



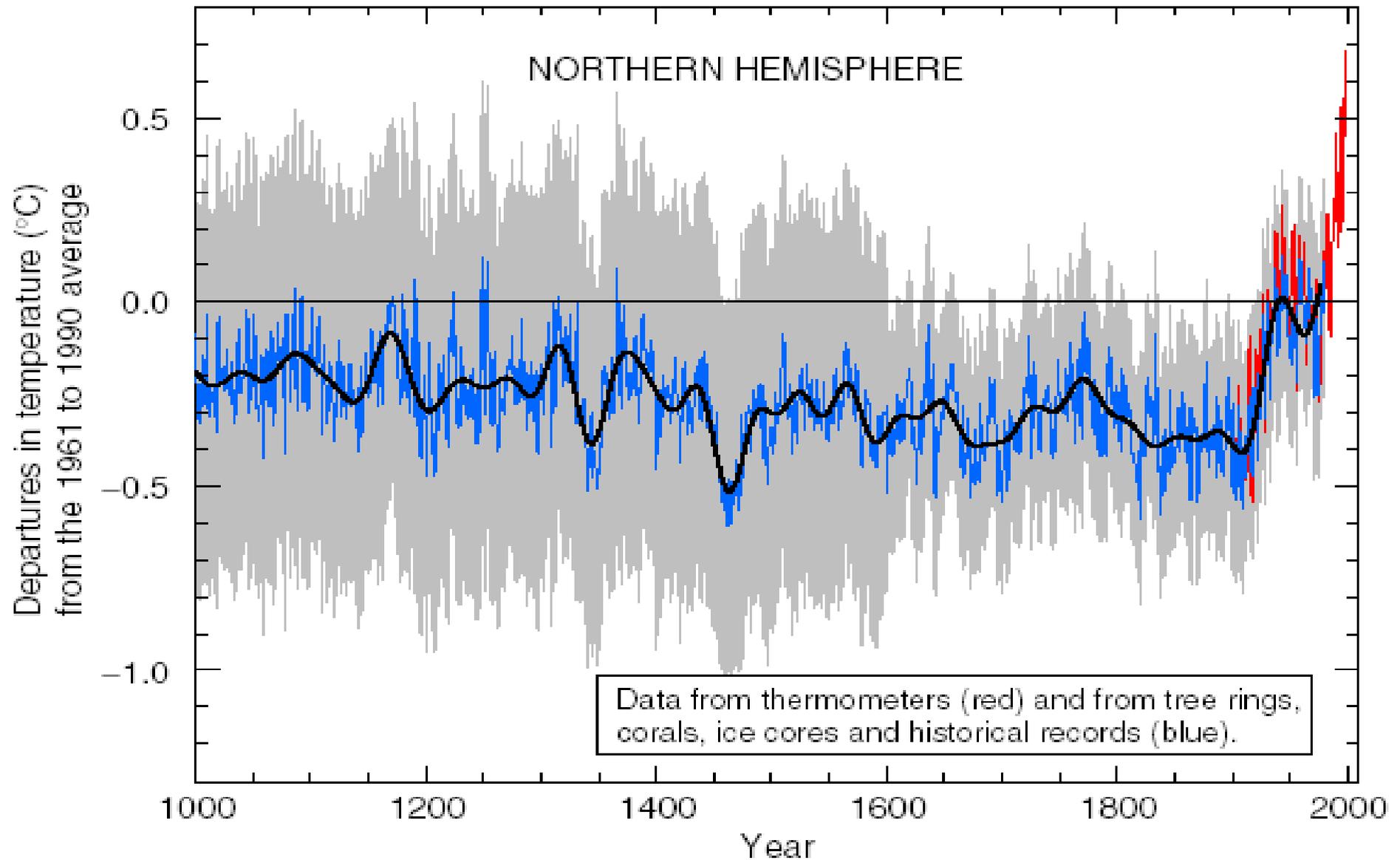
Environment, Climate Change and Food Security in Asia

Mohammad Aslam Khan, PhD
Chiang Rai, February, 2009

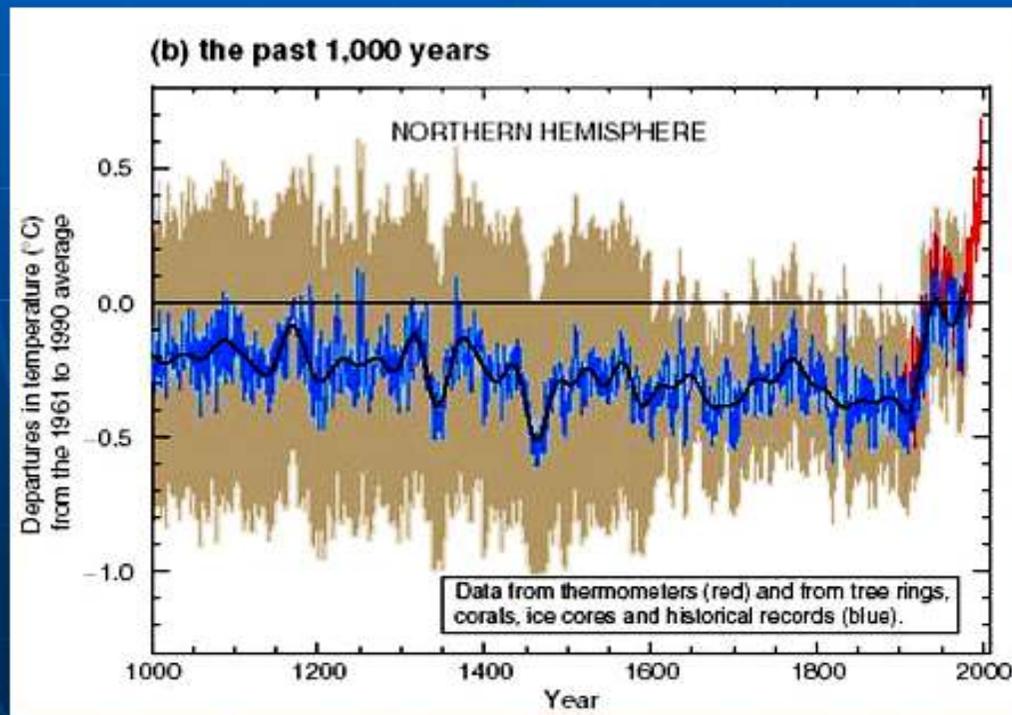
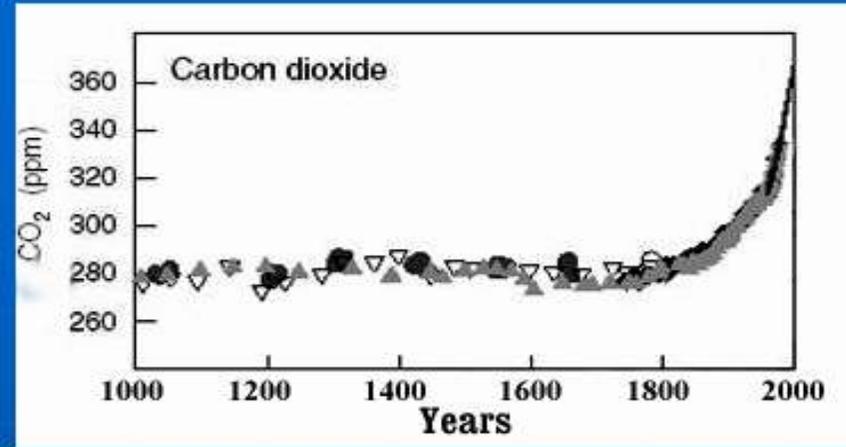
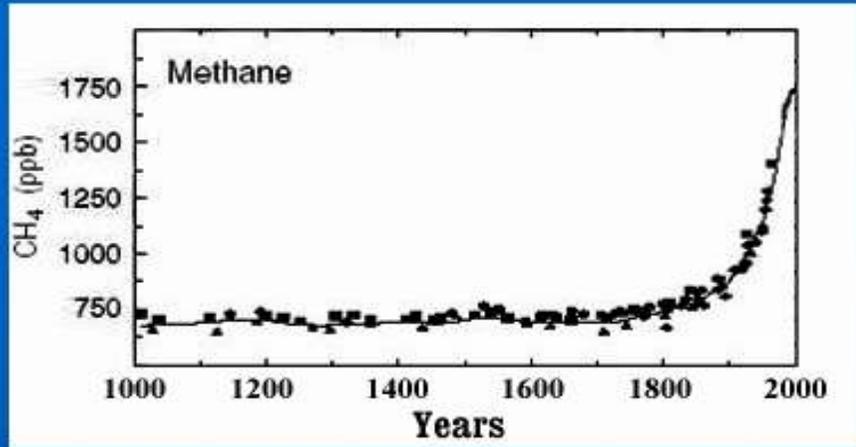
Format of Presentation

- ❖ **Environmental dynamics and climate change**
- ❖ **Climate Change Impacts in Asia and the Pacific**
- ❖ **Why and How Climate Change is a Major Issue in Food Security**
- ❖ **Issues and Challenges**

Northern Hemisphere Temperature Data 1000-2000



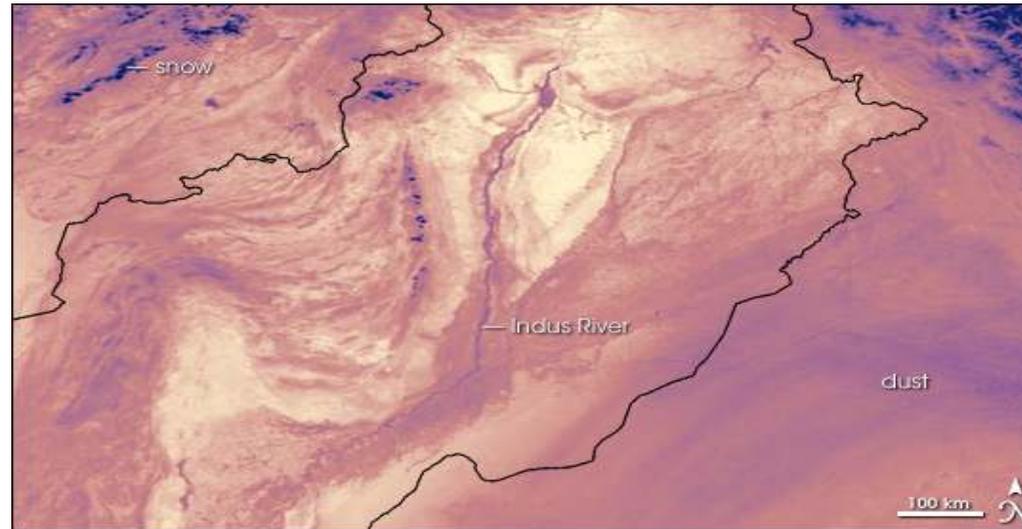
Environmental Dynamics - 1000 Year Changes in CO₂ & CH₄ concentrations and temperature



