IMPACT OF CLIMATE CHANGE AND NATURAL HAZARDS ON PAKISTAN COAST IN WORST CASE SCENARIO

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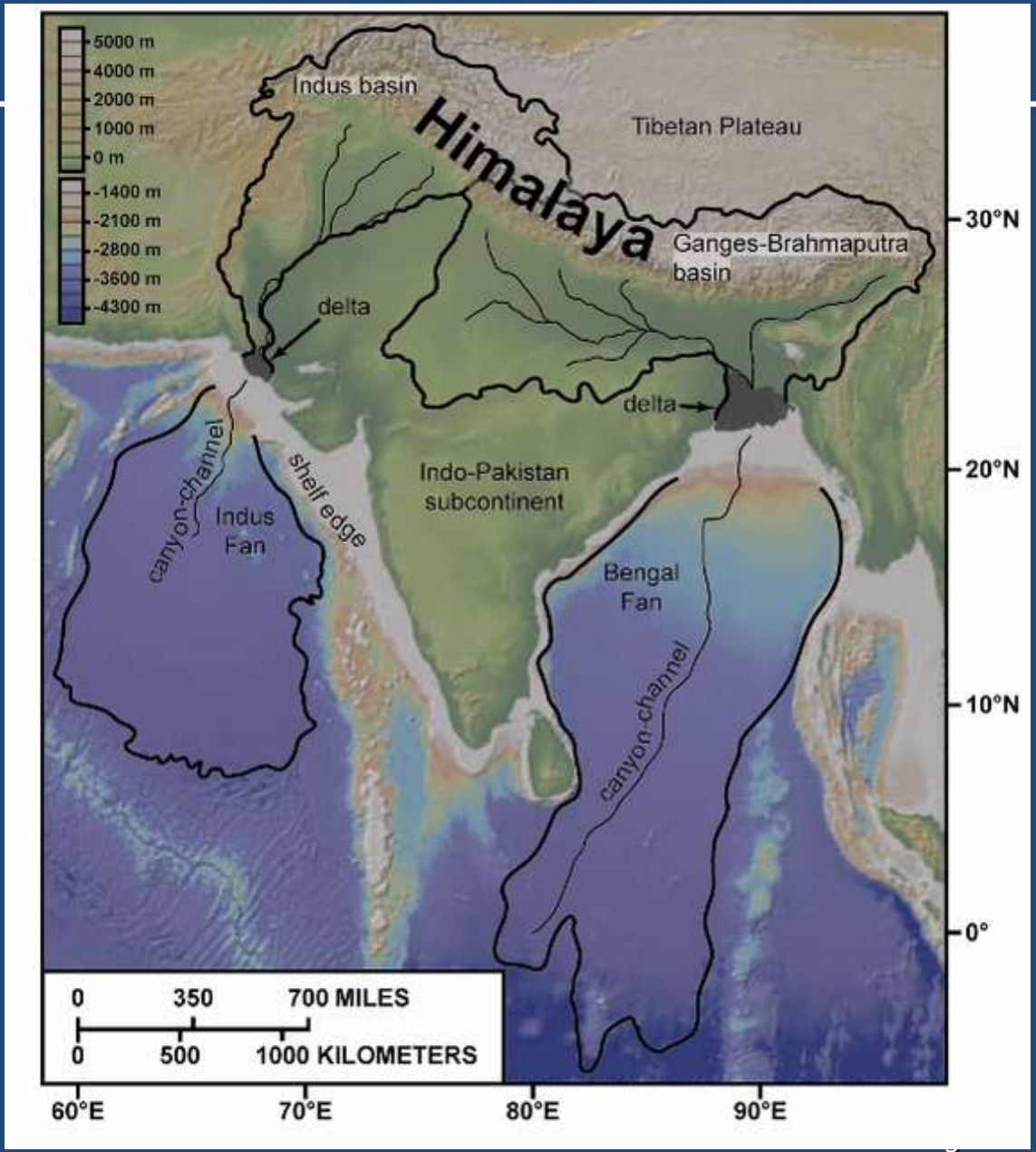
Scheme of Presentation

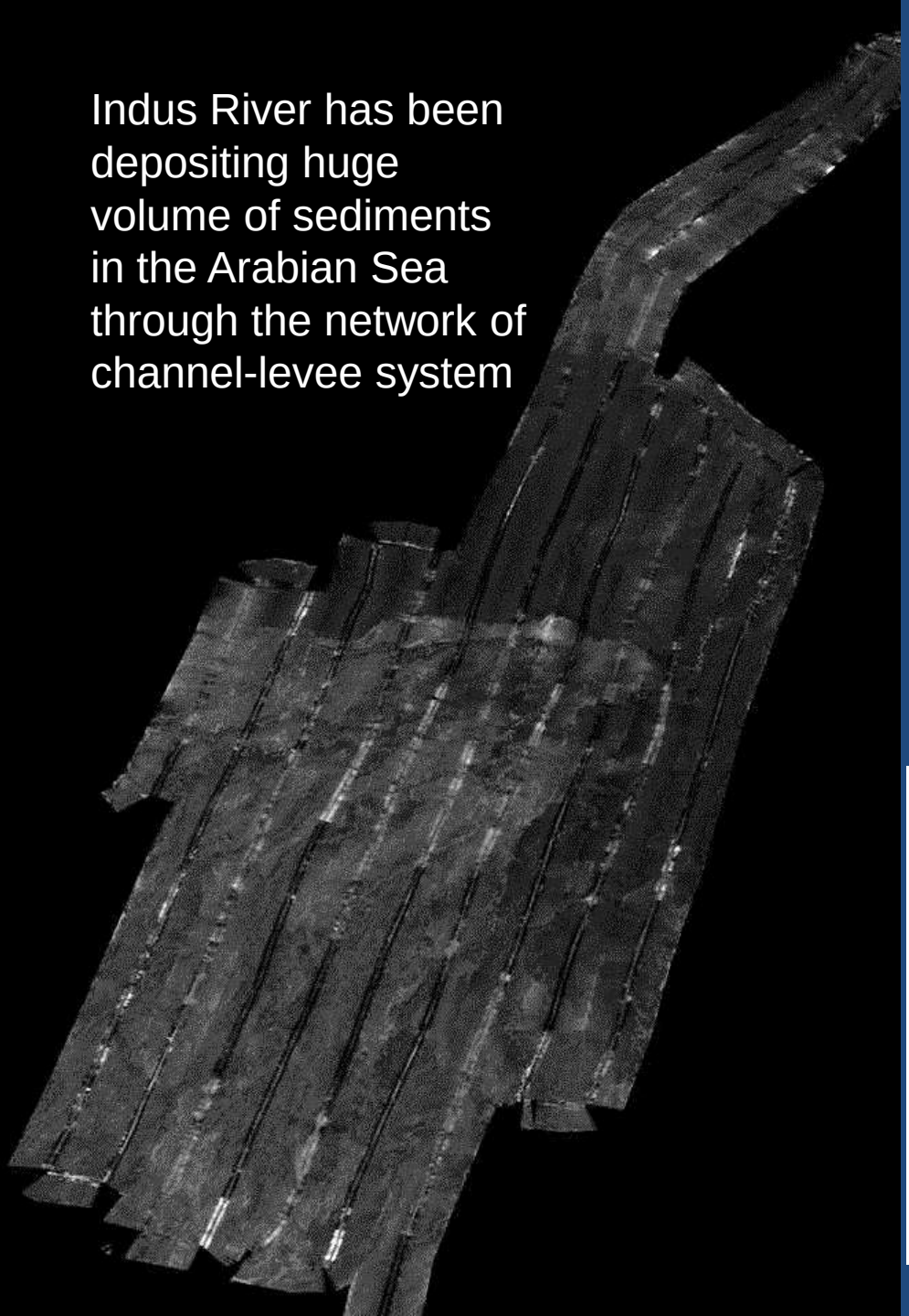
- Origin of the Indus River system
- Climatic cycle – Natural Process
- Human factor
- Sea Water Intrusion – Contributing Factors
- Mitigation strategy

