United Nations Educational, Scientific and Cultural Organization

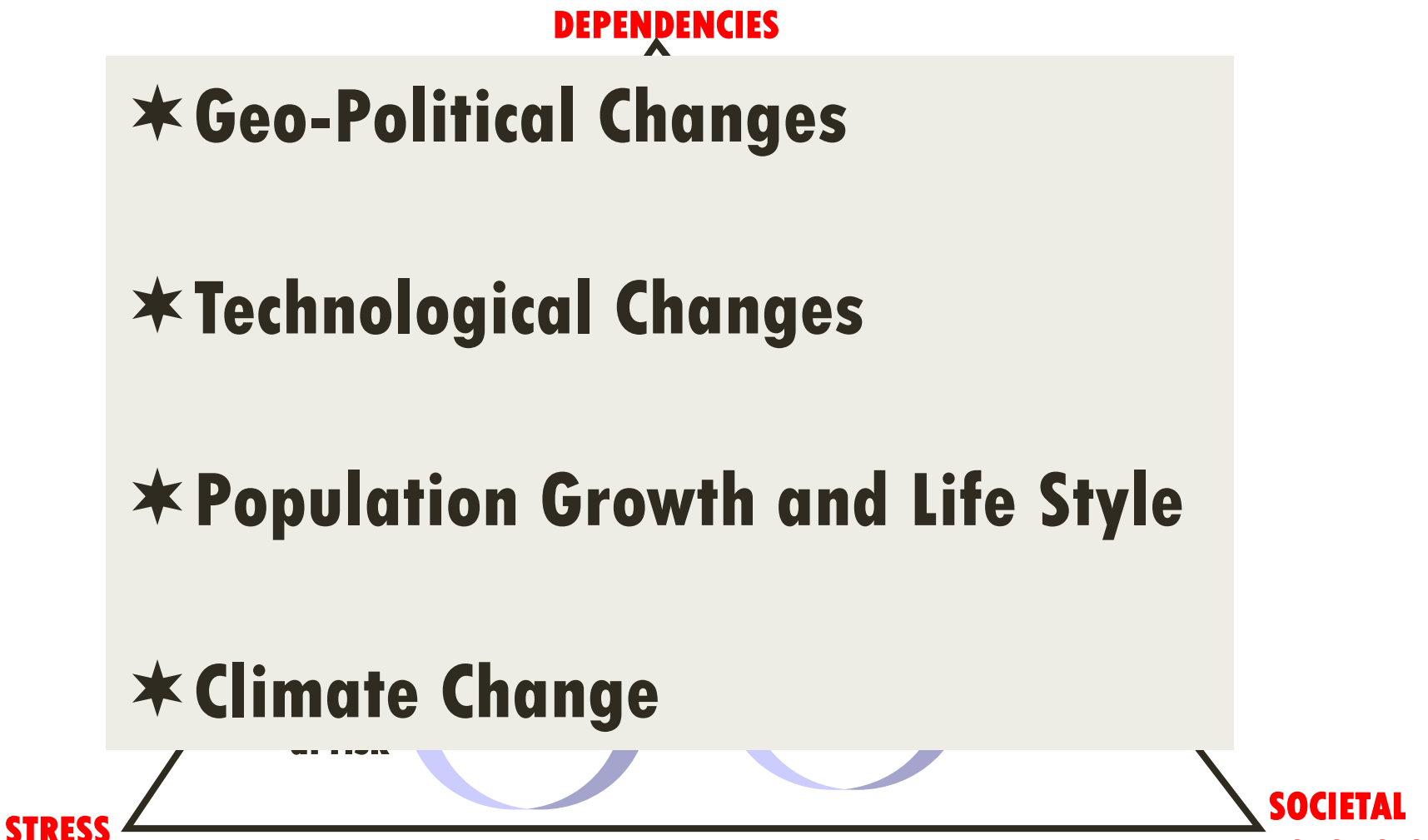
Natural Sciences Sector

UNESCO Science for Sustainable Development

Climate Change Adaptation and IWRM

Dr. R. Jayakumar
UNESCO Bangkok
r.jayakumar@unesco.org

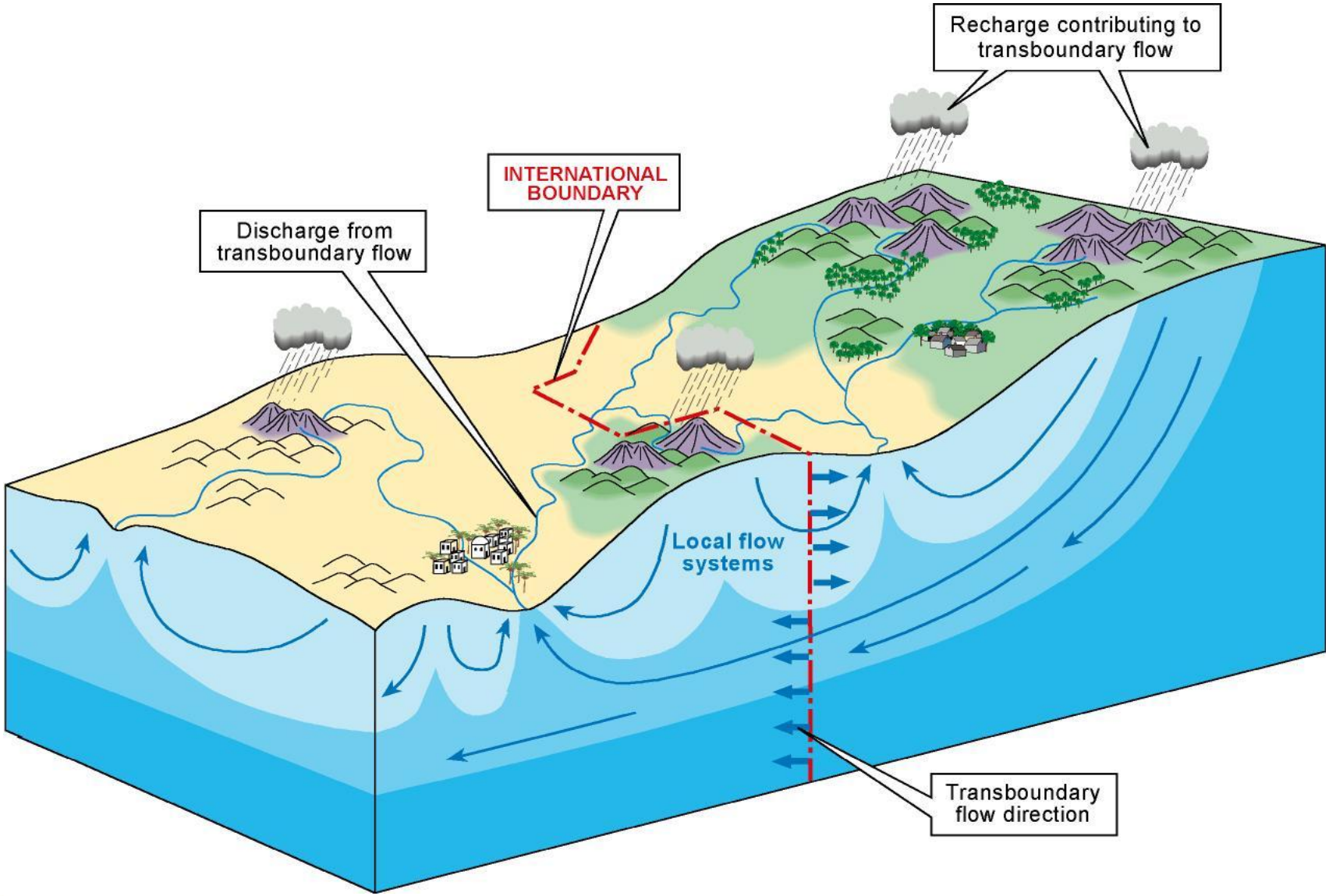
Hydrological System



Geo-Political Issues

- Trans-boundary Waters
  - 90% of worlds population lives in countries sharing international rivers
  - more countries are experiencing water stress (supply < 1700m3/person annually)
  - as water scarcity faces high demands transboundary competition for shared rivers and water resources grow
  - mechanisms(instituitions)to manage water resource disputes are absent or unsatisfactory
  - Since transboundary waters extend hydrological interdependence among nations and countries, managing this interdependence is a crucial task for international community

Trans-boundary Aquifers



United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

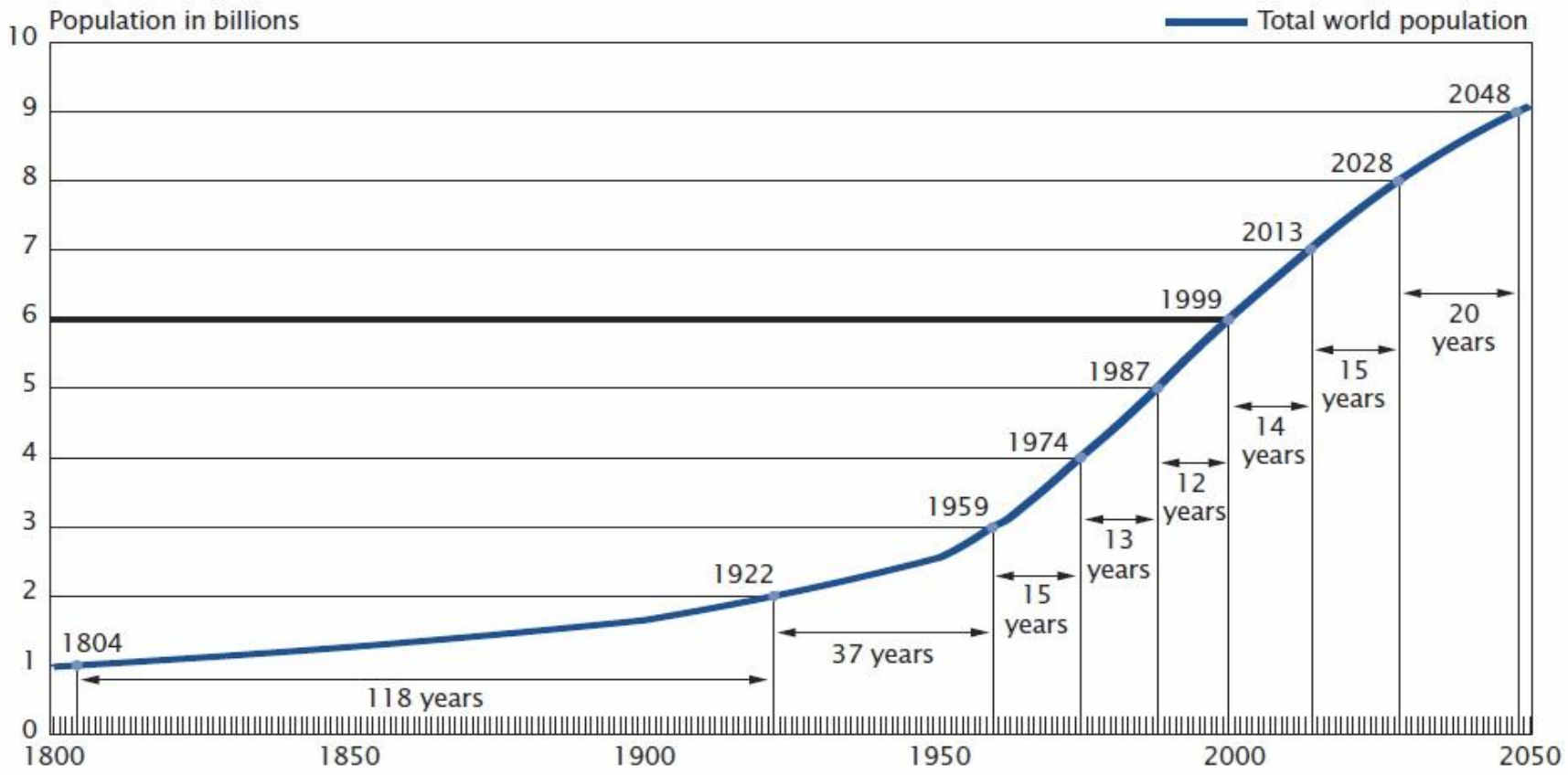
UNESCO Bangkok

Technological Changes

- Uncertain Climate Futures
- Increased Emission a reality
- Crop Yield Vs Climate Change
- Agricultural Vs Domestic Vs Industrial
- Living with extremes

World Population Crisis

Figure 1.
Time to Successive Billions in World Population: 1800-2050
The sixth billion accrues to world population in record time!



