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

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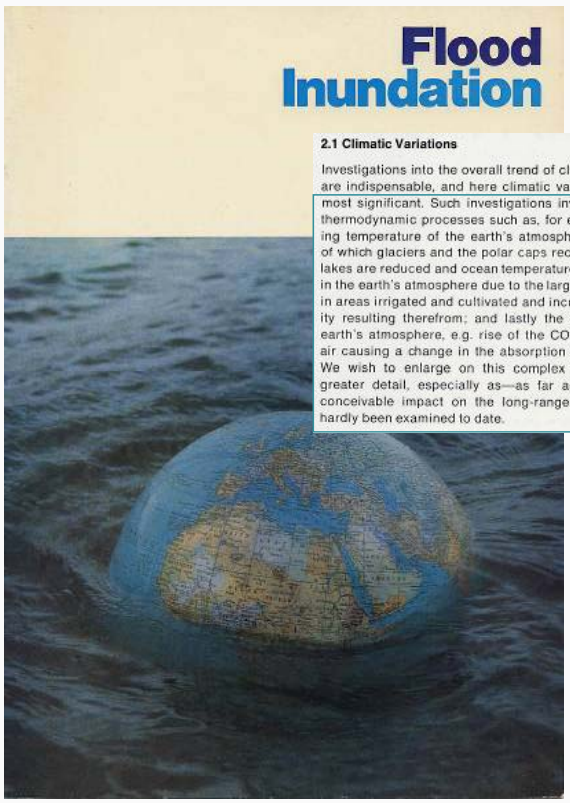
- Founded 1880
- Largest reinsurer
- Leading role in reinsurance of natural catastrophes
- 1973: Climate change identified as risk
- 1974: Foundation of Geo Risks Research Department
- 2007: Climate Change defined as one of two Strategic Topics for the whole Group

Munich Re the first alerter to global warming



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 earth's atmosphere, e.g. rise of the CO_2 content 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.

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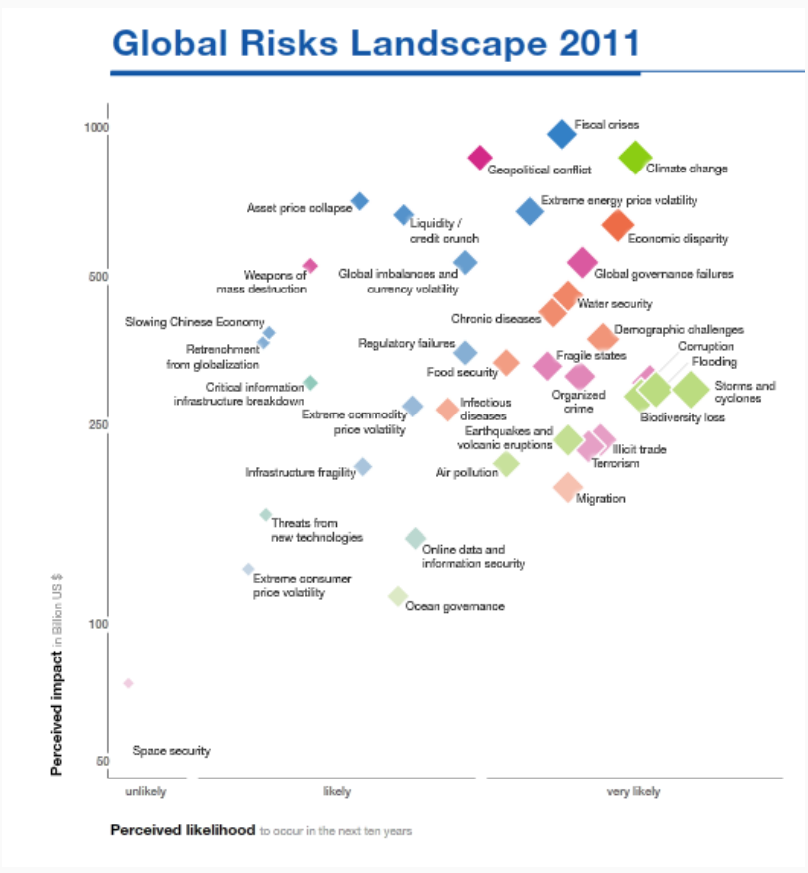
Munich Re Publication,1973

WORLD ECONOMIC FORUM

World Economic Forum 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

2010 one of the warmest years since 1880

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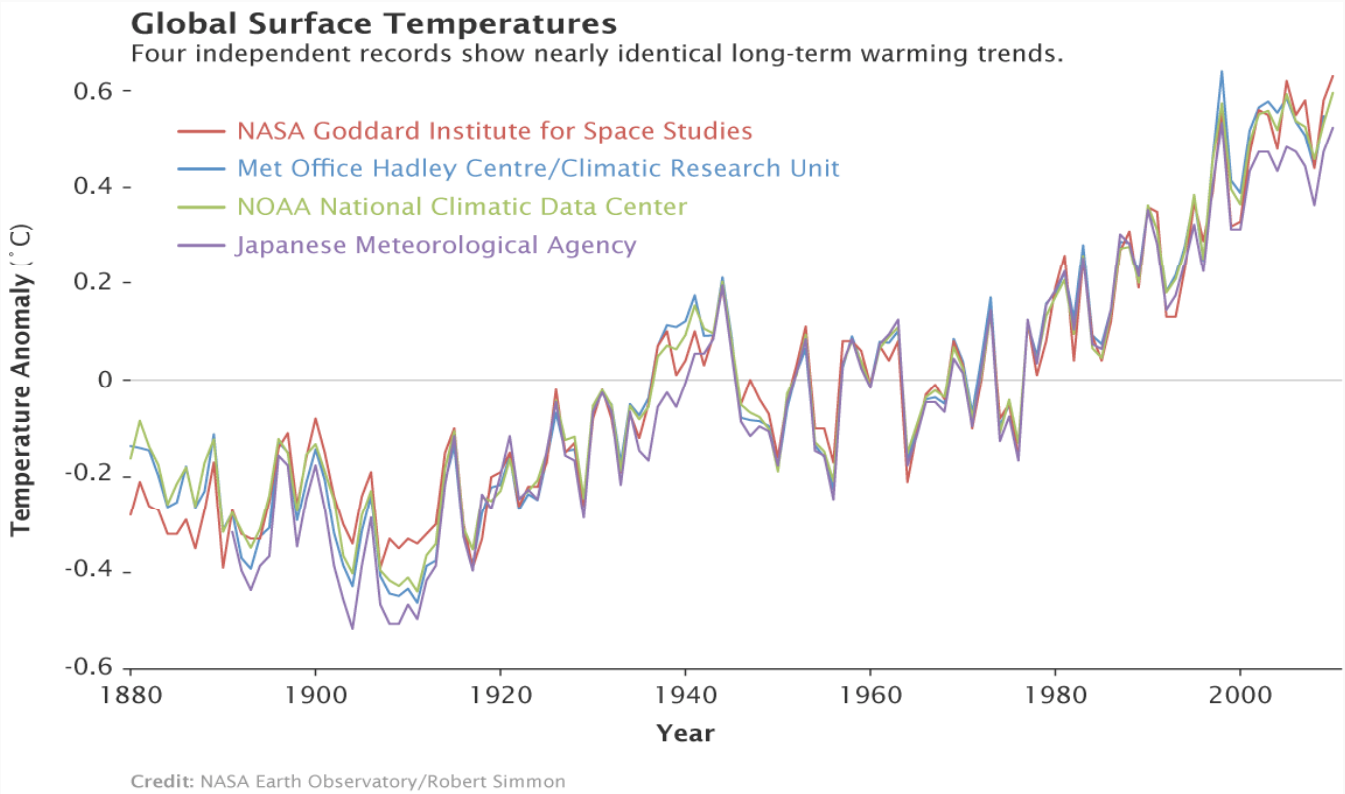

