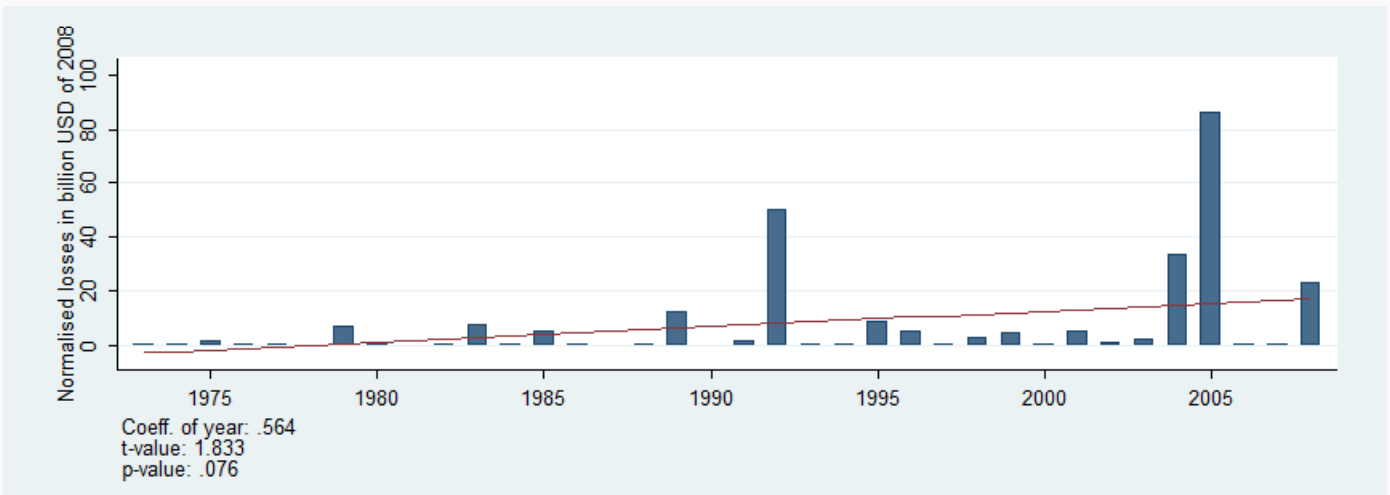
Normalised insured losses of non-geophysical disasters in the U.S.



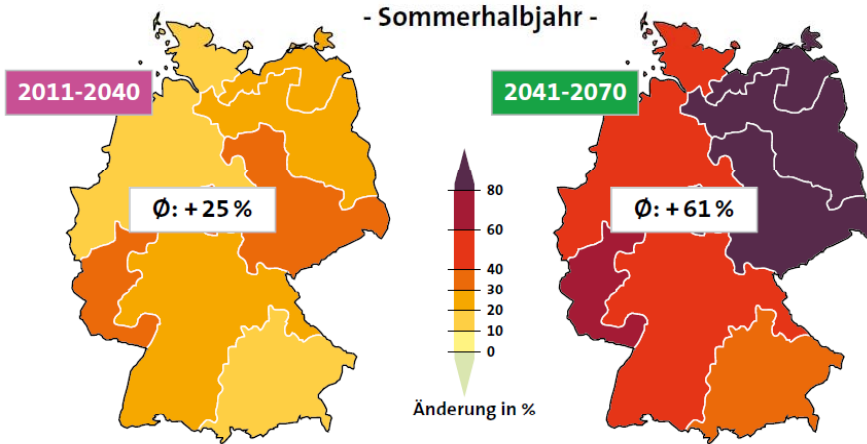
Normalised insured losses from convective events in the United States



Normalised insured losses from hurricanes in the United States



Mean annual loss ratio 1984-2008 in comparison to different future time slices



→ Hail and thunderstorm damages will increase significantly in summertime, especially in eastern Germany

Source: GDV „Herausforderung Klimawandel“ 05/2011

Climate change is a strategic topic for Munich Re
The three pillars of Munich Re’s climate change strategy

Risk assessment	Business opportunities	Asset management
<ul style="list-style-type: none"> ▪ Research of natural hazards and climate change impacts ▪ Climate liability issues ▪ Prospective risk management (considering weather oscillations such as El Niño) 	<ul style="list-style-type: none"> ▪ Growing demand for risk transfer solutions such as renewable energy covers ▪ performance covers for solar modules 	<ul style="list-style-type: none"> ▪ Integration of sustainability criteria into investment strategies ▪ Significant expansion of renewable energy investments where frameworks are appropriate

Becoming carbon neutral (Munich: since 2009, reinsurance worldwide: 2012)

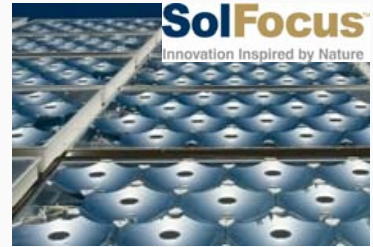
Supporting several climate initiatives (Climate Group, UNEP FI, ...)

Initiating flagship projects such as MCIII and Dii GmbH (“Desertec Industrial Initiative”)

Market leadership

Performance warranty cover for concentrator photovoltaic systems (CPV)

- Innovative cover for SolFocus (leading provider for CPV)
- SolFocus is the first company that can provide its customers with a warranty for its CPV systems for power performance over 25 years.
- If the product fails to reach the performance, Munich Re cover attaches.
- This innovative insurance solution is an important milestone for the financing of photovoltaic projects, offering producers additional financial protection (make financial burden easier, give customers greater security, etc.).



