Impact of Climate Change on Development

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IAIA
Power, poverty and sustainability
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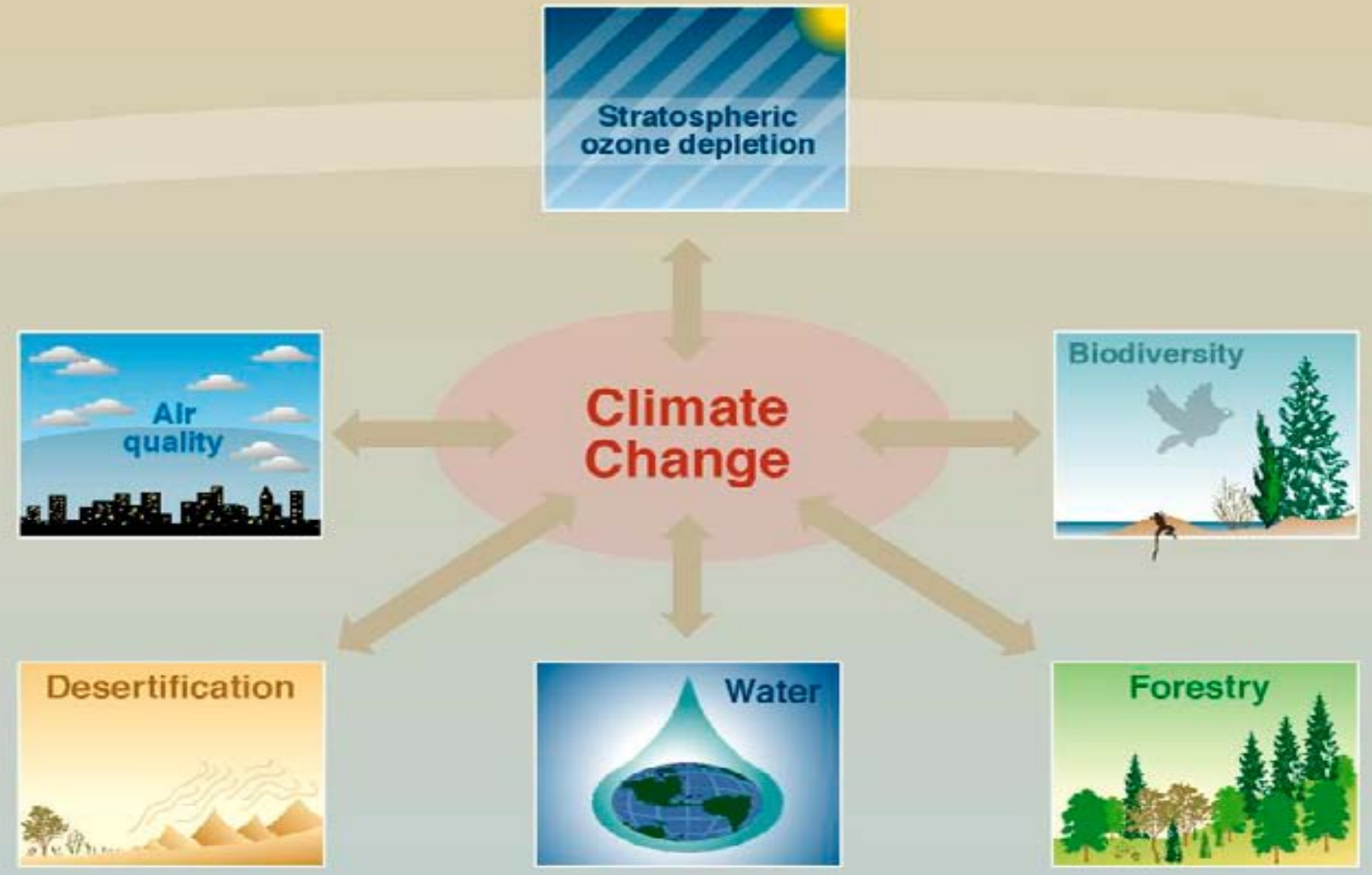
Linkages between climate change and other environmental issues



Underlying Causes of Change

The primary factors underlying environmental degradation include: economic growth, broad technological changes, demographic shifts and governance structures. These can give rise to:

- Increased demand for natural resources and energy
- Market imperfections, e.g., subsidies that lead to the inefficient use of resources and act as a barrier to the market penetration of climate sound technologies; the lack of recognition of the true value of natural resources; failure to appropriate the global values of natural resources to the local level; and the failure to internalize the social costs of environmental degradation into the market price of a resource
- Limited availability and transfer of technology, inefficient use of technologies, and inadequate investment in research and development for the technologies of the future

Climate Change

- Climate change is both a development and global environmental issue, which undermines:
  - environmental sustainability
  - poverty alleviation and the livelihoods of the poor
  - human health
  - national and regional security

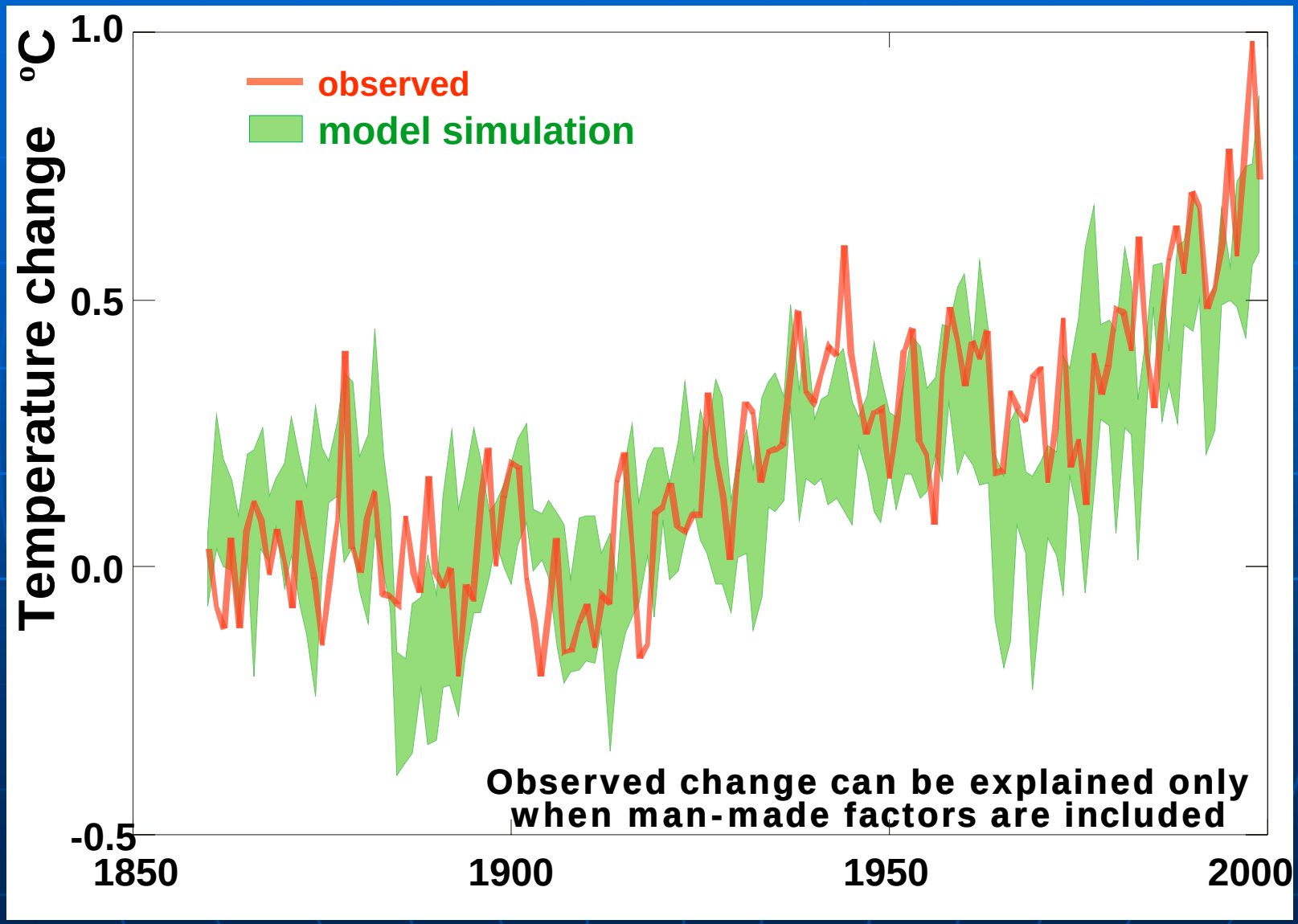
- Climate change is an inter- and intra-generational equity issue:
  - developing countries and poor people in developing countries are the most vulnerable
  - the actions of today will affect future generations because of the long life-times of the greenhouse gases and the inertia within the climate system