Source: United Nations (1995b); U.S. Census Bureau, International Programs Center, International Data Base and unpublished tables.

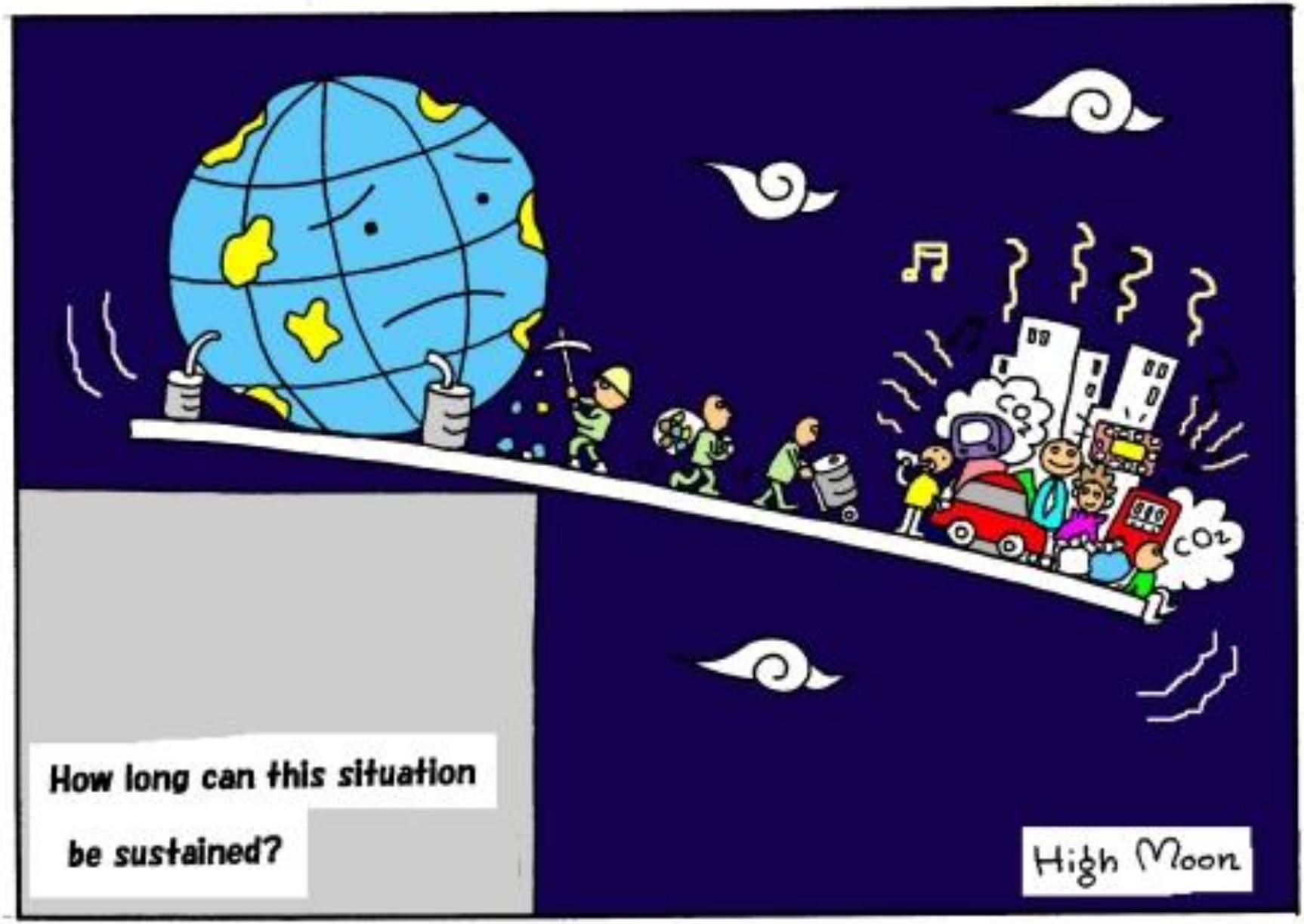
Population

United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

Increasing Demands = Increasing Competition

- "Competition for water exists at all levels and is forecast to increase with demands for water in almost all countries. In 2030, 47% of world population will be living in areas of high water stress."

WWDR3, Chapter 9

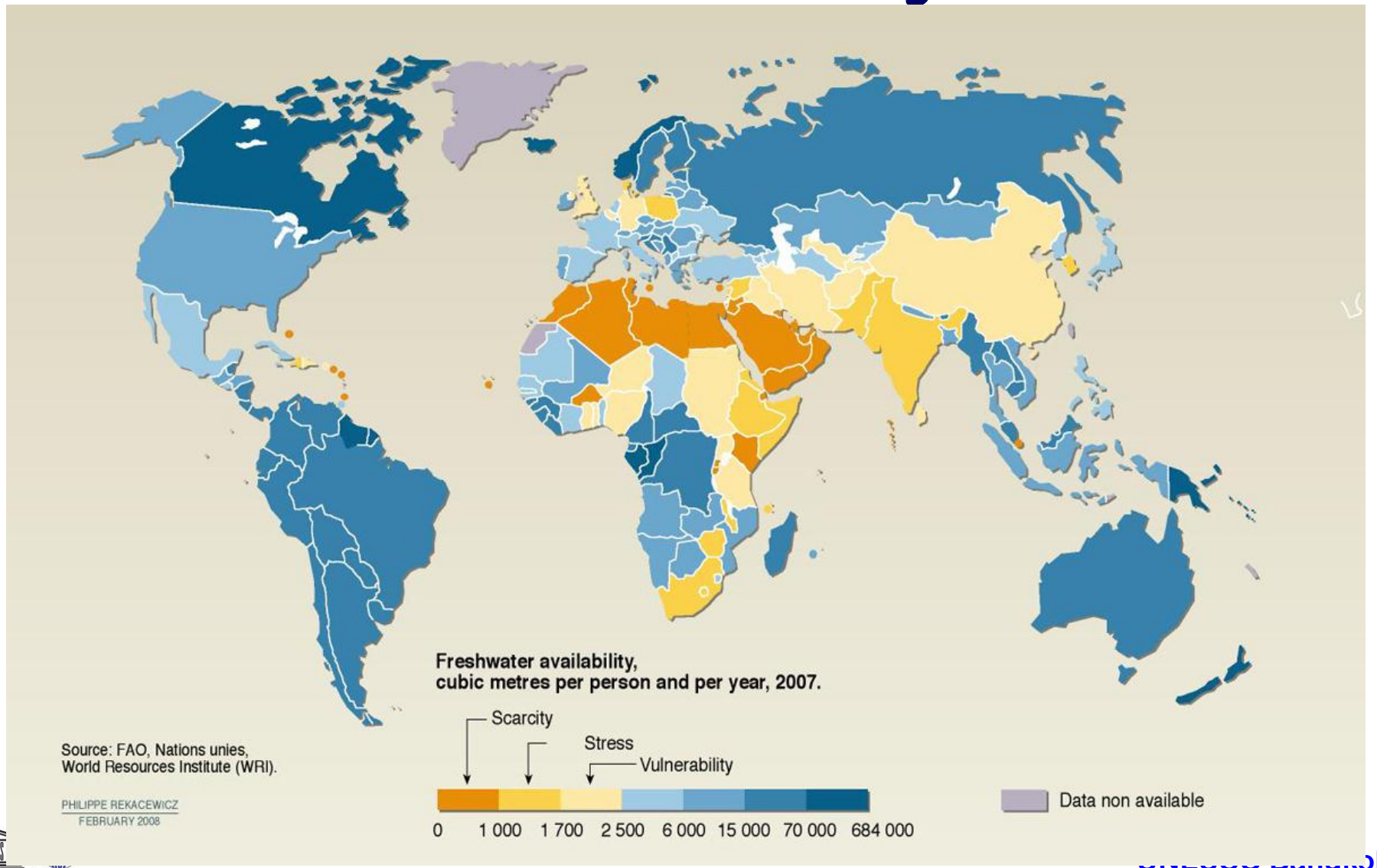

How long can this situation be sustained?
High Moon
CO2
CO2

- The cycle is changing?
- Increased risks?
- Growing vulnerability?
- More disasters ?
- Less water for people?
- Crisis is looming?
- What crisis?
- Global or local?

Water is Already a Global Issue

- More than 2 billion people in 40 countries live in river basins under “water stress”
- Decreasing per-capita water availability – global population increased by a factor of 3 in 20th century, while water withdrawals increased by a factor of 7
- As global population is expected to increase from 7 billion to 10 billion by 2050, demand on water will increase further

Global water stress and scarcity



Water – Essential to sustain human life, environment, but…..

- Competition for scarce water resources is already a source of conflict and it to escalate!
  - Urban vs Rural
  - Upstream vs Downstream
  - Human activities vs Environmental needs
  - National vs International

Drivers of Climate Change

What is Climate Change

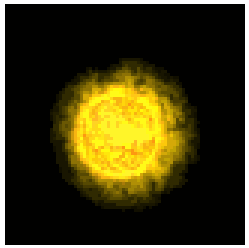
- When we use the term 'climate' what we actually mean is the average weather experienced in a region over a long period of time.
- The climate on earth has undergone many changes in the past and this is entirely natural.

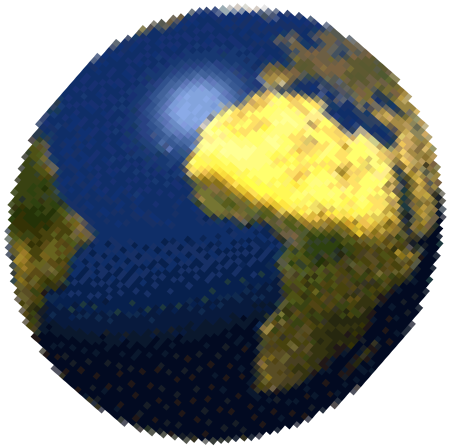
- However, the rate at which the climate has been changing over the past 50 years has led to a consensus amongst scientists that this recent change is likely to be as a result of human's activities.
- This is what we refer to as 'Climate Change'.

