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Hydroclimatic Projection of Coastal Inundation for the 21st Century during Tropical Cyclone AILA in the Bay of Bengal

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The on-shore coastal inundation during a tropical cyclone event can have detrimental effect on the coastal regions. The low-lying head Bay region with Sunderbans of the Bay of Bengal is highly vulnerable to the impact of the tropical cyclones and Sea Level Rise (SLR). Coastal flooding caused by tropical cyclones will increase as a result of increasing SLR under the influence of climate change. Hence, the concurrent effects of tropical cyclone and the SLR are important to consider for the assessment of the future coastal flooding caused during a tropical cyclone event. This is the first time the coupling of projected SLR and forcing from a possible tropical cyclone is done in order the project the future possible coastal inundation till the end of the year 2100 for different climate change scenarios called as Representative Concentration Pathways (RCPs) along the head Bay region of Bay of Bengal. The water level elevation and associated on-shore inundation along the head Bay region (coastlines of West Bengal and Bangladesh) are projected for the years 2025, 2050, 2075 and 2100 following the RCP scenarios. Three different RCPs (RCP 2.6, RCP 4.5 and RCP 8.5) are considered for projection of coastal inundation. The projected SLR used for projecting flooding is corrected for different non-climatic drivers of sea level like Glacial Isostatic Adjustment (GIA) and Vertical Land Motion (VLM). The forcing of the tropical cyclone AILA that caused havoc along the coastline of West Bengal and Bangladesh is considered for futuristic projection of coastal flooding. The cyclone AILA made its land-fall during May, 2009 along the coastline of West Bengal. This work utilizes the state-of-art Advanced Circulation (ADCIRC) hydrodynamic model to project the coastal flooding. In this study, the fact that SLR will be the dominant driver of coastal flooding during a future possible tropical cyclone event irrespective of variation in the tropical cyclone is established and the increased extent of future flooding due to enhanced sea level during future possible impact of cyclonic storm AILA on the head Bay region is demonstrated. The projected peak storm tide obtained in this study by the year 2100 was about 5.4 m (RCP 8.5 scenario), 5.1 m (RCP 4.5 scenario) and 4.9 m (RCP 2.6 scenario). The futuristic projected flooding inundated the Sunderbans and all major river banks in the head Bay region. The maximum future coastal flooding was projected in the district of South 24 Parganas of West Bengal. The future flooding by the year 2100 extended to a maximum of about 50 km (RCP 8.5 scenario), 45 km (RCP 4.5 scenario) and 42 km (RCP 2.6 scenario) from the coastline of the head Bay region.

Keywords: Sea Level Rise (SLR), Tropical Cyclone, AILA, Coastal flooding, Climate Change, Advanced Circulation Model (ADCIRC), Representative Concentration Pathway (RCP), Glacial Isostatic Adjustment (GIA), Vertical Land Motion (VLM)