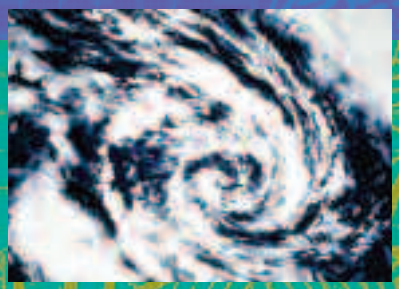
Keysheet
4

Climate Change Impacts on

Sea Level in **India**



Climate change is predicted to result in increases in mean sea level, as well as possible increases in the frequency and intensity of coastal surges and cyclones that already cause significant damage to coastal populations. These predicted changes threaten life, livelihoods and infrastructure, and policy making therefore needs to take account of both physical measures to reduce impacts (such as sea walls) as well as policy measures such as disaster preparedness efforts to reduce vulnerability.

Sea level and climate change

One quarter of the Indian population live along the country's coasts, and are largely dependent on coastal livelihoods. Climate change effects on sea level can impact coastal areas in two ways – through increase in mean sea level, and through increased frequency and intensity of coastal surges and storms. Climate change is of concern to India in view of the damages that occur along the east coast of India from the cyclones that form in the Bay of Bengal. Any increase in the frequency or intensity of tropical disturbances due to climate change in the future could cause increased damages to life and property in the coastal regions.

The National Institute of Oceanography (NIO) conducted a study on the impacts of climate change on sea level to assess the degree to which mean sea level and the occurrence of extreme events may change.

The National Institute of Oceanography

The National Institute of Oceanography (NIO) is a research organisation of the Council of Scientific and Industrial Research (CSIR), Government of India. NIO is a large oceanographic laboratory with a focus on the oceanography of the seas around India. Their core areas of study are ocean processes, coastal studies, resource surveys, conservation, and ocean engineering. www.nio.org

Description of methodology

The project had the following objectives:

- Estimate mean sea level changes along the coast of India
- Study of impact of cyclones and storm surges in the coastal regions of India and make projections on the occurrence of cyclones and storm surges in relation to climate change

Mean sea level: Sea level rise along the Indian coasts was studied by analysing monthly mean sea level data at selected stations such as Mumbai, Vishakhapatanam, Kochi and Chennai.

Storm surges: The impact of climate change on extreme sea level was assessed by analysing data from the regional climate model for the northern Indian Ocean, HadRM2, as developed in the climate change scenarios (see Keysheet 2). The parameters analysed were mean sea level pressure, near surface winds, air temperature and precipitation. The model simulated results were analysed for the period 2041-2060 for a control scenario and a scenario in which greenhouse gas (GHG) levels are doubled by 2070 (IS92a scenario). A two-dimensional barotropic model for the simulation of storm surges was developed for the Bay of Bengal. The model was forced using winds from the HadRM2 model and the storm surge events were analysed for the future climate scenario (2041-2060).

Predicted climate change impacts on sea level

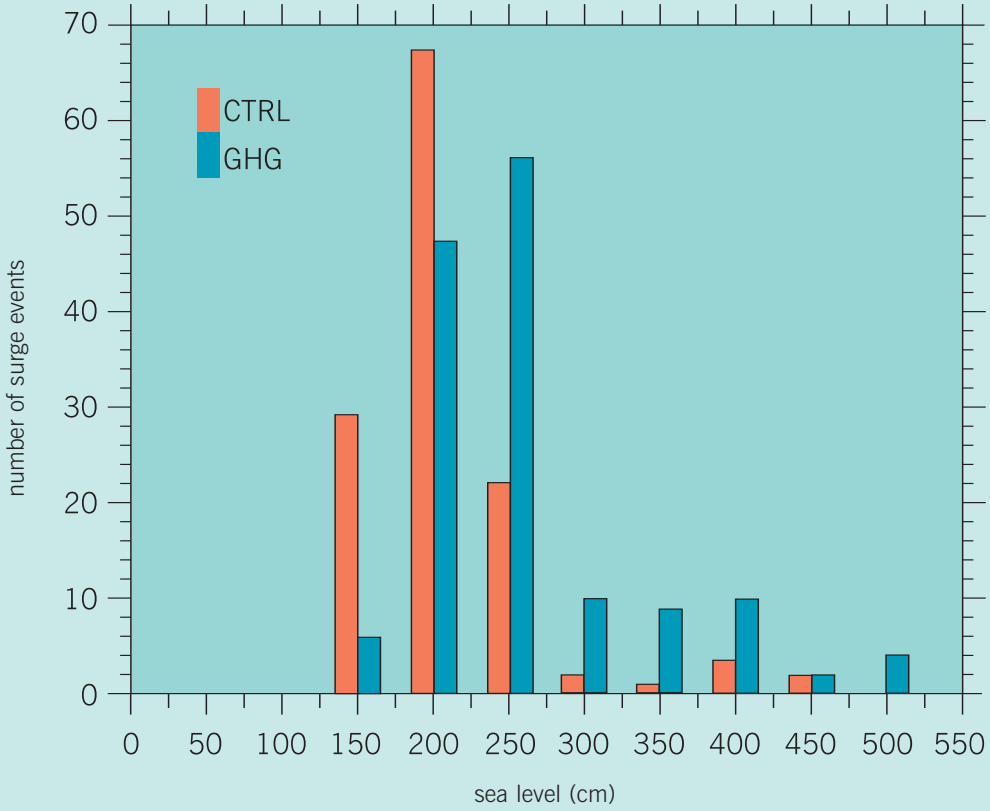
As a result of the study, the following changes due to climate change were predicted for sea level:

Mean sea level: Mean sea level rise estimates (using past tide gauge data) were found to be slightly less than 1 mm/yr for most of the stations analysed along the Indian coast. However, data on vertical land movements was not available, and will need to be incorporated in order to obtain net sea level rise estimates.

Storm surges: The study showed a greater number of high surges under climate change. This is shown in Figure 4.1, contrasting this distribution of maximum surges associated with each cyclone for control and doubled greenhouse gas conditions. In addition, the model showed an increased occurrence of cyclones in the Bay of Bengal, particularly in the post-monsoon period, along with increased maximum wind speeds associated with cyclones.

Figure 4.1

Frequency Distribution of Maximum Surges



What are the policy implications of these predictions?

Sea level rise carries many implications for socio-economic conditions, such as the vulnerability of populations to cyclones and storm surges, loss of assets (for example, infrastructure for water, power), and loss of livelihoods (particularly in the case of coastal based work, such as fishing).

Policy makers may need to consider the following in relation to sea level changes:

- Protection measures will need to be assessed for their long term viability: while sea walls can offset sea level rise in the short term, they can increase damage during extreme events. Hence a range of conservation and technical solutions may be required.
- Technical considerations to protect infrastructure/ industry will need to be investigated and encouraged.
- Disaster preparedness efforts at the national and state level will need to be implemented, along with increased use of disaster risk assessment for infrastructure plans.

Needs for further research

Needs for further research include:

- Revised modelling using the HadRM3 model (cyclones and storm surges in the Bay of Bengal);
- Incorporation of measurements on vertical land movements in estimates of mean sea level rise; and
- Assessment of impacts of climate change on different socio economic groups.

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