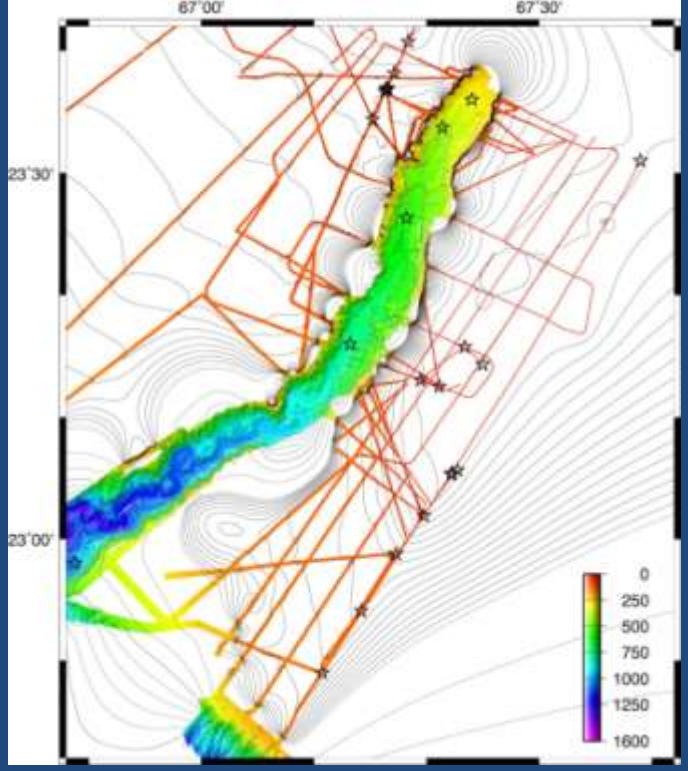
The flood water due to the heavy monsoon rains developed two of the major rivers i.e. Ganges and Indus.

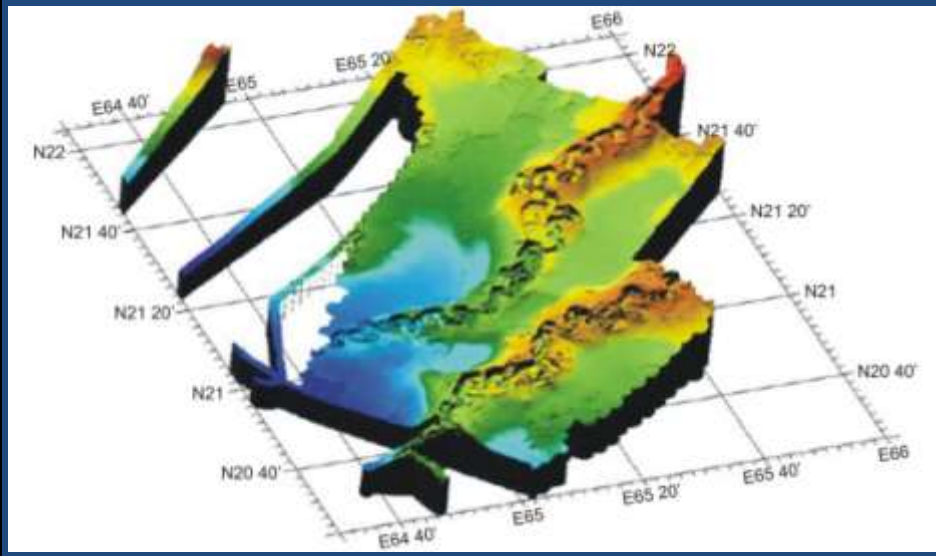
These two rivers dumped huge quantities of sediments and created two of the largest submarine fans in the world

