Deltas: Combining History & Space Age Science

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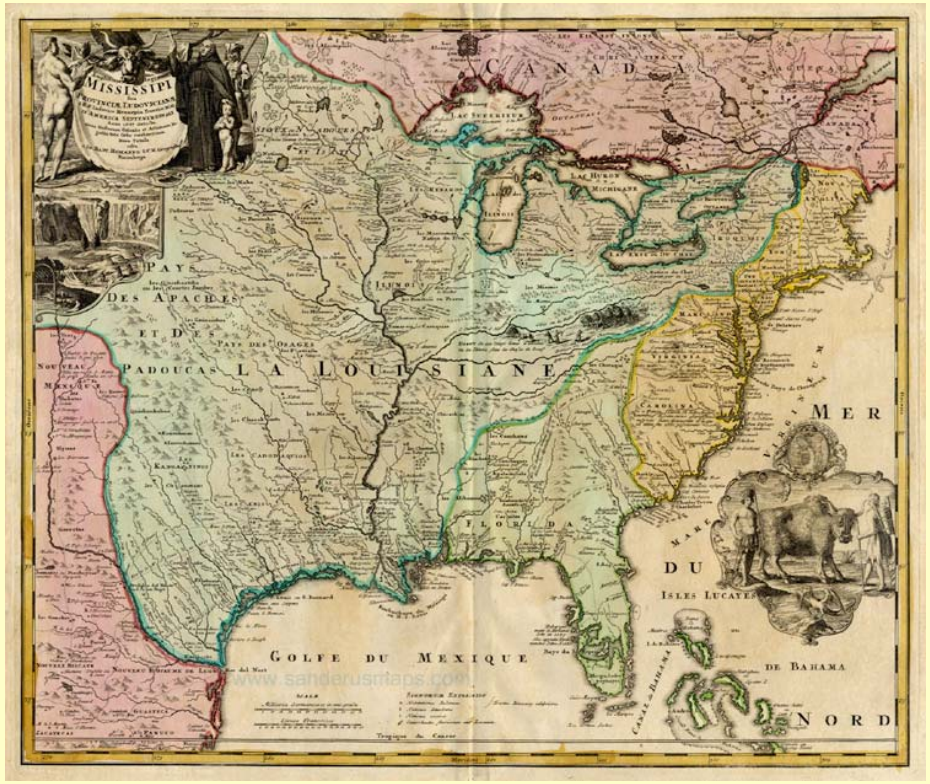


Mississippi 1753

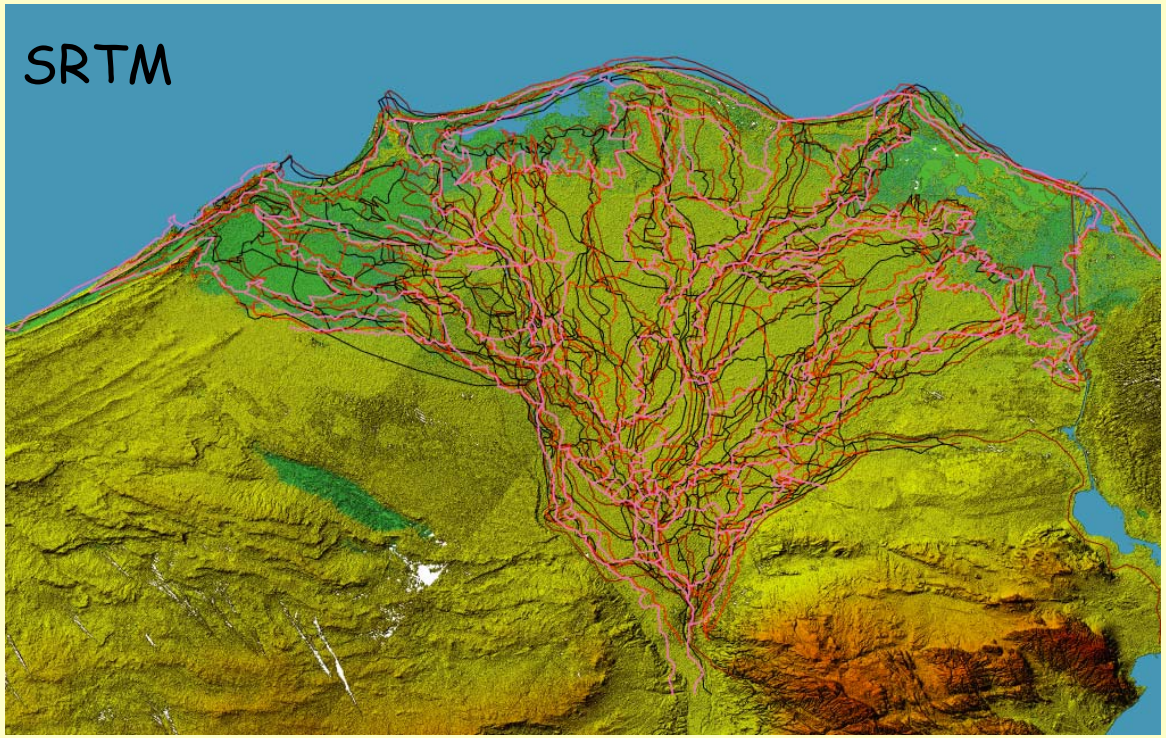
Dynamics and Vulnerability of River Delta Systems, Boulder CO, 2007

Premise:

The level of human influence on the environmental dynamics and architecture of deltas cannot be fully understood unless a historical perspective is established, when the human footprint was much smaller.