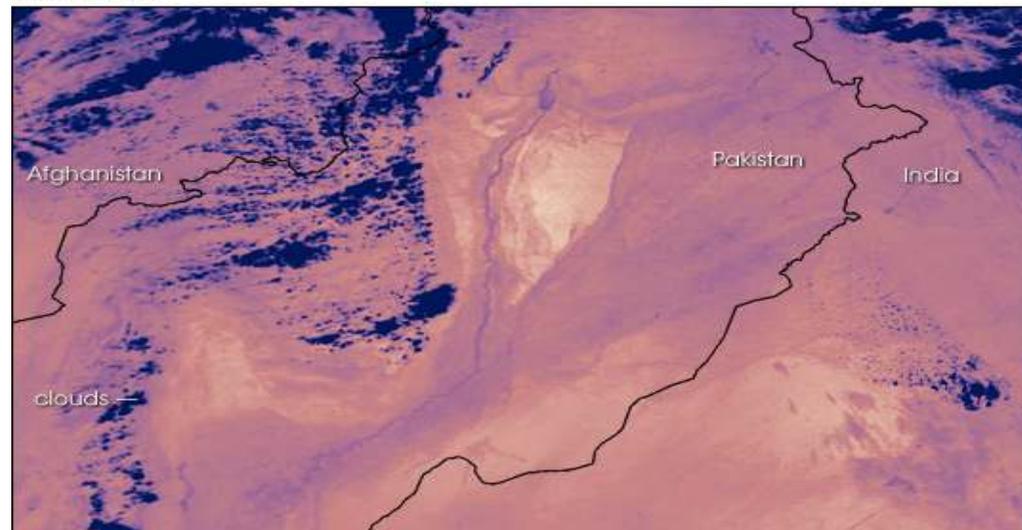
Major Findings of IPCC Third and Fourth IPCC Assessment Reports

- **Future change in global average temperature is expected in the range of 1.8 – 4.0 degree centigrade over the 21st Century,**
- **These will be accompanied by much increased impacts on global precipitation, extreme events, melting of glaciers, sea level rise etc.**
- **Key areas of impacts – water, food, ecosystems, coasts and health**
- **Some major changes associated with this temperature increase are:**
 - **Significant changes in precipitation in different world regions**
 - **Increase in frequency and intensity of climate extremes (storms, floods, droughts)**
 - **Melting of glaciers and polar ice and shrinkage of snow line and permafrost**
 - **Rise in global average sea level as much as 0.17 m, during the 20th century**

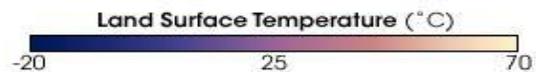
**Pakistan heat wave June, 2007 resulted in 232 deaths-
temperatures climbed to about 70 degrees Celsius (160
Fahrenheit) in rocky deserts**



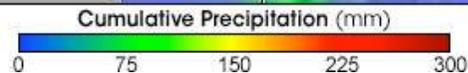
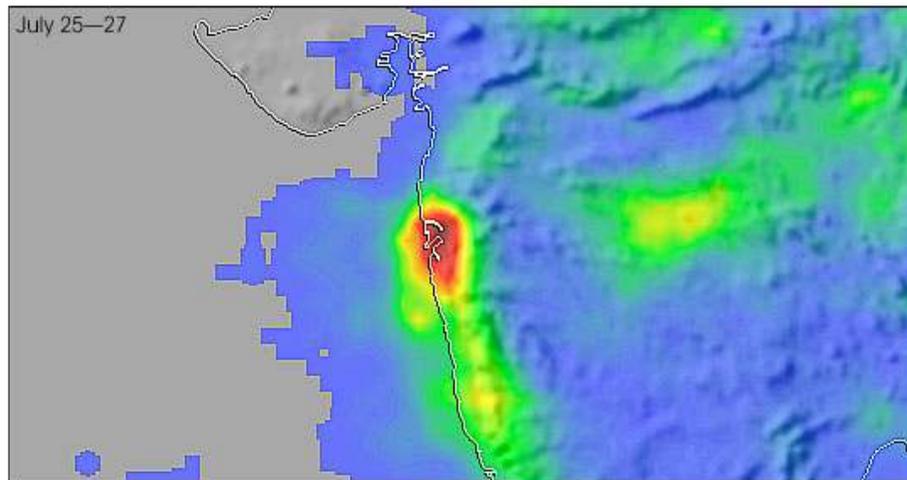
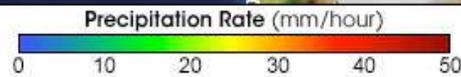
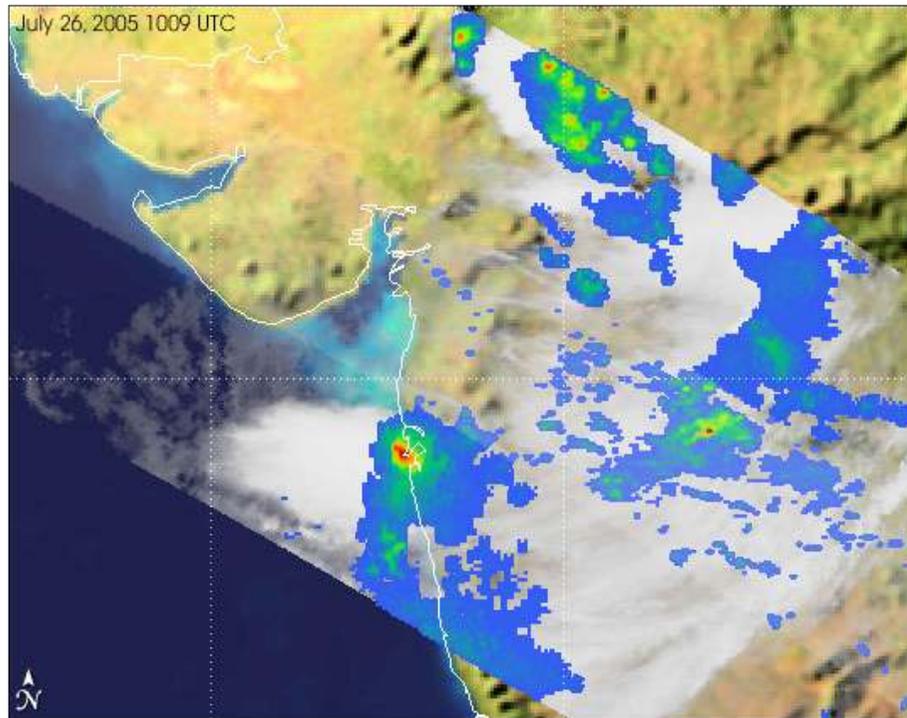
June 10, 2007



May 18, 2007



Record Rainfall over Mumbai

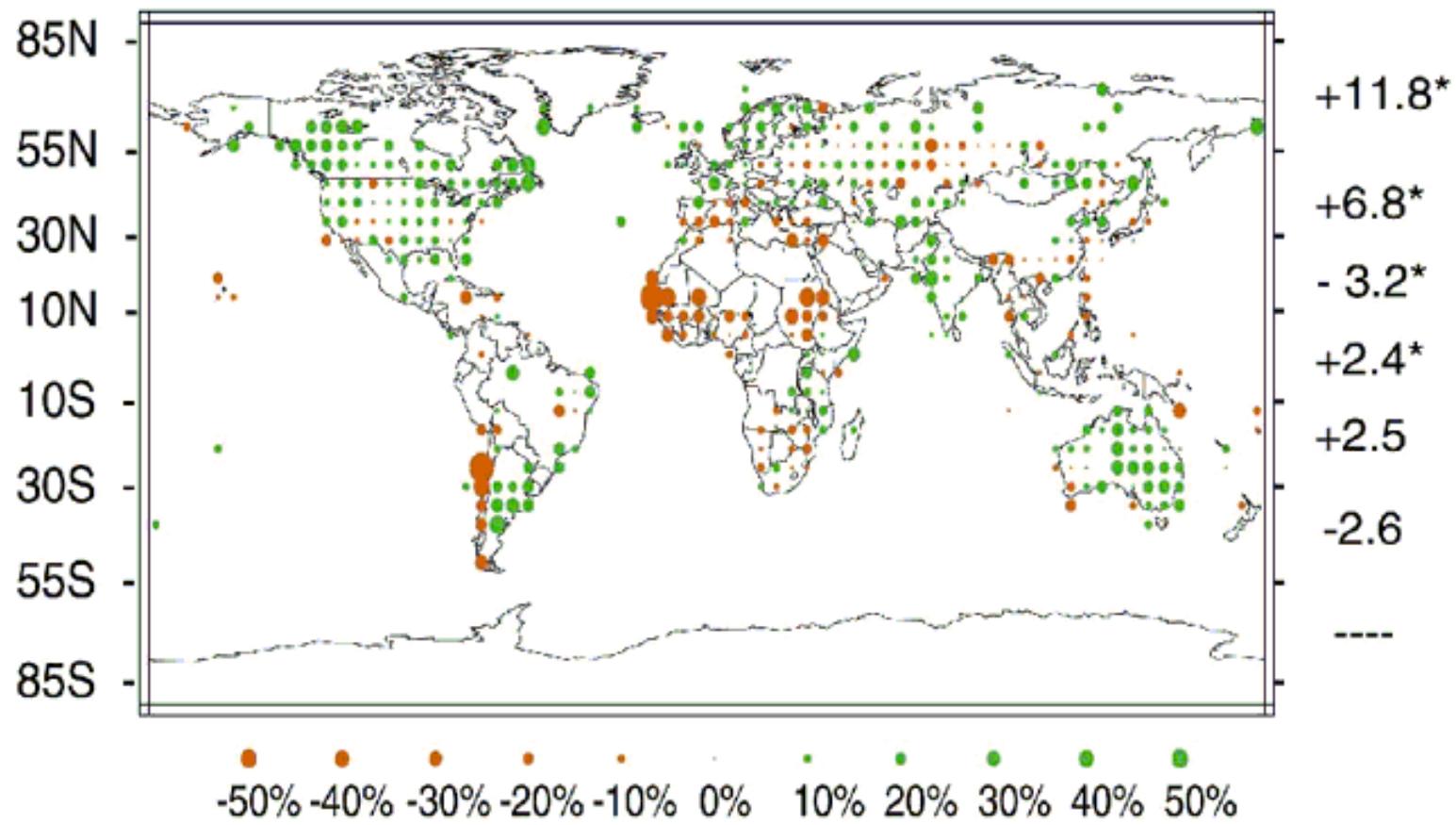


India's financial capital, Mumbai, received a record-breaking 942 millimeters (37.1 inches) of rain in a twenty-four hour period on Tuesday, July 26, 2005. India's previous all-time single-day record of 838 mm (33 inches) was set in 1912. The heavy monsoon rain triggered deadly floods, which claimed more than 500 lives in the country's western Maharashtra state, with 273 fatalities in Mumbai alone, as of July 28. The image shows rain intensity as measured by TRMM's sensors, with the heaviest rainfall in dark red and lighter rainfall in blue. A dark red area of heavy precipitation sits directly over Mumbai, revealing rain rates as high as 50 millimeters per hour immediately around the city. Both images show just how localized extreme rainfall can be.

