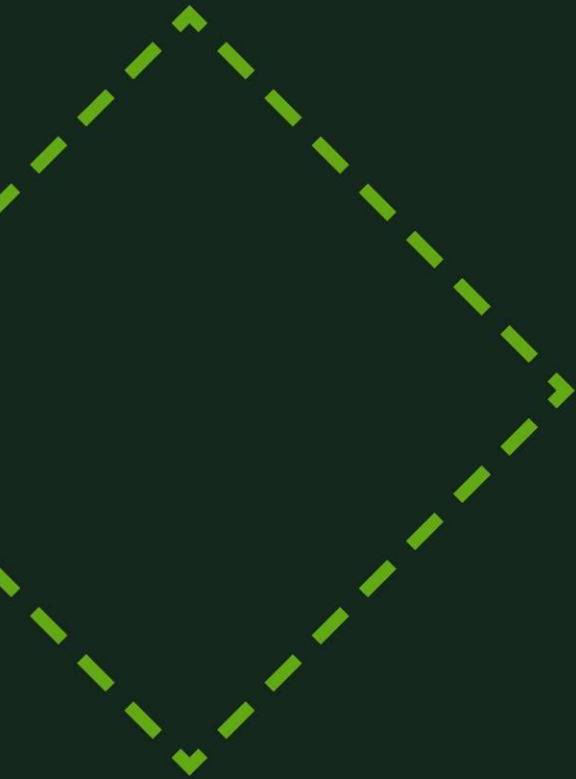


Munich Re Foundation

**Climate change effects
Costs and options**



Leader Maghreb
Casablanca, 17 May 2010

**Munich Re
Foundation**

From Knowledge
to Action

Sustainability and Business in Germany

A little history

1970s Increasing environmental damage and awareness

1980s Concept of sustainability developed

1990s Sustainability a signal of responsibility
“Nice to have”

2000+ Regulatory framework develops
“Must have”

2005+ Sustainability creates business opportunities

Modern perspective

Sustainable managers are better risk managers

They tend to see risk and opportunity potentials earlier

Contents

Data

losses and cost estimations

Scientific aspects

climate change effects

Insurance aspects

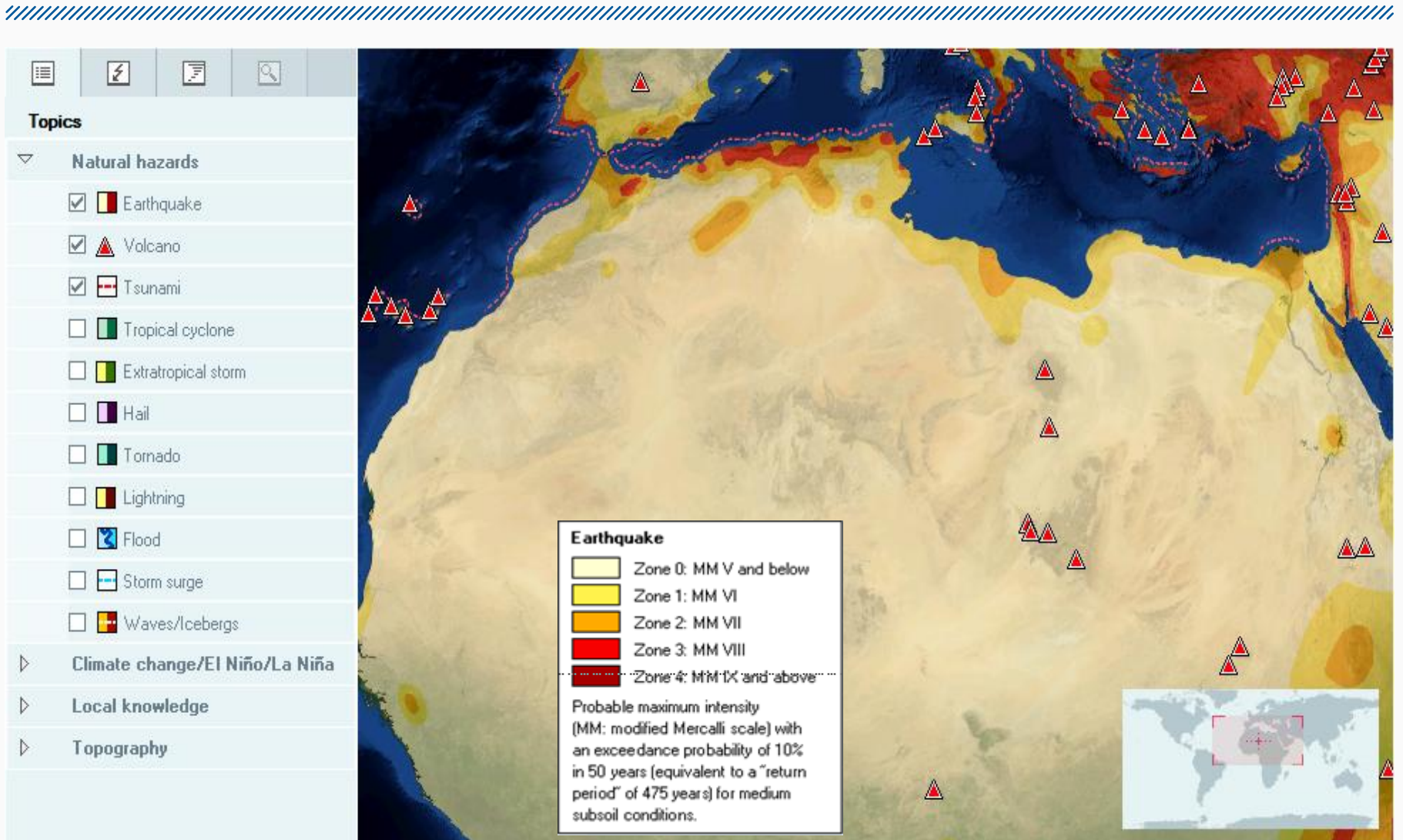
Microinsurance

Energy and Sustainability

Desertec project



Earthquake and tsunami risk mainly in the Mediterranean region



From Knowledge
to Action

Data and Cost Estimations

Global Cost of Climate Change

Famous estimations and reports

1980s/1990s: S. Fankhauser & R. Tol

Expected annual cost of all climate change effects: ca. \$300bn

Source: CSERGE GEC Working Paper 92-29 in London 11/93.

R.S.J.Tol (1995): The Damage Costs of Climate Change: Toward More Comprehensive Calculations. *Env. and Resource Economics*, 5, 353-374.

2000: Andrew Dlugolecki, UK

The current rate of growth of damage of 10 percent a year will exceed global gross domestic product by 2065

Source: COP 6, The Hague, UNEP Press conference

2006: Sir Nicholas Stern (UK, ex World Bank)

(integrated assessment model, macro economic models)

