



Royal Holloway, University of London  
MSc Programme: Practising Sustainable Development  
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# **Vulnerability and Adaptation to Climate Change in Urban Areas: an Environment and Development Approach**

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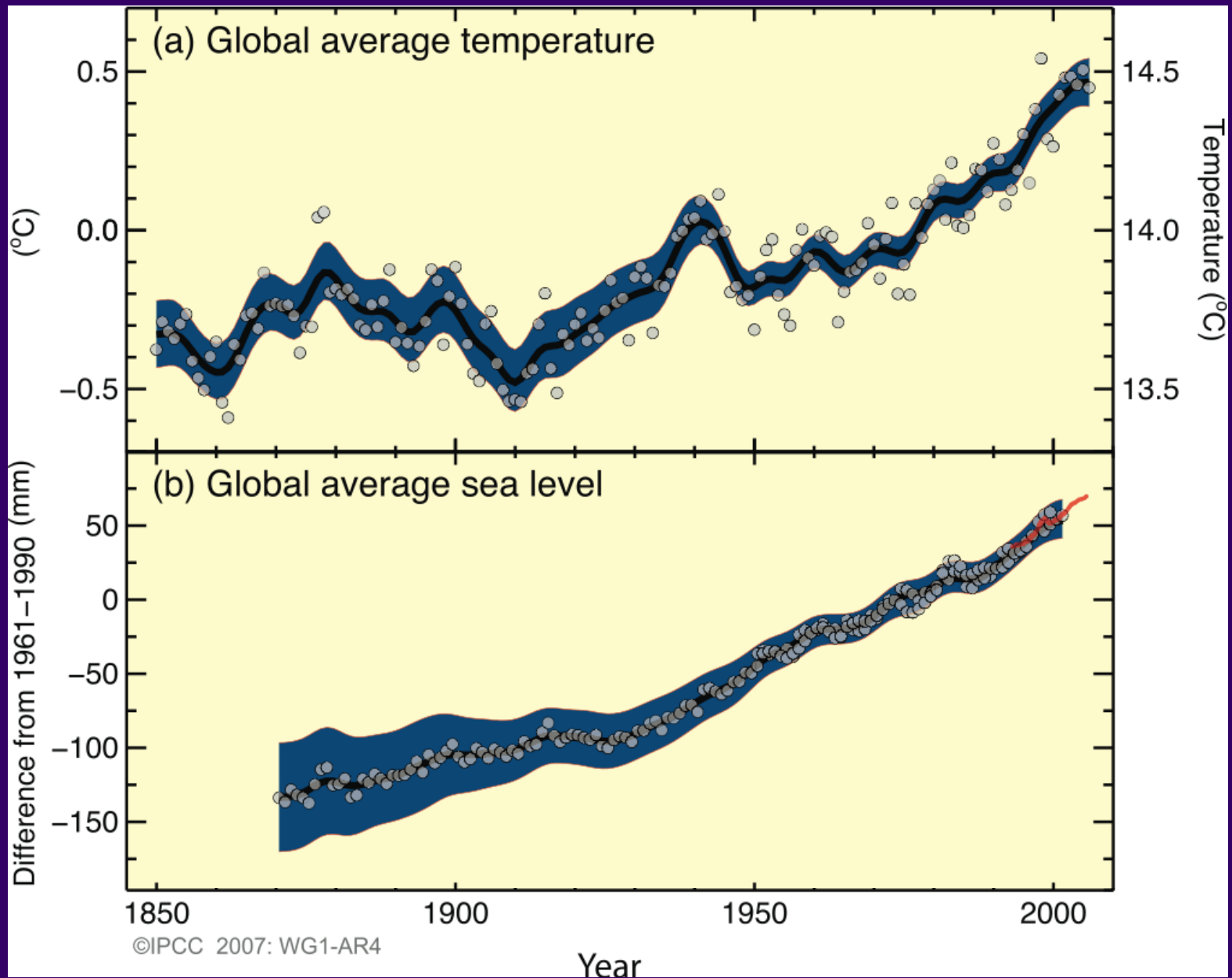
# Seminar outline

- What we know about climate change: the physical science basis
- Effects of climate change
- Climate change impacts in urban areas
- Urban vulnerability to climate change
- Inequality and vulnerability
- Responding to climate change: mitigation and adaptation
- Questions and discussion