Observed changes in sea surface temperature in tropical ocean basins with TC activity

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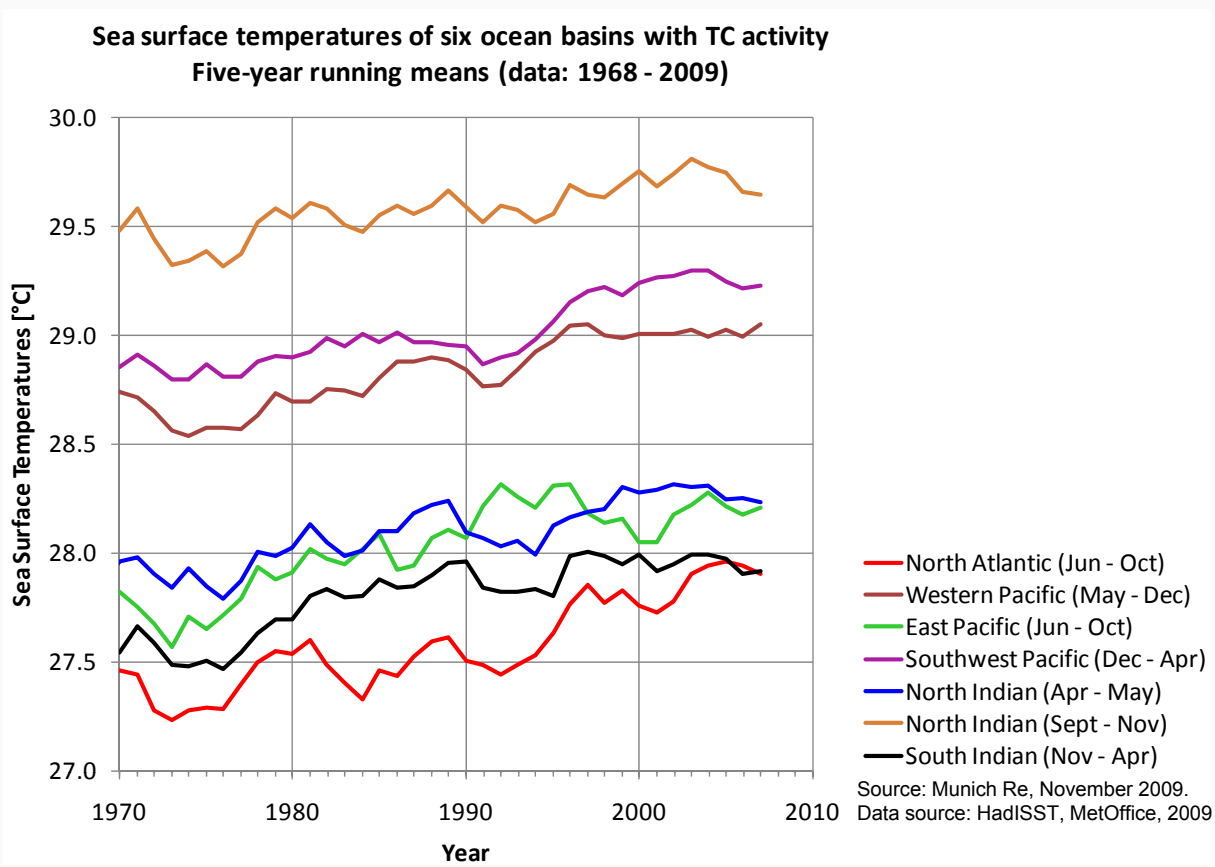

2010: A year of weather extremes

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- 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

Queensland floods – is there a link to climate change?

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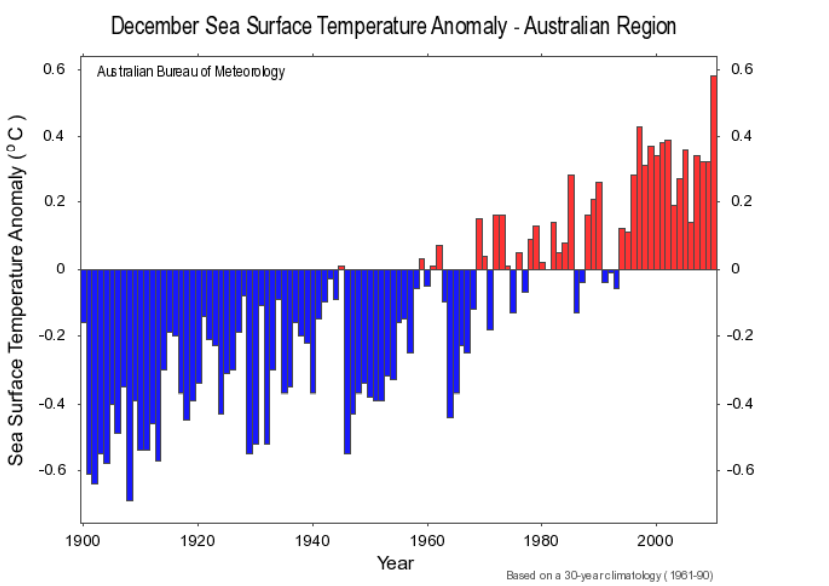

