Climate and Water Related Disasters:

IPCC Assessments and New Approaches to Risk Management

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Three categories

of water problems

too little water

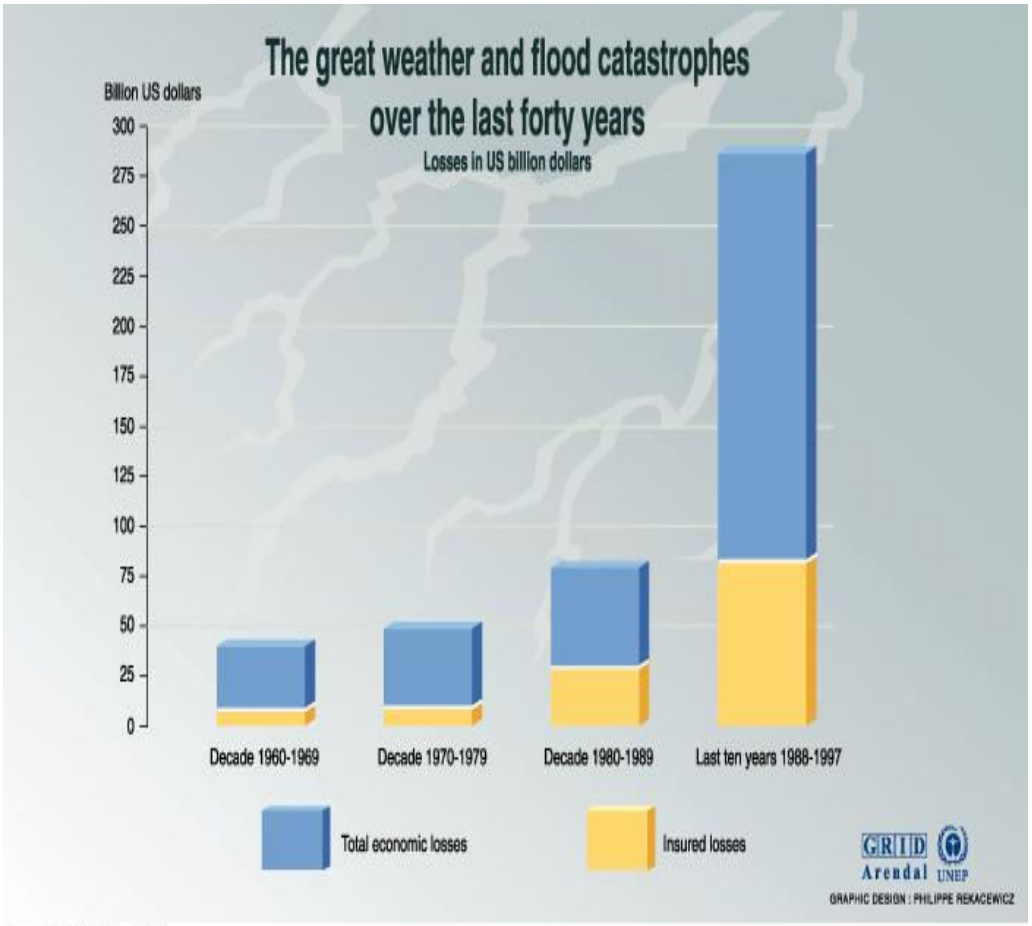
too much water

polluted water

can be exacerbated by climate change

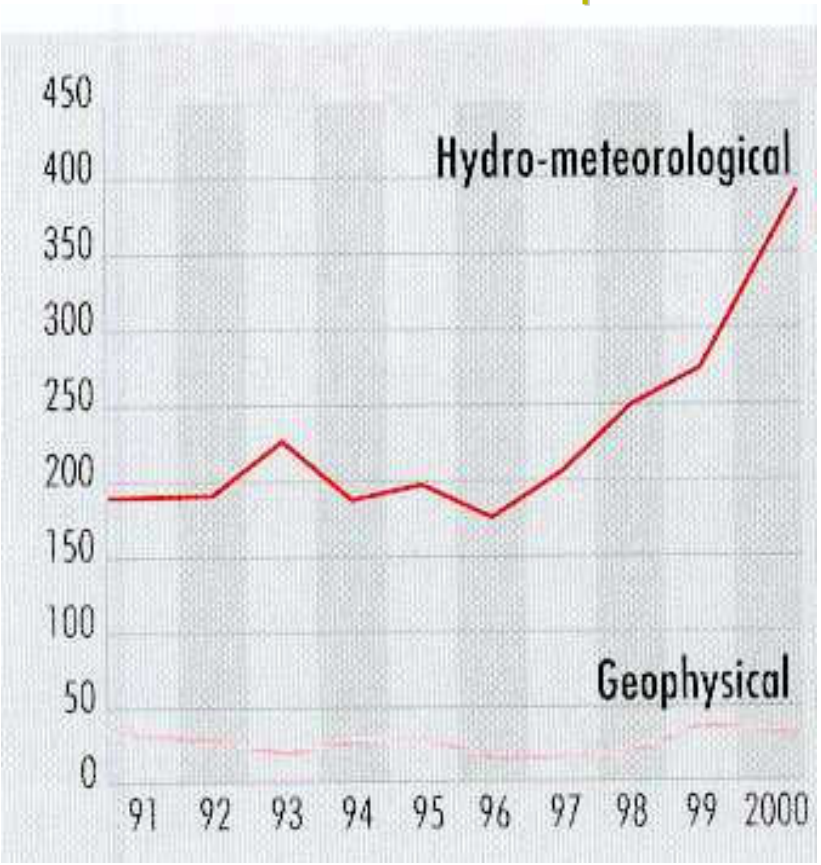

20 lipca 1997
RANKING POLITYKÓW
AMBITNI Z ZAZDROŚCI
NR 29
Cena 2 zł
wprost
KLĘSKA
spezial
CHRONIK
EREIGNISSE, DIE UNS BEWEGEN
SEPTEMBER 2002
DEUTSCHLAND € 3,-
Die Jahrhundertflut
Das Protokoll der Katastrophe
Vom Erlös dieser Ausgabe gehen 100 000 Euro an die Flutopfer

