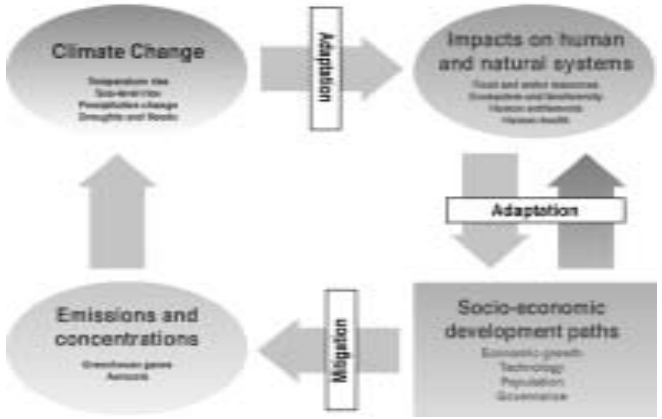
Lecture 14: SPC/ Working Group 2 Impacts, Adaptation, and Vulnerability

This summary represents the formally agreed statement of the IPCC concerning the sensitivity, adaptive capacity, and vulnerability of natural and human systems to climate change, and the potential consequences of climate change.

What will the projected climate change affect human and natural systems?



Observed Impacts On Physical/Biological Systems

- Shrinkage of glaciers
- Thawing of permafrost
- Later freezing and earlier break-up of ice on rivers and lakes
- Lengthening of mid-to-high-latitude growing seasons
- Poleward and altitudinal shifts of plant and animal ranges
- Declines of some plant and animal populations
- Earlier flowering of trees, emergence of insects, and egg-laying in birds

Factors Other Then Global Warming

Factors such as land-use change and pollution also act on these physical and biological systems, making it difficult to attribute changes to particular causes in some specific cases.

Climate Change Impacts On Human Systems

- There is emerging evidence that some social and economic systems have been affected by the recent increasing frequency of floods and droughts in some areas.
- However, such systems are also affected by changes in socioeconomic factors such as demographic shifts and land-use changes.
- The relative impact of climatic and socioeconomic factors are generally difficult to quantify.

What Is Climate Change Sensitivity?

- ***Sensitivity*** is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli.
- Climate-related stimuli encompass all the elements of climate change, including mean climate characteristics, climate variability, and the frequency and magnitude of extremes.
- 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).

What Is Adaptive Capability?

- *Adaptive capacity* 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.

What Is Climate Change Vulnerability?

- Vulnerability is 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 change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Vulnerability of Natural Systems

- Natural systems are vulnerable to climate change, and some will be irreversibly damaged.
- Natural systems at risk include glaciers, coral reefs and atolls, mangroves, boreal and tropical forests, polar and alpine ecosystems, prairie wetlands, and remnant native grasslands.
- It is well-established that the geographical extent of the damage or loss, and the number of systems affected, will increase with the magnitude and rate of climate change.

Vulnerability of Human Systems

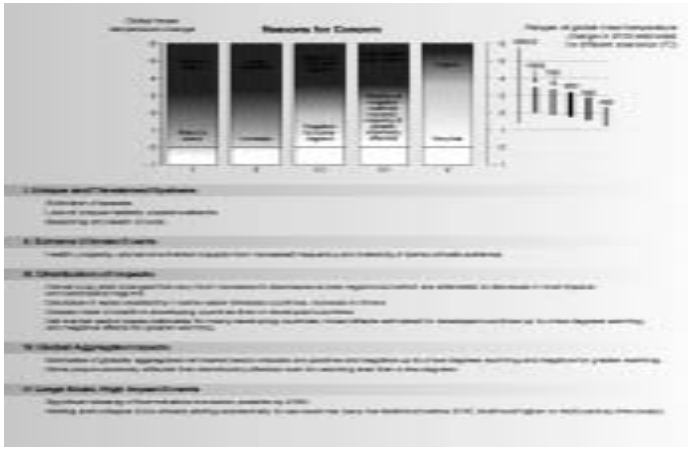
- Many human systems are sensitive to climate change, and some are vulnerable.
- Human systems that are sensitive to climate change include mainly water resources; agriculture (especially food security) and forestry; coastal zones and marine systems (fisheries); human settlements, energy, and industry; insurance and other financial services; and human health.
- The vulnerability of these systems varies with geographic location, time, and social, economic, and environmental conditions.

Projected Adverse Impacts On Human Systems

- A general reduction, with some variation, in potential crop yields in most regions in mid-latitudes for increases in annual-average temperature of more than a few °C.
- Decreased water availability for populations in many water-scarce regions, particularly in the sub-tropics.
- An increase in the number of people exposed to vectorborne (e.g., malaria) and water-borne diseases (e.g., cholera), and an increase in heat stress mortality.
- A widespread increase in the risk of flooding for many human settlements (tens of millions of inhabitants in settlements studied) from both increased heavy precipitation events and sea-level rise.
- Increased energy demand for space cooling due to higher summer temperatures.

