Natural Sciences Sector

United Nations Educational, Scientific and Cultural Organization

UNESCO Science for Sustainable Development

Climate Change Adaptation and IWRM

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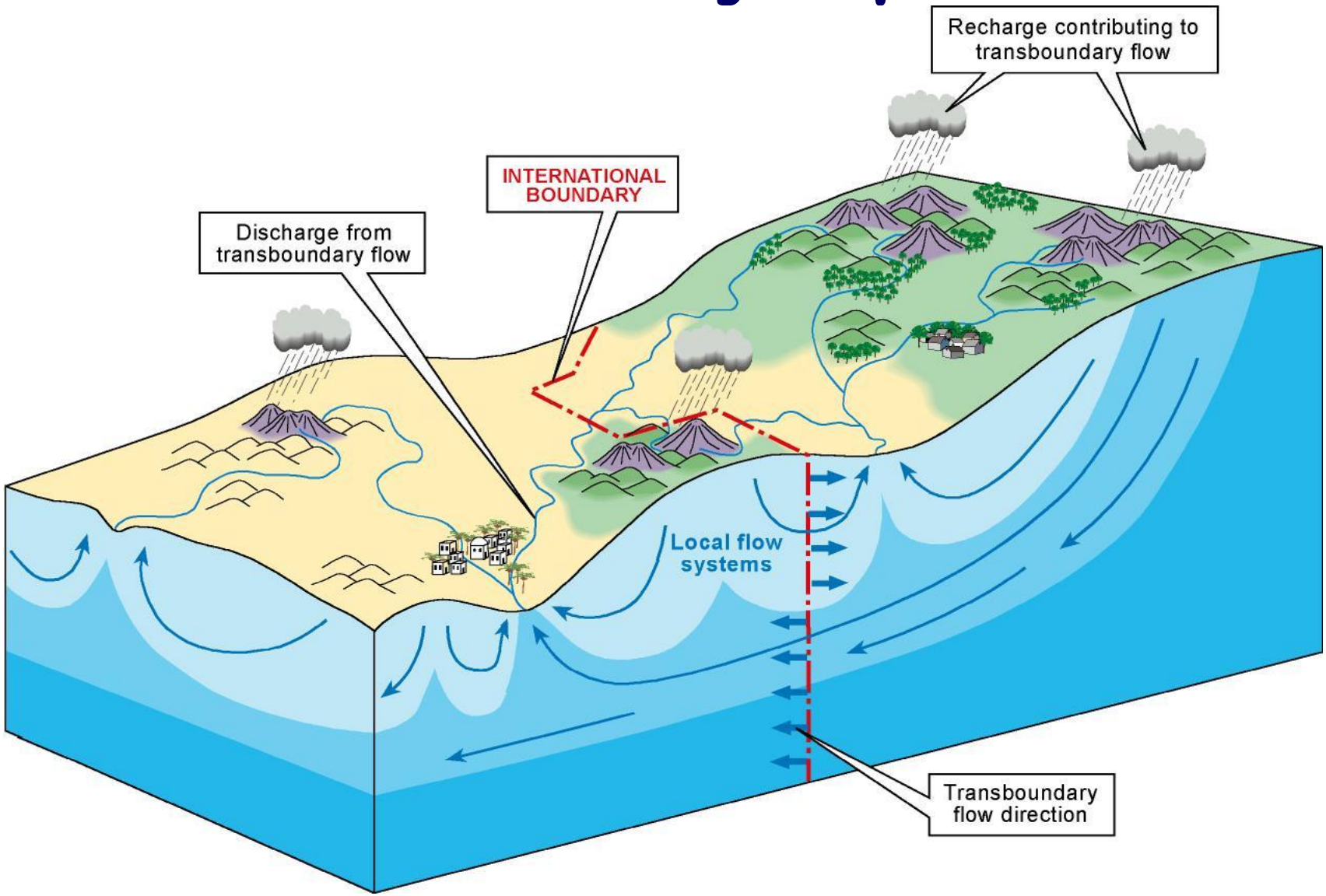
Hydrological System

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

Trans-boundary Aquifers

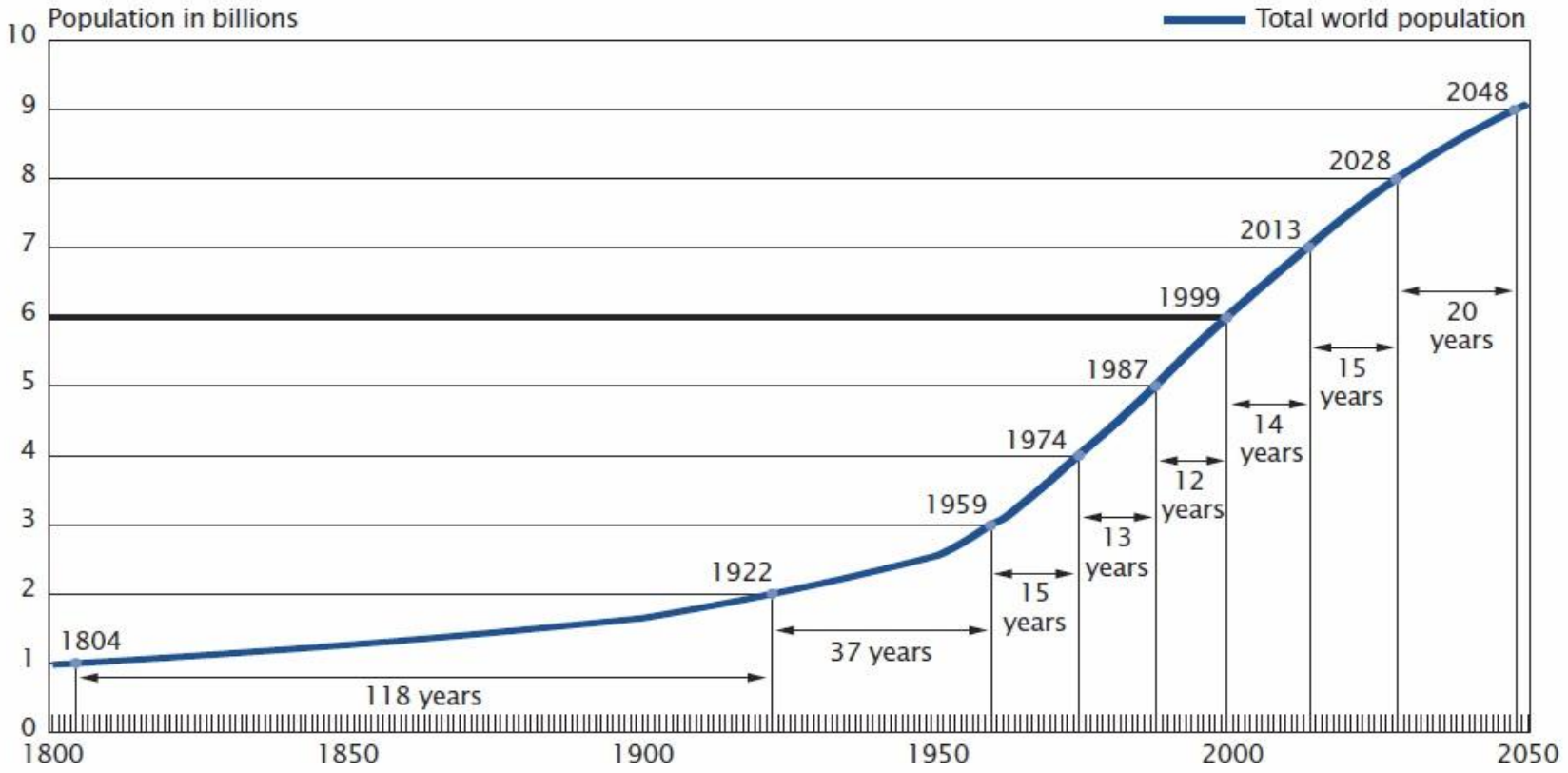


Technological Changes

- 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!