Source: Bureau of Meteorology (Australia)

- 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

Record Tornado Season in the US
April – May 2011

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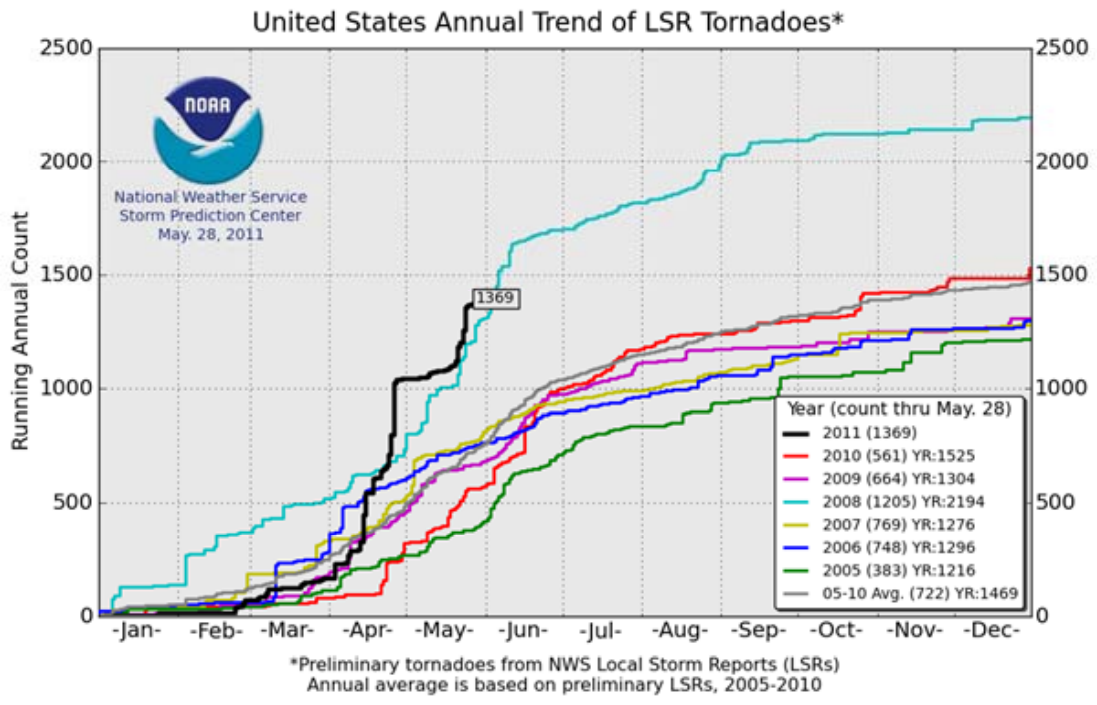

Region	Overall losses	Insured losses	Fatalities
Several States in the US (PCS Cat 44, 46, 48)	US$ >10,000m* * Loss estimation in progress	>US$ 7,000m* * Loss estimation in progress	566

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

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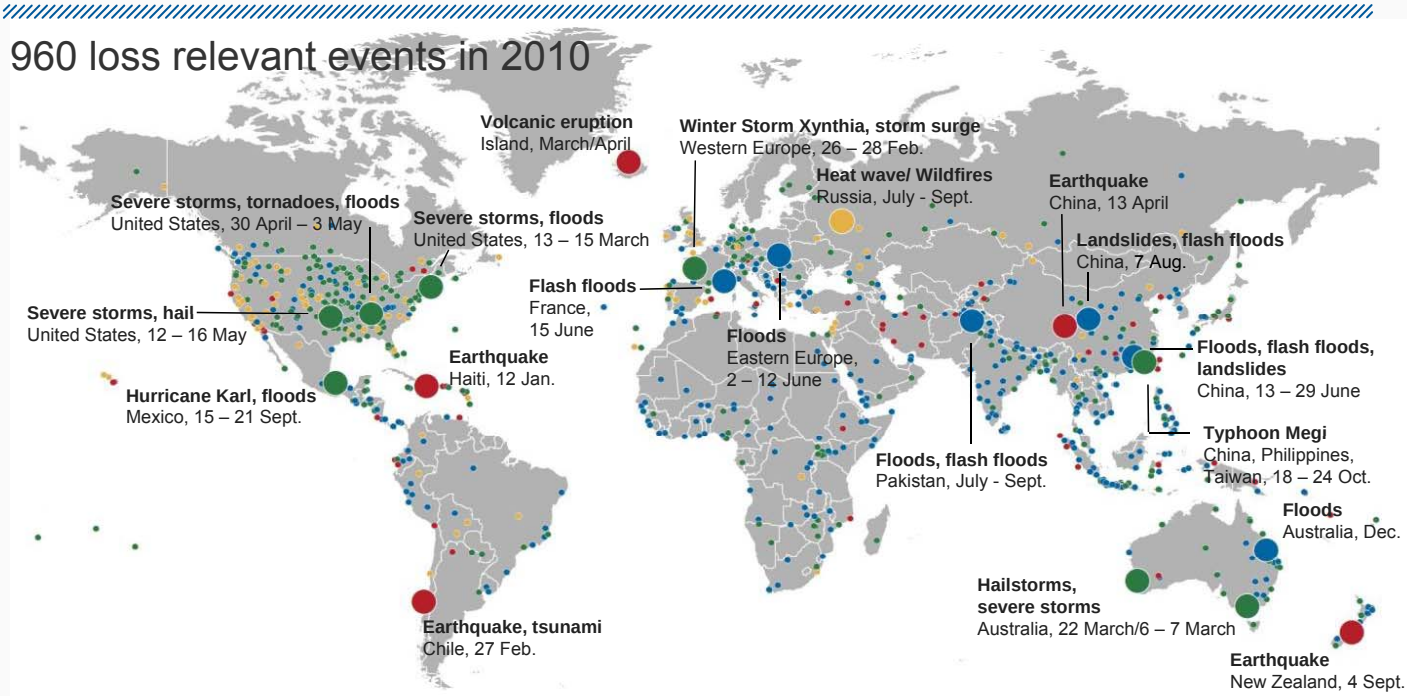
960 loss relevant events in 2010