Climate Change

- The Earths climate has changed, largely due to human activities, and is projected to continue to change, globally and regionally:
  - Warmer temperatures
  - Changing precipitation –temporally and spatially
  - Higher sea levels
  - Retreating glaciers
  - Reduced arctic sea ice
  - More frequent extreme weather events
    - heat waves, floods and droughts

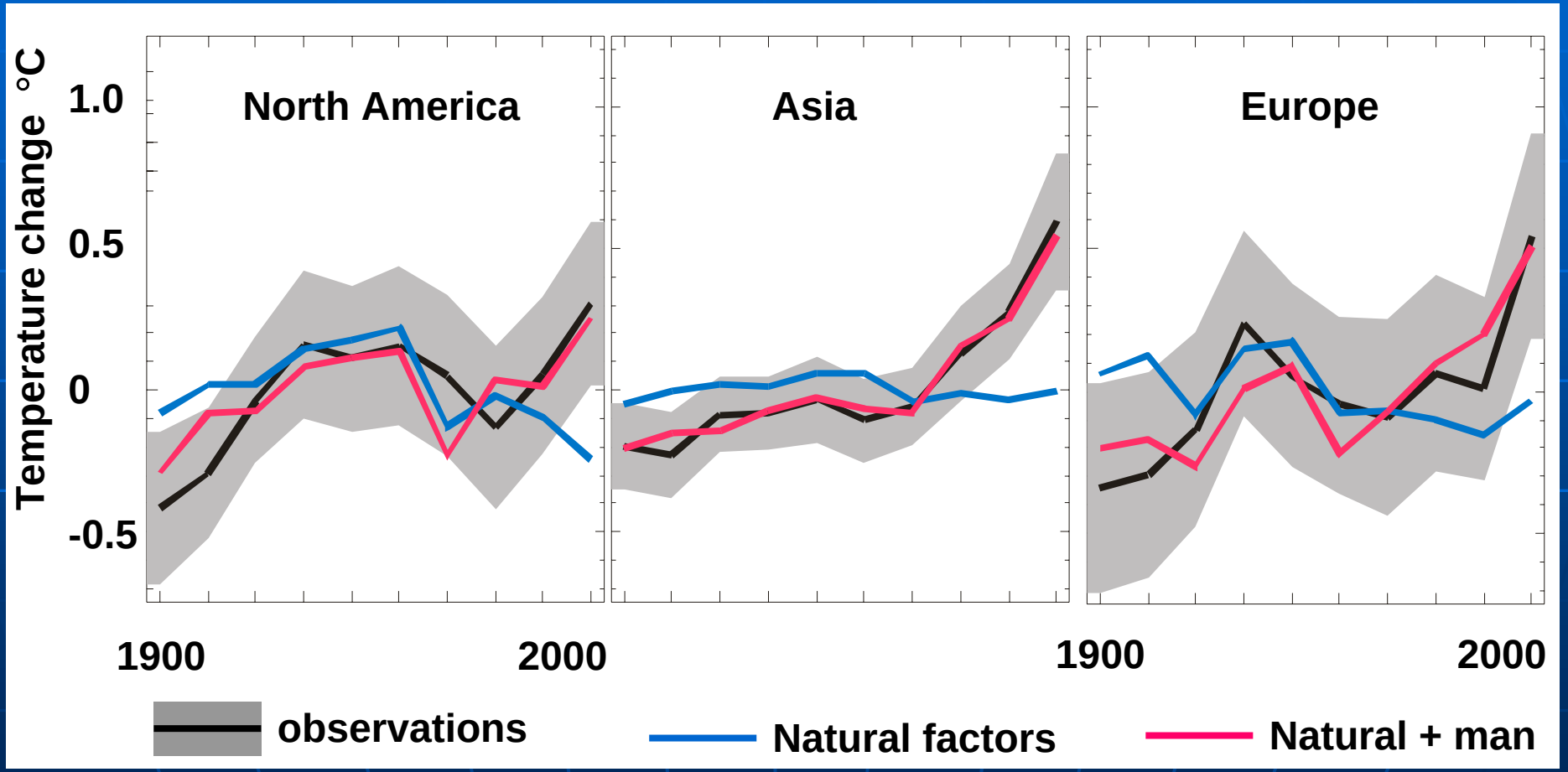
OBSERVED AND SIMULATED CHANGE

natural and man-made factors

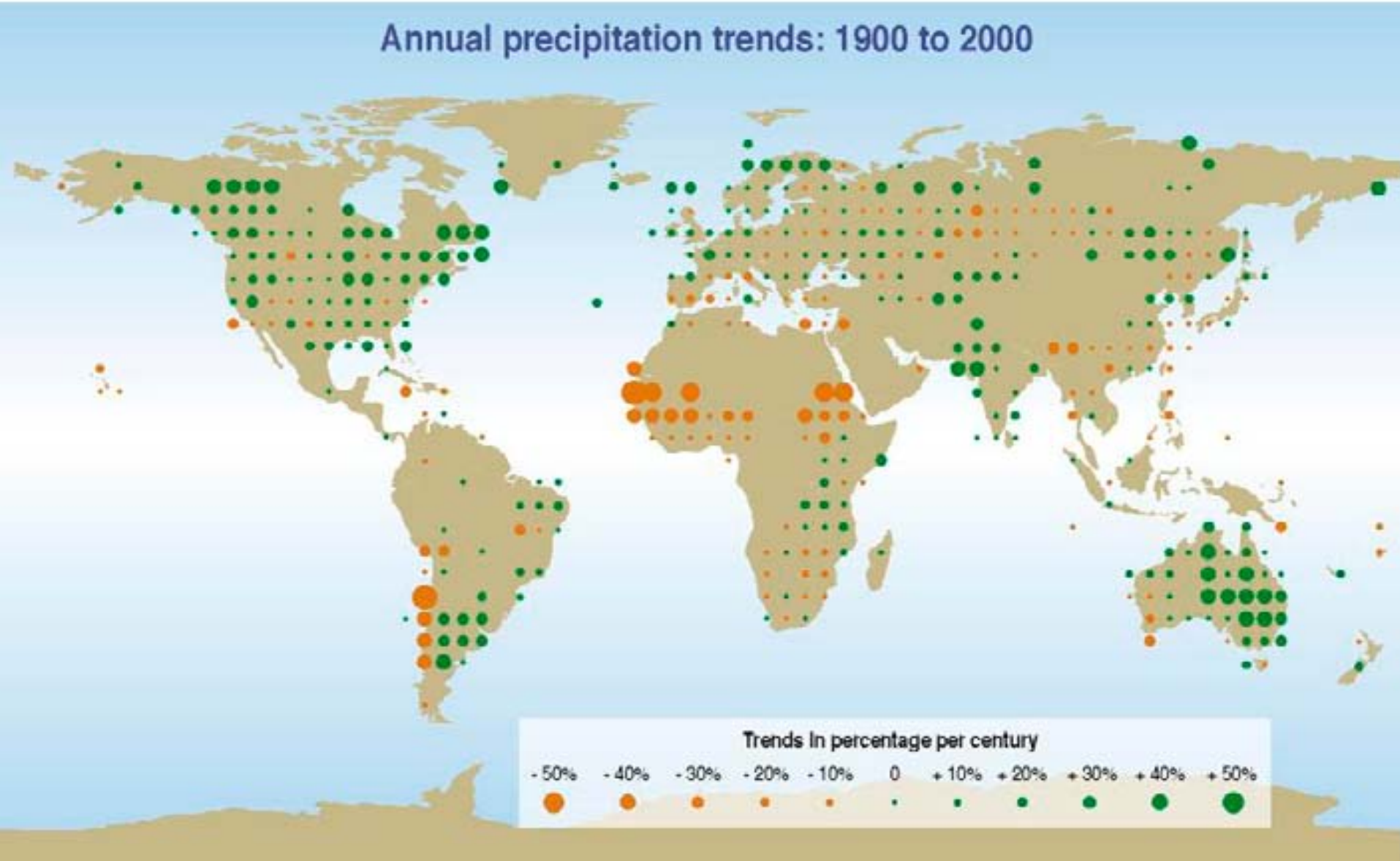


Observed temperature change over North America, Asia and Europe

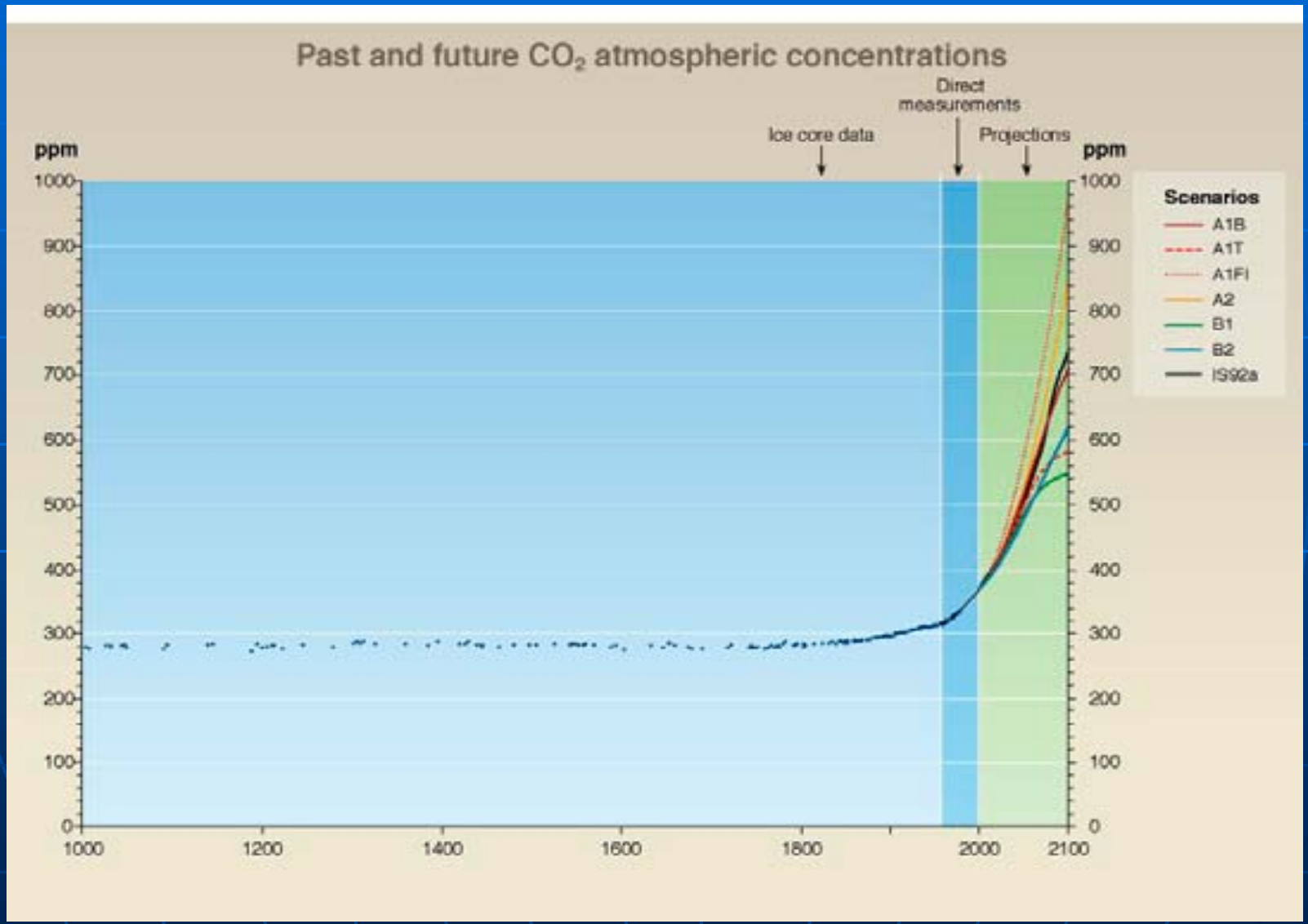
and model simulation with natural and man-made factors