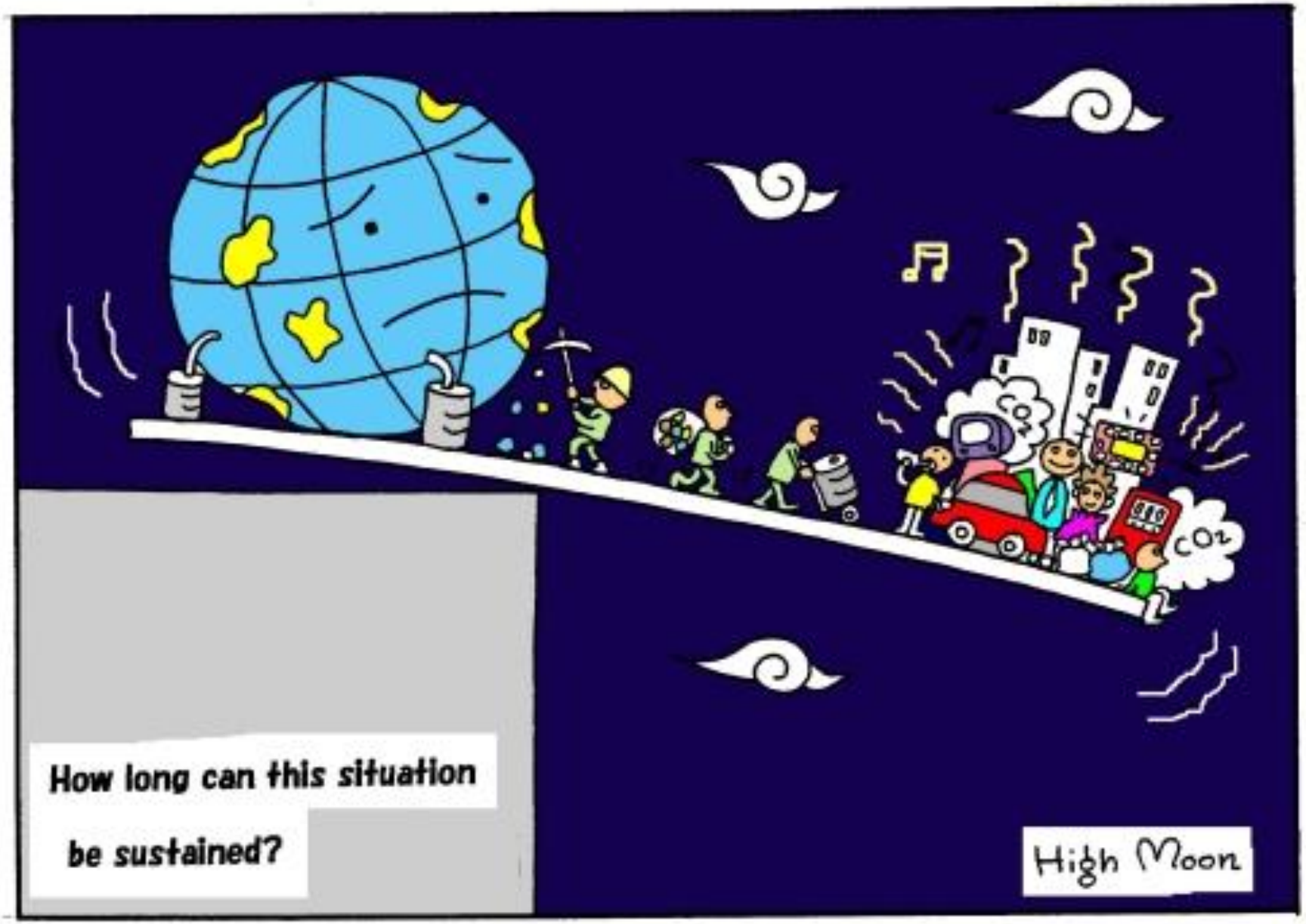
Source: United Nations (1995b); U.S. Census Bureau, International Programs Center, International Data Base and unpublished tables.

Population

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



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

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

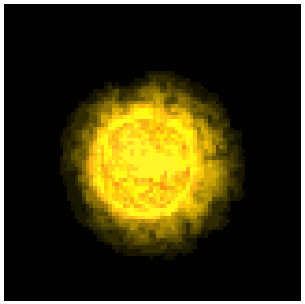
- When we use the term 'climate' what we actually mean is the average weather experienced in a region over a long period of time.
- The climate on earth has undergone many changes in the past and this is entirely natural.

- 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'.

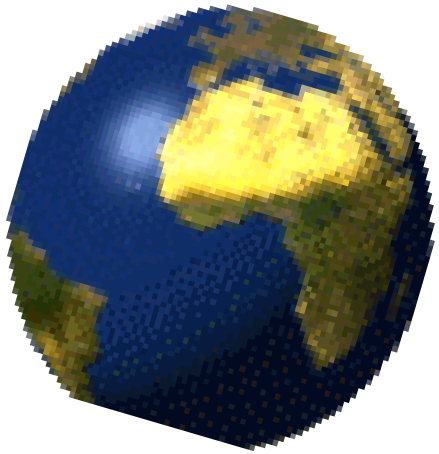
- **Climate change is a global phenomenon, but the problems will be very local and we will have to adapt and plan locally.**