- ○ **Natural catastrophes**
- ◯ **Selection of significant loss events (see table)**
- ● **Geophysical events** (earthquake, tsunami, volcanic activity)
- ● **Meteorological events** (storm)
- ● **Hydrological events** (flood, mass movement)
- ● **Climatological events** (extreme temperature, drought, wildfire)

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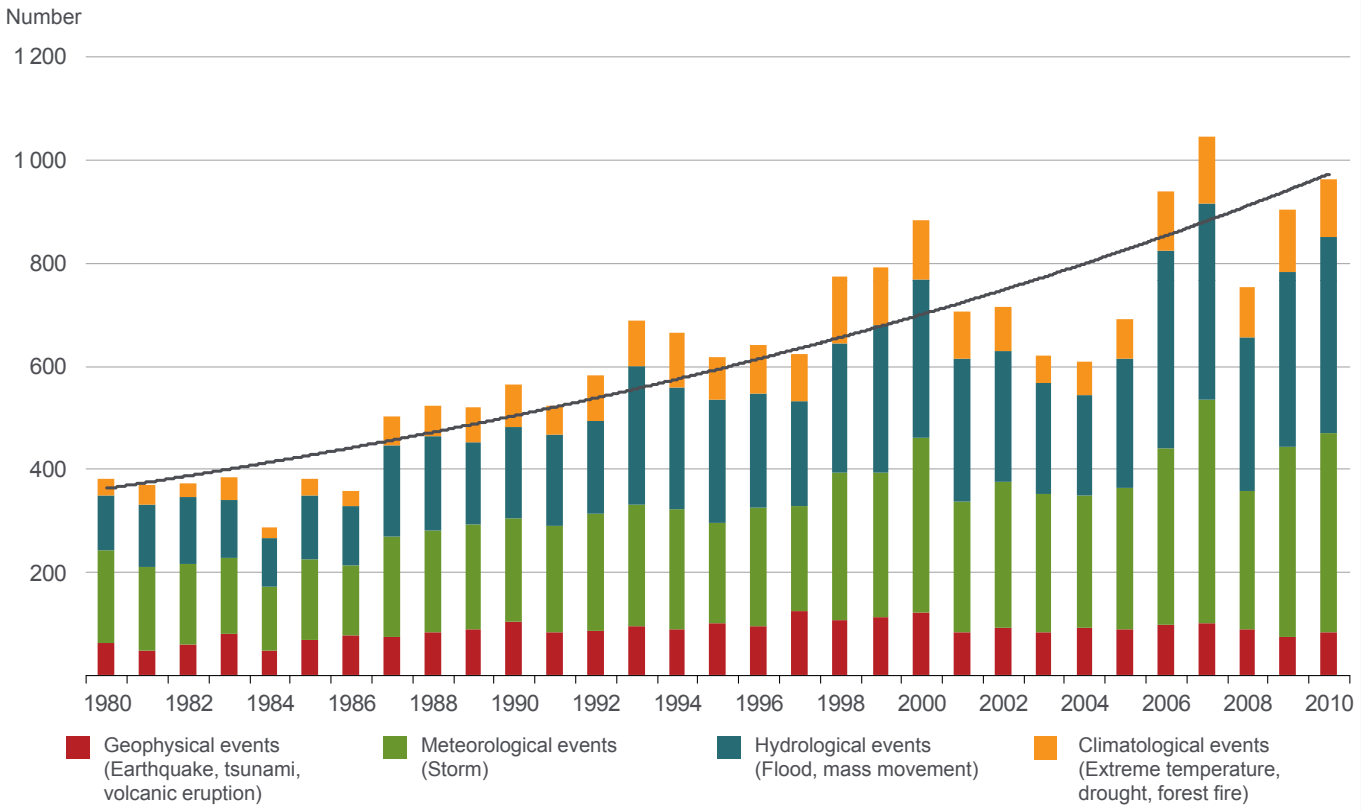
Natural catastrophes worldwide, 1980 – 2010

