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# Overview on Climate Change, Mitigation, Adaptation and related concepts

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# Outline

- Climate and climate variability
- Climate change
- Mitigation
- Adaptation
- Vulnerability and risk
- Coping strategies and adaptation
- Some adaptation measures
- Aim: To provide an overview

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# Understanding Weather and Climate

- **Weather**: The actual state of the atmosphere in a given location at a given time in terms of such variables as air temperature, rainfall and wind speed.
- **Climate**: Average weather of a place over a period of 30 years
- **Various influence factors**: Solar radiation, earth surface, snow and ice, oceans, large water bodies, and living organisms **AND/OR**
- Climate evolves over time through the internal dynamics of the climate system
- Through external factors (the so-called Forcings)

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# Concerns about Climate

- Forcings . . .
- The Greenhouse Gases (GHG) and the GHG effect
- Please note that,
  - The Earth's natural greenhouse effect makes life as we know it possible.

Source: IPCC 2007

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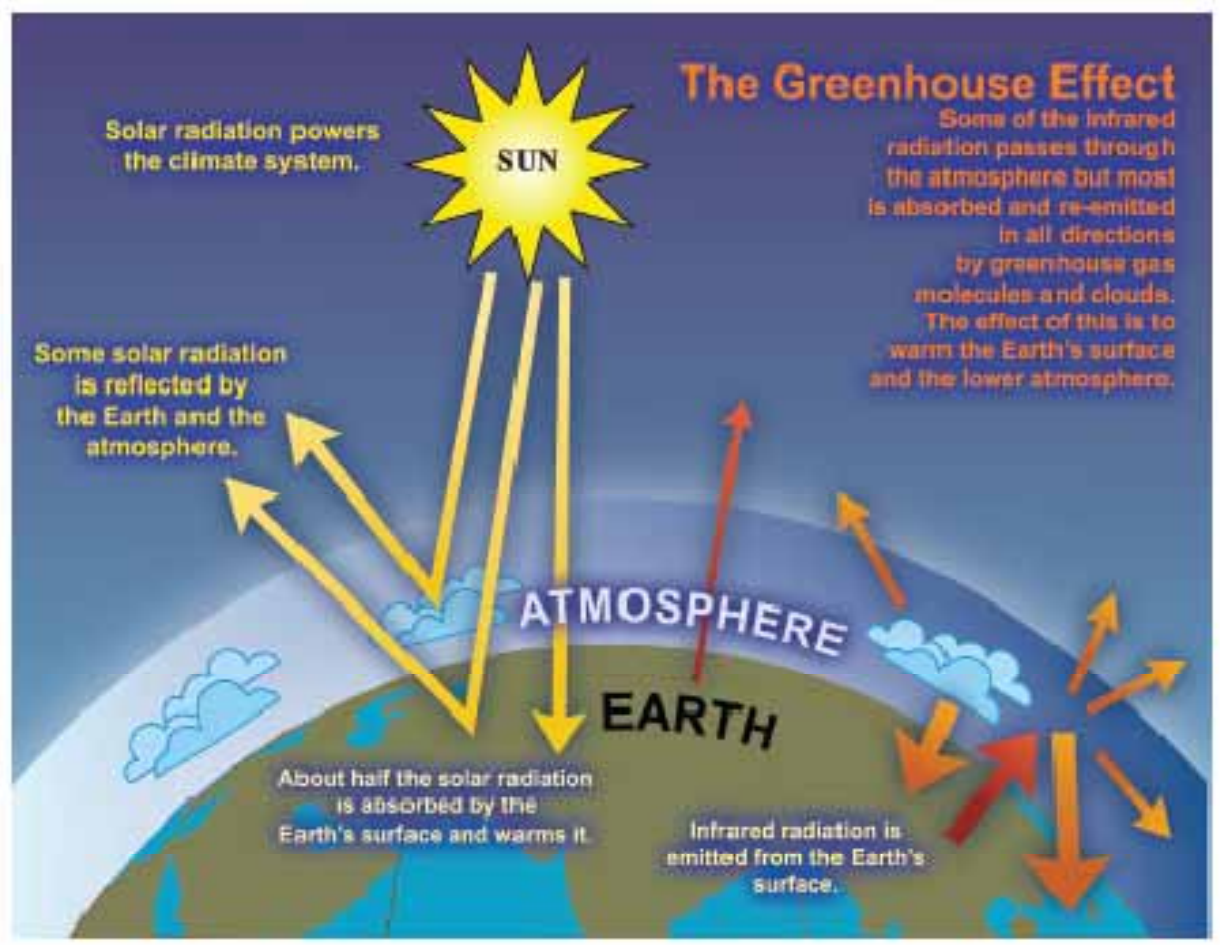
# The Greenhouse Effect






An idealised model of GHG, IPCC 2007:S115

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# The Greenhouse Gases

- Primary GHGs: Water vapour ($H_2O$), carbon dioxide ($CO_2$), nitrous oxide ($N_2O$), methane ($CH_4$) and ozone ($O_3$)
- The Kyoto Protocol deals with the GHG $CO_2$, $N_2O$, and $CH_4$ , sulphur hexafluoride ($SF_6$), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).
- Natural Greenhouse effect
  - The process in which the absorption of infrared radiation by the atmosphere warms the Earth.
- Enhanced (anthropogenic) greenhouse effect
  - results from gases emitted as a result of human activities (mainly through burning fossil fuels and clearing forests)