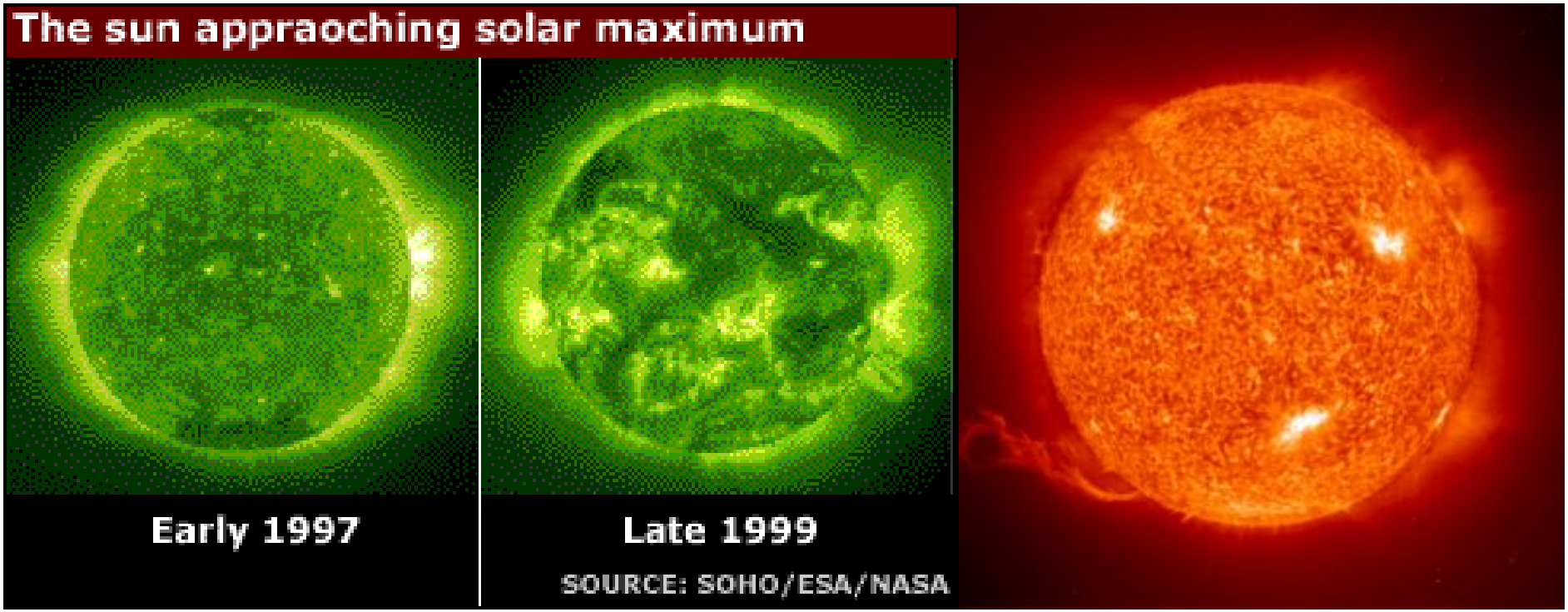
Main Drivers of climate Change

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

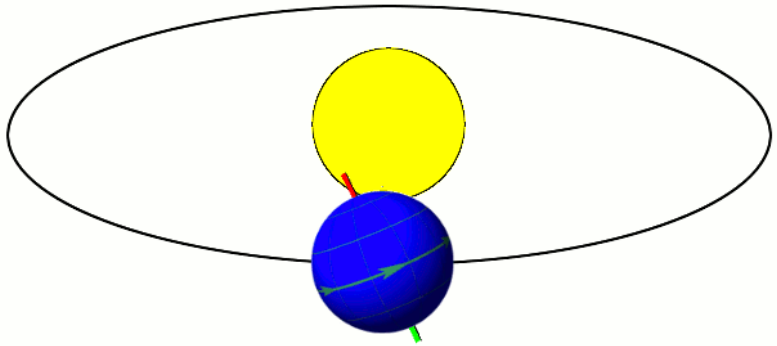


NATURAL

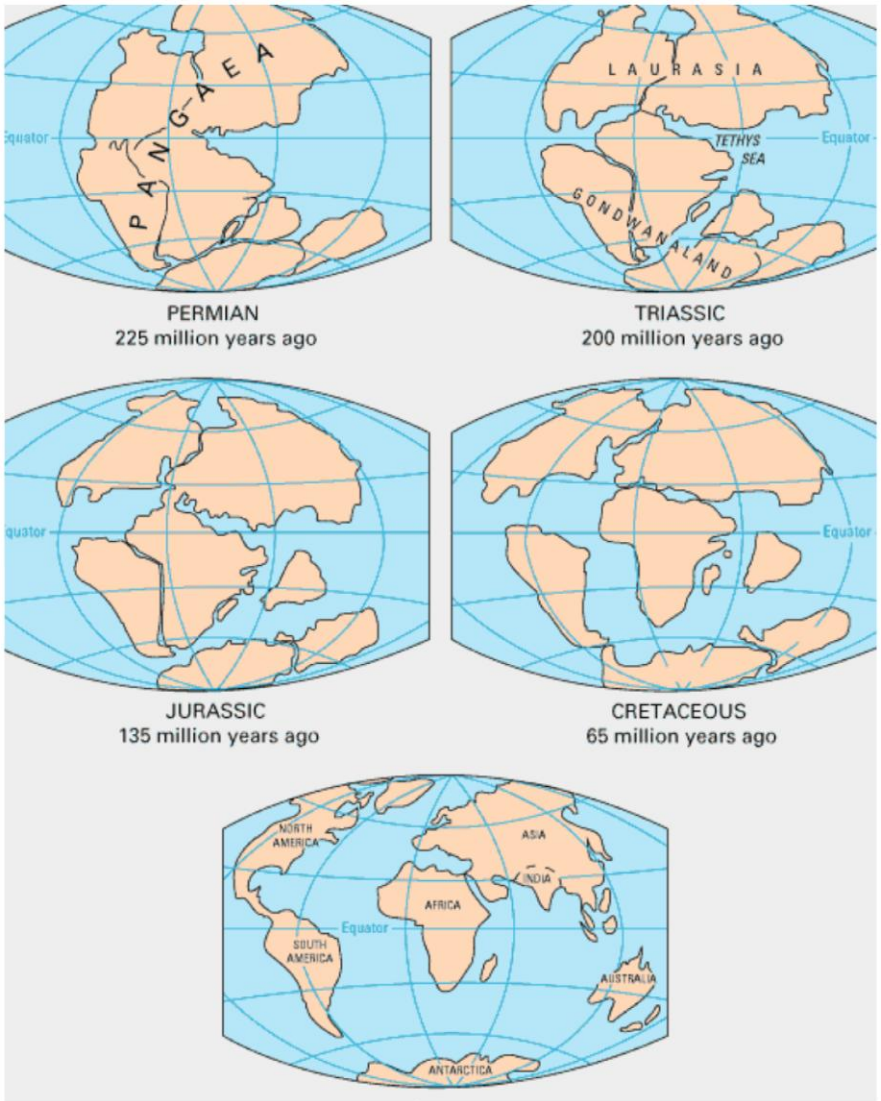


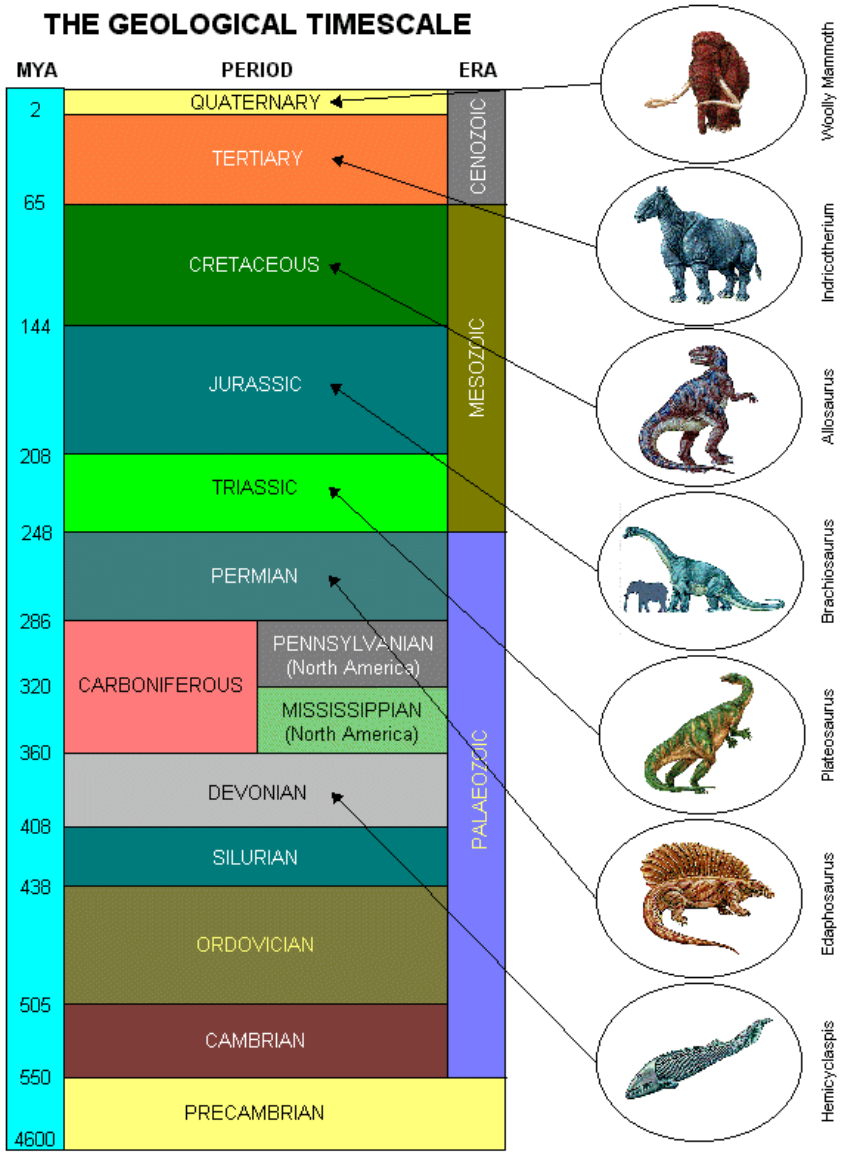


Dr Paal Brekke from the European Space Agency



The Earth showing angle of axis of rotation. When the angle increases the summers become warmer and the winters become colder.





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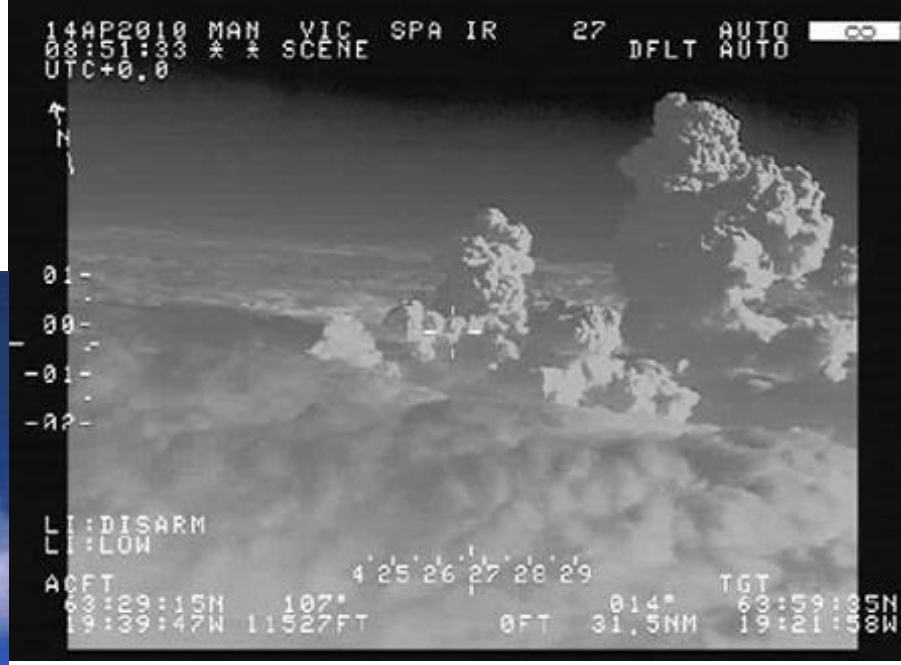
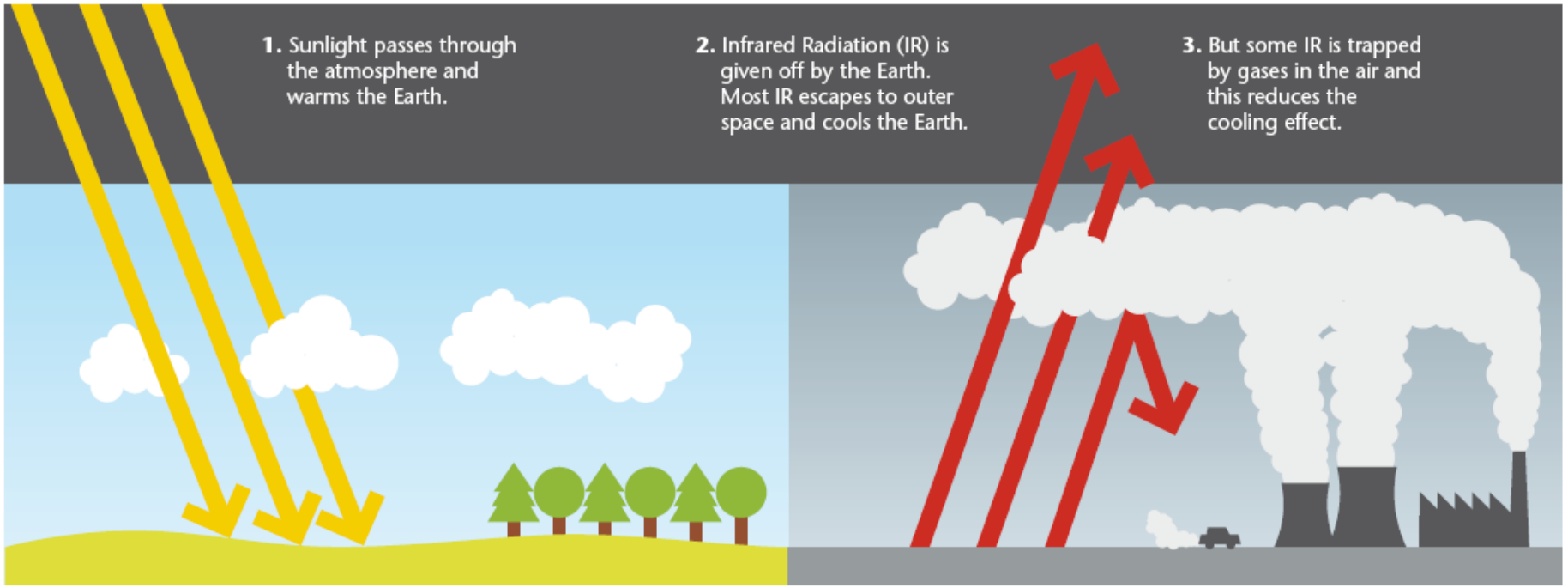