Number of events with trend



Source: Geo Risks Research, NatCatSERVICE

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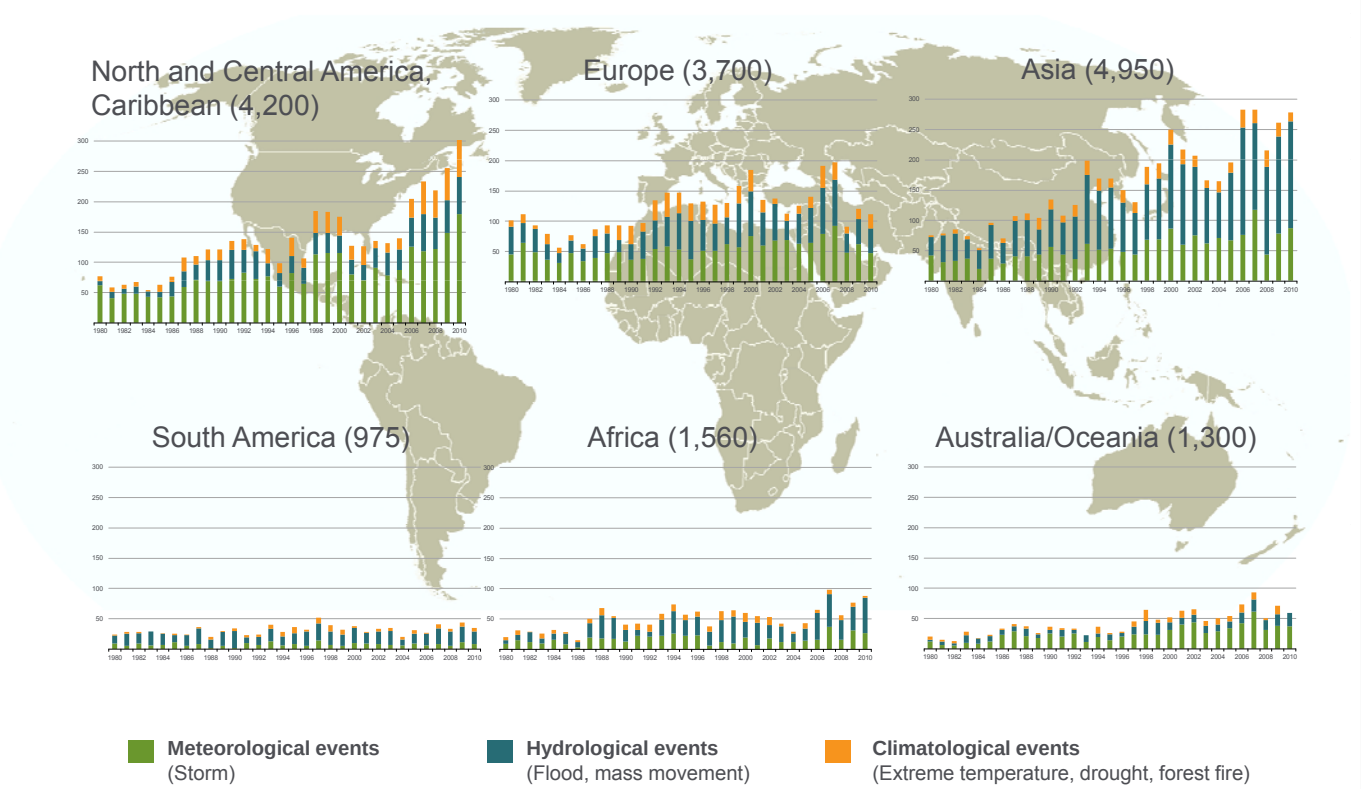
NatCatSERVICE

Weather catastrophes worldwide, 1980 – 2010

Number of weather-related events per continent



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Natural catastrophes worldwide, 1980 – 2010

Number of events by peril with trend

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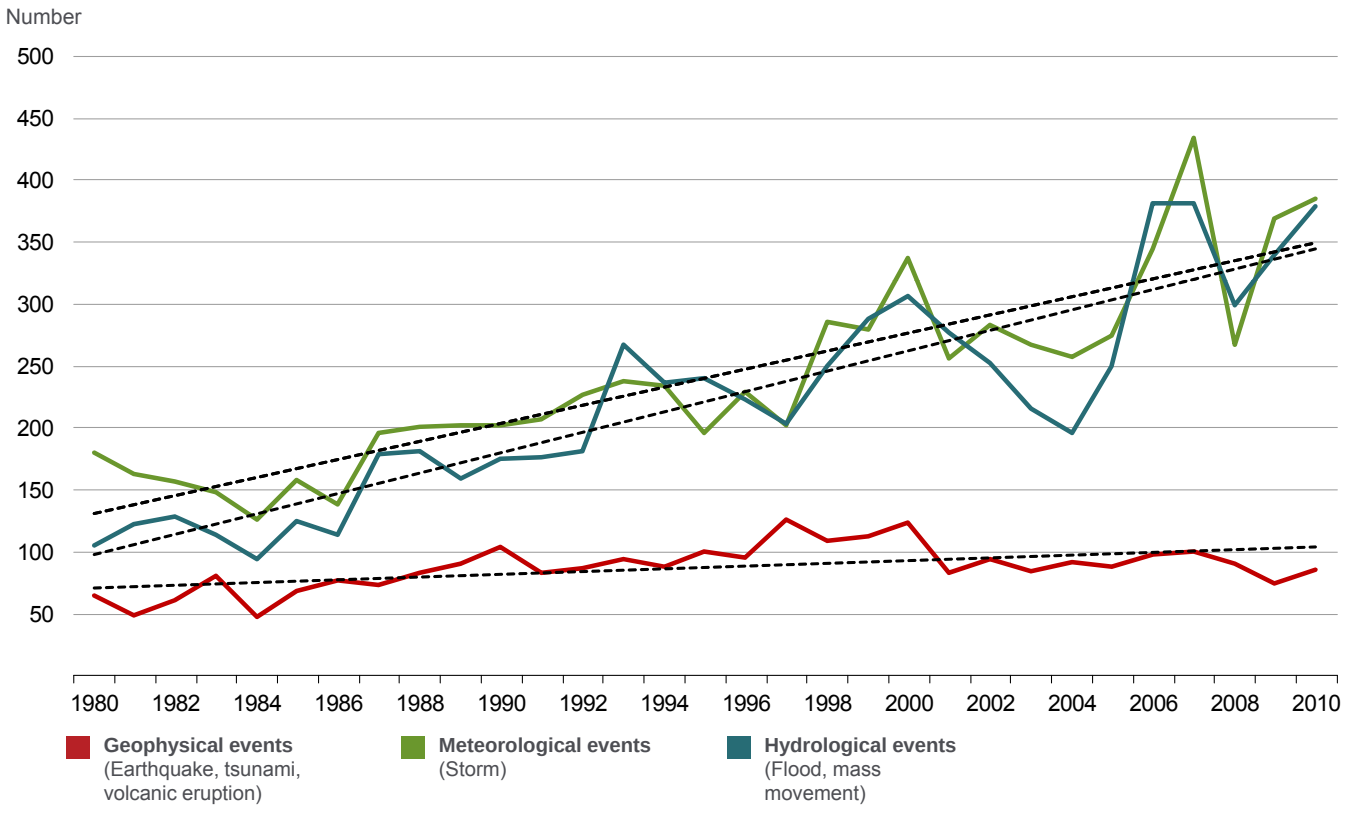

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Climate change and extreme weather events (IPCC, 2007)

