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Real-time storm surge and inundation forecast for very severe cyclonic storm 'Hudhud'

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ABSTRACT

The high population density along the coastal stretch of India necessitates a real-time storm surge warning system. Keeping this in view, the Earth System Science Organization (ESSO) - Indian National Centre for Ocean Information Services (INCOIS) initiated the Storm Surge Early Warning System (SSEWS) for Indian coasts using the ADCIRC (Advanced Circulation) model. ADCIRC is a finite-element based, depth-integrated shallow water model that can be used to model storm surges and for other coastal applications. This warning system utilizes the automated Decision Support System (DSS) based on Geographic Information System (GIS) and database technology. Wind and pressure fields are generated using the Jelesnianski and Taylor dynamic wind model which make use of track forecasts from IMD. While DSS was initially tested for the very severe cyclonic storm 'Phailin' (October, 2013) in experimental mode, it was used for the first time to provide real-time storm surge and inundation forecasts during cyclone 'Hudhud' (October, 2014). In this paper, we highlight the performance of SSEWS during this event while comparing with observations. Forecasts from SSEWS were found to be quite promising and proving its capability.

1. Introduction

Coastal flooding or inundation due to storm surges is one of the potential hazardous elements that can have significant impact on any coastal zone. Consequences of coastal flooding include loss of life and property as well as destruction of coastal infrastructure. Over the past two centuries, around two million people worldwide have died and millions have been injured as a result of tropical storms (cyclones, hurricanes and typhoons) (Ubydul et al., 2012). Around 300,000 lives were lost in severe cyclones that hit Bangladesh in November 1970 while around 10,000 lives were lost due to the Andhra cyclone in November 1977. The Chittagong cyclone of April 1991 claimed around 140,000 lives in Bangladesh and more than 15,000 people lost their lives during the Odisha Supercyclone in October 1999 besides enormous damage to property in the region (Dube et al., 2009). About one million houses and 1.35 million hectares of crops were damaged. India's coastline stretches about 7500 km and supports almost 30% of the Indian population. The East coast of India experiences land falling tropical cyclones almost every year. These cyclones result in enormous destruction of life and coastal property largely due to storm surge-flooding and its associated inland inundation which accounts for most of the deaths associated with tropical cyclones worldwide. The enablement of preparedness measures to cope with storm surges is a key factor in minimizing their impact on society.

The high population density along the coastal stretch necessitates a dedicated operational storm surge warning system to foresee and assess risk due to approaching storms and for the issuance of guidance to the coastal community. Recent study by Bhaskaran et al. (2014) highlighted the importance of coastal warning system for storm surge and the associated coastal flooding. Srinivasa Kumar et al. (2015) also highlight the importance of surge warning system to the Indian coasts. Considering the same, the Earth System Science Organization (ESSO) - Indian National Centre for Ocean Information Services (INCOIS) undertook the responsibility of setting up the Storm Surge Early Warning System (SSEWS). ESSO-INCOIS is mandate to issue of tsunami and storm surge warnings to disaster management offices and coastal authorities. SSEWS uses the ADCIRC model (Luettich et al., 1992) for modeling and forecasting surge and inundation extents. An automated Decision Support System (DSS) was developed and made operational to assess the impact of surge and inundation due to cyclones and issue the necessary advisories to the stakeholders dealing with disasters. Initially the warning system was used to provide

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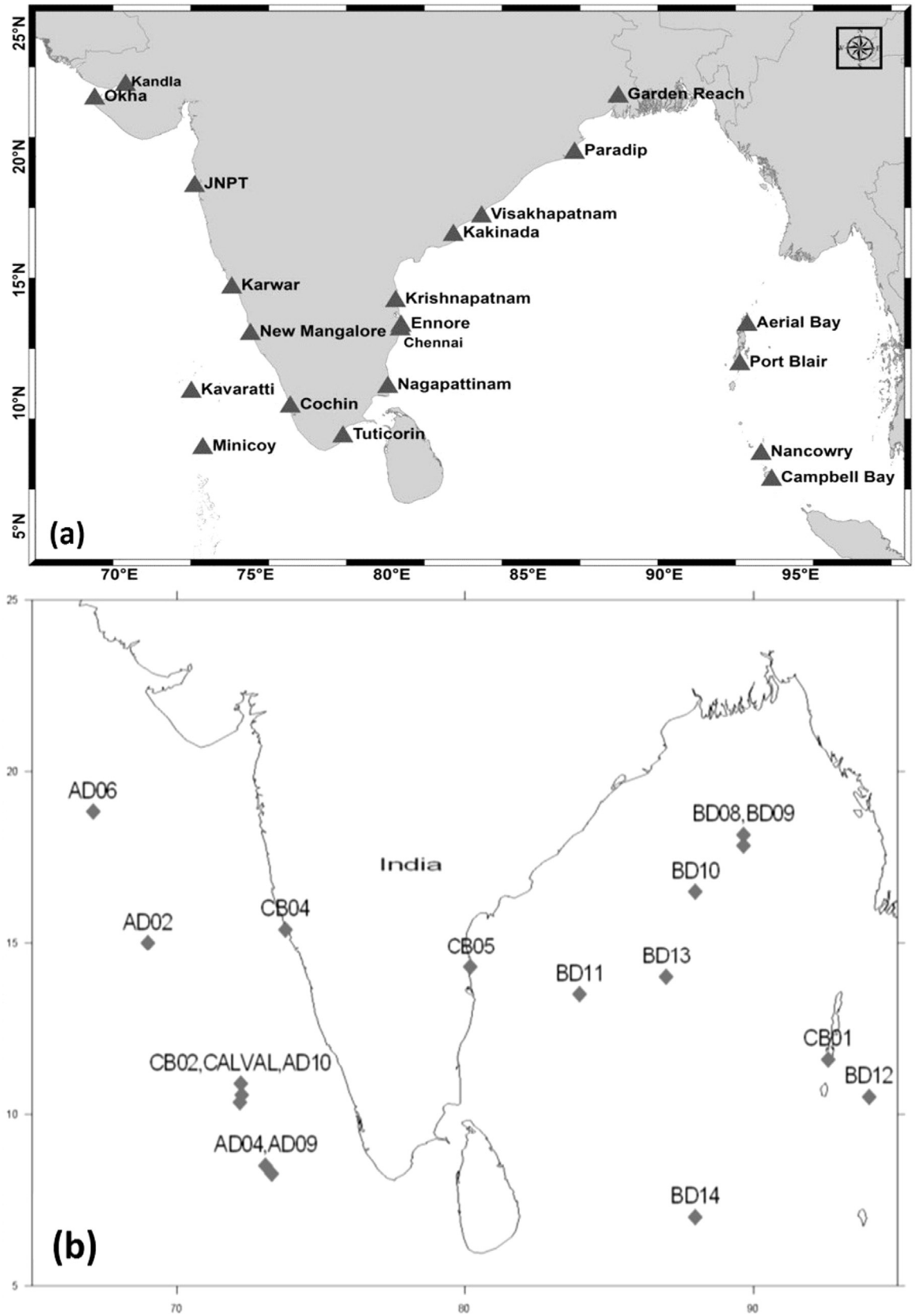

Fig. 1. (a)Real time tide gauge network (b) Moored buoy network.