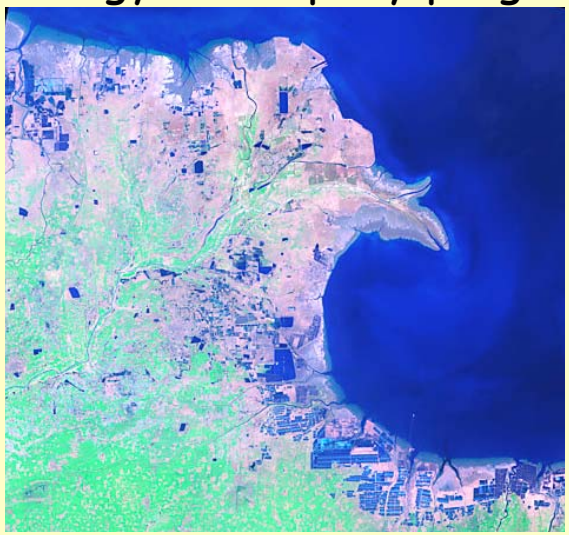
Method:

Evaluate many historical maps for each of the world's major deltas, noting the position of distributary channels, and coastline. Determine the registration error of the channels. Compare the geolocated shape files with high resolution SRTM and LANDSAT ETM+ data.



1) Pink: Pinkerton, 1813, registration error =±3 km;
2) red: Lizars, 1831, re=± 2.6 km;
3) brown: Rand McNally, 1897, re=± 1.5 km;
4) black: Bartholomew, 1922, re=± 1.6 km.

Findings: 1) Some modern deltas are a manifestation of levee control and enlarged sediment fluxes since the middle ages, that overwhelmed the marine energy and rapidly prograded the deltas.