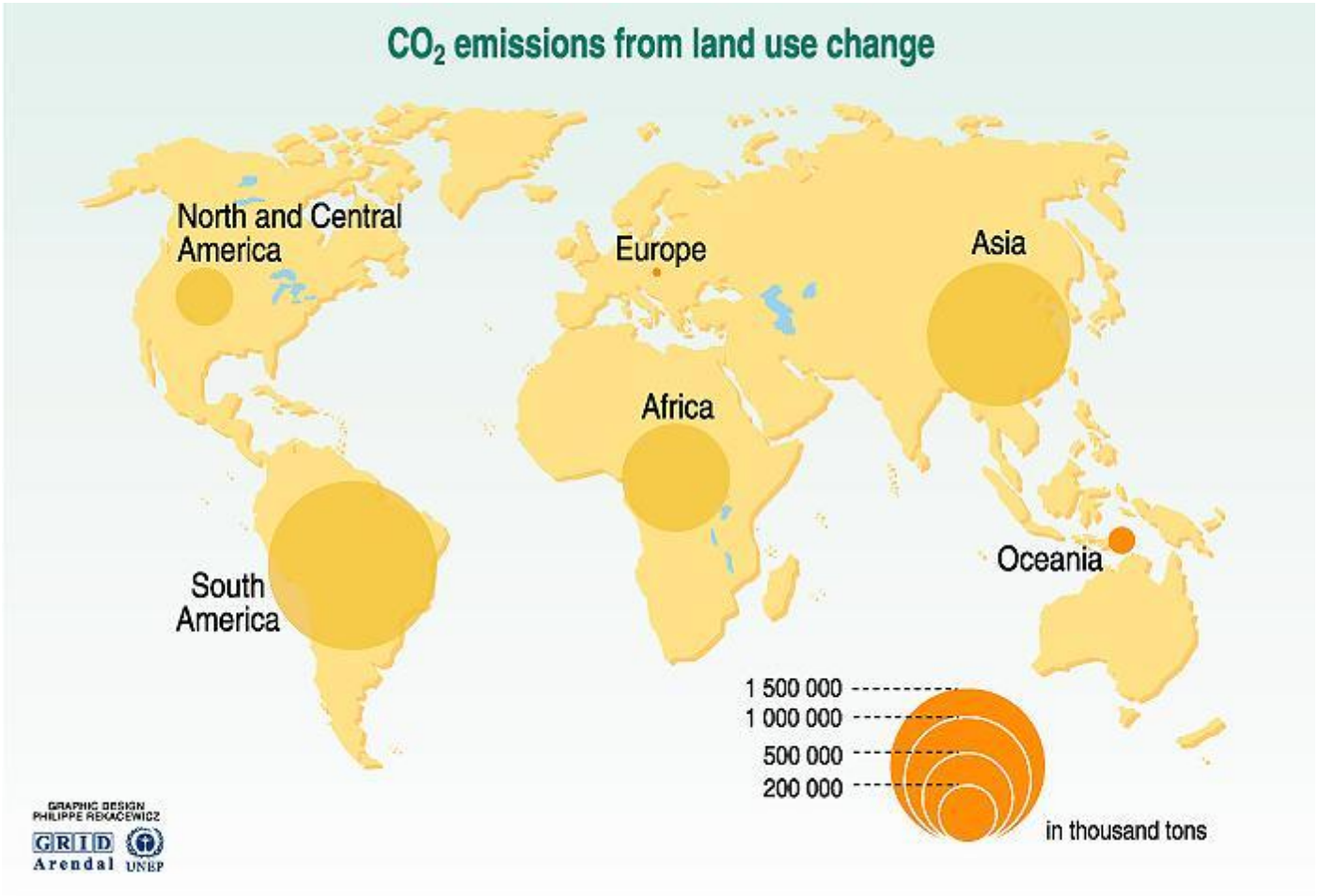
2010 Iceland Volcanic Eruption – A Q300 surveillance aircraft which has captured images of the volcanic plume breaking the cloud layer

Increasing greenhouse gases trap more heat



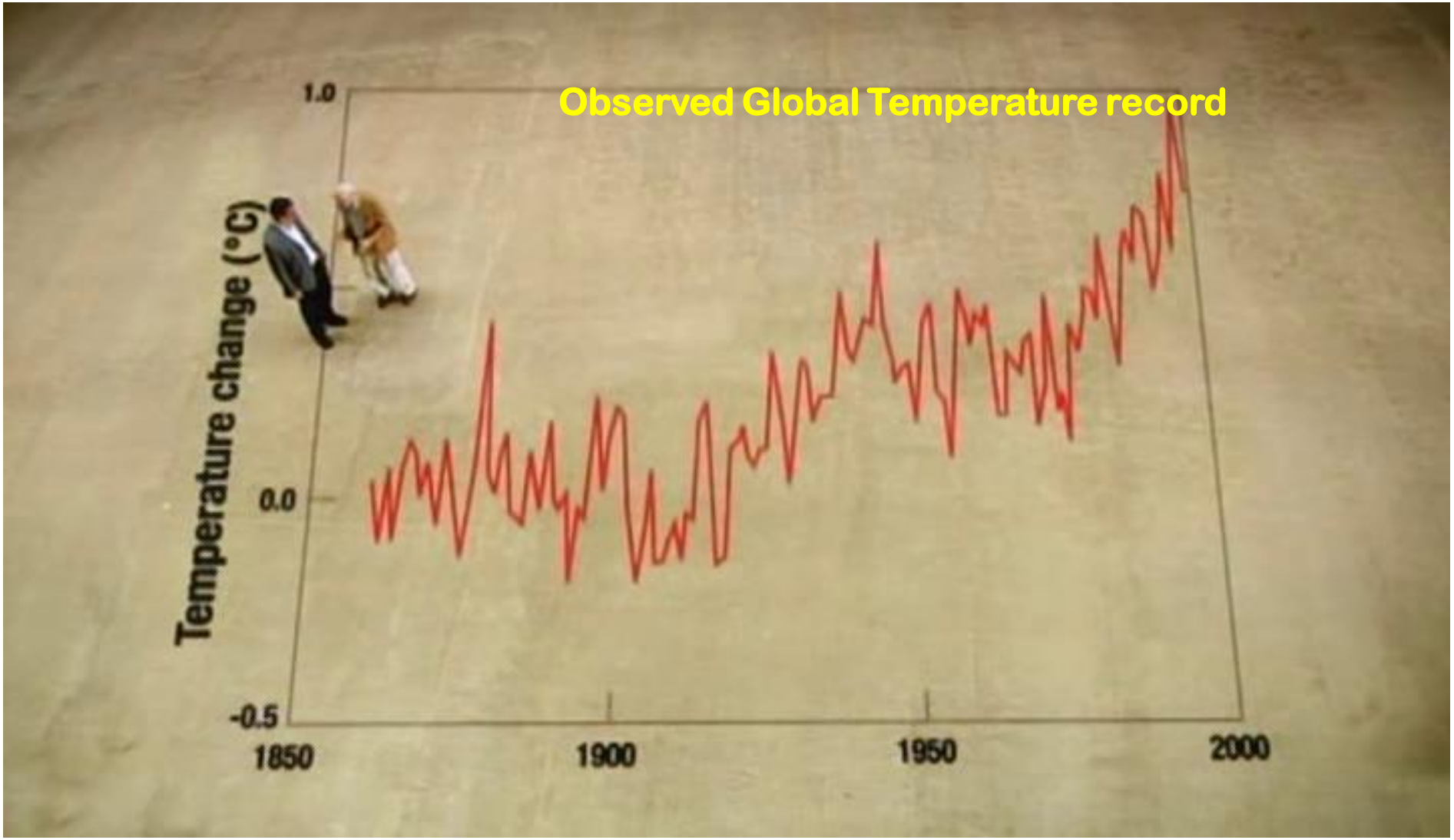
The greenhouse effect.

