Introduction and Motivation

Coastal river deltas are susceptible to drowning via a combination of subsidence and sea-level rise (Syvitski et al., 2009; Higgins et al., 2014). Many river deltas are built by cycles of lobe growth punctuated by abrupt channel shifts, or avulsions, which often recur at a similar location and with a regular frequency (Fig 1) (Slingerland and Smith, 2004). However, river avulsions also pose natural hazards to populations living on river deltas (Fig 2).

Avulsion Frequency Theory

\[ T_A = \frac{h_{fill}}{V_A} \]

Mohrig et al. (2000); Jerolmack (2009)

How is the avulsion frequency influenced by an increase in sea-level rise?

Does sea-level rise influence the amount or the rate of in-channel sedimentation needed to initiate an avulsion?

Experimental Setup and Methods

Phase 1 - Constant Sea Level

Without sea level rise, lobe progradation produced in-channel aggradation and periodic avulsions every 3.6 +/- 0.9 hours (Fig 6a, 6b, 8a), which corresponded to when channels aggraded to approximately one-half of their flow depth (Fig 6c, 6d, 8b).

Phase 1 - Constant Sea Level

With sea level rise (0.25 mm/hr), we observed enhanced aggradation (Fig 6d, 6e), causing channels to grade more quickly and avulse more frequently (every 2.1 +/- 0.6 hours) (Fig 8).

Time between avulsions \([\text{hr}]\)

PHASE 1 PHASE 2

\[ \sigma = 0 \text{ mm/hr} \] \[ \sigma = 0.25 \text{ mm/hr} \]

N = 6 N = 10

Comparison

Avulsions are more frequent during a constant sea level rise of 0.25 mm/hr (Fig 8a).

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References


Syvitski, J. P. M., et al. (2009), Linking deltas to human activities, Nat. Geosci., 2, 661-666