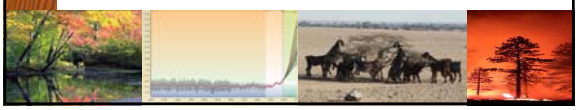
Global change, ecosystem services and human well-being

Habiba Gitay



Overview

- **What is global change?**
- **What are causing these changes**
- **How does global change affect ecosystem services and human well-being?**
  - Focus on climate change
- **What we, as a society, can do and are doing?**
  - Focus on mitigation, adaptation

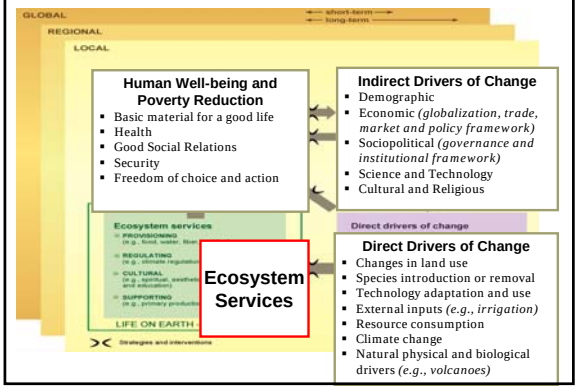
What is global change?

- **Multiple changes in**
  - Land, water and atmospheric systems
  - Land degradation, land, water (fresh and sea), atmospheric and stratospheric pollution, climate change
  - Leading to changes in the ecosystem services
  - Human well-being

Causes of the changes

- **Human activities – consumption and production patterns (direct drivers)**
- Agriculture, forestry, fisheries
  - intensive, agroforestry, timber products, aquaculture, mariculture, ocean and fresh water industrial fishing
- Tourism
- Industry, energy production and use
- Result in land use and land cover change, climate change and then degradation of ecosystems

MA Conceptual Framework



Agricultural Lands | Coastal Zones | Forest Lands | Freshwater Systems | Arid Lands & Grasslands

Food and Fiber Production
Provision of Clean and Sufficient Water
Maintenance of Human Health
Storage and cycling of Carbon, Nitrogen, Phosphorus etc
Aesthetic, spiritual and cultural values

Ecosystem Services

Biodiversity underlies all ecosystem services

Ecosystem Services (from forests)

The benefits people obtain from ecosystems

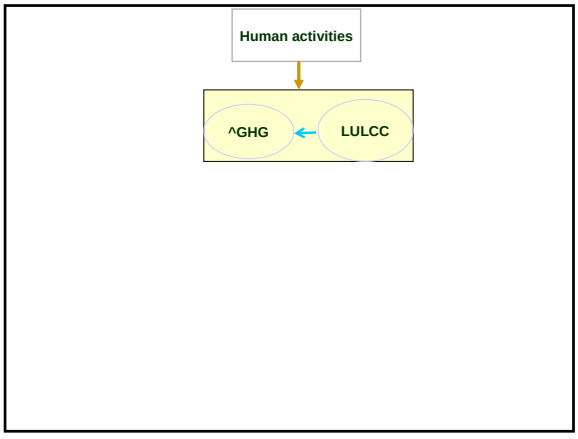
Provisioning	Regulating	Cultural	Supporting
Goods produced or provided by ecosystems	Benefits obtained from regulation of ecosystem processes	Non-material benefits obtained from ecosystems	Services that maintain the conditions for life on earth
· Food (NTFP) · Fresh water · Fuel wood · Fiber · Biochemicals · Genetic resources	· Climate regulation · Disease control · Flood control · Detoxification	· Spiritual · Recreational · Aesthetic · Inspirational · Educational · Communal · Symbolic	· Soil formation · Nutrient cycling · Pollination