Yellow: a post 1855 delta; LANDSAT image from 2006

Yellow in 1791

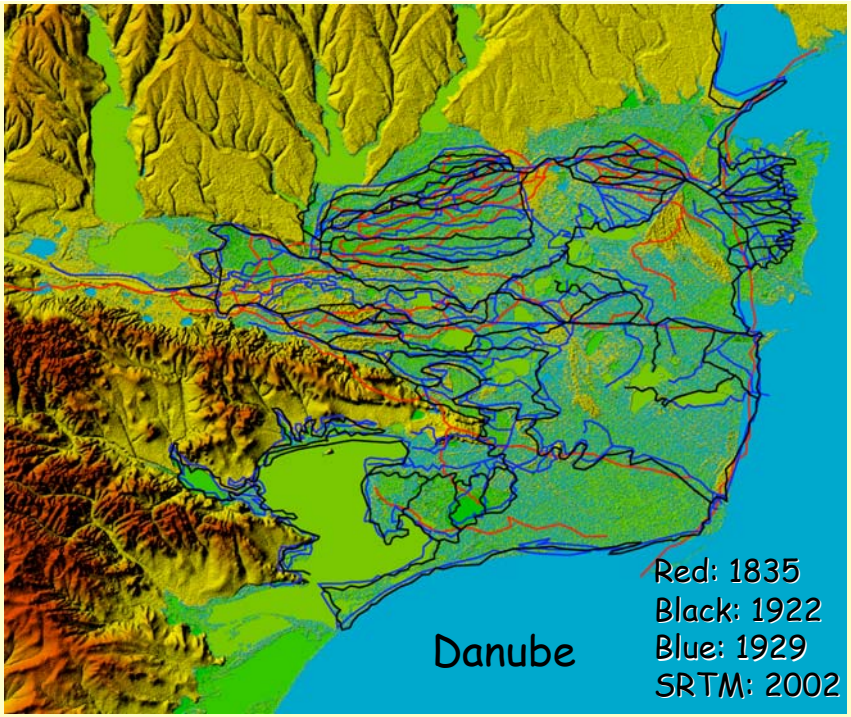
Po: a post 16th century delta

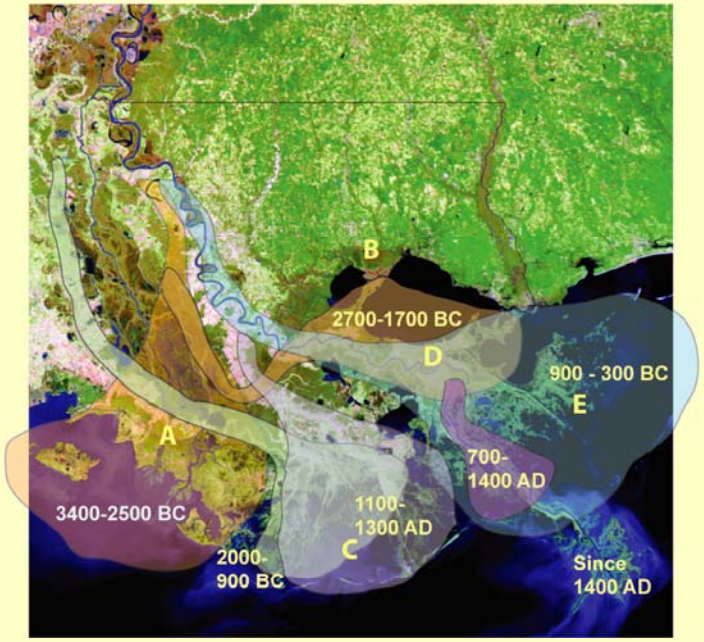
1743

Po in 1645

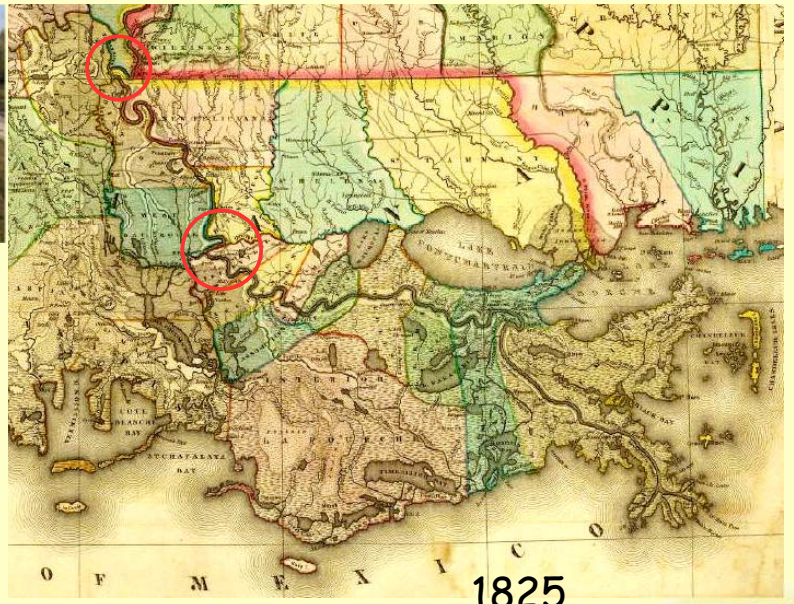
CSDMS
Community Surface Dynamics Modeling System

Other Finding (1) examples: Danube Mississippi, Ebro