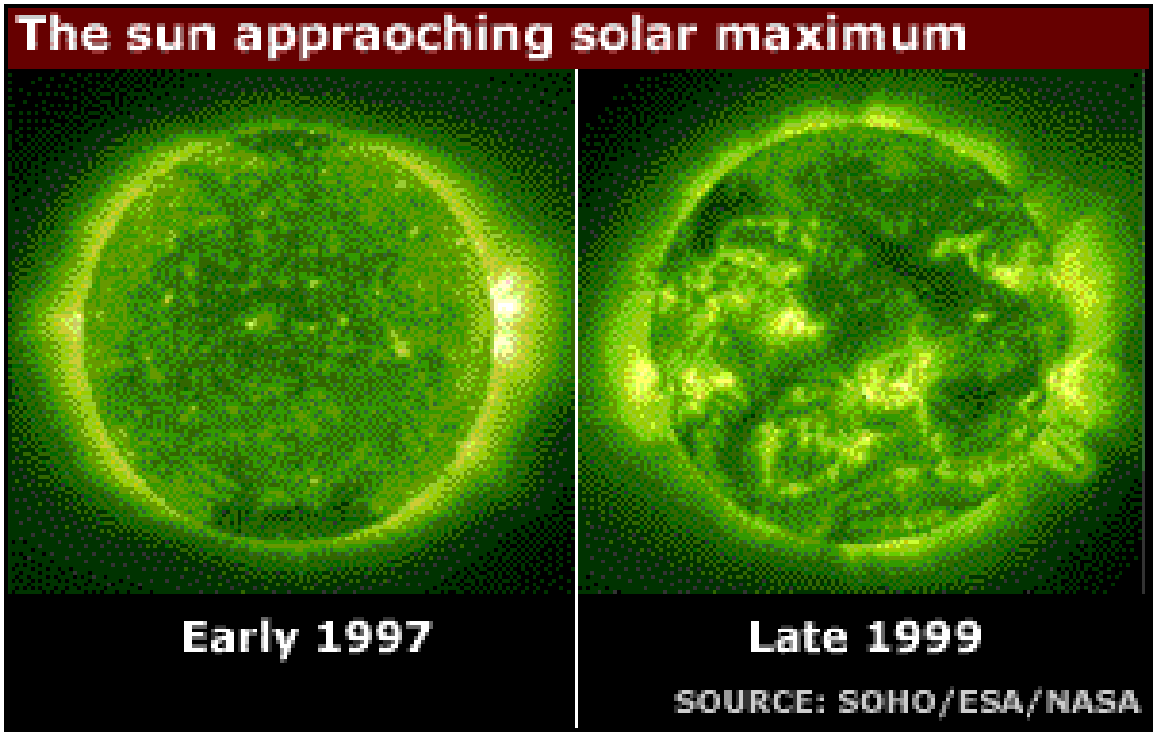
- **Climate change is a global phenomenon, but the problems will be very local and we will have to adapt and plan locally.**

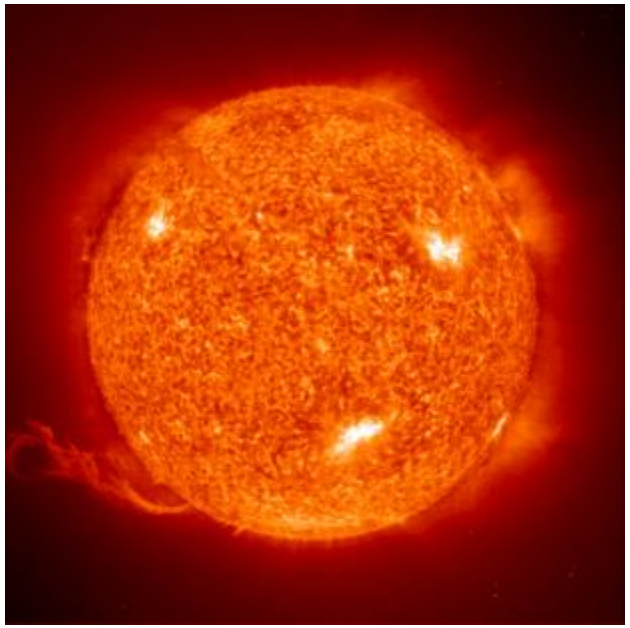
Main Drivers of climate Change

- Changes in:
  - Sun's output
  - Earth's orbit
  - Drifting continents
  - Volcanic eruptions
  - Greenhouse gases
  - Land-use pattern



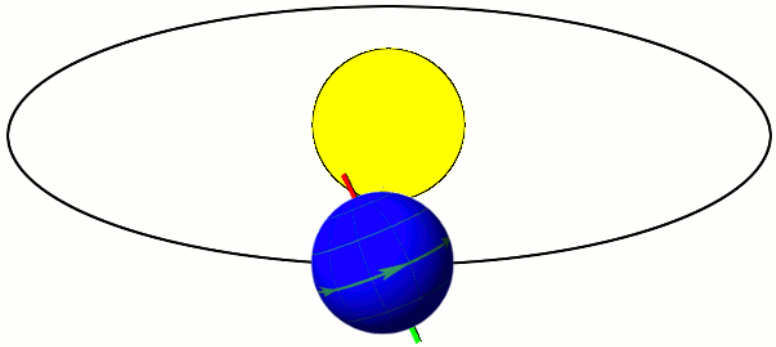


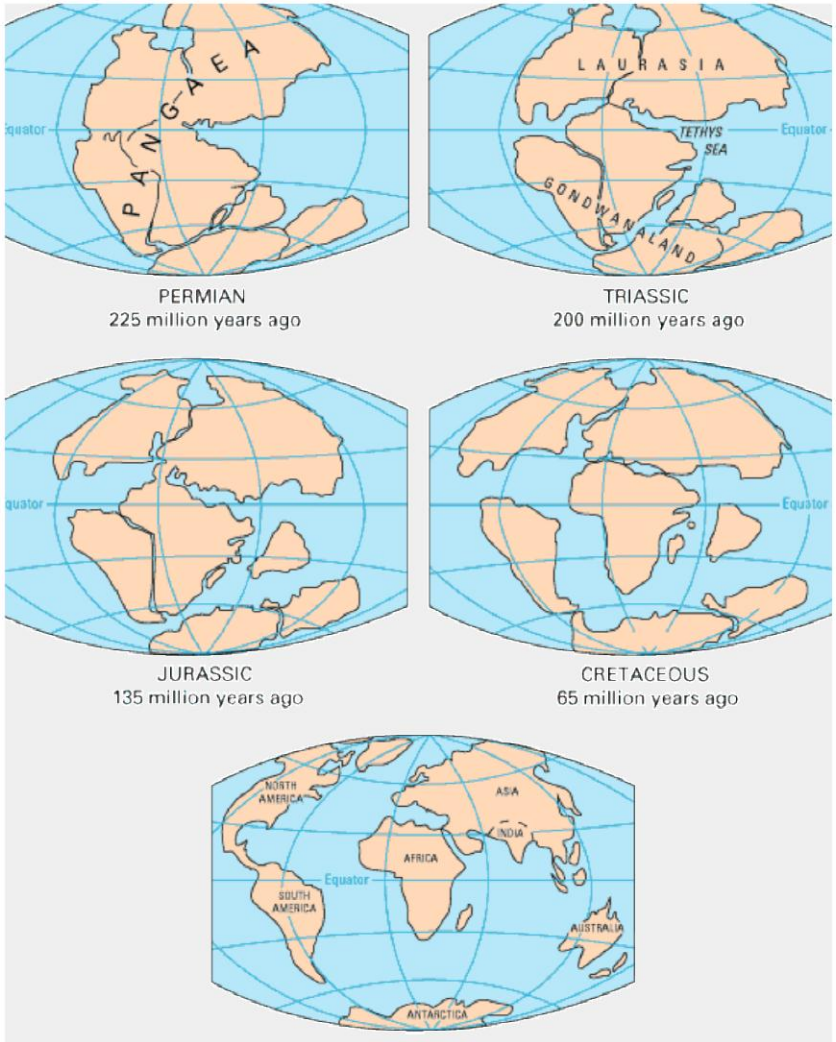


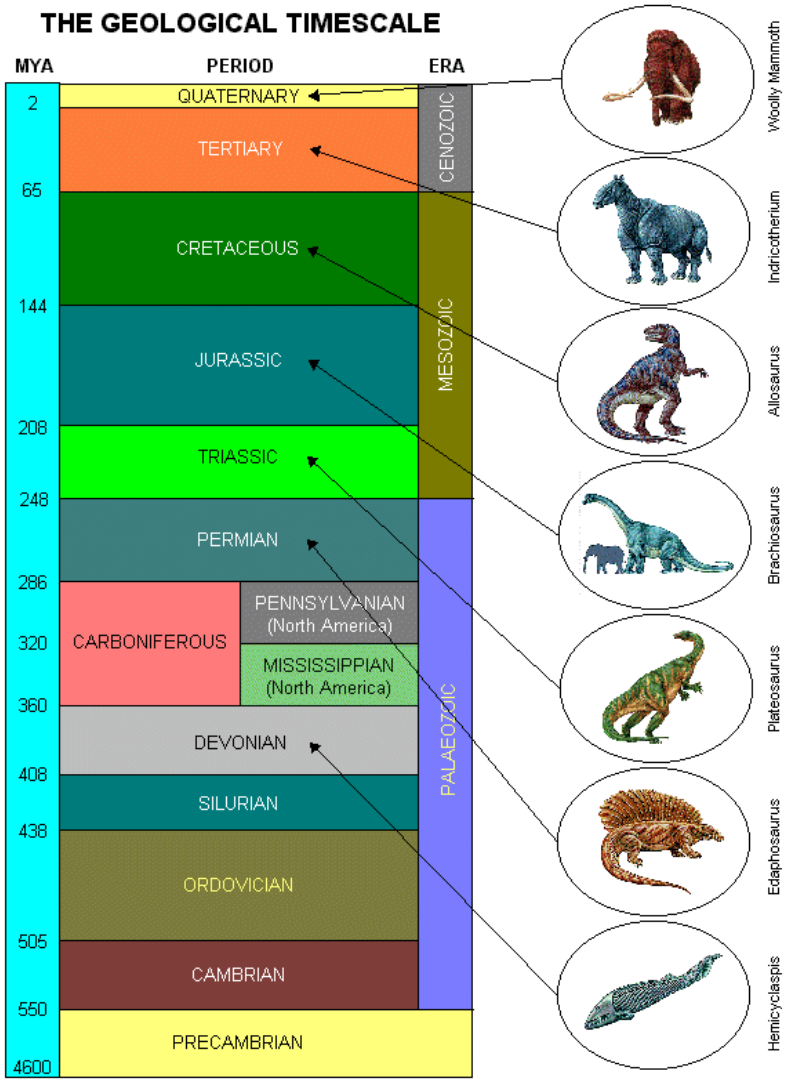


Dr Paal Brekke from the European Space Agency


Axis of rotation
24.5°
21.1°

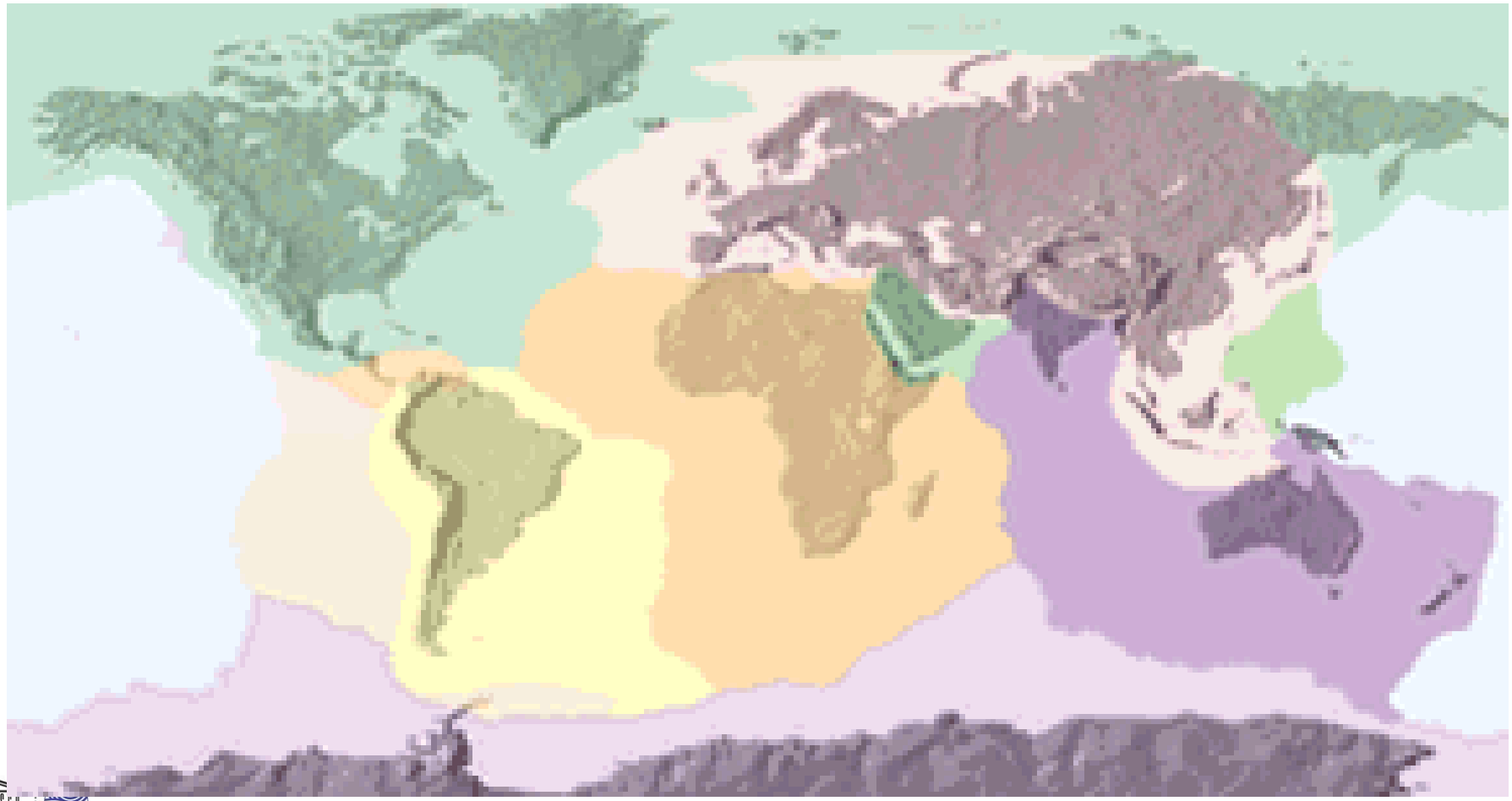



PANGAEA
Equator
PERMIAN
225 million years ago
LAURASIA
TETHYS SEA
GONDWANALAND
Equator
TRIASSIC
200 million years ago
Equator
JURASSIC
135 million years ago
Equator
CRETACEOUS
65 million years ago
NORTH AMERICA
ASIA
INDIA
AFRICA
Equator
SOUTH AMERICA
AUSTRALIA
ANTARCTICA


