Social, economic and political impact of Weather

The role of meteorology

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8th EMS Annual Meeting,
7th European Conference on Applied Climatology (ECAC)
Amsterdam, 29 September-3 October 2008

- For meteorologists:
- For the public:

We know: Weather matters

So, why talk about its impacts?

- social,
- economic &
- political?

Climate change

- We must see how climate has affected the lives and activities of civilized humans
- We must understand the potential consequences of extreme weather events on

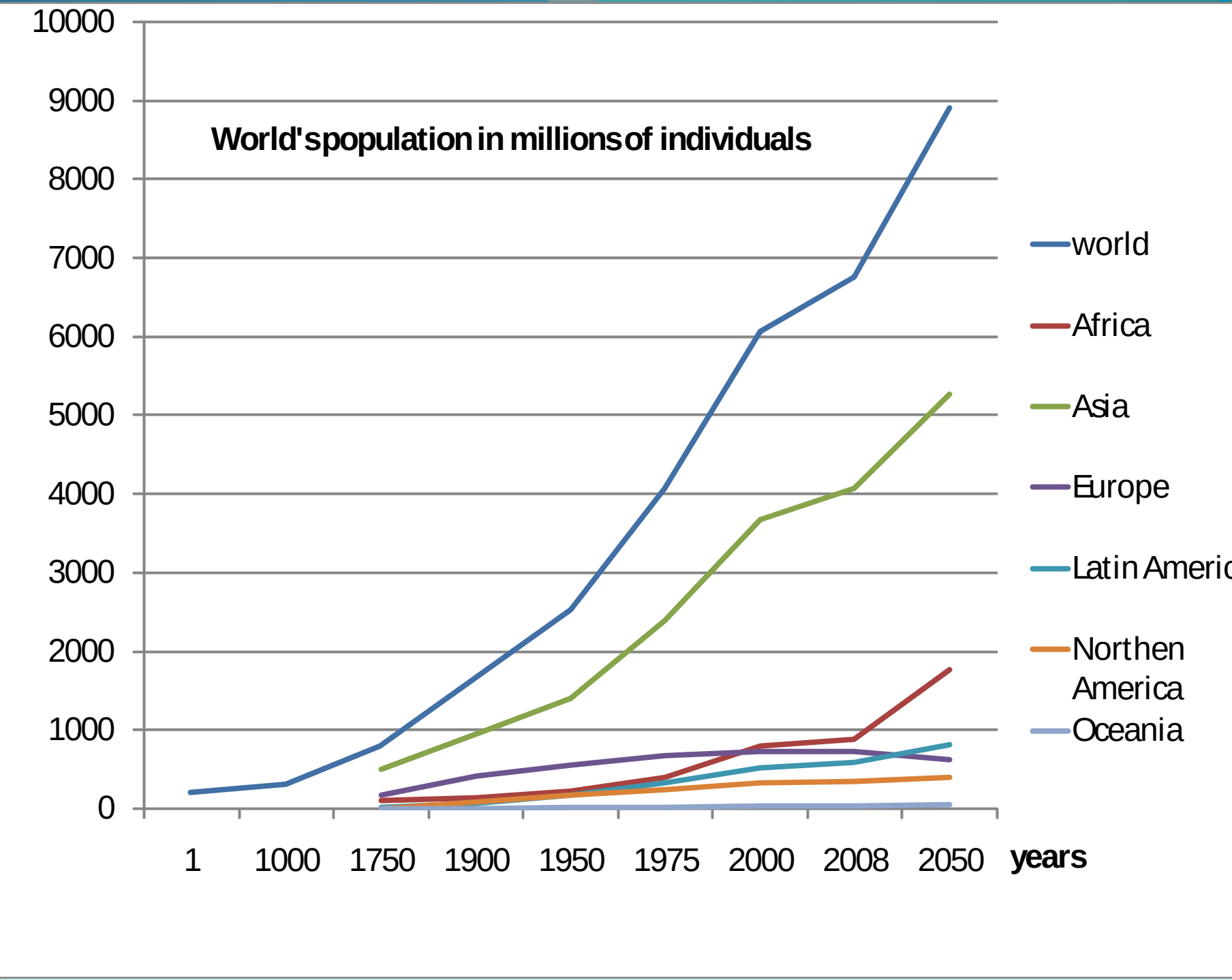
  lives,

  the economy and

  politics.
- We need to contribute to prepare for the impacts of a changed climate and help alleviate them.

Looking first at the past, we shall:

- Choose from inevitably localized events and yet still seek a global message;
- Remember that, even today, information on deaths and economic losses are not completely reliable;
- Remember that the world population continually increases and that societies change.


World'spopulation in millionsof individuals
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1
1000
1750
1900
1950
1975
2000
2008
2050
years
world
Africa
Asia
Europe
Latin Americ
Northen America
Oceania

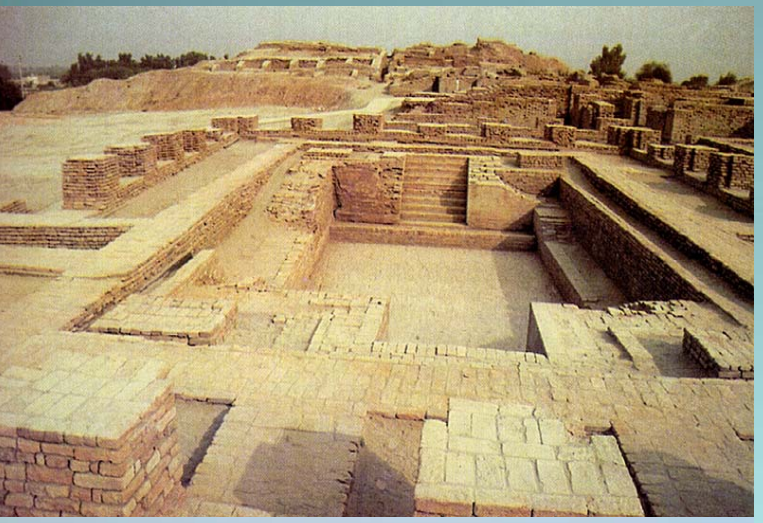
Five ‘chapters’ in my talk:

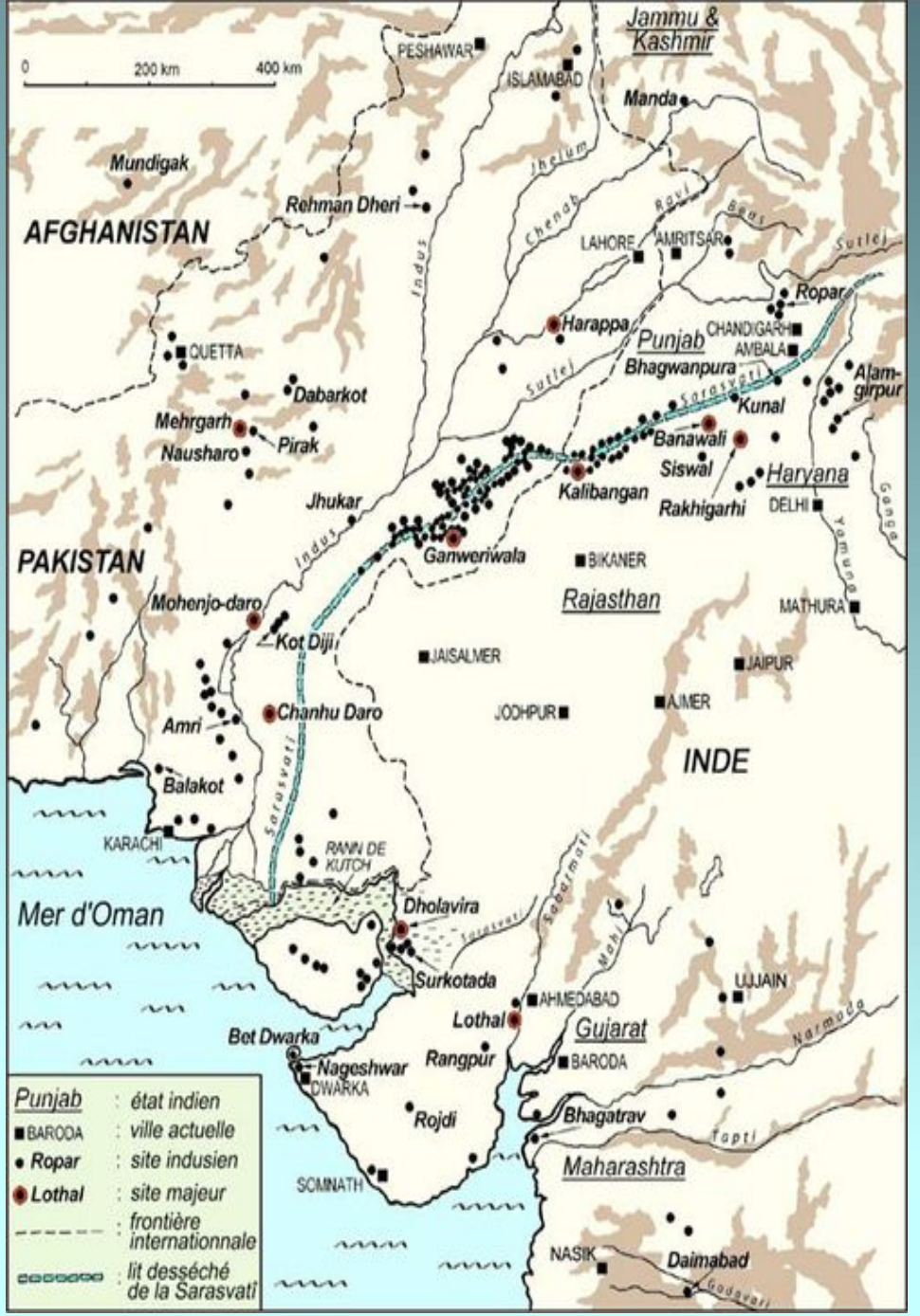
1. Decline and fall of civilizations
2. The historical period
3. Recent years
4. The future
5. The role of meteorology.

‘Chapter 1: Decline and fall of civilizations

- **The Indus river civilization**, also called Harappan (2500-1800 BCE), Pakistan, West India, (discovered in 1800 by a Briton).
  - 1000 big cities along a now dry river, with advanced sanitation system, water supply, and public and private pools
  - analysis of dry river soils shows weakening of monsoon around 1800 BC
  - = climate colder and drier
  - = total abandonment of the site and collapse of the civilization.
  - This climate change may also have influenced the decline of the Mesopotamian civilization.
  -

Indus civilization





- **Mayan culture civilization** (1500 BC–800 AD) (Central America)
  - Famous for monuments (stepped pyramids, palaces)
  - Complete decline around 700–800 AD
  - Recent lake sediment analysis shows very dry period 750–900AD. Then the most accepted explanation:
  - Famine killed millions of people in dry zones; only cities on rivers could survive, but also had to cease all activities.

Mayan Culture

- **The Norse colony in Greenland** (1000-1400),

  Around year 1000, Norse (Vikings) colonized Greenland.