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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	*Very likely*[c]	*Likely*[d]	*Virtually certain*[d]
Warmer and more frequent hot days and nights over most land areas	*Very likely*[e]	*Likely (nights)*[d]	*Virtually certain*[d]
Warm spells/heat waves. Frequency increases over most land areas	*Likely*	*More likely than not*[f]	*Very likely*
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	*Likely*	*More likely than not*[f]	*Very likely*
Area affected by droughts increases	*Likely* in many regions since 1970s	*More likely than not*	*Likely*
Intense tropical cyclone activity increases	*Likely* in some regions since 1970	*More likely than not*[f]	*Likely*
Increased incidence of extreme high sea level (excludes tsunamis)[g]	*Likely*	*More likely than not*[f,h]	*Likely*[i]

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

Global warming will intensify hurricanes

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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. Held[1]

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

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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 of nat cat losses

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- 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

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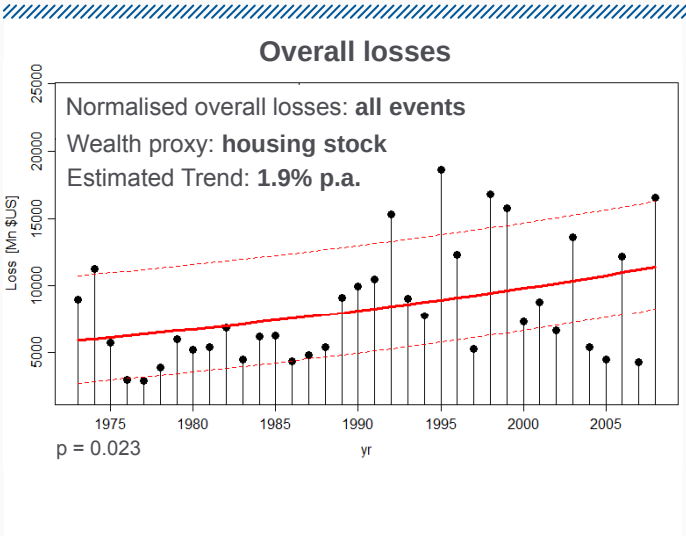
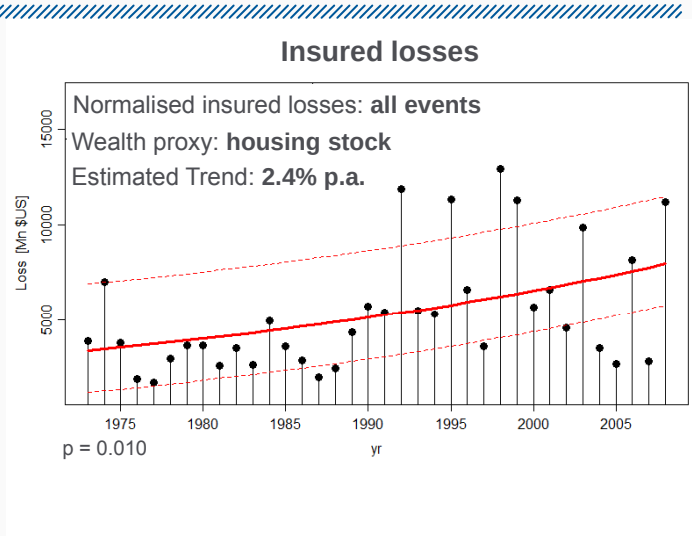
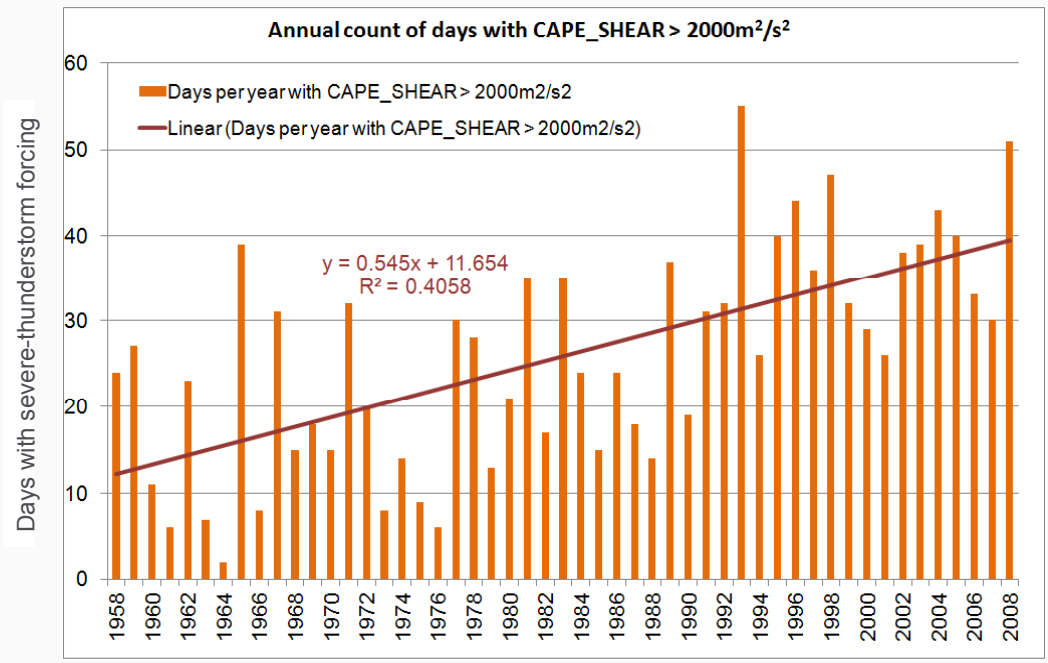