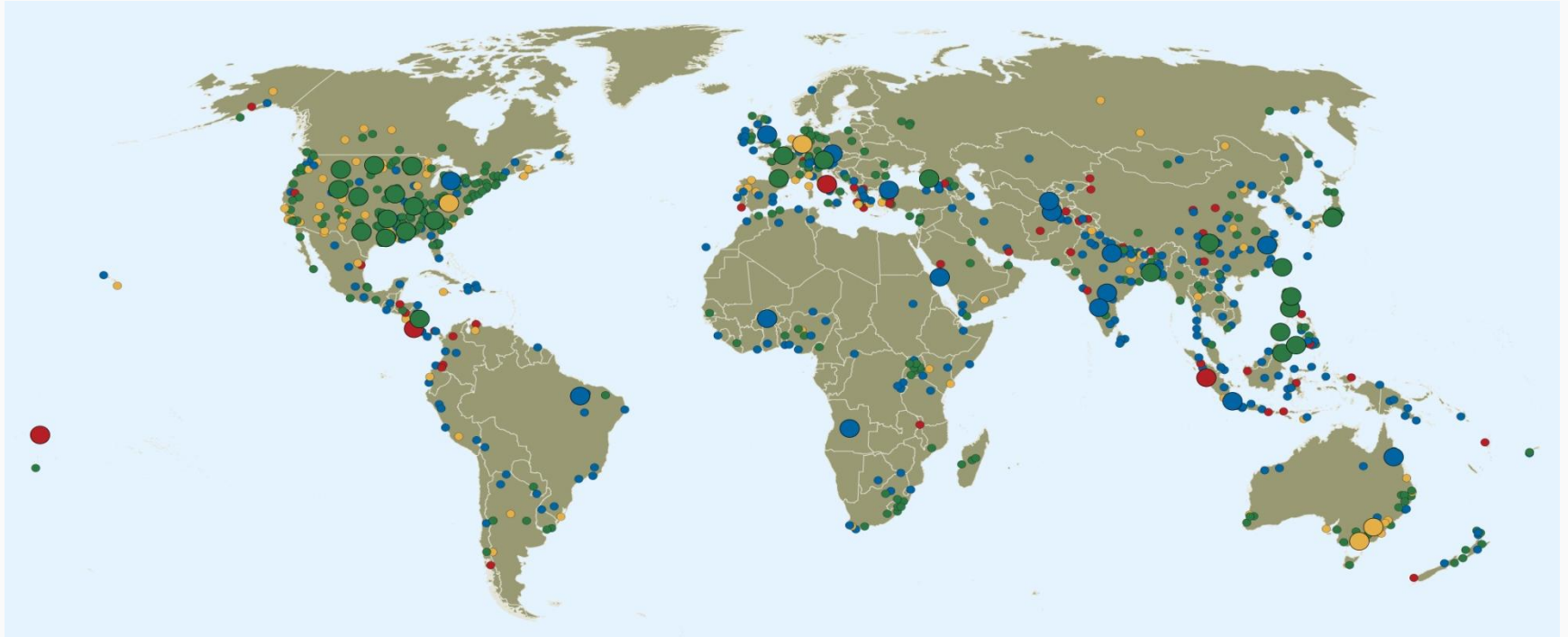
By 2050 approx. 5% of global BIP

- weather disasters 0.5-1 %
- „non-market impacts“ (environment, health) up to 20% BIP

Source: STERN REVIEW: The Economics of Climate Change, October 2006

Natural catastrophes 2009

Worldmap



2009: 850 natural catastrophes

○ Significant natural catastrophes (selection)

Great natural catastrophes:
2009 no event met the requirement "Great natural catastrophe"

- Geophysical events
(Earthquakes, tsunami, volcanic eruption)
- Meteorological events
(Storm)
- Hydrological events
(Flood, mass movement)
- Climatological events
(Extreme temperature, drought, forest fire)

Natural Disasters in Morocco since 2000*

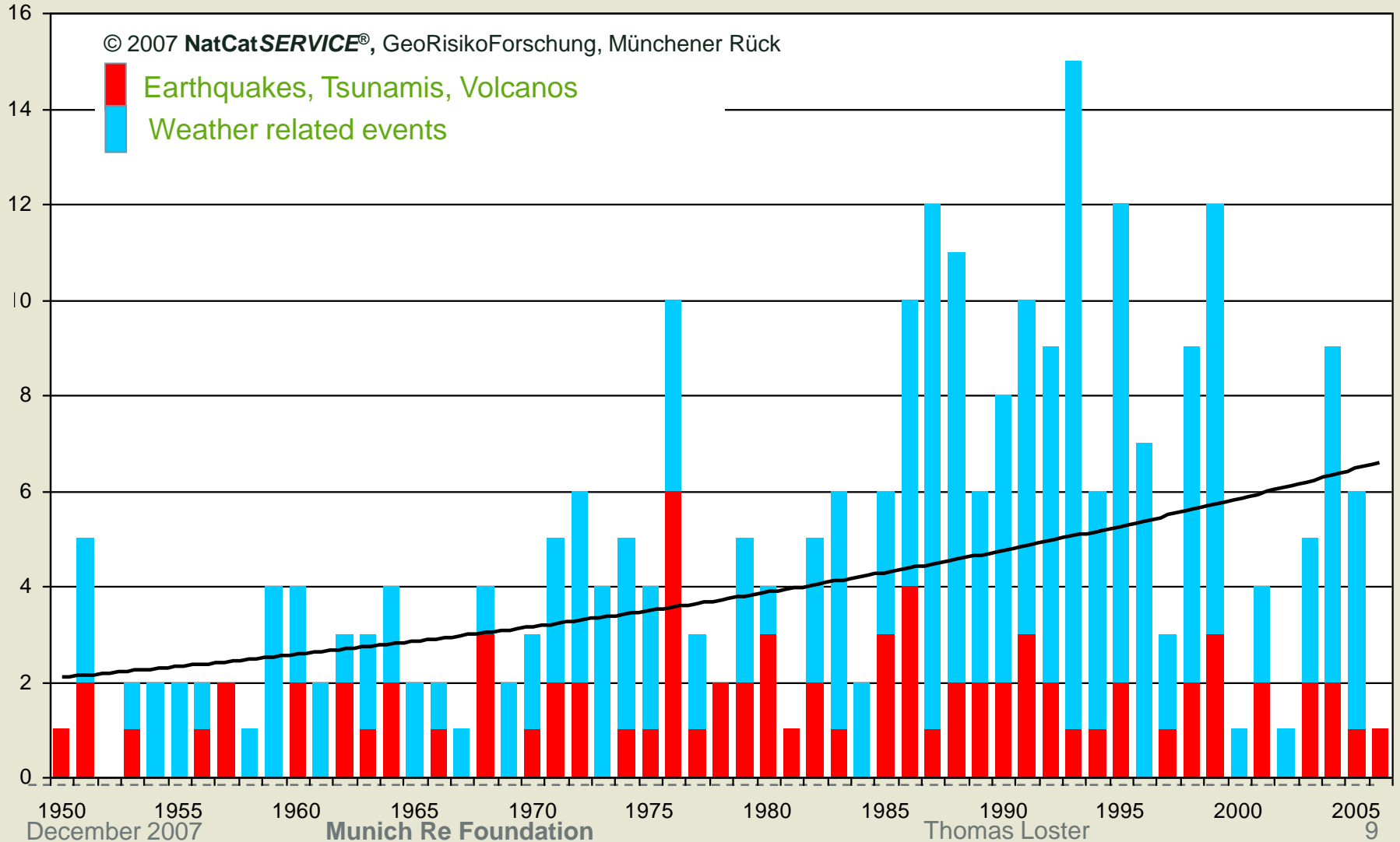
Major loss events since 2000

Period	Event	Affected Area	Losses (in USDm)		Fatalities
			Overall losses	Insured Losses	
24.-26.2.2004	Earthquakes	N, Al Hoceima, Ait Kamara	400	0	640
17.-25.11.2002	Floods, Flash Floods	W, NW, E, Mohammedia, Gharb, Berrechid, Khourigba, Fez, Bengueribi, Settati, Atlantic coast	200	140	63
17.-27.11.2003	Floods, Flash Floods	N, NE, Nador, Al Hoceima	0	0	35
7.-8.2.2009	Floods	NW, C, Gharb	0	0	24
23.-28.12.2001	Floods	C, Settati, Essaouira	2	0	15
20.-27.12.2000	Floods	N, Tetouan, Tangiers	1	0	—
17.-20.10.2008	Flash floods, severe storms	C, S, Oujda, Essaouira, Taza, Al Houaz, Azilal, Chichaoua, Errachidia, Zagora	0	0	7