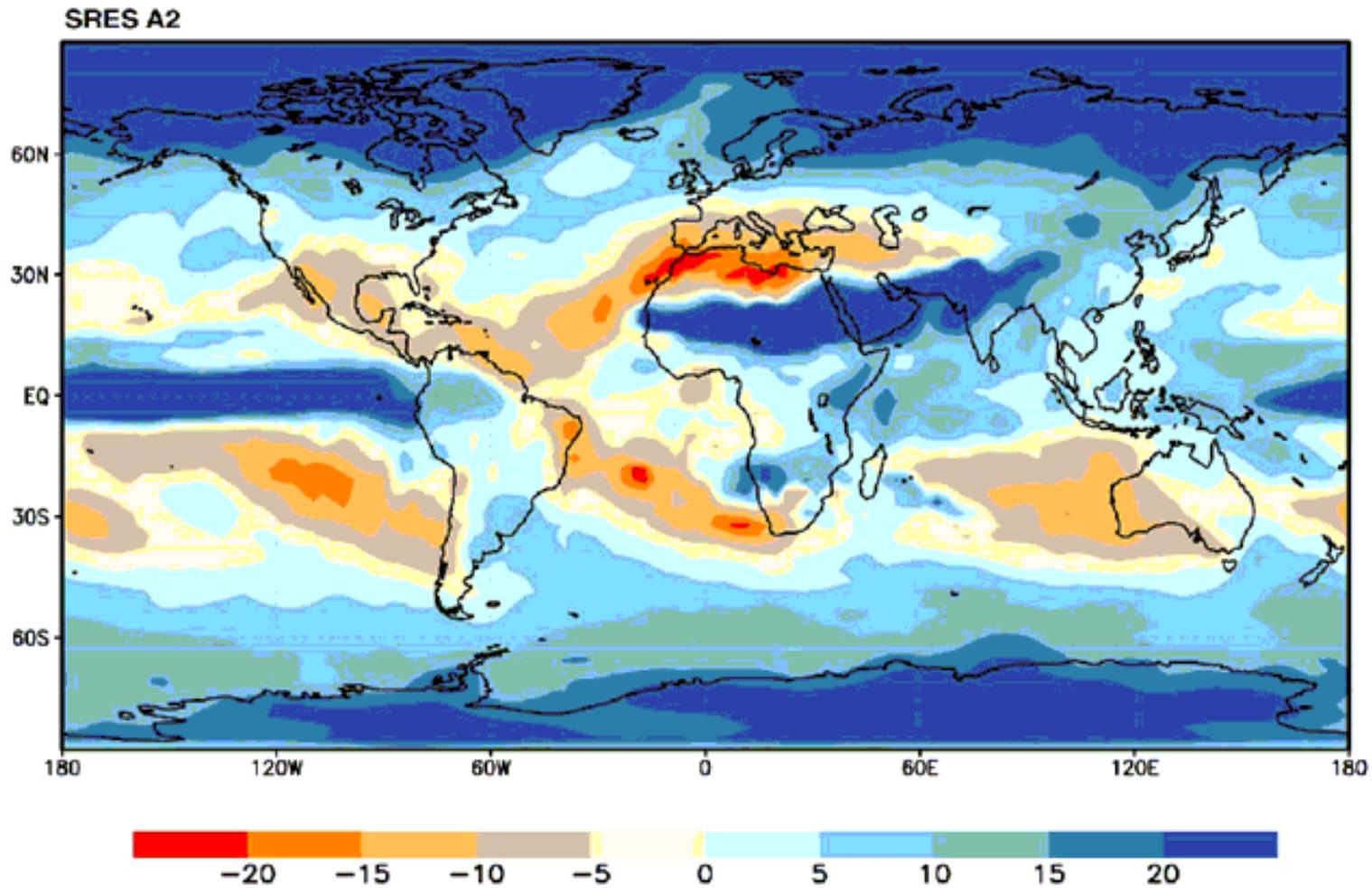
- ❖ **Glaciers, snow and ice are considered to be the most sensitive indicators of climate change**
- ❖ **A 4 degree rise in temperature would eliminate almost all the world glaciers**
- ❖ **Even in the least damaging scenario – a 1°C rise along with an increase in rain and snow – glaciers will continue to lose volume over the coming century**
- ❖ **A remarkable effect of global warming has been the shrinking of glaciers and the ice-cap on the north and south pole**
- ❖ **In India, one of largest glaciers in the Himalayas, the Gangotri glacier that feeds the river Ganges, has retreated about the 2 km in the last 200 years of which about one half of which in the last 30 years.**
- ❖ **Glacier watch is extremely important for Asia as its irrigation system depends on glaciers as source of water**
- ❖ **The mountains of Asia host some of the largest and longest mid-latitude glaciers on Earth. In Pakistan alone they cover 6160 sq.km which is 37% of Karakoram Himalayas**
- ❖ **Glacial melt water makes more than 60% contribution to the flow of Upper Indus Basin (UIB)**



Trend (%/century) in Annual Precipitation 1900 - 1999



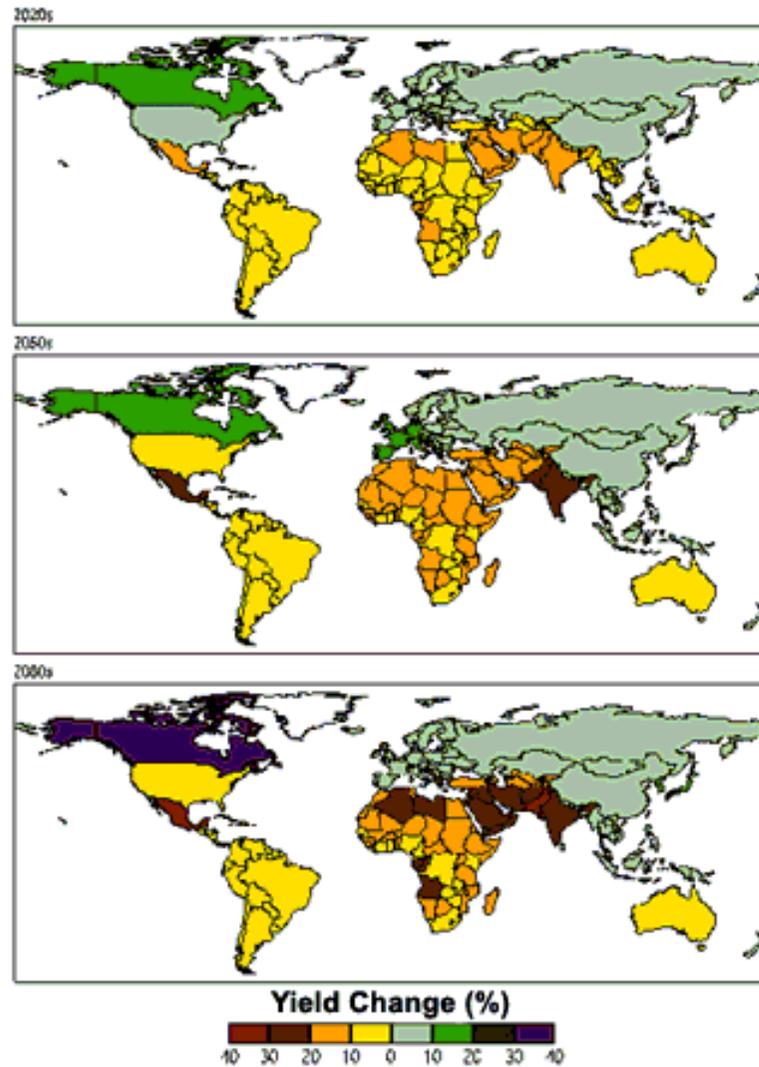
Some areas are projected to become drier other wetter



Seasonal and latitudinal shifts in precipitation and glacial melts

- ✚ **Implications for water resources**
- ✚ **Implications for drought**

Crop yields are projected to decrease in tropics and subtropics and increase in higher latitudes



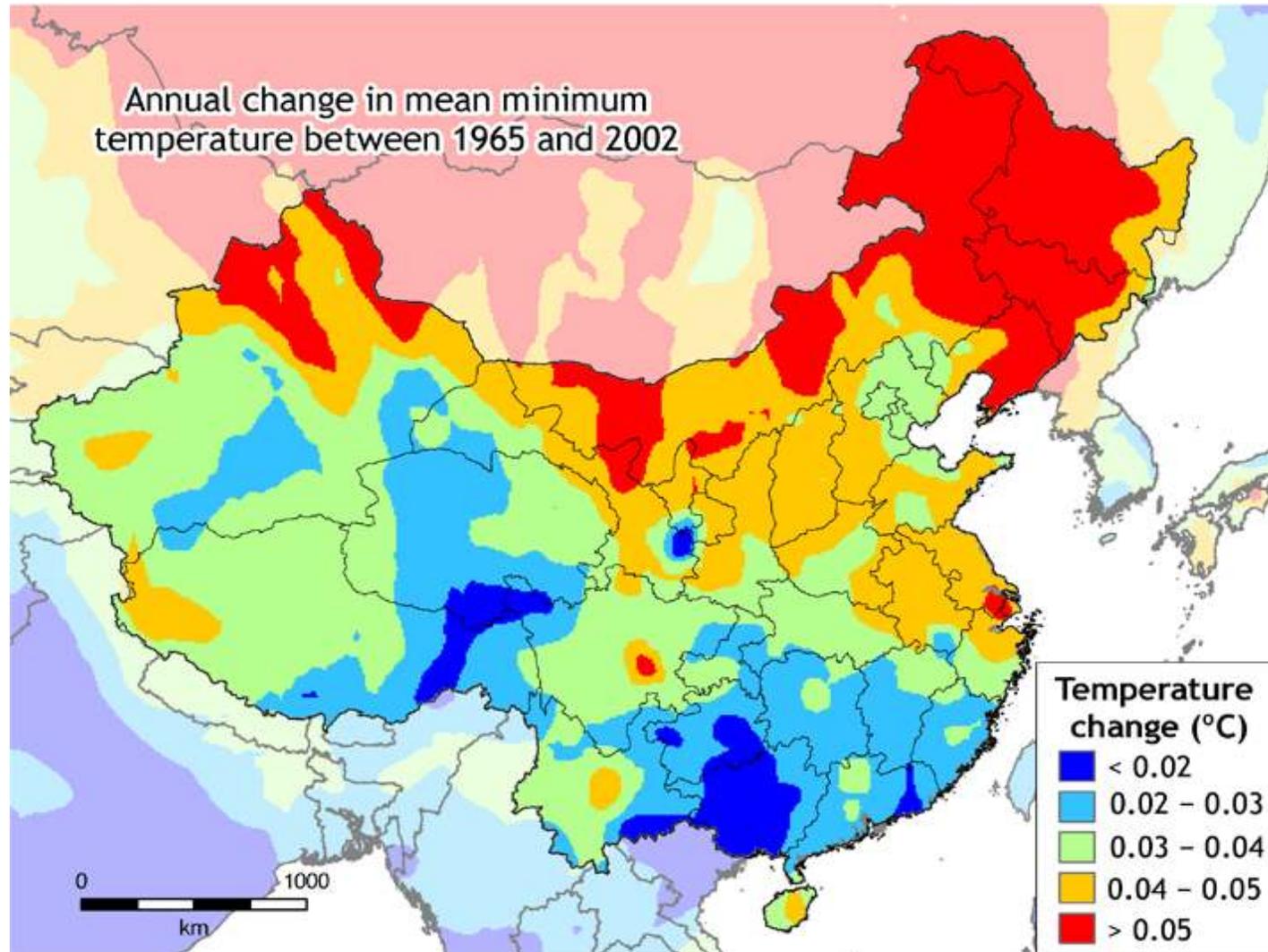
Percentage change in average crop yields for the climate change scenario. Effects of CO₂ are taken into account. Crops modeled are: wheat, maize and rice.

