Impact of Climate Change on Estuarine Ecogeomorphology (C3E2 project) and application to the Loire Estuary

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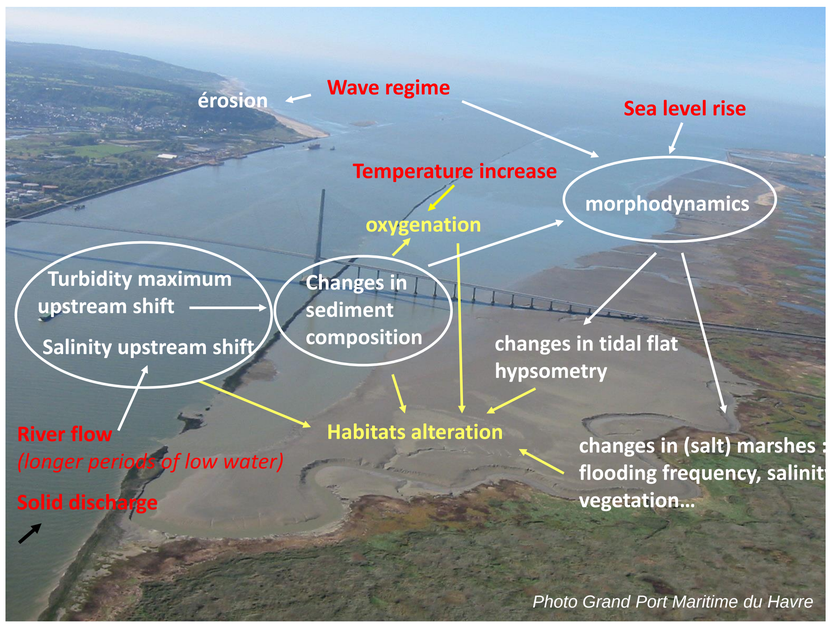


***Expressions of Climate Change**, **morpho-sedimentary impacts** and **ecological impacts** in estuaries*

- Besides temperature increase, the main expressions of climate change (CC) in estuarine environments are sea level rise (SLR) and possible change in storm regimes downstream (not so much in Europe), variations of river flow and solid fluxes upstream. For instance, in northern Europe, lengthening of the low river discharge duration is often predicted, leading to salinity intrusion and upwards shift of turbidity maximum in estuaries, with possible effects on water quality.
- Expected changes in erosion/deposition patterns due to modified forcing conditions are likely to change the estuarine morphology.
- Morphological processes and CC have similar time scales (several decades)
  → CC impacts depend on CC rate

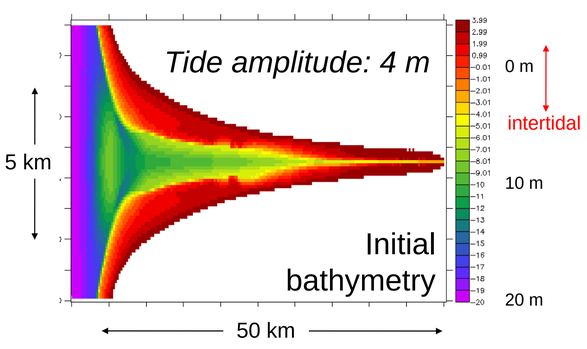
Questions :

- if SLR, will overflooding be more frequent or will morphology adapt ?
- dependence on sediment inputs in the area ?
- will the shift of salinity intrusion and turbidity maximum be effective when morphological evolution is accounted for ?
- what can be the evolution of intertidal areas, taking into account the vegetation in marshes ?

A 3D hydrodynamics and mud/sand transport model for simulating long term evolution of schematic estuaries