* Excluding heat waves and droughts; © Munich Re, Geo Risks Research, NatCatSERVICE, May 2010

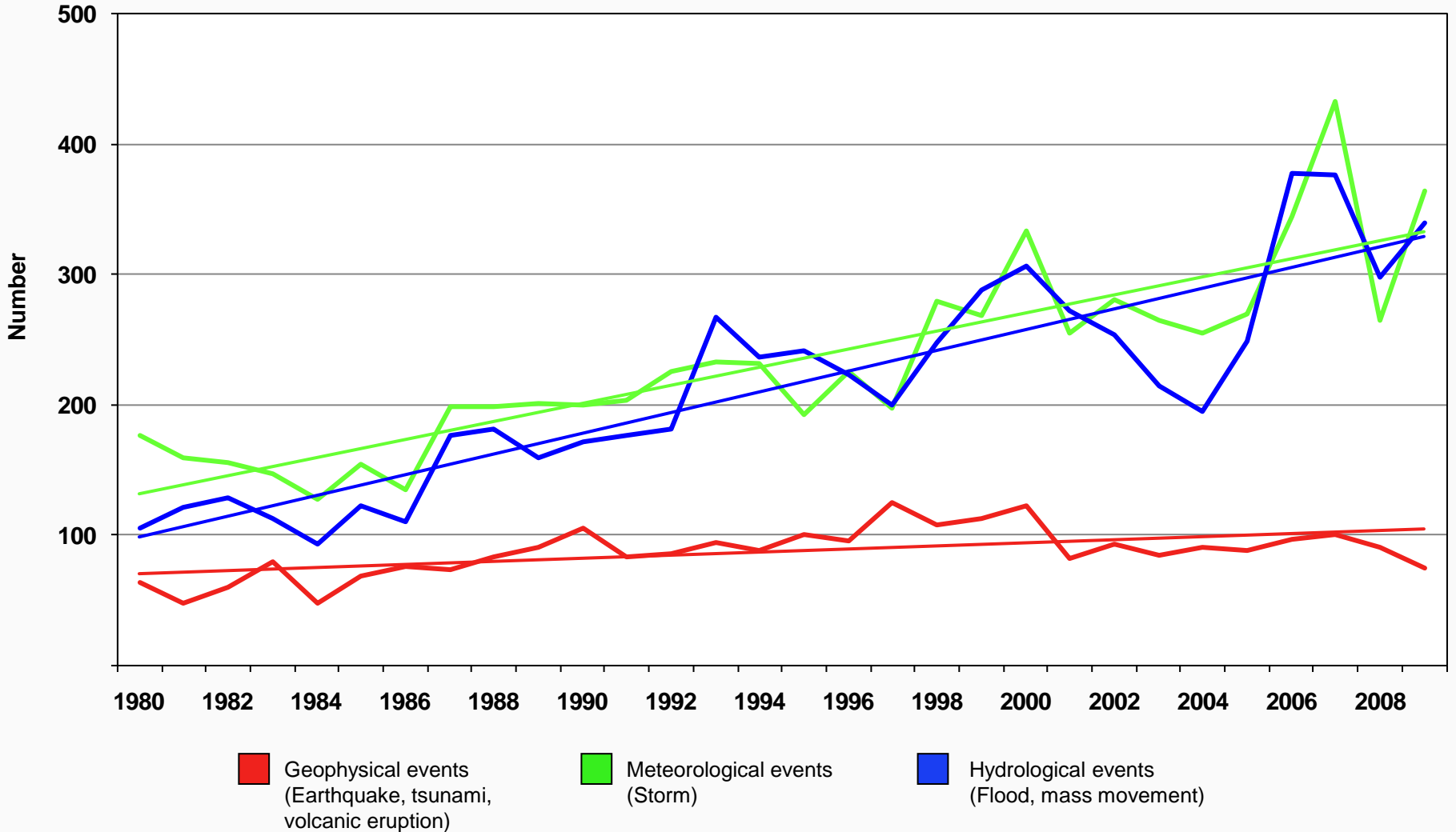
Great Natural Disasters 1950 – 2006

Number of events

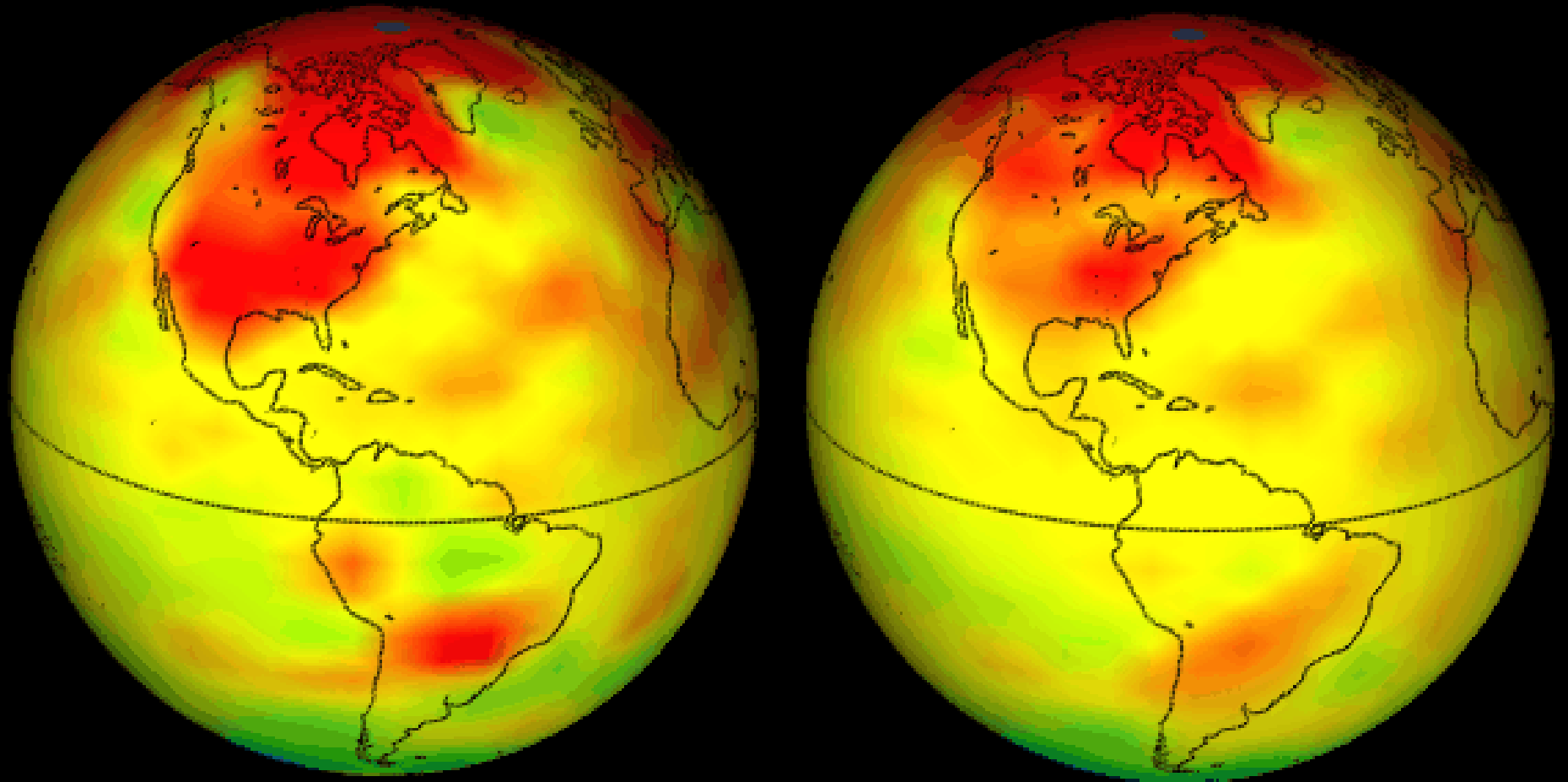


Global natural catastrophes 1980 – 2009

Trend of events (catastrophe class 1-6)