Increasing impacts of extreme events

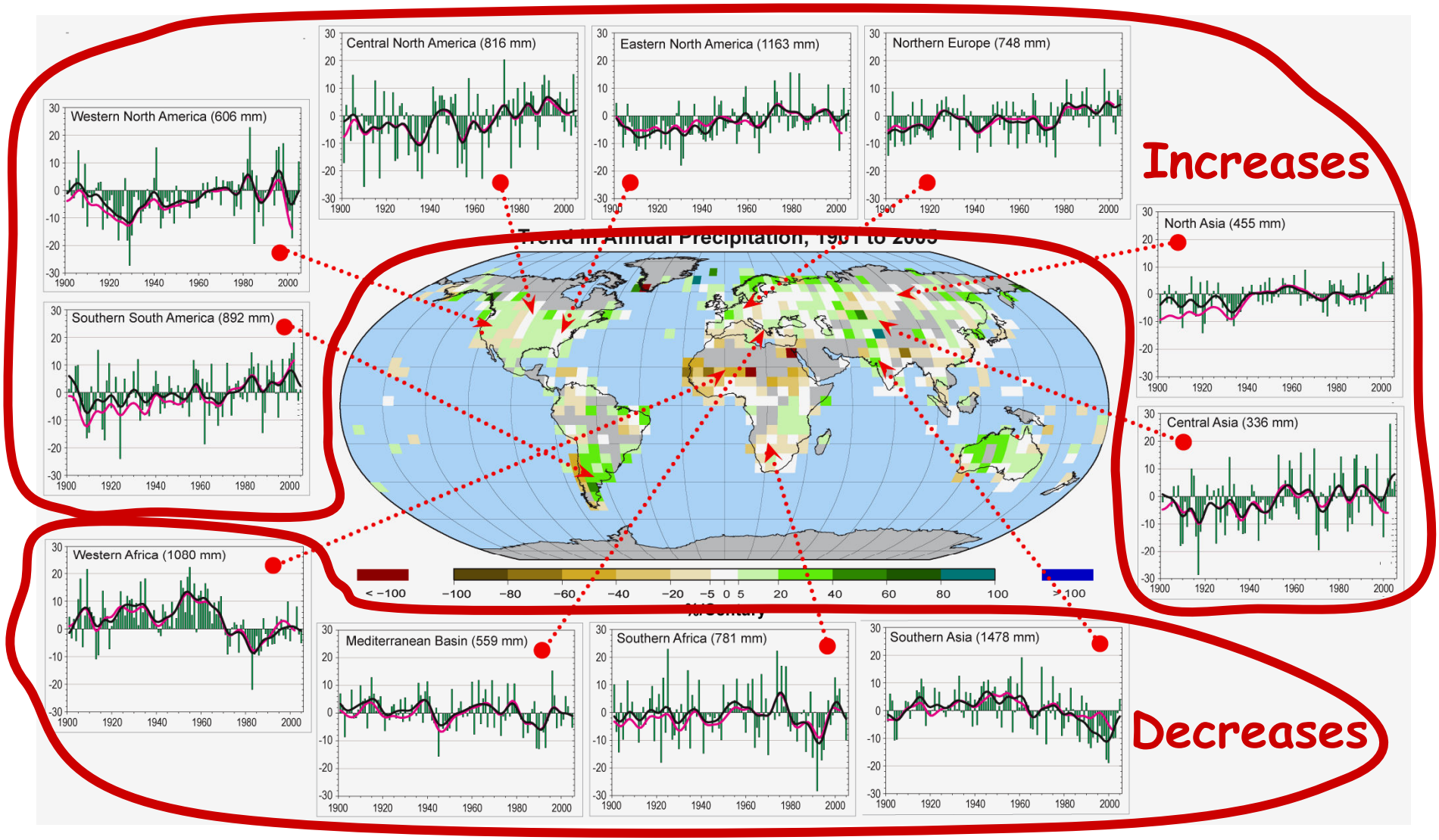


Source: Munich Re Group, 1999.

Number of disasters reported

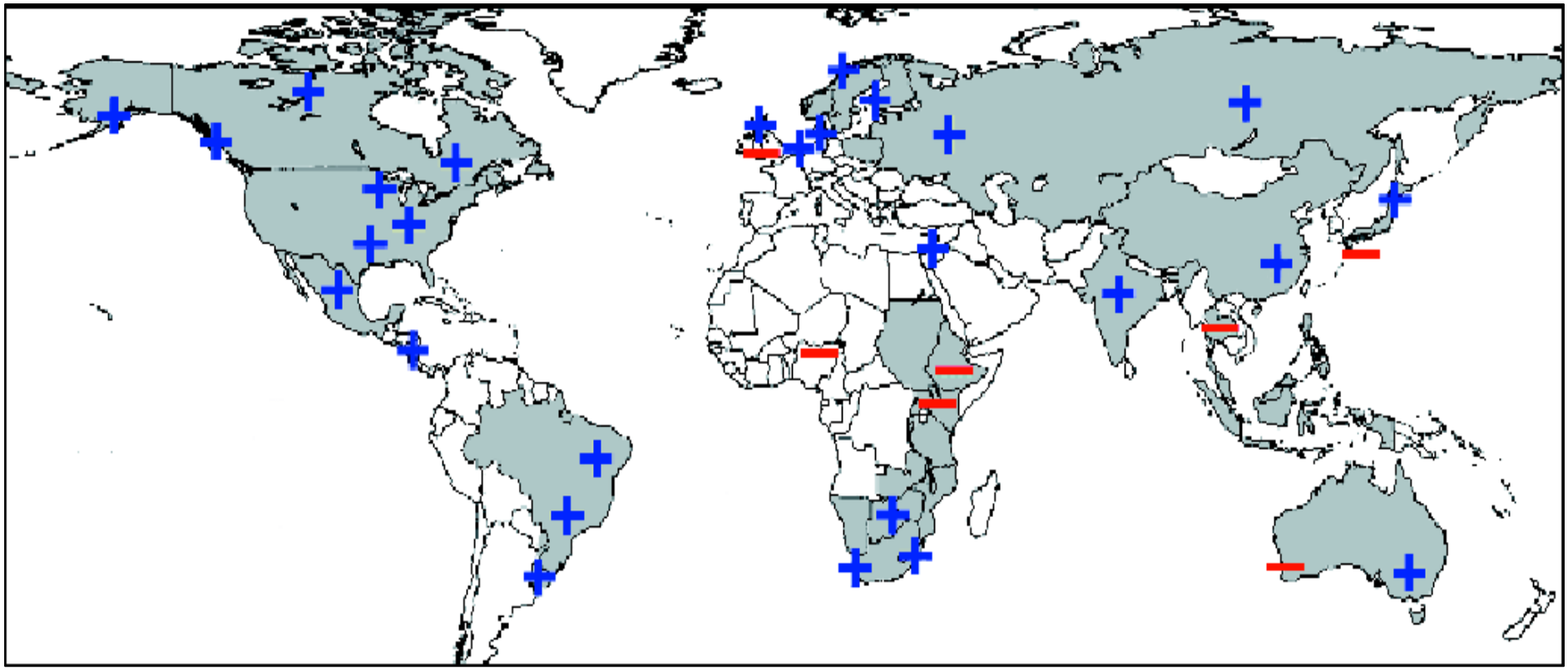


Land precipitation is changing significantly over broad areas



Smoothed annual anomalies for precipitation (%) over land from 1900 to 2005; other regions are dominated by variability.