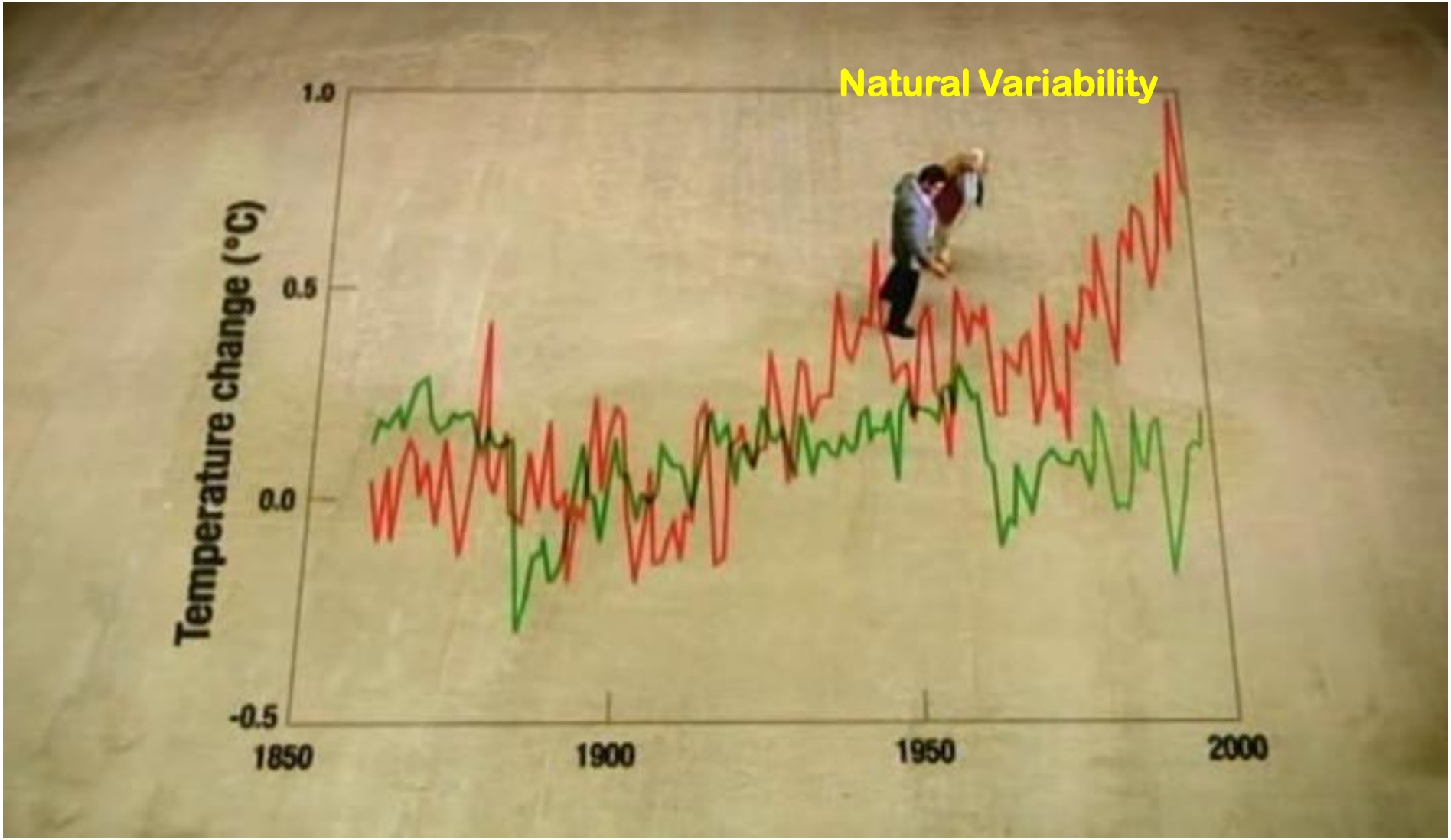
Chronosequence of land-use change: tropical rainforest - corn - cacao agroforest - Dr. Marife D. Corre

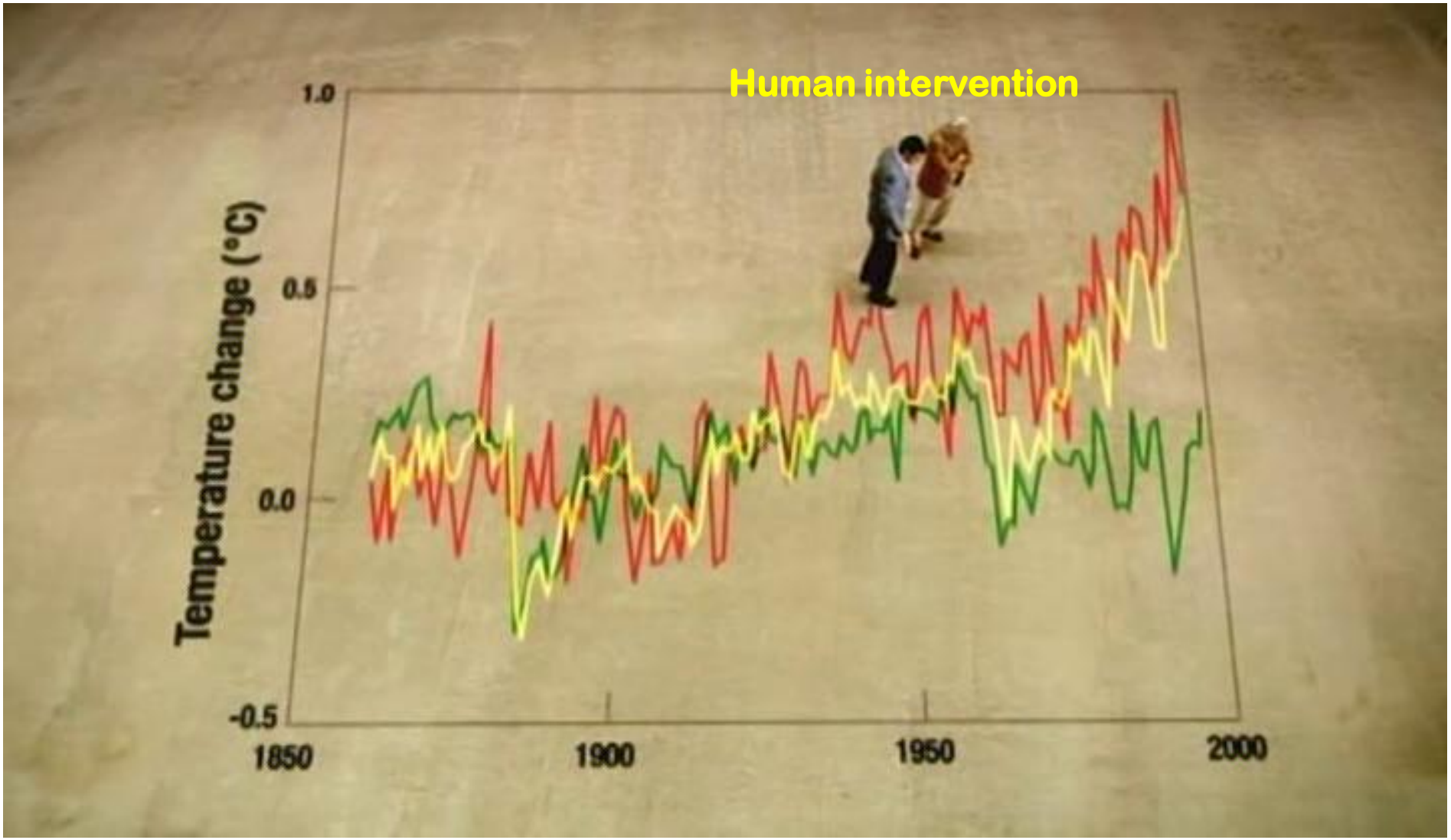


Source : Climate Change Information kit, UNEP IUC, 1997.

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


Observed Global Temperature record
Temperature change (°C)
1.0
0.0
-0.5
1850
1900
1950
2000


Natural Variability
Temperature change (°C)
1.0
0.5
0.0
-0.5
1850
1900
1950
2000


Human intervention
Temperature change (°C)
1.0
0.5
0.0
-0.5
1850
1900
1950
2000

Adaptation v Mitigation

- **Mitigation:**
  - reducing greenhouse gas emissions
  - carbon trading / taxes
  - renewable (and low carbon)energy
  - land use planning
  - protecting and enhancing natural carbon sinks