- Leading to Global Warming ≠ Climate Change

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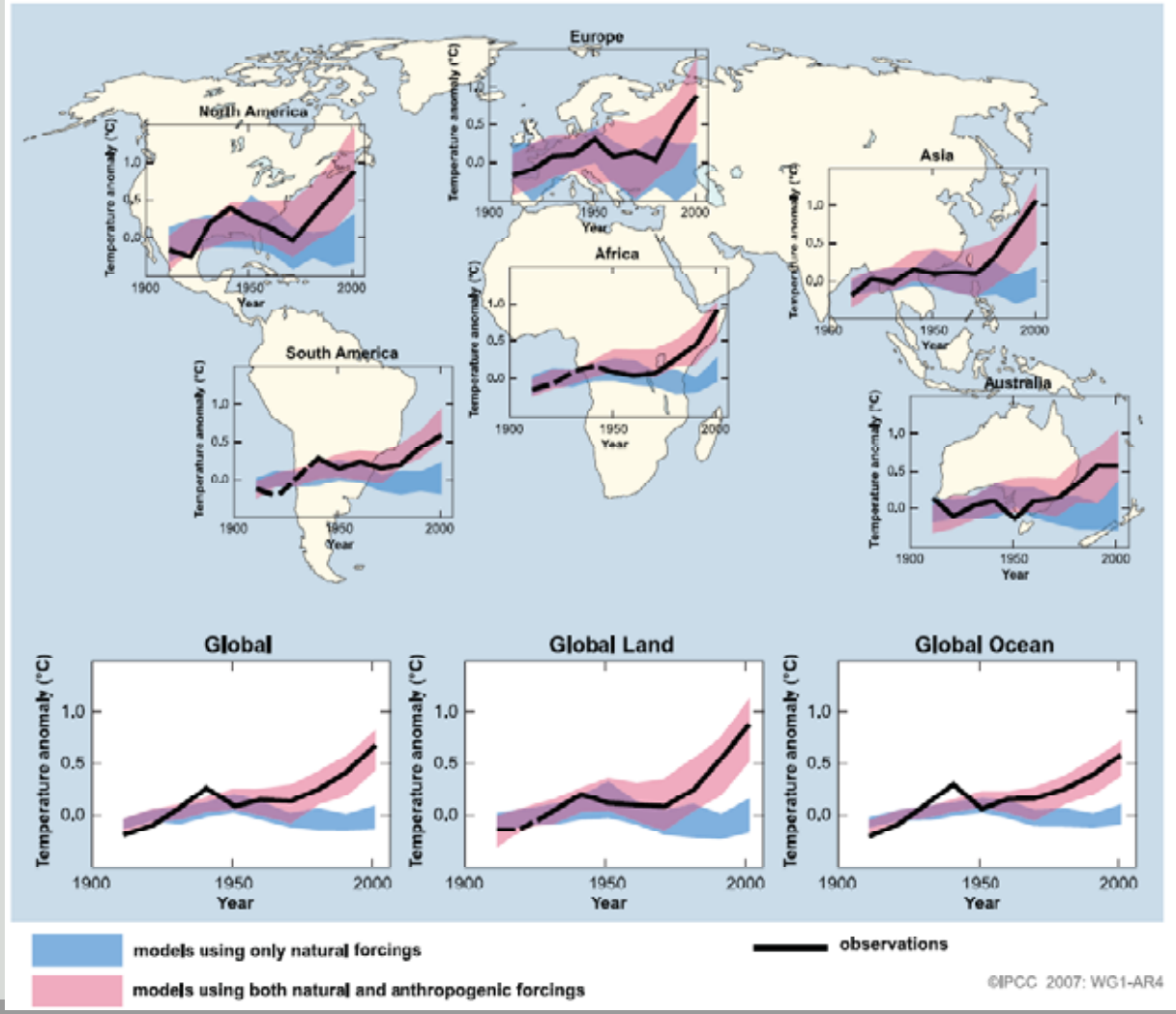
# Observed & Modelled Temperature Changes



