Anthropogenic controls on the formation of the Ebro Delta

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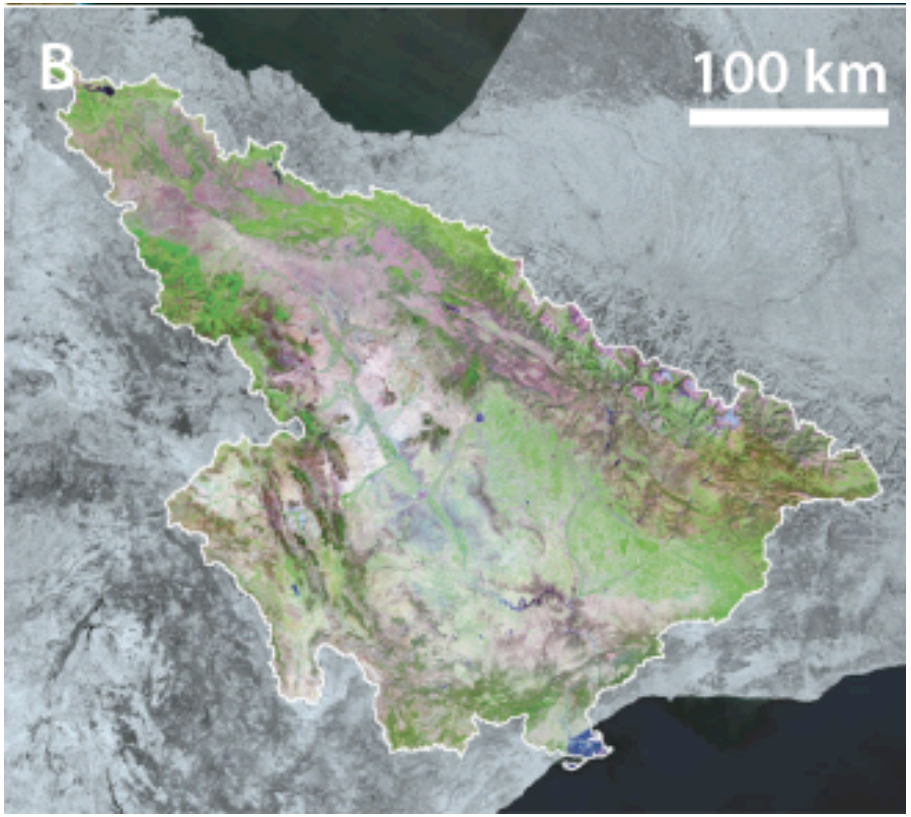
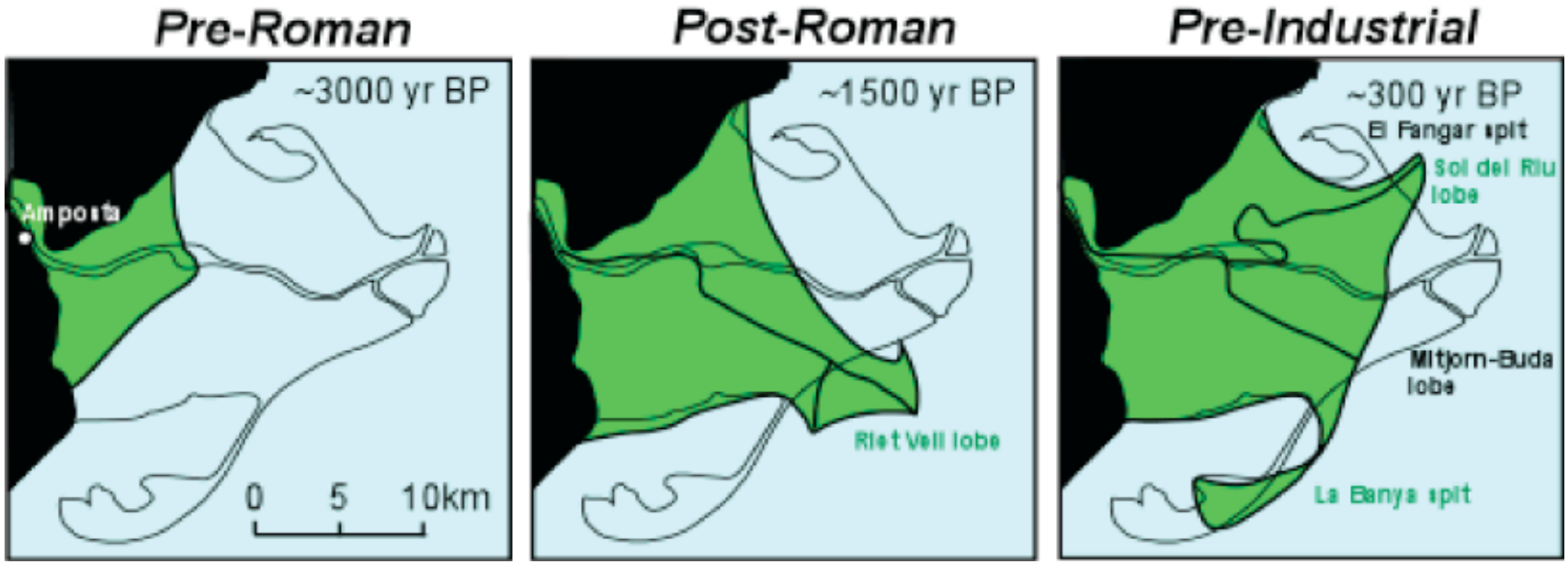