Klimamodelle



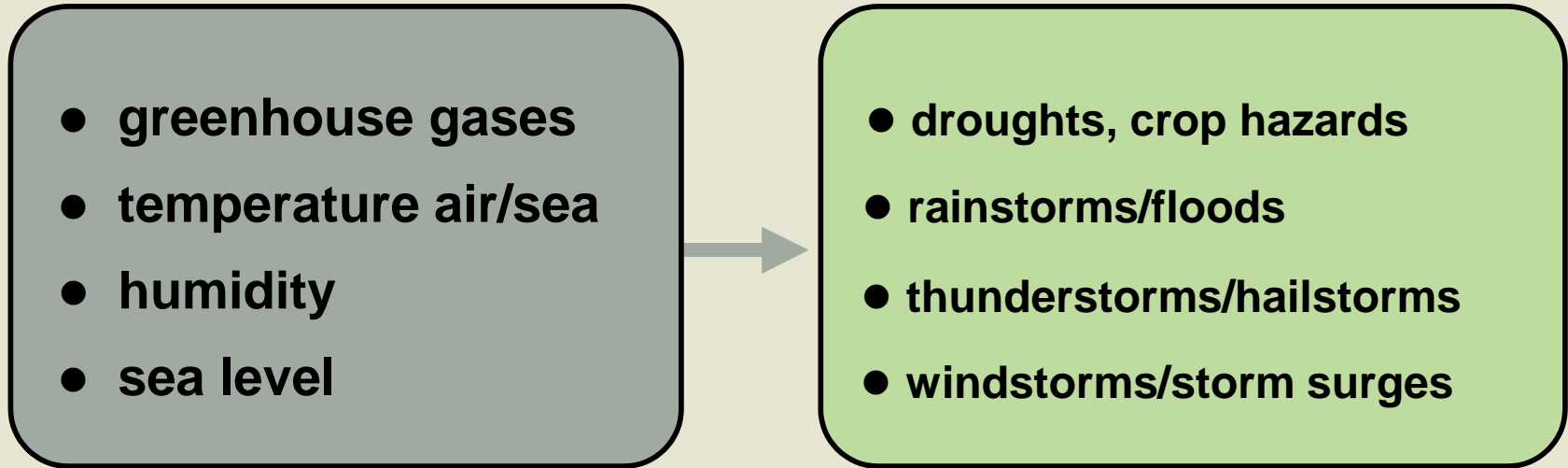
From Knowledge
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Climate Change Science