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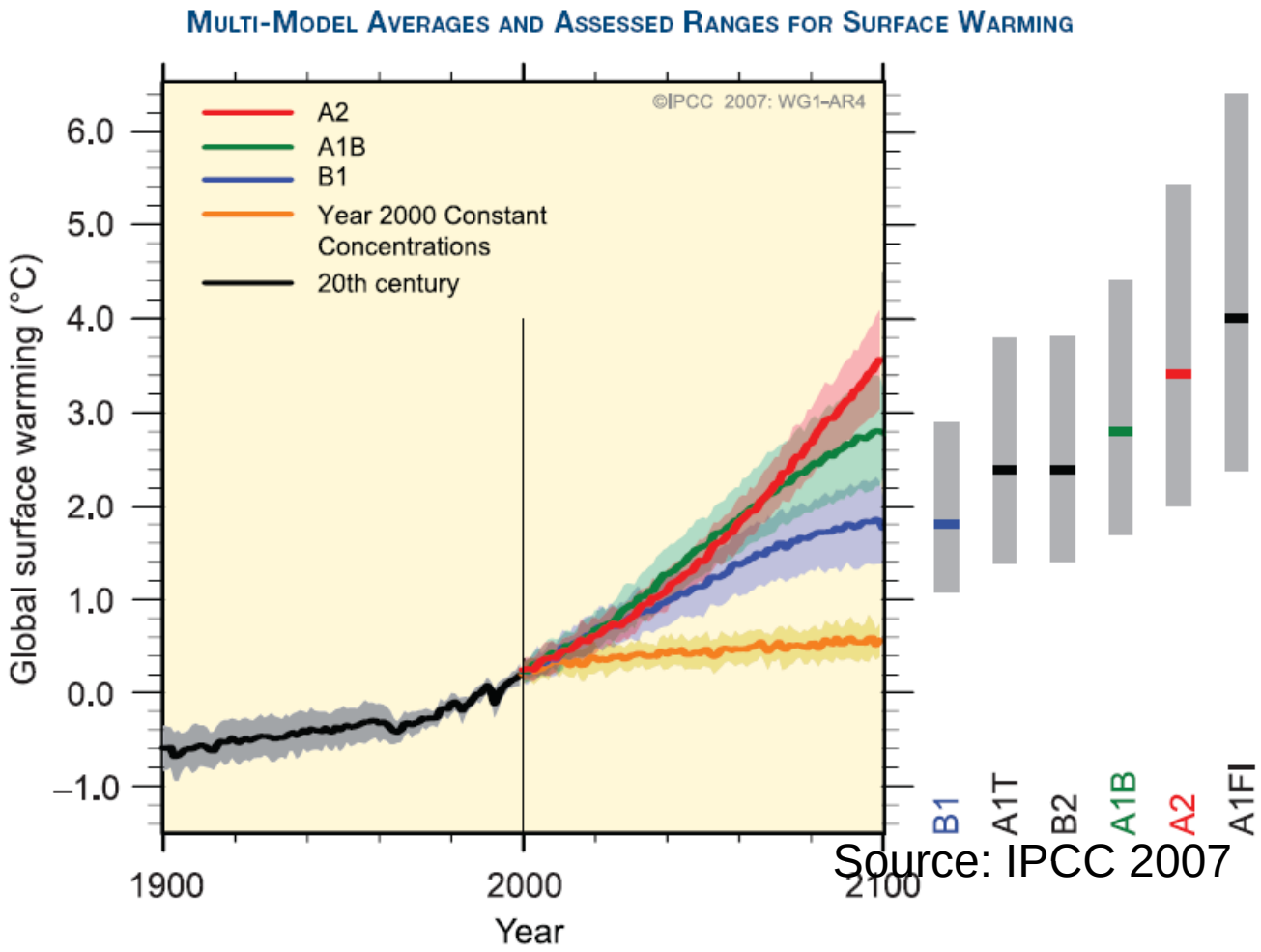
# Multi-Model Averages & Assessed Ranges for Surface Warming




Source: IPCC 2007

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# Climate Variability

- Climate variability refers to **variations in the mean state and other statistics** (such as standard deviations, statistics of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events.

- Variability may be due
  - to **natural internal processes** within the climate system (internal variability), or to variations in natural or **anthropogenic external forcing** (external variability) – IPCC 2007

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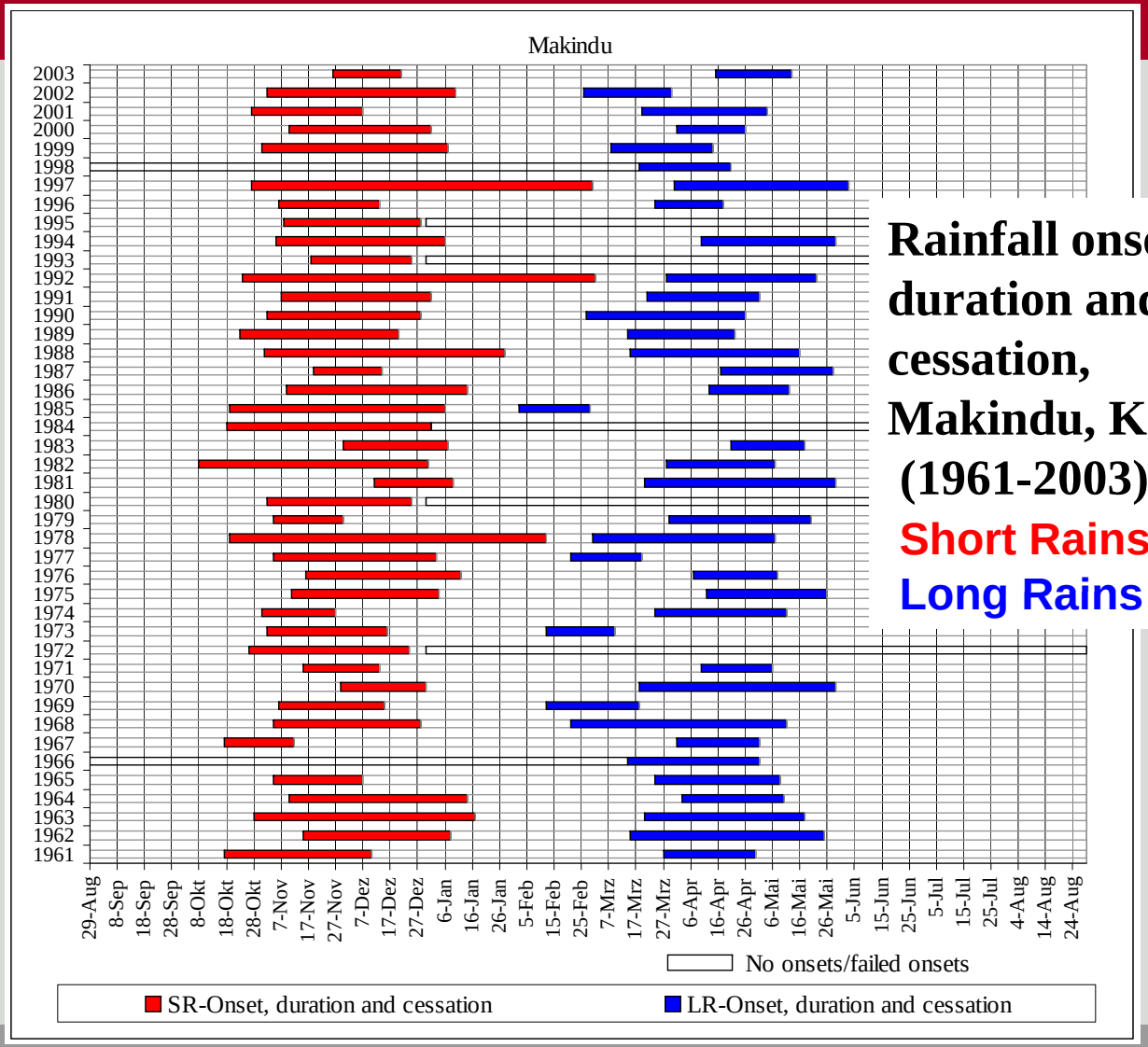
# Climate Variability: e.g. high rainfall variability