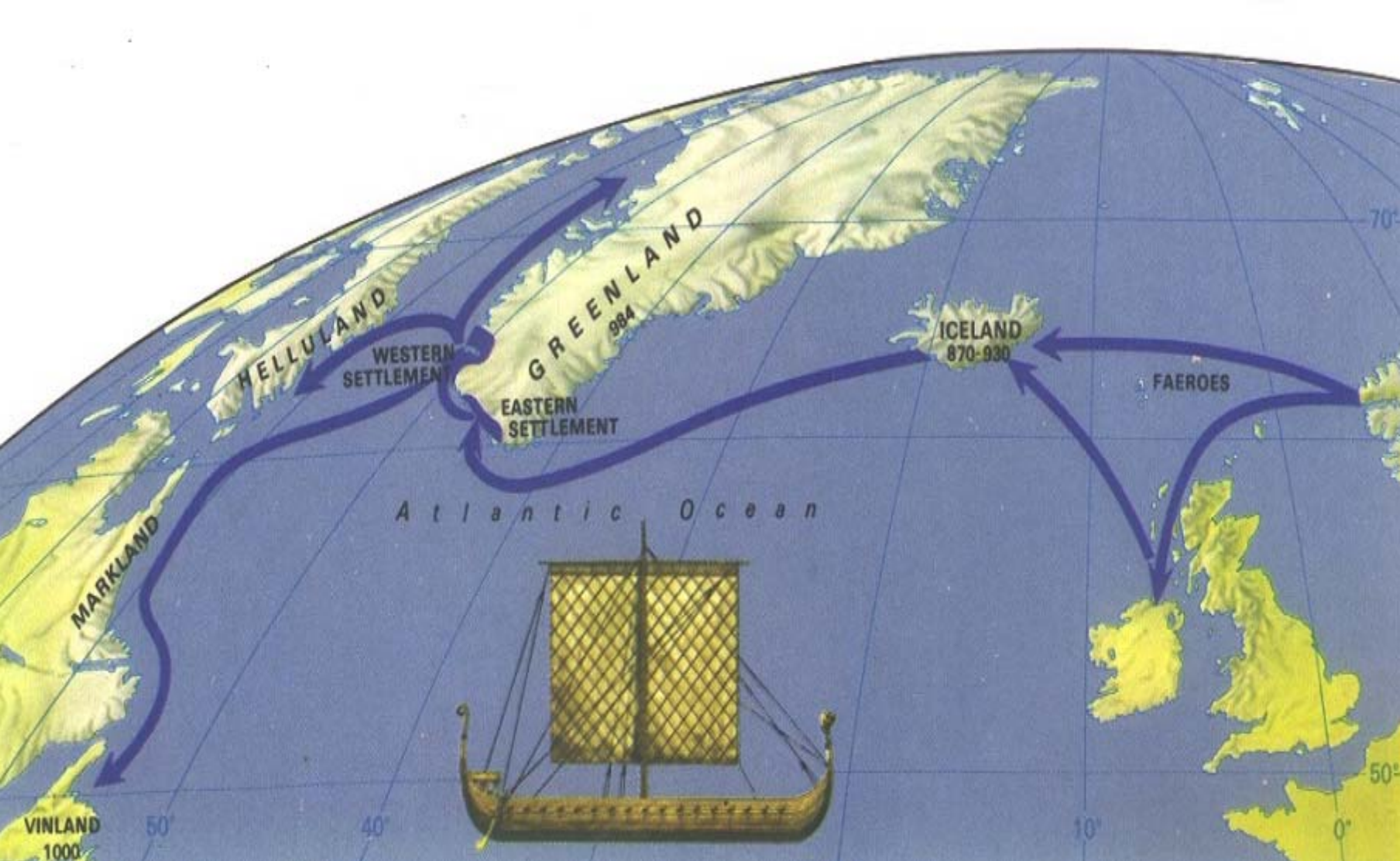
  Originally 5000, then 100 000 habitants.

  In 1315–1319:

  - extremely cold, sea frozen, no contact with Norse
  - fishing not possible during winter
  - no adaptation to new conditions, contrarily to Inuit who also migrated to Greenland
  - = tens of thousands died.

  A ship found no survivors in 1700.

Norse colonization of Greenland



Sahara desert:

- To-day, the world's largest desert, as big as continental USA.
  - 5000 years ago:

    monsoon = large portions had adequate water,locally swampy, with vegetation, often savanna.
  - Progressively:

    the monsoon retreated = desertification, still moving south at 50 km/year.

The Sahara today

2/The historical period

Country	Year	Death toll	Type	Comment
Netherlands **England**	**1090**	**100 000**	**Tide** **storm**	
Japan	**1181**	**100 000**	**Drought**	**Famine**
Netherlands	**1212**	**60 000**	**Storm**	
	1219	**36 000**	**Flood**	
	1228	**100 000**	**Storm**	**Dykes broke**
	1287	**50 000**	**Flood**	**Storm**

Extreme events 11th–13th centuries

Calamitous 14th century everywhere:

- **In Europe**, cold and rainy summers,extremely cold winters(Baltic Sea frozen):

- Wheat harvest failed, price multiplied by 8,
- Grape harvest in France down by 80%

= **Great Famine**:

. horses, dogs, frogs … eaten,

. 10 to 25% of cities' inhabitants died,

. average life expectancy 1300-1325: 29 years

- In 1332, **huge flood in China**, many parts of the country abandoned by population and wildlife (including rodents) to escape the flood

  = triggering factor of the **Black Death** (the bubonic plague) transmitted by rats and fleas.

  China population dropped from 120 millions to 60 millions,

- The disease invaded **Europe** (first Italy in 1348) through ships and killed from 25 to 50 millions people, weather conditions and malnutrition may have contributed to its fast propagation.

- **15th to 18th centuries:**
- **Little Ice Age in much of northern hemisphere**

- ✓ **enhanced temperature variability**
- ✓ **very cold winters: Golden Horn and S. Bosphorus freeze 1622**
- ✓ **Swedish army marches across Great Belt to invade Denmark**
- ✓ **in China, warm weather crops (e.g., oranges)abandoned in Southern provinces where they have grown for centuries**
- ✓ **it is said that Stradivari' violins use a denser wood due to LIA, contributing to their famous tone**
- ✓ **chestnut trees die in France: instead, English furniture makers use mahogany from South America - fashion**
- ✓ **high inflation rate and fall in population in Europe = no renovation of old houses; medieval towns preserved.**

Country	Year	Deaths	Type	Comment
Netherlands	1530	100 000	flood	storm
China	1642	300 000	flood	Huang-he (Yellow river = silt content)
India	1737 1769	300 000 10 millions	typhoon drought	 famine

Extreme events 16th to 18th centuries

Political impact of weather, examples:

- 1789: harsh winter and spring = shortage of grain.