Climate Change Causal Chain

Causes and Effects

Increase in



Important

● **extreme events**

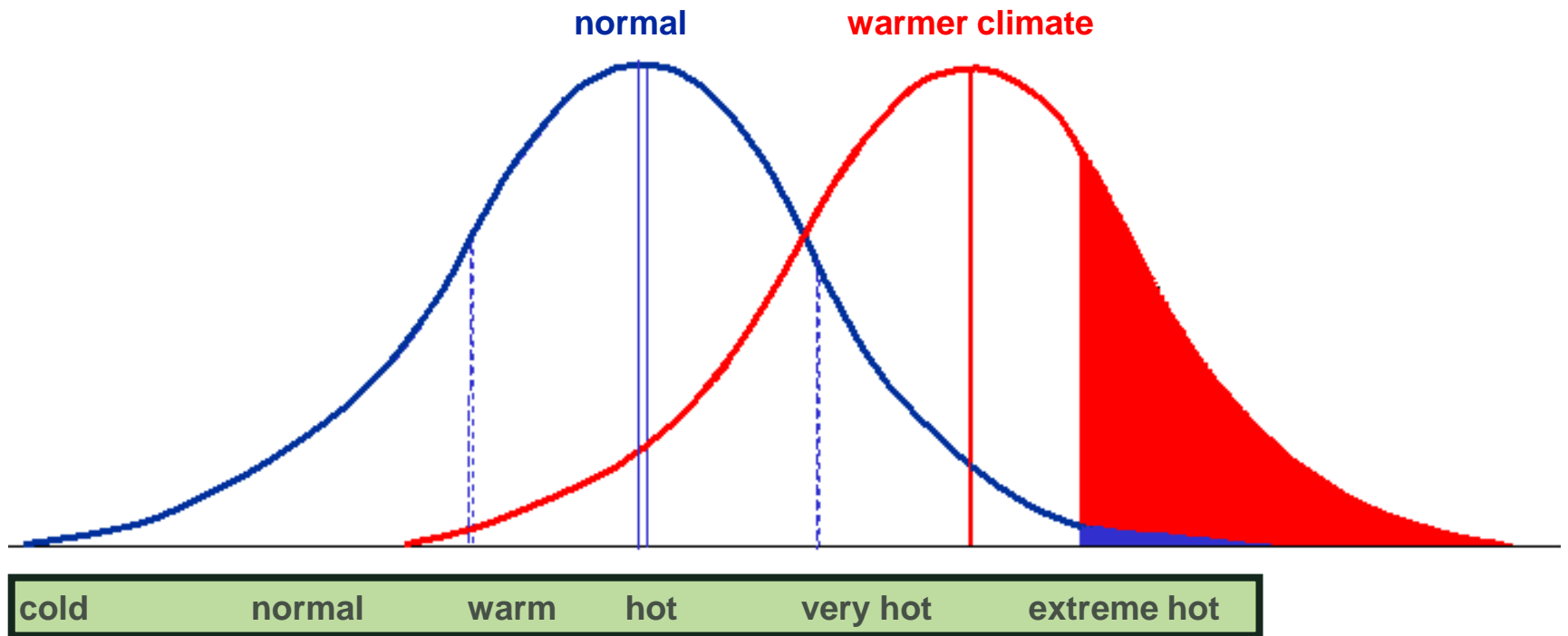


● **extreme losses**

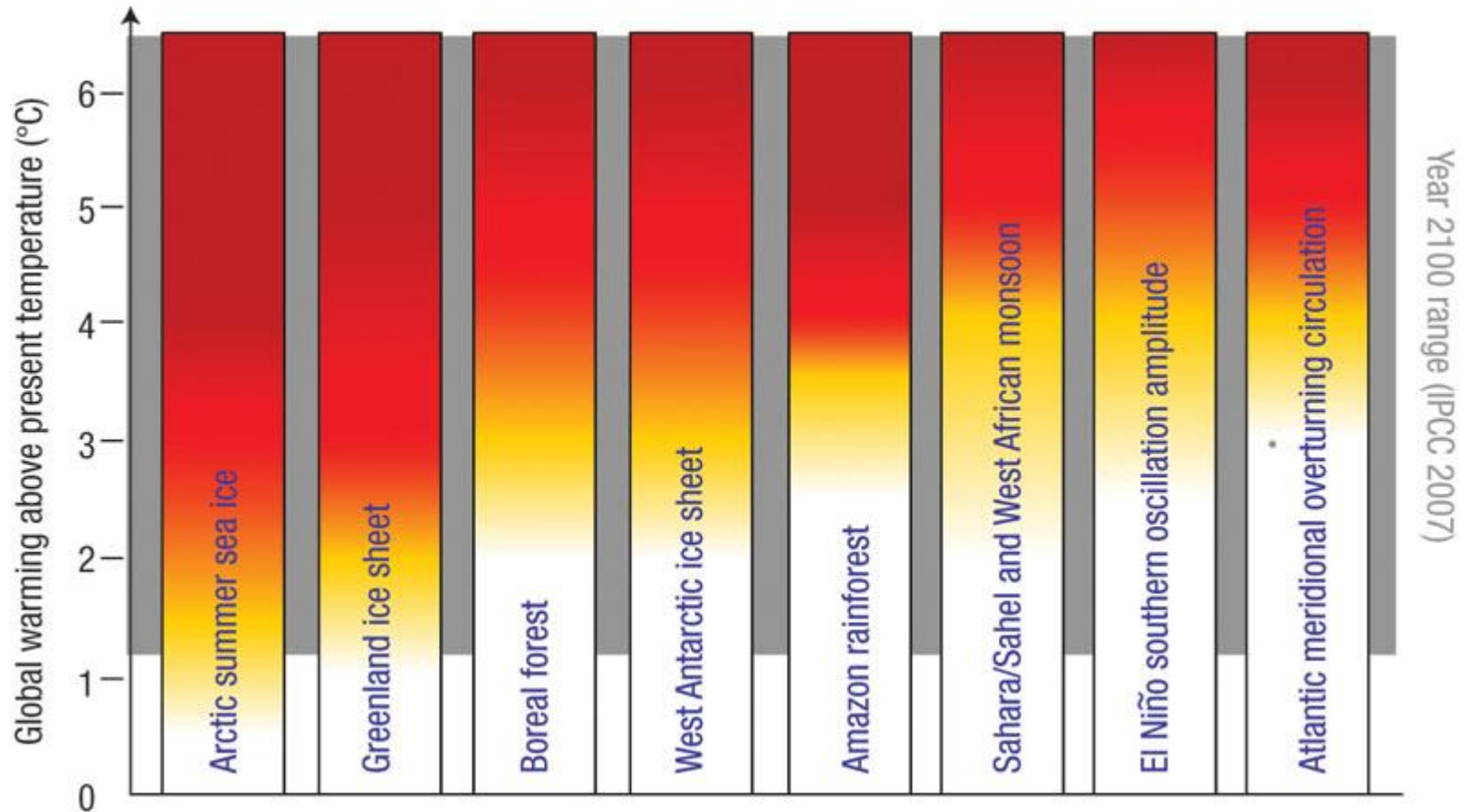
Increasing Probabilities of Extremes

Little changes in average values can have tremendous effects

Example: Heat



Climate Change Tipping Points



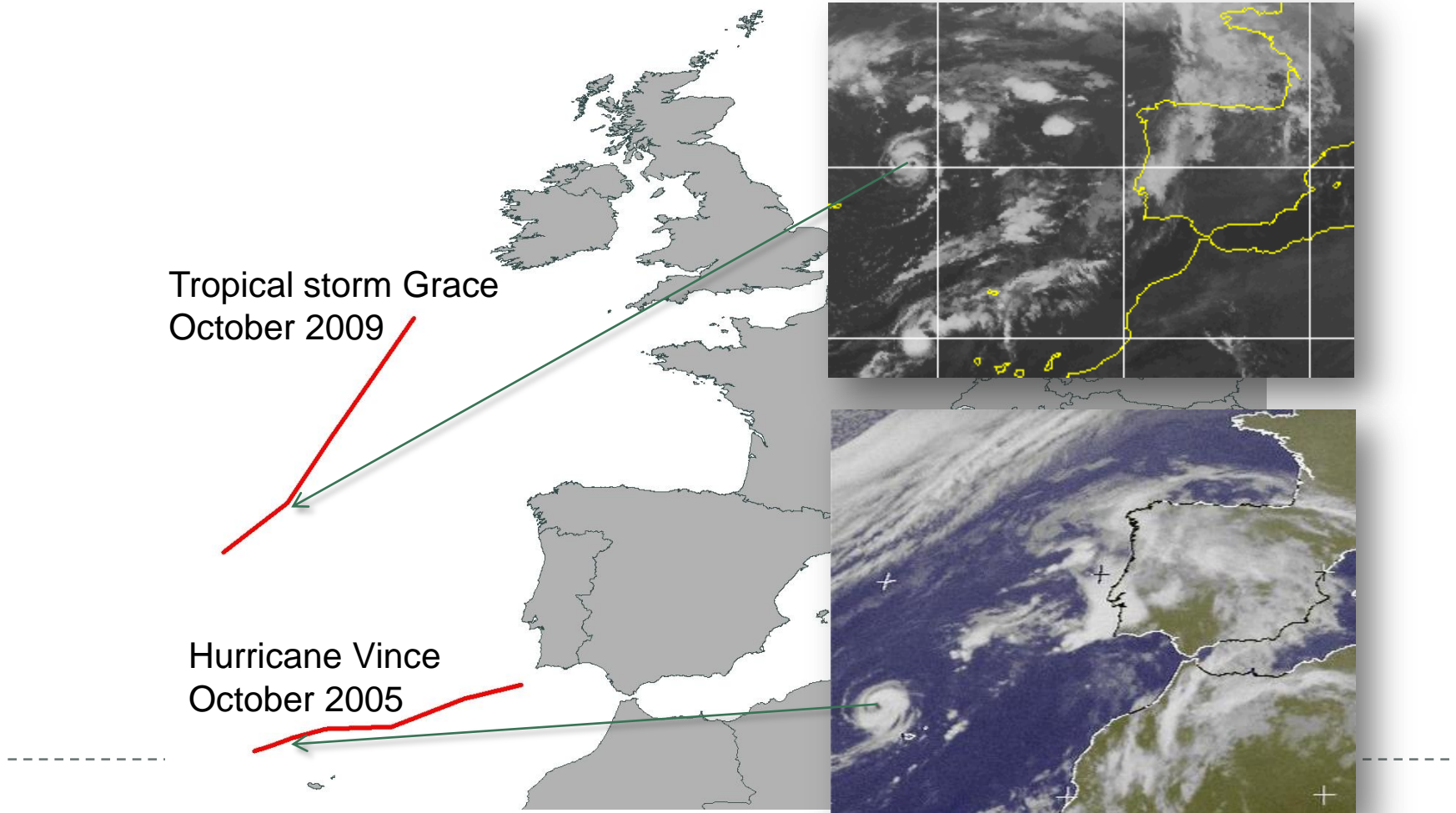
Level of global warming and probability of reaching different tipping points

Source: Lenton, T., Schellnhuber, H.J. (2007, Nature)

Tropical cyclones extend their impact areas

Tracks of tropical cyclones close to us (2005, 2009)

Most northern and most eastern events in history



Morocco in Climate Change Models

Aggravation of the current situation – a summary

Studies by MPAM, World Bank, INRA, FAO, DMN (2008), reports of GTZ, other reports (models 10x10 km grid):