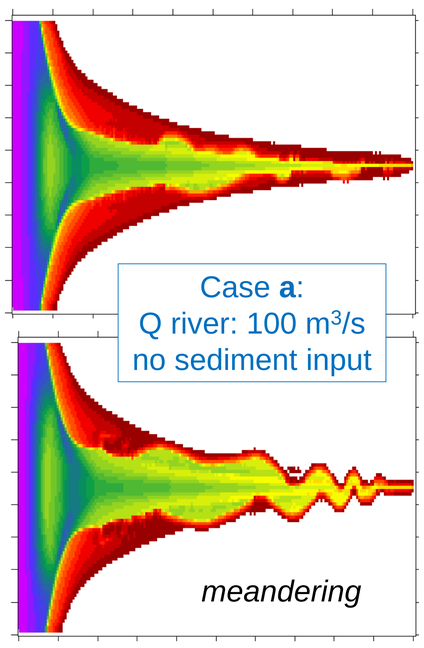
Simulated results after 200 years :

no sea level rise →

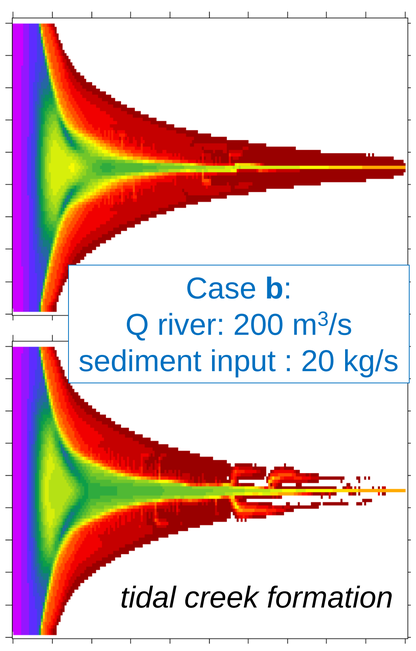


with 0.5 cm/year sea level rise →

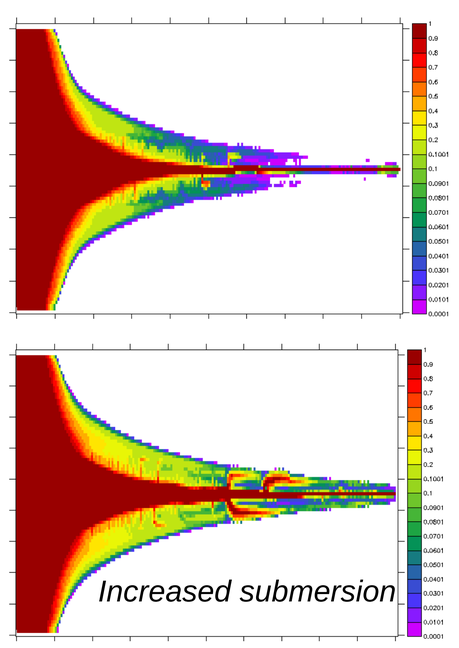
bathymetry (case a)



bathymetry (case b)



relative submersion time (case b)

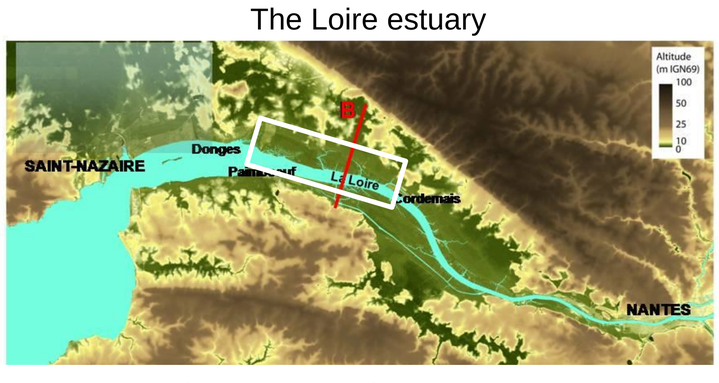


- Tidal prism increase
  → stronger hydraulics
- Downstream channel widening
- Creation of lateral creeks for drainage
- Depending on upstream sediment input :
  - tidal flat vertical accretion
  - erosion / submersion

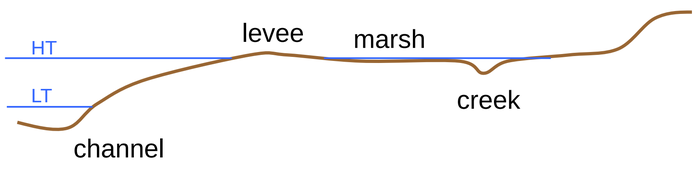
*Computations with **SEDI-MARS 3D** model*

Simulation of salinity intrusion and marsh evolution in the Loire estuary, using an operational 3D model