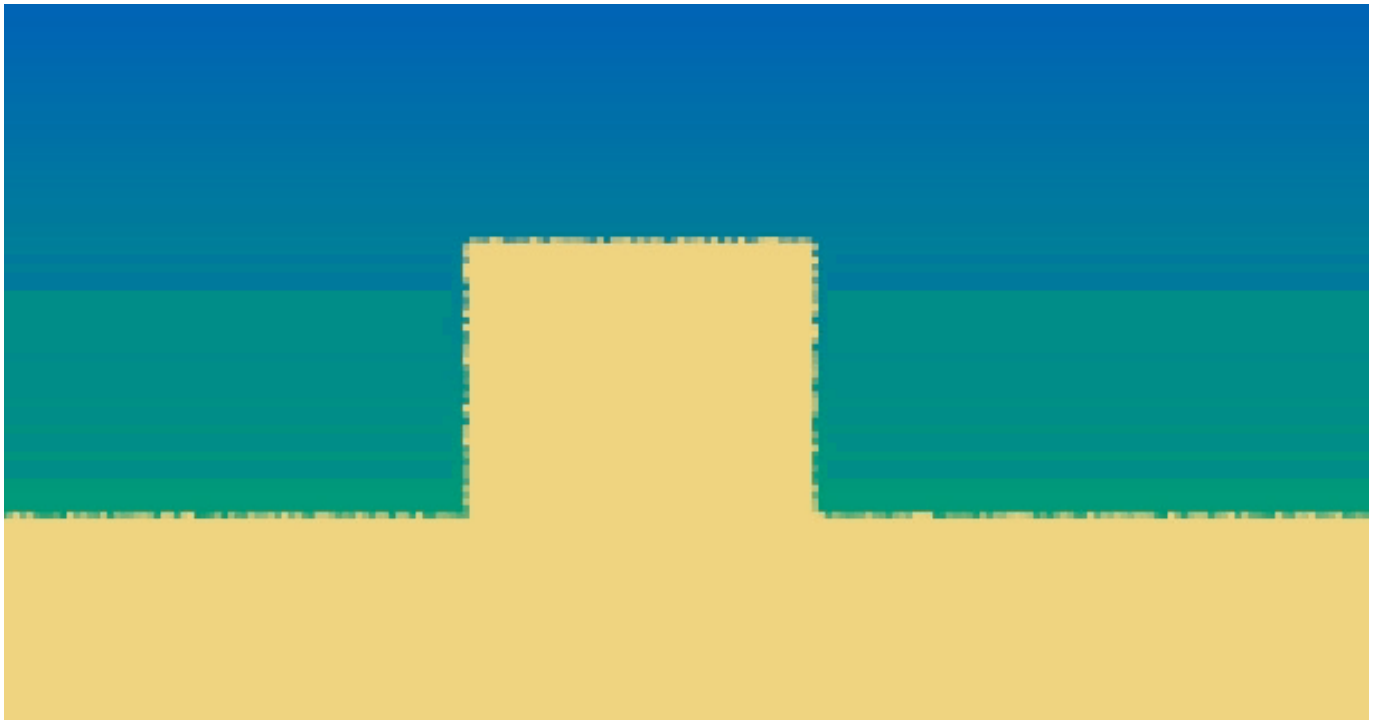
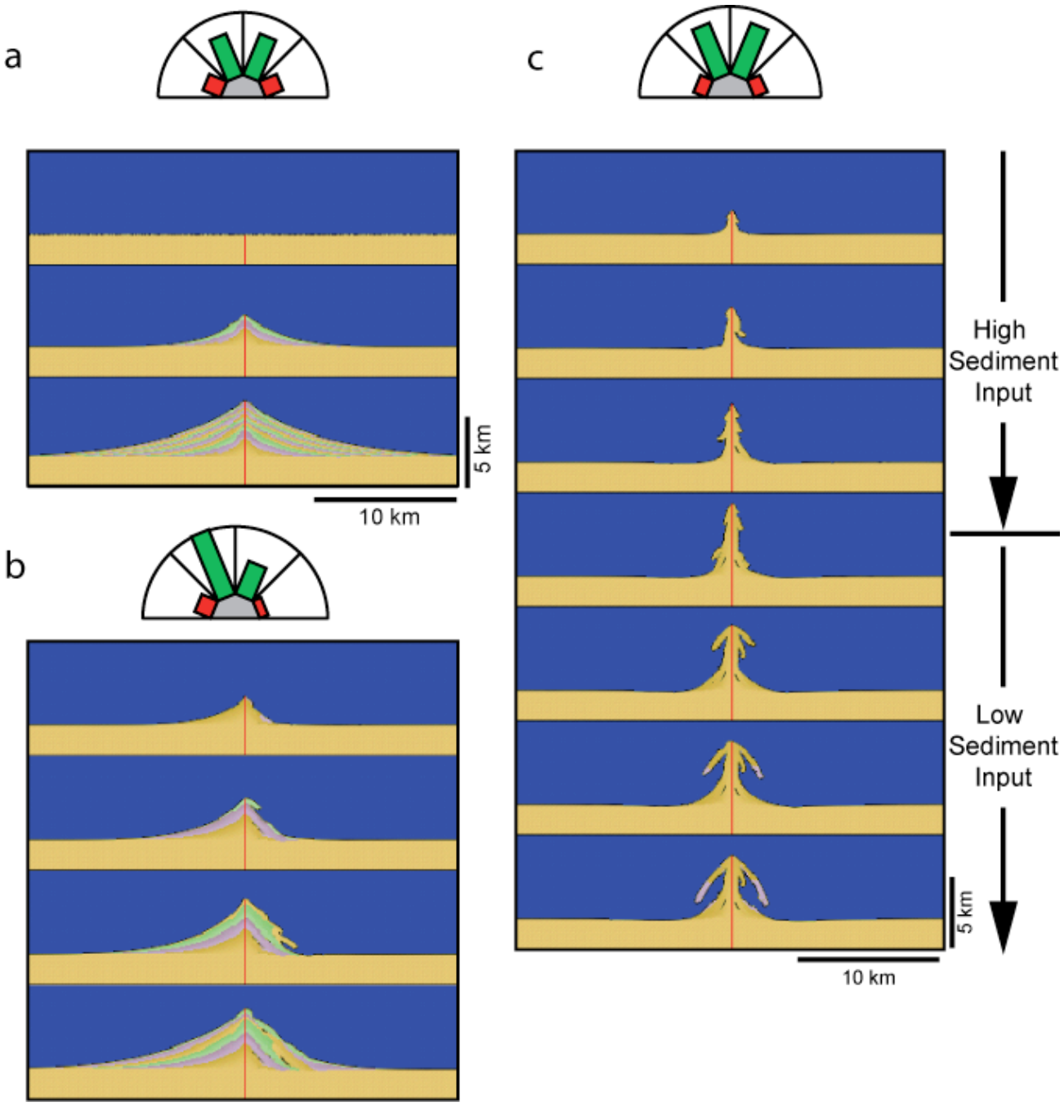