Mississippi birdfoot is post 1500's



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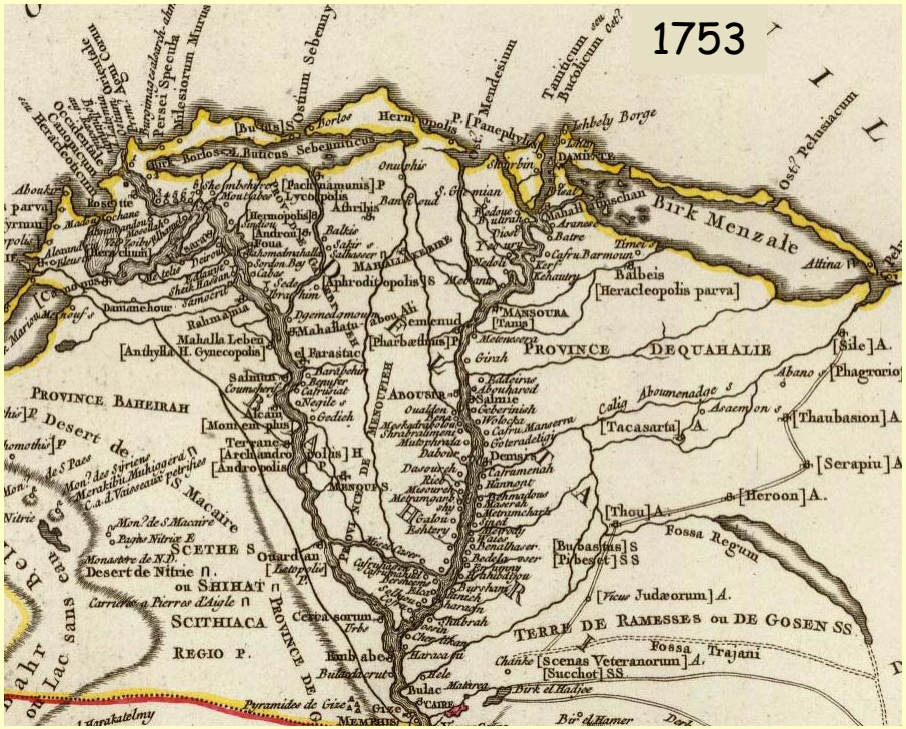
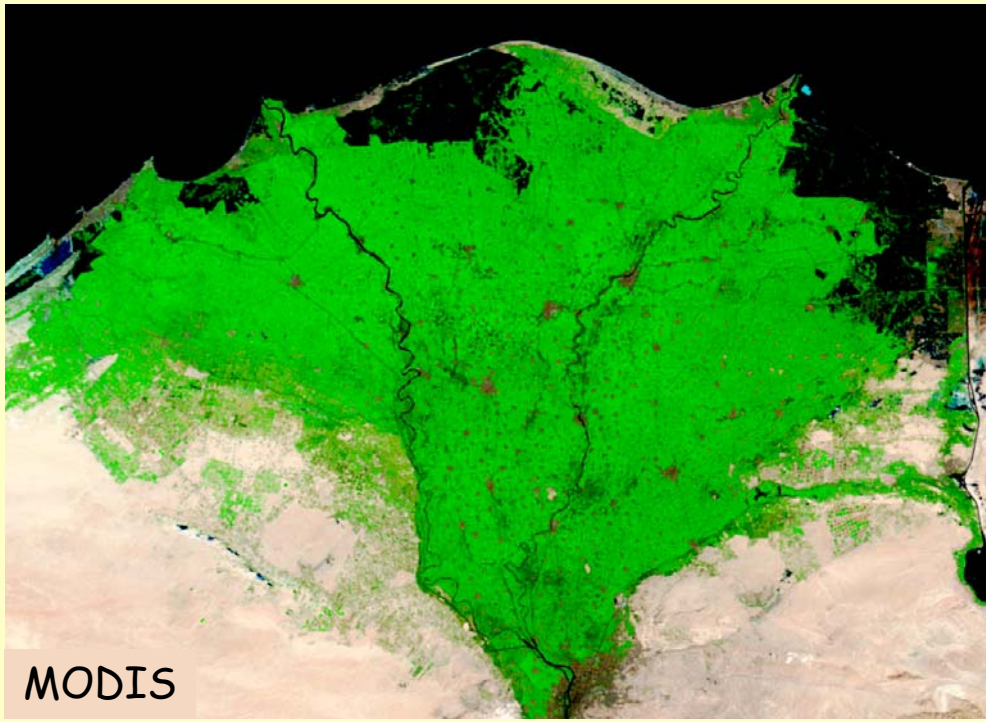
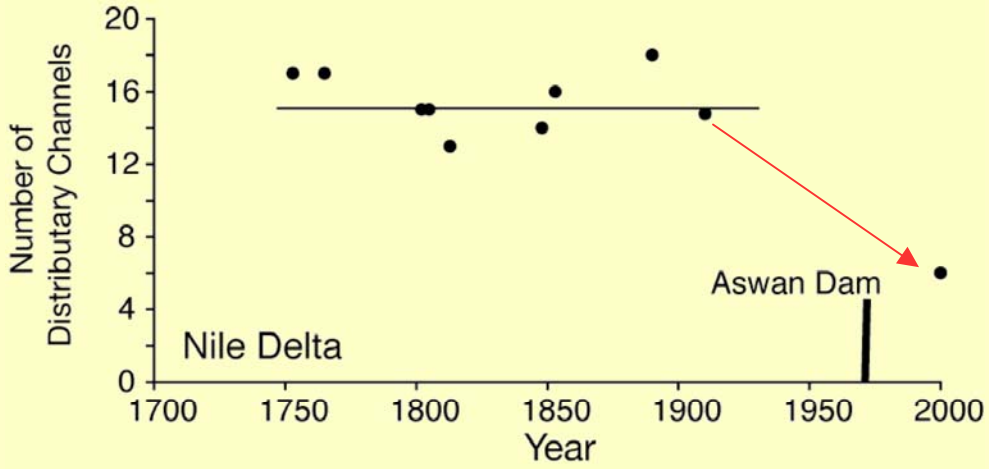
Findings: 2) Most populated deltas have less distributary channels that reach the coastal ocean.