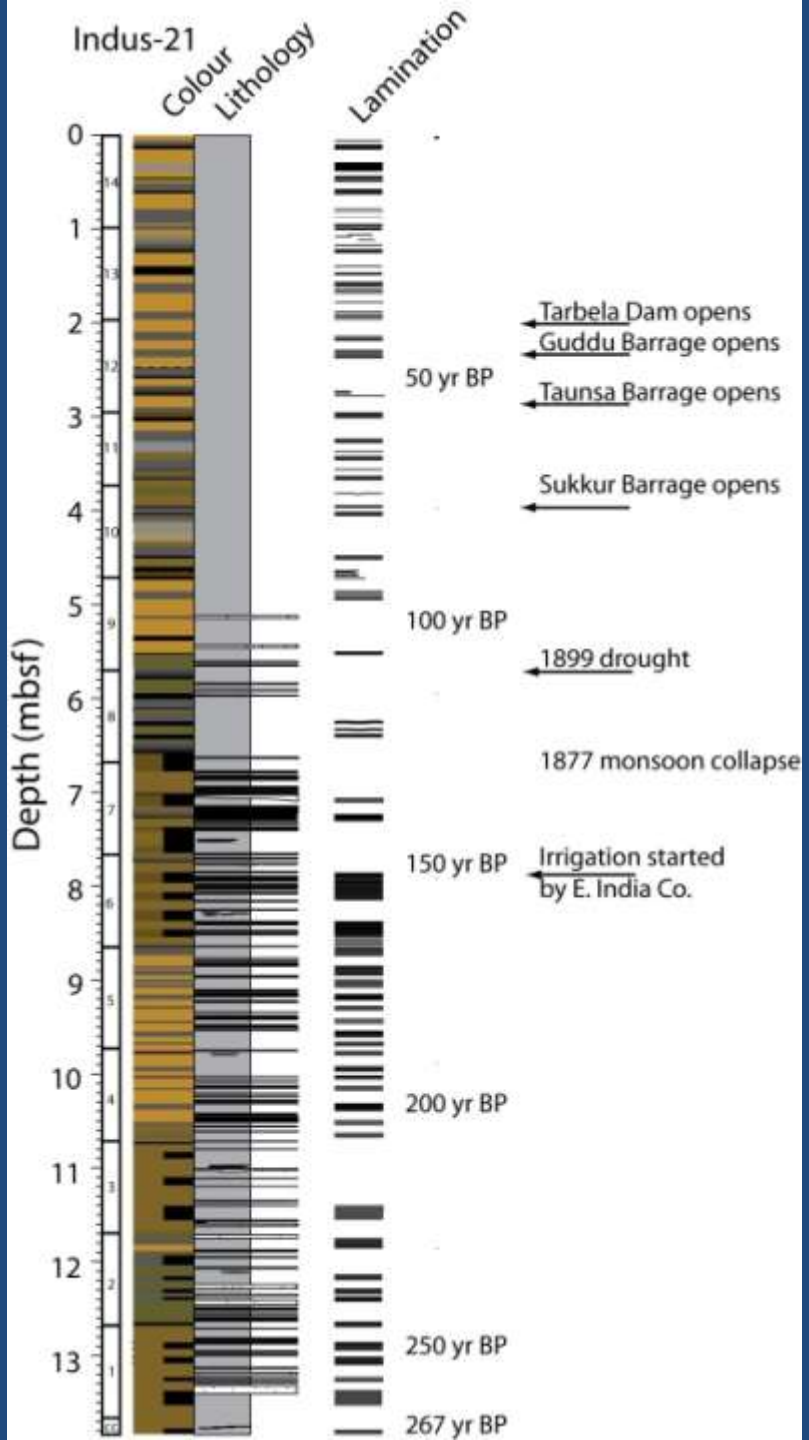


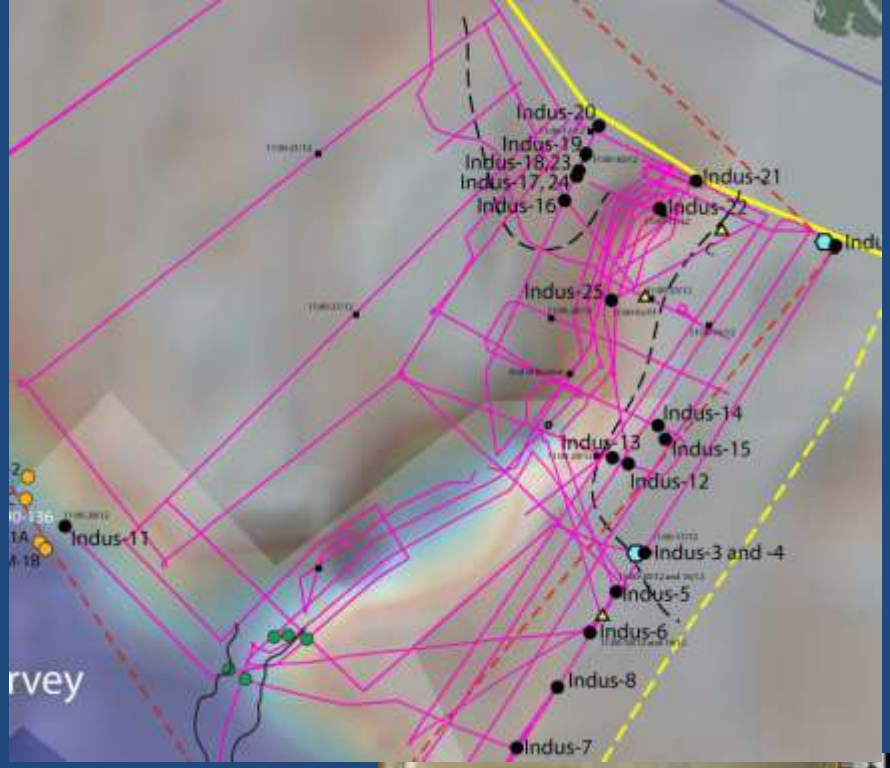
Indus River has been depositing huge volume of sediments in the Arabian Sea through the network of channel-levee system