THE GEOLOGICAL TIMESCALE
MYA
PERIOD
ERA
2
QUATERNARY
TERTIARY
CENOZOIC
65
CRETACEOUS
144
JURASSIC
MESOZOIC
208
TRIASSIC
248
PERMIAN
286
CARBONIFEROUS
PENNSYLVANIAN (North America)
320
MISSISSIPPIAN (North America)
360
DEVONIAN
PALAEOZOIC
408
SILURIAN
438
ORDOVICIAN
505
CAMBRIAN
550
PRECAMBRIAN
4600
Woolly Mammoth
Indricotherium
Allosaurus
Brachiosaurus
Plateosaurus
Edaphosaurus
Hemicyclaspis

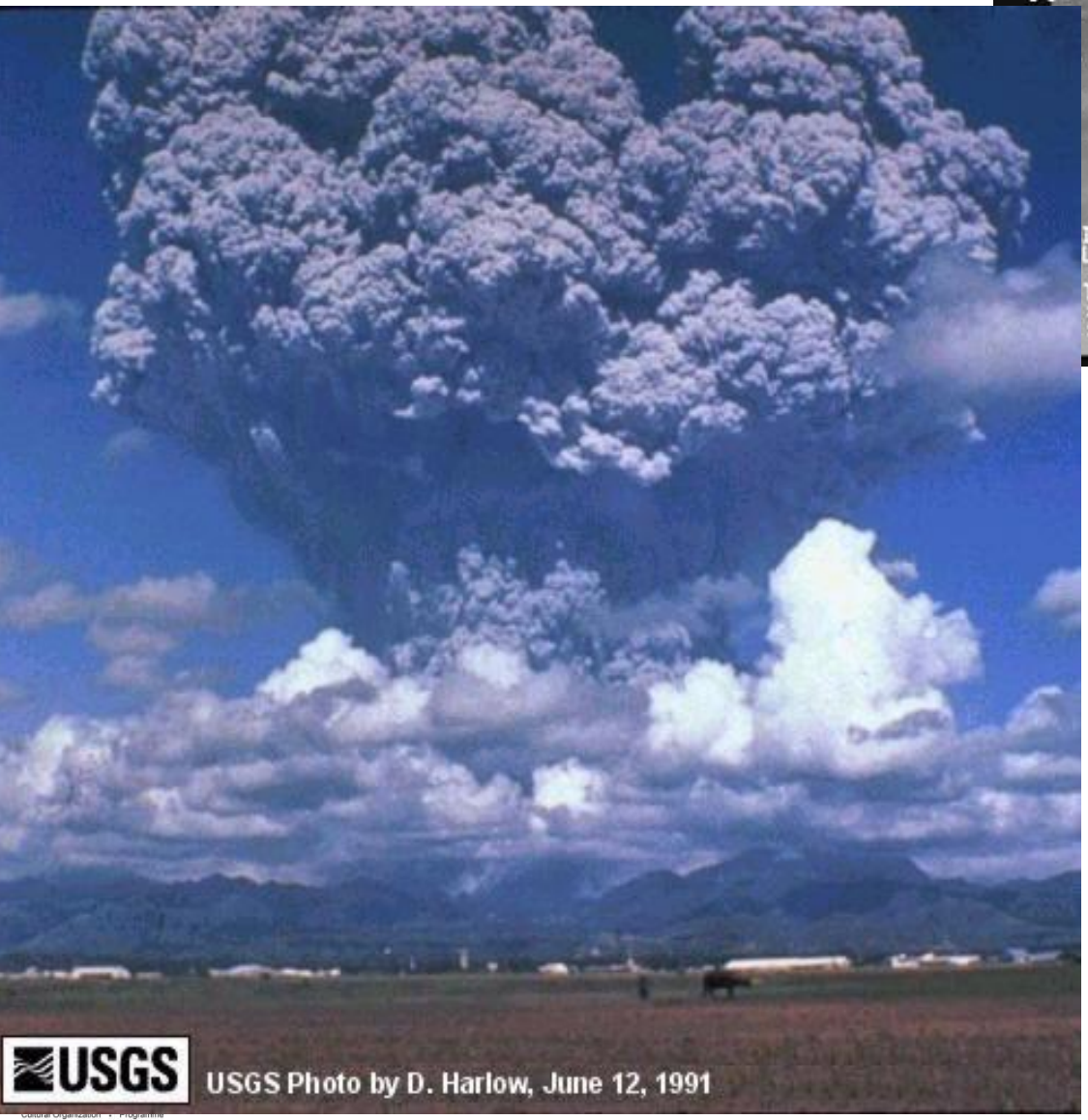
United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