  Price of bread doubles; peasants' "bread riot" evolves into a central cause of the **French revolution**.

Political impact of weather, examples:

- 1789:

- 1812: Napoleon with more than 600 000 soldiers captures Moscow.

  But must march away from burning city; temperatures fall to –40°C. In one day, 50 000 horses die crossing Berezina river. Only 150 000 soldiers get home: beginning of the end of Napoleon's empire.

Political impact of weather, examples:

- 1789
- 1812
- September, 1941: Hitler attacks Moscow in operation Typhoon (one of many military operations-and aircraft-named after extreme weather).
  - German army so confident it would win that several units brought dress uniforms along for the victory march in Red Square, but no winter clothing.
  - Hitler's meteorologically assisted defeats at Moscow and Stalingrad, were turning points in the war

Political impact of weather, examples:

- 1789
- 1812
- September, 1941
- June 1944: Weather a significant factor in the Allied assault on Normandy.

  On 4th conditions still very poor, but British and German meteororologists forecast a ‘brief window of opportunity’ for 6th. German High Command believe this inadequate for a major invasion. Generals stay in Brittany for training and Rommel, the Commander, stays in Germany celebrating his wife’s birthday.

Totals in period from 1800AD to present time

- **Floods:** more than 5 millions deaths
- **Cyclones, etc:** more than 2.8 million deaths
- **Droughts:** 150 to 170 million deaths

Main famines (mainly from drought), 1830AD to present

country	deaths(in millions)	date	comment
China	20 to43	1958-61	drought/ collectivization
"	24	1907	
India	19	1896-1902	
China	13	1876-79	
"	8	2006	
"	5	1936	
Ukraina	5	1921-1922	bad weather
India	5,2 to 10	1876-1878	
China	3	1928-1930	
"	3	1941-1942	
Ireland	1 to 1,5	1846-49	cold, rainy, mildew
North Korea	1,2	1996-1998	weather, politics
Ethiopia	1	1984	
Horn of Africa	1	1888	
Sahel	1,6	1968-1975	many droughts
Finland	0,15	1866-1868	rains, hard winter

Main floods , 1830AD to present

country	death(millions)	comments	year
China	2,5 to 3,7	Yangtze river flood	1931
		51 millions affected	
China	0,9 to 2	Huang He river(Yellow)	1887
"	0,5 to 0,7	Huang He river	1938
"	0,23	typhoon Nina,62 dams out	1975
		losses: 4000 millions $	
"	0,145	Yangtze river flood	1935
North Vietnam	0,1	Hanoi, Red river flood	1971
China	0,1	Yangtze River flood	1911
Bangladesh		30 millions affected	1998

Cyclones, hurricanes 1830AD to present

country	deaths in millions	comments	year		
Bangladesh	0,5	Bhola cyclone	1970		
India	0,3	Coringa cyclone	1839		
Vietnam	0,3		1881		
Bengal	0,2		1876		
Bangladesh	0,14	15 millions affected	1991		
		loss 2000 millions $			
Myanmar	0,14	Nargis cyclone	2008		
Japan		1 million homeless	1958		
Bangladesh		30 millions affected	1998		
China		100 millions affected	1993		