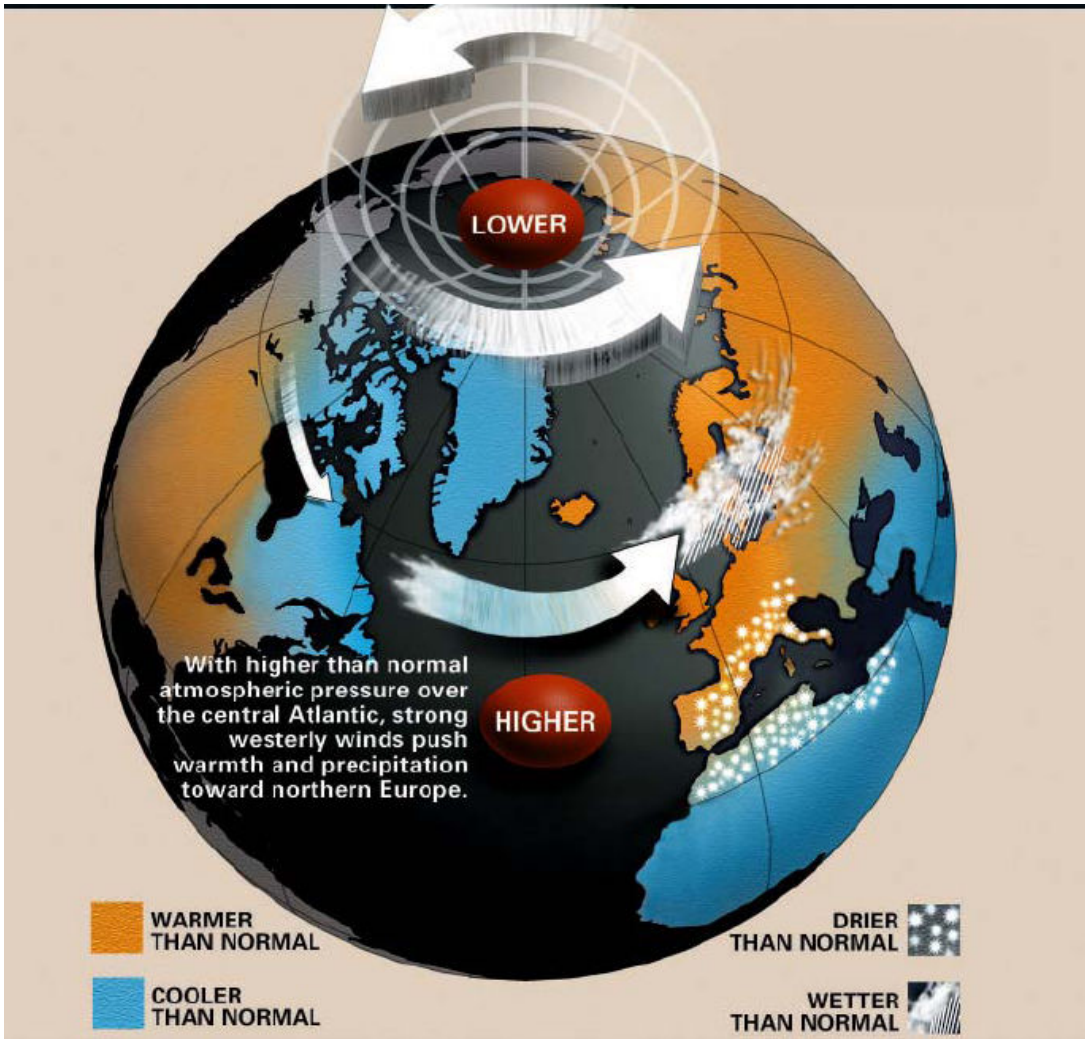
Proportion of heavy rainfalls: increasing in most land areas



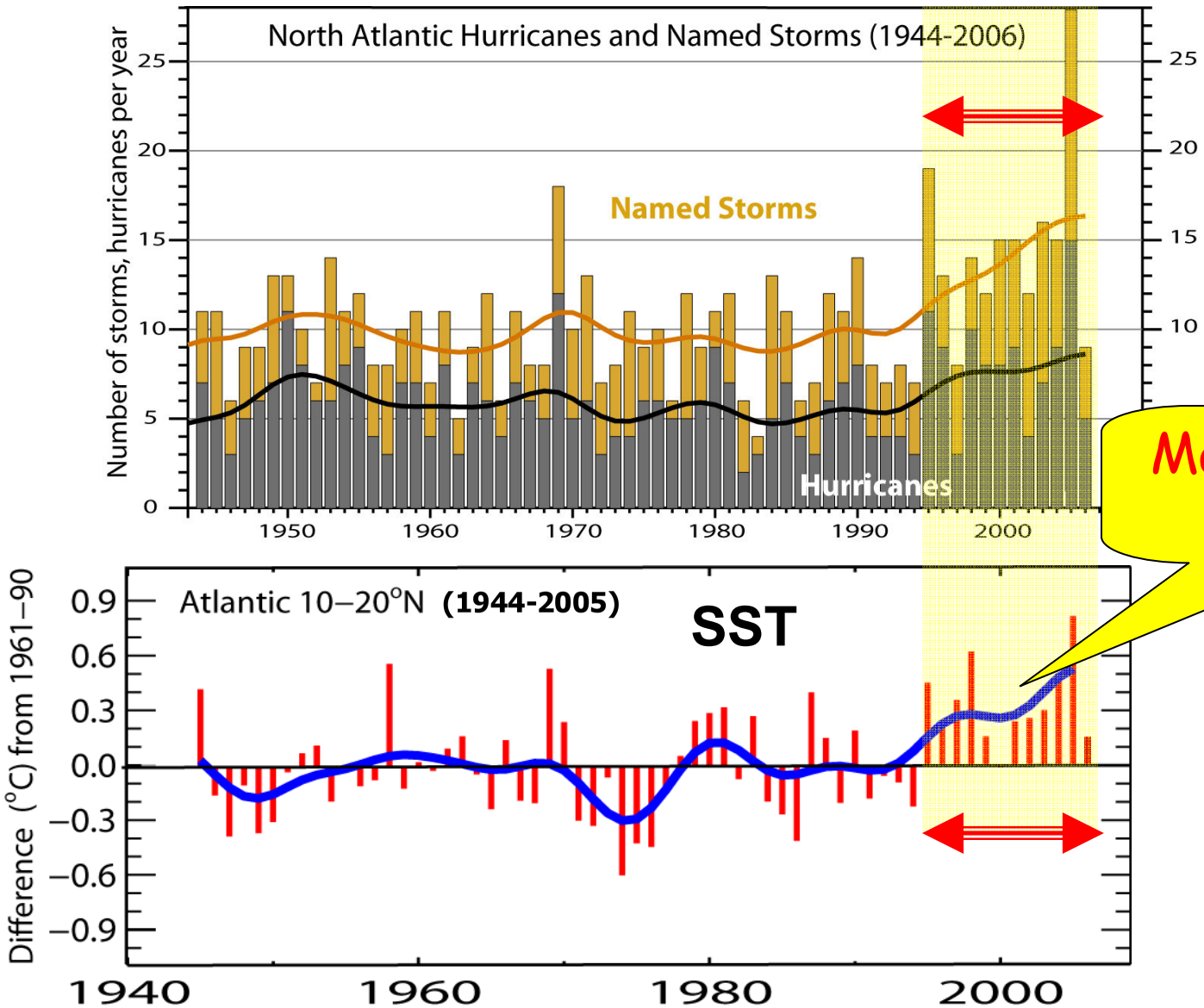
Circulation change

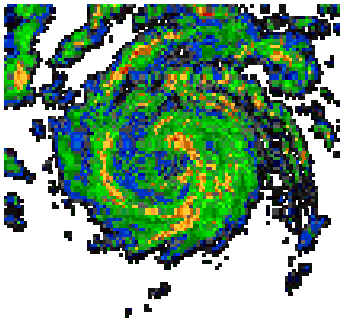
- Climate change is affecting storm tracks, winds and temperature patterns