**Rainfall onset, duration and cessation, Makindu, Kenya (1961-2003)**

**Short Rains**

**Long Rains**



**©Ifejika Speranza 2006**

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# Climate Change

- IPCC 2007:
  *Climate change refers to **any change in climate** over time, whether due to natural variability or as a result of human activity*.

- United Nations Framework Convention on Climate Change (UNFCCC):
  *Climate change is 'a change of climate which is attributed directly or indirectly to **human activity** that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*.

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# Implications of Climate Change

More likelihood of

- Heavy precipitation events (flooding)
- (more severe) droughts
- Sea level rise (excluding Tsunamis)
- More intense tropical cyclones
- Higher storm surges

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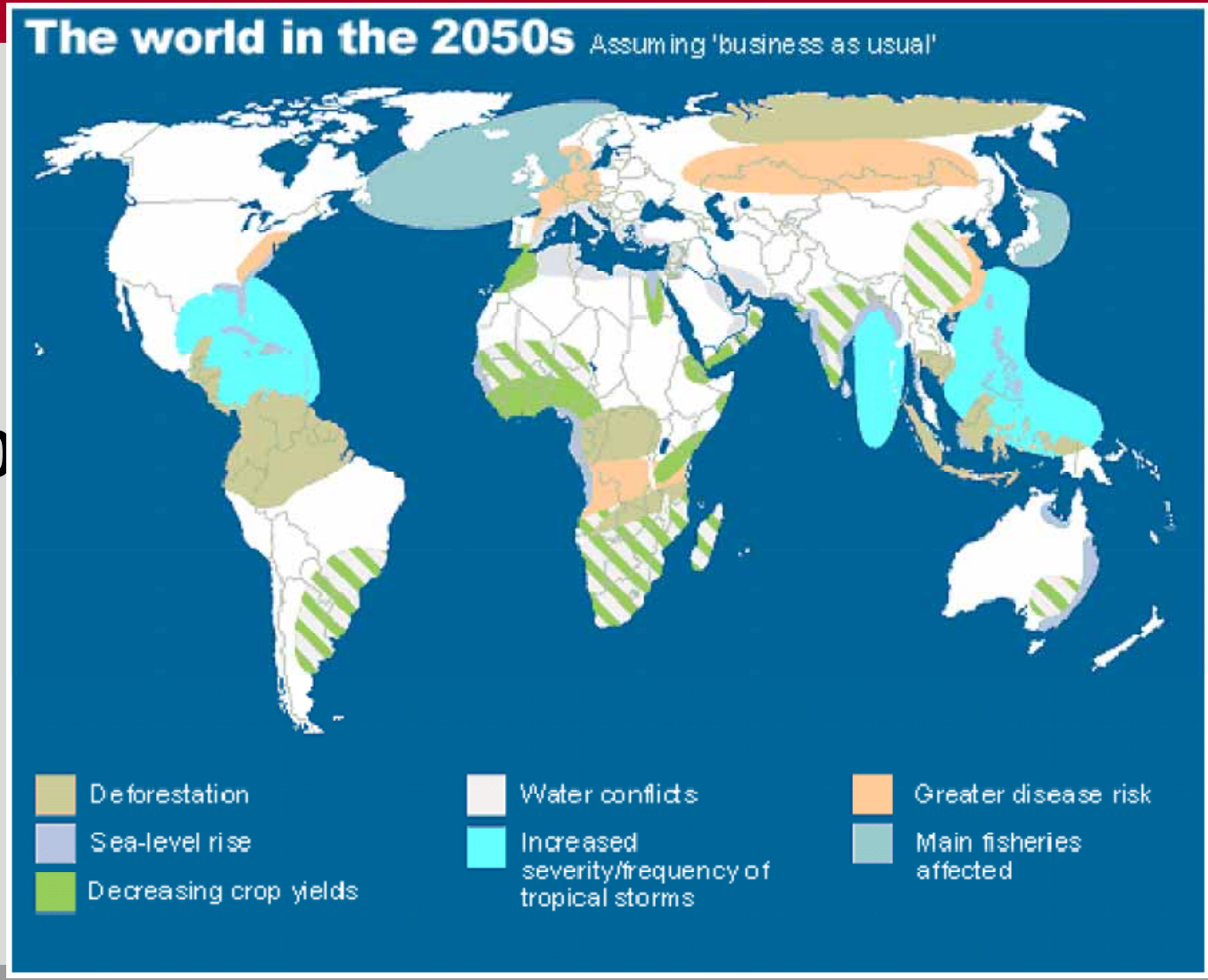
# Scenario of Damage in 2050




Source: The Guardian, based on Pentagon report

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# Vulnerability in the climate change discourse

- IPCC (2001) defines vulnerability as ‘the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.
- Vulnerability is a **function** of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity’.

