Session III: Geohazards - Minimizing Risk, Maximizing Awareness

Grand Challenges on Natural and Human-induced Hazards and Disasters

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IYPE-Global Launch Event

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Hazard + Vulnerability
└▶Disaster

Disasters result when there is the interaction of a hazard and a vulnerability

Types:

NATURAL & HUMAN-INDUCED HAZARDS AND DISASTERS

Hydro-Meteorological Hazards & Disasters:

- **Floods**
- **Mass movements, e.g. erosion, landslides, siltation**
- **Heat Waves**
- **Wildfires**
- **Tropical cyclones, hurricanes**
- **Tornados, hailstorms, dust storms**

Types: Hazards & Disasters -cont-

Geological Hazards & Disasters:

- Earthquakes
- Volcanoes
- Tsunamis
- Collapse of constructions

Biological Hazards & Disasters:

- Diseases
- Pest Infestation
- Biological Weapons

Technological Hazards & Disasters:

- Air pollution (e.g., green-house gases)
- Water pollution (e.g., heavy metals-As, Pb, Cd)

Geohazards: Earthquake Induced Hazards

Fires
(1906 San Fransisco, USA)

Landslides
(2001 Cedar River, USA)

Tsunamis
(1946 Hilo, Hawaii)

Collapse of structures
(1995 Kobe, Japan)

Nyarigagongo: 1977 & 2002

Oldoinyo Lengai (Tanzania):

July 2006 – Overflow towards the west of the Hill

2001: Landslide in El Salvador:
caused by Earthquakes

(http://en.wkipedia.org/wiki/Image:Elsalvador)

Rainfall in Africa

Flooding in Burundi
Feb. 2007
Picture from BBC

Flooding in Mozambique
Feb. 2007
Picture from BBC

FLOODS:
Mozambique in 2000

- Affected 4 million people with estimated 700 deaths
- Losses amounting to ca. US$ 500 million
- GDP growth rate decreased from 10% to 2%

Primary cause:

(a) abnormal rainfall due to tropical cyclones causing excessive flows from 9-12 rivers with catchments in other countries, especially the Limpopo River

Contributory causes:

(a) Land degradation

(b) Deforestation of the Limpopo River catchment area

(c) Increased population density along river banks

Drought: Example in Dertu, Kenya

DROUGHT - Global Level:

By 2080s:

Arid and semi-arid landmasses in Africa will increase by 5-8%.

By 2090s:

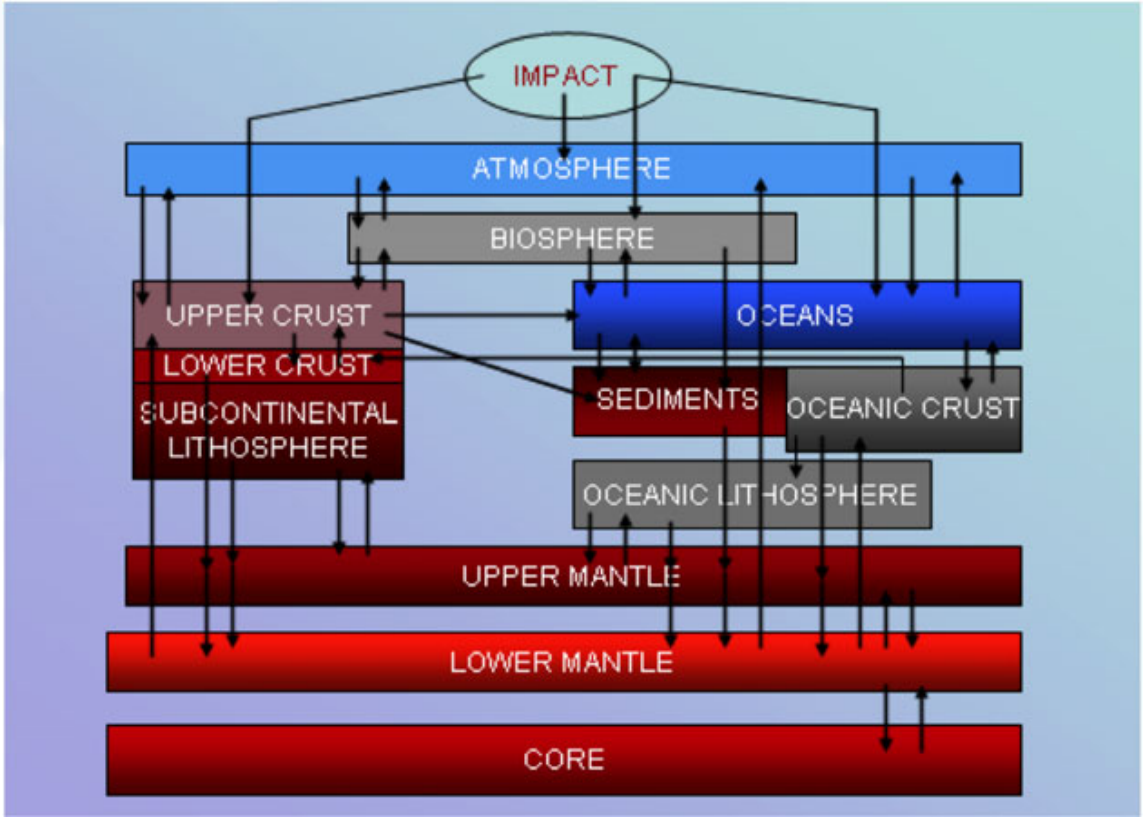
Globally - The LAND AREA in DROUGHT will increase from 1% in the present day to:

- **30 % for Extreme Drought**
- **40 % for Severe Drought**
- **50 % for Moderate Drought**

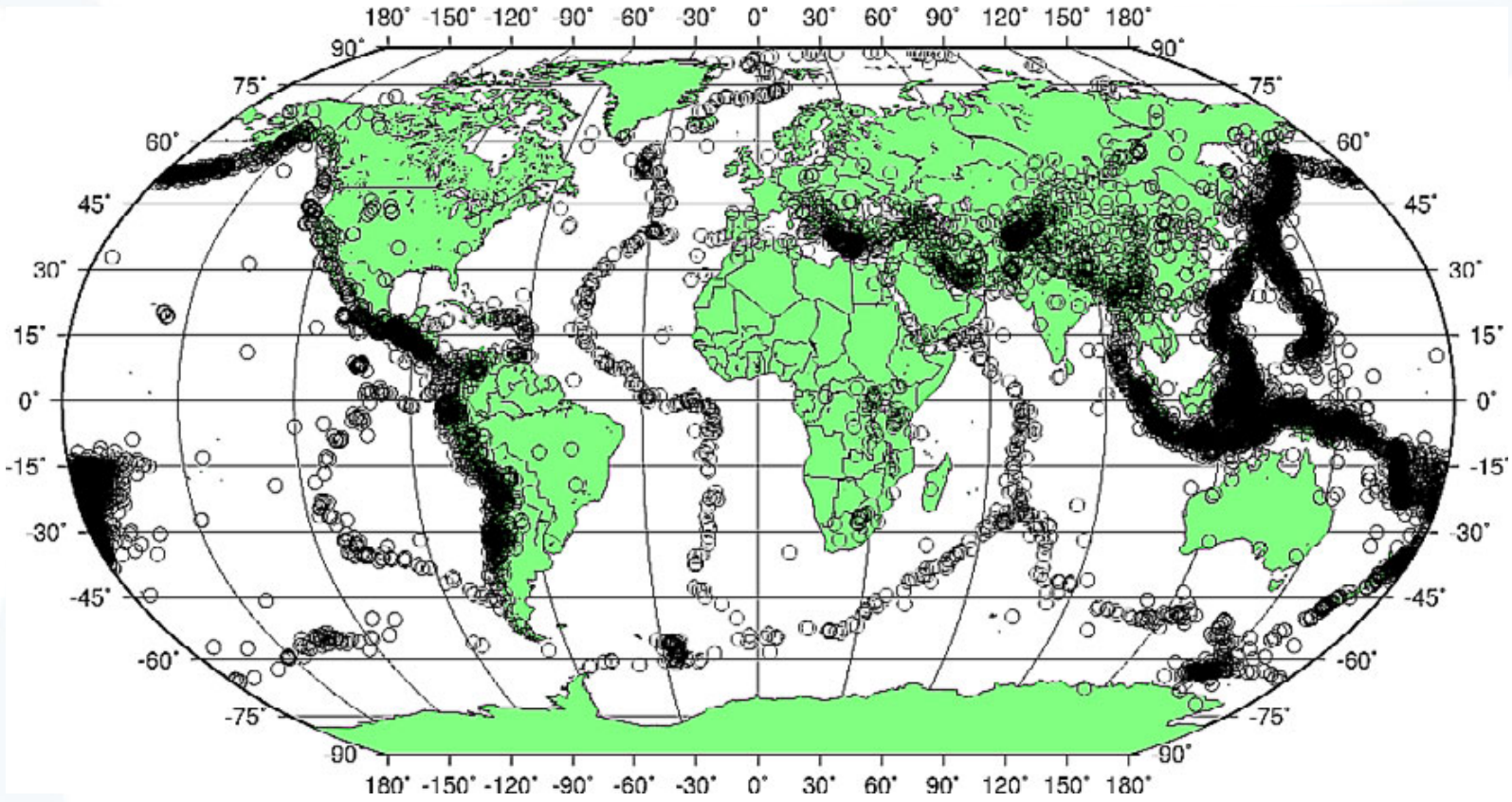
Science of Climate Change & Adaptation:

The Earth System – complex interaction between

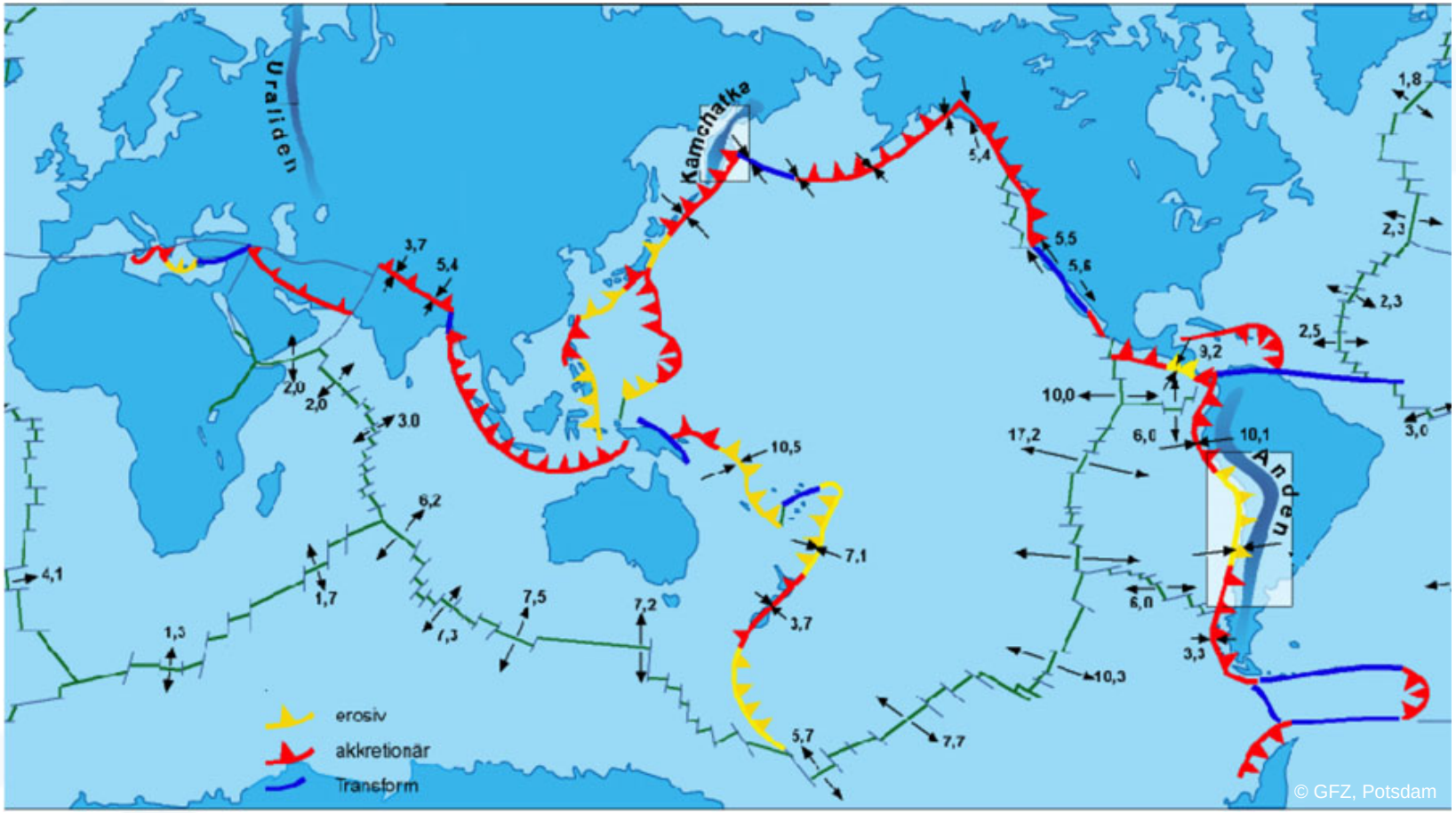
core-mesosphere-asthenosphere-lithosphere-biosphere-atmosphere



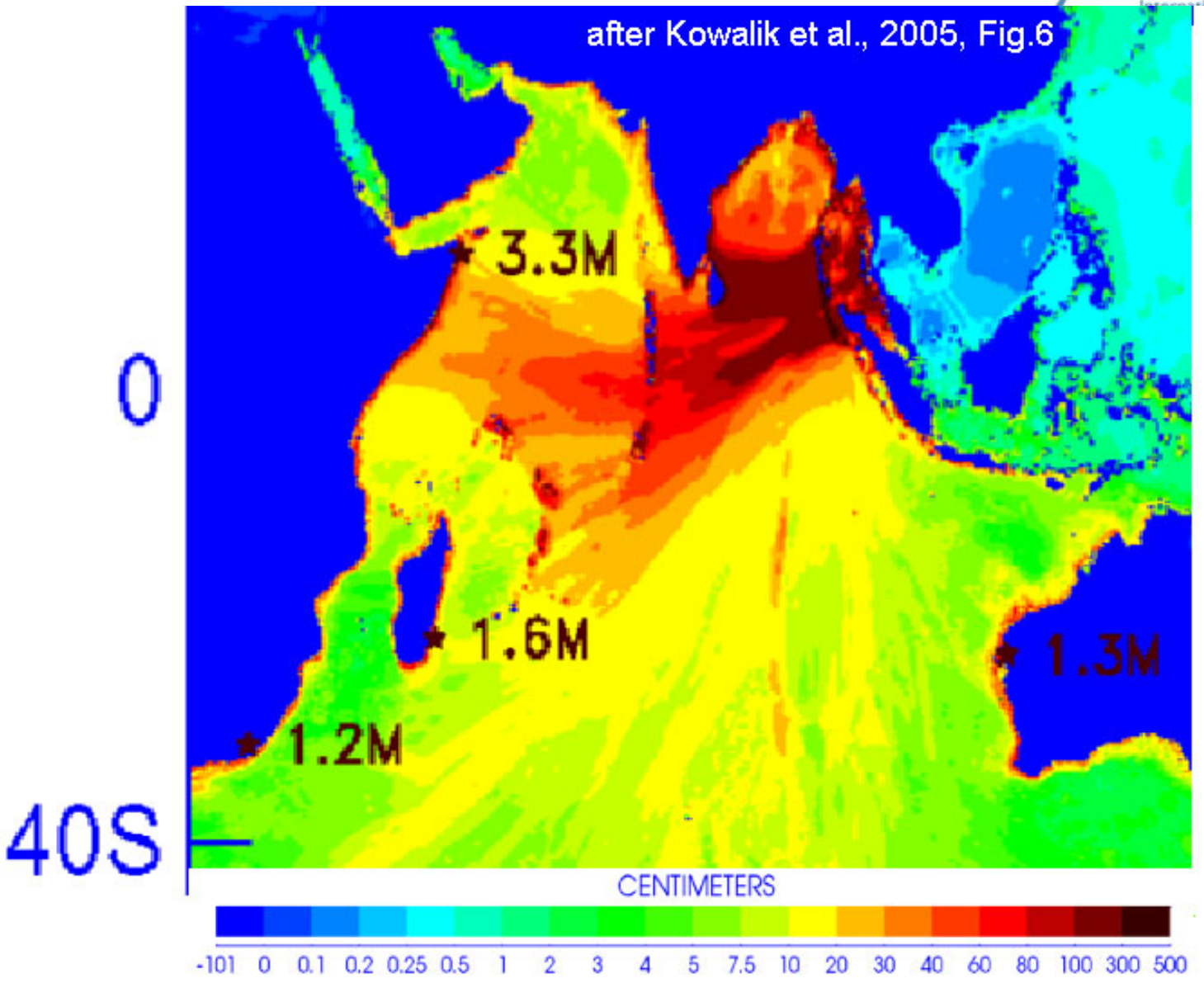
Global Seismicity



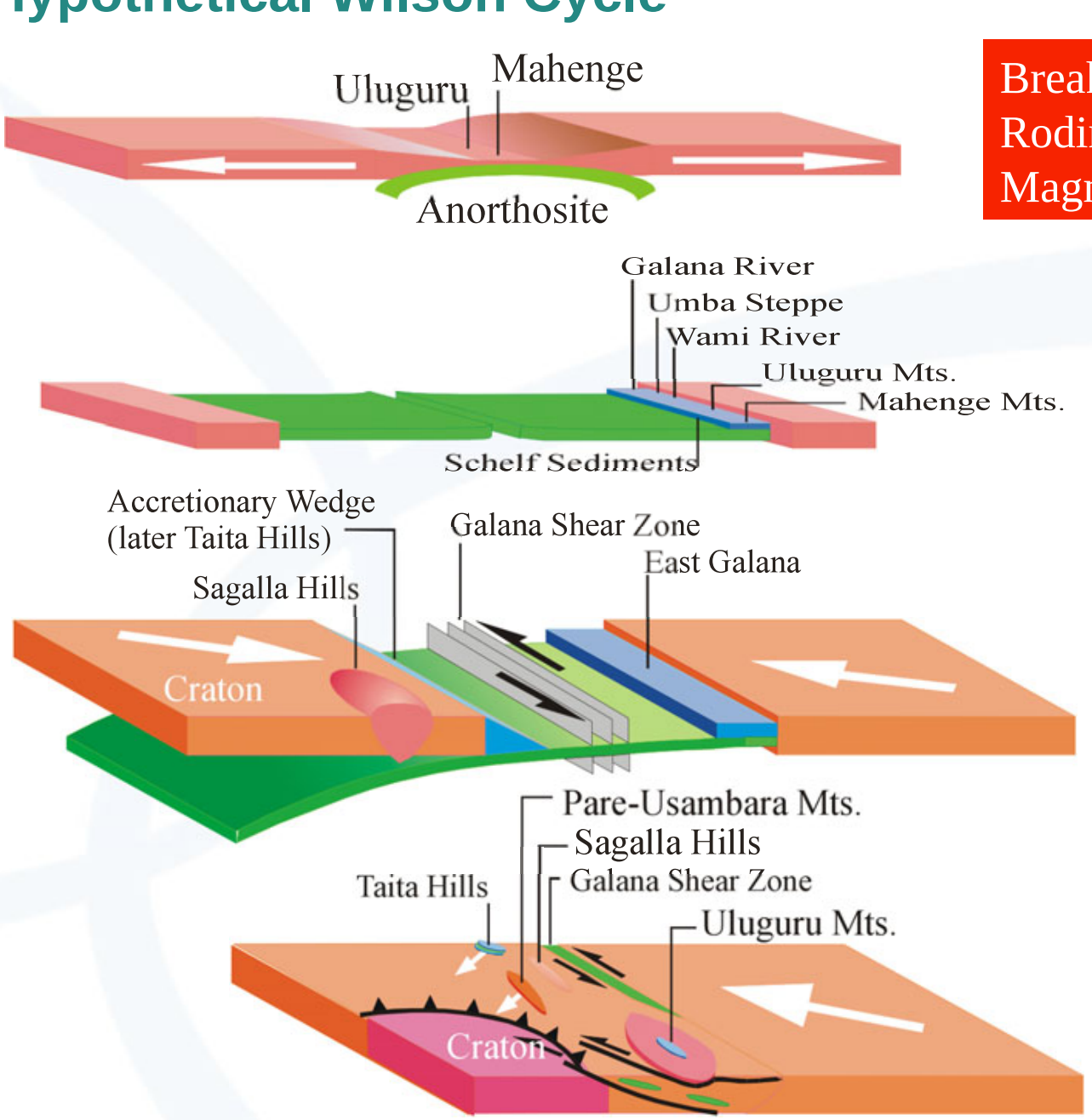
The threat and major source for tsunamis



Tsunamis:
Wave Amplitude Model – 26 Dec 2004



Hypothetical Wilson Cycle



Breakup: Continental Rifting
Rodinia Supercontinent
Magmatic Age: 950 – 850 Ma

Oceanic Stage
(passive margins)