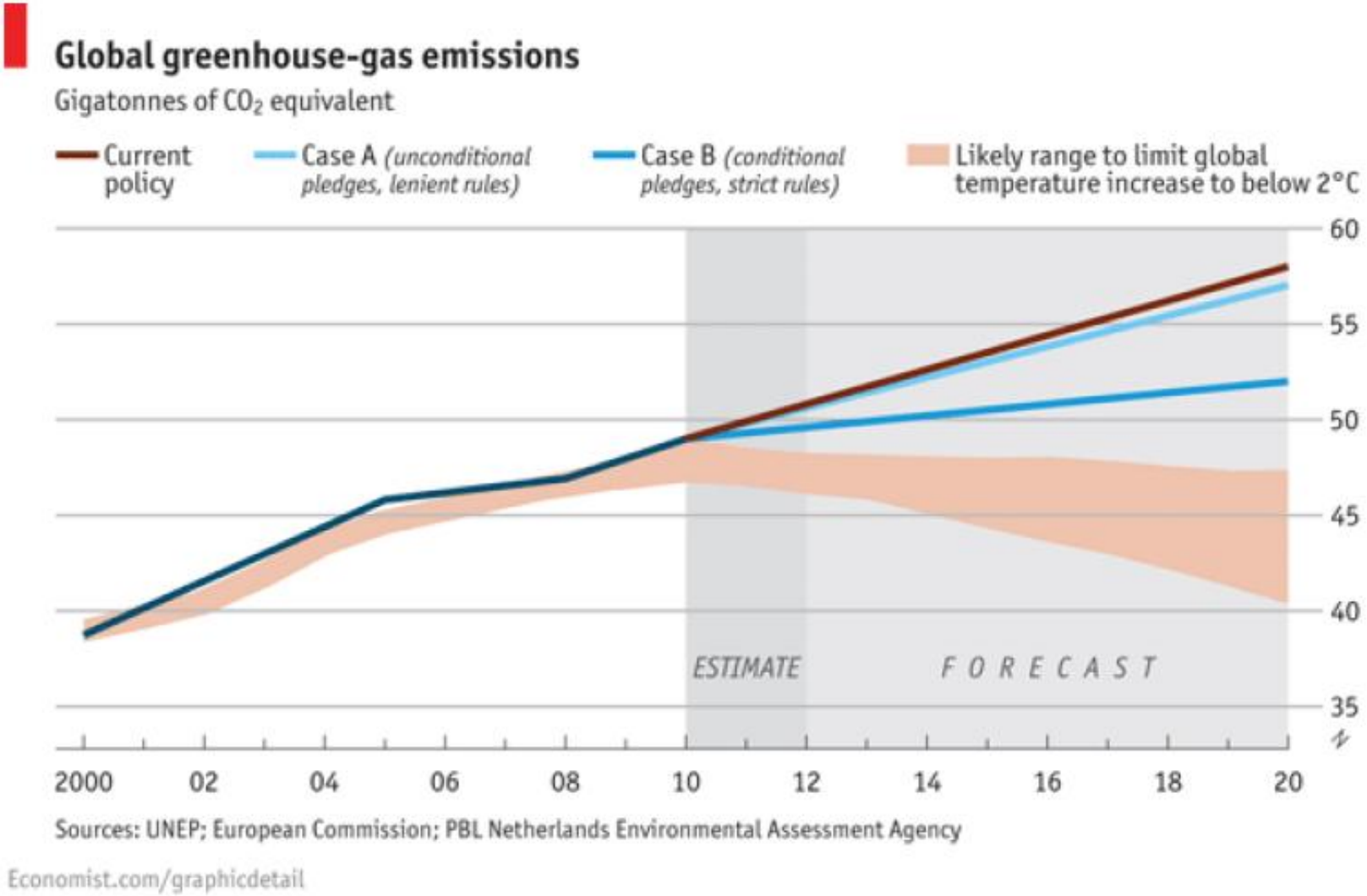
Adaptation v Mitigation

- Adaptation – its about managing:
  - physical impacts (e.g. changes to extreme weather, climate drivers, slow change);
  - economic impact & market shift;
  - health & wellbeing;
  - insurance affordability & availability;
  - understanding and implementing climate legal risk (regulatory changes, litigation, due diligence, contracts etc)
  - constant monitoring and evaluation

Adapting to what?

- Global climate system is complex, understanding how it may change is more complex - links back to mitigation, population growth, technology uptake, environmental feedbacks
- Although there is a high demand to simplify down the science it is critical to recognise that doing so imposes risks and even a false sense of security

Heading in the wrong direction



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!

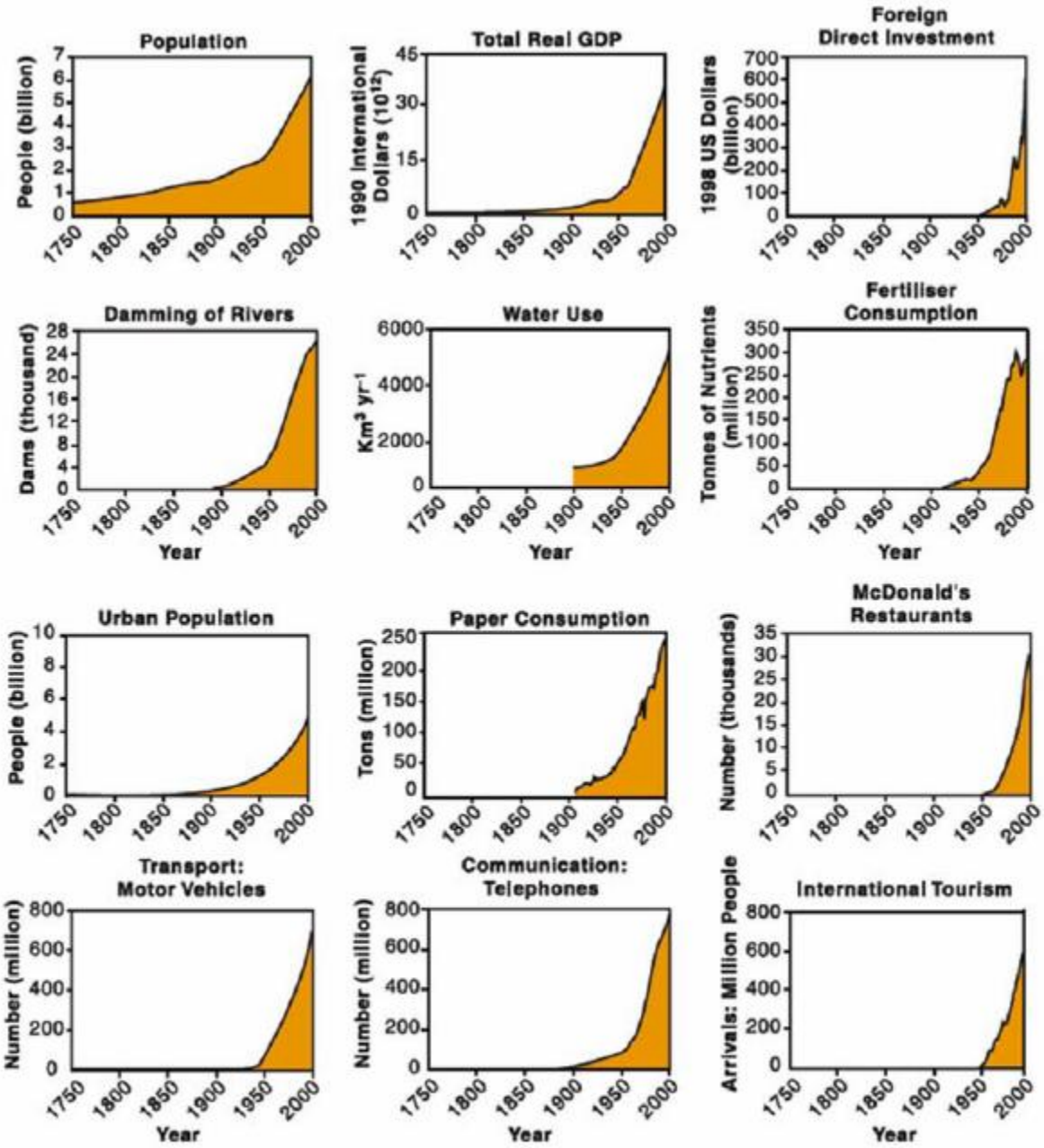


Figure 2. We see an unprecedented change in human activity, with often-unknown impacts on our environment and on the water cycle (from *Steffen et al.* [2004] with kind permission of Springer Science+Business Media).

New Paradigm

Failure with Past Approaches

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

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

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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

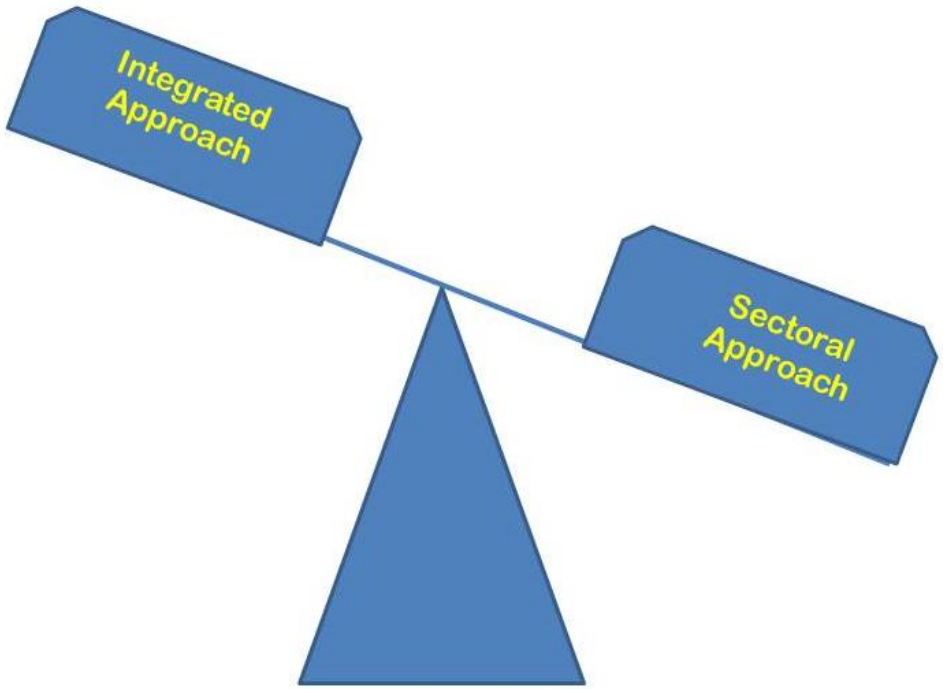
- **Water governance crisis**
  - Sectoral approaches to water resources management have dominated in the past and are still prevailing. This leads to fragmented and uncoordinated development and management of the resource.
- **Increased competition**
  - Increased competition for the finite resource 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…