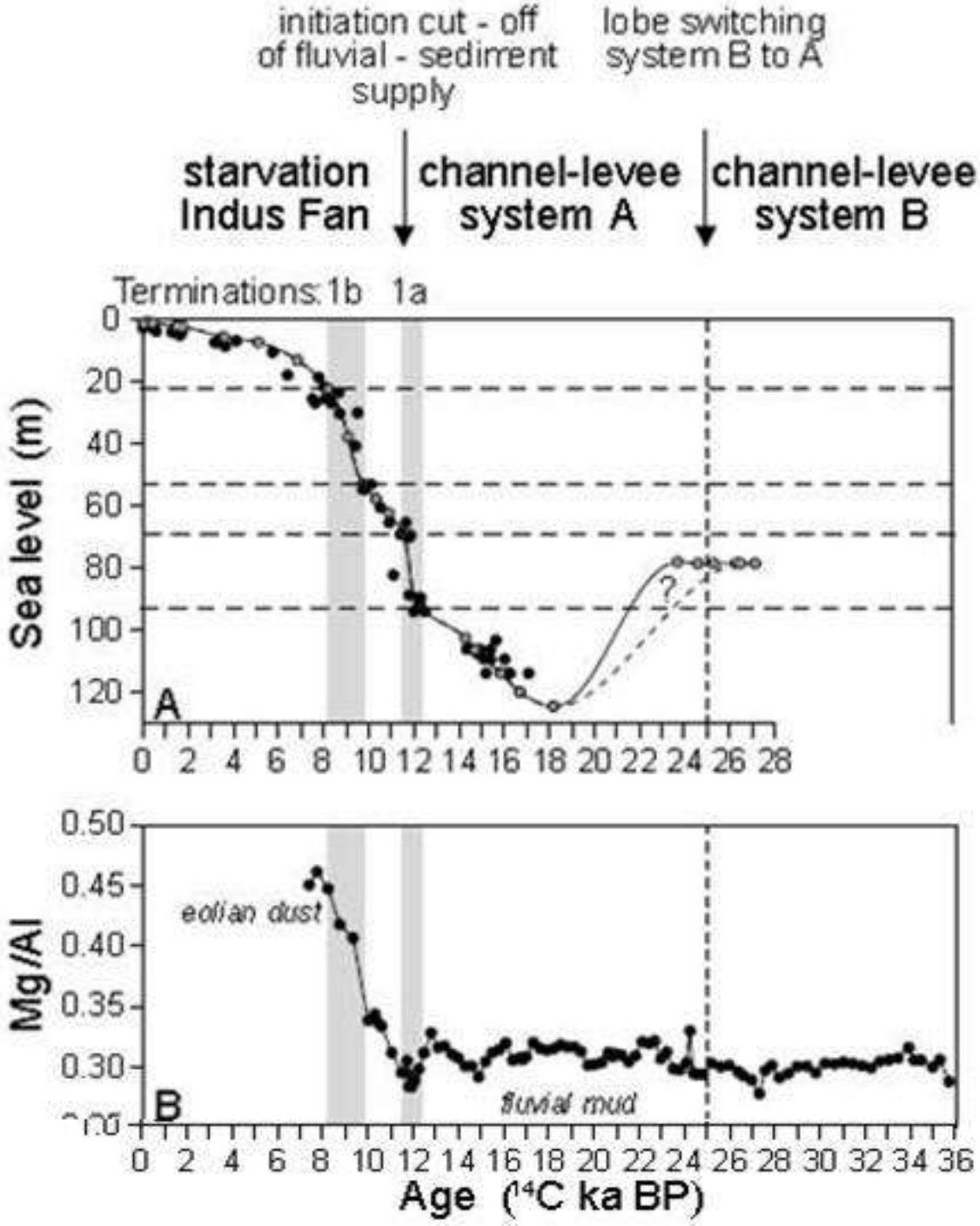




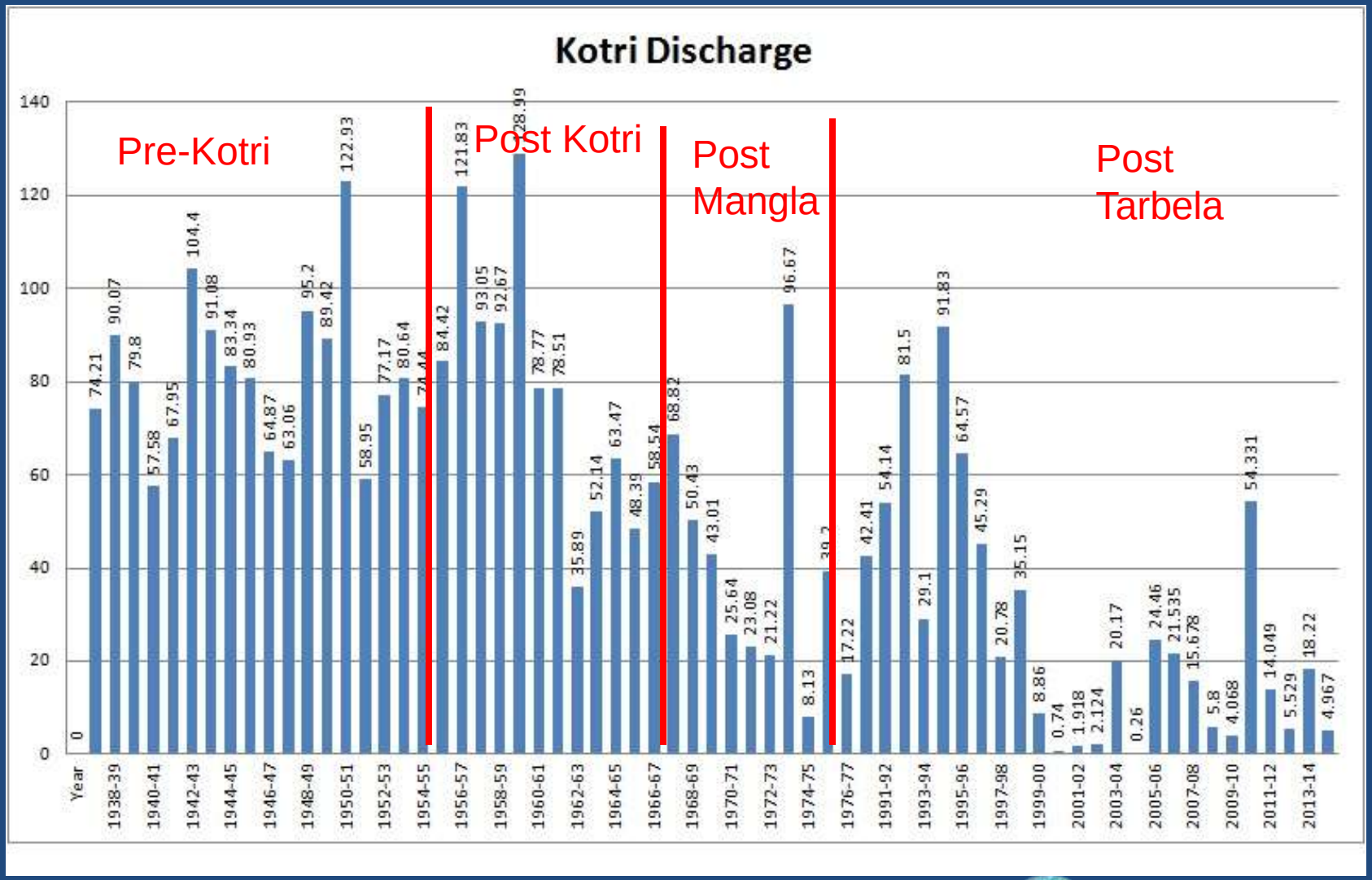




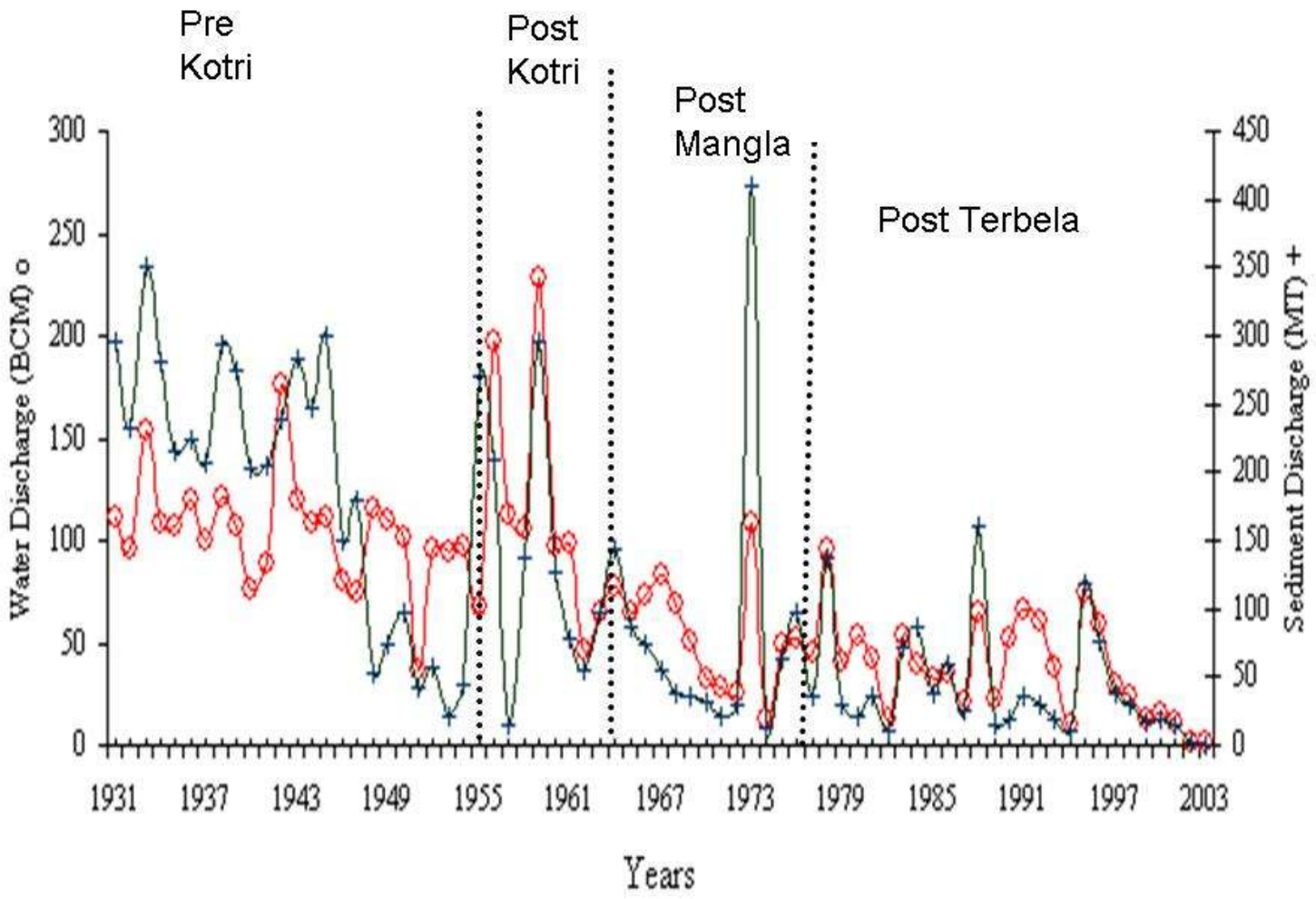
New coring suggests that much of the Indus sediment load is only reaching the upper Indus Shelf since last 7000 years


initiation cut - off of fluvial - sediment supply
lobe switching system B to A
starvation Indus Fan
channel-levee system A
channel-levee system B
Terminations: 1b 1a
Sea level (m)
0
20
40
60
80
100
120
A
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
?
Mg/Al
0.50
0.45
0.40
0.35
0.30
eolian dust
fluvial mud
B
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
Age (14C ka BP)