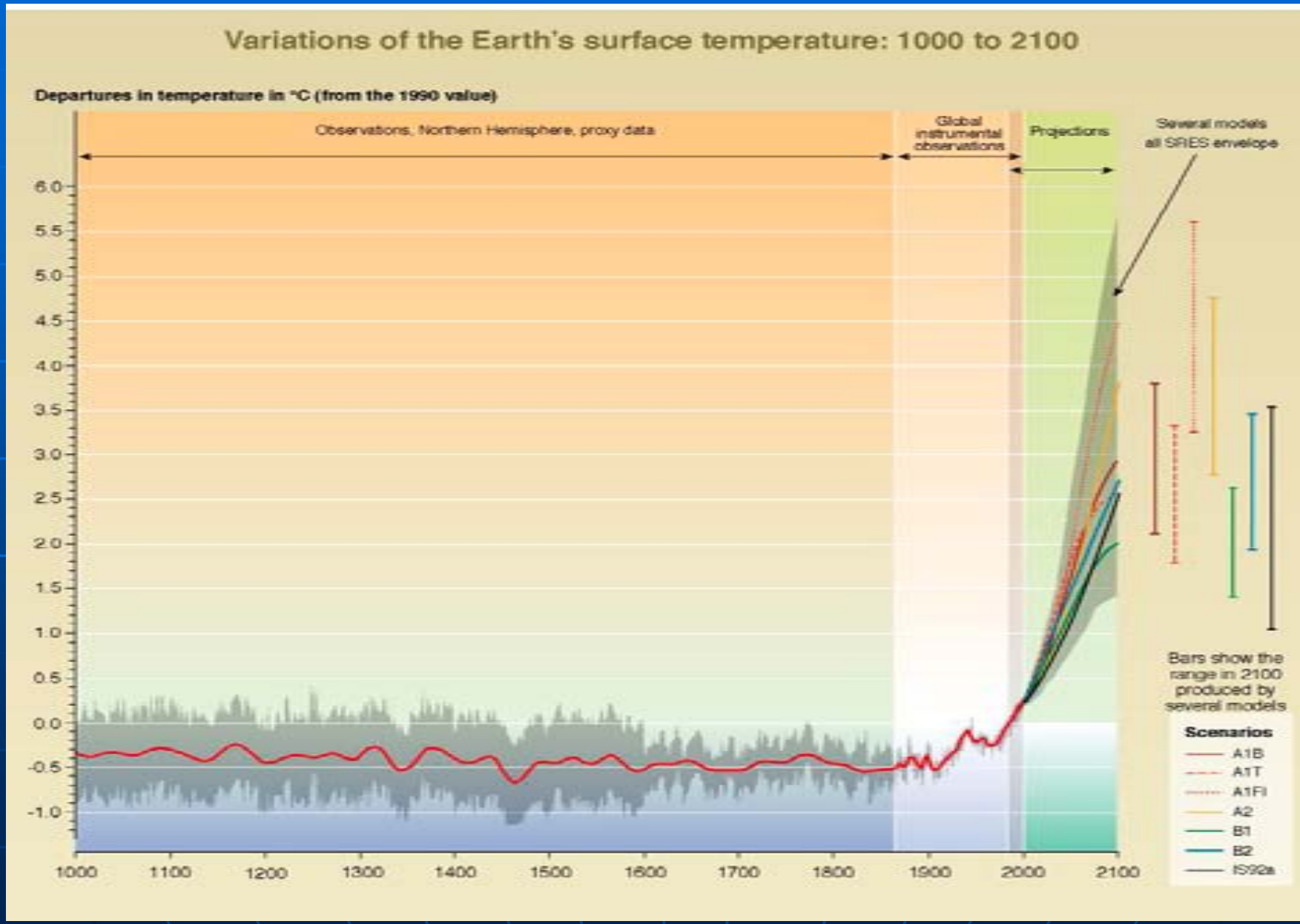
Precipitation Patterns Have Changed



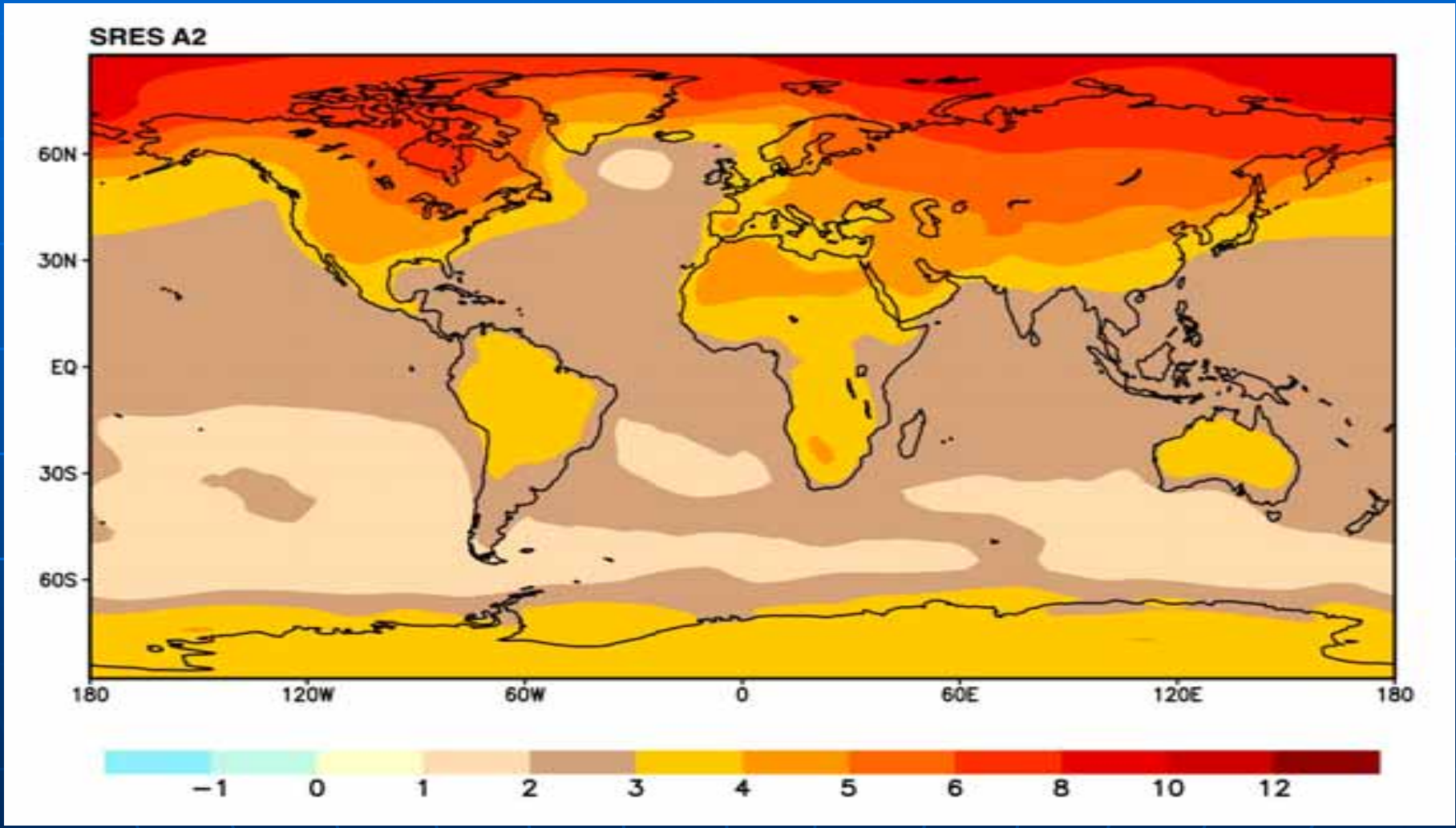
Projected Concentrations of CO_2 During the 21st Century Are Two to Four Times the Pre-Industrial Level