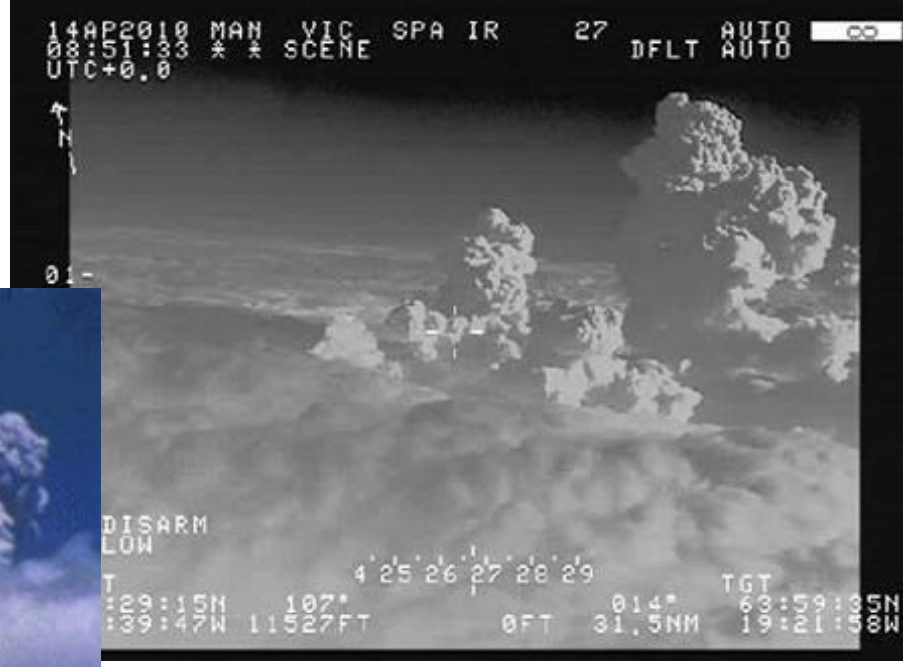
UNESCO Bangkok



United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

UNESCO Bangkok

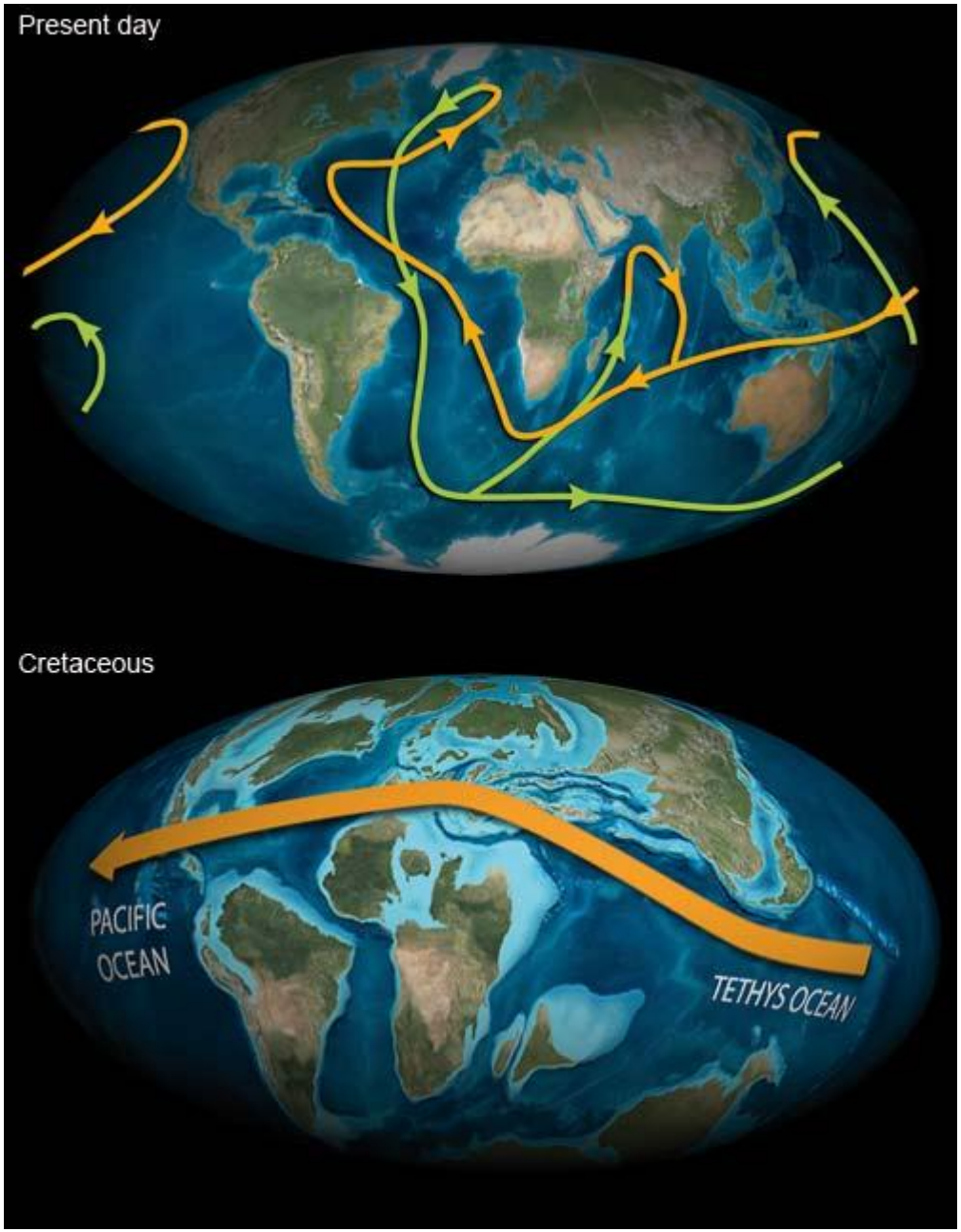




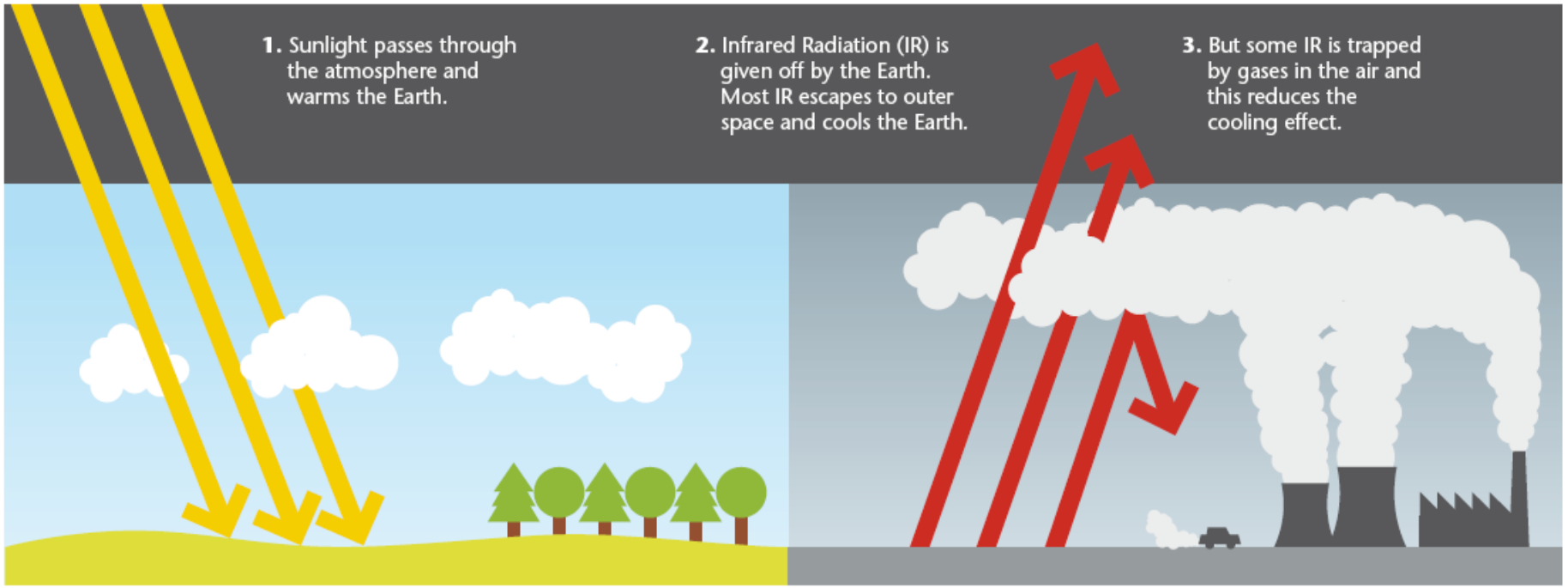
2010 Iceland Volcanic Eruption – A Q300 surveillance aircraft which has captured images of the volcanic plume breaking the cloud layer

UNESCO Bangkok

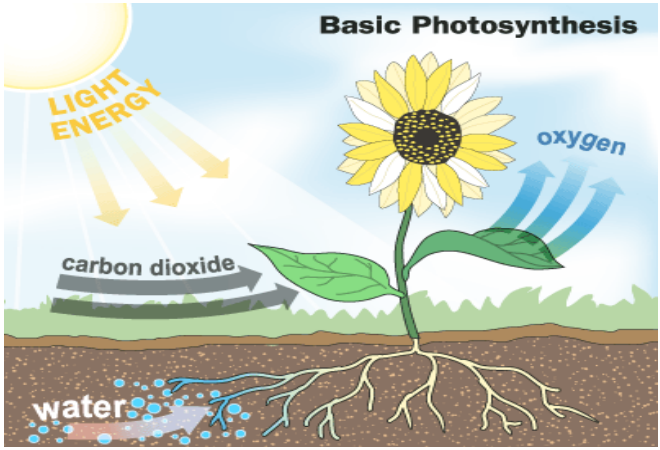
Global ocean currents: Oceans store a large amount of heat, so that small changes in ocean currents can have a large effect on coastal and global climate



Increasing greenhouse gases trap more heat



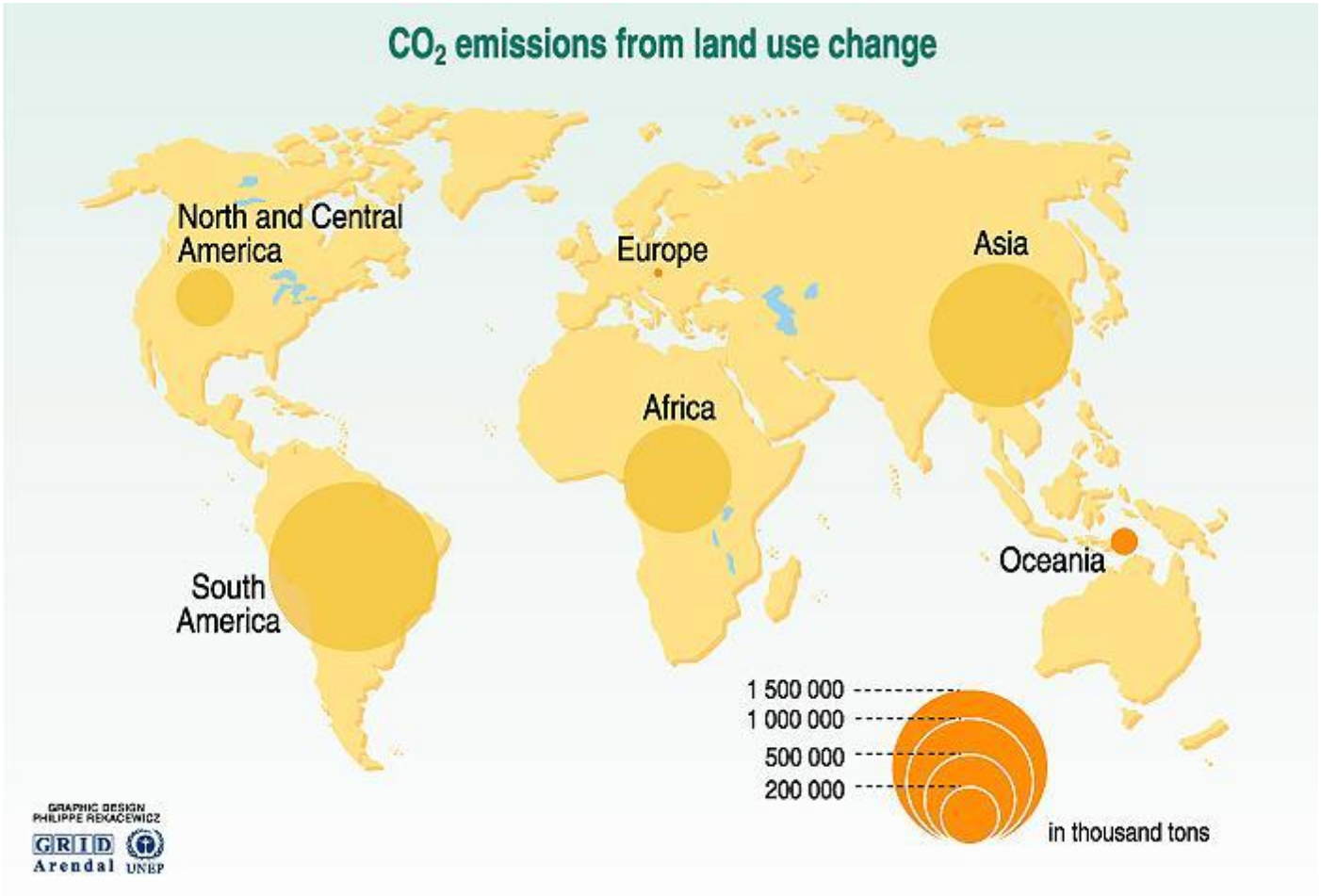
The greenhouse effect.



Photosynthesis

$$6\ CO_2 + 12\ H_2O \rightarrow C_6H_{12}O_6 + 6\ H_2O + 6\ O_2$$

(Trees are made of CO_2 and water!)



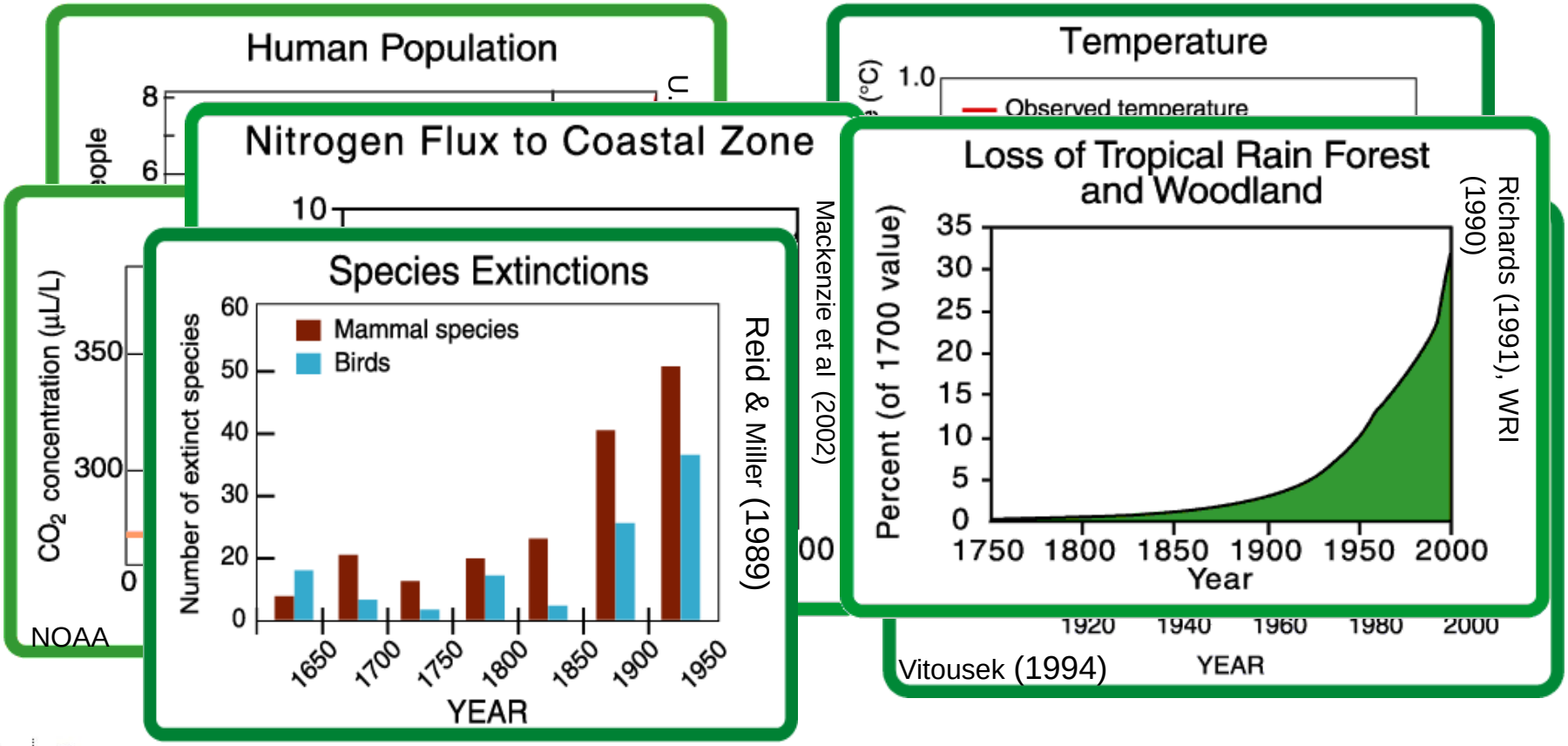
Source : Climate Change Information kit, UNEP IUC, 1997.