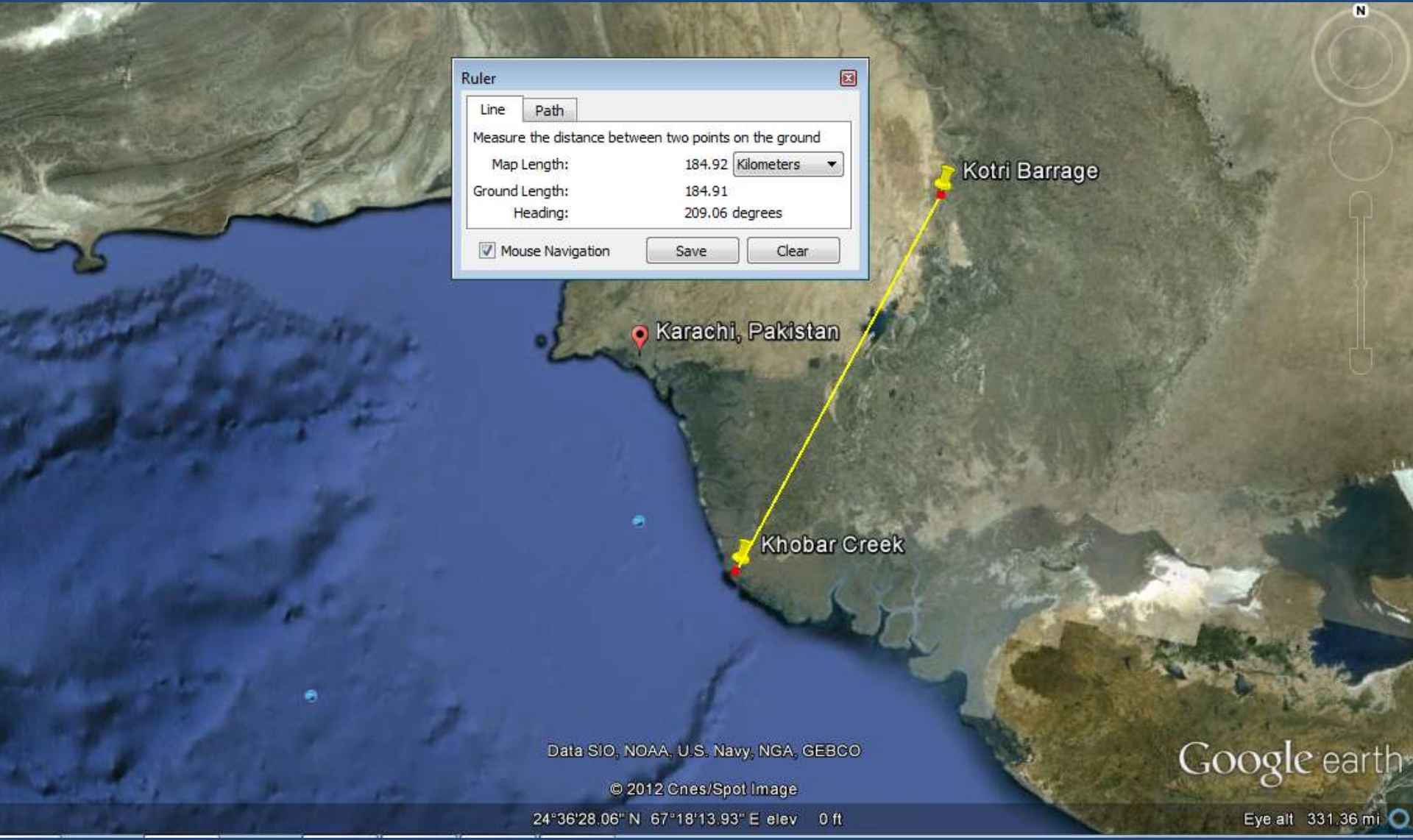
THE HUMAN FACTOR



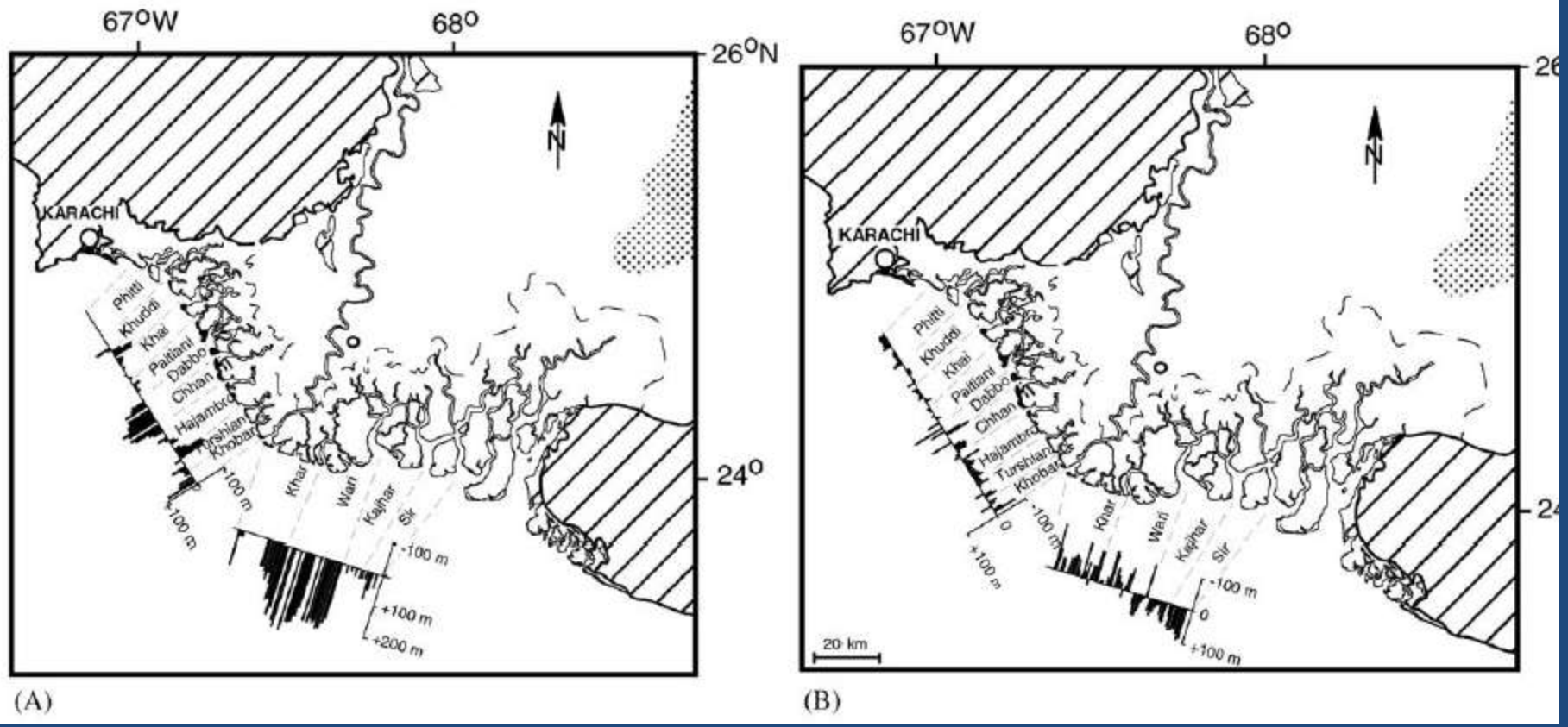
SEDIMENT DISCHARGE DOWNSTREAM KOTRI BARRAGE



Data measured at Kotri Barage



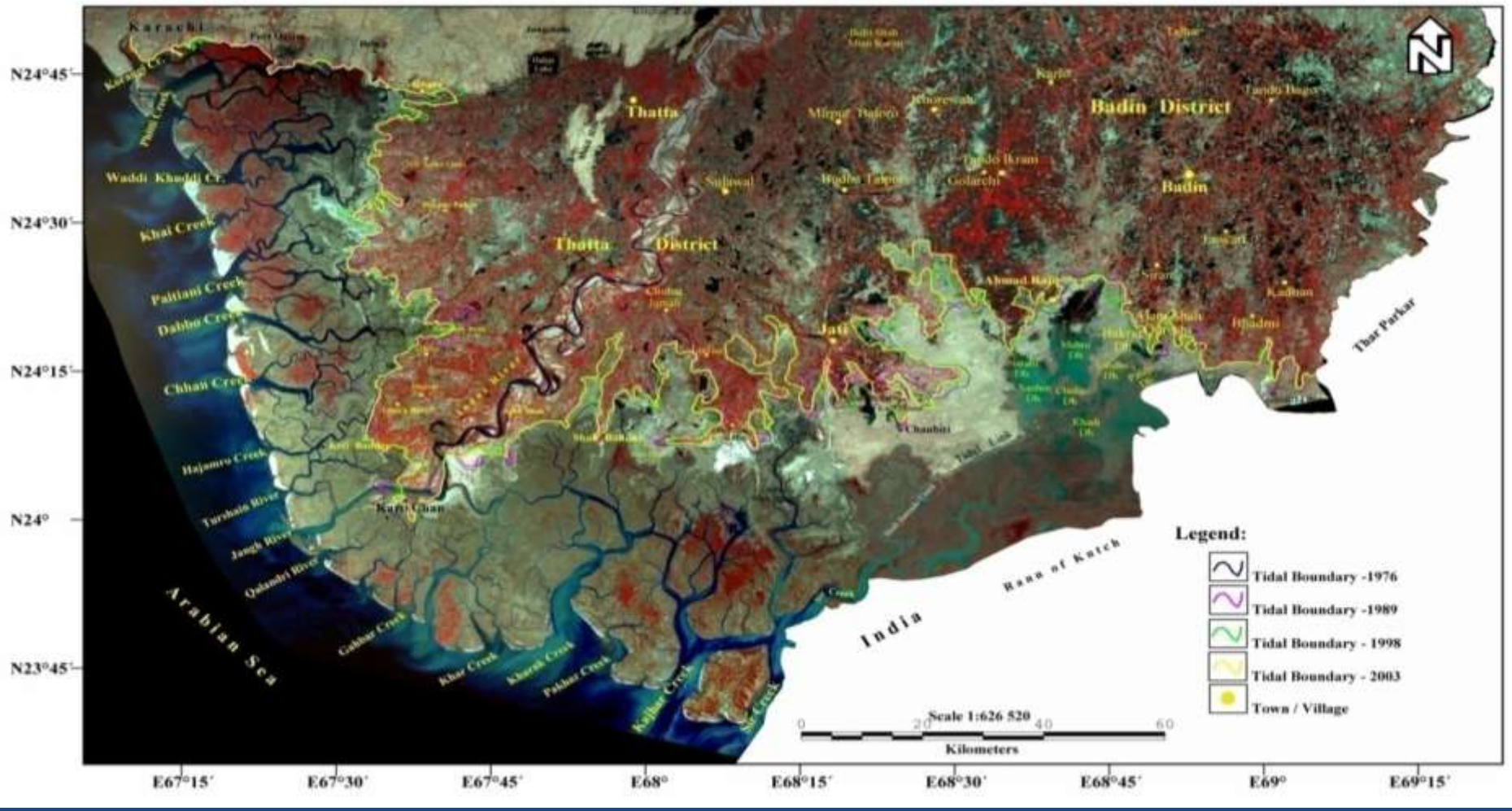
The shortest distance between Kotri and Indus River mouth is about 200 km. No data is available for actual sediment and water discharge to the sea.