Accretion Stage

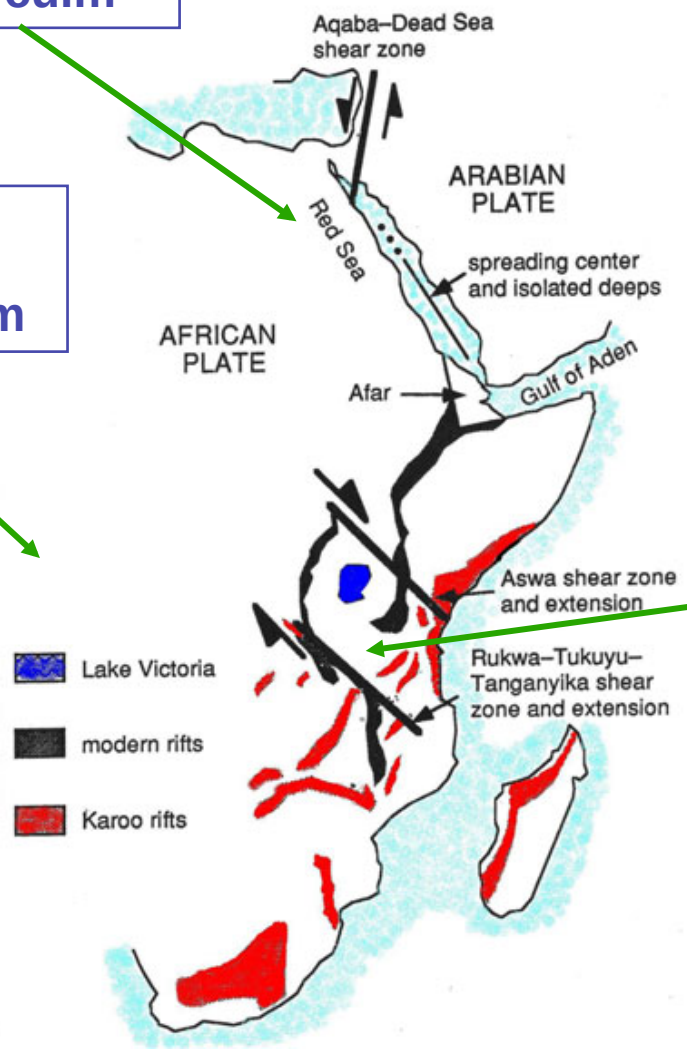
Continent-Continent-
Collision Stage
Gondwana Supercontinent
650 – 580 Ma

Egypt

1,500 billion cu.m

Cameroon

1.1 billion cu.m



Examples of Africa's Phanerozoic Energy Resources: Gas Reserves

Tanzania

56 billion cu.m

Electricity generation:

Dec 2004: 180 MW

Requirement ca 600 MW

World Map of Natural Hazards

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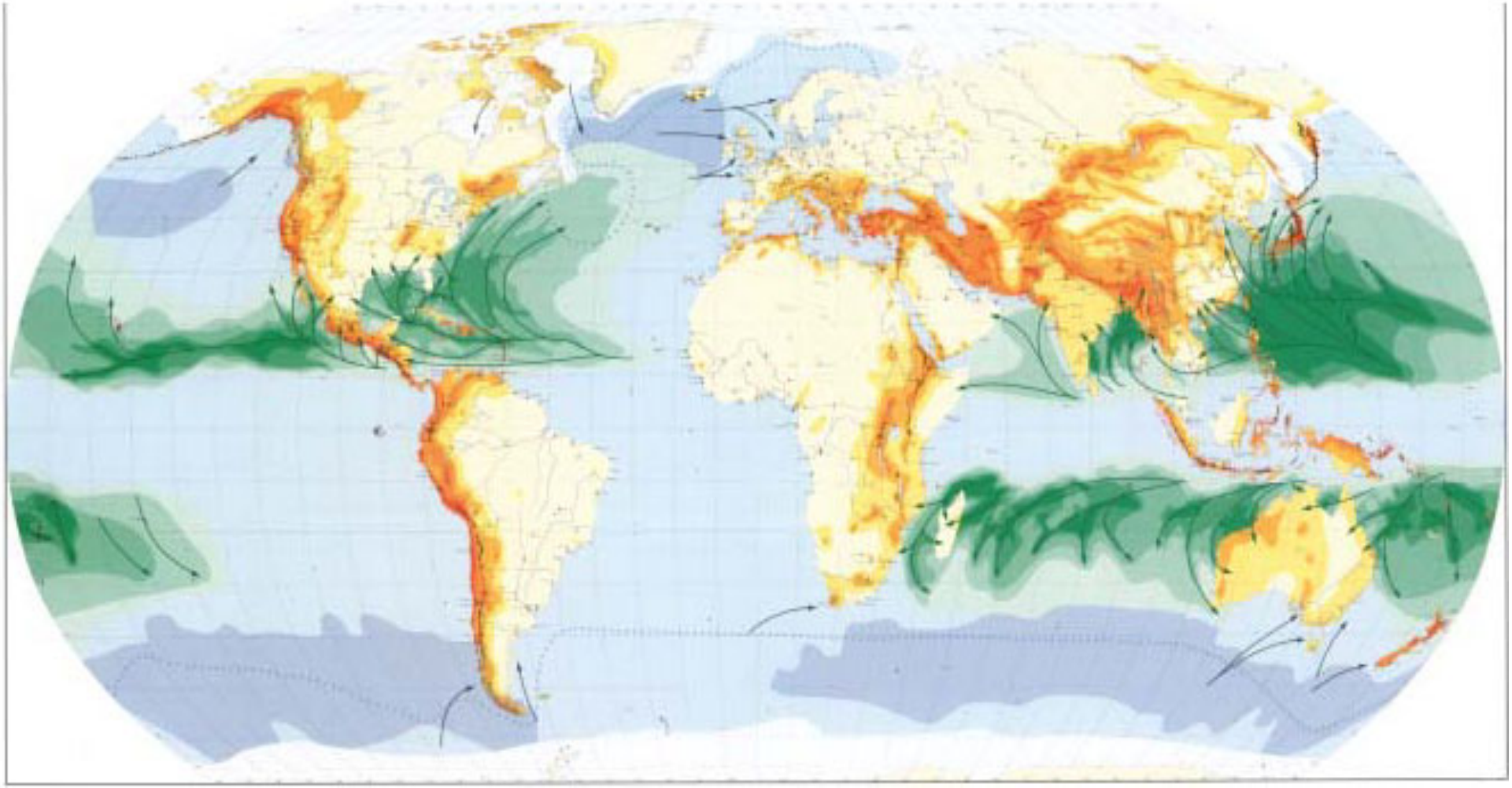
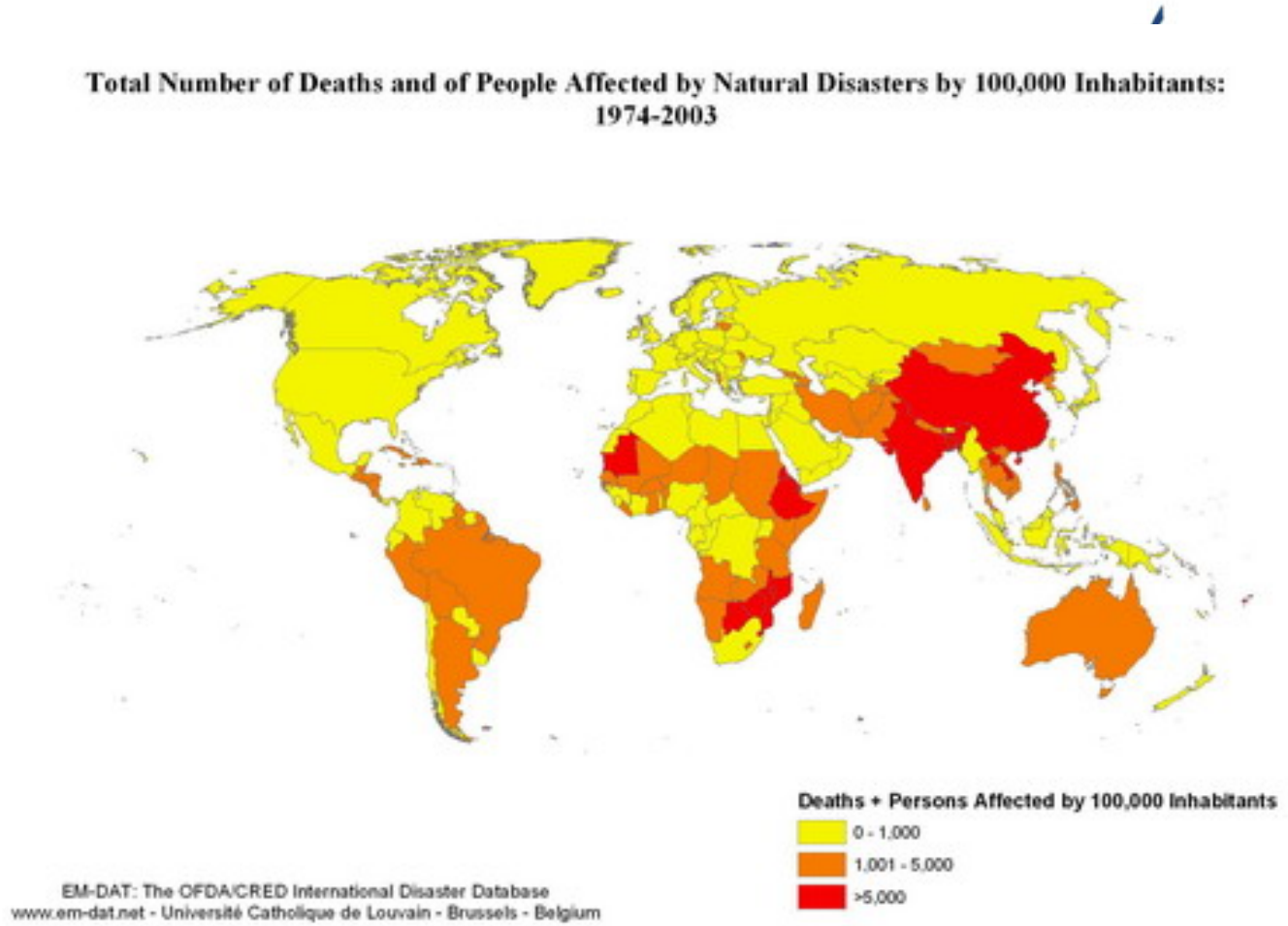
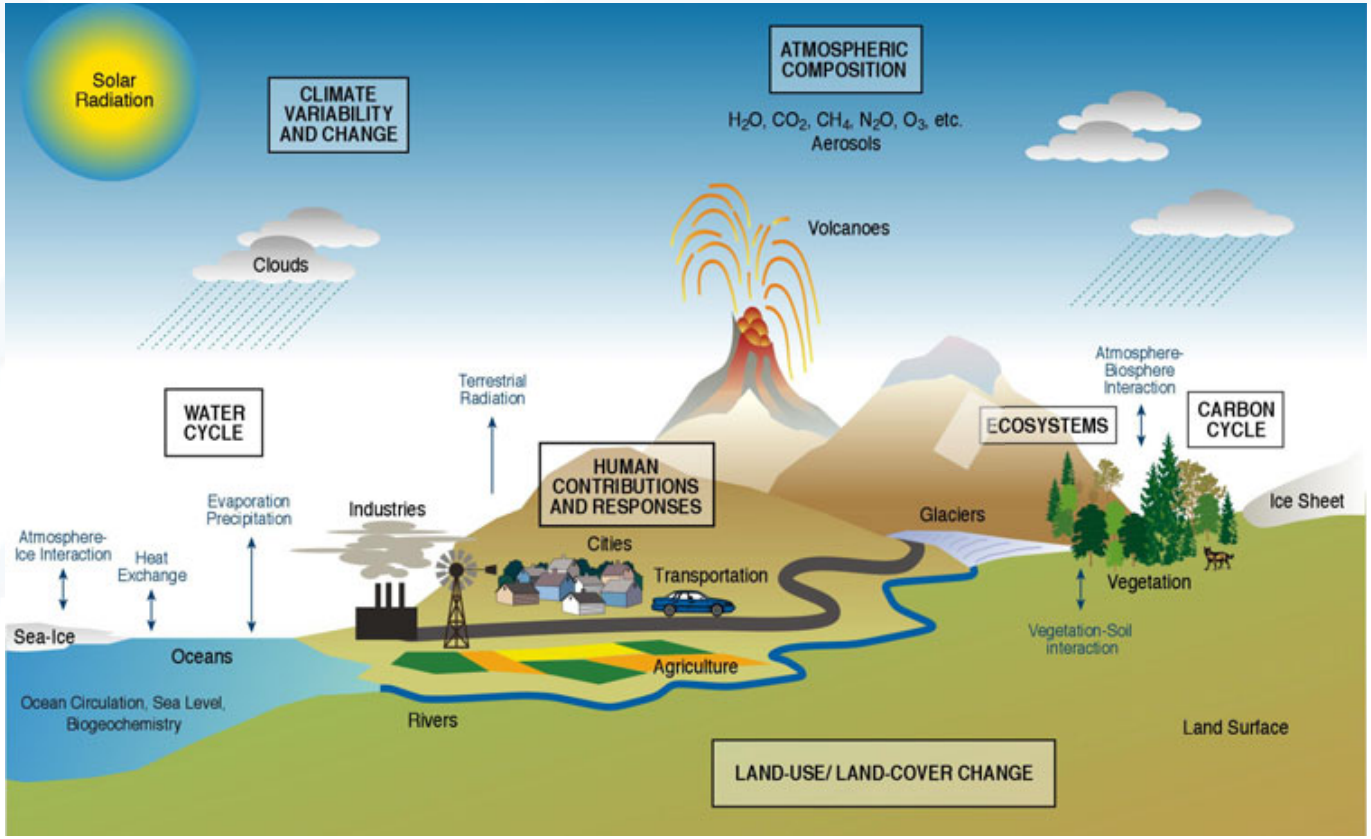