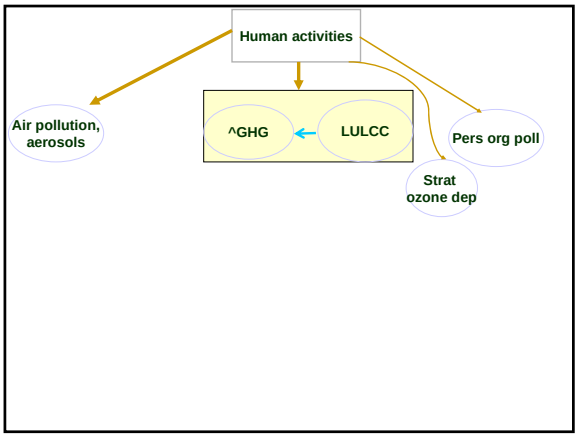
Source: MA 2003

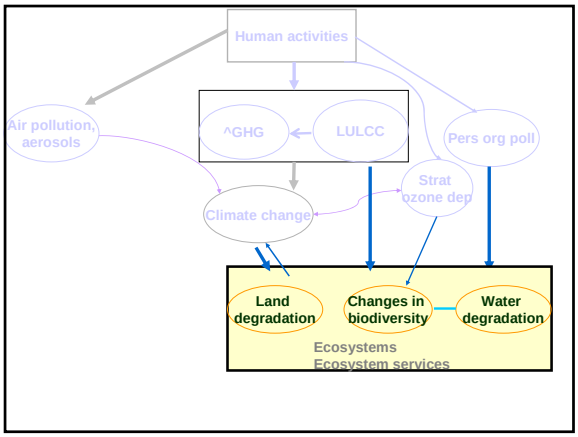
Human well-being – development goals

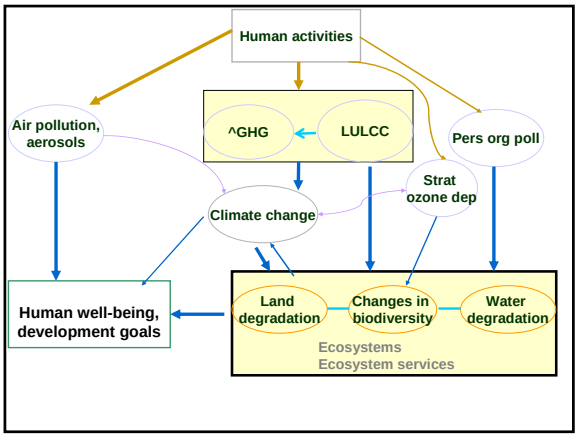
- Basic material, Health, Security, Freedom of choice and action
- Development goals
  - Reducing hunger and poverty
    Improving nutrition, health and rural livelihoods
    Facilitating social and environmental sustainability

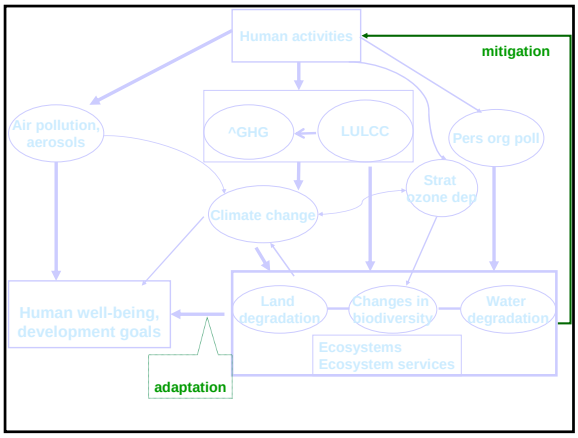
Human activities
Agriculture, forestry, fisheries
Industrial activities











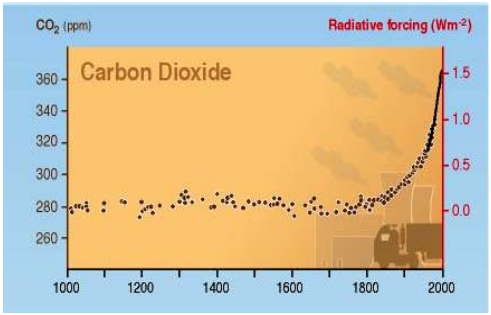
One major component of global change – climate change

other pressures

- ***Land use and land cover change***
- ***Land and water degradation***
- ***Extent of exotic/invasive species***