Distributary channel reduction to support low flow navigation: Nile Delta went from 15 to 4 distributary channels (plus an array of artificial canals)

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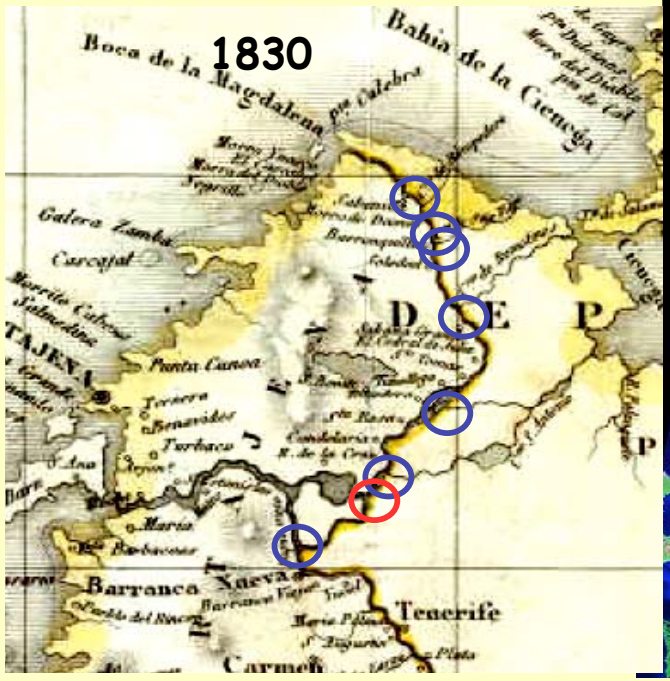
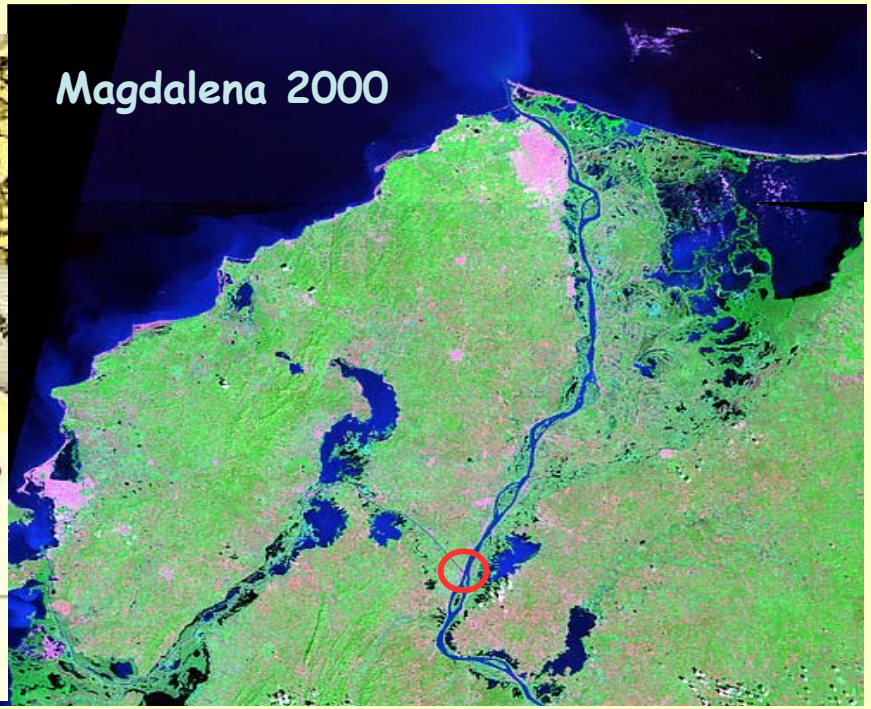
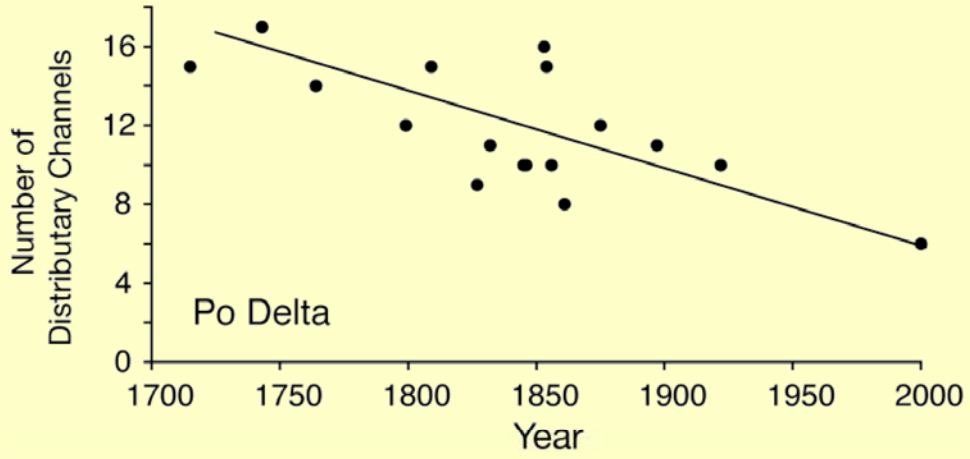