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# Vulnerability from a development perspective

- **Vulnerability, in its simplest denotative sense, means the capacity to be harmed, to experience some loss.**
- Vulnerability as a concept refers to the likelihood of adverse consequences because of various external and internal factors
  - Example: The likelihood of experiencing food insecurity
- The degree of vulnerability depends on the environmental, social, economic and political characteristics of an area, population, activities, or the environment and is measured by the ability to anticipate, cope with, resist, and recover from an event, process, or a phenomenon like a drought hazard.

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# Perspectives of Vulnerability

- Vulnerability **increases** as the magnitude of climate change or sensitivity **increases**
- Vulnerability **decreases** as adaptive capacity **increases**
- **Two competing interpretations of vulnerability**:
- vulnerability as ‘a starting point’ and
- as ‘an end point’ of analyses /policy making.
- Each perspective has implications for both research and policy

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# Principal Components of Vulnerability

- *Component 1 external: Risk exposure:* Vulnerability to X closely relates to characteristics and timing of X.
- *Component 2: Internal (adaptive) capacity:* The capacity of people exposed to X to cope with and adapt to X and its outcomes
- *Component 3 multiple processes (vulnerability context):* Vulnerability is generated by multiple processes such as political and economic marginalisation, weakening social networks. These multiple processes are context-specific and in continuous flux as the biophysical and social processes that shape local conditions and ability to cope also change (Eriksen and O'Brien 2007).

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# Definition of Risk

- **Risk** refers to the probability (chance) of hazard occurrence and its adverse consequences. A **hazard** is defined as the threat of a naturally occurring (in this case, a drought) or human-induced process or event which has adverse consequences on human life, property, or activity and the environment within a given time period and area.
- Risk is represented as the sum/product of hazard and vulnerability, either as R = H + V or R = H x V
- Since people also have capacities to reduce their vulnerability and the impacts of hazards, capacity was integrated into the function: R = H x V/C

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# Different Perspectives of Risk

- Risk generally denotes expected losses due to a particular hazard, but the term risk is used in different senses:
- In terms of probability of loss indicating the possibility of suffering harm, loss or danger.
- In terms of a hazard - a danger or risk, a source of danger/risk.
- In terms of loss or adverse consequences
- In terms of perceptions – the perception of a risk/source of a risk.
- objective risk in terms of probabilities and loss quantification or
- Subjective risk in terms of perception, capacities and loss. These meanings show that risk does not only arise from physical processes but is also socially constructed in terms of risk perception, risk avoidance and acceptable risk (cf. Krüger and Samimi, 2003).

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# Mitigation

- An anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.

**Mitigation measures in agriculture (some examples)**

- Improved crop and grazing land management to increase soil carbon storage; improved rice cultivation techniques and livestock and manure management to reduce $CH_4$ emissions; improved nitrogen fertilizer application techniques to reduce $N_2O$ emissions; dedicated energy crops to replace fossil fuel use; improved energy efficiency.

**Mitigation measures in Forestry/forests**

- Afforestation; reforestation; forest management; reduced deforestation; harvested wood product management; use of forestry products for bioenergy to replace fossil fuel use.
- **Synergies and trade-offs with adaptation**

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# Inter-relationships between Adaptation and Mitigation

- Four types (IPCC 2007):
  - Adaptation actions that have consequences for mitigation
  - Mitigation actions that have consequences for adaptation
  - Decisions that include trade-offs or synergies between adaptation and mitigation
  - Processes that have consequences for both adaptation and mitigation - strategic planning, policies, budgetary allocation processes, UNFCCC obligations