Jackson Institute, University College London / Goddard Institute for Space Studies / International Institute for Applied Systems Analysis

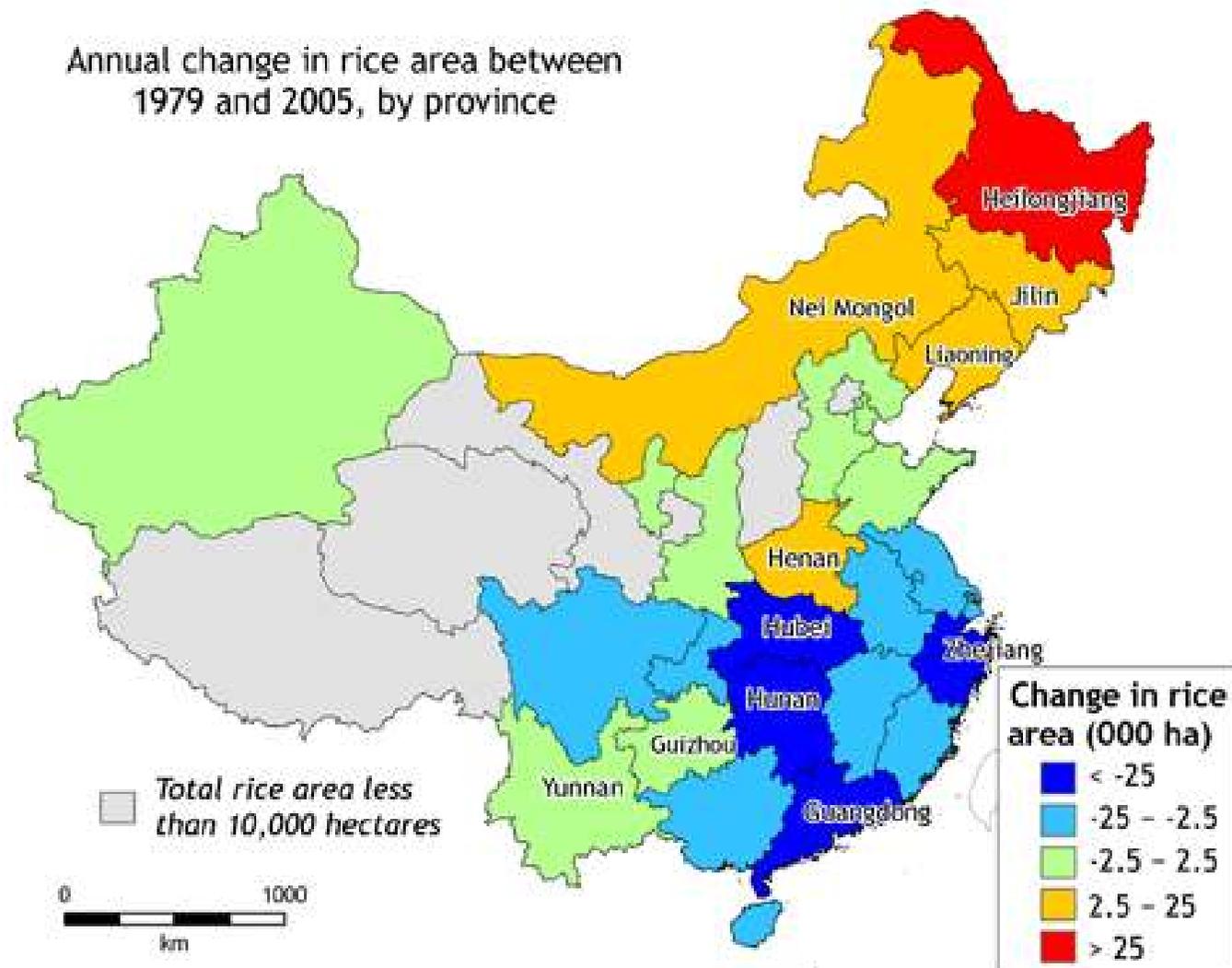
97/1091 16

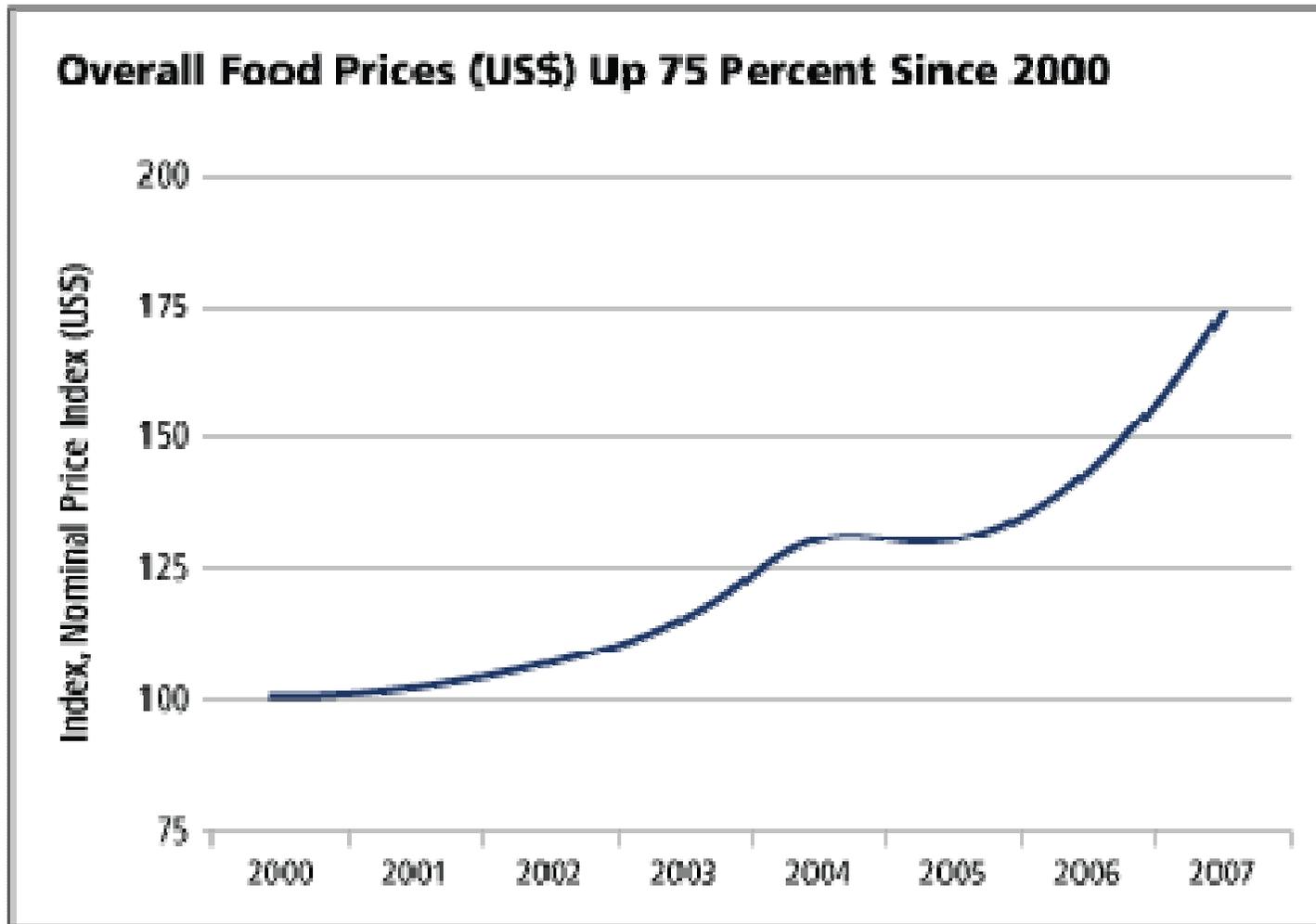
- **Glacier melt in the Himalayas is projected to increase flooding, and rock avalanches from destabilized slopes. This will be followed by decreased river flows as the glaciers recede.**
- **Freshwater availability in Central, South, East and Southeast Asia, particularly in large river basins, is projected to decrease adversely affecting more than a billion people by the 2050s.**
- **It is projected that crop yields could increase up to 20% in East and Southeast Asia while they could decrease up to 30% in Central and South Asia by the mid-21st century. Considering the influence of rapid population growth, the risk of hunger is projected to remain very high in several developing countries.**
- **Increases in coastal water temperature would exacerbate the abundance and/or toxicity of cholera in South Asia.**
- **The consequences of sea level rise will be the inundation of coastal areas. Much of the land area in many small island developing states is less than 4 meters above the present mean sea level. In these countries there are signs that sea level rise is underway.**
- **Extended tidal peaks, salt intrusions into agricultural lands and resultant impacts in the form of low freshwater availability are pointers in that direction.**
- **Deterioration in coastal conditions, for example through erosion of beaches and coral bleaching, is expected to affect local resources, e.g., fisheries**
- **Climate change is projected by the mid-century to reduce water resources in many small islands in the Pacific, to the point where they become insufficient to meet demand during low rainfall periods.**
- **With higher temperatures, increased invasion by non-native species is expected to occur, particularly on middle and high-latitude islands.**

China: Annual Change in Mean Temperature



Annual Change in Rice Area





Source: World Bank, DEC PG.

Why climate change is a food security issue?

- **Because its impacts will be on rainfall, temperature and humidity with adverse impacts on crop yields.**
- **It will also have impacts on crop diseases hence affecting crop yields again.**
- **It will again affect crop production by aggravating climate related disasters**

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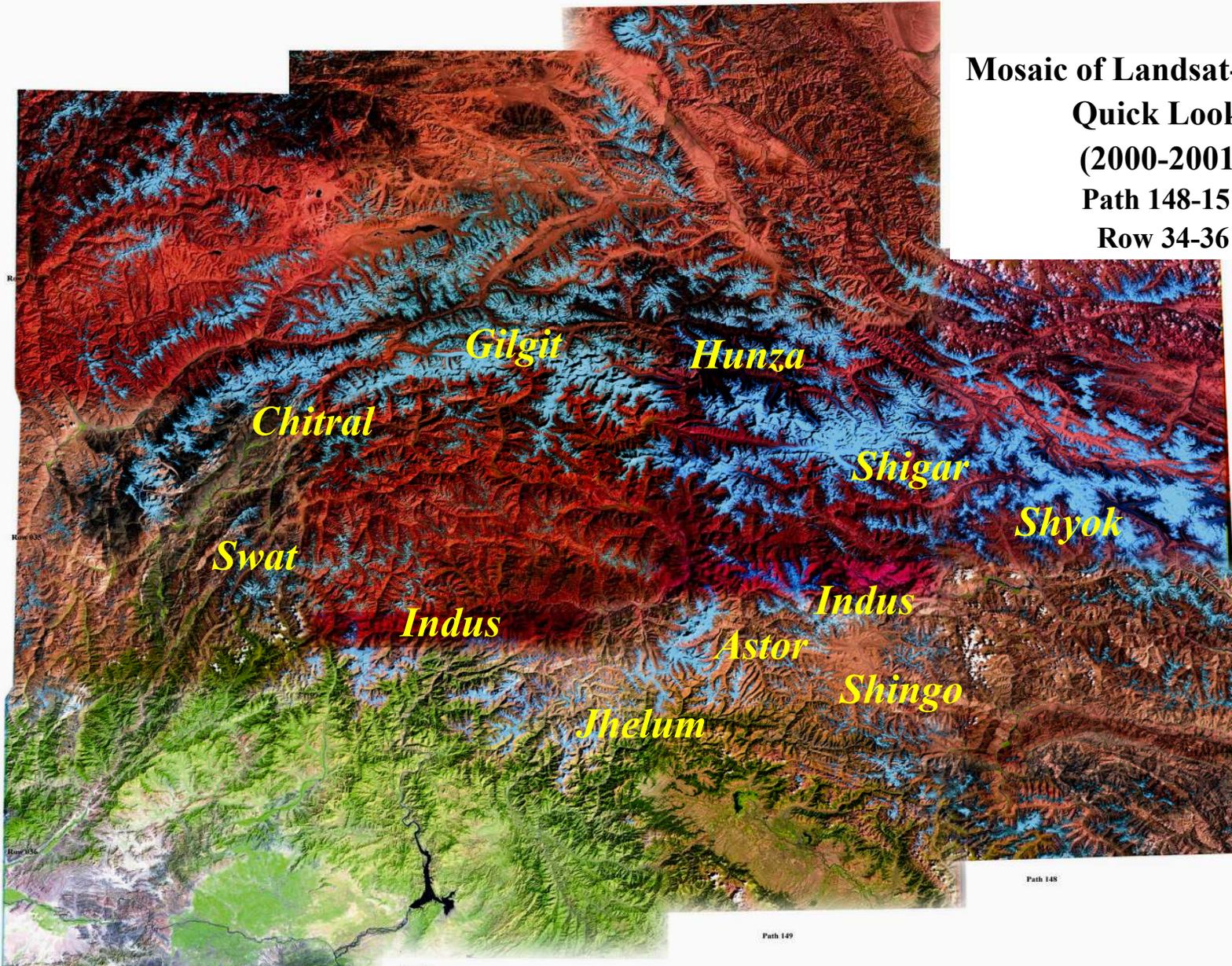
Global Warming, Water Shortages and Food Security