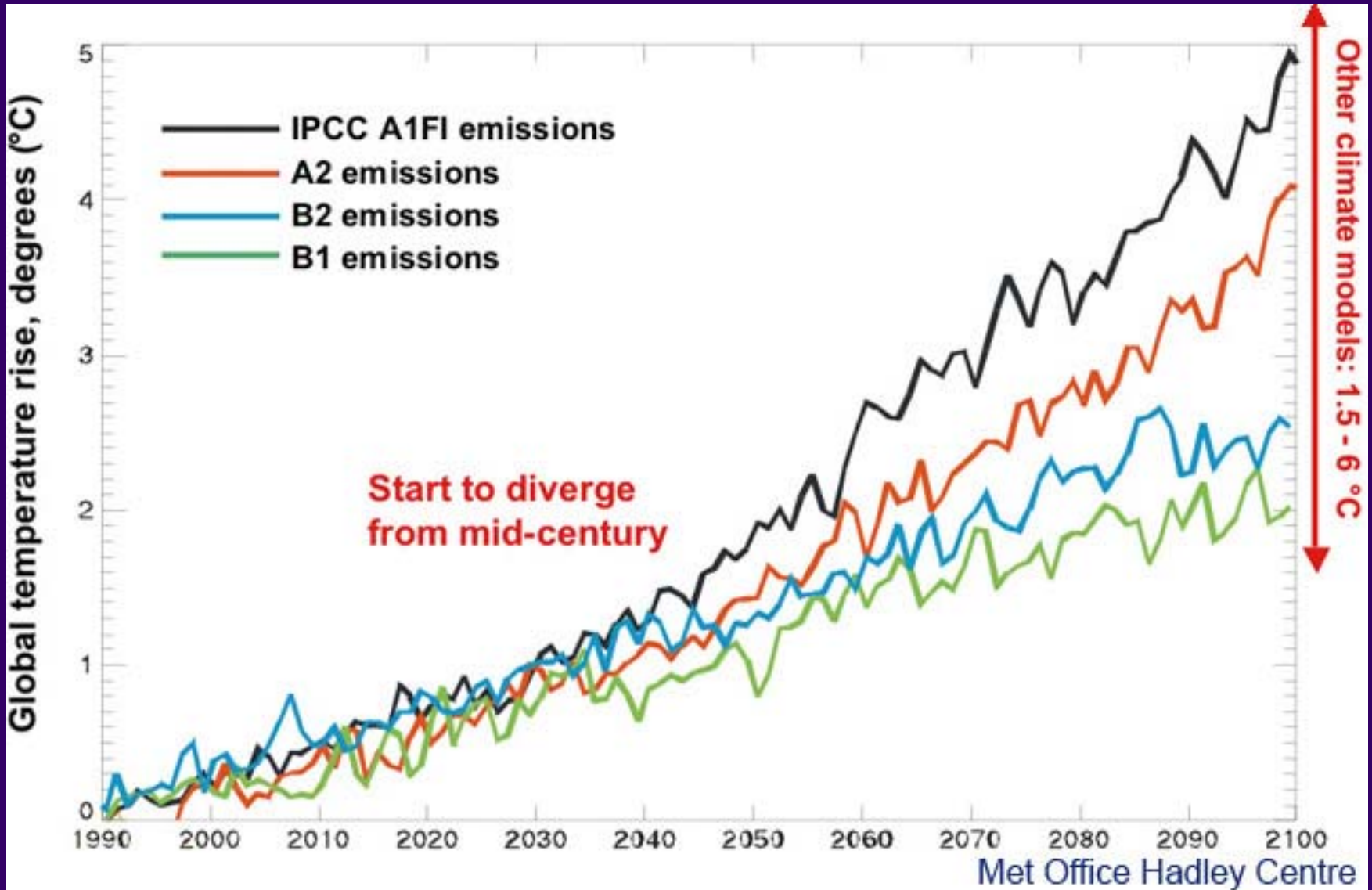
# What we know about climate change

- CO<sub>2</sub> concentration rising  
(matching growth in fossil fuel use)
- Systematic change in precipitation
- Increased ocean temperature; increased ocean acidity
- Loss of Arctic sea ice
- Loss of glacier mass  
(increased run-off; earlier spring peak discharges)
- More intense extreme weather events
- Shifts in animal and plant species
- Warming of climate system
- Sea-level rise
- **High levels of uncertainty:**  
many possible (but uncertain) 'high impact' changes