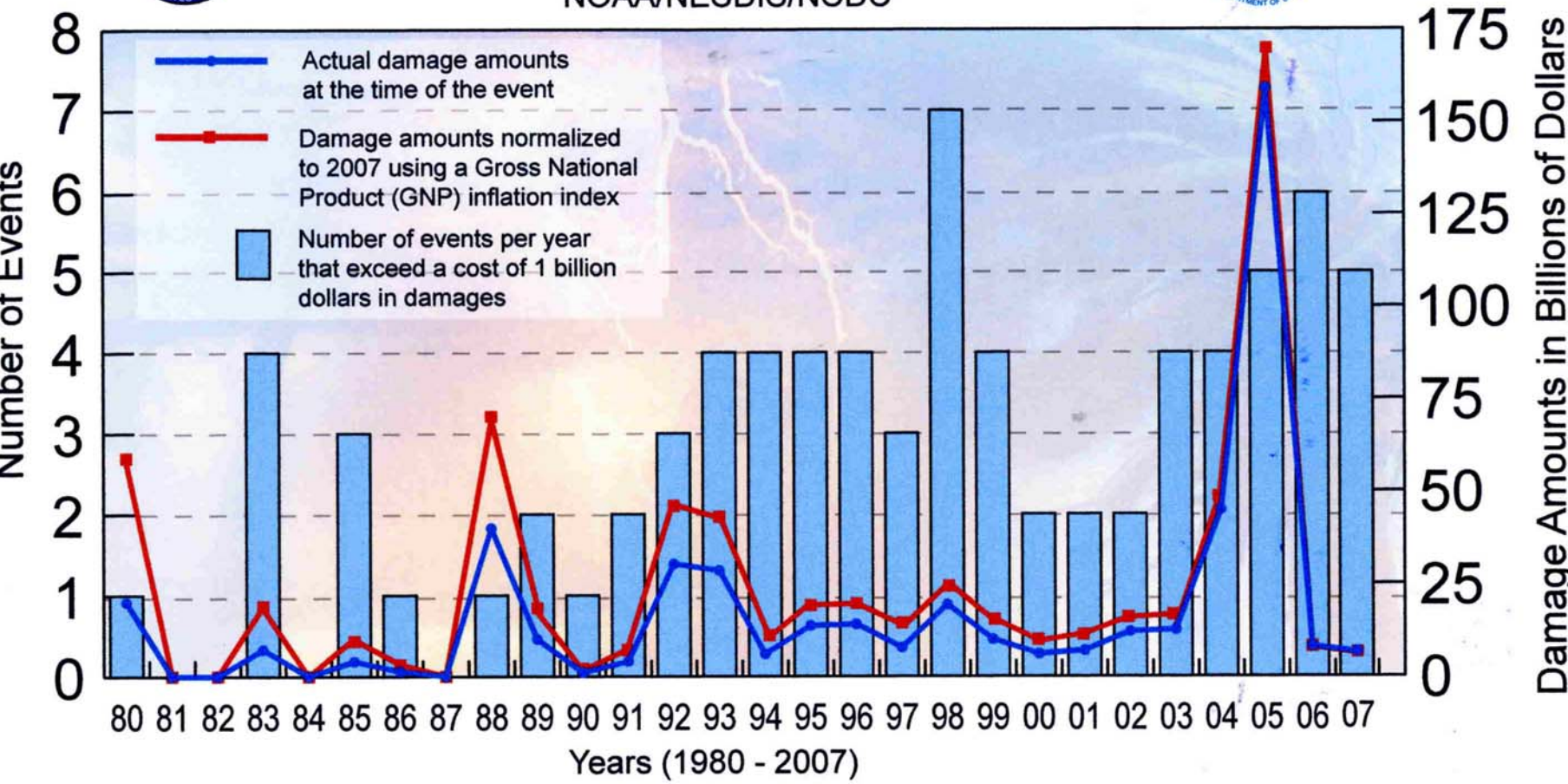
3/Recent years

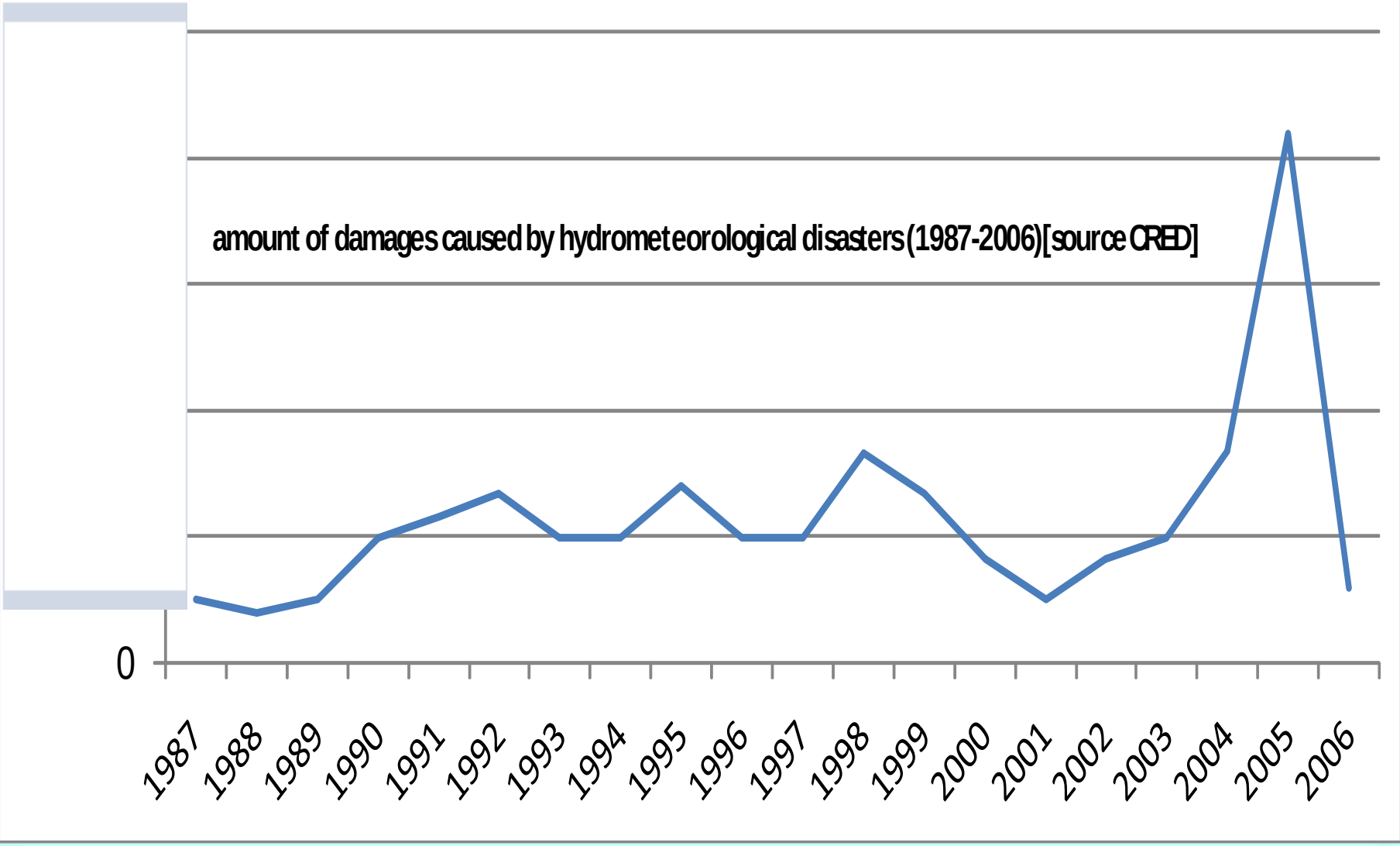
Since 1970, WMO (World Meteorological Organization), CRED (Centre for Research on Epidemiology of Disasters), NOAA and others have seriously investigated the death toll and real economic cost of extreme weather events. But figures are not yet fully reliable.

- The economic losses are much bigger in developed countries. See the dollar cost per year of extreme events in USA (source NOAA) between 1980 and 2007. Note the impact of Katrina in 2005 (129 billion $).