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

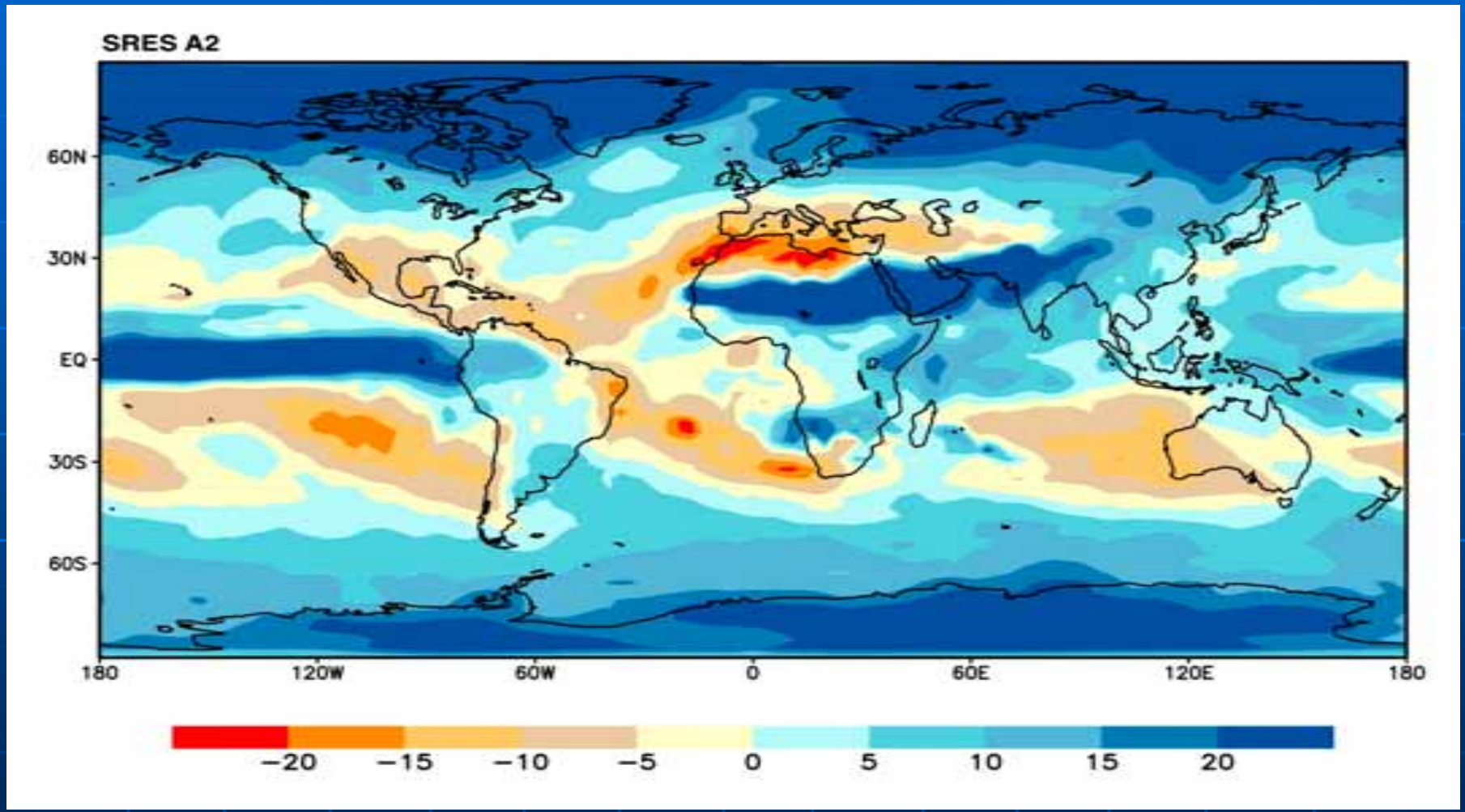


Land Areas Warm More Than the Oceans with the Greatest Warming at High Latitudes



Annual mean temperature change, 2071 to 2100 relative to 1990: Global Average in 2085 = 3.1°C

Some Areas are Projected to Become Wetter, Others Drier



Annual Mean Precipitation Change: 2071 to 2100 Relative to 1990

Extreme Weather Events

Model Prediction	Confidence in Observed Change
Higher maximum temperatures and more hot days	66-90%
Higher minimum temperatures, fewer cold days and frost days over nearly all land areas	90-99%
Reduced diurnal temperature range over most land areas	90-99%
Increased heat index over most land areas	90-99%
More intense precipitation events over many areas	90-99%
Increased summer continental drying and associated risk of drought – mid-latitude continental interiors	66-90%

Recent Findings

- Compared to the IPCC TAR in 2001, there is greater clarity and reduced uncertainty about the impacts of climate change

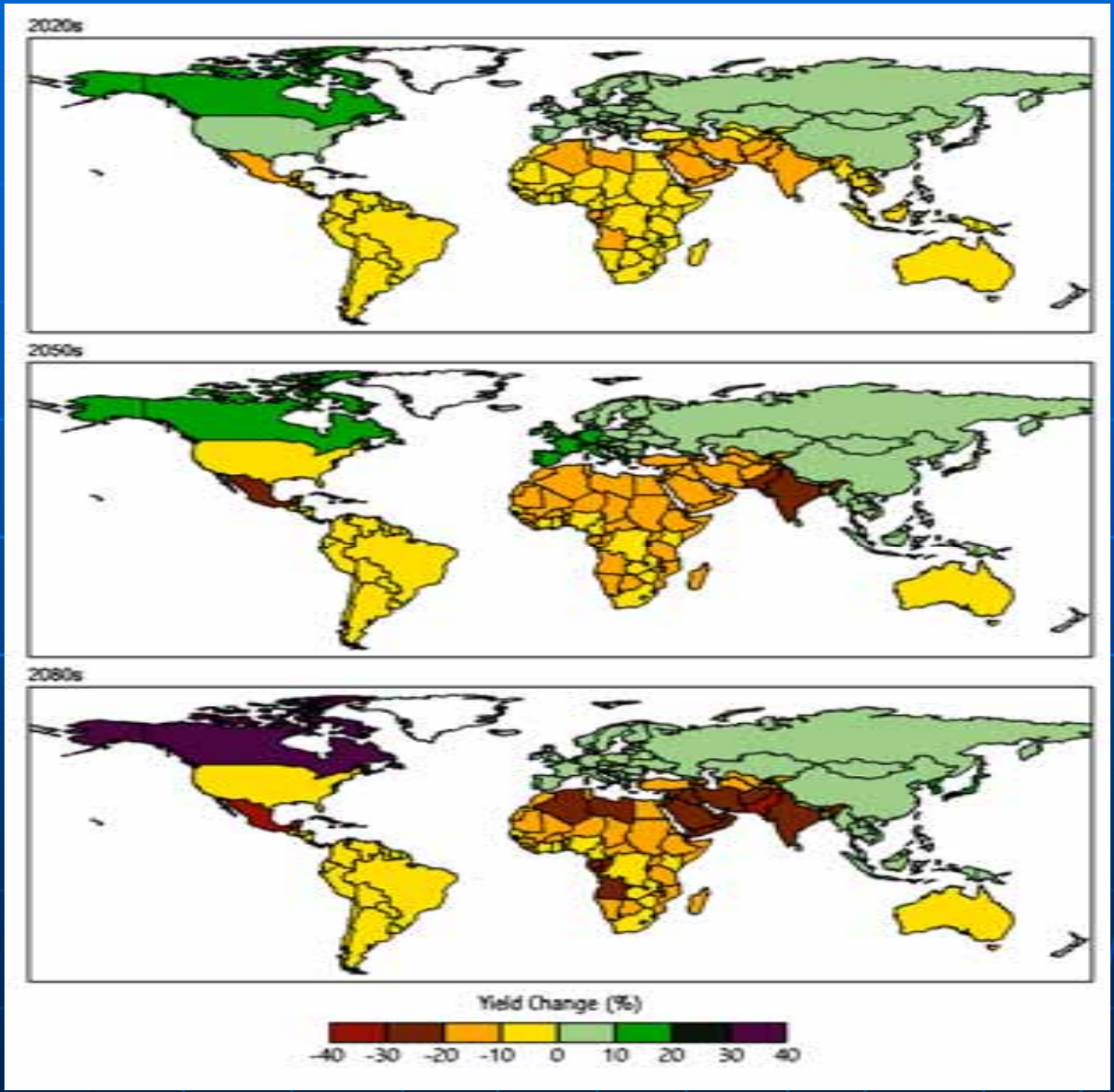
- A number of increased concerns have arisen:
  - Increased oceanic acidity likely to reduce the oceans capacity to absorb carbon dioxide and effect the entire marine food chain
  - A regional increase of 2.7^{o}C above present (associated with a global temperature rise of about 1.5^{o}C above present) could trigger a melting of the Greenland ice-cap
  - An increase in ocean surface temperature of 1^{o}C is likely to lead to extensive coral bleaching1
  - Possible destabilization of the Antarctic ice sheets becomes more likely above 3^{o}C – the Larson B ice shelve is showing signs of instability