A


Pre-Roman
~3000 yr BP
Amposta
0 5 10km
Post-Roman
~1500 yr BP
Riet Vell lobe
Pre-Industrial
~300 yr BP
El Fangar spit
Sol del Riu lobe
Mitjorn-Buda lobe
La Banya spit

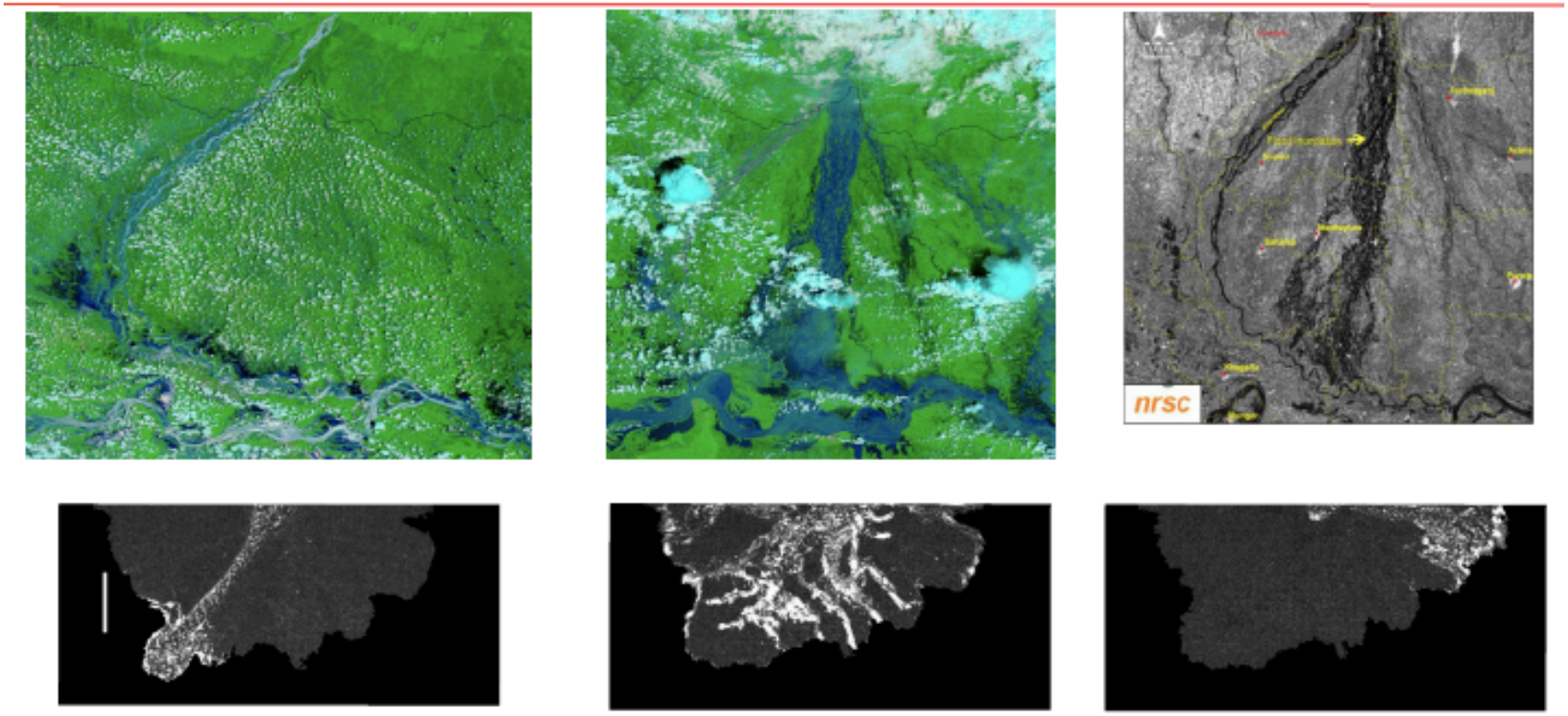
B




a
b
c
5 km
10 km
High
Sediment
Input
Low
Sediment
Input
5 km
10 km

Delta avulsion and shoreline evolution

Avulsions – path selection by reoccupation



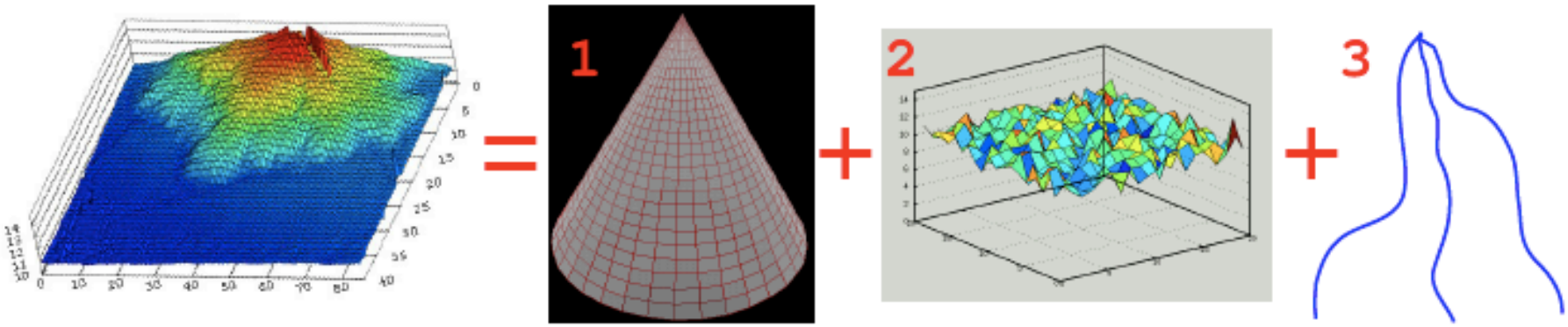
Flood waters fill abandoned channels – inundating distant areas

New channel path is almost always a previously occupied channel

Avulsion – a directed random walk with memory

Thin floodplain flows: **Friction dominated.**

→ Flow follows **steepest-descent path**