Billion Dollar U.S. Weather Disasters 1980 - 2007

NOAA/NESDIS/NCDC

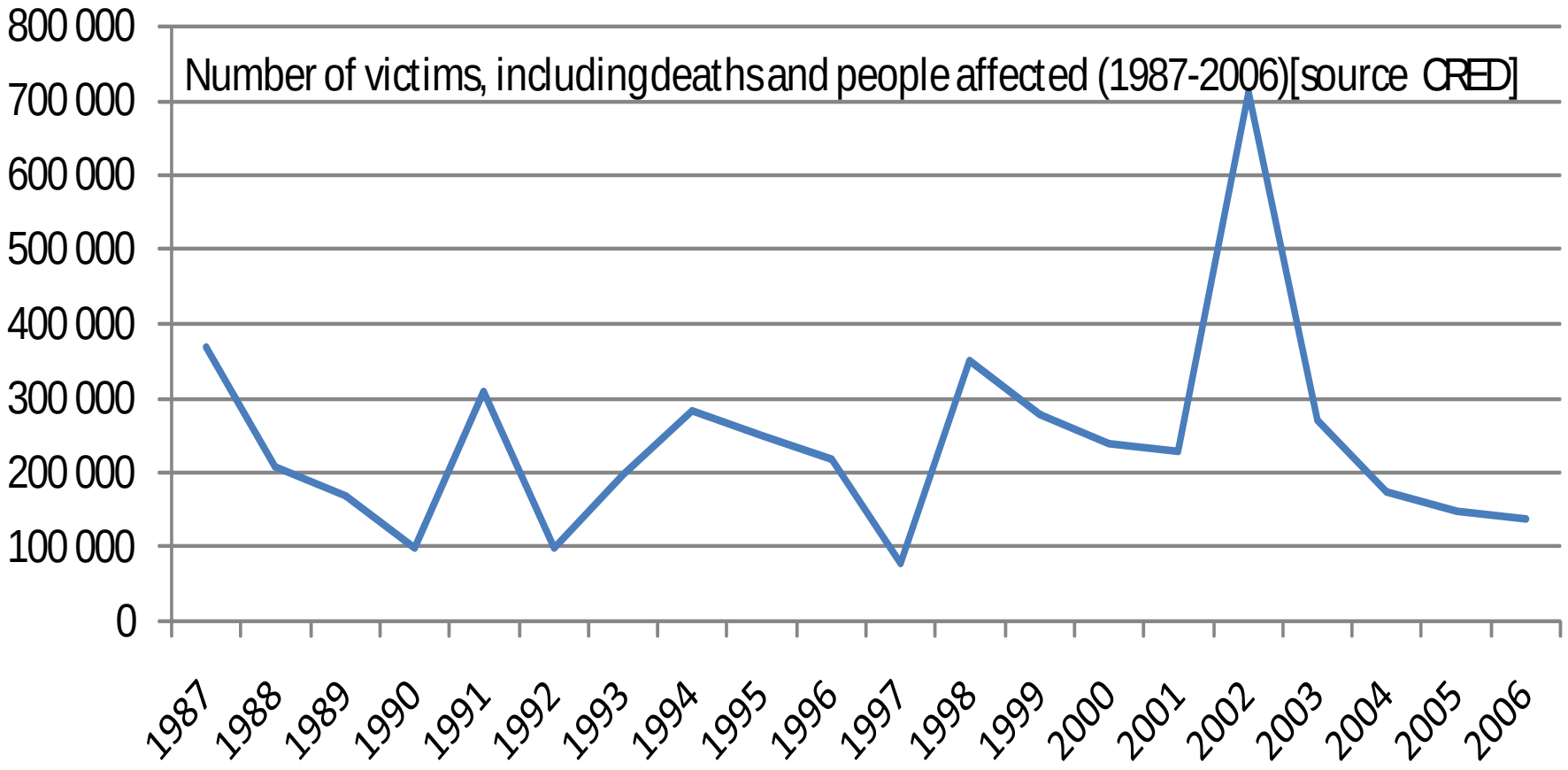



amount of damages caused by hydrometeorological disasters (1987-2006)[source CRED]
0
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

The economic *impact* can be colossal in developing countries.

Losses as a proportion of GDP for top 10 disasters (source CRED)

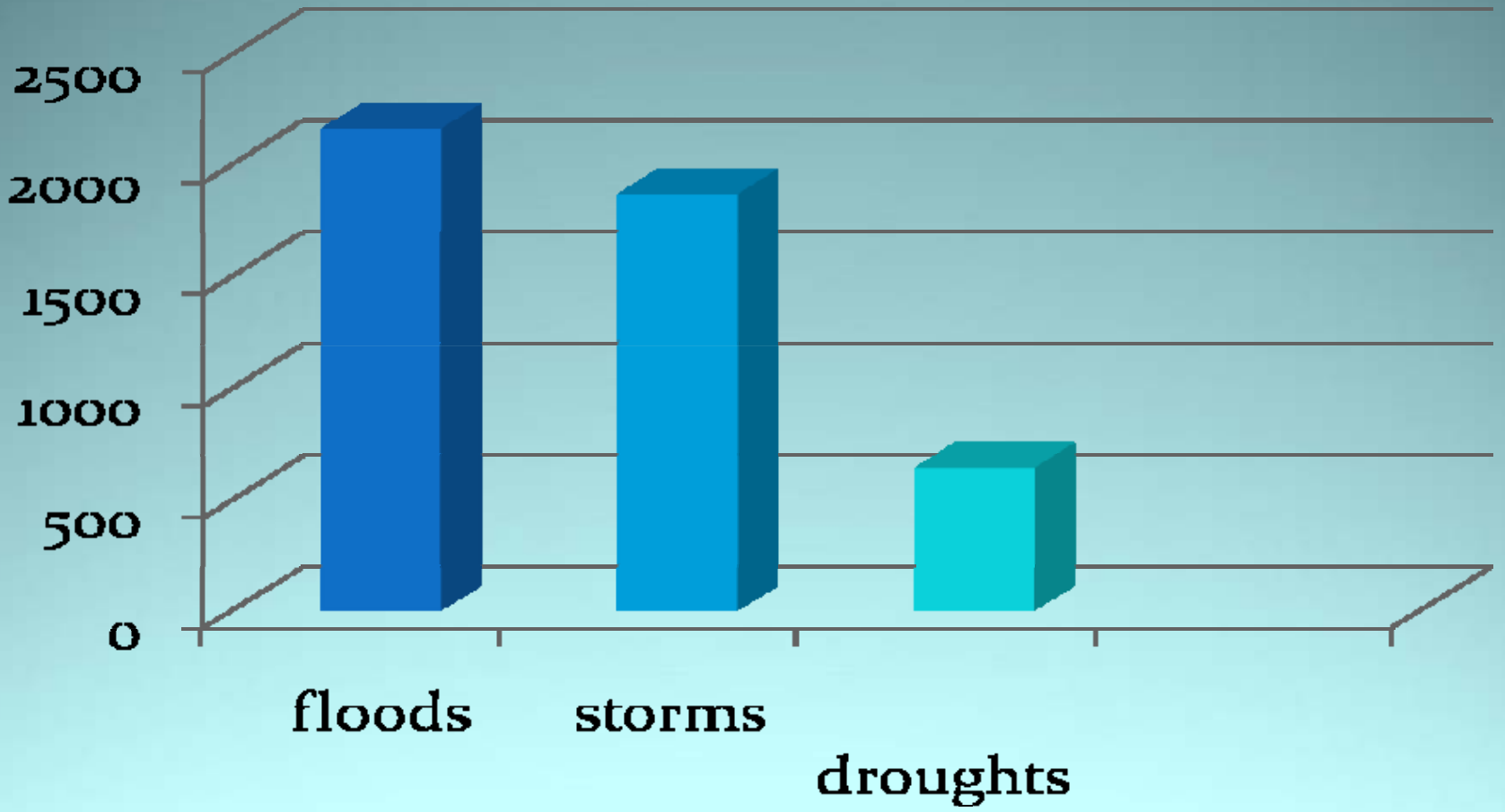
country	year	type	cost in US$	% of GDP
St Lucia	1988	hurricane	1558	413%
Montgolia	1996	forest fire	2013	192%
Vanuatu	1985	cyclone	296	139%
Samoa	1991	cyclone	376	138%
Domenica	1979	hurricane	113	99%
Montgolia	2000	storm	937	97%
St Kitts and Nevis	1995	hurricane	238	89%
Samoa	1990	cyclone	119	62%
Nicaragua	1998	hurricane	1131	51%
Honduras	1998	hurricane	2262	42%