Global warming will create at least one billion refugees by 2050 as water shortages and crop failures force people to leave their home

Environment, Climate Change and Food Security in Asia-Pacific

Northern Glaciated Region of Pakistan



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Melting Glaciers in Himalaya



Environment, Climate Change and Food Security in Asia-Pacific



Environment, Climate Change and Food Security in Asia-Pacific

Impacts of Receding Glaciers

- **Sea level rise during 1993-2003 was at an average rate of 3.1mm/year)**
- **Drying up of rivers-shortage of water resources**
- **Impacts on economy – agriculture etc.**
- **Himalayan glacier lakes are filling up with more and more melted ice and 24 of them are now poised to burst their banks in Bhutan, with a similar number at risk in Nepal.**
- **The melting glaciers will ultimately trigger more droughts, expand desertification and increase sand storms**

Impacts of sea level rise

According to IPCC (2001), sea level has risen 10-20 cm since 1900, and it is projected to rise between 110 and 170 mm between 1990 and 2100 in its Third Report. Impacts may include

- **Implications for small island developing states (SIDS) and low-lying coastal areas (e.g., Marshall Islands: projected 80% land loss to 1-m sea-level rise)**
- **FOR SIDS, it is not only a matter of sustainable development, but also a matter of survival!**
- **Increased coastal erosion, higher storm-surge flooding, inhibition of primary production processes, more extensive coastal inundation**
- **Changes in surface water quality and groundwater characteristics, increased loss of property and coastal habitats,**
- **Increased flood risk and potential loss of life, loss of non-monetary cultural resources and values,**
- **Impacts on agriculture and aquaculture through decline in soil and water quality, and loss of tourism, recreation, and transportation**
- **about two thirds of the world's cities with over five million people are located in these low-lying coastal areas.**

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SIDS Survival is at Stake Due to Sea Level Rise



Environment, Climate Change and Food Security in Asia-Pacific

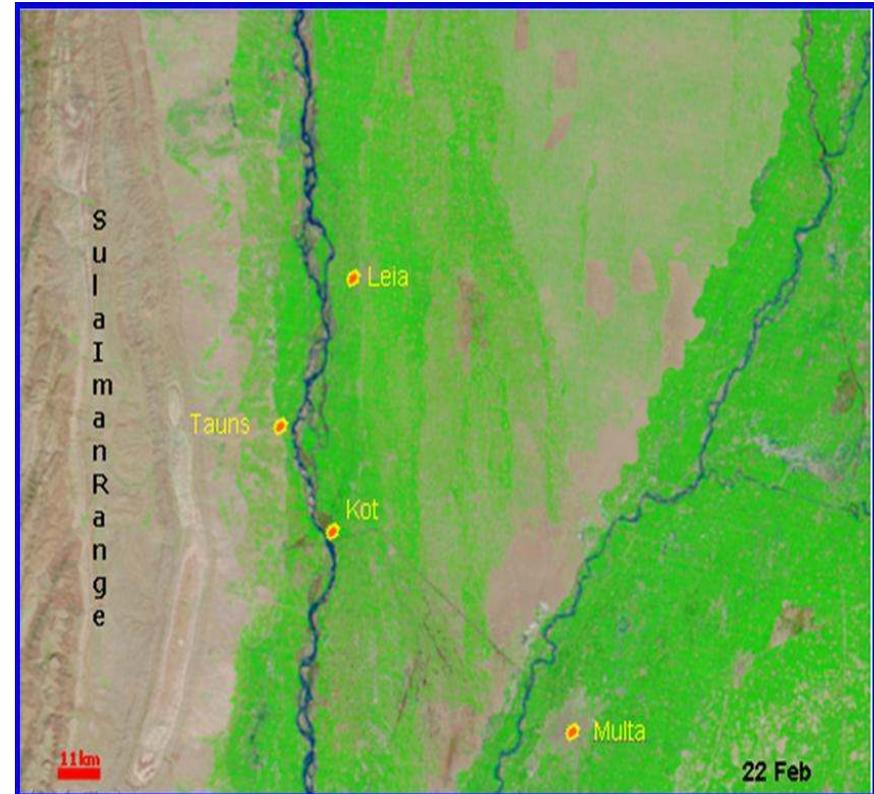
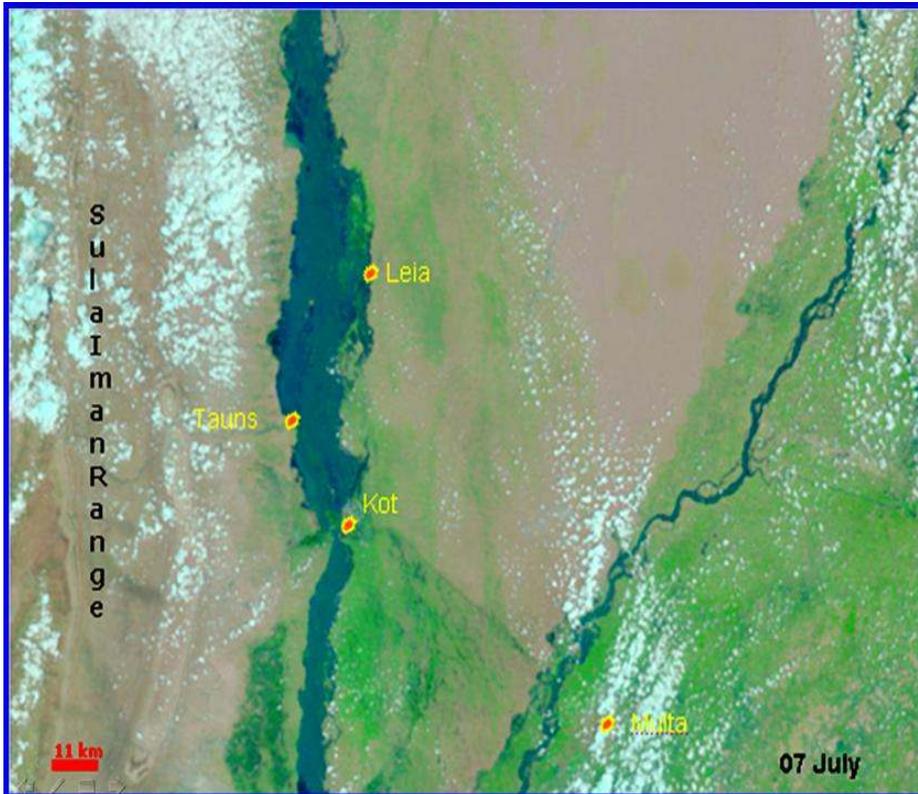
Climate Change and Incidence of Natural Disasters in Asia and the Pacific

- ✦ **during the last decade (1995-2004), the total loss of life caused by disasters in the region accounted for about 80 per cent of the world figure. The total number of people affected was over 2.3 million. The total financial loss was estimated at over 450 billion dollars (Red Cross and Red Crescent, 2005).**
- ✦ **China, India, Afghanistan, Bangladesh, Pakistan, Indonesia, Iran and Turkey were among the most disaster prone countries in the world in 2005 (UN/ISDR, 2006).**
- ✦ **Overall, there was an increase in the number of natural disasters in 2005, mainly due to the rise in the incidence of floods – 57 percent increase over 2004, and droughts - 47 percent increase over 2004 (UN/ISDR, 2006).**
- ✦ **Incidence of some extreme events, such as high temperature, floods, droughts, soil moisture deficits, fires and pest outbreak, are expected to increase in future**

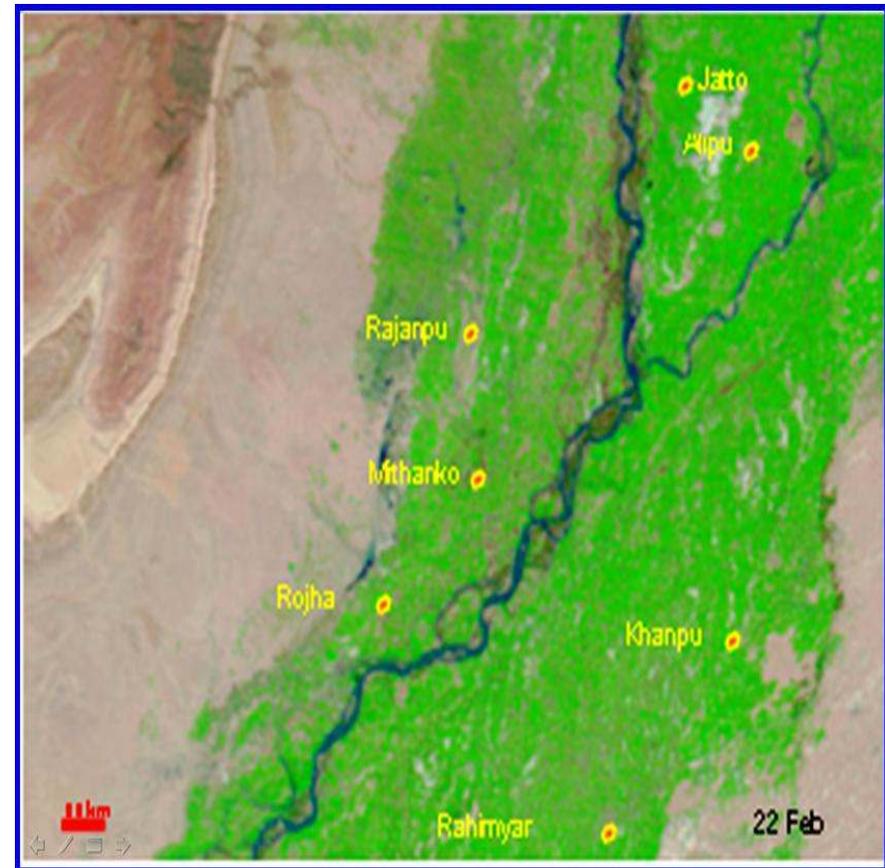
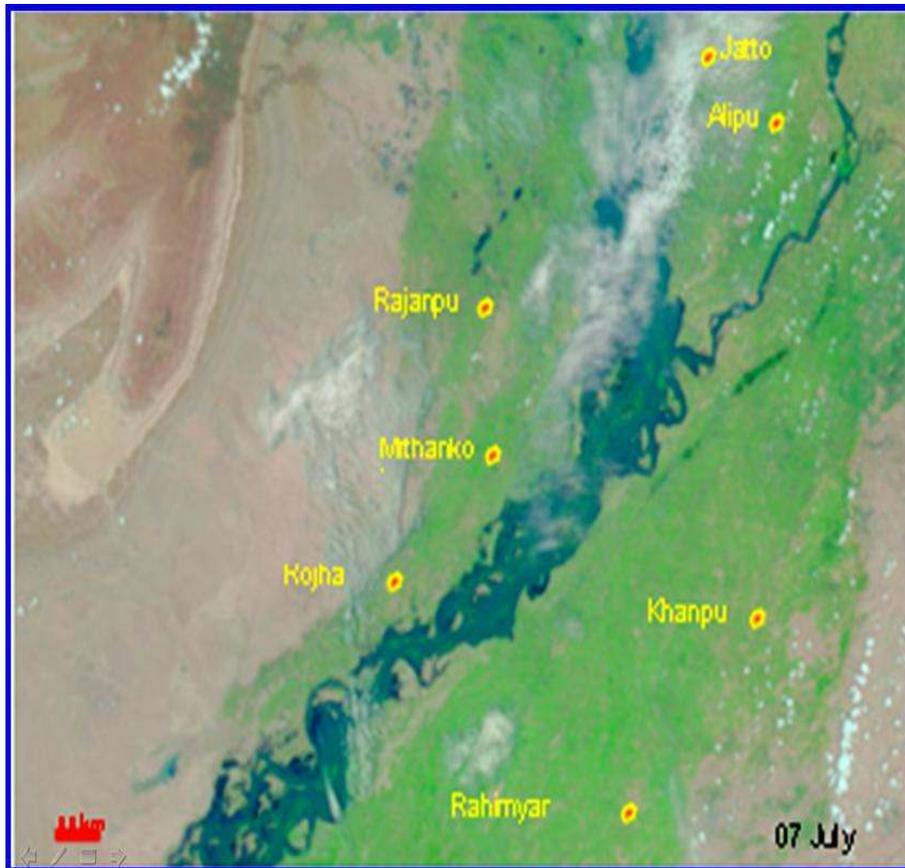
Some Climate Extremes Recently Experienced in South Asia