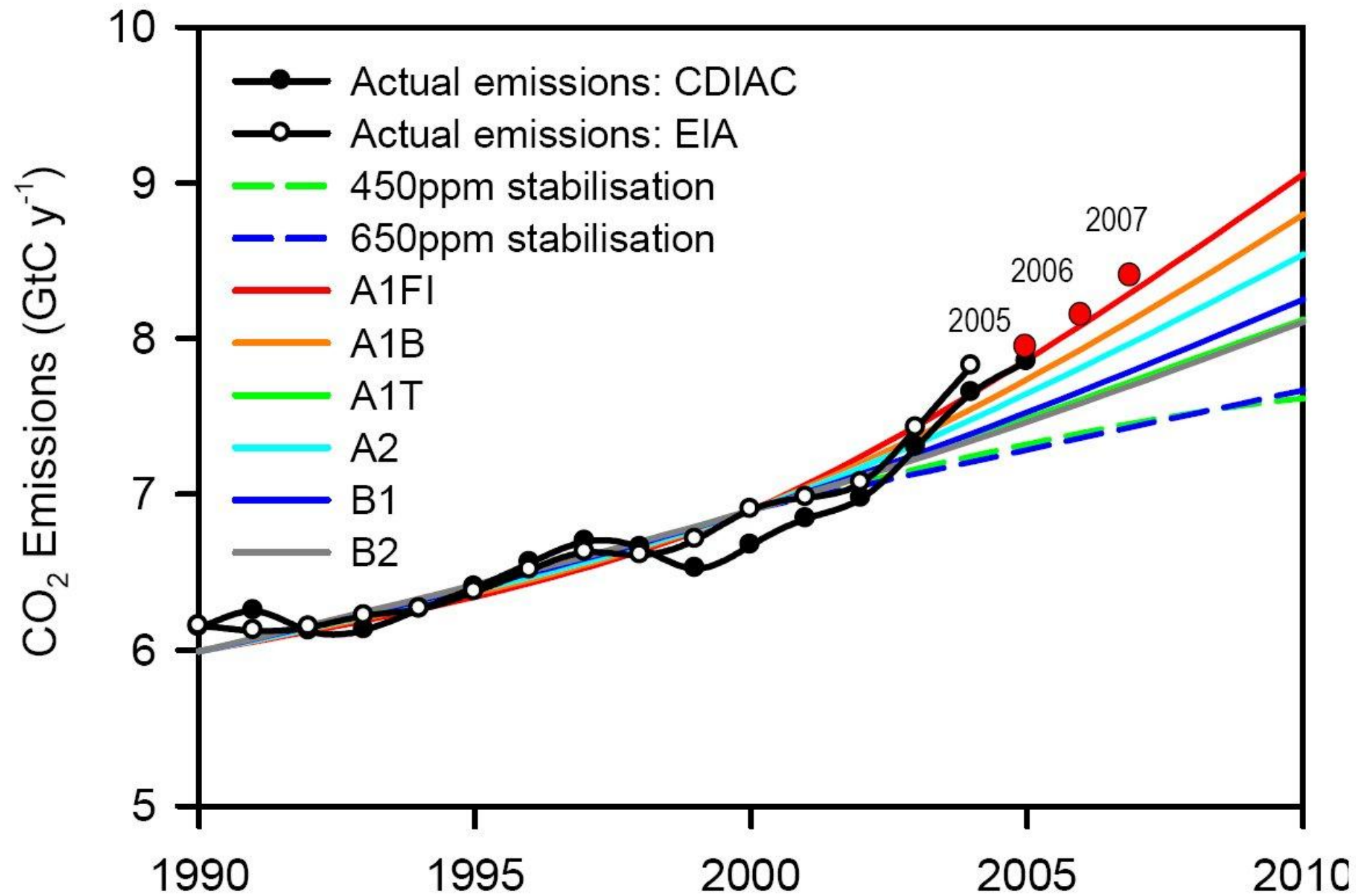
Physics

- temperature increase +3°C until 2080 (+5°C east, mountains)
- less rainfall (-20% until 2050, -40% until 2080)
- decrease of rain felt in spring and autumn
- more pronounced rain, increase in evapotranspiration
- biggest impact in the south and east
- salt intrusion in coastal areas (Sea Level Rise)

Effects

- higher impact on small and medium farming (>3ha, >15ha)
- social pressure (small farmers, nomads, other competition)
- increasing imports, higher prices for vegetables and fruit

Source: WB/Morocco/FAO climate Change Study 2008, GTZ 2008, Froehlich/Houdret 2008, Estimations by Rousset/Arrus 2006, STERN REVIEW: The Economics of Climate Change, October 2006, others 2007



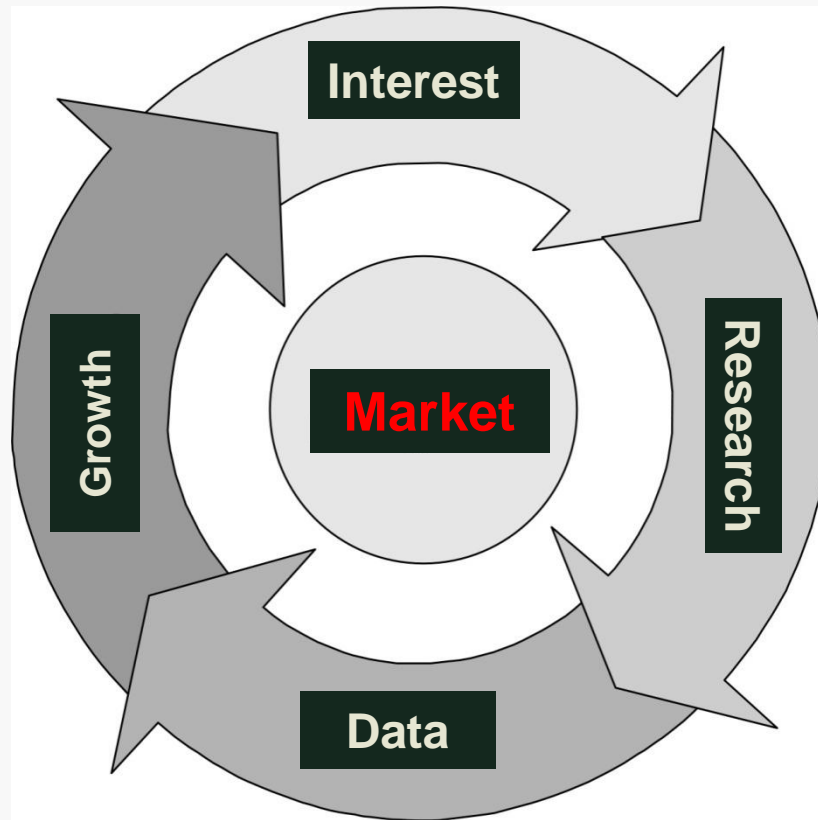
From Knowledge
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Insurance in the rich and the poor world