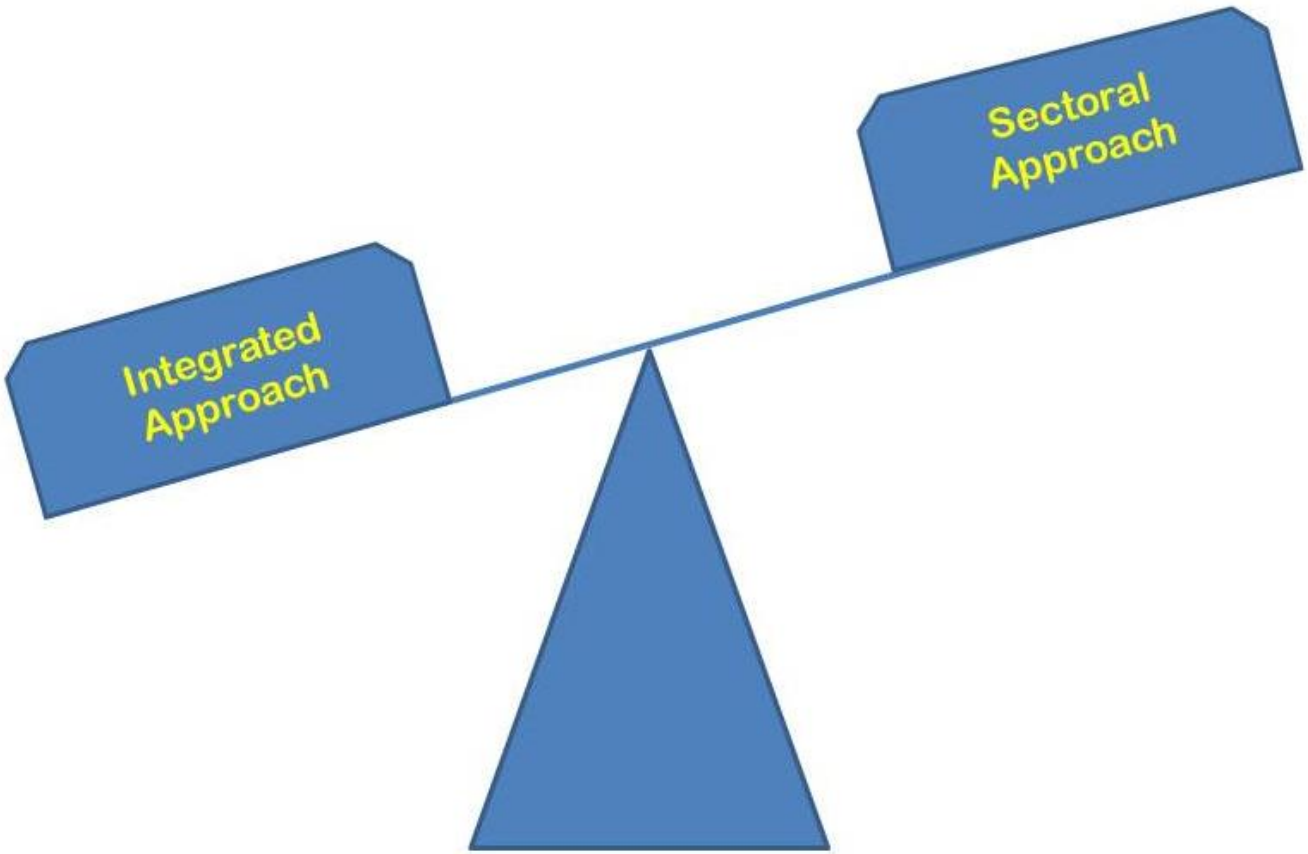
Risks of fully sectoral approach

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



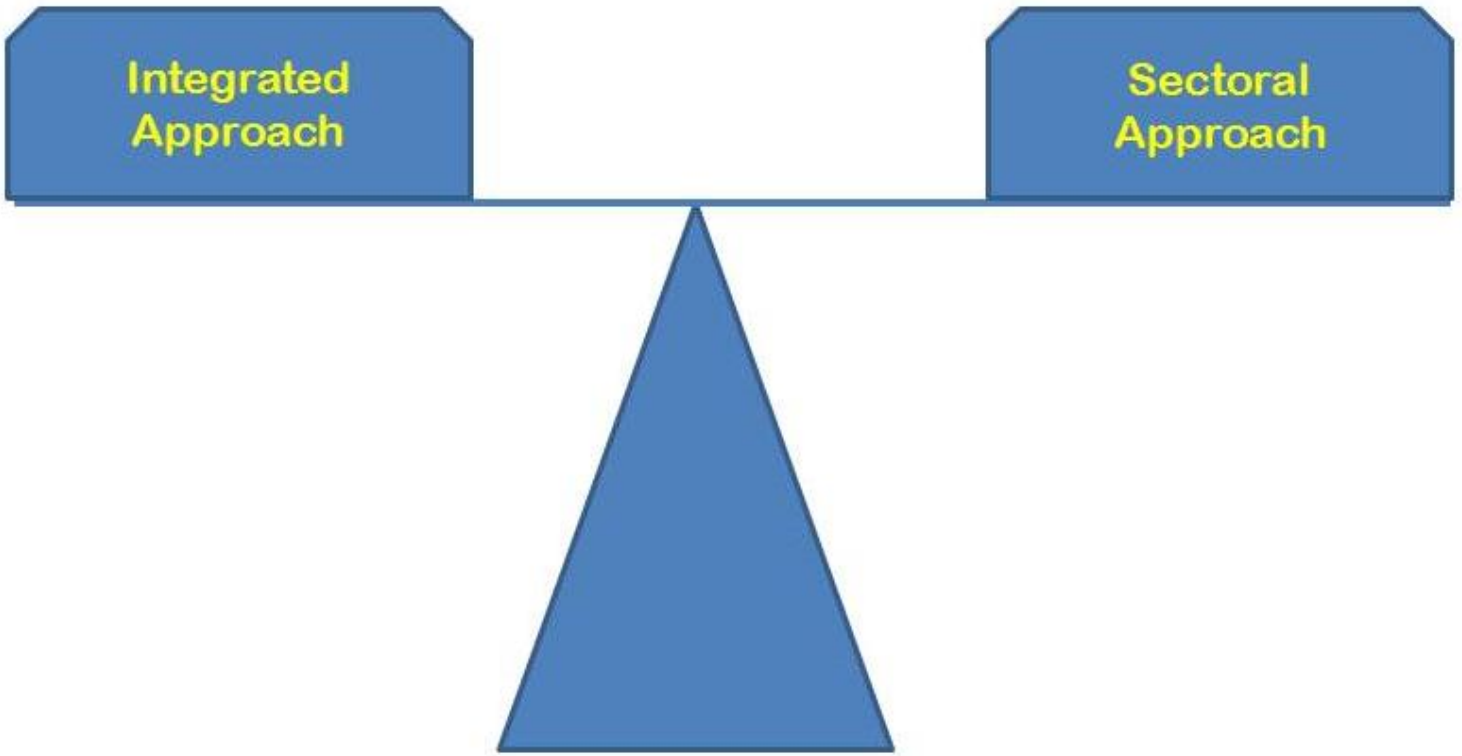
Risks of fully integrated approach

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



Finding a balance

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



Practicing IWRM

Concept

Practice

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

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.