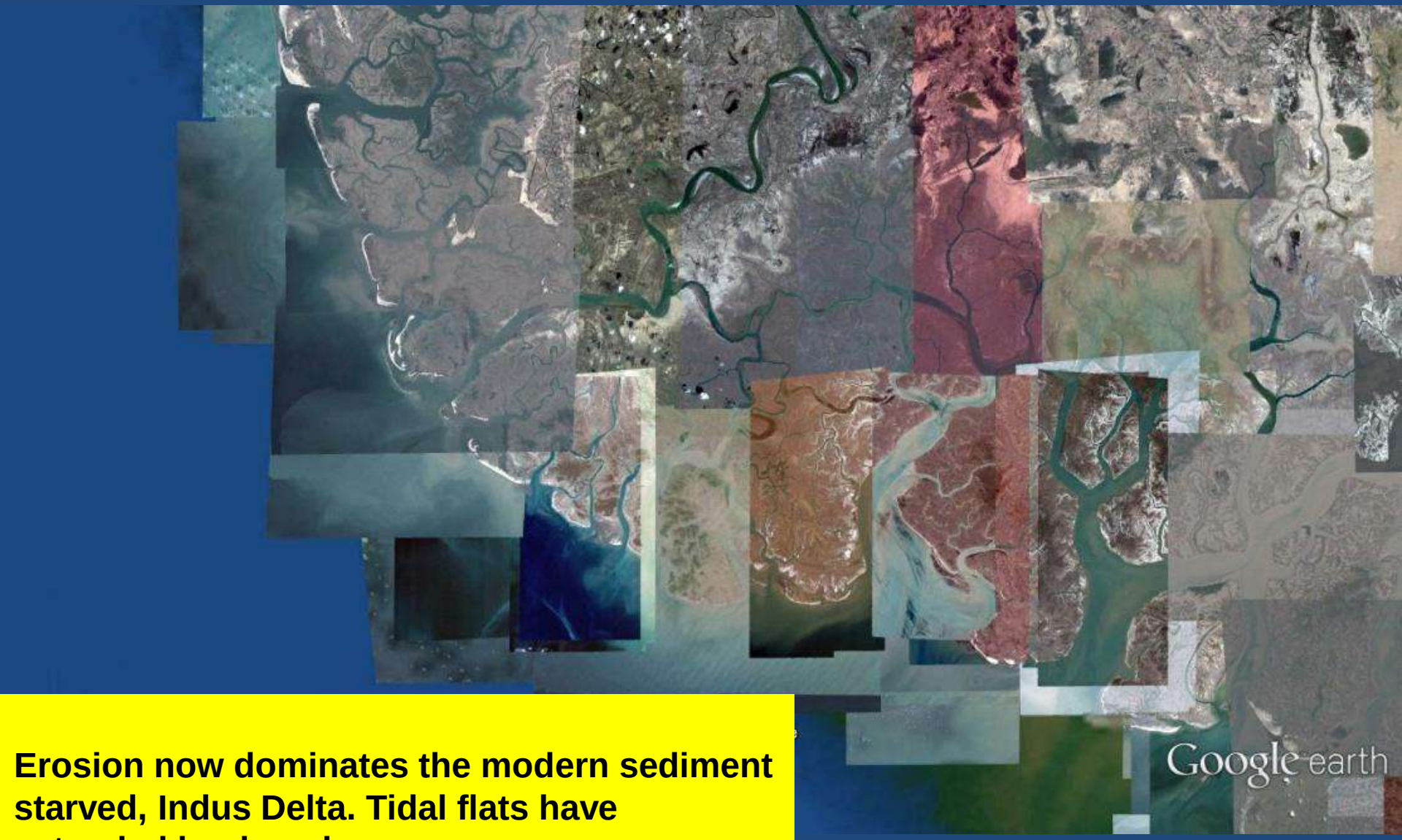
A: Pre dam situation (1895 to 1954)

B: Post dam construction (1978 to 2000)

Seawater intrusion in the deltaic area



EROSION OF INDUS DELTA (as on 19 May 2014)



Erosion now dominates the modern sediment starved, Indus Delta. Tidal flats have extended landward

SUBSIDENCE IN DELTAS

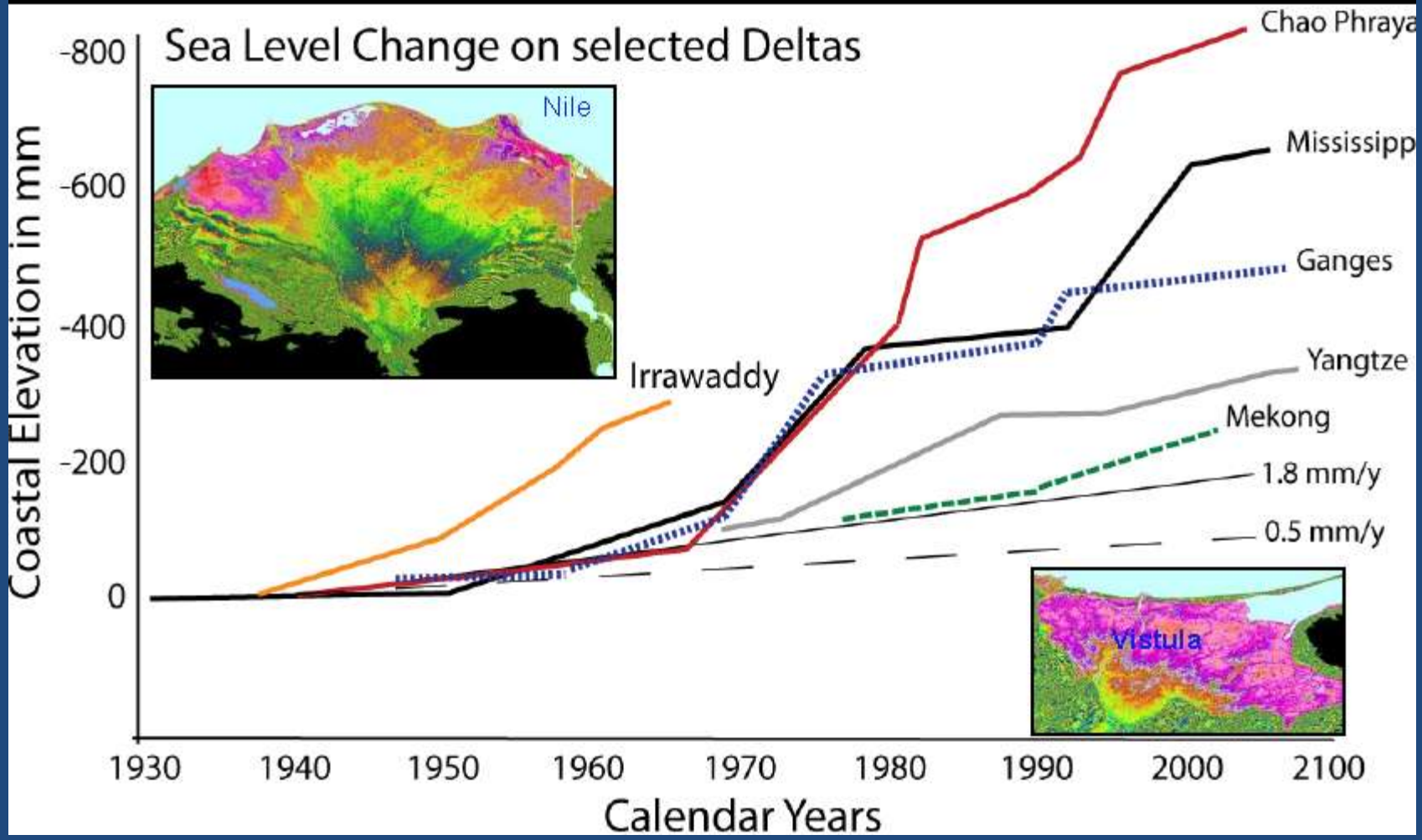
Normally:

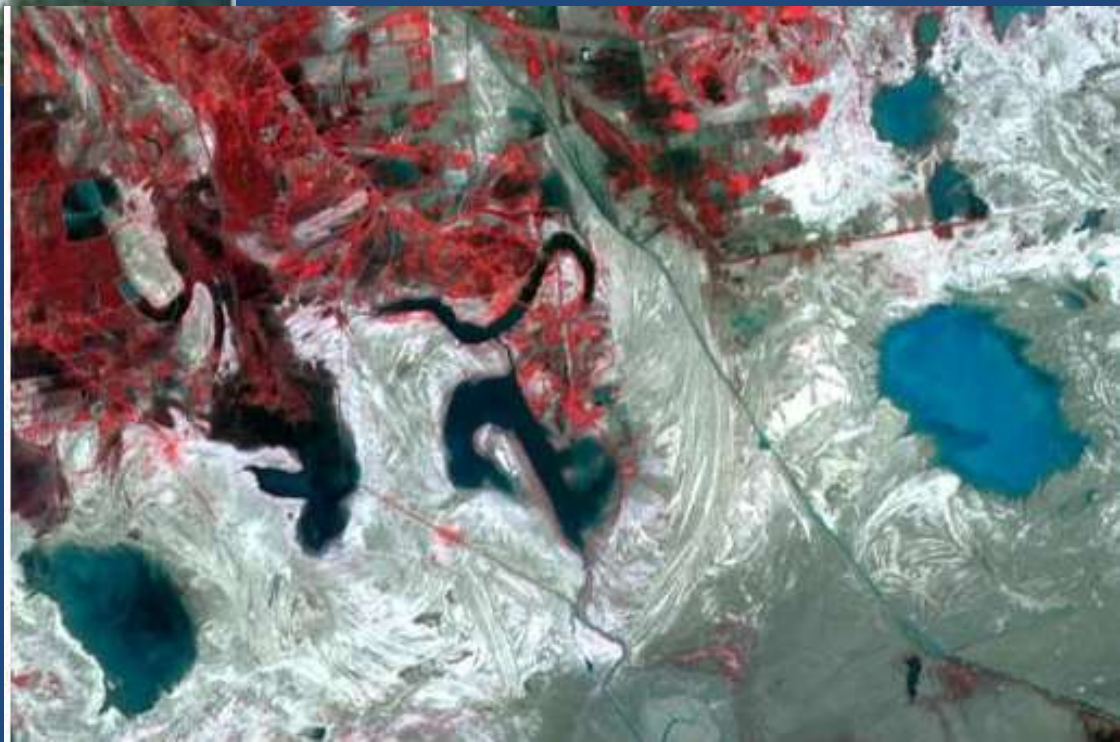
- Delta subsidence is due to tectonic sinking and dewatering of sediments (compaction)
- Delta is replenished and compensated by river-borne water and sediment to keep it in equilibrium

However:

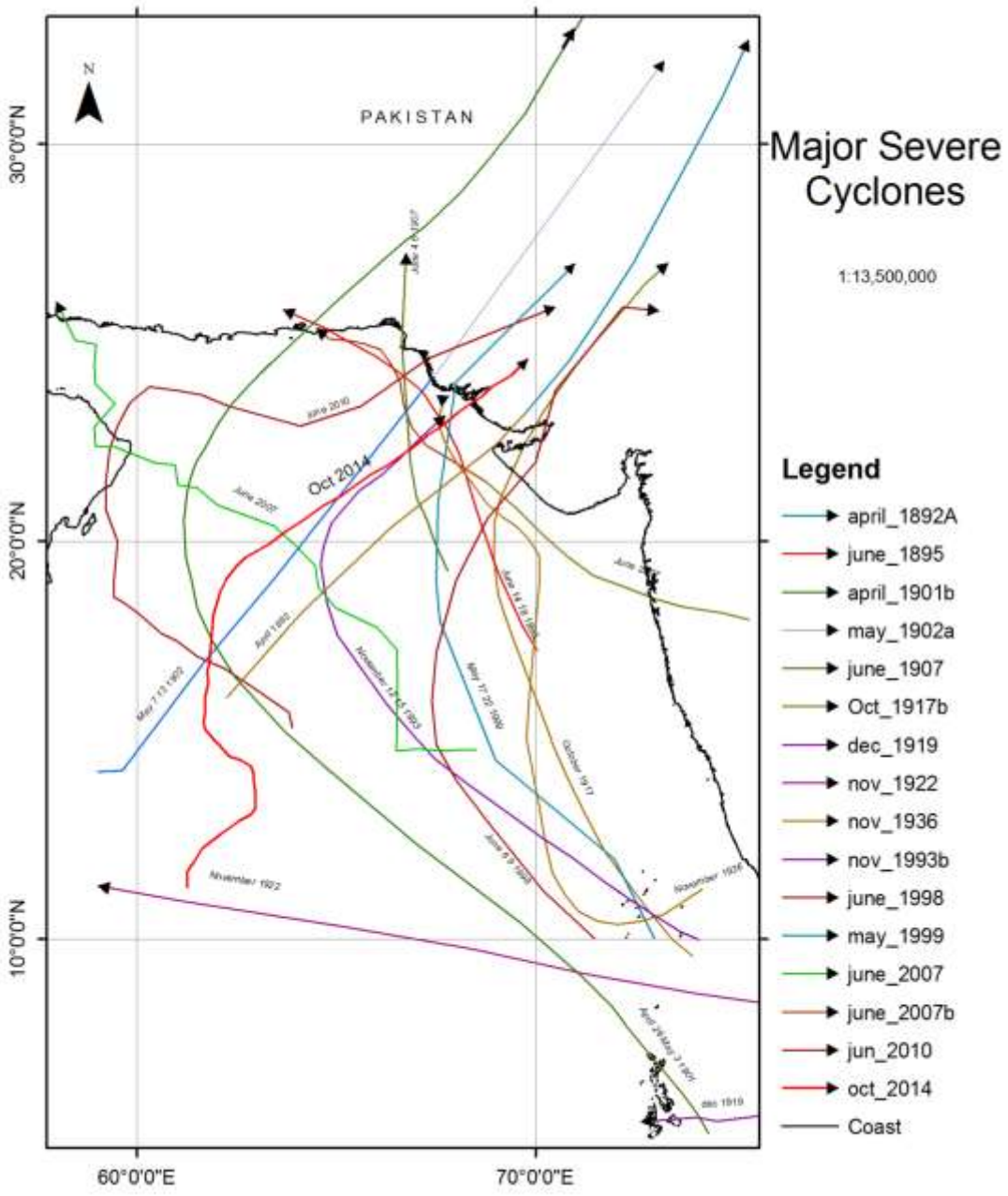
- Damming, diverting or channeling upstream leads to loss of sediment and accelerated subsidence
- Rapid local relative sea-level rise, salt-water intrusion inland, decreased biological productivity and biodiversity commonly results

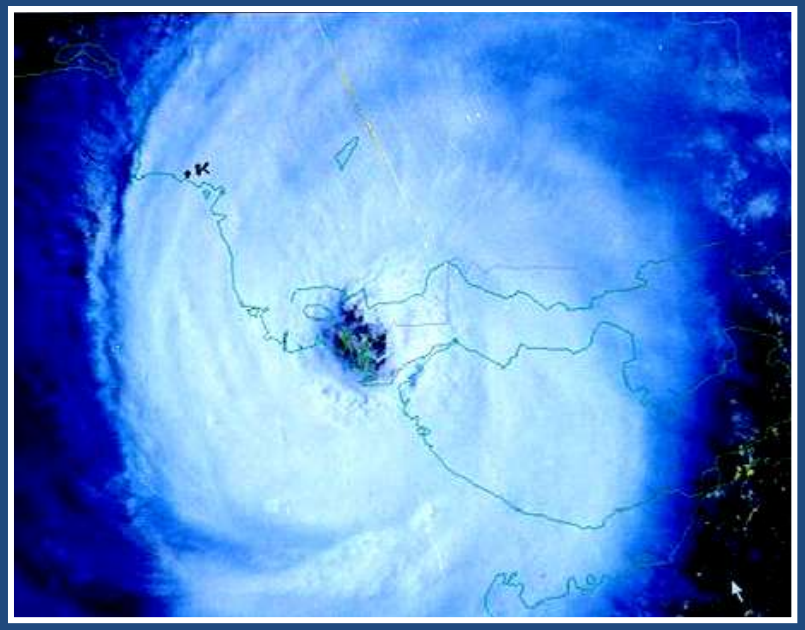
Humans are sinking deltas 4x faster than SL is rising.