Source: Munich Re; picture source: SolFocus

Worldwide first guarantee cover for wind power plants

- Munich Re is insuring the guarantees which Fuhrländer, a German builder of wind-power plants, is giving its customers.
- By doing this, Munich Re is facilitating business for both vendors and investors and paving the way for future technologies to enter the market.



Origin and Vision



- Developed by the Club of Rome's **TREC Initiative** (Trans-mediterranean Renewable Energy Cooperation)
- Vision:** Providing Europe (EU), the Middle East and North Africa (MENA) with a sustainable supply of renewable energy by the year 2050

“Within 6 hours, deserts receive more energy from the sun than humankind consumes within a year.”

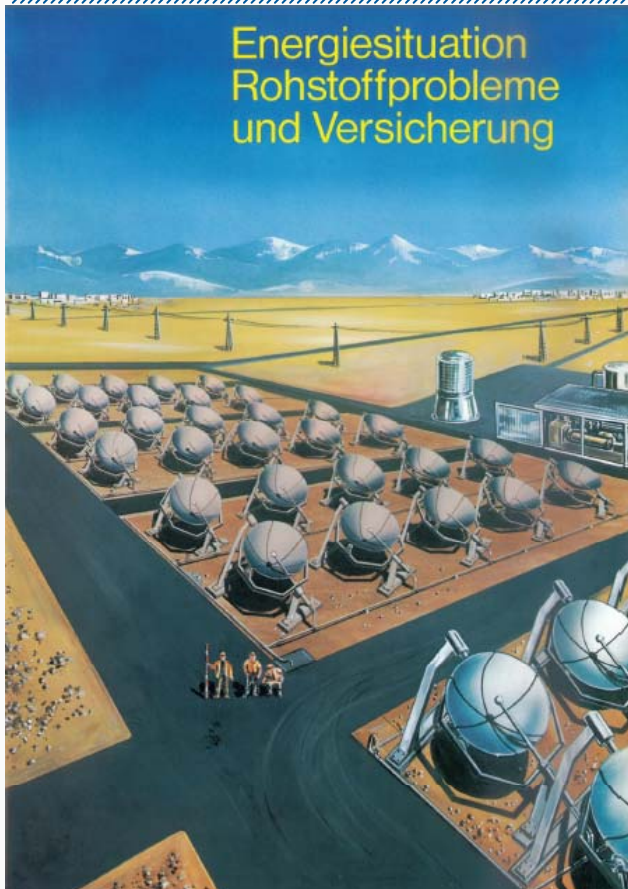
Munich Re together with the Desertec Foundation initiated the Dii GmbH

07/13/09	<ul style="list-style-type: none"> Joint signature for a memorandum of understanding by 12 companies and the DESERTEC Foundation for the formation of the Dii GmbH
10/30/09	<ul style="list-style-type: none"> Legal foundation of the planning company Appointment of Paul van Son as CEO
03/10/10	<ul style="list-style-type: none"> Appointment of Prof. Klaus Töpfer as special envoy
10/31/12	<ul style="list-style-type: none"> Development of an implementable roadmap to „green energy generation“ in the deserts of North Africa and the Middle East
2020	<ul style="list-style-type: none"> 20GW installed capacity (according to political goal of MSP)
2050	<ul style="list-style-type: none"> 100GW installed capacity (referring to the 15% aim of the Dii concept)



<p>CLIMATE PROTECTION</p>	<p>Essential contribution to the solution of one of humankind's largest problems in this century (global warming) by significant reductions of CO₂ emissions</p>
<p>BUSINESS POTENTIALS</p>	<p>Leading role in developing and providing new risk transfer products for renewable energies/new technologies</p>
<p>INVESTMENTS</p>	<p>New (direct) investment opportunities</p>

Munich Re publication on „Energy Situation, Problems with Commodities and Insurance“ dated 1978



Das Titelbild zeigt eine Sonnen- oder Solarfarm, wie sie für Afrika und die südlichen Gegenden Europas konzipiert wird. Mehrere zusammenschaltete Parabolspiegel sorgen für Wassererhitzung im Paraboloidbrennpunkt. Der Wasserdampf wird zu einer Dampfturbine geleitet, die einen Stromgenerator antreibt. Vor dem Rücklauf zu den Spiegeln durchläuft das Wasser noch einen Kühlturm (neben dem Generator-Container sichtbar). Die hier gezeigte Anlage, deren kleinste Einheit auf 50 kW ausgelegt ist, wurde vom Luft- und Raumfahrtkonzern Messerschmitt-Bölkow-Blohm entwickelt.

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- Natural catastrophes, especially weather-related events, are increasing in number and magnitude. Loss potentials have reached new dimensions.
 - The findings of climate research are robust - global warming is real and most probably caused by anthropogenic emissions of greenhouse gases.
 - There is more and more scientific evidence for causal links between climate change and increasing frequencies and intensities of natural catastrophes.
 - We have to mitigate global warming and adapt to the changing risks in respect to the regionally specific risk patterns.
 - Mitigation and adaptation measures open up great economic chances for companies and countries being vanguards in these processes.
 - Munich Re is an initiator and driver of large mitigation (e.g. Desertec Industrial Initiative) and adaptation (e.g. MCII) projects.
 - Munich Re has created unique expertise on risks and opportunities of climate change and shares it with our clients, the industry, government authorities, NGOs, science and the UNFCCC community.