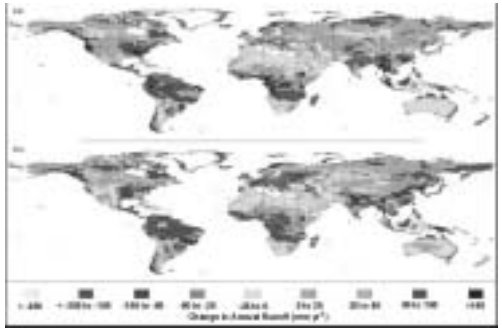
Projected Beneficial Impacts

- Increased potential crop yields in some regions at mid-latitudes for increases in temperature of less than a few °C.
- A potential increase in global timber supply from appropriately managed forests.
- Increased water availability for populations in some water-scarce regions—for example, in parts of southeast Asia
- Reduced winter mortality in mid- and high-latitudes.
- Reduced energy demand for space heating due to higher winter temperatures.



Those with the Least Resources *(i.e, wealth, technology, education, information, skills, infrastructure, access to resources, and management capabilities)* **have the Least Capacity to Adapt and are the Most Vulnerable.**

Impacts On Water Resources



A consistent projection across most climate change scenarios is for **increases in annual mean streamflow in high latitudes and southeast Asia**, and decreases in central Asia, the area around the Mediterranean.

Impacts on Agriculture

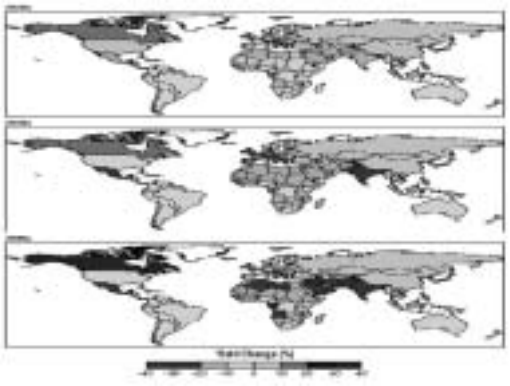
- Based on experimental research, crop yield responses to climate change vary widely, depending upon species and cultivar; soil properties; pests, and pathogens; the direct effects of carbon dioxide (CO2) on plants; and interactions between CO2, air temperature, water stress, mineral nutrition, air quality, and adaptive responses.
- Even though increased CO2 concentration can stimulate crop growth and yield, that benefit may not always overcome the adverse effects of excessive heat and drought.

Projected Impacts on Corp Production

2020s

2050s

2080s



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Impacts On Food Security

- Most studies indicate that global mean annual temperature increases of a few °C or greater would prompt food prices to increase due to a slowing in the expansion of global food supply relative to growth in global food demand.
- It is established, though incompletely, that climate change, mainly through increased extremes and temporal spatial shifts, will worsen food security in Africa.

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Impacts On Terrestrial Ecosystems

- Vegetation modeling studies continue to show the potential for significant disruption of ecosystems under climate change.
- The results of these changes will lag behind the changes in climate by years to decades to centuries.

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Impacts On Human Health

- Under climate change scenarios, there would be a net increase in the geographic range of potential transmission of malaria and dengue–two vector-borne infections each of which currently impinge on 40-50% of the world population.
- Extensive experience makes clear that any increase in flooding will increase the risk of drowning, diarrhoeal and respiratory diseases, and, in developing countries, hunger and malnutrition.

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Table SPM-2 (continued)

Region	Adaptive Capacity, Vulnerability, and Key Concerns
North America	• Adaptive capacity of human systems is generally high and vulnerability low in North America, but some communities (e.g., indigenous peoples and those dependent on climate-sensitive resources) are more vulnerable; social, economic, and demographic trends are changing vulnerabilities in subregions. [5.6 and 5.6.1] • Some crops would benefit from modest warming accompanied by increasing CO_2, but effects would vary among crops and regions (*high confidence*[6]), including declines due to drought in some areas of Canada's Prairies and the U.S. Great Plains, potential increased food production in areas of Canada north of current production areas, and increased warm-temperate mixed forest production (*medium confidence*[6]). However, benefits for crops would decline at an increasing rate and possibly become a net loss with further warming (*medium confidence*[6]). [5.6.4] • Snowmelt-dominated watersheds in western North America will experience earlier spring peak flows (*high confidence*[6]), reductions in summer flows (*medium confidence*[6]), and reduced lake levels and outflows for the Great Lakes-St. Lawrence under most scenarios (*medium confidence*[6]); adaptive responses would offset some, but not all, of the impacts on water users and on aquatic ecosystems (*medium confidence*[6]). [5.6.2] • Unique natural ecosystems such as prairie wetlands, alpine tundra, and cold-water ecosystems will be at risk and effective adaptation is unlikely (*medium confidence*[6]). [5.6.5] • Sea-level rise would result in enhanced coastal erosion, coastal flooding, loss of coastal wetlands, and increased risk from storm surges, particularly in Florida and much of the U.S. Atlantic coast (*high confidence*[6]). [5.6.1] • Weather-related insured losses and public sector disaster relief payments in North America have been increasing; insurance sector planning has not yet systematically included climate change information, so there is potential for surprise (*high confidence*[6]). [5.6.1] • Vector-borne diseases—including malaria, dengue fever, and Lyme disease—may expand their ranges in North America; exacerbated air quality and heat stress morbidity and mortality would occur (*medium confidence*[6]); socioeconomic factors and public health measures would play a large role in determining the incidence and extent of health effects. [5.6.6]