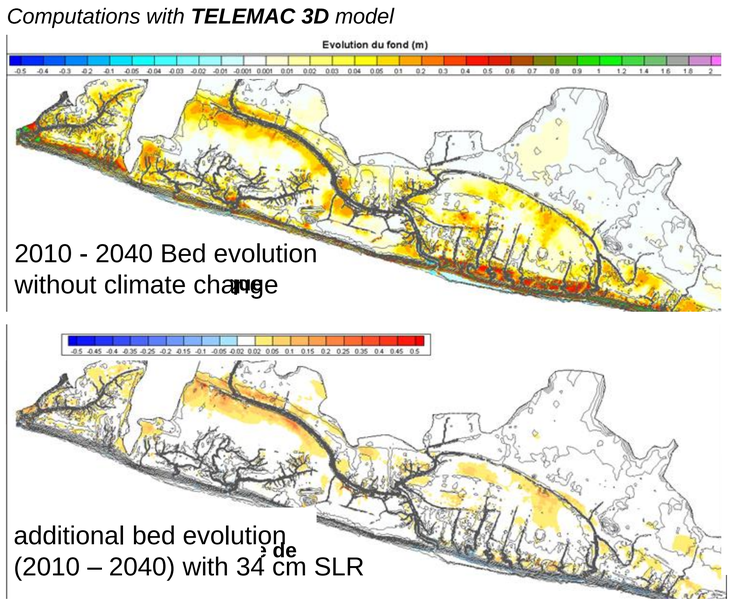
The Loire estuary

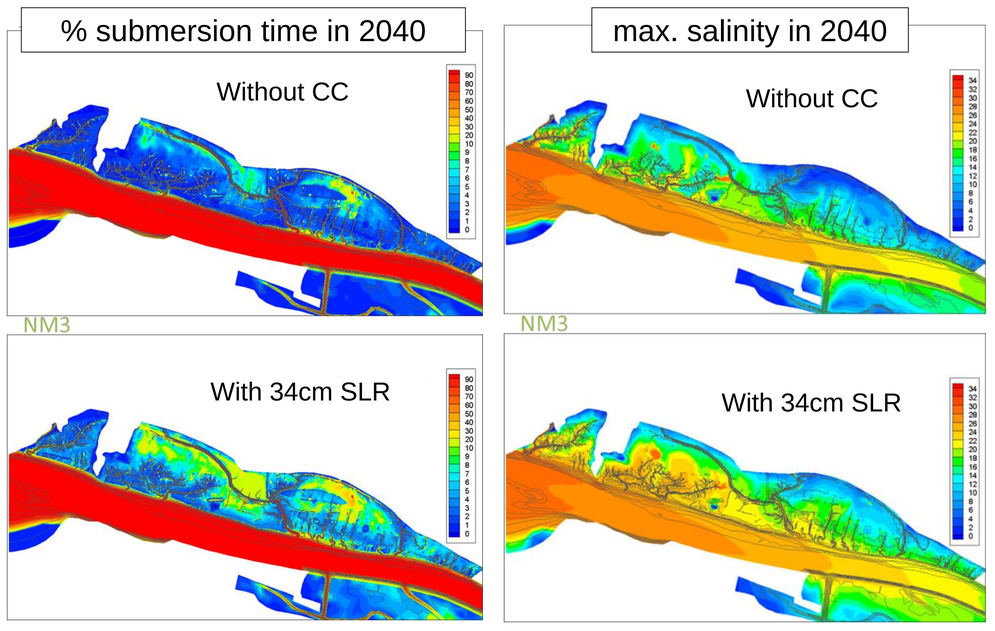


Representative cross-section:



*Computations with **TELEMAC 3D** model*





Simulated results show that sedimentation is in progress on upper intertidal areas even without climate change. A moderate sea level rise (34 cm in 30 years) would generate an upstream 5 km shift of both salinity intrusion and turbidity maximum, inducing an increase of salinity in lateral marshes. Sedimentation on lateral marshes is only slightly increased, so that their submersion should become much more frequent and higher. Change on vegetation types are anticipated in these areas where extensive grazing is maintained.

Contribution of the GICC program (management and Impacts of Climate Change)