Emissions of carbon dioxide due to changes in land use mainly come from the cutting down of forests.

Not only the climate is changing….

- Changes with natural and human/social dimensions
- Global changes but with local, regional and global impacts
- Constellation of changes with numerous feedbacks!

Some examples are….
(modified from Young, 2004)



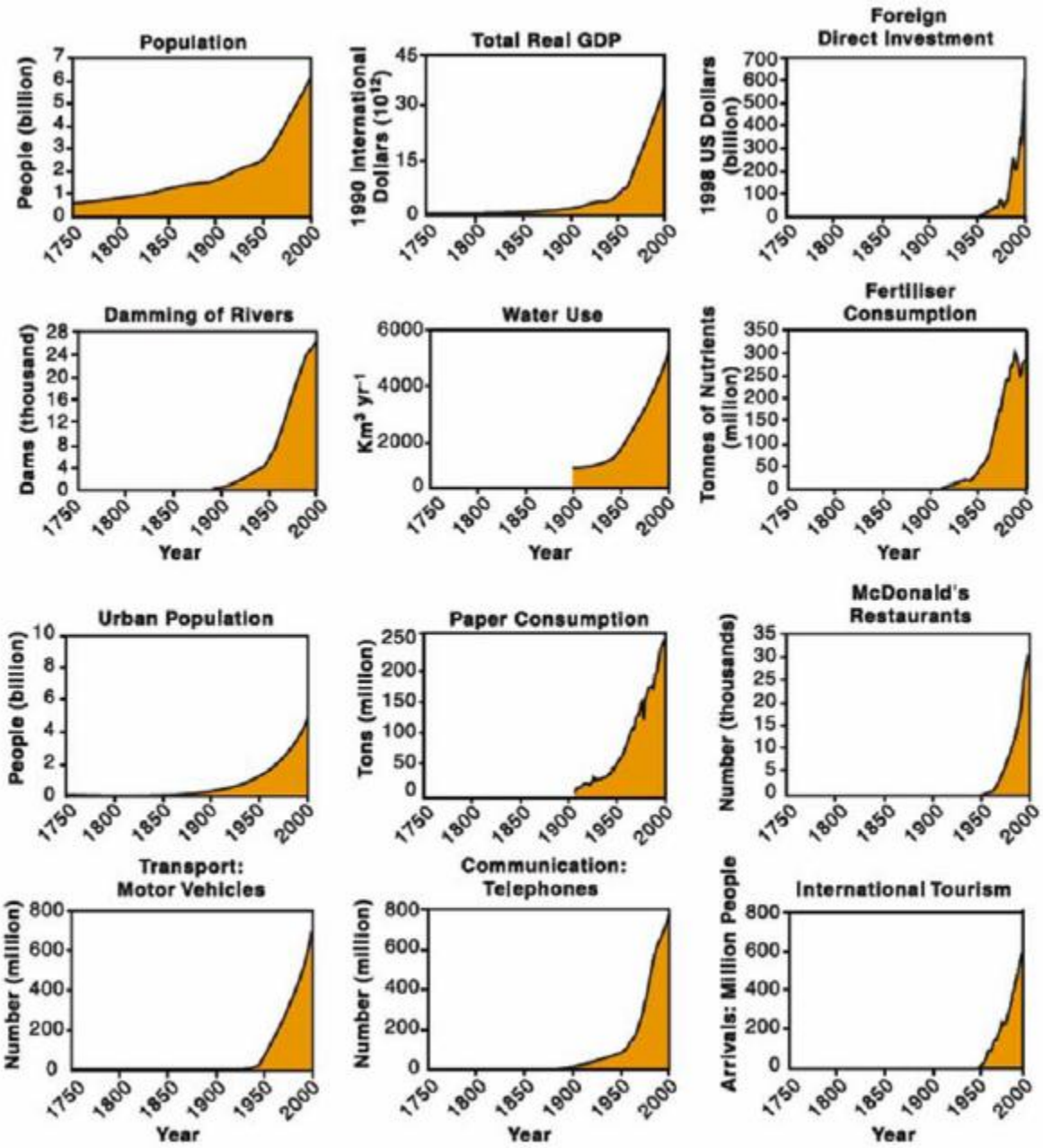


Figure 2. We see an unprecedented change in human activity, with often-unknown impacts on our environment and on the water cycle (from *Steffen et al.* [2004] with kind permission of Springer Science+Business Media).

Current vulnerabilities of freshwater resources

(Source: Kundzewicz et al., 2007; chapter in IPCC, 2007)

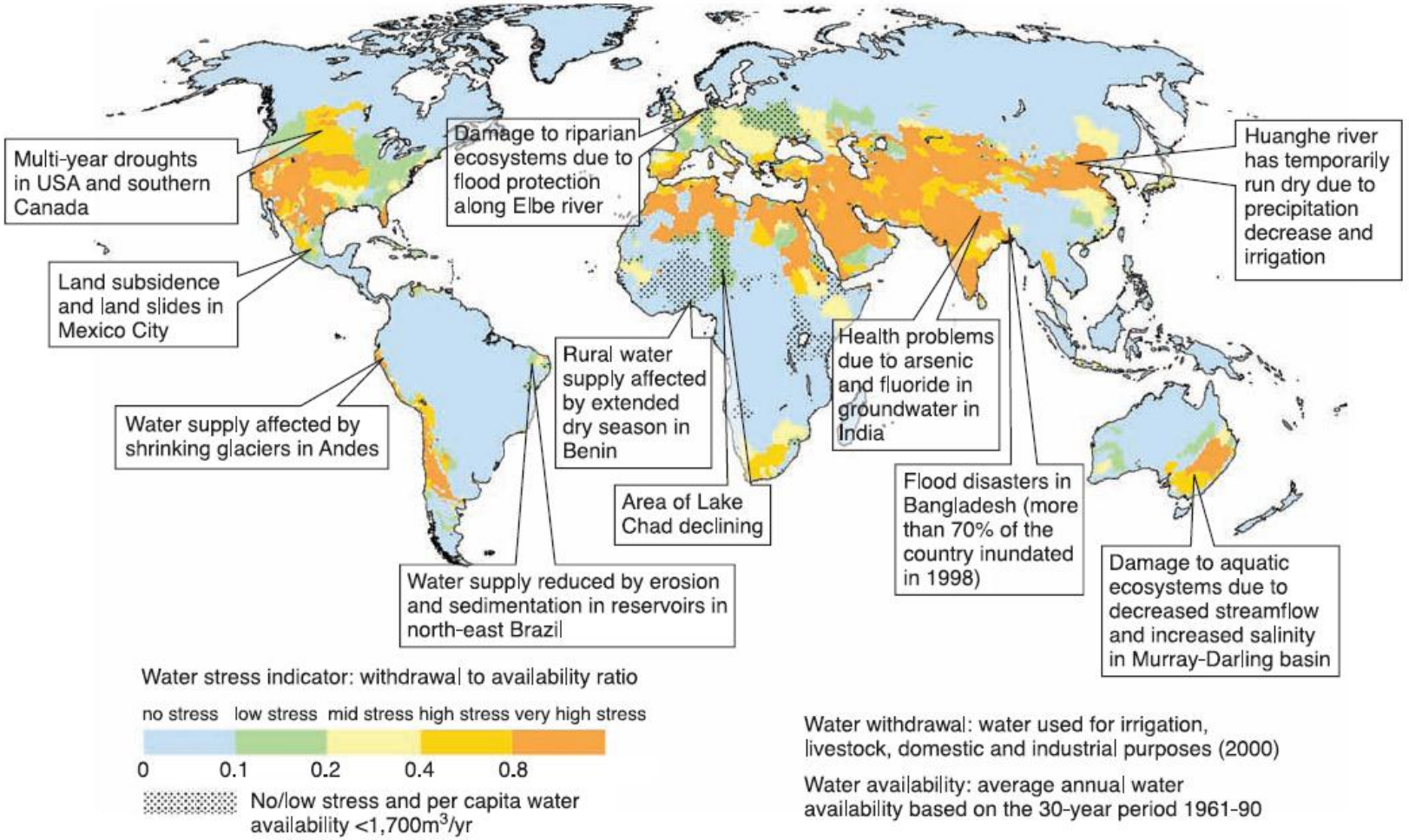


Figure 3.2. *Examples of current vulnerabilities of freshwater resources and their management; in the background, a water stress map based on Alcamo et al. (2003a). See text for relation to climate change.*

Future Climate Change Impacts on Freshwater Resources

(Kundzewicz et al., 2007)

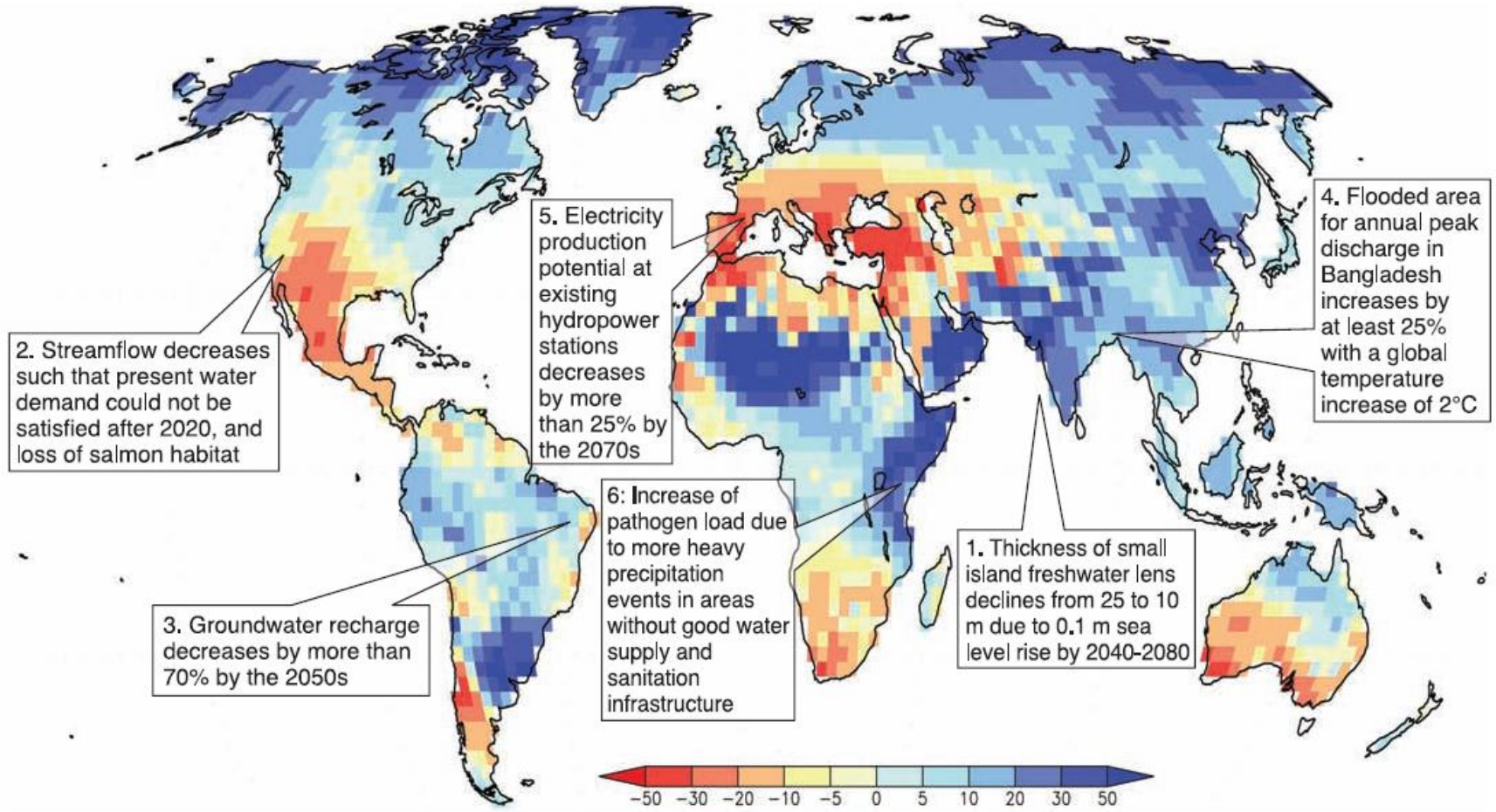


Figure 3.8. *Illustrative map of future climate change impacts on freshwater which are a threat to the sustainable development of the affected regions. 1: Bobba et al. (2000), 2: Barnett et al. (2004), 3: Döll and Flörke (2005), 4: Mirza et al. (2003) 5: Lehner et al. (2005a) 6: Kistemann et al. (2002). Background map: Ensemble mean change of annual runoff, in percent, between present (1981 to 2000) and 2081 to 2100 for the SRES A1B emissions scenario (after Nohara et al., 2006).*

New Paradigm

Failure with Past Approaches

- Sectroal, limited coordination, fragmented, uncoordinated development – inadequate to meet global challenges!
- Top-down management , lack of demand management, waster of water

Crisis of Governance

or Physical Scarcity?

