CLIMATE CHANGE & COASTS

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Coastal Management South Asia

IPCC WORKING GROUP I – Fifth Assessment Report, 2012

Highlights from the Working Group I, Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), a UN body, released in 2012, on past trends and future projections of climate change impacts.

PAST TRENDS

- **Upper ocean warming**: It is virtually certain that the upper ocean (0–700 m) warmed from 1971 to 2010. More than 60 per cent of the net energy increase in the climate system is stored in the upper ocean (0–700 m) during the 40-year period from 1971 to 2010 and about 30 per cent is stored in the ocean below 700m. On a global scale, ocean warming is largest near the surface – the upper 75m warmed by 0.11°C per decade over the period 1971 to 2010.

- **Salinity**: It is very likely that regions of high salinity where evaporation dominates have become more saline, while regions of low salinity where precipitation dominates have become fresher since the 1950s. These regional trends in ocean salinity provide indirect evidence that evaporation and precipitation over the oceans have changed.

- **Sea level rise**: The rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia. Over the period 1901 to 2010, global mean sea level rose by 0.19m. It is very likely that the mean rate of global averaged sea level rise was 1.7 mm/yr between 1901 and 2010, 2.0 mm/yr between 1971 and 2010, and 3.2 mm/yr between 1993 and 2010.

- **Glacial loss and ocean expansion**: Since the early 1970s, glacier mass loss and ocean thermal expansion from warming together explain about 75 per cent of the observed global mean sea level rise. Over the period 1993 to 2010, global mean sea level rise is consistent with the sum of the observed contributions from ocean thermal expansion due to warming (1.1 mm/yr), from changes in glaciers (0.76 mm/yr), Greenland ice sheet (0.33 mm/yr), Antarctic ice sheet (0.27 mm/yr), and land water storage (0.38 mm/yr). The sum of these contributions is 2.8 mm/yr.

FUTURE PROJECTIONS

Precipitation

- **India**: High-resolution projections showed an overall increase of precipitation over a large area of peninsular India, but a significant reduction in orographic rainfall (resulting from the effects of mountains in forcing moist air to rise) in both seasonal mean and extreme events on west coasts of India.

- **South Asia, Cyclone**: Enhanced summer monsoon precipitation; increased rainfall extremes of landfall cyclones on the coasts of the Bay of Bengal and Arabian Sea.

- **Southeast tropical Indian Ocean**: On islands neighbouring the Southeast tropical Indian Ocean, rainfall is projected to decrease during July to November, consistent with a slower oceanic warming in the east than in the west tropical Indian Ocean. Strong regional variations are expected because of terrain.

- **Coastlines and sea level rise**: Sea level rise will not be uniform. By the end of the 21st century, it is very likely that sea level will rise in more than 95 per cent of the ocean area. About 70 per cent of the coastlines worldwide are projected to experience sea level change within 20 per cent of the global mean sea level change.

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- **Sea level extremes:** In the future it is very likely that there will be a significant increase in the occurrence of sea level extremes and similar to past observations, this increase will primarily be the result of an increase in mean sea level.

- **Regional sea level:** In some coastal locations, changes in the hydrological cycle, ground subsidence associated with anthropogenic activity, tectonic processes and coastal processes can dominate the relative sea level change, i.e., the change in sea surface height relative to the land.

- **Ocean:** It is very likely that over 95 per cent of the ocean will experience regional sea level rise, while most regions experiencing a sea level fall are located near current and former glaciers and ice sheets.

- **Wave heights:** The probability of extreme wave heights is projected to increase in the Southern Hemisphere, the Arctic and Indian Oceans, but decrease in the North and Equatorial Atlantic and in the Pacific. In addition to wind changes, the projected loss of summer sea-ice extent in the Arctic Ocean is expected to increase overall wave activity there.

- **Bay of Bengal:** Combined effect of mean sea level rise of 4 mm/yr and regional climate modeling projections for the A2 scenario (2071–2100) gave an increase in 100-year return levels of total sea level (including tides) between 0.40m and 0.67 m (about 15–20 per cent) along the northern part of the east coast of India, except around the head of the bay, compared to those in the base line (1961–1990) scenario. The A2 scenario describes a very heterogeneous world, marked by self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly; Economic development is primarily regional and per capita economic growth and technological change are more fragmented and slower than in other scenarios.

IPCC WORKING GROUP II – Fourth Assessment Report, 2007

The Second Working Group of the IPCC in its sectoral report on coasts, released in 2007, highlighted threats the sector faces.

- **In danger:** Coasts are experiencing adverse consequences of hazards related to climate and sea level. The impact of climate change on coasts will be exacerbated by increasing human-induced pressures.
- **Adaptation and action:** Adaptation for the coasts of developing countries will be more challenging than for coasts of developed countries, due to constraints on adaptive capacity. Adaptation costs for vulnerable coasts are much less than the cost of inaction.
- **What extreme sea levels mean:** Increases of extreme sea levels due to rise in mean sea level and/or changes in storm characteristics are of widespread concern. Models suggest both tropical and extra-tropical storm intensity will increase. This implies additional coastal impacts than attributable to sea-level rise alone, especially for tropical and mid-latitude coastal systems. Increases in tropical cyclone intensity over the past three decades are consistent with the observed changes in sea surface temperature (SST). Rising sea level also negatively impacts coastal agriculture.
- **South Asia:** Most of the land area of Bangladesh consists of the deltaic plains of the Ganges, Brahmaputra and Meghna rivers. Accelerated global sea-level rise and higher extreme water levels may have acute effects on human populations of Bangladesh (and parts of West Bengal, India) because of the complex relationships between observed trends in SST over the Bay of Bengal and monsoon rains, subsidence and human activity that has converted natural coastal defences (mangroves) to aquaculture.
- **Coral bleaching:** Mass coral bleaching events are clearly correlated with rises of SST of short duration above summer maxima. Particularly extensive bleaching was recorded across the Indian Ocean region associated with extreme El Niño conditions in 1998. There is limited ecological and genetic evidence for adaptation of corals to warmer conditions.
- **Cyclones:** Cyclone landfalls causing floods and destruction have negative impacts on coastal

productivity, e.g., on coconut ßin India, or on sugar cane and bananas in Queensland. Tropical cyclones have major economic, social and environmental consequences for coastal areas. Up to 119 million people are on average exposed every year to tropical cyclone hazard. Worldwide, from 1980 to 2000, a total of more than 250,000 deaths were associated with tropical cyclones, of which 60 per cent occurred in Bangladesh.

- **Development conflicts:** The unavoidability of sea-level rise, even in the longer-term, frequently conflicts with present-day human development patterns and trends.
- **Human activities:** The direct impacts of human activities on the coastal zone have been more significant over the past century than impacts that can be attributed to observed climate change. The major direct impacts include drainage of coastal wetlands, deforestation and reclamation, and discharge of sewage, fertilisers and contaminants into coastal waters. Increasing shoreline retreat and risk of flooding in coastal cities of Thailand, India, Vietnam and the United States have been attributed to degradation of coastal ecosystems by human activities, illustrating a widespread trend.
- **Urbanisation:** Rapid urbanisation has many consequences; enlargement of natural coastal inlets and dredging of waterways for navigation, port facilities and pipelines exacerbate saltwater intrusion into surface and ground waters.
- **Shrimp aquaculture:** Large-scale conversions of coastal mangrove forests to shrimp aquaculture have occurred during the past three decades along the coastlines of Vietnam, Bangladesh and India, Hong Kong, the Philippines, Mexico, Thailand and Malaysia. Such additional stressors associated with climate change could lead to further declines in mangroves forests and their biodiversity.

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