Hazards:1974-2003

Africa, Asia & Latin America are the main victims

The Earth:
complex processes within a system of complex systems



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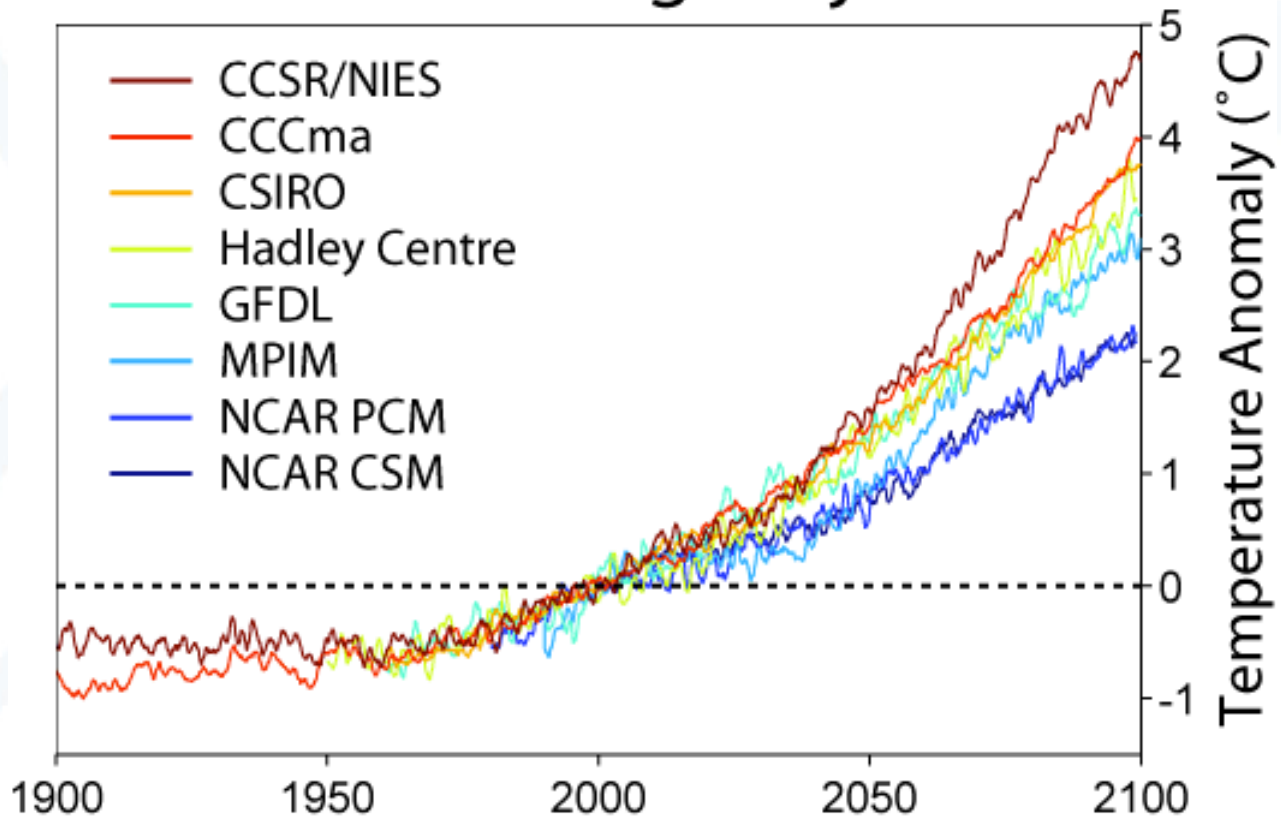
Global Warming Projections



The Climate Change threats: Global Warming

- **Since 1860 Global Temperature Rise is: 0.6±0.2^{0}C**
- **Last 2 decades were the hottest in this century**
- **20th Century:**

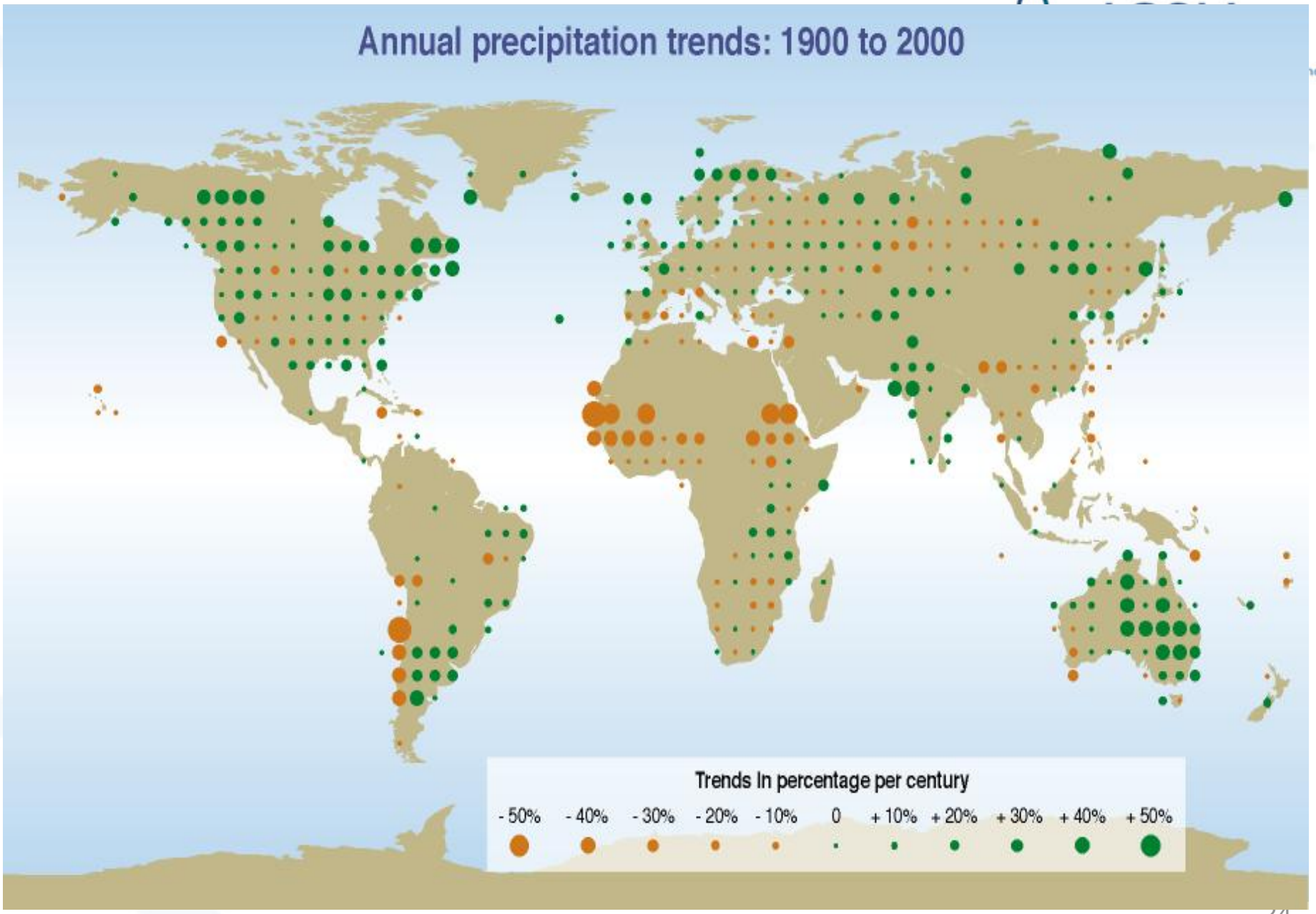
  Average atmospheric temperature rise of 0.7 ºC in Africa