Other Finding (2) examples: Magdalena Po

Levee manipulation to support navigation: From 8 to 2 distributary channels



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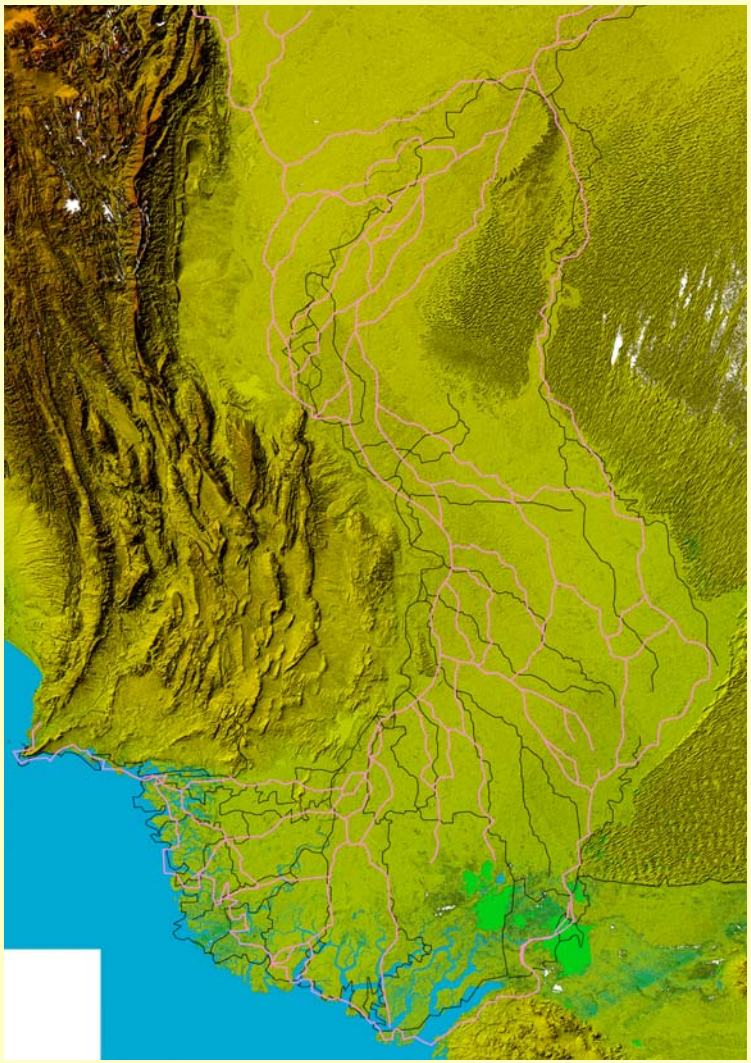
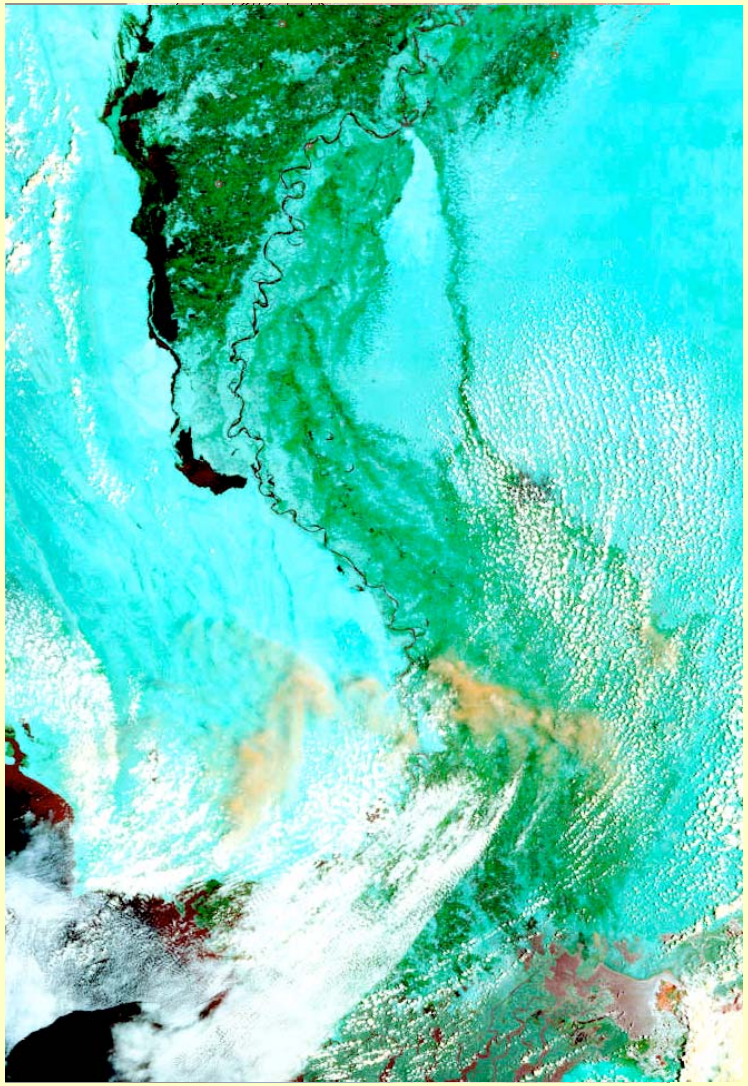
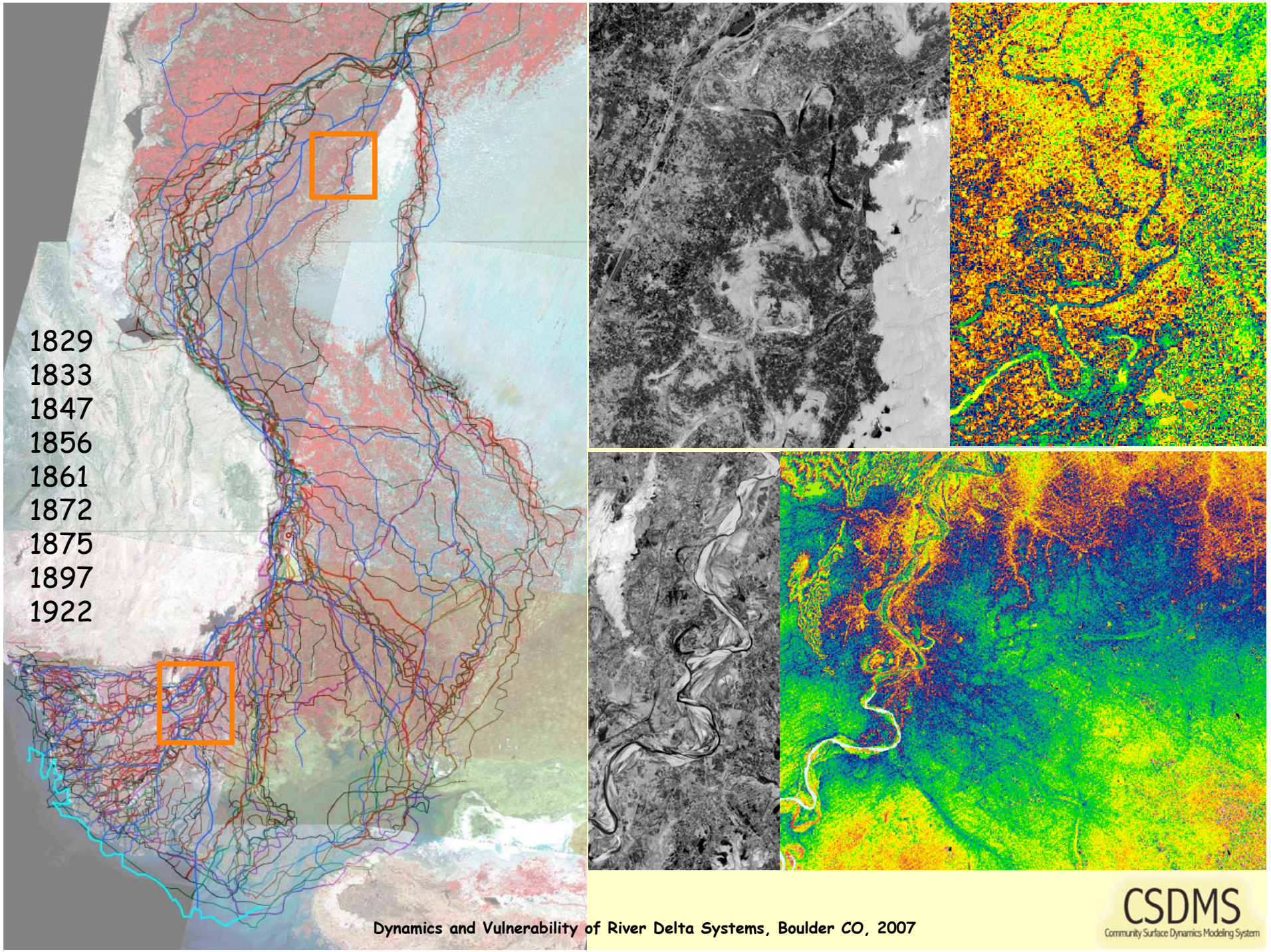
Another Finding (2) example: Indus from 9 to 1 channel