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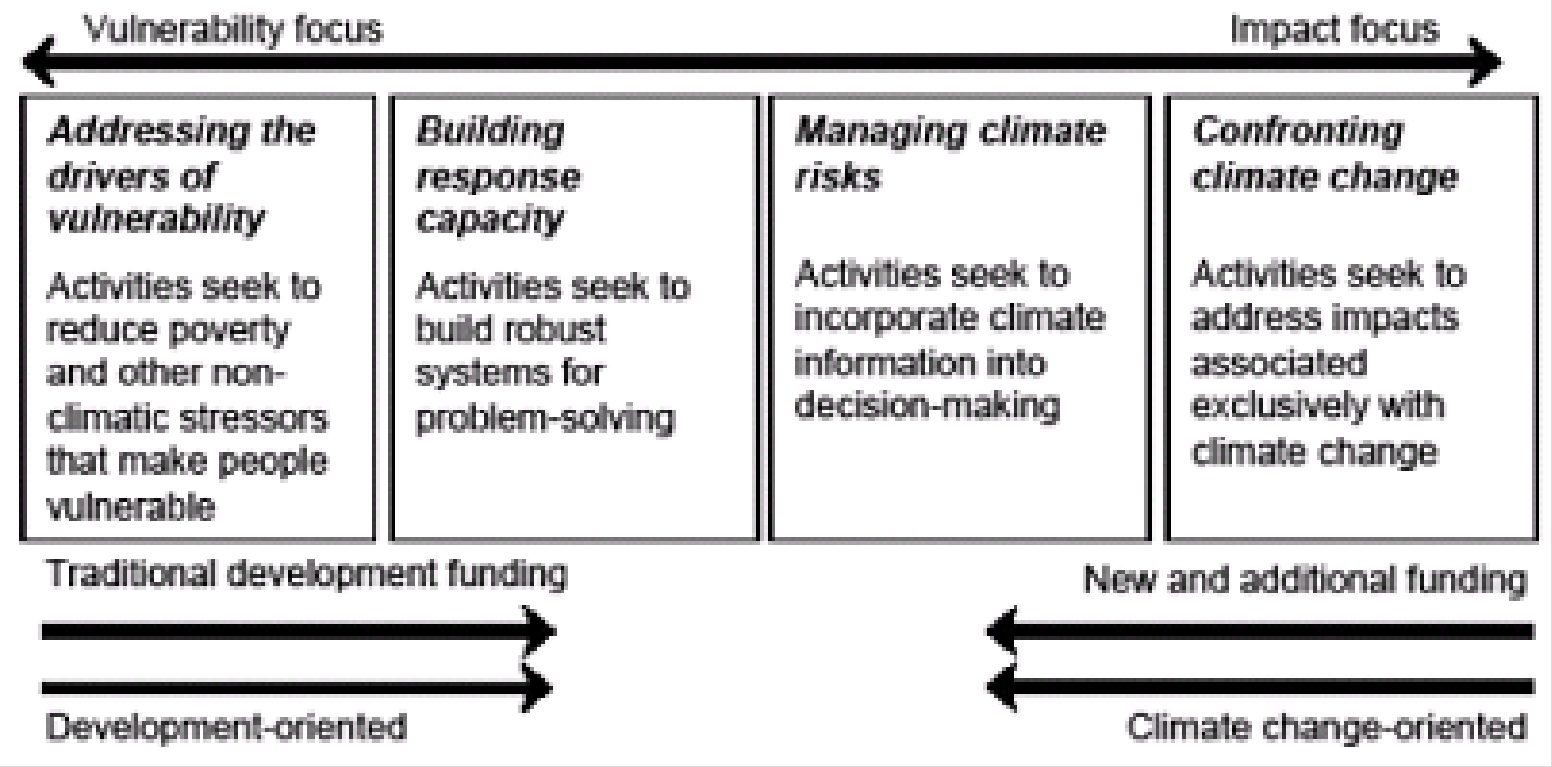
# Adaptation to Climate Change (IPCC 2007)

- Uncertainty as to the future temporal and spatial manifestations of climate change
- (a) Adaptation to what? (b) who or what adapts? and (c) how does adaptation occur?
- *Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities* (IPCC 2007).
- Various types of adaptation: anticipatory, autonomous and planned adaptation
- Mal-adaptation

# Adaptation as a Continuum I




Source: McGray et al., 2007

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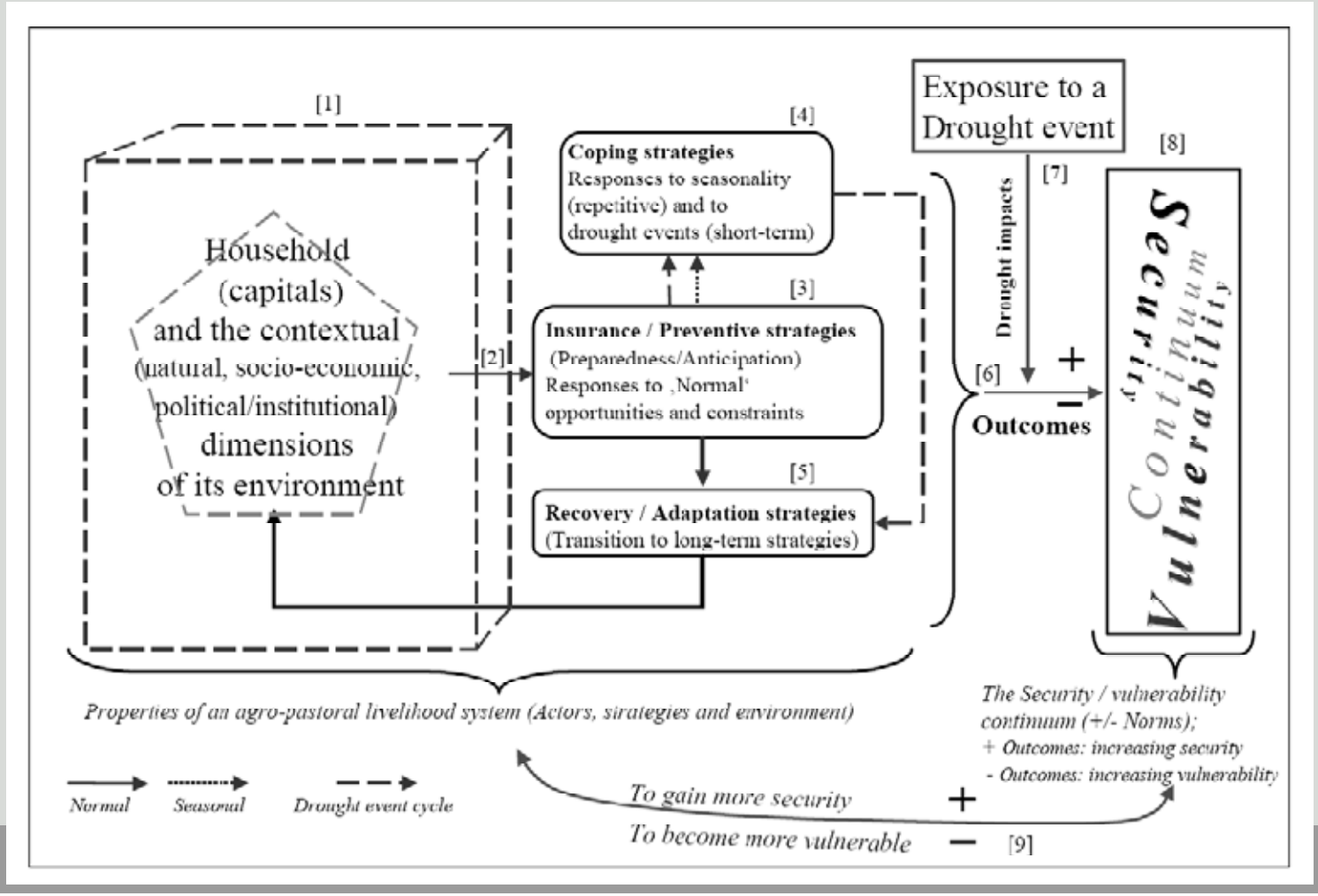
# Coping and Adaptation