The wheel of insurance

Insurance Markets

Tools and Data – interest is crucial

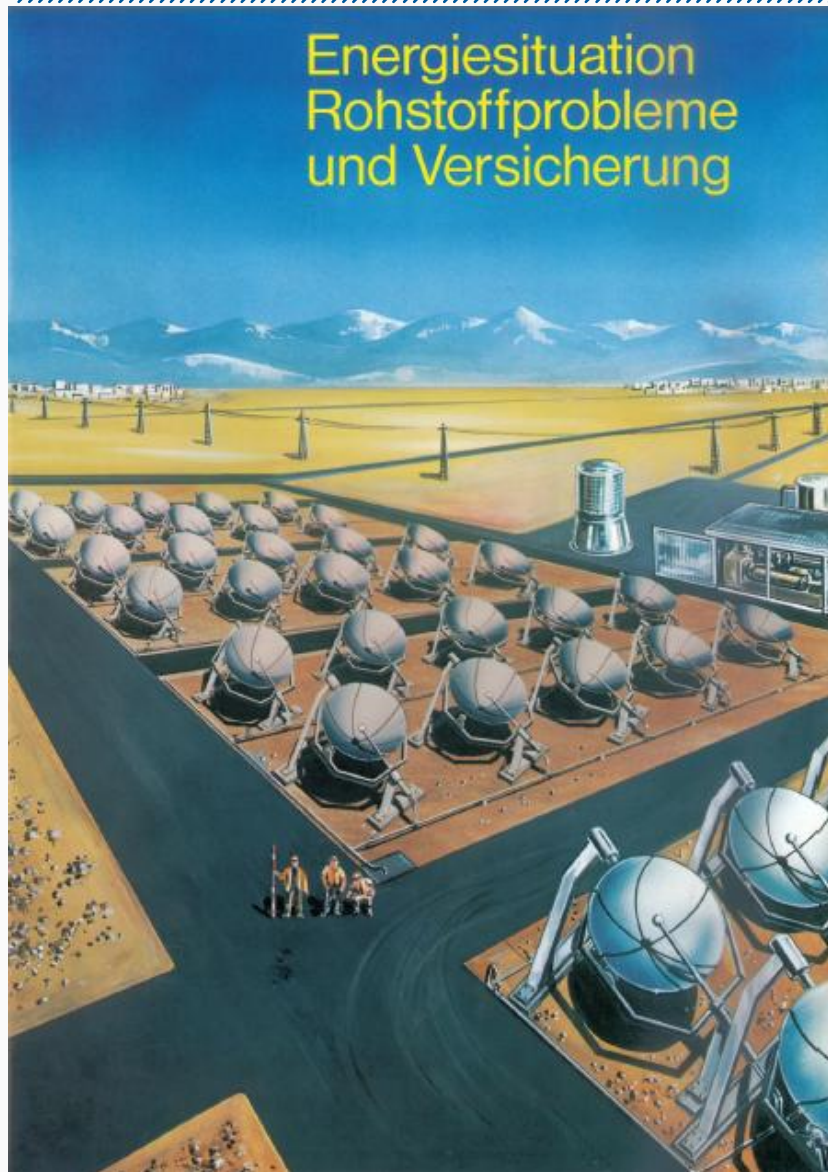


From Knowledge
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Sustainable Solutions

The Desertec Initiative

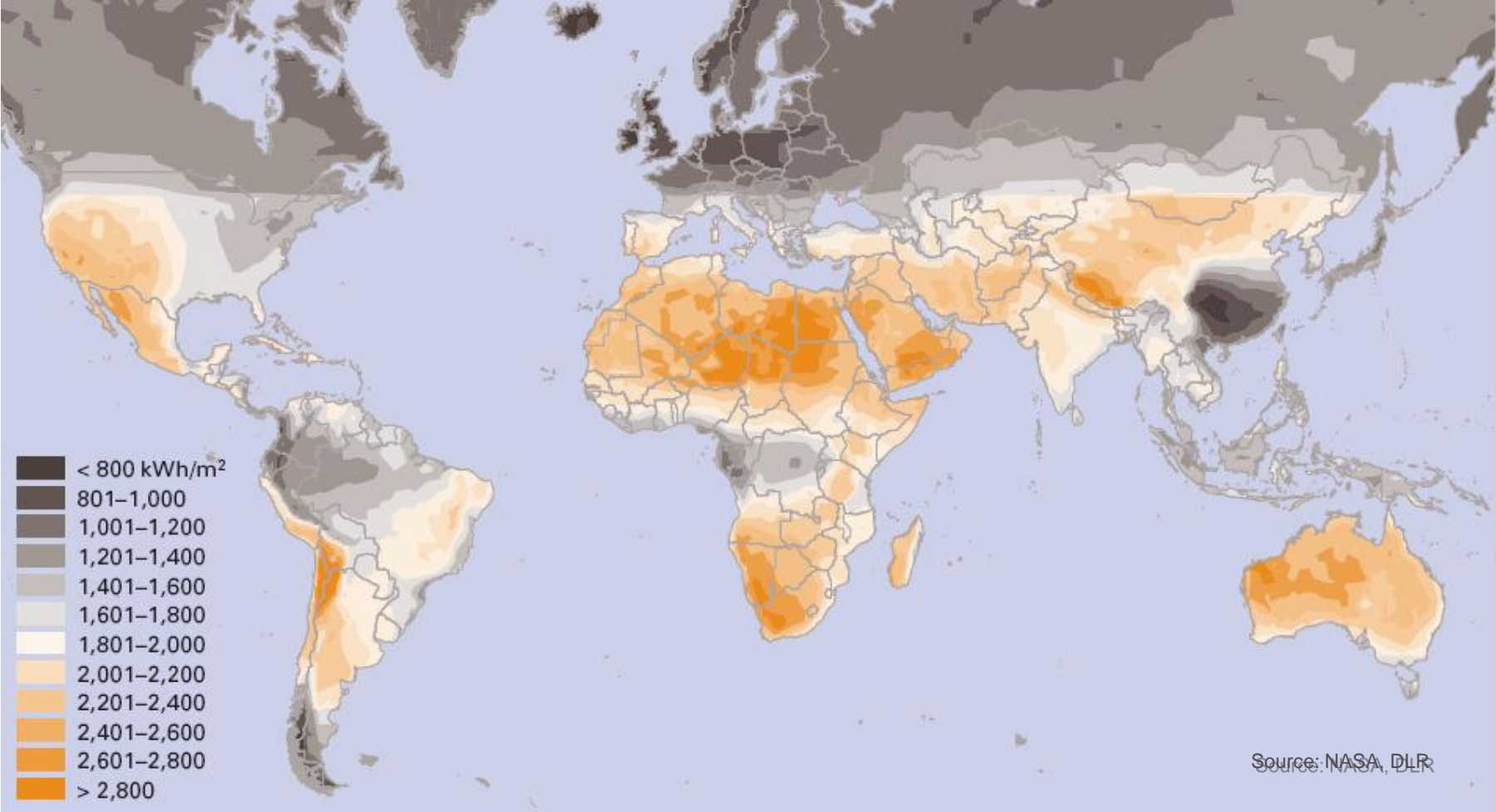
Munich Re Publication „Energy situation, problems with basic resources and insurance published in **1978**



Regions with high potential for solar electricity generation



Global distribution of direct normal radiation (needed for CSP* technology)