Pink: Lapie, 1829
Black: Bartholomew, 1922
Image: SRTM 2002



Dynamics and Vulnerability of River Delta Systems, Boulder CO, 2007

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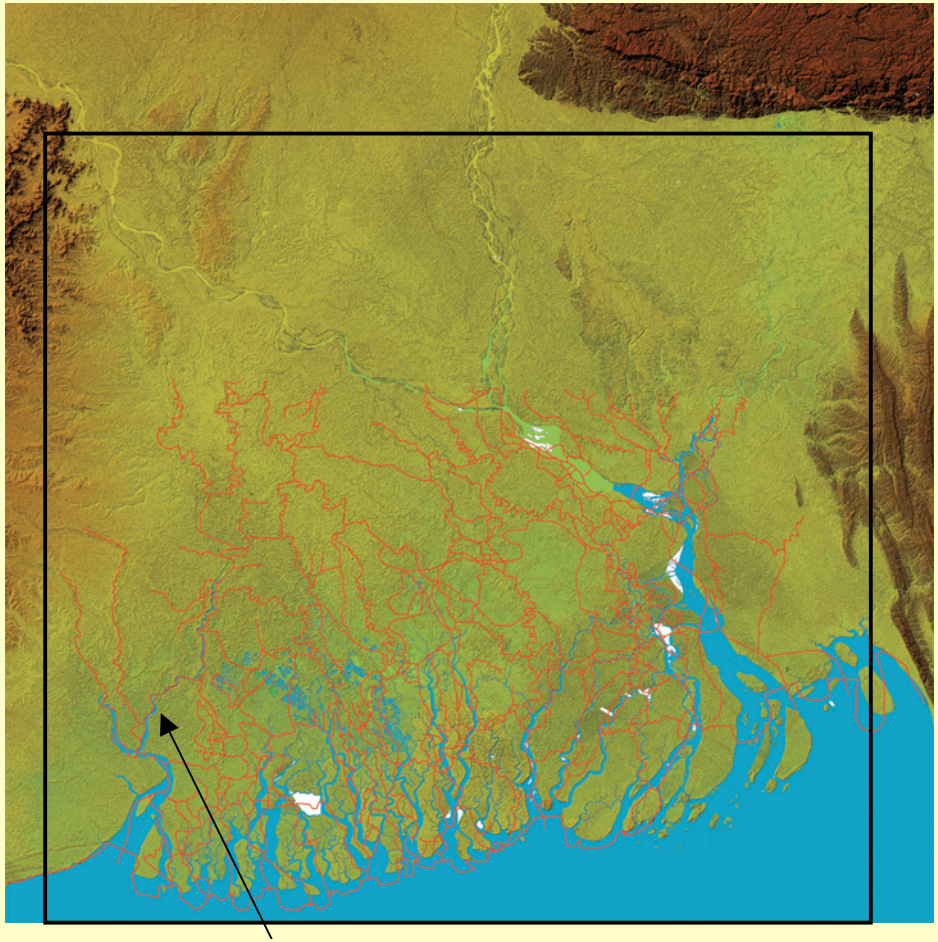
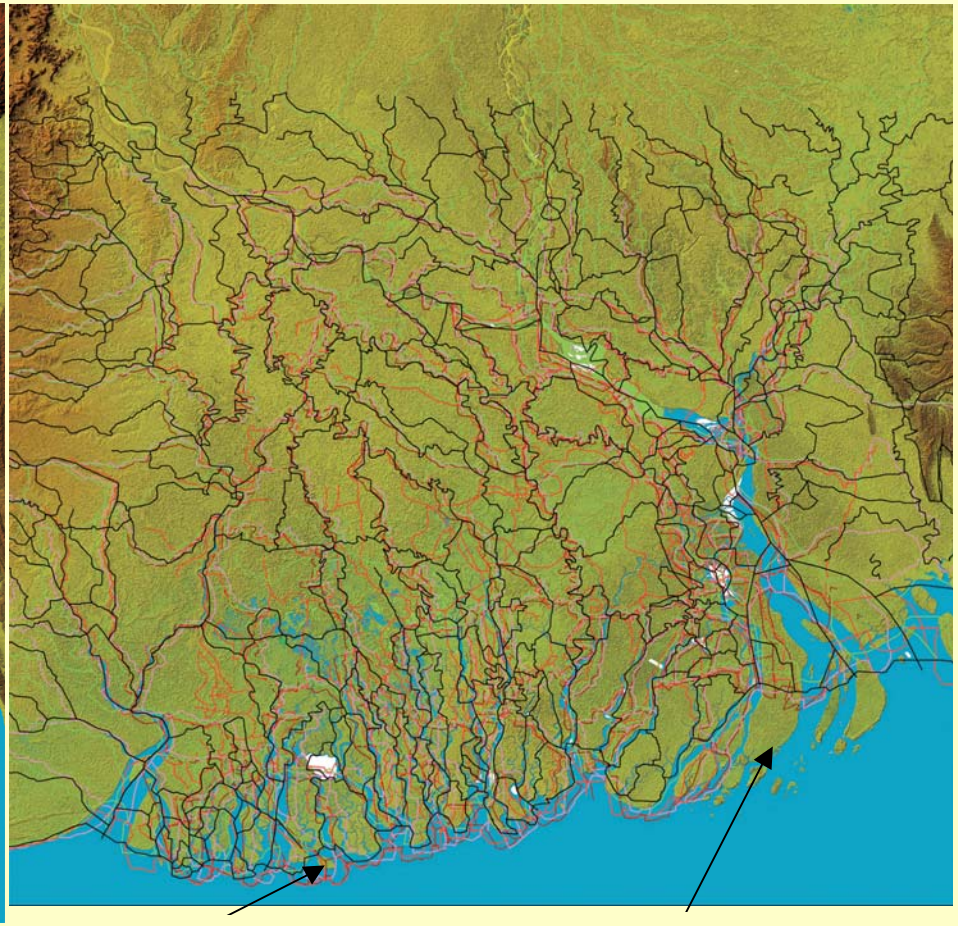
Finding 4: The **grain-size** of delta sediments and **vegetation** variations play an important role in channel stabilization