Meteorology: Observed changes in US severe thunderstorm parameters

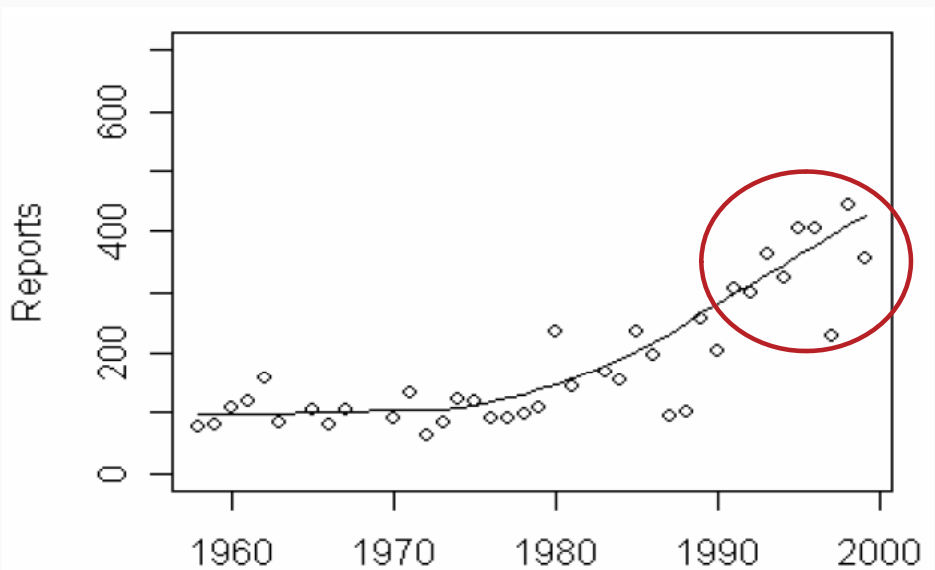


CAPE = Convective Available Potential Energy (f(atmospheric stability, humidity)
SHEAR = Change of wind direction and wind speed with height

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)



Source: Brooks & Dotzek (2008)

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

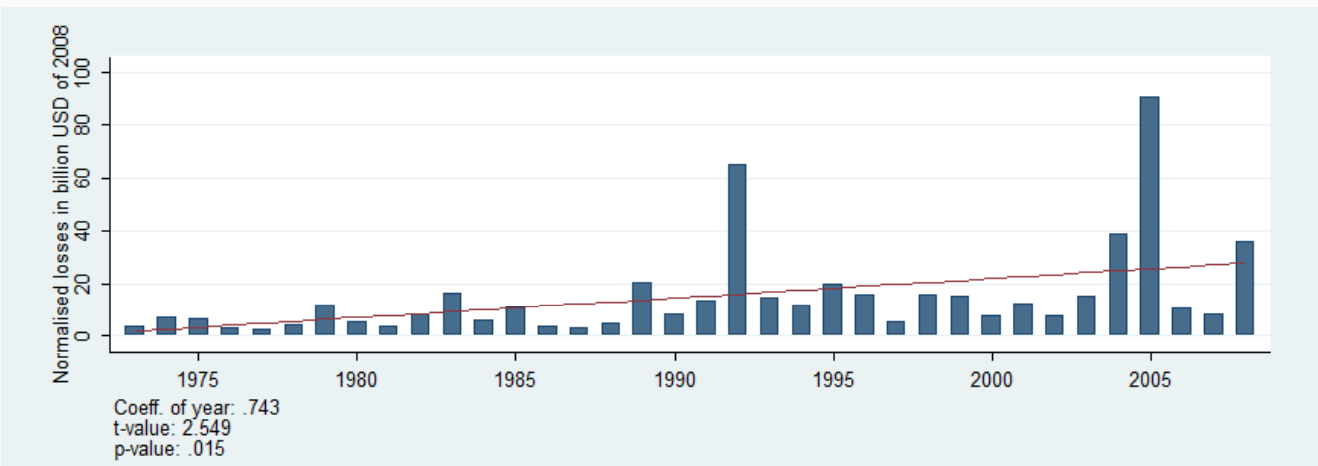
First study of this kind!

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

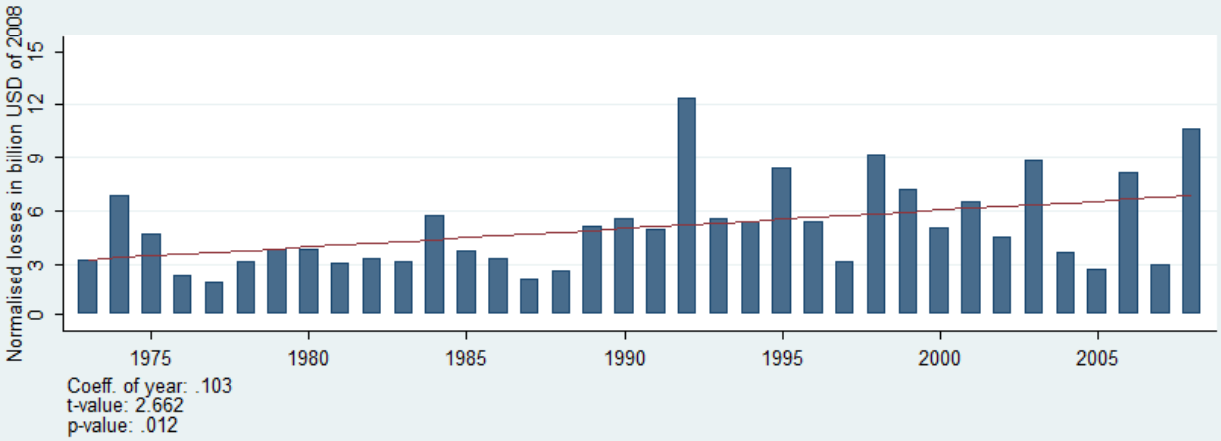
Normalisation by insurance premiums

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

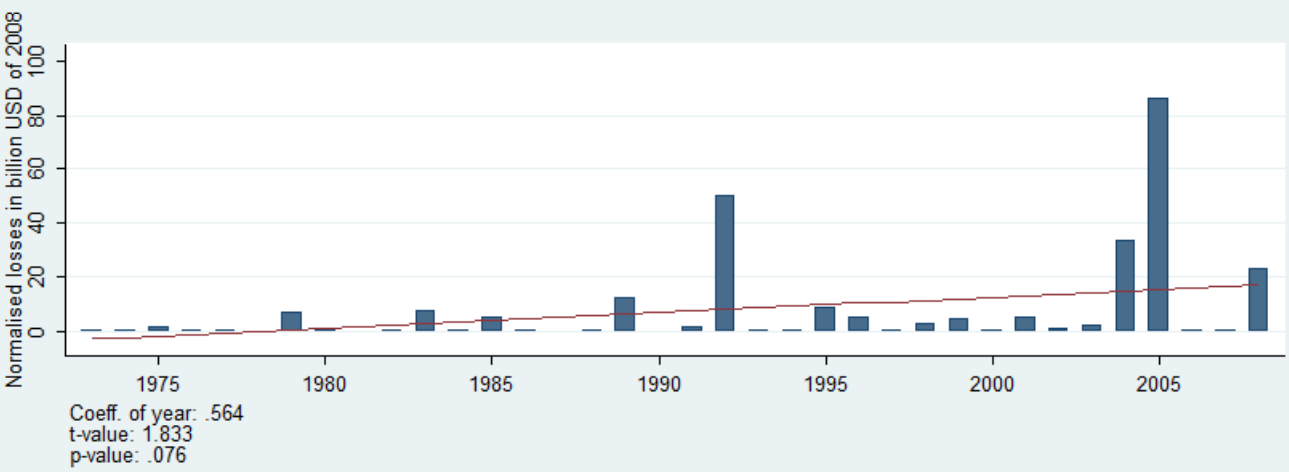
Normalised insured losses of non-geophysical disasters in the U.S.