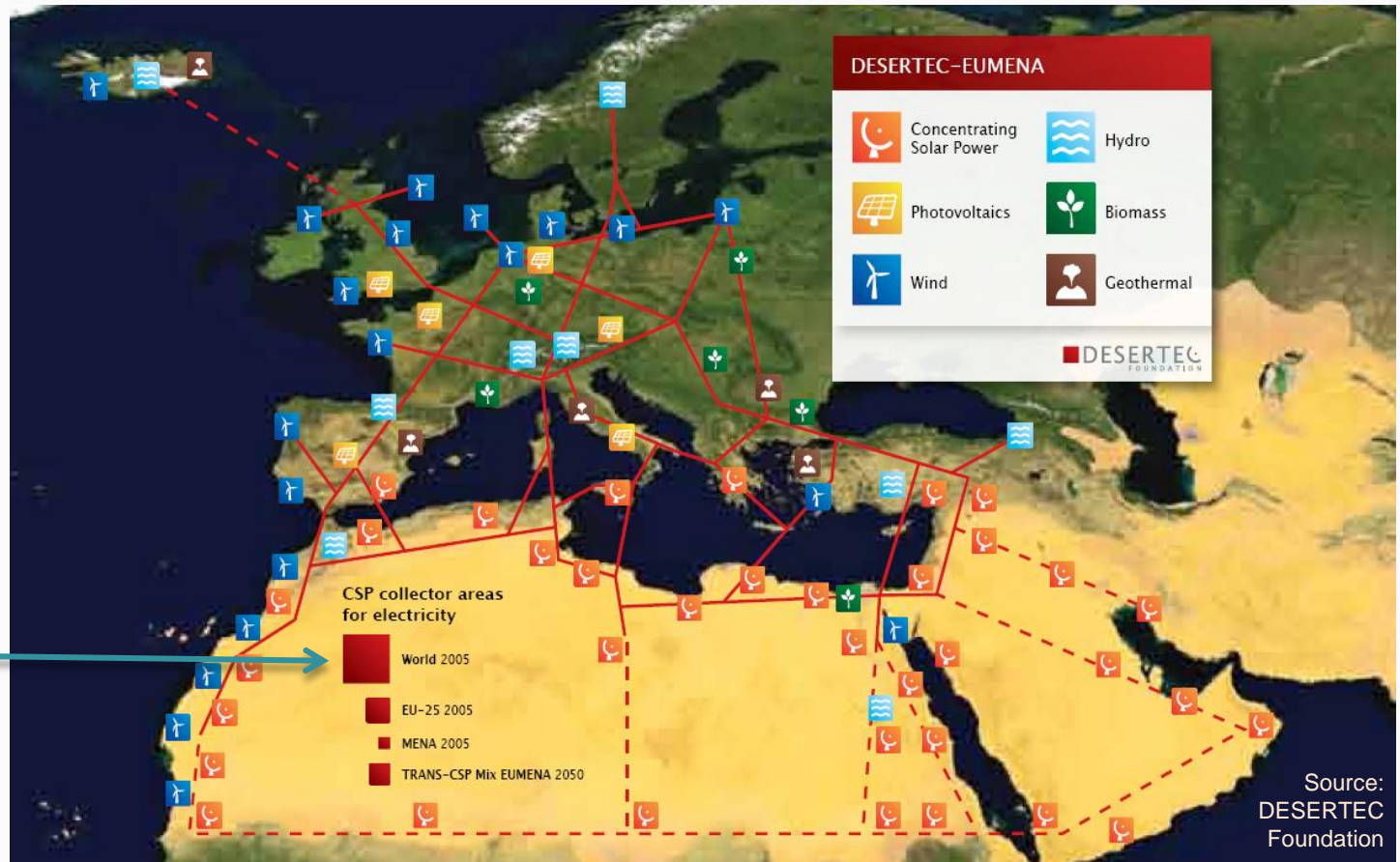
*Concentrated Solar Power

Dii GmbH („Desertec Industrial Initiative“)

Munich Re as the initiator

The world's deserts receive in 6 hours the amount of energy, that mankind consumes in a hole year.

solar collector area necessary to meet the world's energy demand



The realization of the Desertec concept makes it possible to achieve a sustainable energy-mix in Europe by 2050

Background, aims and approach

Background	<ul style="list-style-type: none">▪ Concept was developed by the Club of Rome and by the TREC Initiative (Trans-mediterranean Renewable Energy Cooperation)▪ The German Centre for Aerospace (DLR) conducted several feasibility studies
Aims	<ul style="list-style-type: none">▪ Energy supply in the EUMENA area (Europe, Middle East, North Africa) with a share of at least 15% of renewable energy in Europe by 2050▪ Comprehensive solution to the global problems of the future: Lack of energy, Water scarcity, climate change and food shortage.
Approach	<ul style="list-style-type: none">▪ Solar and wind power from the MENA-region as basic elements of the future energy-mix (scenario-analysis)▪ Consideration of already existing and approved technologies<ul style="list-style-type: none">– Solar and wind power generators– High-voltage direct-current transmission <p>Overall calculated investment needs are approximately 400 Billion € by 2050; in the mid and long term grid parity has to be achieved.</p>

Dii Shareholder





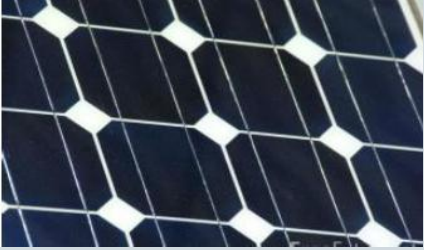

A grid of logos for Dii Shareholders, arranged in three rows and five columns. The logos include: ABB, ABENGOA SOLAR, ceYital, Deutsche Bank, Enel Green Power, e.on, HSH NORDBANK, DESERTEC FOUNDATION, MAN Solar Millennium, Munich RE, m+w zander, NAREVA Holding, SAINT-GOBAIN SOLAR, SCHOTT solar, SIEMENS, RED ELÉCTRICA DE ESPAÑA, and VORWEG GEHEN.

Dii Associated Partners



A grid of logos for Dii Associated Partners, arranged in three rows and five columns. The logos include: 3M, BILFINGER BERGER, COMMERZBANK, EVONIK INDUSTRIES, First Solar, FLABEG, IBM, Italgem Italcementi Group, KAEFER, LAHMEYER INTERNATIONAL, Morgan Stanley, NUR ENERGIE, OMV, SP Schoeller Industries, TEPNA ENEPTEIAKHABETE, and Audi Truth in Engineering.

The DESERTEC concept: open for all field-proved technologies

<h2>CSP</h2> <p>Concentrating Solar Power</p>	<h2>Wind power</h2>	<h2>PV</h2> <p>Photovoltaic Power</p>	<h2>HVDC</h2> <p>High Voltage Direct Current</p>
			
<ul style="list-style-type: none">▪ Concentration of sunlight by mirrors/lenses, transformation into heat▪ Power generation by steam turbines▪ Heat storage enables base load capability	<ul style="list-style-type: none">▪ Conversion of wind to electricity by wind turbines▪ Onshore/offshore wind farms▪ Limited space requirements, but higher power volatility	<ul style="list-style-type: none">▪ Direct conversion of sunlight to electric energy (photoelectric effect)▪ Large fields with trackers aligned to sunlight▪ No storage solutions yet	<ul style="list-style-type: none">▪ Power transmission over large distances▪ Selected reinforcement of existing transmission grids▪ Design for EUMENA super grid



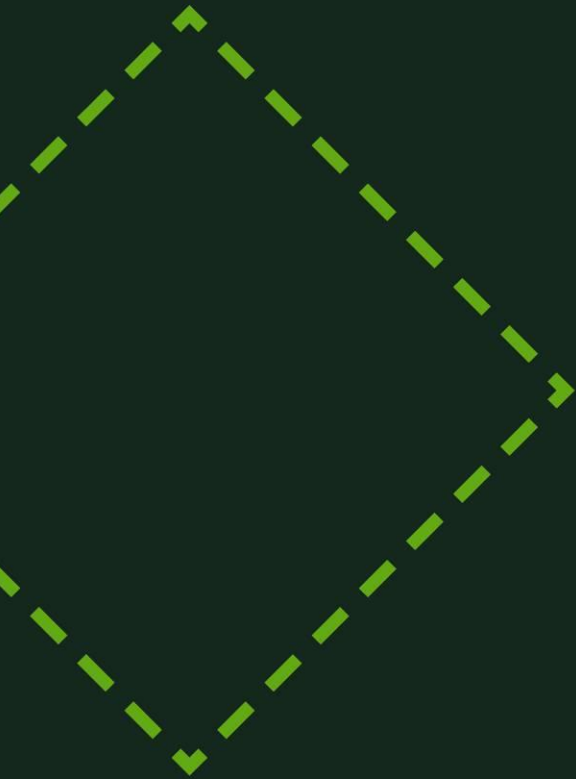
Mid term	INSURANCE SOLUTIONS FOR RENEWABLE ENERGIES	<ul style="list-style-type: none">▪ Leading role in developing new risk transfer solutions for renewable energies / new technologies
	INVESTMENT	<ul style="list-style-type: none">▪ New (direct) investment options▪ Part of Munich Re strategy to boost investments in renewable energies
Long term	CLIMATE PROTECTION	<ul style="list-style-type: none">▪ Climate change is a tremendous challenge in regard to insurability▪ Meets the sustainability strategy of MR▪ Takeover of social responsibility
	BUSINESS OPPORTUNITIES	<ul style="list-style-type: none">▪ Rising insurance demand (esp. infrastructure)▪ Sharpening of Munich Re's profile as provider for innovative insurance solutions

- New potential for economic, ecological and social development in the Maghreb
- Growth, development and employment opportunities for the Maghreb as a result of substantial private investment
- Greater energy security in the EUMENA countries
- Utilisation of excess energy in, for example, seawater-desalination plants
- Mitigation of the North-South conflict
- Reduction of carbon-dioxide emissions and thus a significant contribution to climate protection targets

*Europe, Middle East and North Africa

Munich Re Foundation

Thank you



Leader Maghreb
Casablanca, 17 May 2010

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