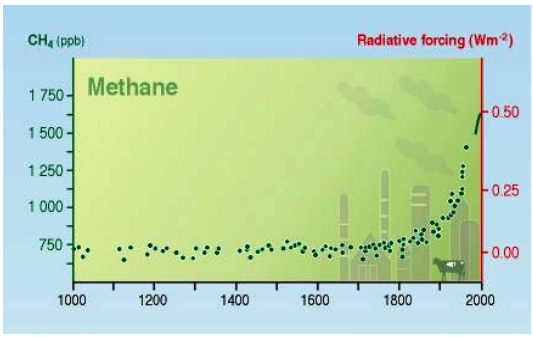
Pressures interact with each other and climate change

Human activities have changed composition of the atmosphere since the pre- industrial era

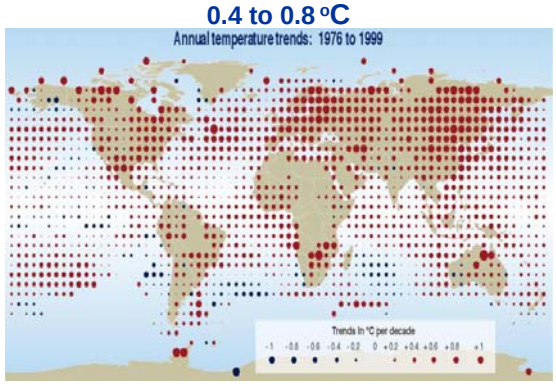


Carbon dioxide has increased by about a third

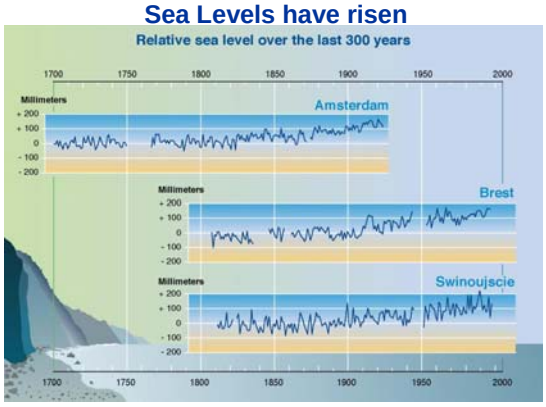
Methane as another major greenhouse gas --- has doubled



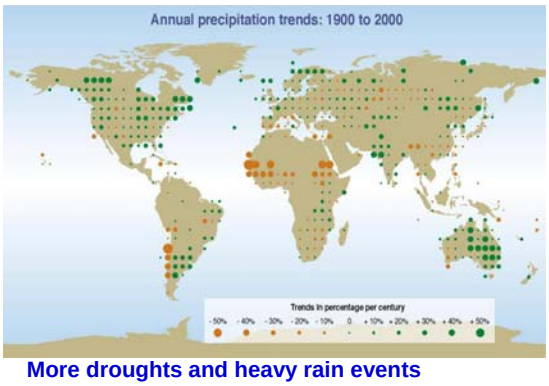
The land and oceans have warmed 0.4 to 0.8 °C



Sea Levels have risen

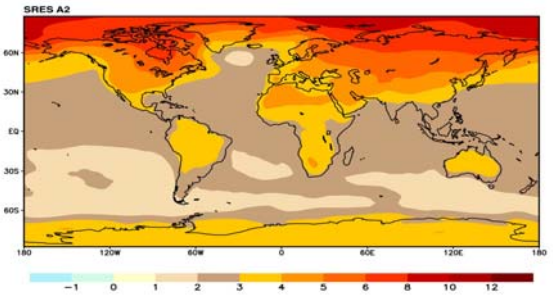


Precipitation patterns have changed



More droughts and heavy rain events

Projected temperature changes to 2100



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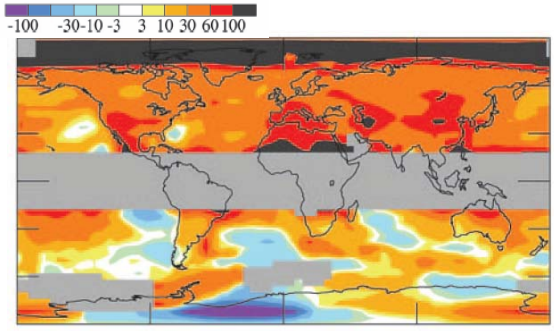
A mid-range scenario - projection of change from 1990 to 2100 – a global average of 3.1ºC with a range from 1.4ºC to 5.8ºC