Globally Realized that:

- Business as usual no longer works

- There are urgent need for reform…., for a significant shift… in the way water resources are managed, water services are provided

United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

ngkok

Definition of IWRM

- "A process which promotes the coordinated development and management of water, land and other resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" GWP, 2000

What is IWRM

- The GOAL is the sustainable management and development of water resources.
- The basis of Integrated Water Resources Management (IWRM) is that different uses of water are interdependent.
  - Integrated management means that all the different uses of water resources are considered together.
  - Water allocations and management decisions consider the effects of each use on the others.
  - They are able to take account of overall social and economic goals, including the achievement of sustainable development

Why IWRM

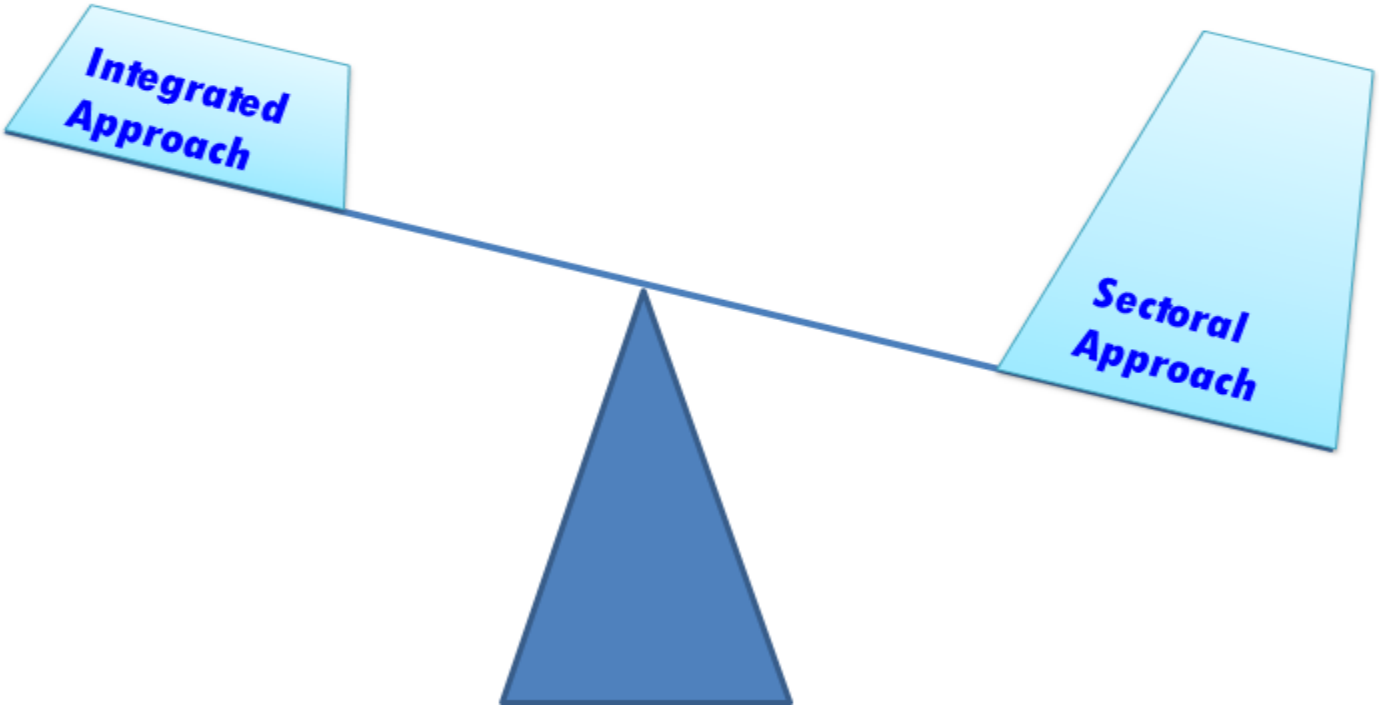
- **Water governance crisis**
  - Sectoral approaches to water resources management have dominated in the past and are still prevailing. This leads to fragmented and uncoordinated development and management of the resource.
- **Increased competition**
  - Increased competition for the finite resource is aggravated by inefficient governance.
- **Securing water for people**
  - One fifth of the world's population is without access to safe drinking water and half of the population is without access to adequate sanitation.
- **Securing water for food production**
  - Over the next 25 years, food will be required for another 2–3 billion people.
- **Protecting vital ecosystems**
  - Aquatic ecosystems depend on water flows, seasonality and water table fluctuations and are threatened by poor water quality.

Advantages of IWRM

- Coordinated activities rather than amalgamated programs
- Top-down meeting bottom-up management
- Strategic planning : targeting and prioritizing
- Integrating goals rather than planning for single goals.
- Proactive : identify problems before they occur
- Cooperative work environment , inclusiveness
- Encouraging commitment –Empowering local decision making rather than centralizing decisions
- Providing appropriate and relevant information
- Using equitable management methods sensitive to cultural needs, gender issues, poverty eradication…

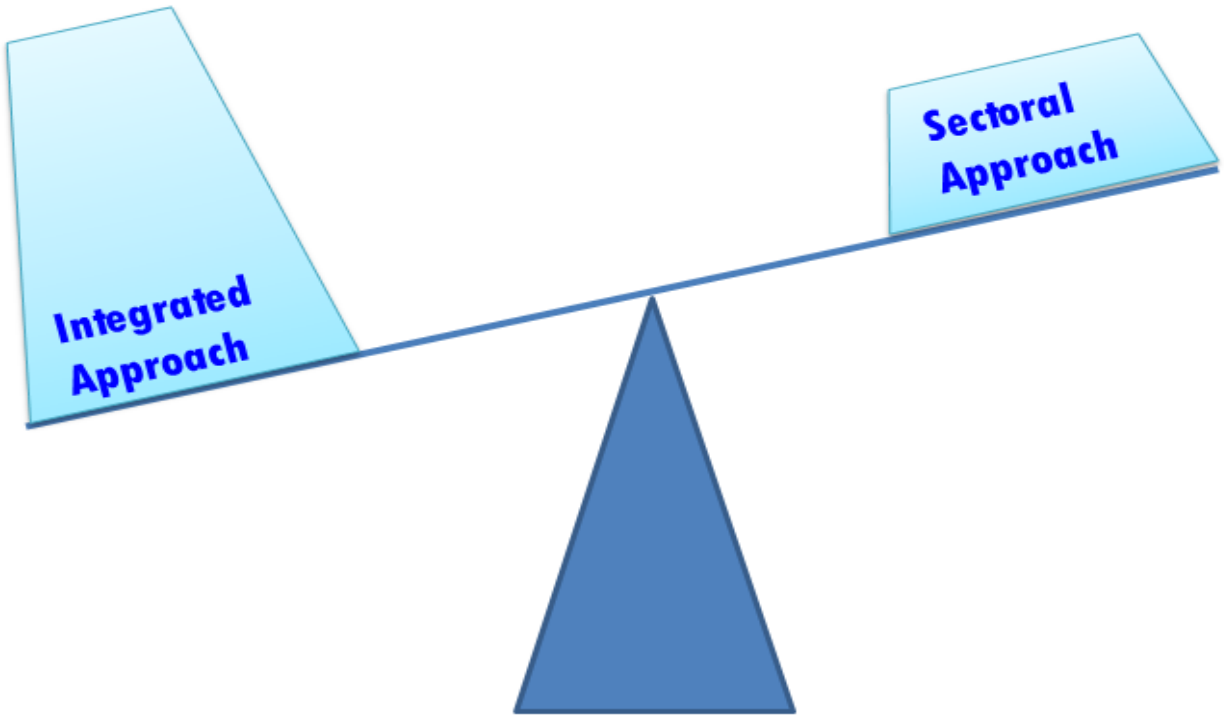
Risks of fully sectoral approach

- Overlooking negative impacts on environment and other sectors
- Inefficient use of resources—natural and financial

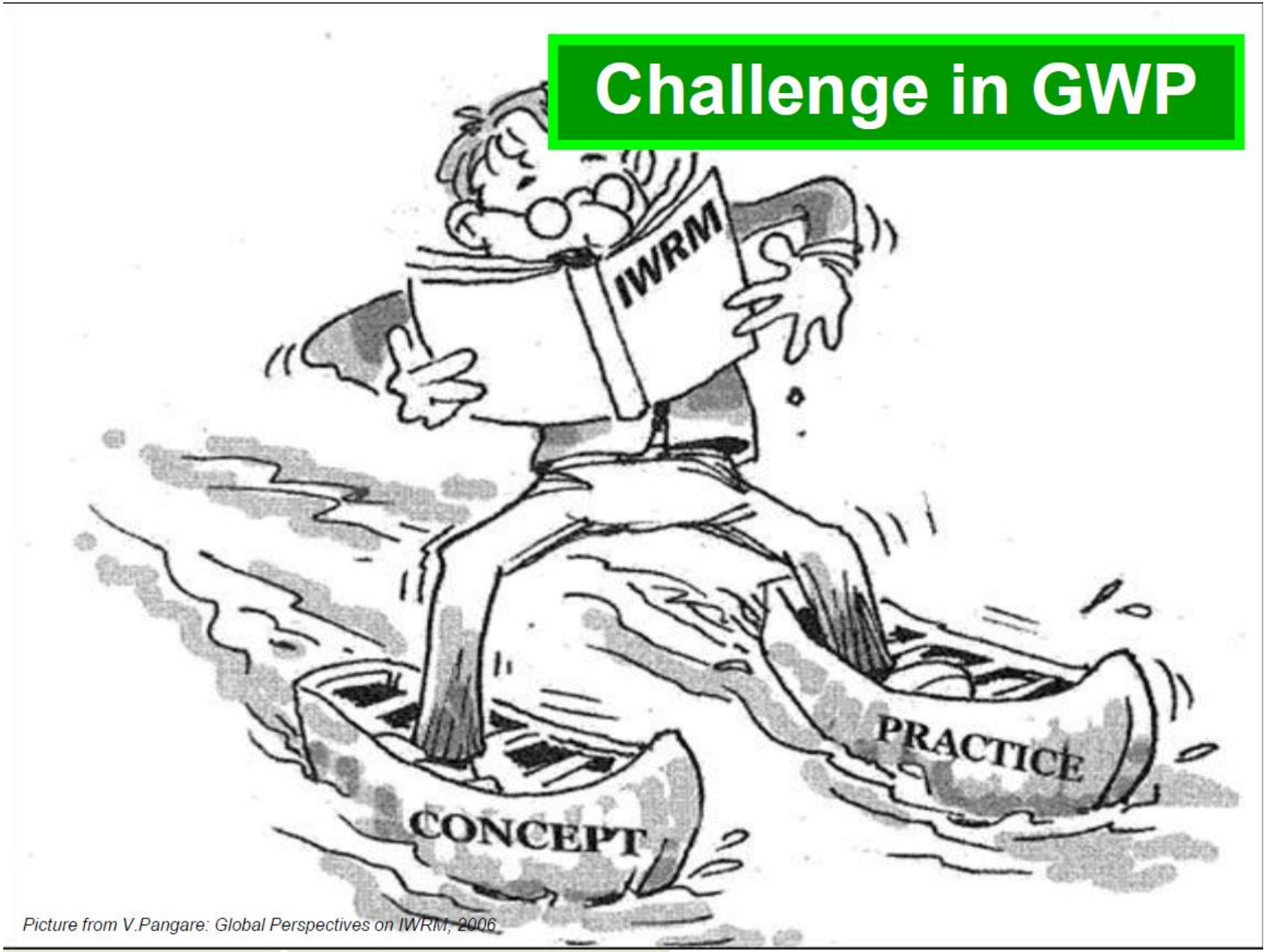


Risks of fully integrated approach

- Getting mired in complexity.
- Not making good use of specialist expertise.