# Coping and Adaptation

- Insurance strategies can be understood in terms of investing now with the aim of reaping the returns in future. Insurance strategies are those activities, which are implemented with the objective of
  - avoiding or minimising livelihood stresses and insecurities such as food shortages,
  - creating buffers to cushion loss (as in the processing of farm produce, preservation and storage; investment in livestock and social networks etc.) and
  - diversifying livelihoods in anticipation or knowledge of livelihood risks.

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# Coping and Adaptation

- In daily life, insurance strategies are translated into coping/response measures.
  - **Coping strategies** are fallback mechanisms to deal with short-term livelihood stresses in the face of an adverse event like drought and the failure of normal livelihood practices to ensure household welfare. They can also be repetitive responses to seasonality of prices and production.
  - **Recovery strategies** are those coping strategies, which households adopt to reactivate their livelihoods to enable them bounce back to their former or similar welfare status.
  - **Adaptation strategies** are those that lead to a considerable or complete change in livelihoods as a result of a shock. Sometimes livelihood strategies are no longer periodically or occasionally applied but become permanent in response to changes in the livelihood context. This is called **adaptation,** individuals adapting to new situations to maintain or improve their livelihoods.

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# Adaptive capacity

- **Adaptive capacity** (in relation to climate change impacts) is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.
- AC - a function of the relative level of availability, access and distribution of resources
- The level of adaptive capacity tends to be positively correlated to he level of development
- Having adaptive capacity is no guarantee that it will be used effectively

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# Some examples of climate change adaptation measures

- **Agriculture** – Change of crops grown
- Increase water availability – rainwater/runoff harvesting, irrigation
- Shift to conservation or organic agriculture practices
- **Infrastructure** – improving road construction/dams to withstand extreme flooding
- **Natural resources management** – Afforestation /reforestation
- Incorporating climate risks into water resources' policies and management; land use planning;
- **Health and Sanitation** – improve health and sanitation education / diseases surveillance; increase efforts on diseases' prevention; improve capacities to treat diseases (malaria, meningities, cholera etc)
- **Cross-Sectoral** – improve disaster risk management; insurance; mainstreaming CC, gender

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# Sensitivity

- Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise).

- Sensitivity includes exposure which considers
  - the nature and magnitude of cc
  - whether a system will be affected or not
  - the extent to which a system can be affected by climate change