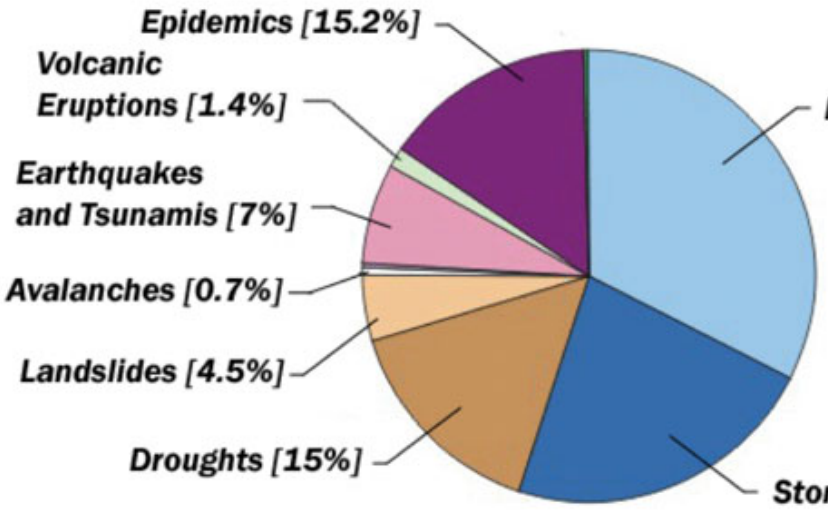
- **Since 1950:**

  Sea surface temperature rise: + 1ºC in the Indian ocean

- **Projections – Rainfall –**
  - Increased frequency of floods
  - Increased frequency and duration of droughts

Precipitation patterns have changed

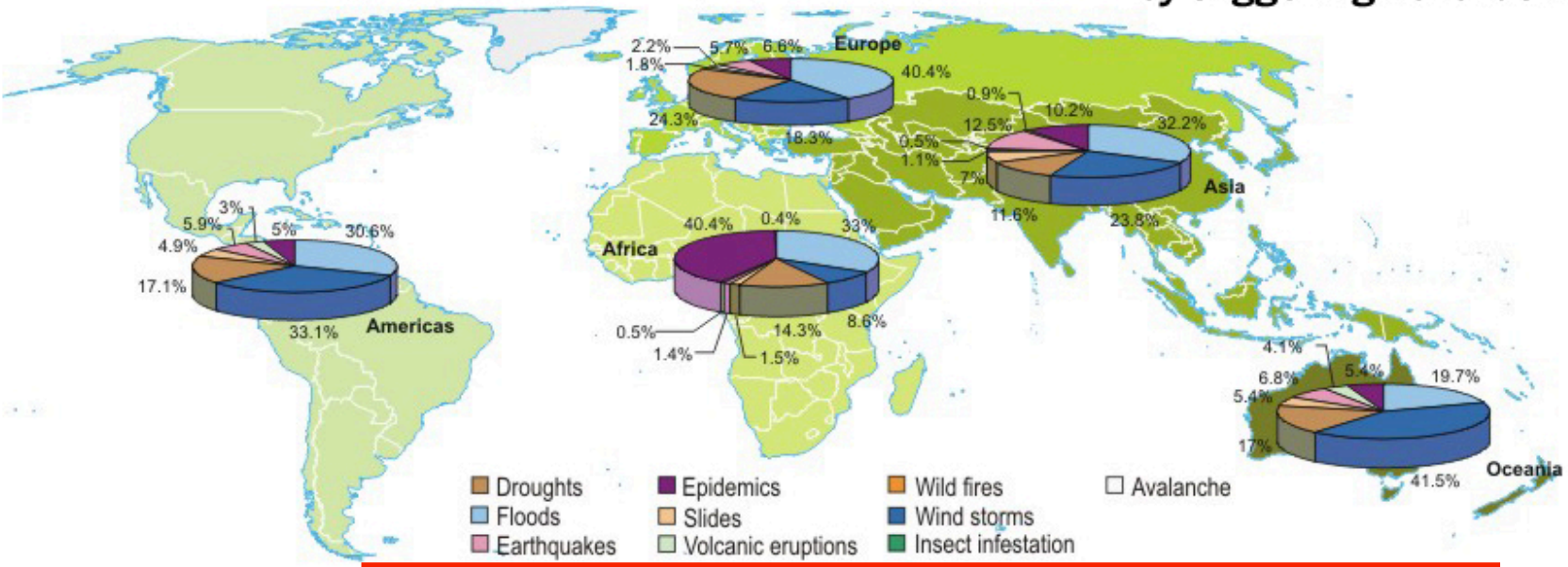




World distribution of disasters: by triggering hazards 1994-2003

Floods, storms, droughts, …>75%

Regional distribution of disasters: by triggering hazards 1994-2003

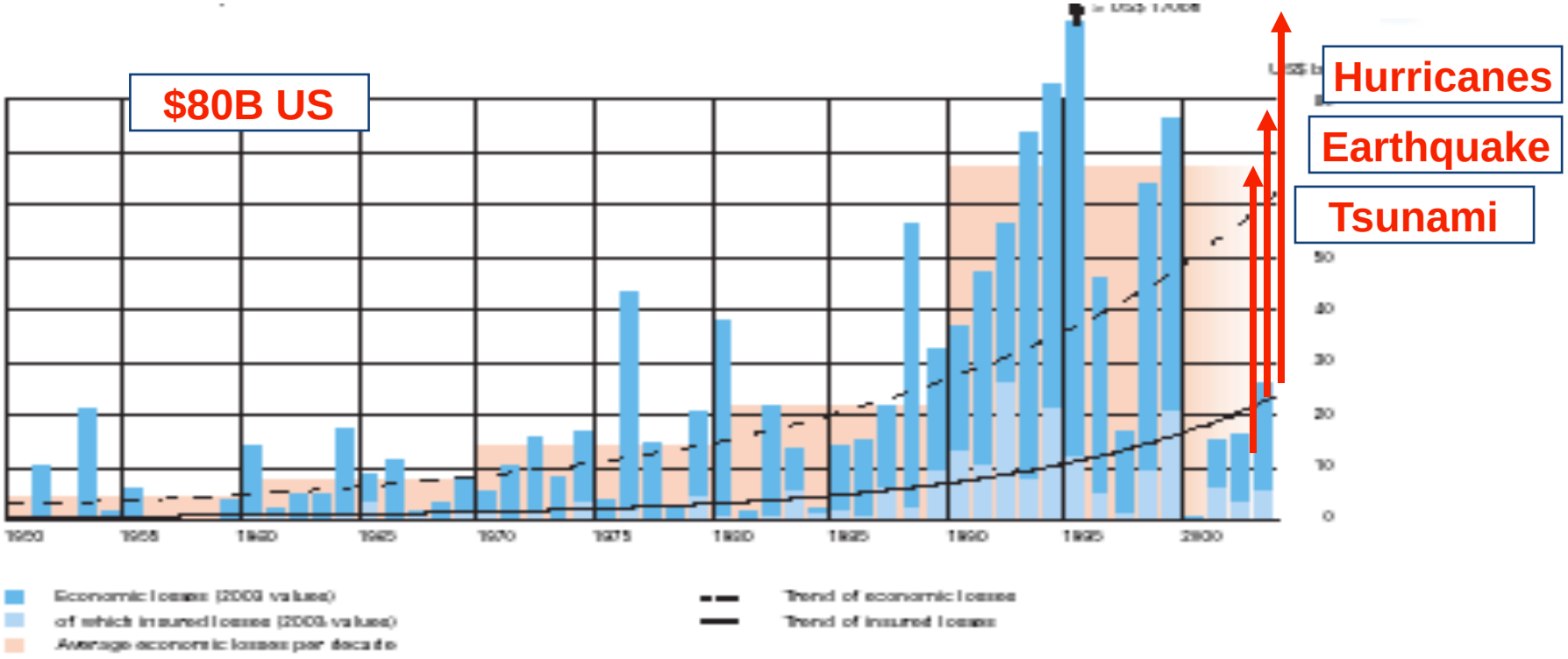


Earthquakes, tsunamis -7% - horrific

Distribution of natural disasters: by origin
(1900-2003, by decades*)

65 99 200 280 470 PER YEAR

	1900-1909	1910-1919	1920-1929	1930-1939	1940-1949	1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2003	Total
Hydrometeorological	28	75	56	74	128	280	511	795	1575	2139	1444	7105
Geological	36	26	32	38	53	58	94	128	234	283	152	1134
Biological	5	12	10	3	3	3	40	65	167	351	297	956
Total	69	113	98	115	184	341	645	988	1976	2773	1893	9195



Estimated total loss of $140B US in 2004 due to natural disasters

Global Impacts of Natural Hazards

FOOD SECURITY:
feeding the hungry world

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Population

1999 6 billion people

2050 9 billion people

90% of population will be in the South

Poverty:

1.3 billion afflicted by poverty

Malnutrition

840 million people suffer from malnutrition

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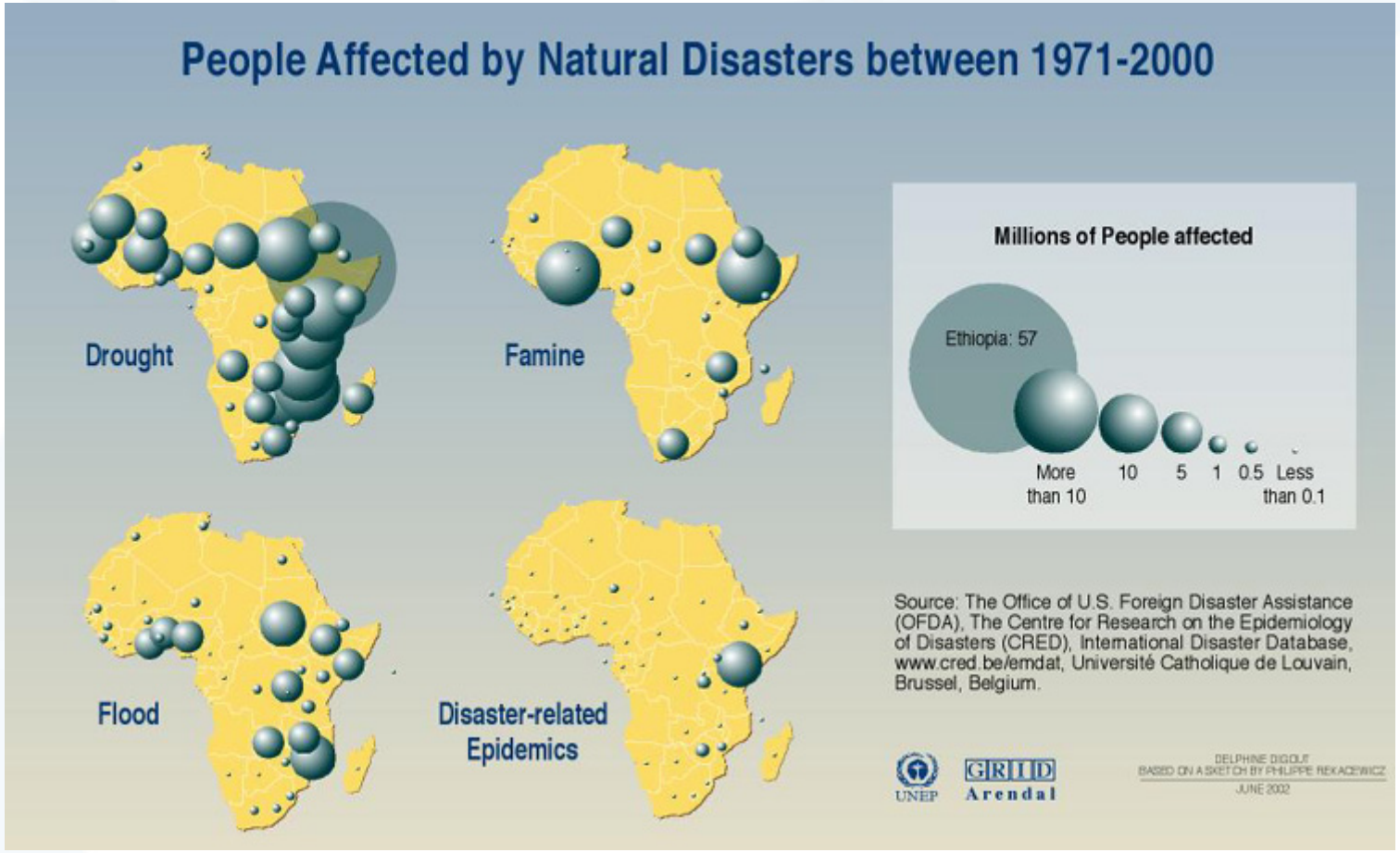
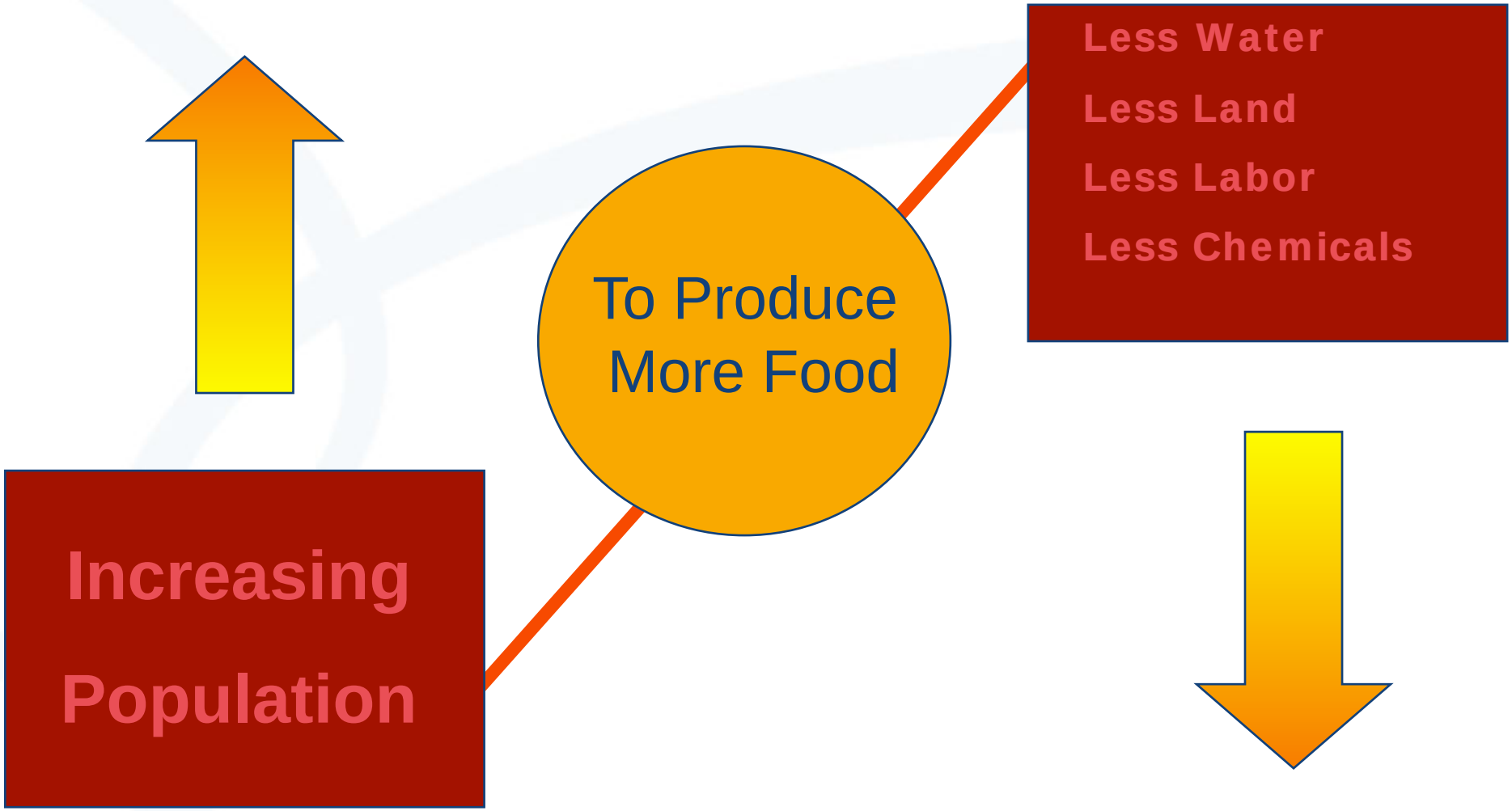


STI: Future Challenges



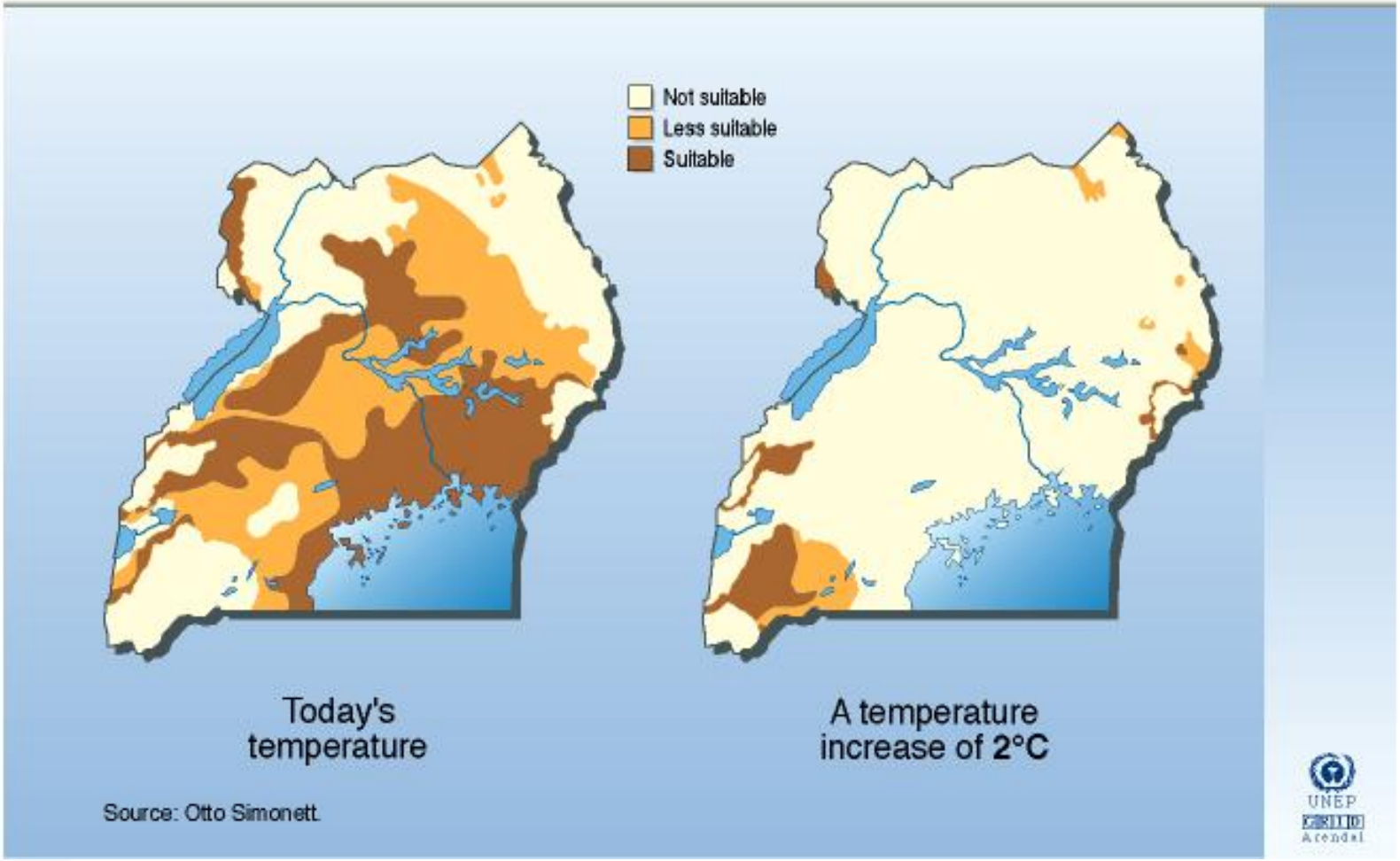
The science of Climate Change and Adaptation: Global Warming