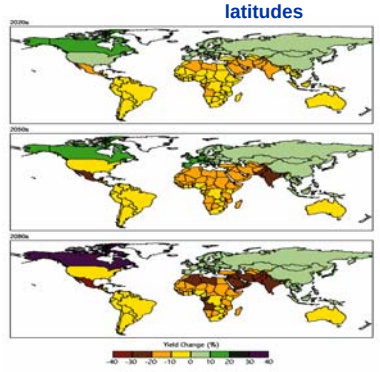
Poleward migration of isotherms (km/decade)

– Observed 1975-2005 (Hansen et al 2006 PNAS)



Crop yields - projected to change

decrease in the tropics and sub-tropics, but increase at high latitudes



Percentage change in average crop yields for the IS 92a climate change scenario.

Effects of CO_2 fertilization are taken into account and some adaptation, but not increased incidence of pests. Crops modeled are: wheat, maize and rice -- 2020s, 2050s and 2080s

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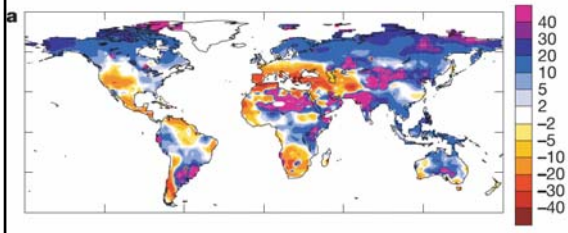
Precipitation projections

Wetter, but more variable in time and space



Percentage change in runoff by 2050

Many of the major "food-bowls" of the world are projected to become significantly drier

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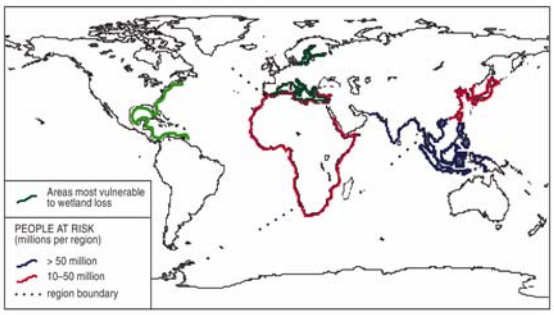
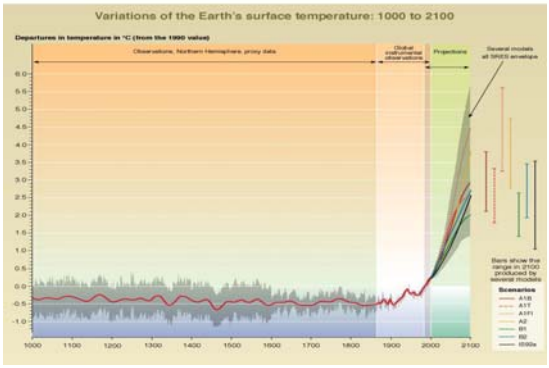
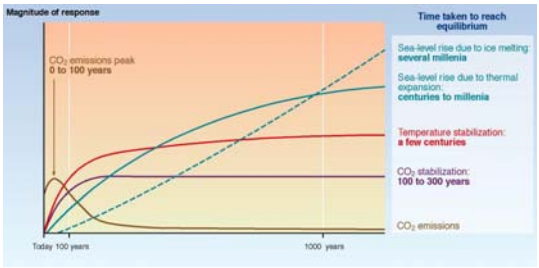
Many coastal wetlands would become vulnerable due to sea level rise - fisheries will be adversely affected