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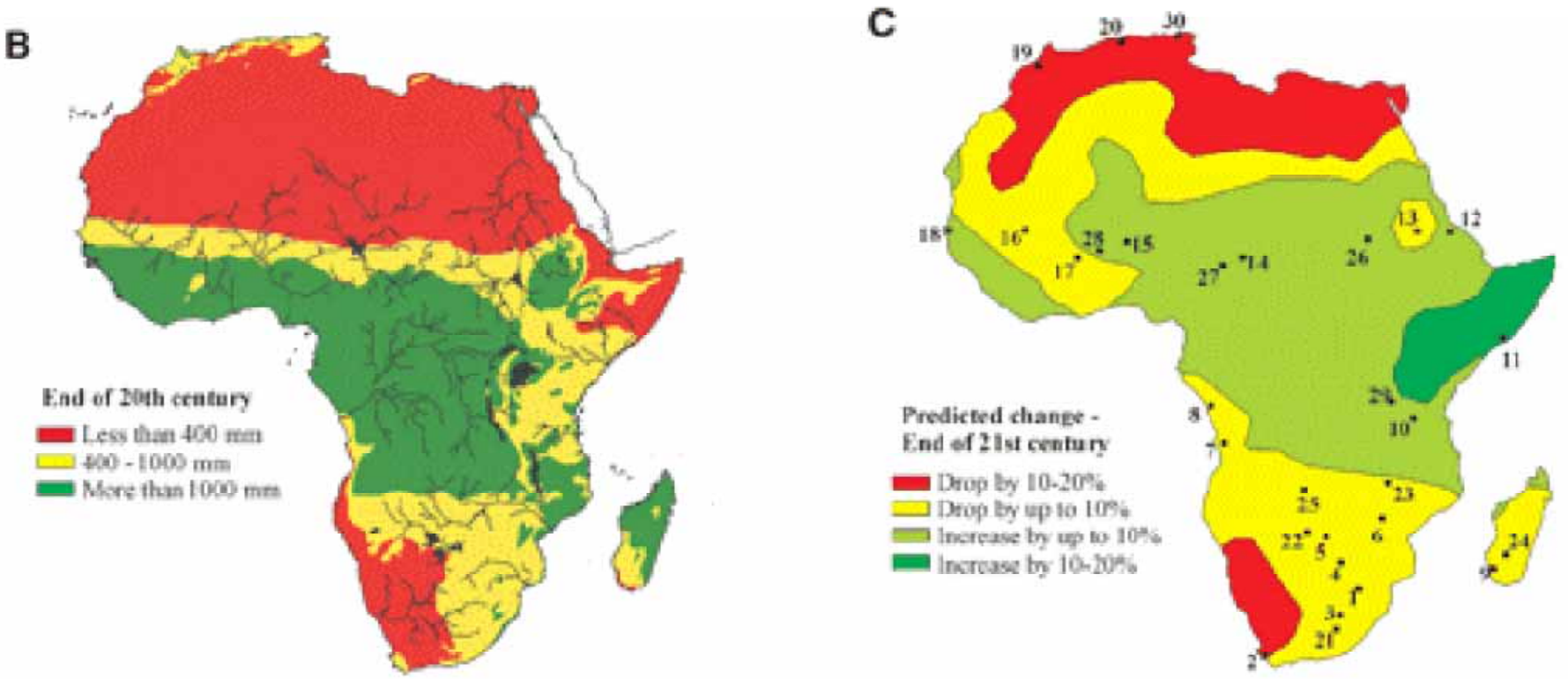
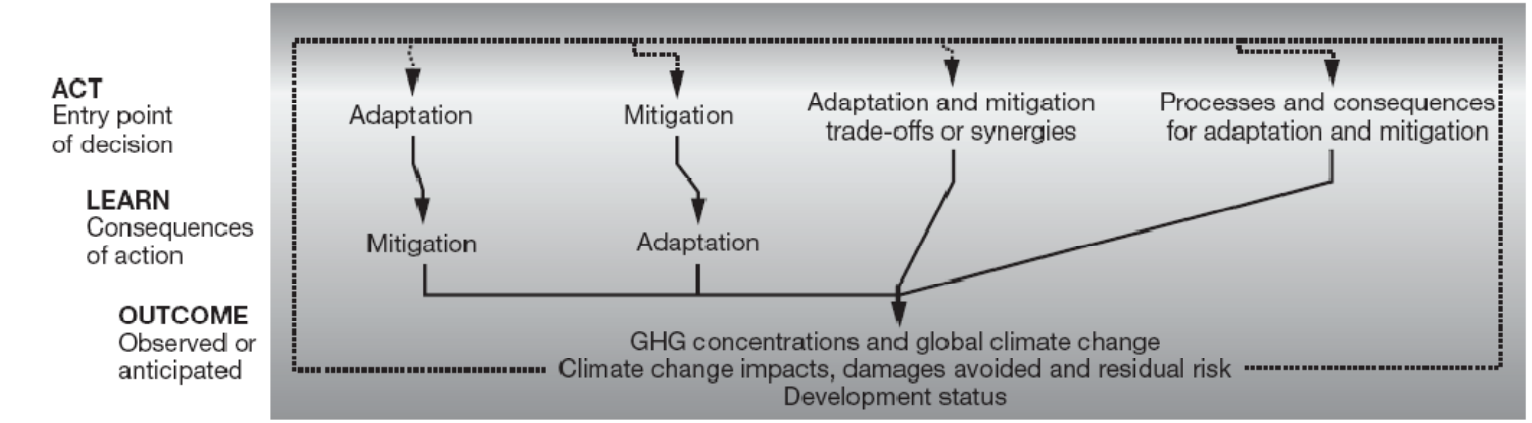
# Changes in available water






Source: Maarten de Wit and Jacek Stankiewicz, *Science* 31 March 2006, http://www.sciencemag.org/cgi/content/figsonly/311/5769/1917

# Typology of inter-relationships between CC adaptation & mitigation




| Illustrative examples organised according to the scale of action | A→M | M→A | ∫(M,A) | A∩M |
|---|---|---|---|---|
| **Global / Policy** | Awareness of limits to adaptation motivates negotiations on mitigation | CDM trades provide funds for adaptation through surcharge | Assessment of costs and benefits in A and M in setting targets for stabilisation | Allocation of MEA funds or Special Climate Change Fund |
| **Regional / national strategic / sectoral planning** | Watershed planning e.g. hydroelectricity and land cover, affect GHG emissions | Fossil-fuel tax increase cost of adaptation through higher energy prices | Testing project sensitivity to mitigation policy, social cost of carbon and climate impacts | National capacity (e.g., self-assessment) supports A and M in policy integration |
| **Local / biophysical community and individual actions** | Increased use of air-conditioning (homes, offices, transport) raises GHG emissions | Community carbon sequestration affects livelihoods | Corporate integrated assessment of exposure to mitigation policy and climate impacts | Local planning authorities implement criteria related to both A and M in land use planning |

MEA = Multilateral Environmental Agreements.



Source: Klein et al 2007, p. 761