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Changing Freshwater Regimes and Sea Level Rise in Bengal Delta: Implications for World's Largest Mangrove Forest, The Sundarbans

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The Sundarbans, the largest single block of tidal halophytic mangrove forest in the world, is located on the mouth of the Ganges basin region in Bengal Delta, covering parts of India and Bangladesh. This UNESCO World Heritage Site is under severe threat due to significant changes in the coastal sea level in Bay of Bengal and freshwater availability in the Ganges-Brahmaputra-Meghna basin region of South Asia. Water is intricately linked with the natural and societal ecosystems of this region; home to over 500 million of the world's less developed. The strong seasonal and inter-annual variability of the large eastern Himalayan Rivers pose a great challenge for efficient and sustainable water resources availability and management in the basin. Although disasters such as monsoon floods constitute a major threat to the region, the region also faces severe freshwater shortages during the prolonged dry season. Decreasing dry season flow volumes have led to saltwater intrusion in the estuarine channels. In addition, sea level rise in the Bay of Bengal have accelerated the movement of salinity across a large region of coastal Bangladesh and Eastern India, affecting coastal ecosystems, agricultural output, and public health problems over large areas.

With rising population, increasing pressure of urbanization, and changing climate patterns, these calamities are expected to become more severe. There is a growing consensus that frequency and intensity of droughts and floods are likely to increase over many areas during the 21st century. The Intergovernmental Panel on Climate Change projects prolonged drought events in the Ganges basin region in Central India while monsoon runoff in the Brahmaputra basin is expected to increase in Northeastern Indian catchments. Climate induced changes in precipitation and streamflow patterns of the Brahmaputra and the Ganges basin are also slated to impact seasonal availability of freshwater runoff for agriculture, public health, and ecosystem needs. We focus on understanding the changes in the large-scale ocean-atmospheric processes affecting the precipitation and streamflow patterns of the region. We analyze precipitation and temperature changes for the Brahmaputra and the Ganges basin regions for coming decades at monthly, seasonal, and annual scales. While we see no trend in total annual streamflow or precipitation, seasonal flow values for both basins show a pattern of increased extreme events. Extreme climatic events such as prolonged droughts and record floods may cause major disruption in the ecosystem biodiversity and subsequently trigger large epidemics. A quantitative understanding of the environmental changes taking place, and the hydroclimatic controls and dominant processes with significant system memory will form the basis for forecasting such natural disasters. In addition, a region wide effort to interpret and disseminate research findings to various stakeholders across the riparian countries of the GBM river system is needed.