Climate Change

Human-induced climate change is projected to:

- Decrease water availability and water quality in many arid- and semi-arid regions – increased risk of floods and droughts in many regions
- Decrease the reliability of hydropower and biomass production in some regions
- Increase the incidence of vector- (e.g., malaria and dengue) and water-borne (e.g., cholera) diseases, as well as heat stress mortality, threats nutrition in developing countries, increase in extreme weather event deaths
- Decrease agricultural productivity for almost any warming in the tropics and sub-tropics and adverse impacts on fisheries
- Adversely effect ecological systems, especially coral reefs, and exacerbate the loss of biodiversity

Crop yields are projected to decrease in the tropics and sub-tropics, but increase at high latitudes



Percentage change in average crop yields for a mid-range climate change scenario

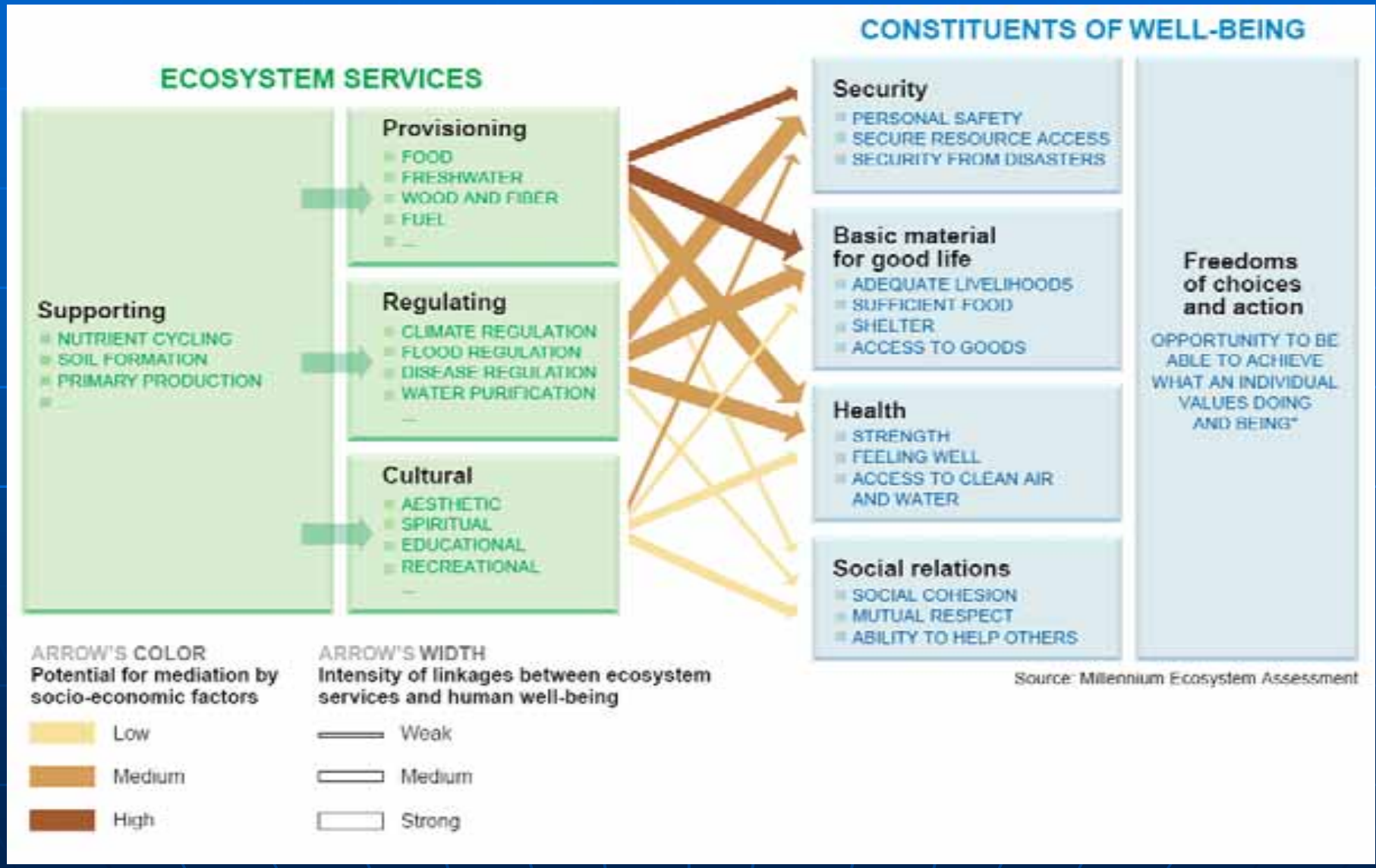
Even as soon as 2020 crop yields in SSA and parts of Asia are projected to decrease by up to 20%

Estimated 10-15% of the world's species will be committed to extinction over next 30 years independent of climate change

Biodiversity underlies all ecological goods and services – provisioning, regulating, supporting and cultural

Climate change will exacerbate the loss of biodiversity

Consequences of Ecosystem Change for Human Well-being



Climate Change and Conflict

- Tens of millions of people displaced
  - Low lying deltaic areas
  - Small Island States
- Food shortages where there is hunger and famine today
- Water shortages in areas already with water shortages
- Natural resources depleted (e.g., coral reefs, forests), loss of ecological goods and services
- Increased incidence of disease
- Increased incidence of severe weather events