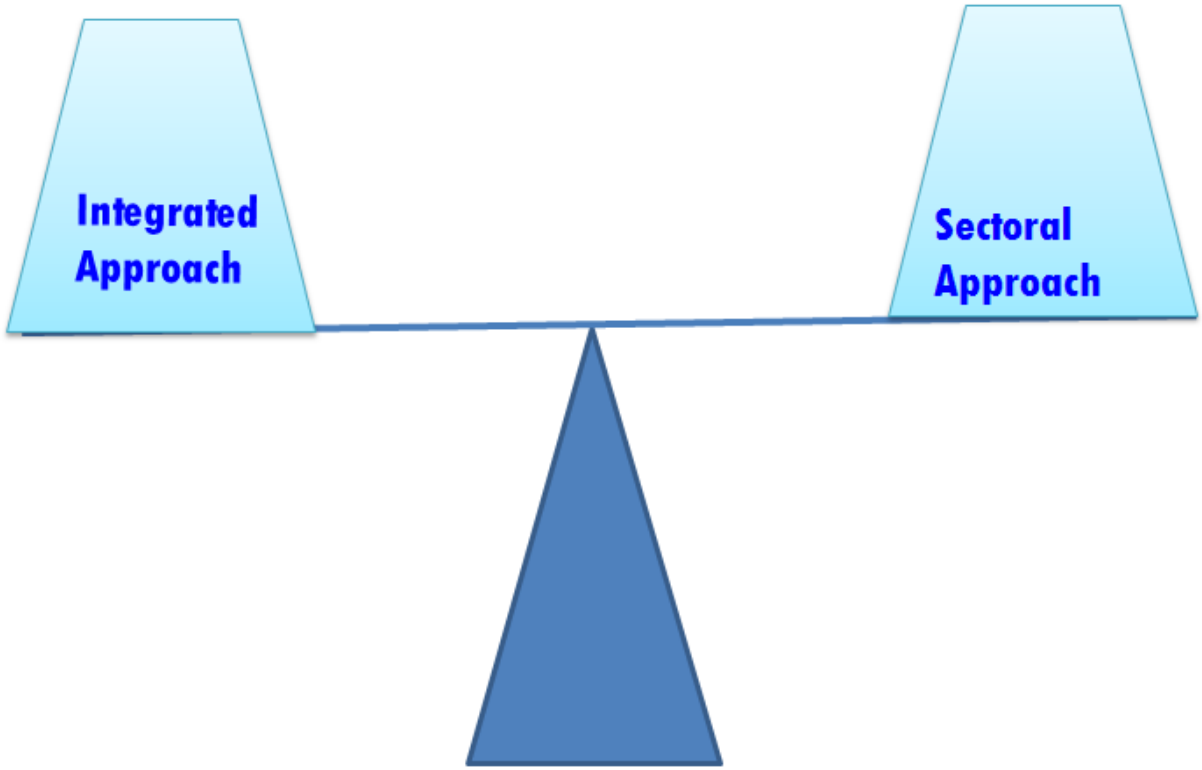
Challenge in GWP



Picture from V.Pangare: Global Perspectives on IWRM, 2006

Finding a balance

- **Each country needs to decide where integration makes sense based on its social, political and hydrological situation.**



IWRM – Process not product
Tool not Blueprint

- Is a coordinated process to bring together all stakeholders
- Emphasizes on economic, social welfare, equity and protecting ecosystem
- Is based on scientific data / tools for judgment / decisions
- Promotes good governance, with democratic participation

Dealing with uncertainties

Uncertainties

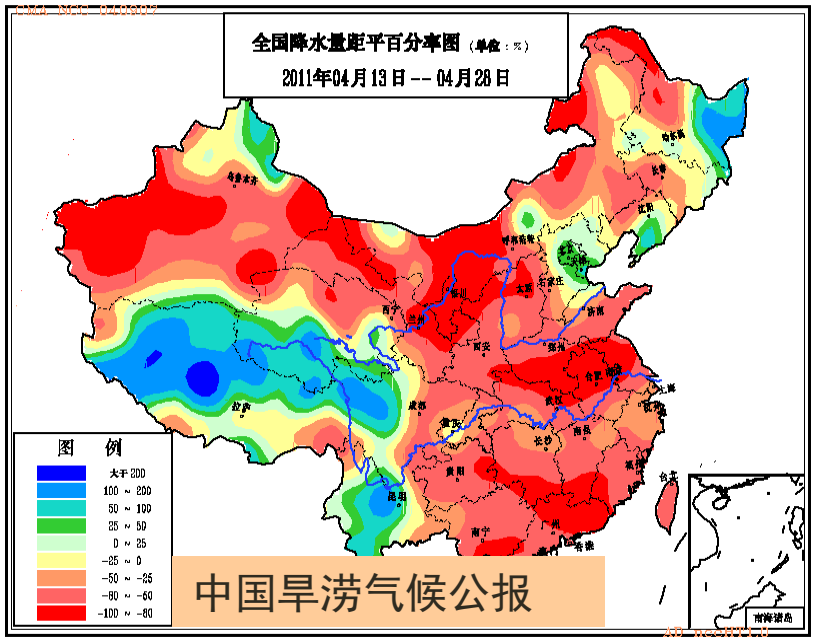
One thing is certain:

Nothing is certain

- Uncertainty and climate change
- How to deal with uncertainties
- Types of uncertainties
- Adaptation to climate change under uncertainty:
  - Prediction-oriented approaches
  - Resilience-oriented approaches

South China during 2010 classical example – drought followed by flood

2011's Extremely Droughts during spring in southern China, late flood dizaster



Precipitation change on April in China

Only for *flood disaster* until July, directly economic loss reaches *43.2 Billion RMB*,

Impacted *27 provinces* and regions and *36.7 Million population, 239 victim …*

UNESCO Bangkok

United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

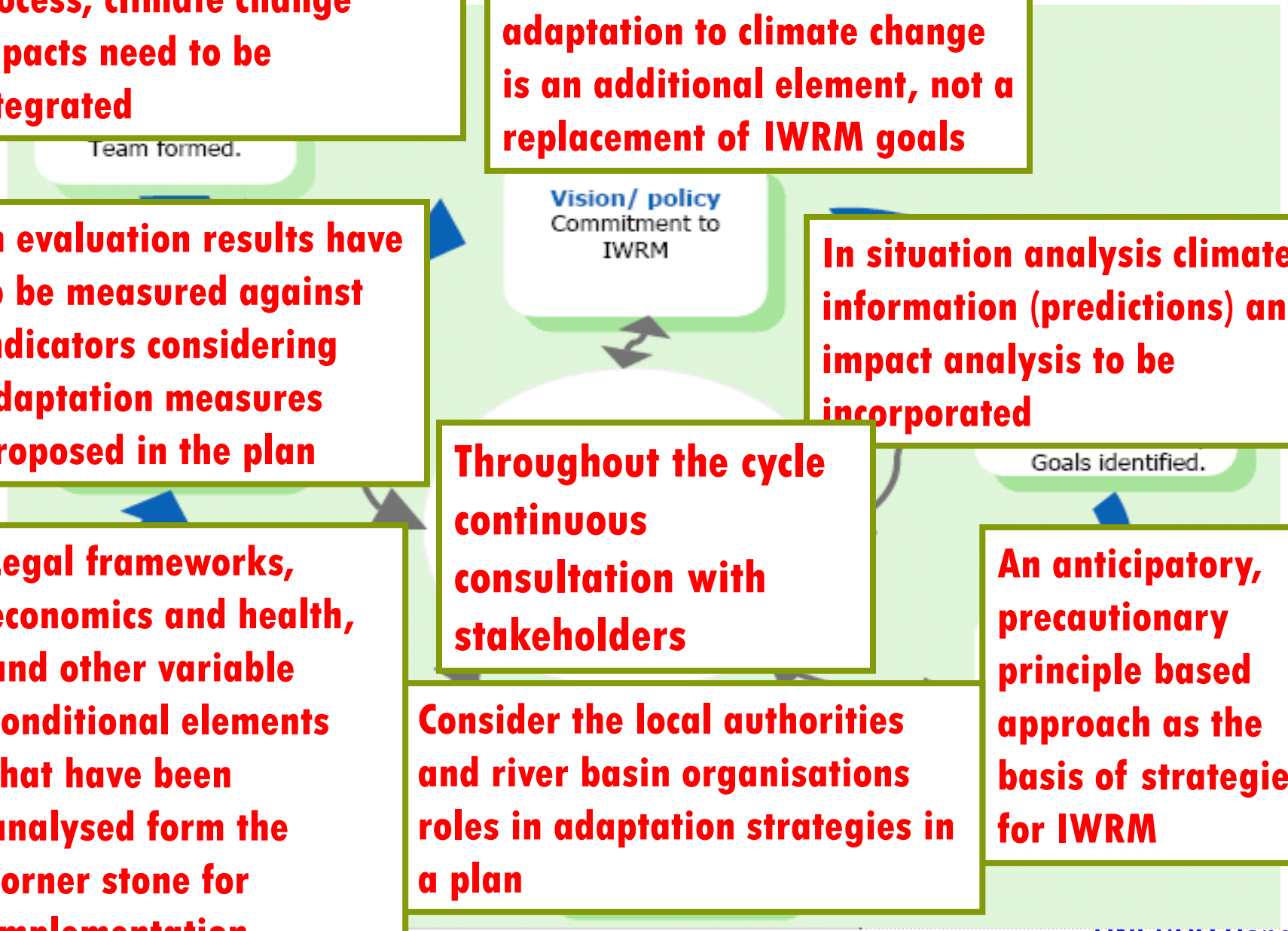
2012's May- June Floods in South China & Drought in North China

Just in Guanxi, the heavy rainfall resulted in 21 million peoples to suffer *flood disaster!*

Same in Yellow R Huai R & Hai R, the extremely draught resulted in 67 million *affected farm!*

When initiating the planning process, climate change impacts need to be integrated

In the vision and policy development phase adaptation to climate change is an additional element, not a replacement of IWRM goals



In evaluation results have to be measured against indicators considering adaptation measures proposed in the plan

In situation analysis climate information (predictions) and impact analysis to be incorporated

Throughout the cycle continuous consultation with stakeholders

Legal frameworks, economics and health, and other variable conditional elements that have been analysed form the corner stone for implementation

Consider the local authorities and river basin organisations roles in adaptation strategies in a plan

An anticipatory, precautionary principle based approach as the basis of strategies for IWRM

IWRM can help adaptation to climate change

- Better water management makes it easier to respond to changes in water availability.
- Basin planning allows for risk identification and mitigation.
- Stakeholder participation helps in mobilization for action, risk assessment.
- Good management systems allows the right incentives to be passed on to water users.

United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

Climate Change

Prevent **Mitigate …** **… *and* adapt!**

WE NEED TO DO MORE THAN JUST STARE AT THE PROBLEM!

United Nations Educational, Scientific and Cultural Organization · International Hydrological Programme

Be the change that you want to see in the world

“There is a sufficiency in the world for man’s need but not for man’s greed.”

谢谢！

Thank You