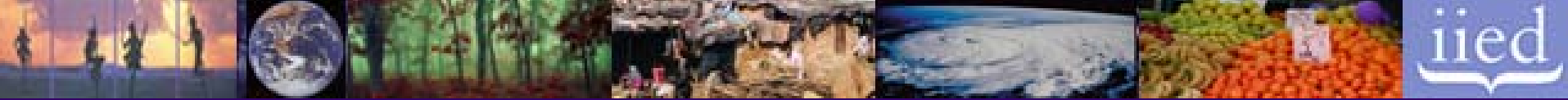
Source: Met Office / Hadley Centre





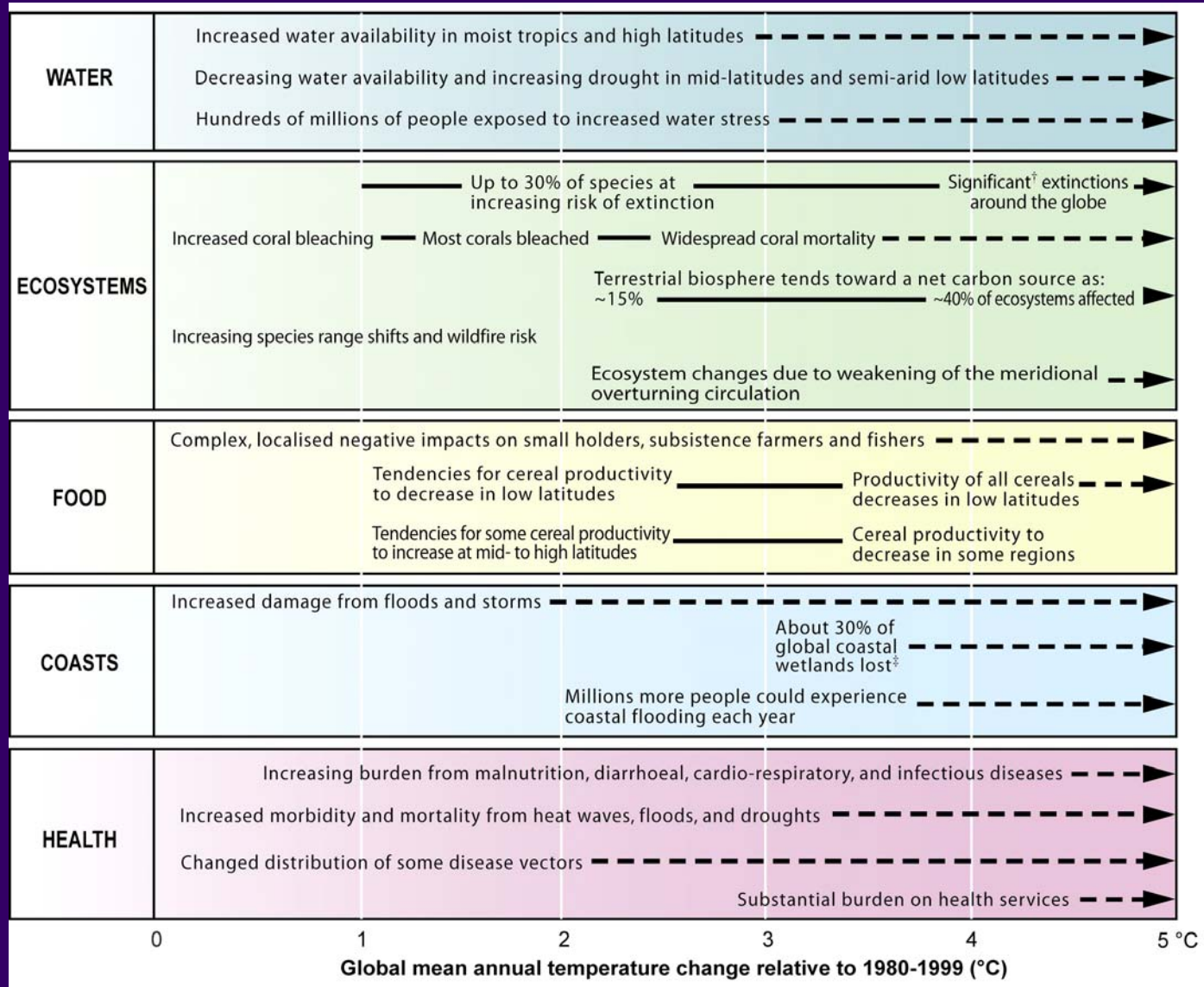
# Likely Effects of Climate Change

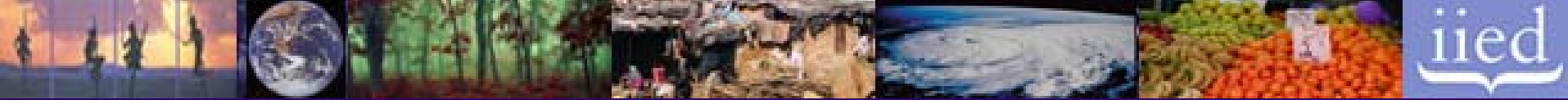
- Warmer and fewer cold days and nights; warmer and more frequent hot days and nights
- Increased frequency of warm spells / heat waves over most land areas
- Increased frequency over heavy precipitation events over most areas
- Increased area affected by drought
- Increased intense tropical cyclone activity
- Increased incidence of extreme high sea level



# Impacts of Climate Change

Source: Intergovernmental Panel on Climate Change Fourth Assessment Report (2007)





# Climate Change Impacts in Urban Areas: Changes in Means

Change	Urban impacts	Health impacts
Temperature	Increased energy demand for heating / cooling; worsening of air quality	Increased vulnerability to respiratory diseases; young and elderly particularly at risk
Precipitation	Increased risk of flooding; increased risk of landslides; distress migration	Increase in water-borne and water-washed diseases; food shortages and malnutrition
Sea-level rise	Coastal flooding; salinisation of water sources	Loss of land and property; health problems from salinated water (especially children)





# Climate Change Impacts in Urban Areas: Changes in Extremes

Change	Urban impacts	Health impacts
Extreme rainfall / tropical cyclones	More intense flooding; higher risk of landslides; disruption to livelihoods and city economies	Higher levels of mortality and morbidity; loss of income and assets
Drought	Water shortages; higher food prices; disruption of hydro-electricity	Higher prevalence of water-borne and water-washed diseases; food shortages
Heat- or cold-waves	Short-term changes in energy demand	Mortality from extreme heat or cold
Abrupt climate change	Rapid and extreme sea-level rise / Rapid and extreme temperature change	Significant effects on morbidity and mortality (especially in most vulnerable groups)



# Climate Change Impacts in Urban Areas: Changes in Exposure

Change	Urban impacts	Health impacts
Population movements	Movements from stressed rural habitats	Increased population; increased stress on infrastructure and resources