The drainage system has been less effective due to low gradient/flat topography

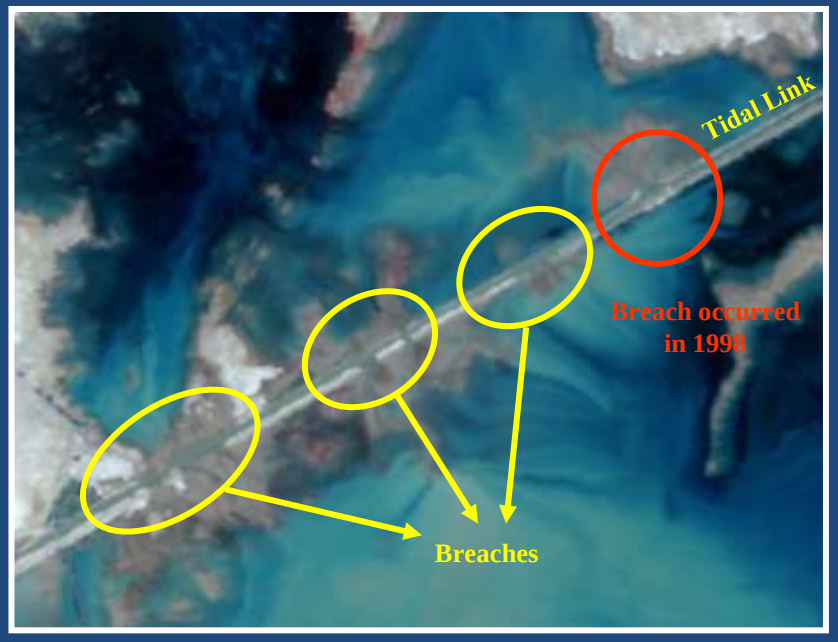

PAKISTAN
N
30°0'0"N
20°0'0"N
10°0'0"N
60°0'0"E
70°0'0"E
Oct 2014
Major Severe Cyclones
1:13,500,000
Legend
april_1892A
june_1895
april_1901b
may_1902a
june_1907
Oct_1917b
dec_1919
nov_1922
nov_1936
nov_1993b
june_1998
may_1999
june_2007
june_2007b
jun_2010
oct_2014
Coast



Satellite picture of powerful Cyclone TC- 02A of 20th May, 1999.

Mangrove Forests of Indus Delta deteriorated due to Cyclone TC- 02A.

Landsat TM Image of Feb 1999 of Dhands & Tidal Link prior to Cyclone TC-02A. The breach occurred in 1998 is prominent in this

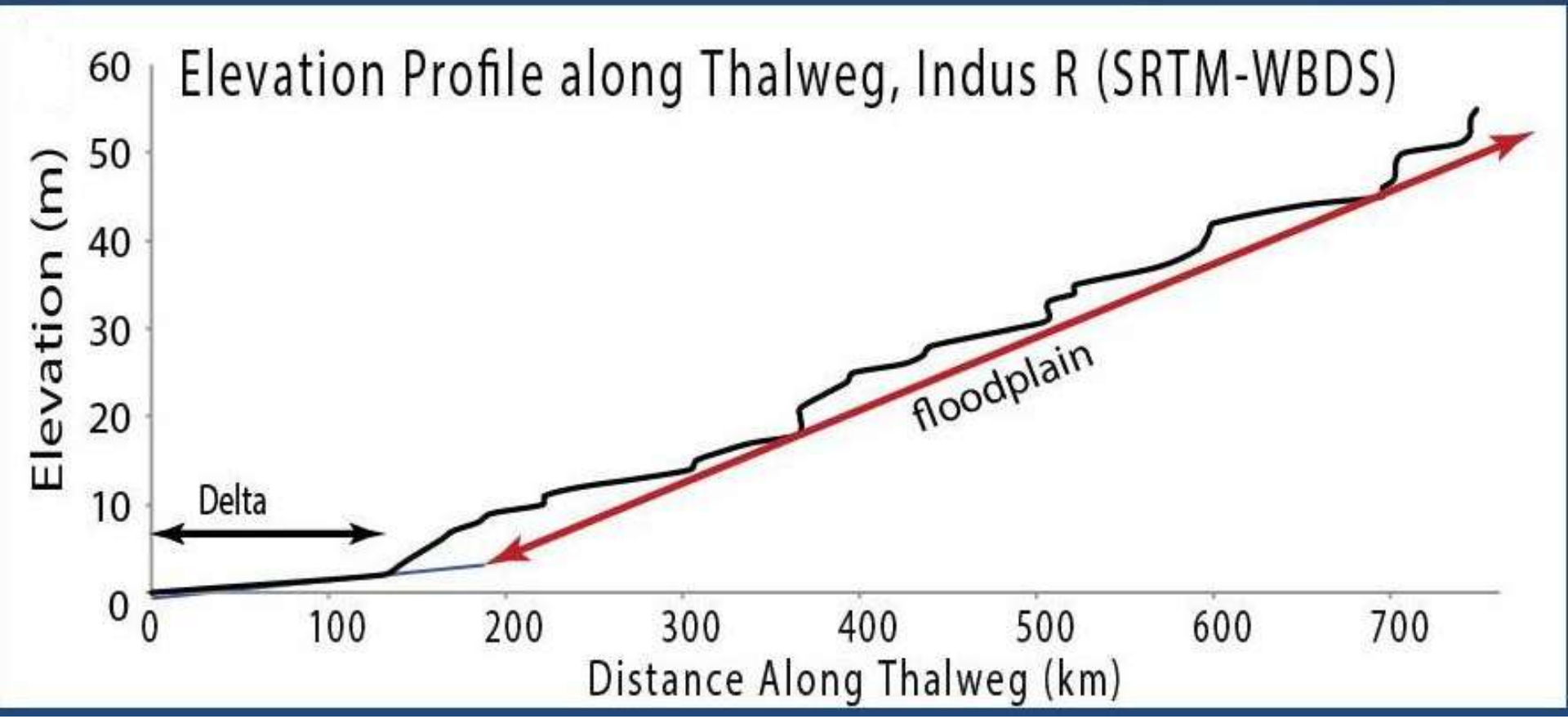


Landsat ETM Image of post cyclone period (Nov. 1999) of Tidal Link. The breaches occurred due to cyclone in Tidal Link are shown in yellow circles.

SEA LEVEL CHANGES IN THE KARACHI AREA AND CHANGES IN THE TIDAL RANGE

A rate of 1.1mm/yr rise in the Local Level has been estimated. Projected levels after 100 years would be

Tidal State	Present Level (m)	Projected Level (m)
Lowest Astronomical Tide	-0.49	+0.11
Mean Lower Low Water	+0.97	+1.57
Mean Higher Low Water	+1.43	+2.03
Mean Sea Level	+2.04	+2.64
Mean Lower High Water	+2.65	+3.25
Mean Higher High Water	+3.38	+3.98
Highest Astronomical	+3.84	+4.44



If one adds the projected rate of global component of sea-level rise of up to 6mm/year in the next century, Indus Delta could experience a relative rise of sea level of up to 8 to 10mm/year. At this pace, the inundation of the delta could be rapid, at the rate of several m/year (Haq, 1999).

Mitigation Measures?

i. Monitoring of the water and sediment discharge to the Arabian Sea – specially during floods – Remote sensing.

ii. Coastal elevation data to determine the present heights and identification of vulnerable areas.

iii. Erosion/Accretion along the Sindh Coast

iv. Installation of permanent stations with tide gauges and high precision GPS to monitor any changes in the water and ground levels.


THANK YOU