- Anthropogenic forcing has likely contributed

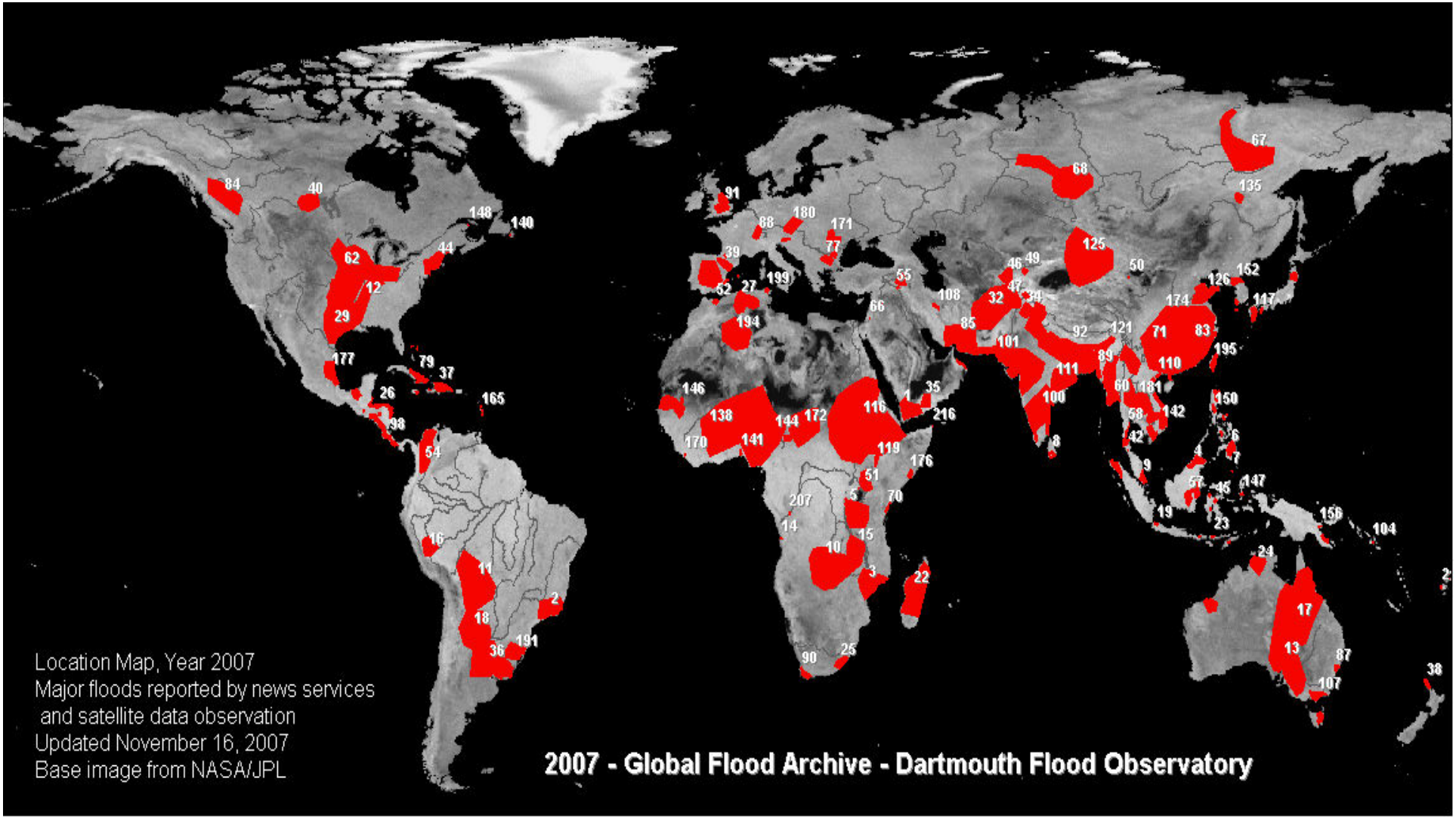


North Atlantic hurricanes have increased with SSTs



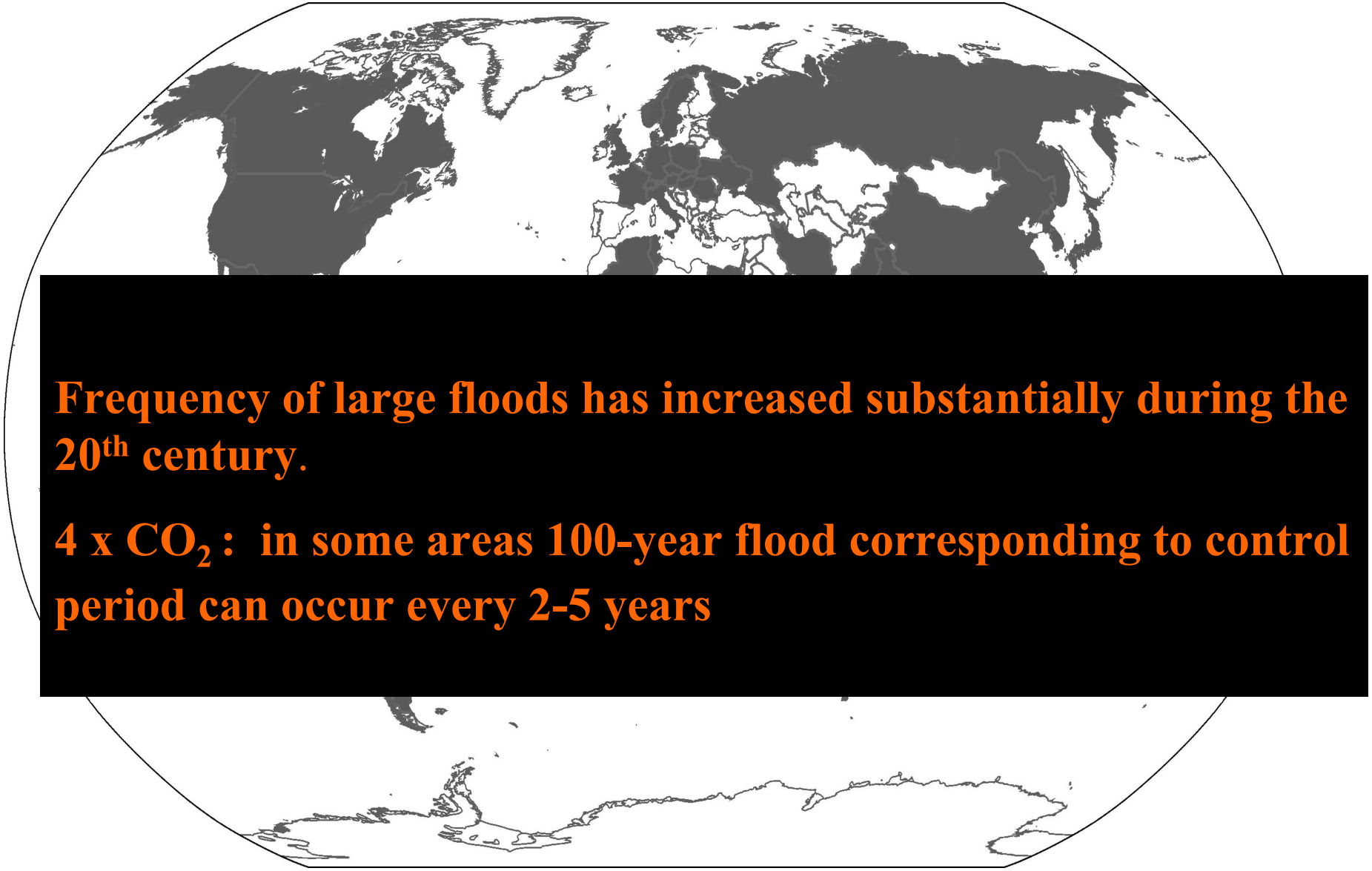


Marked increase after 1994



Major floods in 2007

[Dartmouth Flood Observatory]



Frequency of large floods has increased substantially during the 20th century.