Normalised insured losses from convective events in the United States



Normalised insured losses from hurricanes in the United States



GDV-Study 2011: „Challenge Climate Change“
Storm and Hail

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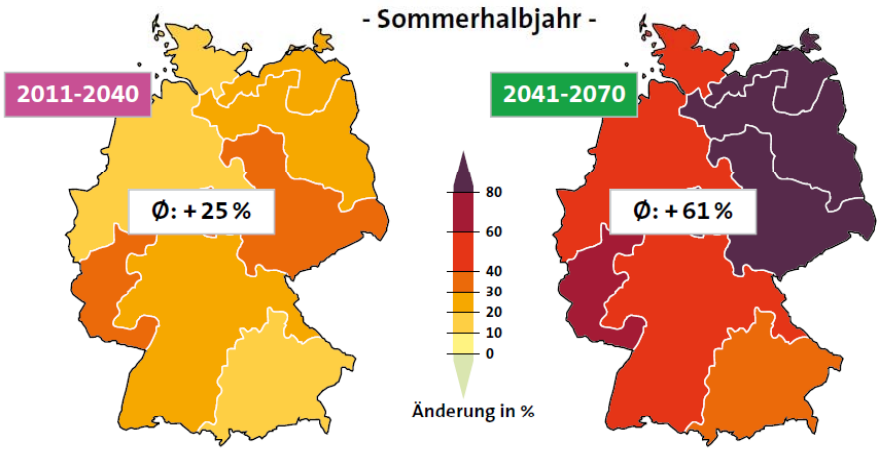
Mean annual loss ratio 1984-2008 in comparison to different future time slices



→ 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

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Risk assessment

- Research of natural hazards and climate change impacts
- Climate liability issues
- Prospective risk management (considering weather oscillations such as El Niño)

Business opportunities

- Growing demand for risk transfer solutions such as renewable energy covers
- performance covers for solar modules

Asset management

- 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

New Munich Re risk cover for renewable energies
CPV cover

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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

New Munich Re cover for wind power plants

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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.

The DESERTEC concept

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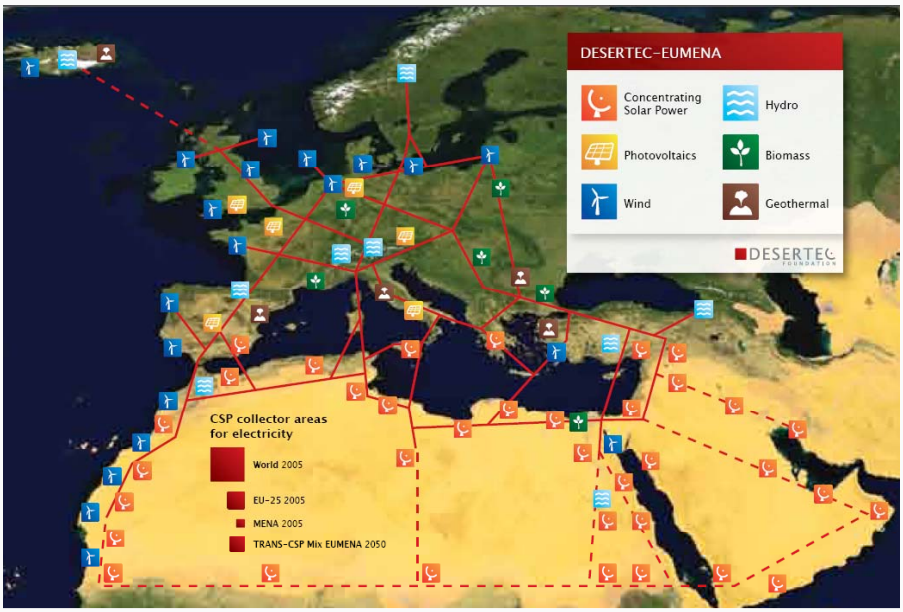
Origin and Vision



- 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

Munich RE

07/13/09

- **Joint signature for a memorandum of understanding** by 12 companies and the DESERTEC Foundation for the formation of the Dii GmbH

ABB · ABENGOA SOLAR · ceVital · Deutsche Bank · DESERTEC · e·on · HSH NORDBANK · FLAGSOL · Munich RE · m·w zander · RWE · SCHOTT solar · SIEMENS

10/30/09

- **Legal foundation of the planning company**
- **Appointment of** Paul van Son as **CEO**

Dii
Renewable energy bridging continents

03/10/10

- **Appointment of** Prof. Klaus Töpfer as **special envoy**

10/31/12

- Development of an **implementable roadmap to „green energy generation"** in the deserts of North Africa and the Middle East

2020

- **20GW installed capacity** (according to political goal of MSP)

2050

- **100GW installed capacity** (referring to the 15% aim of the Dii concept)

Objectives of Munich Re as initiator of the Dii GmbH

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CLIMATE PROTECTION	Essential contribution to the solution of one of humankind‘s largest problems in this century (global warming) by significant reductions of CO_2 emissions
BUSINESS POTENTIALS	Leading role in developing and providing new risk transfer products for renewable energies/new technologies
INVESTMENTS	New (direct) investment opportunities

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

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Das Titelbild zeigt eine Sonnen- oder Solarfarm, wie sie für Afrika und die südlichen Gegenden Europas konzipiert wird. Mehrere zusammengeschaltete 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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Conclusions

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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.