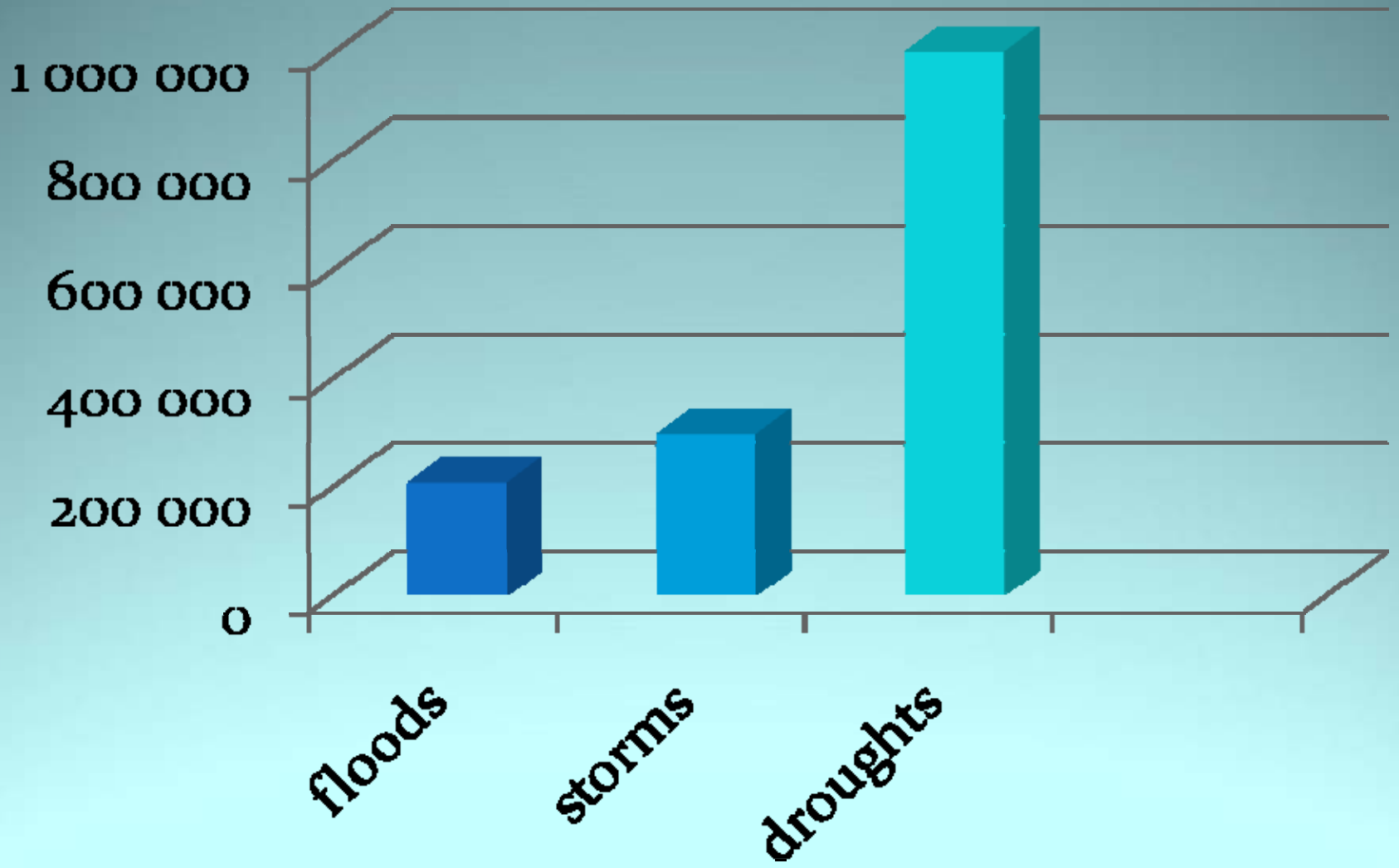
Peaks: **1987: drought in India, 300 millions affected,**