GHGs changing due to **Human Activities:**

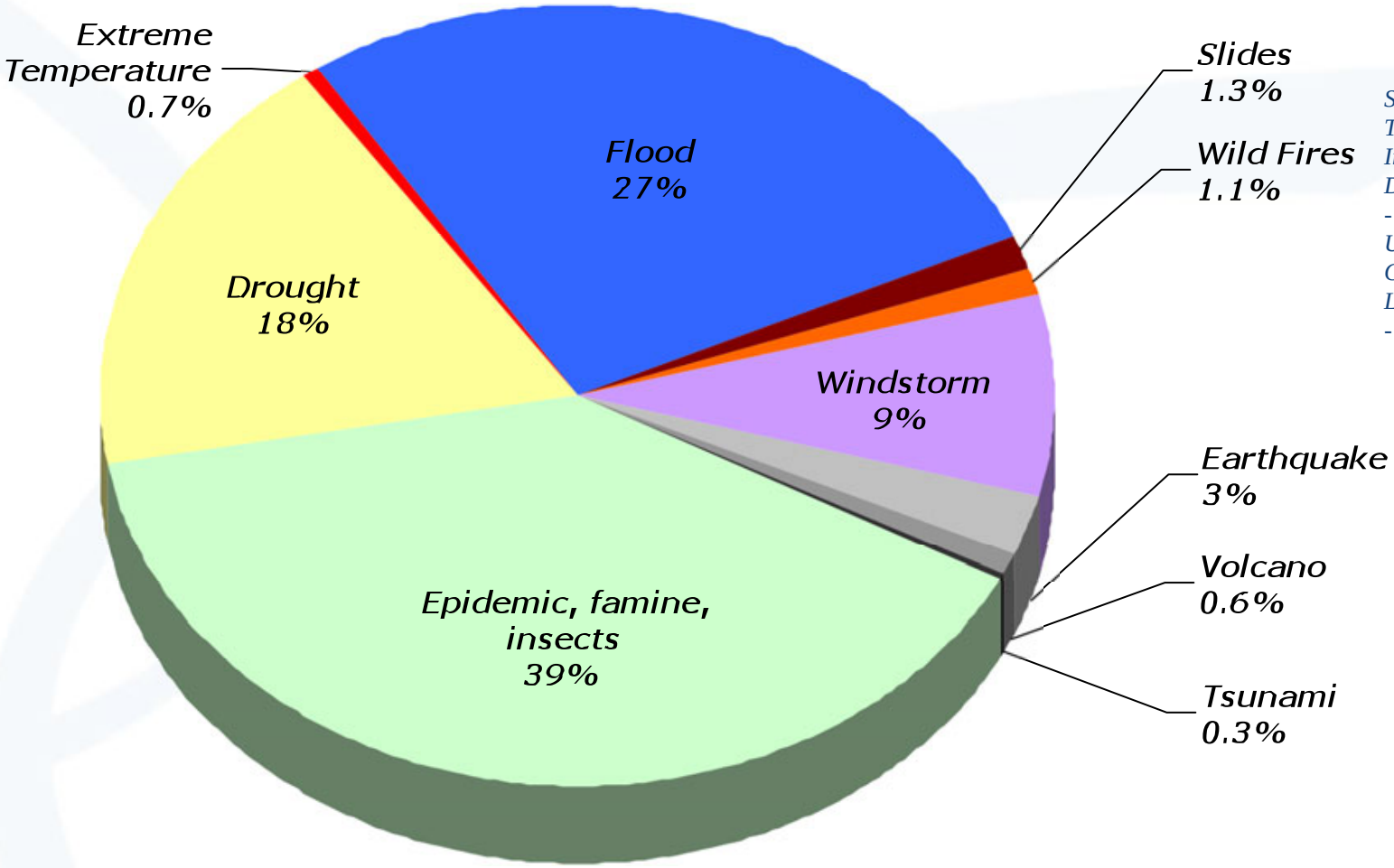
- **since pre-Industrial Era (~ 1750)**
  - **CO2 by 30%**
  - **CH4 by over 100%**
  - **N2O by 15%**

concentrations are higher now than any time during the last 420,000 yrs

Suitability for the production of Robusta Coffee in Uganda

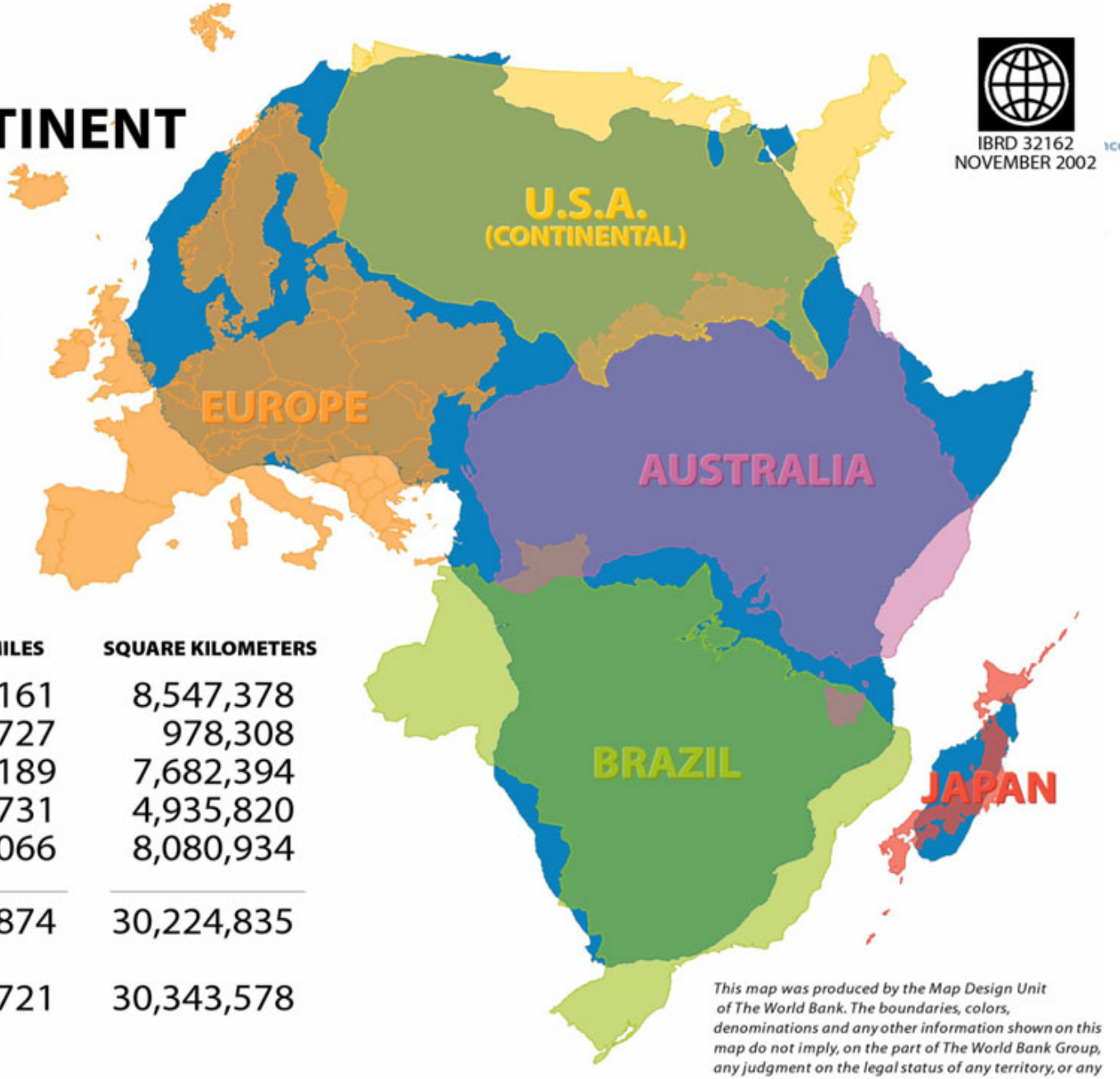


Distribution of Natural Disasters Events in Africa (1980-2005)

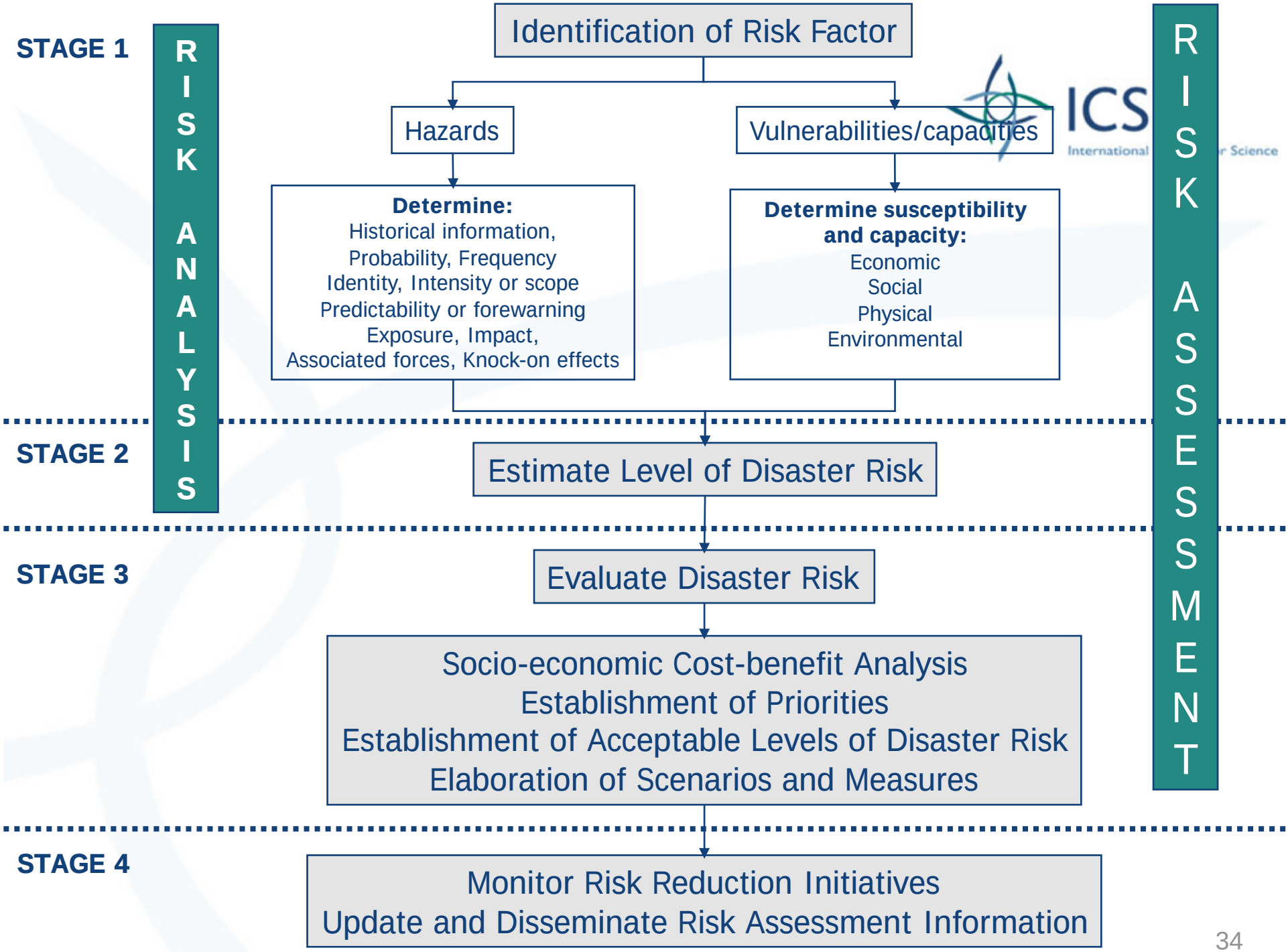


Source: EM-DAT: The OFDA/CRED International Disaster Database - www.em-dat.net - Université Catholique de Louvain - Brussels - Belgium