4 x CO_2 : in some areas 100-year flood corresponding to control period can occur every 2-5 years

Countries affected by destructive flooding since 1990

Extreme hydrological events
Too much water: Floods

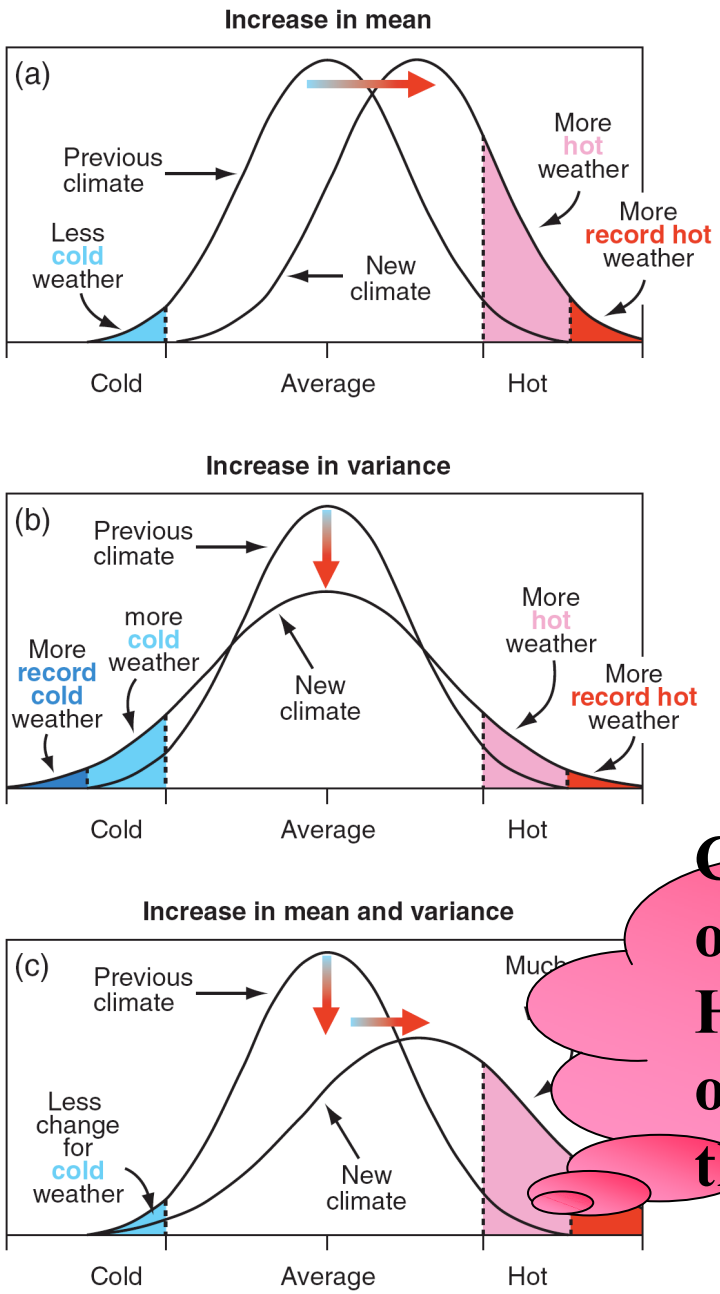

Weisseritz, Saxony 2002: flash flood


Rhine at Koblenz 1993/94: plain flood

Between 1998 and 2004, Europe suffered over 100 major floods, with
~ 700 fatalities,
~ 500 000 people displaced
~ 25 billion € insured econ. losses

In summer 2002, Europe suffered a devastating flood, with a total material damage over 20 billion € (highest ever recorded in Europe).

Frequency of Extreme Events in a Changing Climate

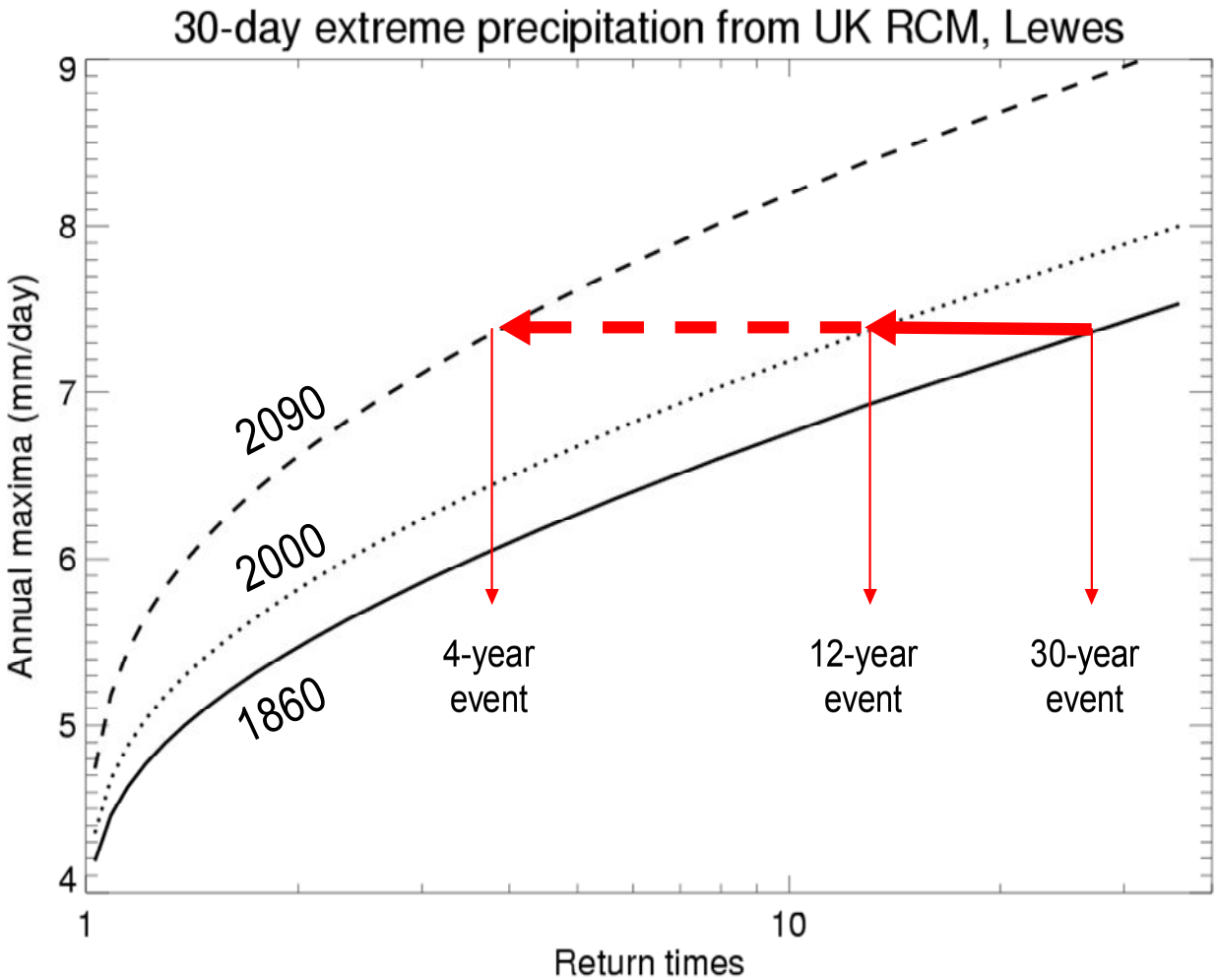


Climate change is not responsible for occurrence of a single extreme event. However, frequency of several categories of such events is likely to increase in the changed climate