<u>Year</u>	<u>EVENTS</u>
1991	A catastrophic cyclonic storm in Bangladesh left 100,000 people dead.
1992	Last decade's worst flood in Jhelum river in Pakistan.
1998	Two-thirds of the Bangladesh area was inundated by flood waters and forced more than 20 million people to evacuate their homes.
1999	Severe Cyclonic Storm hit the coastal areas of Pakistan and India.
1998-2001	History's worst drought in Pakistan.
2001	621 mm rainfall in Islamabad during 10 hours in the month of July.
2005	Heavy winter rains in parts of Pakistan and Afghanistan in March caused severe flash flooding in Balochistan province.
2005	Unusual high temperatures in northern mountains during the month of June; accelerated snow melt caused heavy flooding of Kabul, Swat, Shah Alam, Kunar and Chitral rivers.

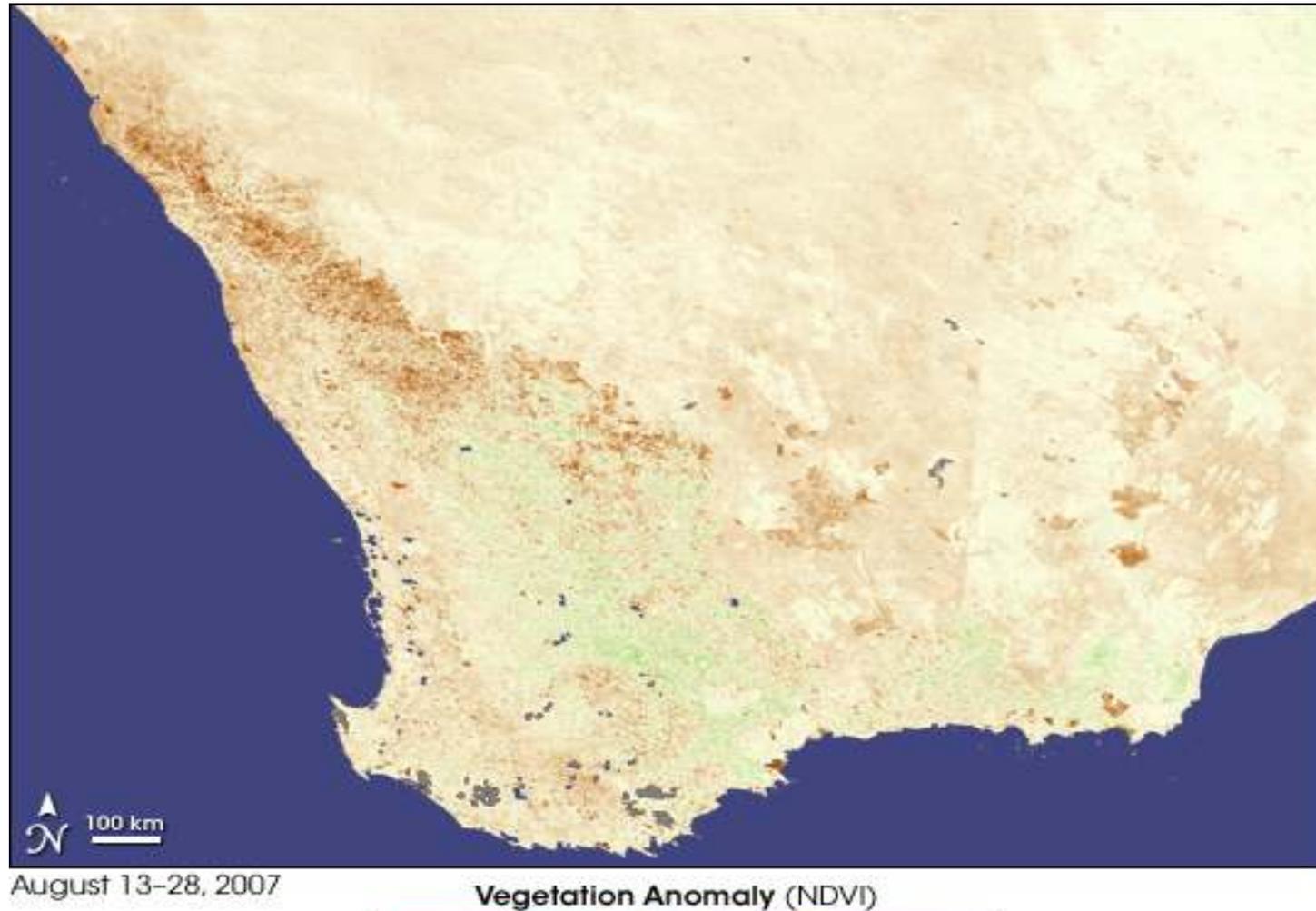
River Indus Before and After Flood 2005



River Indus Before and After Flood 2005



Drought in Australia

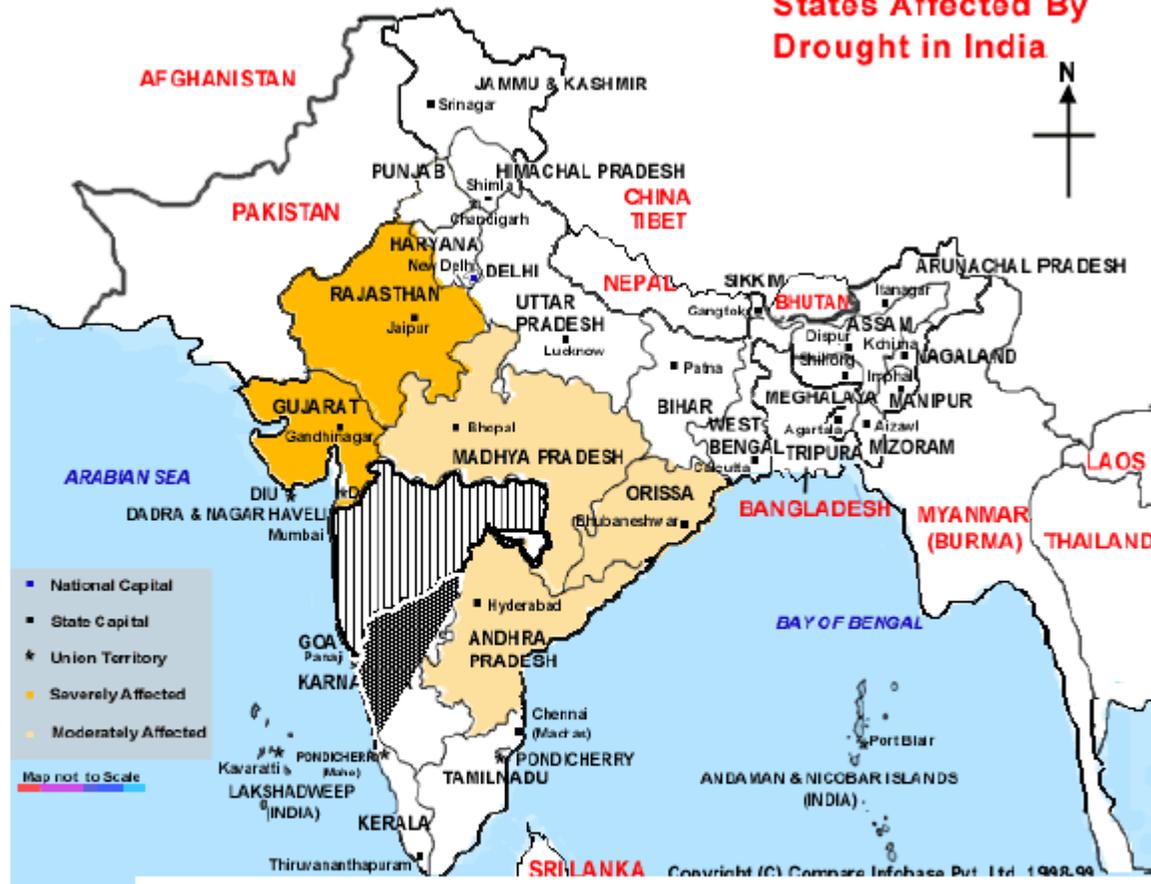


Australian farmers seeking to make a living on the driest inhabited continent were in the grip of its worst drought in 20 years; high rural suicide rates were linked to this drought, a situation which was replicated in India .

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Drought and India

States Affected By
Drought in India



- 16% of India's total area is drought prone
- On an average 191 of 543 districts are affected by drought
- More than 68% of the Land is vulnerable to drought
- 50 million people are annually affected by drought