SIZE OF THE AFRICAN CONTINENT COMPARED TO OTHER LAND MASSES



	SQUARE MILES	SQUARE KILOMETERS
BRAZIL	3,300,161	8,547,378
JAPAN	377,727	978,308
AUSTRALIA	2,966,189	7,682,394
EUROPE	1,905,731	4,935,820
U.S.A. (Continental)	3,120,066	8,080,934
TOTAL	11,669,874	30,224,835
AFRICA (including MADAGASCAR)	11,715,721	30,343,578


STAGE 1
RISK ANALYSIS
Identification of Risk Factor
Hazards
Vulnerabilities/capacities
Determine:
Historical information,
Probability, Frequency
Identity, Intensity or scope
Predictability or forewarning
Exposure, Impact,
Associated forces, Knock-on effects
Determine susceptibility and capacity:
Economic
Social
Physical
Environmental
STAGE 2
Estimate Level of Disaster Risk
STAGE 3
Evaluate Disaster Risk
Socio-economic Cost-benefit Analysis
Establishment of Priorities
Establishment of Acceptable Levels of Disaster Risk
Elaboration of Scenarios and Measures
STAGE 4
Monitor Risk Reduction Initiatives
Update and Disseminate Risk Assessment Information
RISK ASSESSMENT
ICS
International

STI Reality in Africa

Number of scientists/engineers vs. population:

Africa: less than 1 per 10,000

Asia & Europe: 2-5 per 10,000

- **Brazil produces > 10, 000 PhDs per annum**

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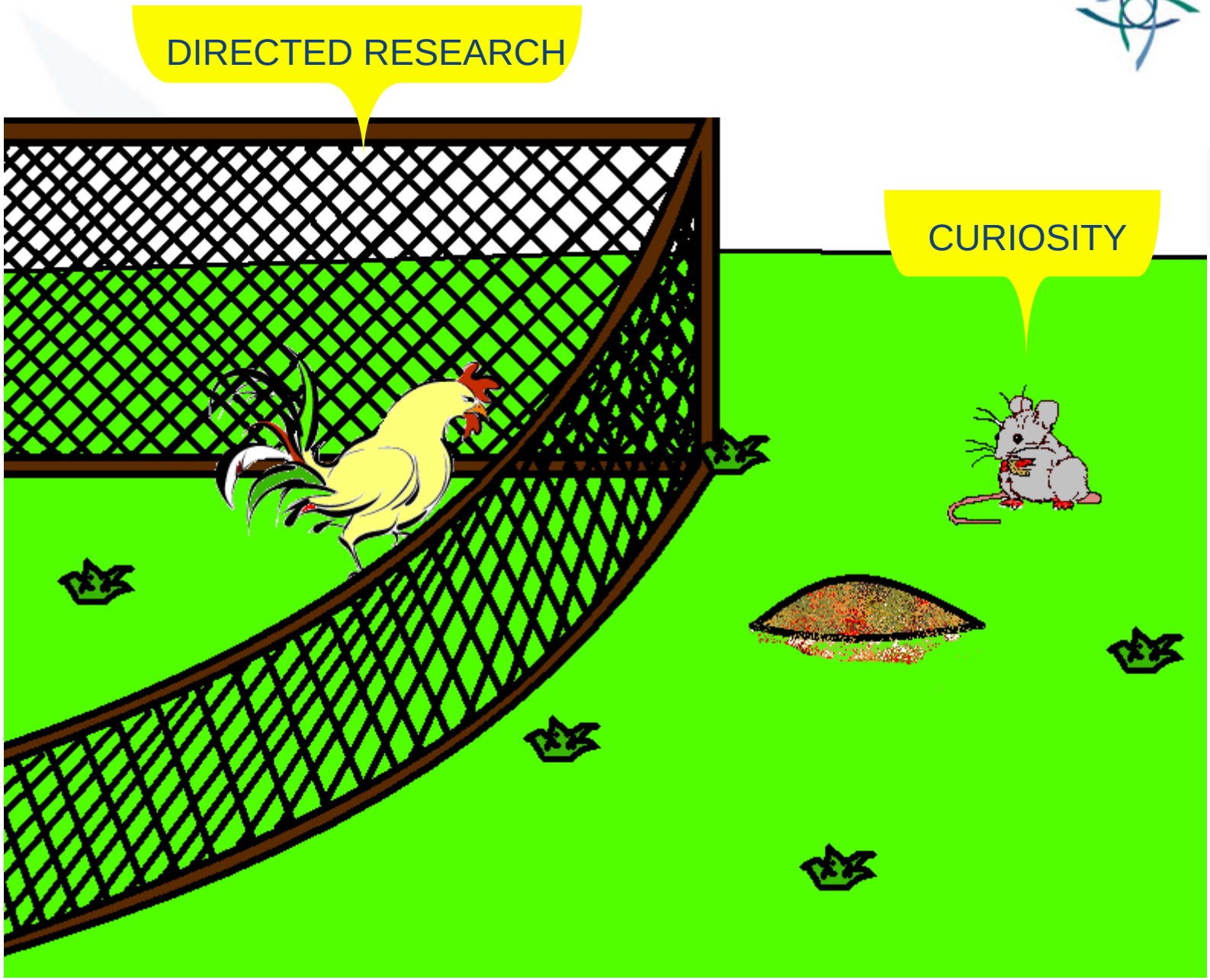


ICSU ROA Science Plan:
Natural and Human-induced Hazards and Disasters

Selected Research Themes:

- Creation and maintenance of a multidisciplinary hazards database
- Vulnerability science
- Science and policy linkage
- Integrated modelling of multiple disasters
- Geo-hazards (UN-proclaimed IYPE)

Projects under preparation:

Project I: Geo-hazards and disasters in sub-Saharan Africa (e.g., earthquakes, volcanoes, tsunamis) within the framework of UN-proclaimed IYPE

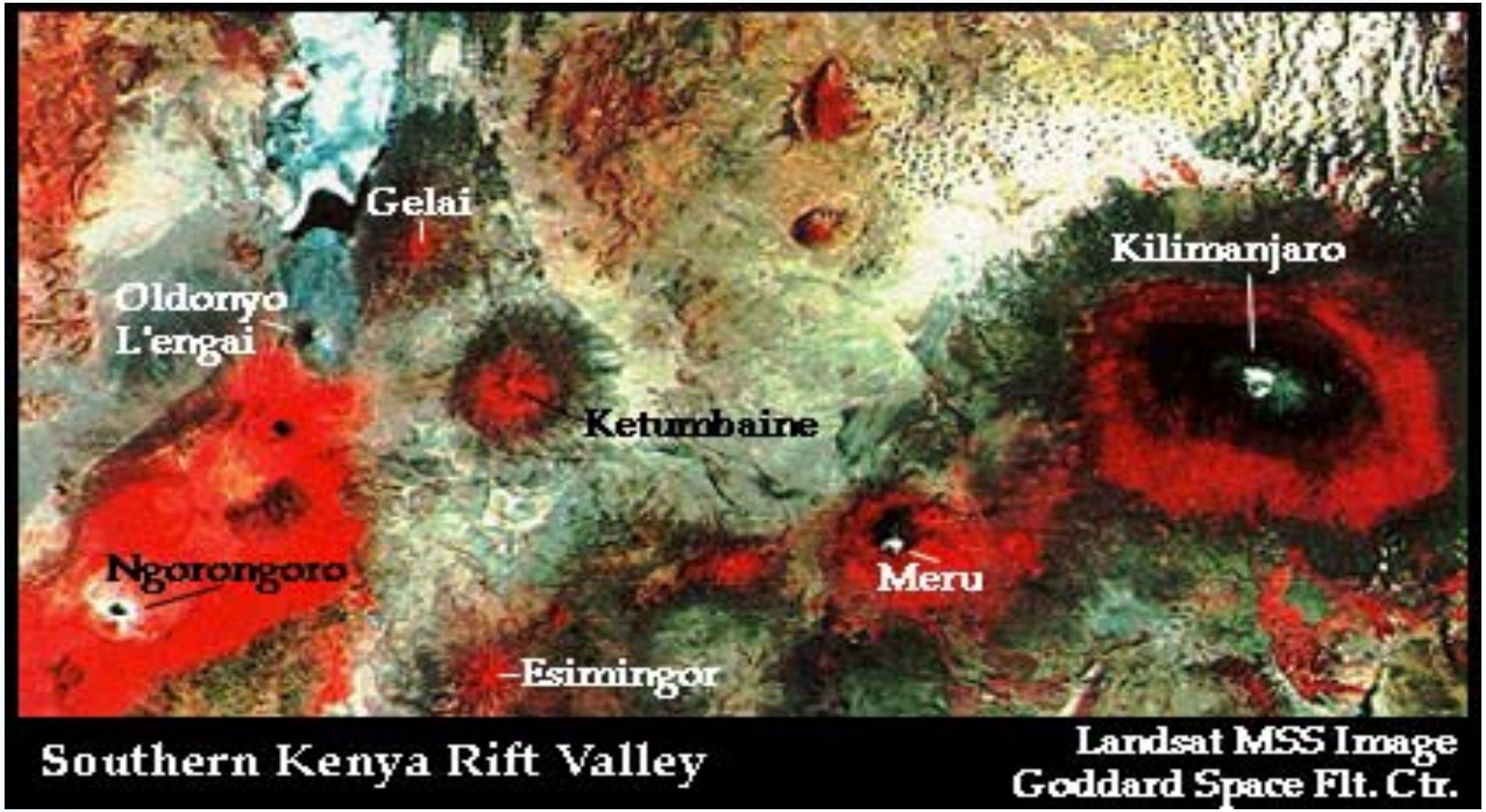
Project II: Hydro-meteorological hazards and disasters in sub-Saharan Africa (e.g., floods, droughts, wildfires, landslides, tropical cyclones)

The Hyogo Framework for Action

"The starting point for reducing disaster risk and for promoting a culture of disaster resilience lies in the knowledge of the hazards and the physical, social, economic and environmental vulnerabilities to disasters that most societies face, and of the ways in which hazards and vulnerabilities are changing in the short and long term,…."

Kyoto Protocol expires in 2012!

Space Science and Technologies (SST):
A Satellite Image showing volcanoes in northern Tanzania



Investment in STI: Global partnership

In 2006 USA: Expenditure on R&D

Estimated Total: US$ 340 billion

18% (US$ 62 billion): Basic Research

22% (US$ 75 billion): Applied Research

60% (US$ 203 billion): Development

In 2006 USA: Source of funding:

60% Federal Government

17% Industry

23% Private Foundations, Academic Institutions, Other Government Entities

STI: New Paradigm for Global Partnership

Rhetoric ⟶ Action

Plans / Reports / Declarations ⟶ Usable Products

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