Fig. 2.32, Folland et al., 2001. IPCC WGI TAR

South Oxford 5 januari 2003

Regionally predictions generally suggest an increase in extreme rainfall



Adaptation to CC in water sector

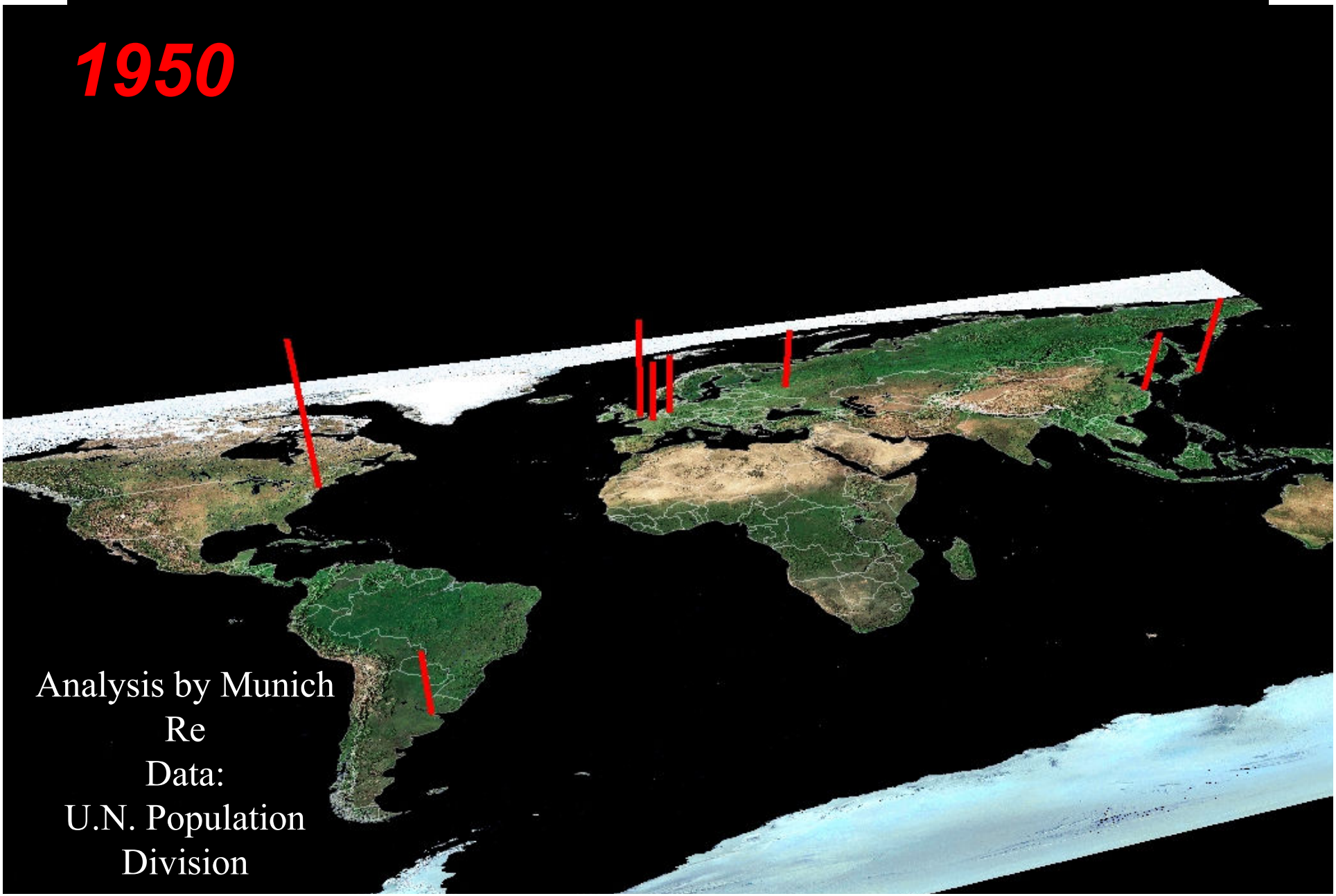
Hazard

Exposure