Climate Change, coupled with other local and global environmental issues can lead to local and regional conflict

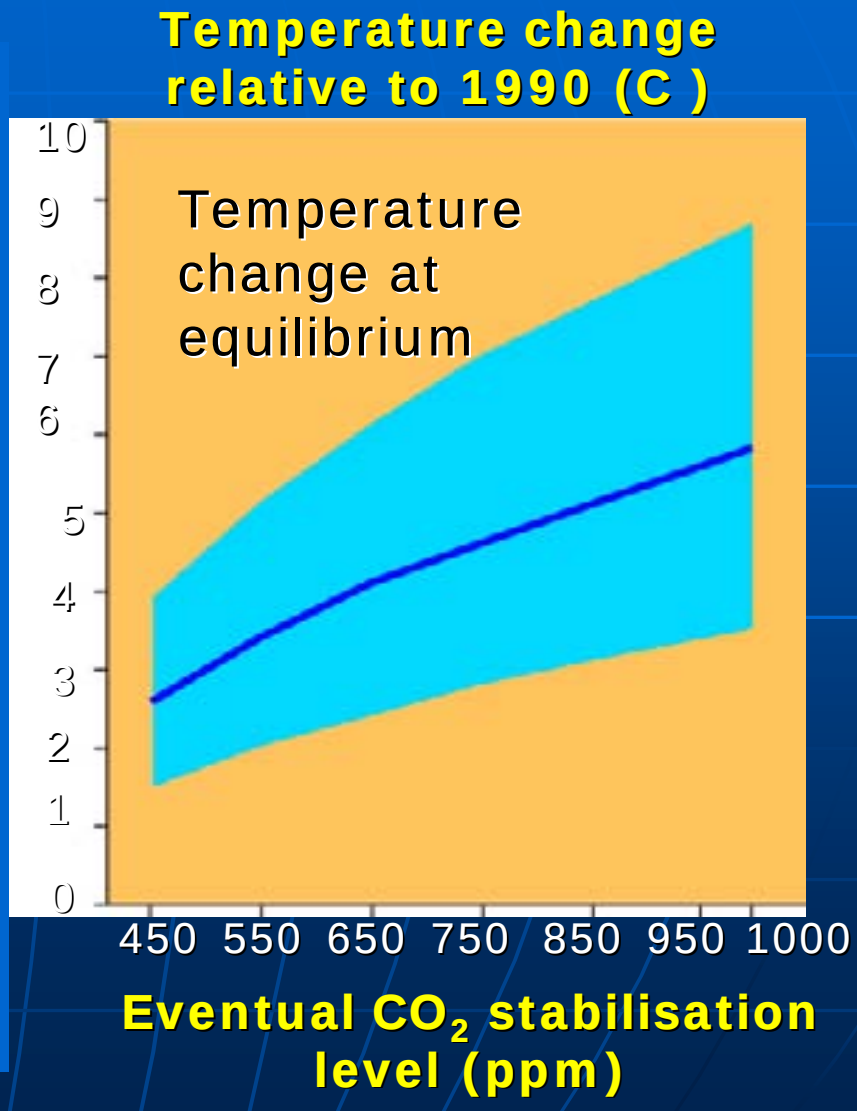
Warming resulting from different stabilized concentrations of greenhouse gases

pre-industrialized level - 280 ppm, current level - 370 ppm

Even if the atmospheric concentration of carbon dioxide was stabilized at today's level, the Earth's temperature would still increase by over 0.5ºC

The current atmospheric concentration of carbon dioxide equivalent (i.e., taking into account other GHGs) is close to 450ppm.

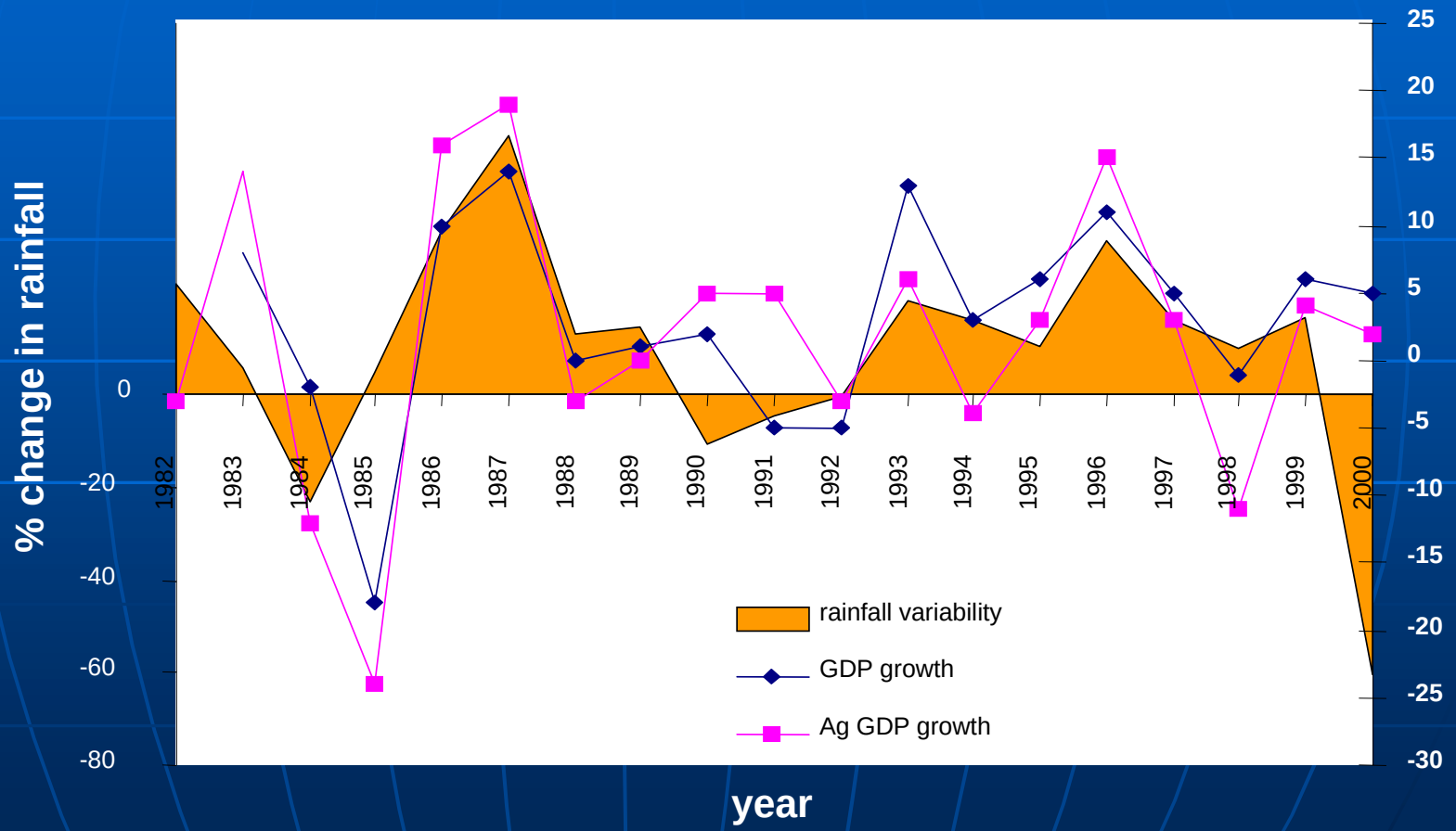
Even if the atmospheric concentration of carbon dioxide was stabilized at 450-550 ppm, a significant increase in temperature is projected, thus adaptation is an important part of a climate strategy