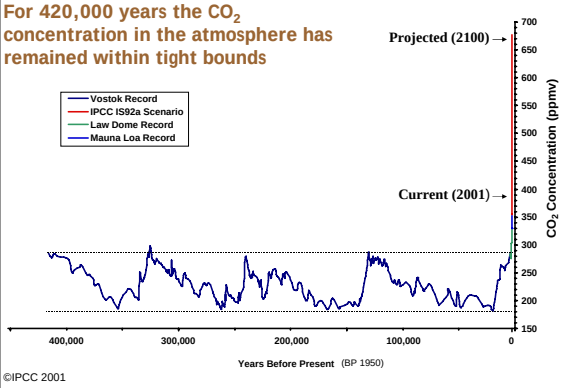
Projected Temperatures During the 21st Century Are Significantly Higher Than at Any Time During the Last 1000 Years



CO_2 concentrations, temperature and sea level continue to rise long after emissions are reduced



For 420,000 years the CO_2 concentration in the atmosphere has remained within tight bounds



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Ecosystems and ecosystem services most affected..

- coral reefs, mangroves and other coastal wetlands
- low lying deltaic regions and islands
- boreal forests
- remnant ecosystems and some ecosystems with restricted distribution
- high latitude/high altitude ecosystems and the human societies

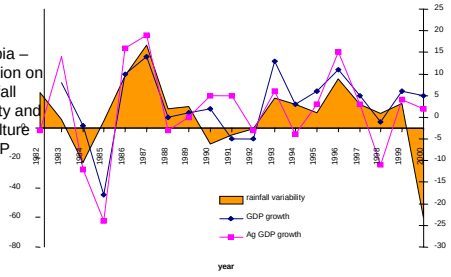
Impacts and ability to cope with them worst in developing countries

will be further affected (direct and indirect)

lack of knowledge, technology, institutions for adapting to change

Climate variability and development - Ethiopia

Ethiopia – information on rainfall variability and agriculture's GDP

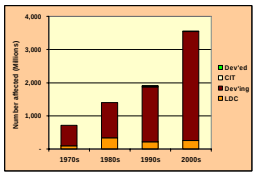


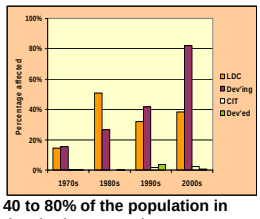
Preliminary results from : A Country Water Resources Assistance Strategy for Ethiopia
From Claudia Sadoff

People affected by climate related disasters have increased

2 Billion people in developing countries affected by climate related disaster in the 1990s.

Double in the 2000s?





40 to 80% of the population in developing countries versus a few % in more developed countries

Mitigation – reduce pressures Through changes in…

- **Consumption patterns**
  - population size and demography
  - Food consumption 37 - 300kg per capita
    - higher level of fish and meat products
  - 800 million people still malnourished
  - Origin of food, distribution patterns and trade (energy)
- **Production patterns –**
  - agriculture, forestry, fisheries
    - Intensive – high input and outputs
    - timber products, aquaculture, mariculture, ocean and fresh water industrial fishing
    - Environmental degradation, marginal land use etc
  - Industrial, energy production and use
  - Tourism/trade

Aim : sustainable development

Adaptation

- **Adaptation: minimise the negative impacts and move towards sustainable development**
- **learning to live with the change**
- **Start with climate variability**

Approach to Adaptation

- **Climate risk approach – in all development planning take into account issues arising from current climate variability while ensuring actions are consistent with future climate projections**

- ***Tackling the here-and-now is the best step to addressing future changes***

Adaptation

- **Is relevant to developed countries – Australia, Canada, UK, Finland developing their own policies**
- **Is seen to be a process or a risk management approach**
- **All communities/countries have some level of 'adaptation deficit'**
- can produce immediate benefits, but cannot prevent all damages
- will incur costs - not estimated at present
- greater magnitude and rate of climate change would pose greater challenges for adaptation

Approach being taken for adaptation

- **Knowledge management/dissemination, knowledge generation, knowledge application**
  - Awareness raising (incl existing projects/programs), coping strategies
  - Developing new analytical methods and tools
  - Pilots on the ground – learning by doing

What to do…?

- Refocus on landscape/watershed management
- Retain capacity once built (long-term benefits)

And….

- Can look at multiple ecosystem services and tradeoffs between them in space and time
- Use "adaptation" as a vehicle for addressing multiple pressures
- Moving towards sustainable development, not a short-term project but sustainable outcome

Thank you

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