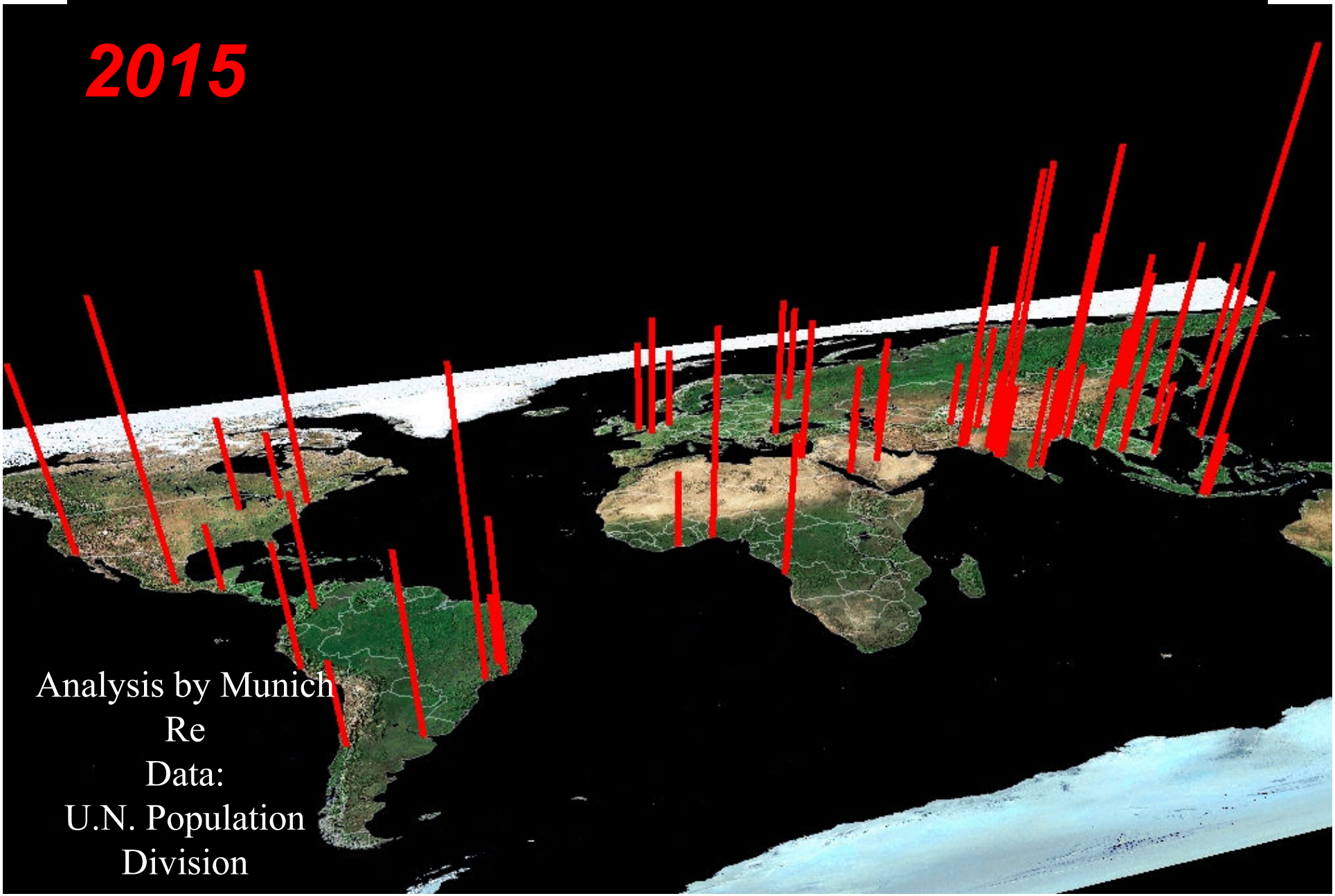
adaptive capacity

vulnerability

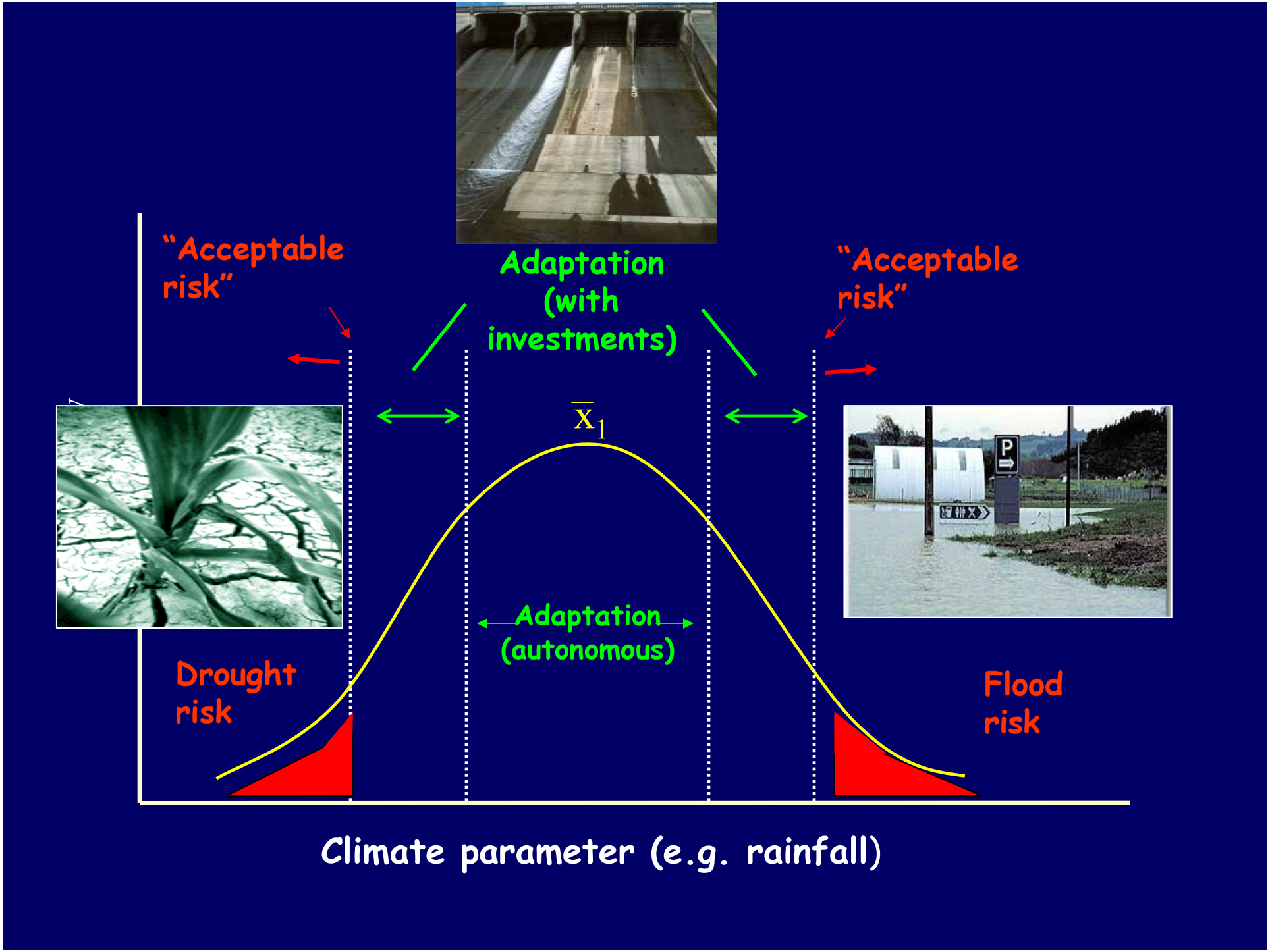
Exposure: World Cities exceeding 5 million residents



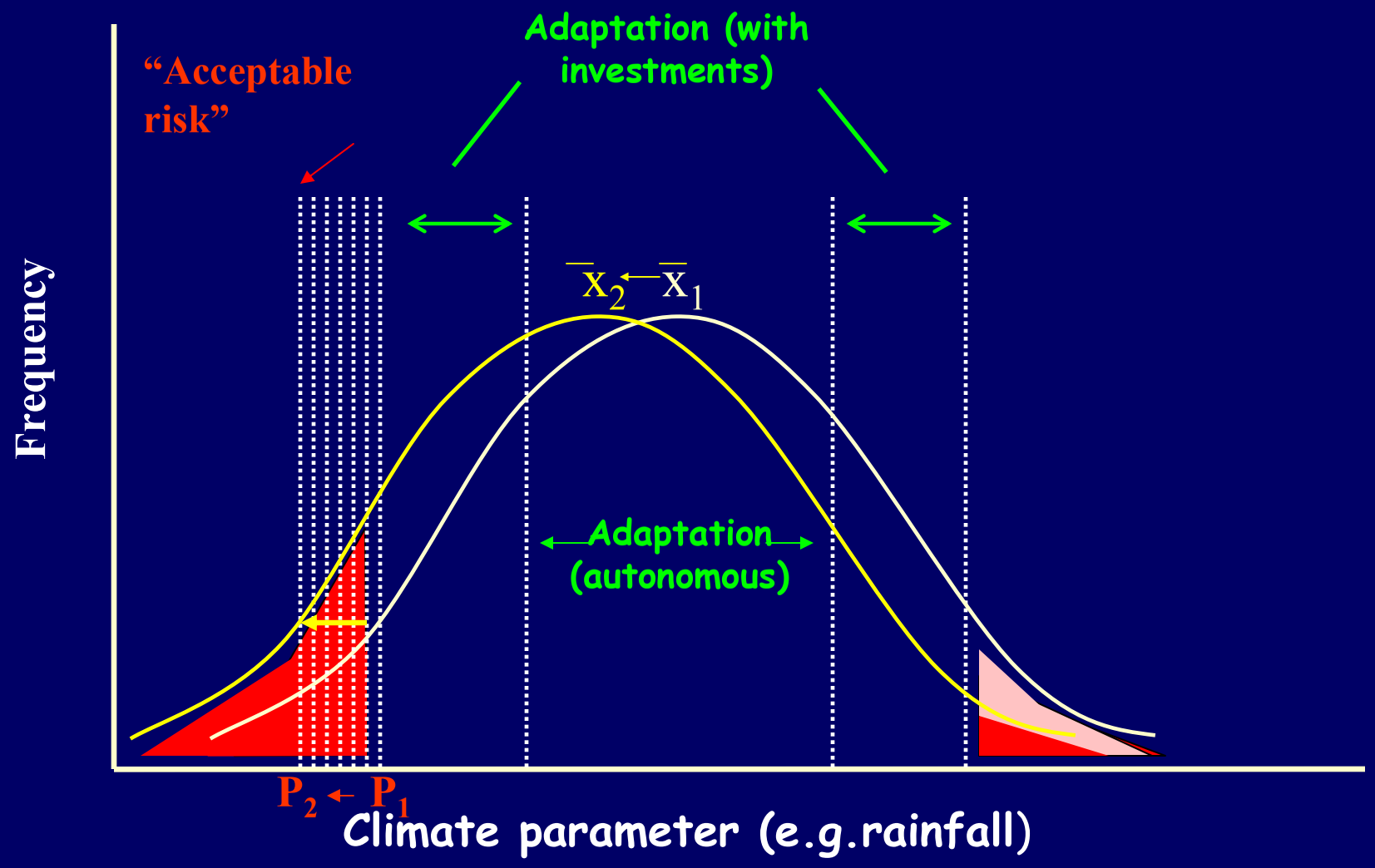
Exposure: World Cities exceeding 5 million residents