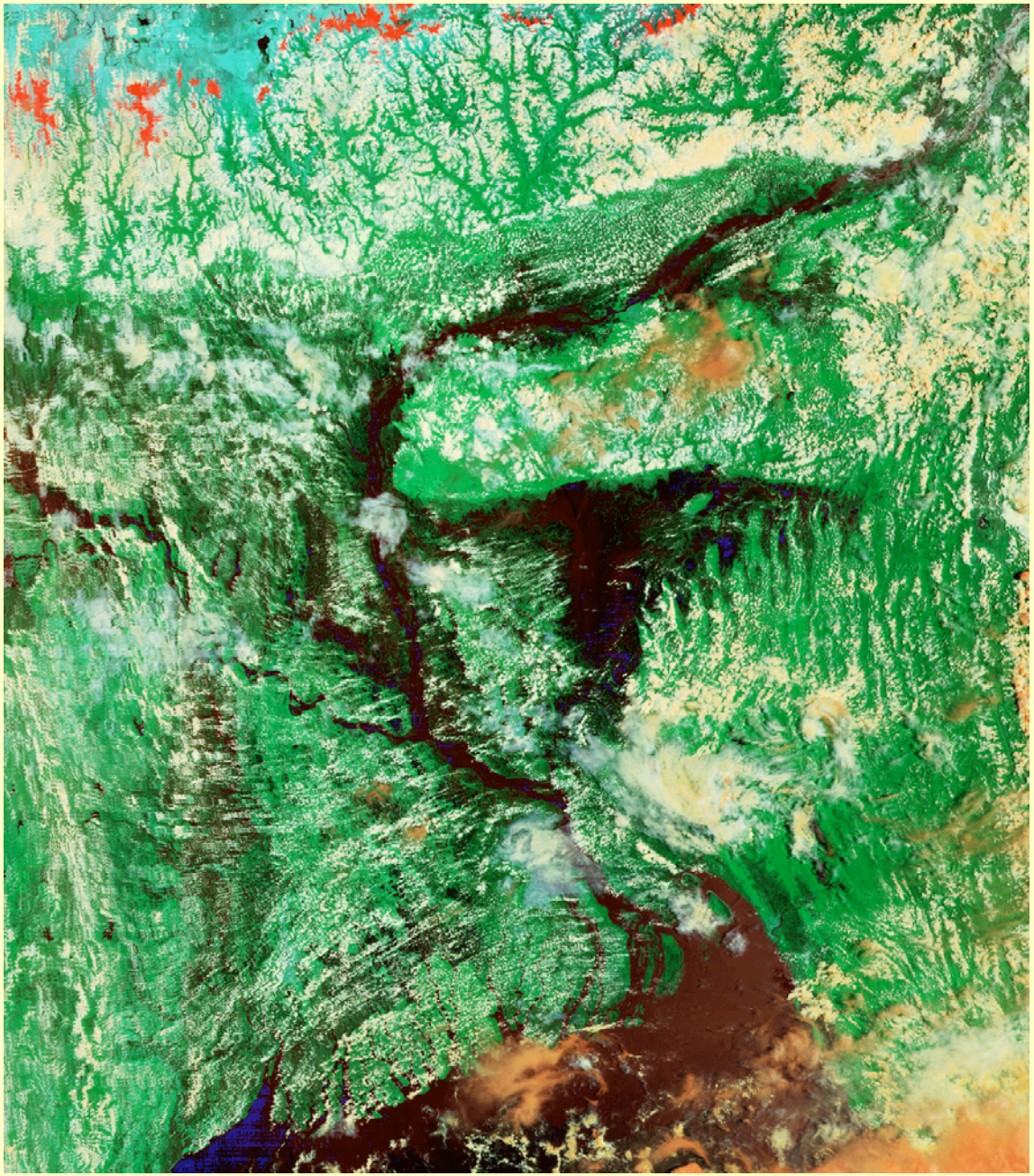


1794 muddy channels are very stable



Coastal erosion of mangroves

Delta growth



Finding 5: During the 2007 megafloods of the Ganges, Brahmaputra, and Indus, old channels are reoccupied creating havoc: 30 million displaced habitants, and resulting in tens of thousands of deaths.

Summary

Geological Perspective: The present is not always the key to the past — many deltas would not reach their present shape without human engineering.

Human Perspective: i) We now plumb deltas to reduce river flooding through floodwave mitigation & channel stabilization. ii) Stabilized channels allows for the safety of riverside towns & cities, and their commerce via ship traffic. iii) Reduced sediment delivery to the delta surface has accelerated the impact of subsidence — seaward flooding is being replaced by landward flooding, on many deltas.