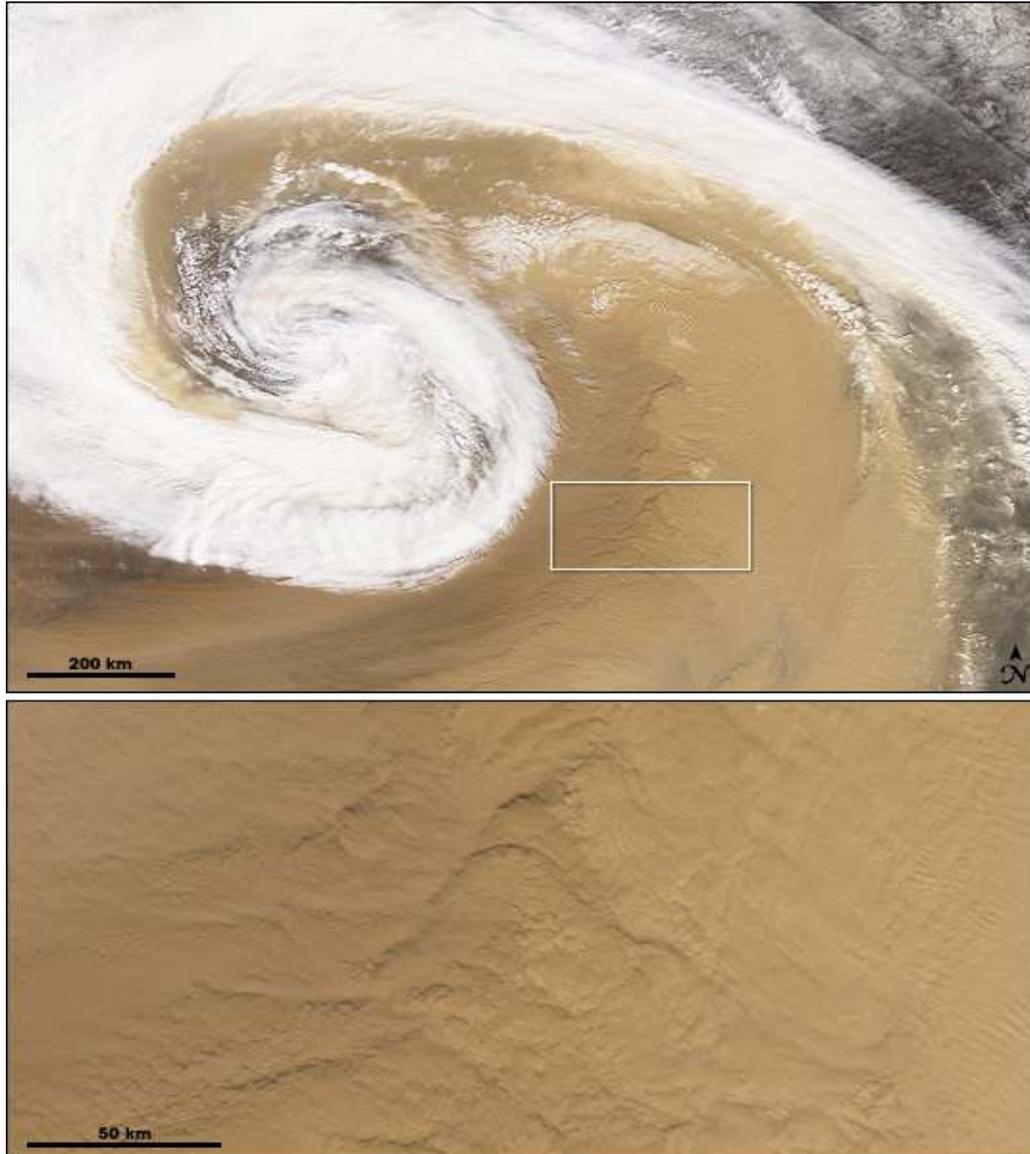
Observed Trends and Projections

- **Observed trends**
 - **Drought events in a package of 5 years**
 - **2 drought years, 2 normal rainfall, 1 good rainfall**
 - **2 consecutive drought years after 1960s**
 - **3 consecutive drought years after 1980s**
- **Projections**
 - **There is a general increase in drought conditions in the western India**
 - **More drought weeks in western India**

Climate Change, Desertification and Food Security

- ✚ **Climate models suggest that a build-up of greenhouse gases in the atmosphere could lead to a warming of Asia, increased potential evapotranspiration rates, a reduction of soil moisture, and an increase in the frequency, intensity, and magnitude of droughts.**
- ✚ **UNEP estimates that every year, 10 million hectares of arable land are being lost to desertification, costing the world close to \$42 billion annually. Asia has the largest area biggest population affected by desertification.**
- ✚ **The loss of land by desertification has serious implications for food security**
- ✚ **Dust and sandstorms from the degraded lands are now blowing across national boundaries, and also have implications for food security.**

**Dust storm in China April 2001- dust from it crossed
Pacific reaching as far east as the Great Lakes and even
Maryland**



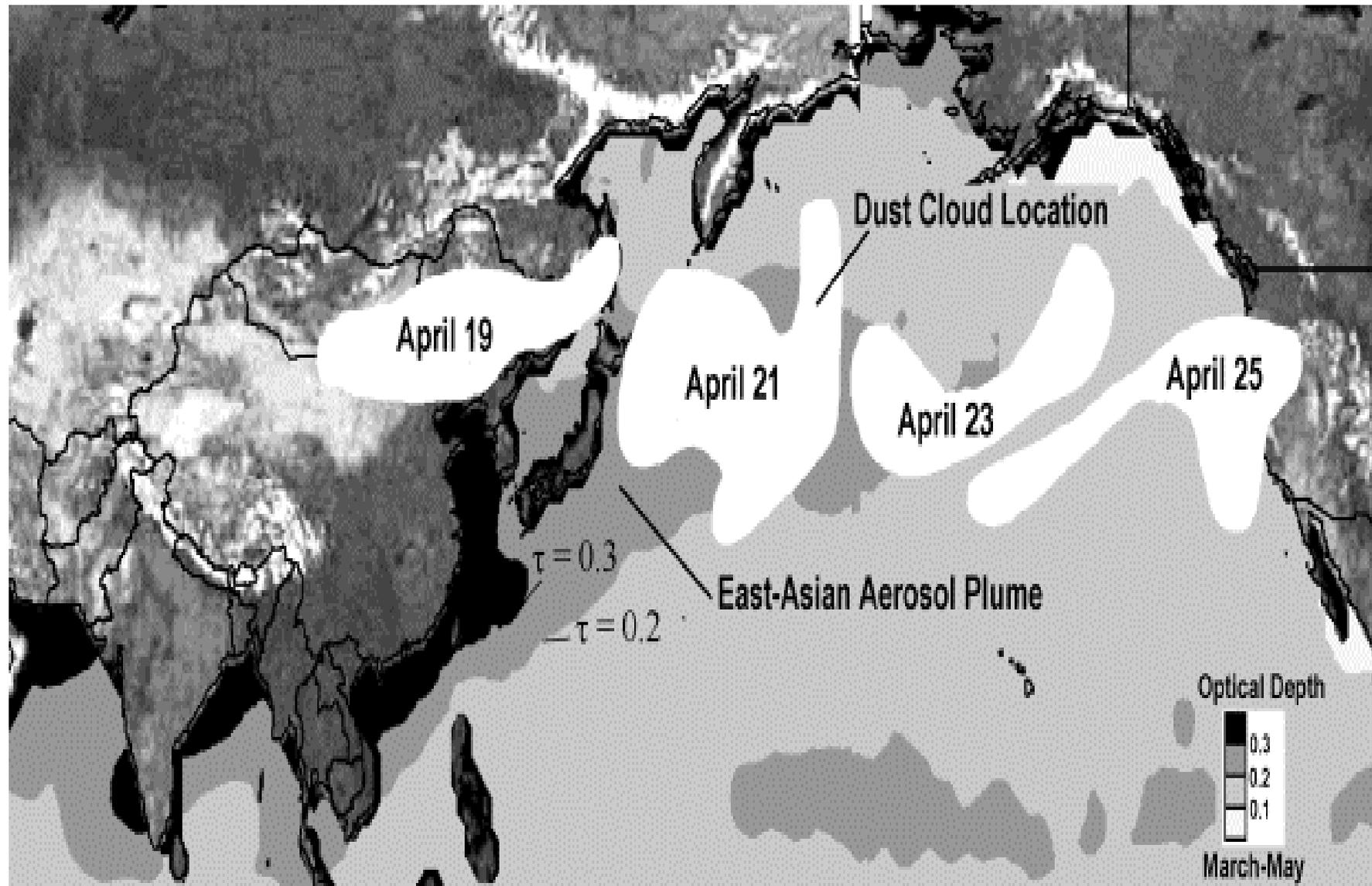
***From AD 300 to 1949,
China experienced a
dust storm on average
every 31 years. After
1990, a dust storm
occurred almost every
year. The increase in
such storms is partly
attributed to
deforestation and
changes in water
usage***

Dust obscures Korea



The dust cloud over eastern Asia was so thick on March 21, 2002, that the Korean Peninsula completely disappeared from view in this Sea-viewing Wide Field-of-view Sensor (SeaWiFS) image of the region. Parts of South Korea reported that visibility at the surface was less than 50 m (165 feet). Airports throughout the region canceled flights due to the poor visibility.

**Approximate location of the 19 April 1998 dust cloud over
the Pacific Ocean between 21-25 April 1998.**

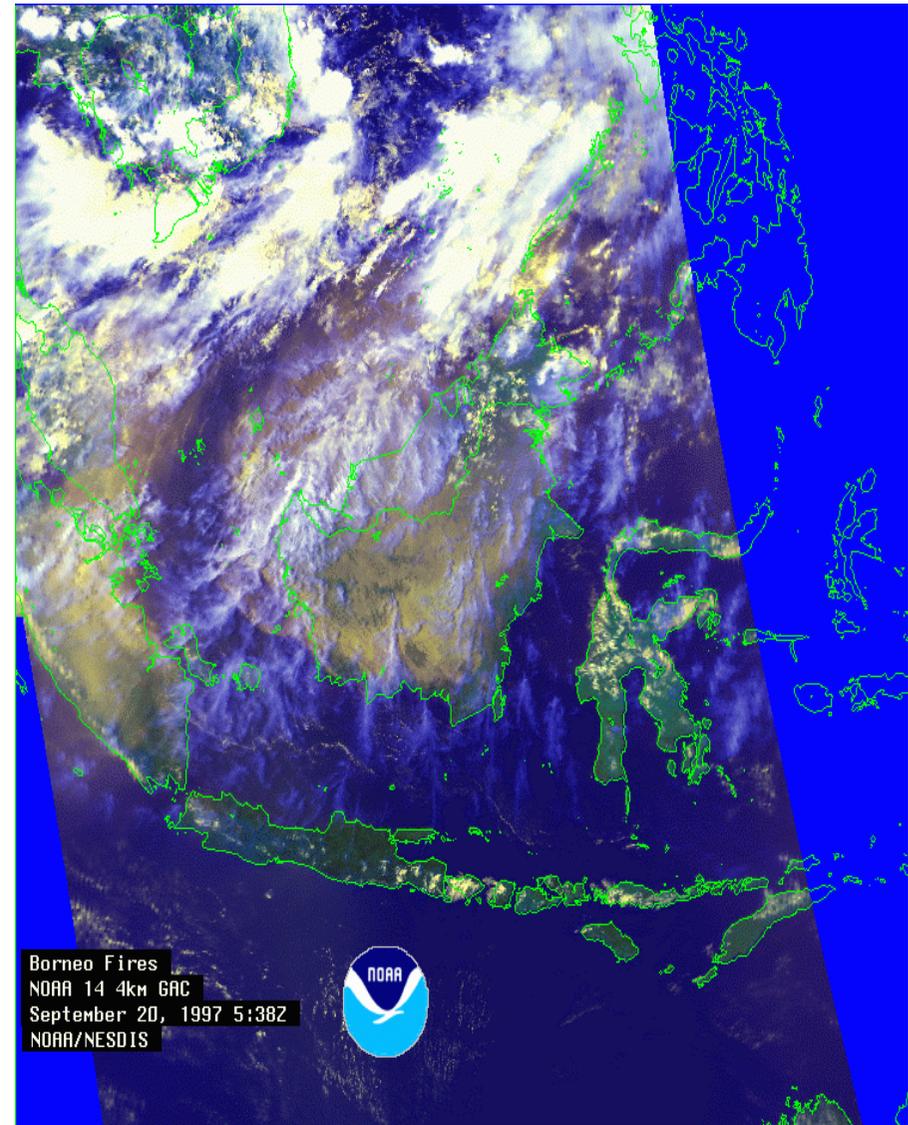
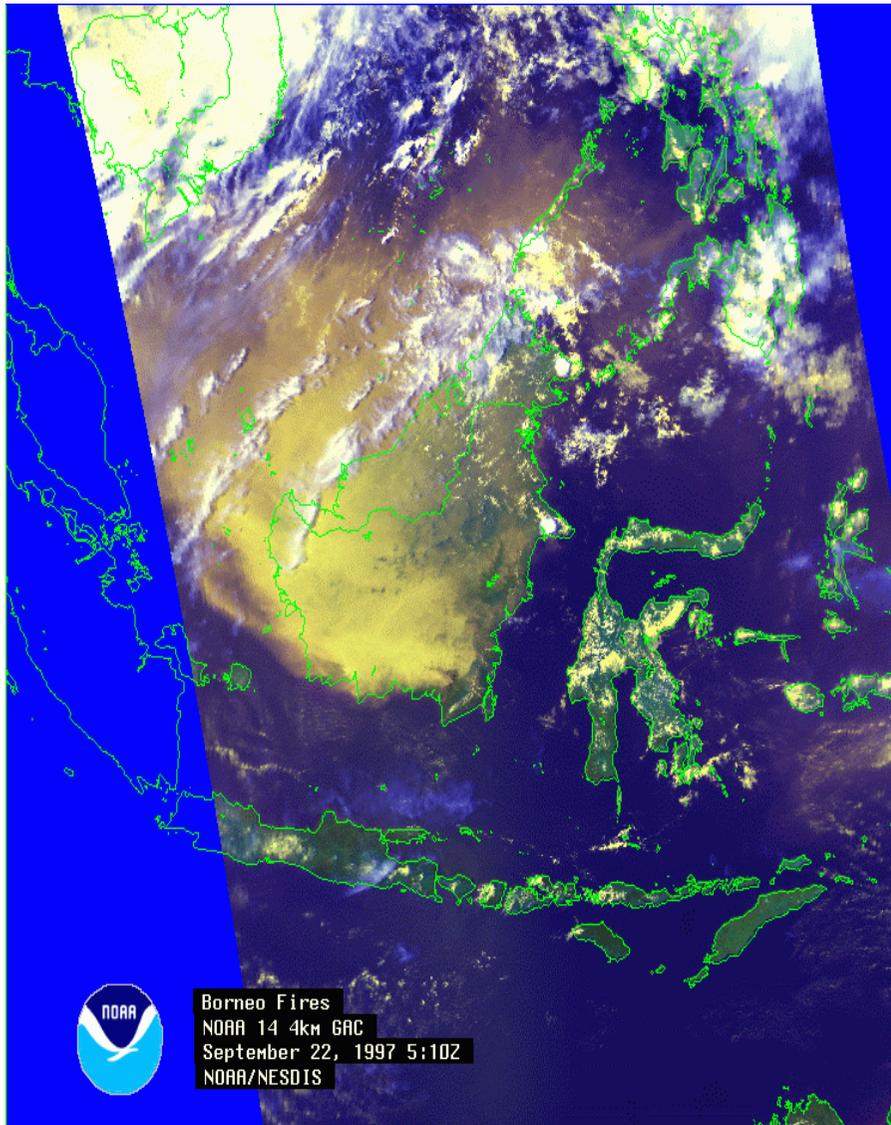