1991: Flood in China, 210 millions affected

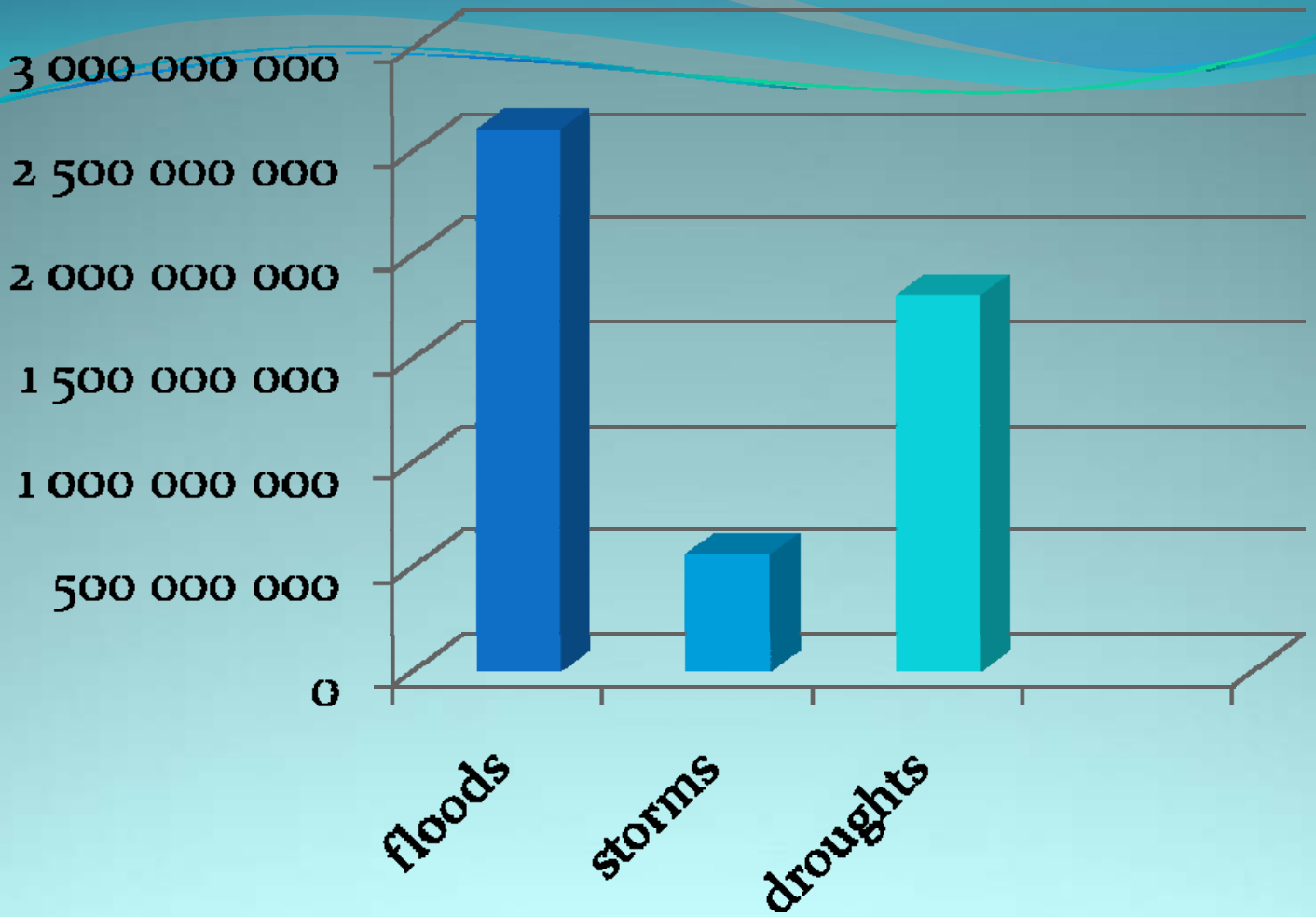
2002: China, 60 millions affected by flood , 100 by storm ,
60 by drought
India, 300 millions affected by drought



Number of floods, storms & droughts in past 30 years



Death toll during past 30 years



Number of people affected in past 30 years

Floods: 1 death for 13 000 people affected

Storms: 1 death for 1 900 people affected

Droughts: 1 death for 2 000 people affected

4/ The future

Potential consequences of climate change as considered by IPCC

- Very severe water problem in Africa, Middle East, South America, South Asia, South Europe
- Flood and drought cycles in Asia, around Himalaya
- Decline in food availability in China, Asia, Africa, South America
- Sea level rise impacts on populated areas
- Desertification will progress
- Consequences: - social tensions
  - huge migration of populations
  - diseases
  - wars for survival
  - USA & Europe close their frontiers.

5/The role of meteorology

In the past, weather had huge impacts.
With **global climate change**, risks are increased further.

Meteorologists should continue to

-make accurate observations
-deliver forecasts with high level of accuracy at short and long time scales
-improve long-term forecasts
-anticipate impact of climate change
-contribute to data collection of extreme events
-contribute to develop risk assessment and support risk identification
-cooperate with economists and other disciplines to prepare the future
-propose convincing analysis of trends inducing politicians to organize prevention and mitigation measures

5/The role of meteorology

In the past, weather had huge impacts.
With **global climate change**, risks are increased further.

Meteorologists: This is a noble task!

Year	World	Africa	Asia	Europe	Latin America	Northen America	Oceania
25000BC	**15**						
1000 BC	**50**						
1	**200**						
1000	**310**						
1750	**791**	**106**	**502**	**163**	**16**	**2**	**2**
1900	**1650**	**133**	**947**	**408**	**74**	**82**	**6**
1950	**2519**	**221**	**1399**	**547**	**167**	**172**	**13**
1975	**4068**	**408**	**2398**	**676**	**322**	**243**	**21**
2000	**6071**	**796**	**3680**	**728**	**520**	**316**	**31**
2005	**6454**	**888**	**3918**	**725**	**558**	**332**	**33**
2050	**8909**	**1766**	**5268**	**628**	**809**	**392**	**46**

Fig. 1 World's population in millions of individuals