Biological changes	Extended vector habitats	Increased risk of diseases such as malaria and dengue



# Vulnerability to Climate Change

The degree to which a system is susceptible to, and 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 change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.



Turag River, Dhaka, Bangladesh



Sea wall, Rufisque, Senegal



Fishing Beach, San Fernando, Trinidad



Housing on Landfill Site, Mandaue City, Philippines



# Urban Vulnerability to Climate Change

- Large and growing proportion of those most at risk from climate change are in cities
- Rising water tables undermine infrastructure and cause saline water intrusion in groundwater resources
- Many large developing country cities are coastal so vulnerable to storms, high tides and sea level rise (23% of LDC urban population lives in coastal zone at <10 metres elevation)
- Non-coastal cities often beside rivers (e.g. Dhaka) or mountains so at risk from flooding





## Urban Vulnerability to Climate Change <sup>(ii)</sup>

- Many coastal cities (e.g. in Latin America) rely on glacial melt for water
- Damage to beaches / tourism infrastructure
- Temperature increases (greater in cities) will compound local air pollution problems and increase heat-stress related death
- Water supply disruption and ensuing health problems
- Expanded disease ranges (vector- and water-borne)



# Inequality and Vulnerability

“The distribution of impacts and vulnerabilities is still considered to be uneven, and low-latitude, less-developed areas are generally at greatest risk due to both higher sensitivity and lower adaptive capacity”

“Regions that are already at high risk from observed climate variability and climate change are more likely to be adversely affected in the near future by projected changes in climate and increases in the magnitude and/or frequency of already damaging extreme events”



# Slums and Climate Change

- Nearly 1 billion people globally, and 72% of people in sub-Saharan African cities live in slums
- Many slums in coastal areas or areas prone to floods / mudslides
- Many urban dwellers suffer from malnutrition, low/no income and poor access to water, healthcare and sanitation
- Migration to cities from drought prone rural areas – transient / new population