Forest Fires have become common with the global warming

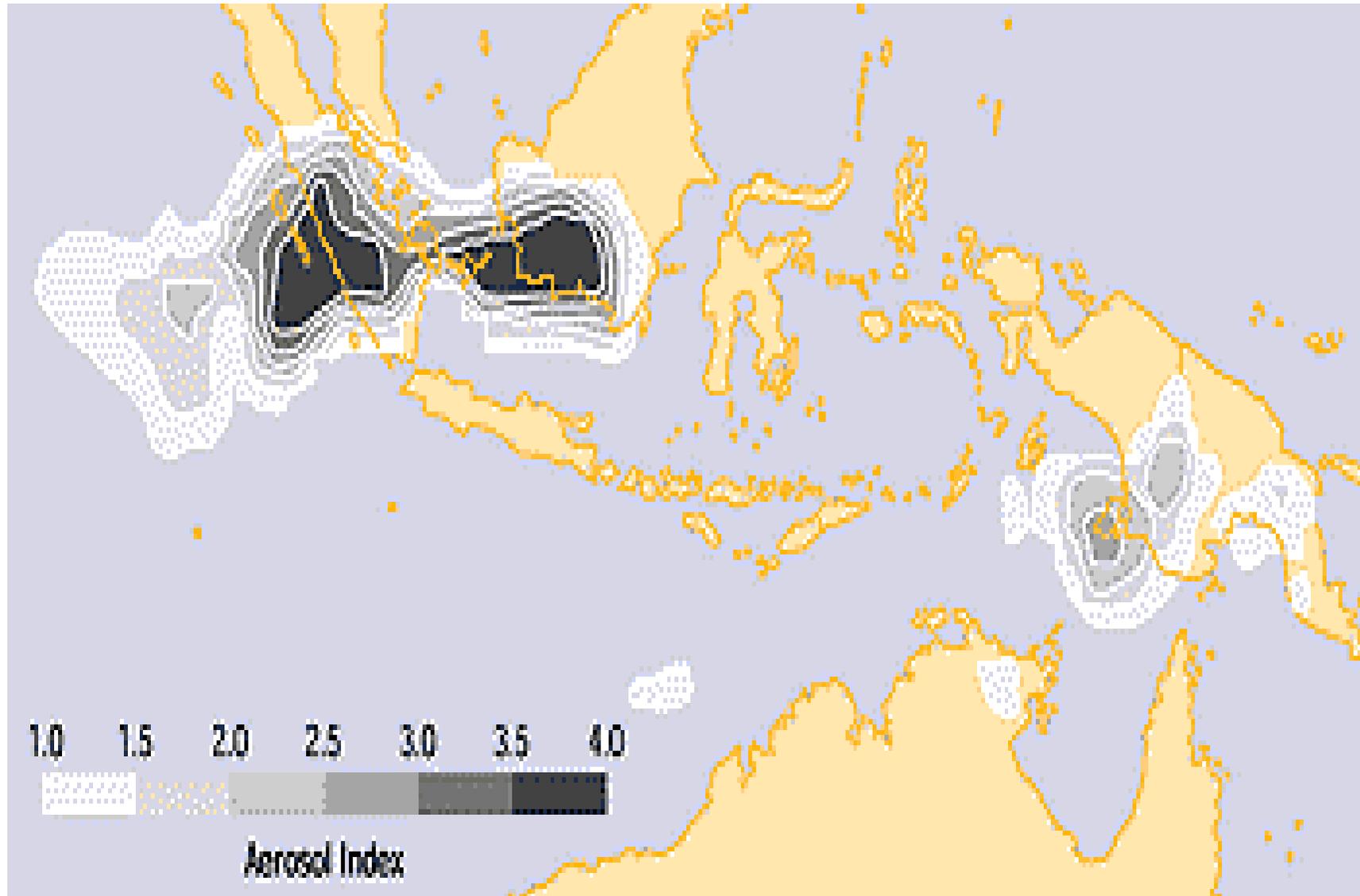


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Forest Fires in Southeastern Borneo with Their Massive Smoke Plumes Spreading Over Indonesia and Surrounding Territories



Haze Caused by the 1997 Indonesian Forest Fires



Due to Increasing Temperatures

- **Shift in spatial crop boundaries will have enormous economic and social impact e.g. Rice transplantation, Cotton picking etc.**
- ⊕ **Increase/decrease in crop yields**
- **Rise in evapotranspiration rates, calling for greater efficiency of water use**
- **Shift in timing of developmental stages of pests in Crop-weed-pest relationships**

Decreased Surface Water Supplies and droughts

- ⊕ **Reduction in yield and quality of crops due to water stress during critical growth stages**
- **Shift in cropping patterns**
- ⊕ **Nitrogen volatilization losses from ammonical fertilizers**

More dependency on ground water in the face of low precipitation

- **Danger in depletion of aquifer due to injudicious pumping**
- **increased cost of cultivation**
- **soil salinization due to poor quality ground water**

- **Who are the most affected by Climate Change?**
 - Rural communities/women in the developing countries
- **How they are affected?**
 - Climate change impacts in the form of disasters like drought, severe rainfall and floods, unusual typhoon etc.
 - Life loss, Property loss
 - Agriculture, and Livestock
 - Ad-hoc responsive measures after the disasters
 - Climate change as one of the major contributing factors
 - Contributing to poverty and development issues
 - **Drought conditions diminished food security and affected more than 600 million people across the region between 1995 and 2004**



Responding to climate change

⊕ **Mitigation**

⊕ **Adaptation**

Why mitigation and adaptation?

- **The world's climate system has such long response times that experts now agree that, to some extent, climate change can no longer be halted completely. The impacts of climate change are already being felt around the world.**
- **However, many impacts can be avoided, reduced or delayed by mitigation.**
- **Further, adaptation strategies need to be developed to cope with the impacts.**
- **A portfolio of adaptation and mitigation measures can diminish the risks associated with climate change.**

Drought and Flood Mitigation

- **Weather forecast and early warning**
 - **Right information**
 - **Flow of information**
- **Relief financing**
 - **Calamity relief fund and its disbursement**
 - **Political angle of the relief issues**
 - **Dependency syndrome of the relief issues**

What is adaptation

- ❖ **examining ways to adapt to unavoidable climate change, whether gradual changes in average conditions, rapid changes as have happened in the past, or increases in extreme weather events**
- ❖ **Adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions.**
- ❖ **Past emissions are estimated to involve some unavoidable warming even if atmospheric greenhouse gas concentrations remain at 2000 levels.**
- ❖ **There are some impacts for which adaptation is the only available and appropriate response. An indication of these impacts can be seen in the table in the next slide**

Adaptive Measures

- ❁ **Water resource adaptation options**
 - ❁ **Plan and coordinate use of river basin**
 - ❁ **Marginal changes in construction of infrastructure**
 - ❁ **Conserve water**
 - ❁ **Control pollution**
 - ❁ **Use market to allocate water**
 - ❁ **Drought contingency planning**
 - ❁ **Interbasin transfers**
 - ❁ **Options for developing new reservoir sites**

Some examples of adaptation

There is growing evidence since the IPCC Third Assessment of human activity to adapt to observed and anticipated climate change as follows:

- **For example, climate change is considered in the design of infrastructure projects such as :**
- **coastal defense in the Maldives and The Netherlands**
- **prevention of glacial lake outburst flooding in Nepal,**
- **policies and strategies such as water management in Australia**
- **government responses to heat waves in, for example, some European countries**
- **However, there are barriers, limits and costs, but currently these are not fully understood**

The array of potential adaptive responses and need

- ✦ **The array of potential adaptive responses available to human societies is very large ranging from**
- ✦ **purely technological (e.g., sea defenses), through**
- ✦ **behavioural (e.g., altered food and recreational choices), to**
- ✦ **managerial (e.g., altered farm practices) and to**
- ✦ **policy (e.g., planning regulations)**
- ✦ **While most technologies and strategies are known and developed in some countries, the assessed literature does not indicate how effective various options are at fully reducing risks, particularly at higher levels of warming and related impacts, and for vulnerable groups such as women**
- ✦ **In addition, there are formidable environmental, economic, informational, social, attitudinal and behavioural barriers to implementation of adaptation. For developing countries, availability of resources and building adaptive capacity are particularly important**



Way Forward

What basic principles should guide adaptation at local levels?

- Adaptation measures should be calibrated to local culture, socio-economic and geo-political context Adaptation measures should be participatory
- Adaptation measures should be institutionalized through local development policies
- Adaptation measures should find its niche among other development initiatives

Issues and Challenges

- **Base-line and continuous data**
- **Involvement of key stakeholders including MET department Integration and coordination among stakeholders**
- **Continuous assessment of the impacts**
- **Preparation of adaptation strategies**
- **Creation of mass awareness**
- **Demarcation of hazard prone areas**
- **Hazard preparedness planning**
- **Regional and international cooperation to check global warming**
- **Capacity building in Climate Change and Health**
- **Strengthening existing infrastructure and interventions along with capacity building**
- **Initiation of pilot projects in the field of climate change.**



Thank you
for your attention