Poor countries face the greatest threats from climate change

- They often lack the physical, financial and human resources to institute adaptive measures
- Many are in areas greatly affected by climate change
- The poorest populations are often particularly exposed
- Highly dependent on climate sensitive sectors, e.g., agriculture, tourism

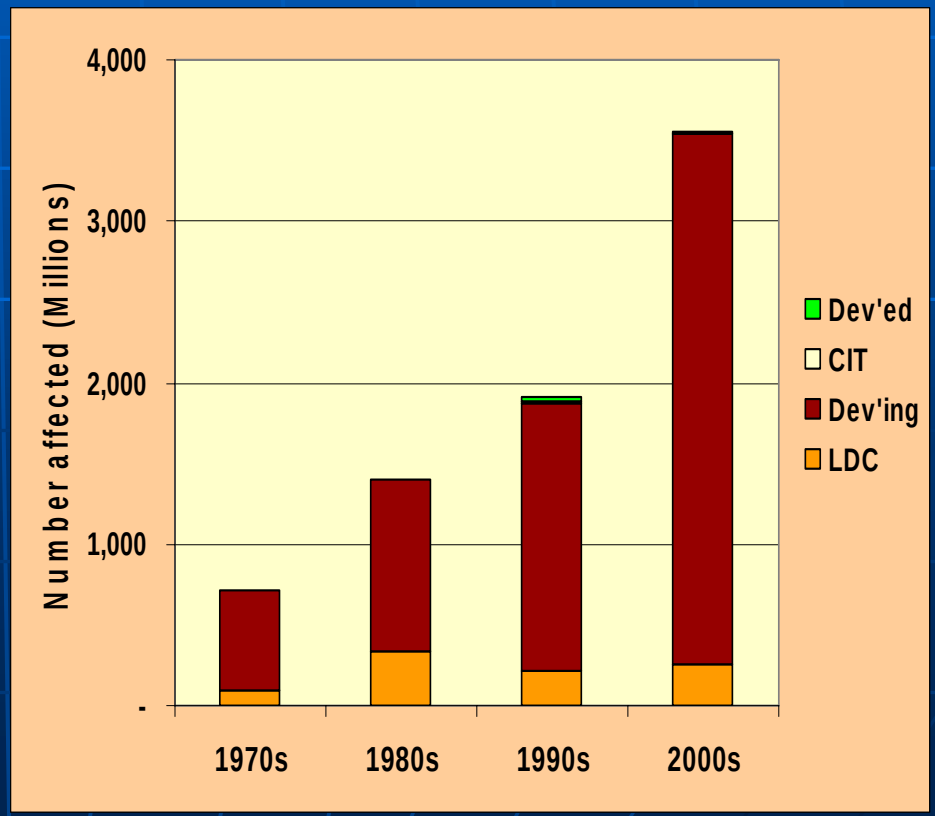
Climate variability is already a major impediment to development



Ethiopia: A water rich developing country, but with GDP still tied to yearly rainfall variations

Adaptation and the Poor

- Developing countries and the poor within countries are most vulnerable to impacts
  - In the 1990s, 2 billion people in the developing world were affected (i.e., displaced from their homes, required medical or financial assistance) by climate related disasters (primarily floods and droughts) compared with 20 million people in developed countries.
- Developing countries and the poor within countries are the least able to autonomously adapt to changing climates



Adaptation

- Effective adaptation begins with improving the capacity of institutions and communities to deal with existing climate variability, while ensuring that any actions are compatible with projected climate change
  - this is the first, and most important step, towards coping with climate change

- Adaptation to climate change must be part of the development process and not separated from it – must be integrated into national economic planning

- Climate risk management means that countries should assess, and where necessary act upon, the threats and opportunities that result from *both existing and future* climate variability, including those deriving from climate change, in all activities

Clean Energy for Development

- Climate change presents an urgent and additional challenge, which will require mitigating greenhouse gases and adapting to the impacts of climate change.
- The incremental costs of mitigating greenhouse gas emissions and adapting to climate change is estimated to be several tens of billions of dollars per year;
- While energy production and use technologies are currently available to reduce greenhouse emissions, supplemented by improved waste- and land-management practices, research and development is needed to further improve certain technologies, especially very low-emission coal-fired power plants;
- There are only three sources of funding for mitigating greenhouse gas emissions: (i) voluntary actions; (ii) international grants; and (iii) trade.
- Trade is likely to confer the biggest flow of funds to developing countries (between $20 and $120 billion per year), but will require a long term, stable and predictable framework and accompanying regulatory system, with differentiated responsibilities;

Establish a Long-term Target

- A long-term target could be based on emissions, a temperature goal or common policies, but would need to recognize the concept of differentiated responsibilities
- The EU has suggested limiting the rate of change of global mean surface temperature to 0.2^0C per decade and the equilibrium temperature change to 2^0C above pre-industrial levels
- This would require limiting the atmospheric concentration of carbon dioxide equivalent to about 450ppm or less
- Intermediate targets and equitable allocation of emissions will be needed
- A long-term target will send a strong signal to the private sector, governments and the research community that there will be a market for technologies that efficiently produce and use energy

Potential Actions

Energy Efficiency and Conservation: Efficient vehicles, Reduced use of vehicles, Efficient buildings, and Efficient coal plant

Fuel shift: Gas power for coal power

CO_2 Capture and Storage: Capture CO_2 at power plant; Capture CO_2 at H_2 plant; Capture CO_2 at coal-to- synfuels plant; --- geological storage

Nuclear fission: Nuclear power for coal power

Renewable Electricity and Fuels: Wind power for coal power; PV power for coal power; Wind H_2 in fuel-cell car for gasoline in hybrid car; Biomass fuel for fossil fuel

Forests and Agricultural Soils: Reduced deforestation, plus reforestation, afforestation and new plantations; and Conservation tillage

Policy Instruments

- Policies, which may need regional or international agreement, include:
  - Energy pricing strategies and taxes
  - Removing subsidies that increase GHG emissions
  - Internalizing the social costs of environmental degradation
  - Tradable emissions permits--domestic and global
  - Voluntary programs
  - Regulatory programs including energy-efficiency standards
  - Incentives for use of new technologies during market build-up
  - Education and training such as product advisories and labels
- Accelerated development of technologies requires intensified R&D by governments and the private sector

Conclusions

- Human-induced climate change threatens poverty alleviation, sustainable economic growth and regional security
- "Industrialized countries have caused human-induced climate change, but developing countries and poor people are the most vulnerable
- The actions of today's generation will profoundly effect the Earth inherited by our children and future generations
- Cost-effective and equitable solutions exist, but political will and moral leadership is needed
- Innovative public-private partnerships, technology transfer and market reforms are needed
- Increased public and private sector funding for energy R@D