## Urban Vulnerability Mombasa, Kenya

- history of disasters related to climate extremes
- flooding in October 2006 affected 60,000 people





## Urban Vulnerability

# Mombasa, Kenya

- sea-level rise of 0.3m would submerge 17% of land area
- damage to port and other coastal infrastructure
- heat stress / demand for cooling
- exacerbation of already serious flood risks
- impact on tourism: beach erosion and disruption of marine ecosystems
- impact on agriculture: salinisation



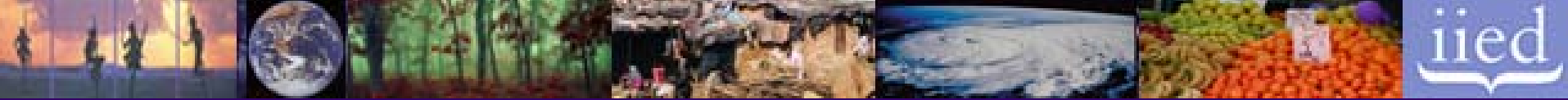
# Responding to Climate Change

Mitigation: reducing greenhouse gas emissions

*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*

Adaptation: preparing for climate change

*Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities*



# Responding to Climate Change

Mitigation:

*avoiding the unmanageable*

Adaptation:

*managing the unavoidable*



# Mitigation in Cities

- most urban population growth will be in poor countries: therefore mitigation necessary
- good city planning (e.g. transport) and governance to reduce urban carbon footprints and de-link development from high greenhouse gas emissions
- encouraging energy efficient buildings (building standards and regulations)
- developing and enforcing policies to reduce emissions from industry, commerce, services





## Mitigation in Cities

# Mexico City

- city-wide strategy (*Proaire*) integrates air quality and emissions reductions
- replacing 80,000 old taxis with lower-emissions vehicles
- dedicated traffic lanes for fuel efficient high capacity buses (rapid transit corridor carries 250,000 passengers/day)
- water and energy-efficient systems (CF bulbs, low-flow shower heads, tap aerators, solar powered heaters) in social housing units



# Adaptation to Climate Change

“Adaptation can significantly reduce many potentially dangerous impacts of climate change and reduce the risk of many key vulnerabilities. However, the technical, financial and institutional capacity, and the actual planning and implementation of effective adaptation, is currently quite limited in many regions”

IPCC Fourth Assessment

Chapter 19: Assessing Key Vulnerabilities and the Risks from Climate Change



# Adaptation in Cities: Strategies

- Climate-resilient urban growth (floodplain protection, infrastructure quality): *climate proof* and *climate friendly*
- Disaster preparedness (storm / flood warnings)
- Disaster response
- City-level climate predictions from climate scientists
- Focus on most vulnerable communities and households



# Adaptation in Cities: Challenges

- Lack of awareness (in government ministries, local authorities, media, scientific community, NGOs, general public)
- Mainstreaming into urban / national policies and programmes
- Juggling multiple priorities
- Capacity: scientific, planning, technical
- International funding:
  - not targeted at urban areas
  - charity or responsibility?



## Adaptation in Cities

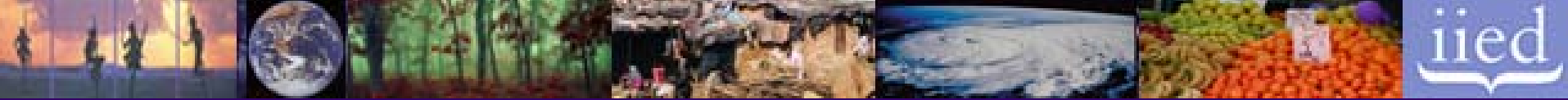
# Durban, South Africa

- 'Climate Future for Durban' programme including 'Headline Climate Change Adaptation Strategy'
- increasing water-absorbing capacity of urban landscape
- improving urban drainage and storm-sewer design
- increasing height of natural shoreline stabilization measures
- utilizing storm-water retention / detention ponds and constructed wetlands
- land-use planning and zoning to avoid locating structures in risky areas
- working with industry to reduce water demand



## Questions for Discussion

- what are the additional challenges that climate change - as opposed to simply disaster risk reduction - imposes on cities?
- who are the key stakeholders that need to be involved in developing urban adaptation strategies?
- how can cities (and groups within them) engage with the international policy and funding frameworks for climate change?



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