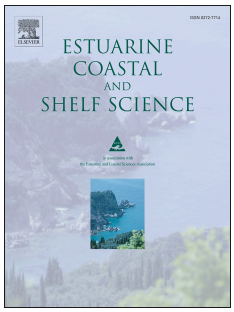
Accepted Manuscript



Tidal propagation and its non-linear characteristics in the Head Bay of Bengal

Linta Rose, Prasad K. Bhaskaran

PII: S0272-7714(16)30431-0

DOI: 10.1016/j.ecss.2017.02.024

Reference: YECSS 5401

To appear in: *Estuarine, Coastal and Shelf Science*

Received Date: 3 October 2016

Revised Date: 13 January 2017

Accepted Date: 21 February 2017

Please cite this article as: Rose, L., Bhaskaran, P.K., Tidal propagation and its non-linear characteristics in the Head Bay of Bengal, *Estuarine, Coastal and Shelf Science* (2017), doi: 10.1016/j.ecss.2017.02.024.

Tidal Propagation and its Non-linear characteristics in the Head Bay of Bengal

Linta Rose and Prasad K. Bhaskaran*

Department of Ocean Engineering and Naval Architecture
Indian Institute of Technology Kharagpur
Kharagpur-721 302, India

*Email: prasadlsu@yahoo.com, pkbhaskaran@naval.iitkgp.ernet.in
Tel: +91-3222-283772, Fax: +91-3222-255303

ABSTRACT

The Head Bay of Bengal is highly vulnerable to flooding events caused due to monsoons, cyclones and sea-level rise, owing to its funnel-like shape, high tidal range, presence of numerous river drainage systems, low-lying topography, and shallow bathymetry. Tides dominate the hydrodynamic behaviour and coastal processes in this region and its propagation is quite distinct. The present study uses ADCIRC hydrodynamic model customized for the Head Bay of Bengal, discretized using unstructured finite elements and validated against limited available observations in this data sparse region. The water-level elevations derived from ADCIRC simulation was used to understand the pattern of non-linear tidal propagation with respect to complex coastal geomorphology prevalent in this region. The study finds a marginal amplification of diurnal tide, nearly double amplification of semi-diurnal components, and existence of a degenerate amphidromic point near Meghna delta consistent with previous studies. The spatial and temporal variability of tidal spectral components were examined by applying the techniques of wavelet, harmonic, and time-series analysis at various locations. Maximum amplification of tides occurs at the head of the bay, along a zone enclosing the mouth of tidal inlets; and for regions northward, the tides decay with progressively increasing phase lags. The study signifies dominance of a forced fortnightly tide and tidal asymmetry leading to flood-dominance in the rivers Hooghly, Meghna, and Tetulia. The non-linear properties of tides have been elucidated, and their origin and spatio-temporal variability in these riverine systems were further investigated. Shallow depth and sharp depth gradients were discerned to be the important conditions for the origin of non-linear components. It has been deduced that non-linear tides are generated in regions where propagating tides are accumulated, and amplified in regions where they are funneled. A study of tidal energetics show that maximum rate of tidal energy dissipation is deep inside the rivers at head of the bay. The spatial variability analysis of tidal form factor shows an overall semi-diurnal dominance in the Head Bay.

Keywords: Tidal Propagation, Non-linearity, ADCIRC Model, Spectral Components, Riverine Systems, Head Bay of Bengal