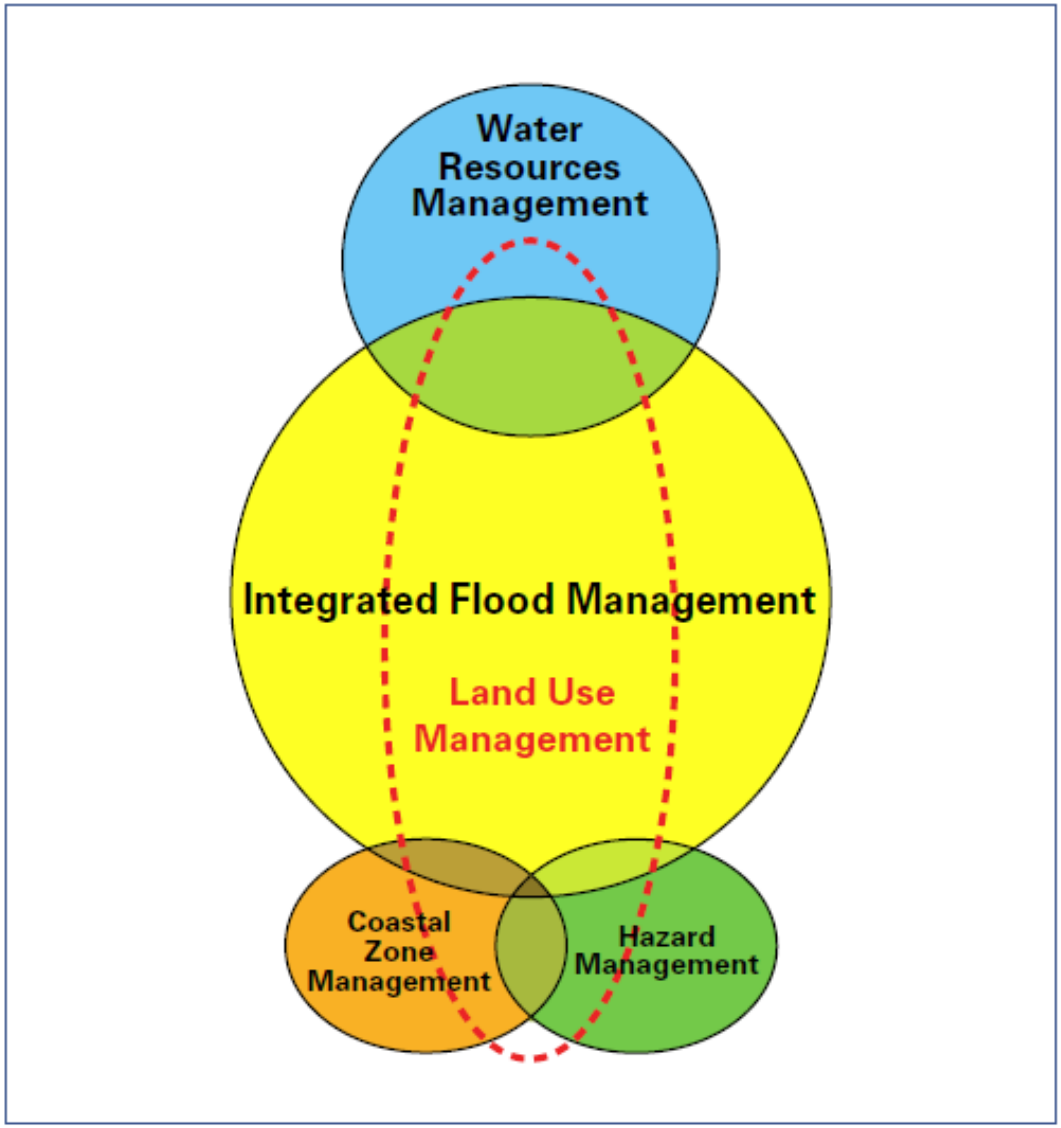


Figure 1. Integrated flood management model

WMO-No. 1047

1. Manage the water cycle as a whole;
2. Integrate land and water management;
3. Manage risk and uncertainty;
4. Adopt a best mix of strategies;
5. Ensure a participatory approach

Strategy	Options
Reducing Flooding	Dams and reservoirs
	Dikes, levees and flood embankments
	High flow diversions
	Catchment management
	Channel improvements
Reducing Susceptibility to Damage	Floodplain regulation
	Development and redevel-opment policies
	Design and location of facilities
	Housing and building codes
	Flood proofing
	Flood forecasting and warning
Mitigating the Impacts of Flooding	Information and education
	Disaster preparedness
	Post-flood recovery
	Flood insurance
Preserving the Natural Resources of Flood Plains	Floodplain zoning and regulation

Table 1. Strategies and Options for Flood Management

The adoption of a strategy depends critically on the hydrological and hydraulic characteristics of the subject river system and region.

Dealing with uncertainties

Uncertainties

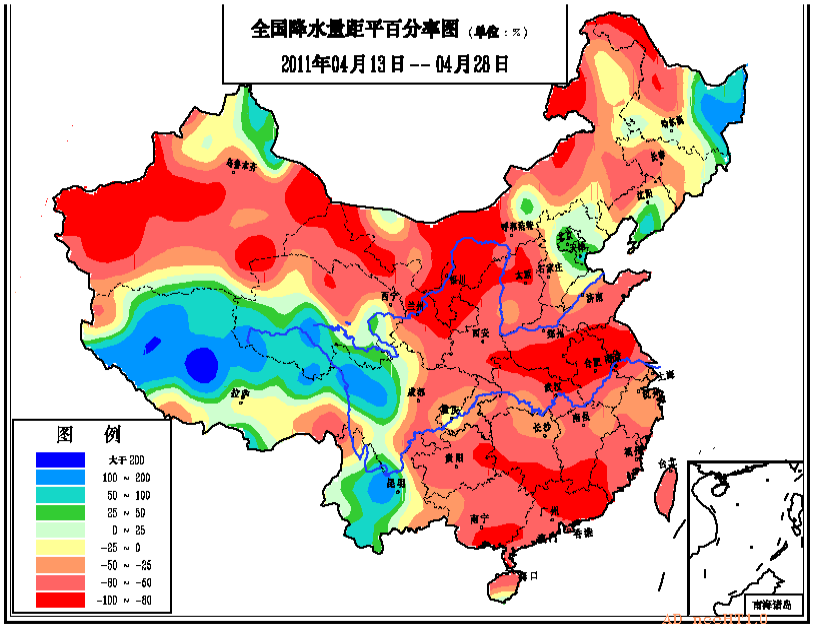
One thing is certain:

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 disaster



中国旱涝气候公报

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 …*

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!*

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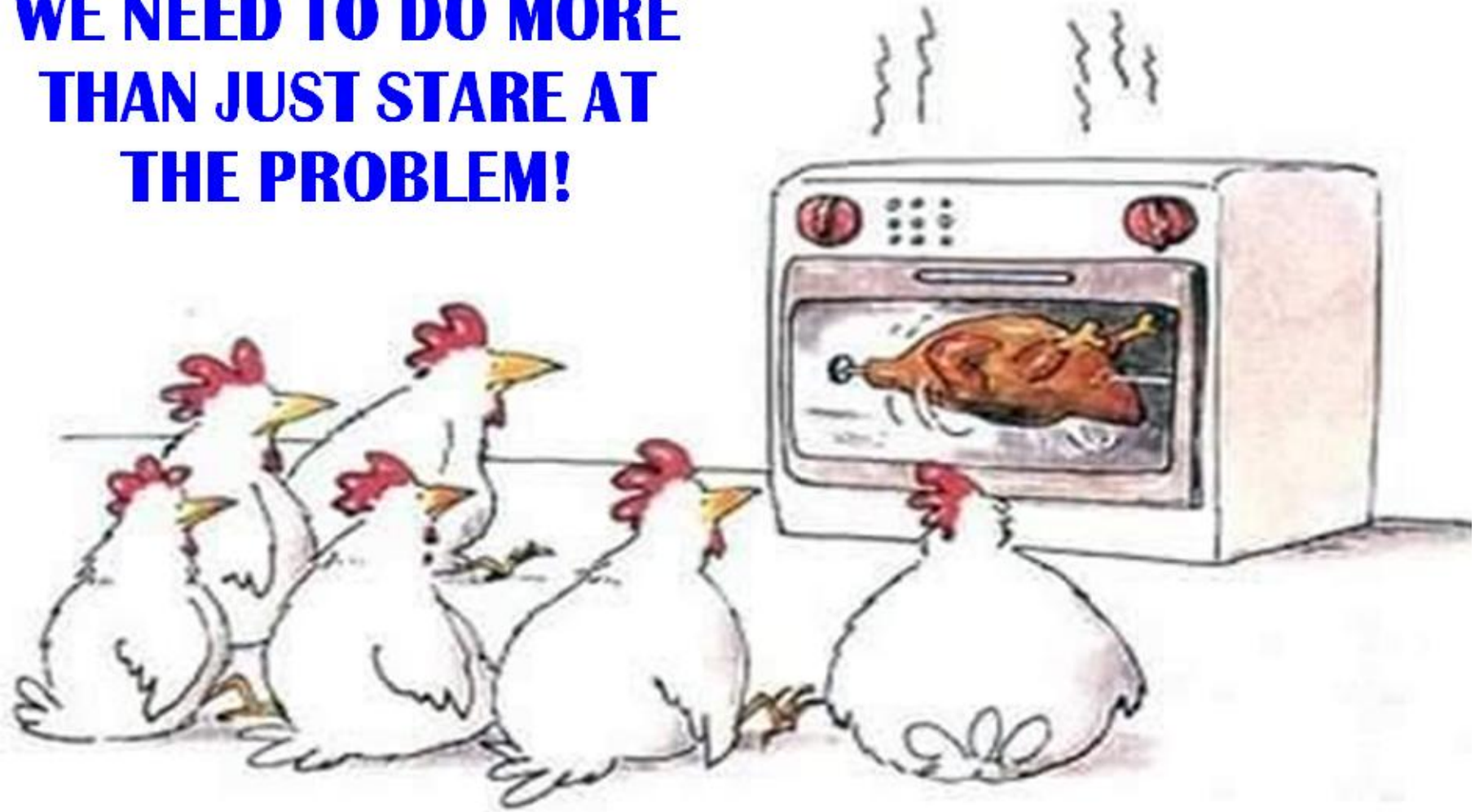
WE NEED TO DO MORE THAN JUST STARE AT THE PROBLEM!



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.”