Stationarity *lock-in* in Water Engineering and Disaster Management


"Acceptable risk"
Adaptation (with investments)
"Acceptable risk"
$\overline{x}_1$
Adaptation (autonomous)
Drought risk
Flood risk
Climate parameter (e.g. rainfall)

Climate Change



GIS-based Risk Assessment Tool 'HAZUS - MH'

(Hazards in the United States for Multi Hazards: Earthquakes, Wind, Flood).

Risk = Sum (Hazard x Assets x Vulnerability)

$ / year or /event — over Region — probability per time — $ value — 0 < V < 1

Risk	Expected Losses for either a scenario event ($) or in terms of probabilistic annual losses ($/year)
• **Hazards**	Probability per unit time of exceeding a certain wind speed or flood height (P=1 for scenario event)
• **Assets**	Replacement Value in Dollars for Buildings or Infrastructure, (or $ / live !)
• **Vulnerability**	Dimensionless Value between 0 and 1. It is the Fraction of Replacement Value of a Given Asset, Given the Hazard Level it is exposed to.

HAZUS-MH also has a Built-in Economic Model for Damage-Related, Indirect Losses.

Risk Management Tools: **Minimizing the Risk** via **Mitigation** and **Adaptation** Measures (Let's use the Risk Equation and GIS-based Models!) :

Risk = Sum (Hazard x Assets x Vulnerability)

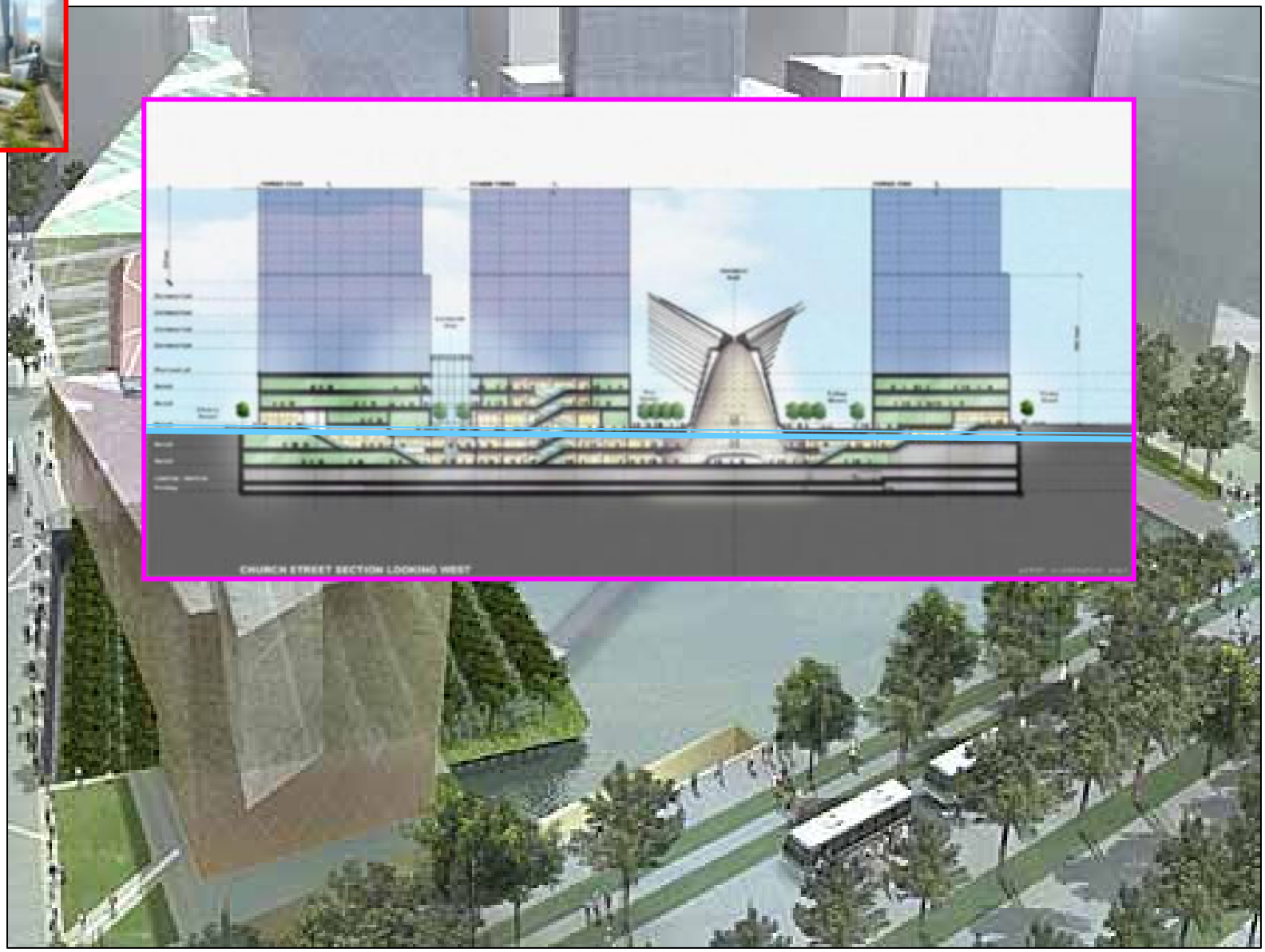
Mitig.: Reduce GW + SLR Hazards

Adapt.: Land Use Planning & Zoning,
Considerate Placements of new Assets,
Relocation of Essential Assets.
Levees & Dams (?).
Equity Issues.

or by **Risk = Sum (Hazard x Assets x Vulnerability)**

Adapt.: Good Engineering, Construction Quality-Control,
Codes and Code Enforcement, Retrofitting,
Raising Assets in Place
Reinforcing Levees and Pump Stations

World Trade Center Site Redevelopment "Bathtub"



Thank you!

Dresden (Zwinger), August 2002