



Contents lists available at ScienceDirect

Quaternary International

journal homepage: [www.elsevier.com/locate/quaint](http://www.elsevier.com/locate/quaint)

# Fluvial response to Late Quaternary sea level changes along the Mahanadi delta, east coast of India

Chinmay Dash<sup>a,\*</sup>, Manoj K. Jaiswal<sup>b</sup>, Pitambar Pati<sup>a</sup>, Narendra Kumar Patel<sup>a</sup>,  
Atul Kumar Singh<sup>c</sup>, Rayees Ahmad Shah<sup>d</sup>

<sup>a</sup> Indian Institute of Technology, Roorkee, 247667, India

<sup>b</sup> Indian Institute of Science Education and Research, Kolkata, 741246, India

<sup>c</sup> Inter University Accelerator Center, New Delhi, 110067, India

<sup>d</sup> Physical Research Laboratory, Ahmedabad, 380009, India

## ARTICLE INFO

### Keywords:

Late Quaternary  
Mahanadi delta  
Sea level change  
Anastomosing channels  
Dendritic channels  
River mouth shift

## ABSTRACT

This study presents the fluvial response to late Quaternary sea level changes in the Mahanadi delta. Channel morphological adjustments indicative of sea level changes, such as anastomosing-meandering transition, dendritic channels, and river mouth shift, have been used to reconstruct the paleo-coastlines. Major rivers in the Mahanadi delta (e.g., Mahanadi, Devi, Brahmani, and Baitarani) show alteration of anastomosing and meandering fluvial systems at the late Quaternary strandlines. Two generations of dendritic channels, i.e., Early to Mid- (>5 ka) and Mid-to Late (<5 ka) Holocene, have been identified based on OSL ages and affinity to the paleostrandlines. Lateral shift of river mouths in response to sea level changes have been observed in the lower deltaic plain. The delta distributaries such as Bhargavi, Kushabhadra, Brahmani and Baitarani rivers shifted their mouths due to Early to Mid-Holocene (6–7 ka) marine transgression. Different generations of paleochannels in the Mahanadi delta indicate episodes of the delta progradation since Mio-Pliocene. The distributary paleochannels along the Mio-Pliocene strandline indicate the initial stage of Mahanadi delta development. The river morphological response to the changing coastline of the Mahanadi delta is similar to paleo-fluvial morphological adjustments observed along the paleostrandlines of major deltas around the world.

## 1. Introduction

The concept of the base level has been critically important to understand the fluvio-geomorphic response to external forcings. The base level is the lowest limit to which a river can flow and erode its bed, the ultimate base level being the sea level (Powell, 1875; Schumm, 1993). The sea level has fluctuated many times in the earth's history (Banerjee, 1993, 2000; Murray-Wallace and Woodroffe, 2014). The Quaternary has witnessed sea level changes up to 100 m, resulting from fluctuation of ice volumes during the glacial and interglacial cycles (Schumann et al., 2016; Martinson et al., 1987; Hope, 2005; Murray-Wallace and Woodroffe, 2014). Tectonically driven upliftment and subsidence are the other major contributing factors to sea level change. Fluvial channels respond to sea level change by adjusting their length, gradient, width, sinuosity, and pattern, to adjust their flow velocity and sediment discharge. Previous studies concerning fluvial response to sea level

change have focused on paleochannel morphology/pattern, such as anastomosing-meandering transition (Smith et al., 1989; Tornqvist, 1993; Makaske, 2001), river mouth shift (Dominguez et al., 1987; Schumm, 1993; Kapsimalis et al., 2005; Hijma and Cohen, 2011; Wang et al., 2018; Xue, 1993; Ren and Shunan, 1990), and paleo-dendritic channels (Gammisch et al., 1988; Schumm, 1993; Eisma, 1998; Kong et al., 2011), to reconstruct paleo-coastline positions. Anastomosing channels are formed due to aggradations during transgression and are readjusted to straight/meandering channels at a lower slope during regression (David Knighton and Nanson, 1993; Tornqvist, 1993; Berendsen and Berendsen, 1995; Makaske, 2001). Channel avulsion associated with sea level rise shifts the river mouth (Schumm, 1993; Hori et al., 2002; Tanabe et al., 2006; Hori and Saito, 2007; Tamura et al., 2009; Tjallingii et al., 2010, 2014; Hijma and Cohen, 2011; Stouthamer et al., 2011; Zong et al., 2012; Song et al., 2013). Flow accumulation generates dendritic drainage networks in low-lying areas

\* Corresponding author.

E-mail addresses: [chinmay.ism@gmail.com](mailto:chinmay.ism@gmail.com) (C. Dash), [manoj@iiserkol.ac.in](mailto:manoj@iiserkol.ac.in) (M.K. Jaiswal), [impitambarpati@gmail.com](mailto:impitambarpati@gmail.com) (P. Pati), [narendrap9@gmail.com](mailto:narendrap9@gmail.com) (N.K. Patel), [aksingh21sep@gmail.com](mailto:aksingh21sep@gmail.com) (A.K. Singh), [shahrayees04@gmail.com](mailto:shahrayees04@gmail.com) (R.A. Shah).

<https://doi.org/10.1016/j.quaint.2020.07.033>

Received 22 March 2020; Received in revised form 7 July 2020; Accepted 22 July 2020

Available online 3 August 2020

1040-6182/© 2020 Elsevier Ltd and INQUA. All rights reserved.