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The role of receiving basin substrate cohesivity in delta morphodynamics

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Deltas form an important part of coastal environments and are occupied by hundreds of millions of people worldwide. Due to their low elevation, many deltas are under threat from sea level rise as well as human influences on flow, sediment flux and subsidence across the delta plain. River sediment grain size and cohesivity are known to be an important factors in determining the erosion and deposition regimes within a delta system, but the influence of the receiving basin substrate characteristics is poorly constrained. It has previously been shown that basin substrates composed of finer sediment can lead to more incisive channels and lower subaerial delta volume. However, the exact controls of substrate sedimentology and characteristics on delta morphodynamics has not been quantified.

This paper presents an investigation of the receiving basin sediment grain size and cohesivity on the morphodynamics of deltas, especially the ability of distributary channels to migrate or avulse after incising into the basement material during progradation. A suite of numerical experiments were conducted where a generic delta was modelled in the Delft3D modelling suite. Incoming flow discharges were varied between 102 and 105 m3s-1 and basin floor cohesive sediment fractions were systemically varied from 0 to 100%. Results suggest that increasing cohesive sediment fraction of the receiving basin substrate bed leads to higher sinuosity channels and fewer distributaries. Data on channel migration speed and avulsion frequency were extracted from each model run to explore how higher cohesive sediment fraction in the substrate leads to a reduction in lateral movement in incised channels and ultimately how this will affect the morphodynamic evolution of the delta.