1 + 2 = Directed random walk. Flow goes downhill, around bumps.

- → Channel paths are directed random walks.

3 = Memory. Each channel acts as attractor for future flow.

- → Abandoned channels are absorbing boundaries.

4: Annealing. Abandoned channels eventually erased by floodplain deposition. System 'loses memory'.

Two timescales:

- → **Avulsion time:** Conservation of mass. Sets evolution pace.
- → **Annealing time:** Floodplain deposition. Fine-grain load.

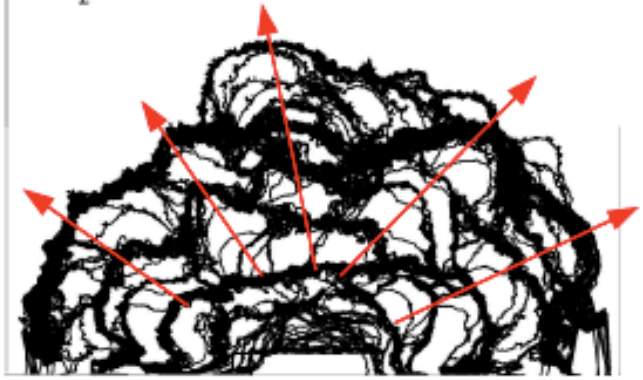
Avulsions – path selection by reoccupation

Map of flow reoccupation

Avulsions occur at fan apex.

Flow oscillates among a fixed set of channels (**4–5**).

Self-similar shoreline growth from persistent channels.



Shoreline migration