What would happen if the Mississippi River changed its course to the Atchafalaya?

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Were the sediment to remain in the Mississippi, the Mississippi would sooner or later change its channel.

- Hans A. Einstein, 1952

Historical Avulsions of Mississippi River

The Mississippi River has changed its course many times in the past. In the first half of the 20th century, flow volume of the river into the Atchafalaya was rapidly increasing, which could have led to a significant change in its course again.

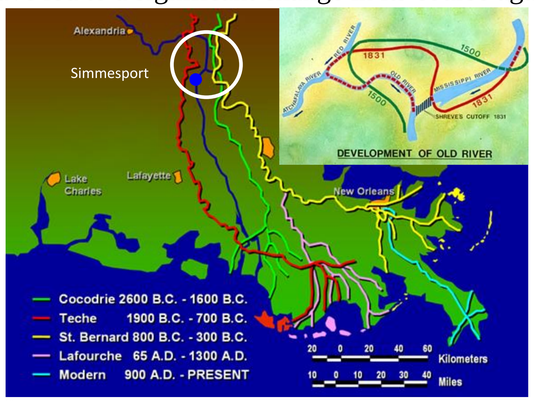


Fig. 1 Ancient and modern courses of the Mississippi River (top) and the Mississippi-Atchafalaya System in the 1940s (bottom).

Current Course and Control Structures

To prevent the Atchafalaya River from completely capturing the Mississippi River flow, a complex of control structures, also known as the Old River Control Structure (ORCS), was built in the 1960s and was extended in 1980s. The ORCS regulates the flow of water, but it does little to address sediment moving downstream in the Mississippi.

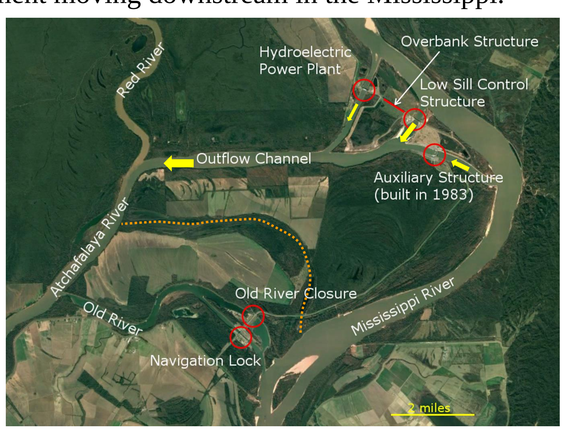


Fig. 2 The Old River Control Structure diverts approximately 25% of the Mississippi River flow into the Atchafalaya River.

Likelihood of Mississippi River Switching Its Course

- ***Riverbed aggradation and bar growth downstream of the ORCS***

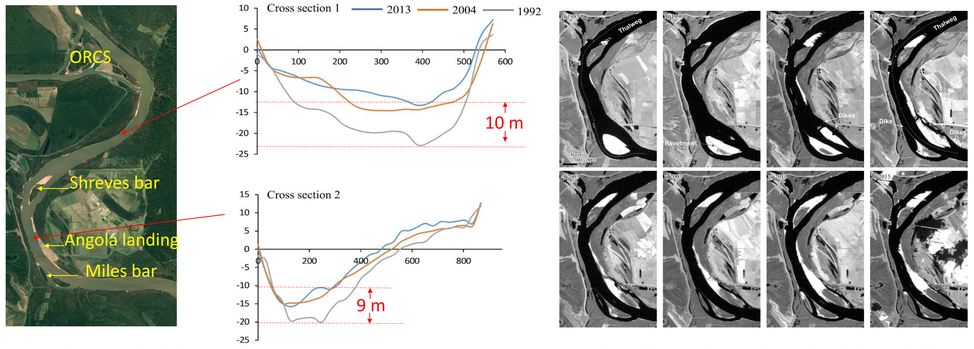


Fig. 3 The riverbed downstream of the Old River Control Structure has elevated significantly (left) and the channel has narrowed by 800 m, affecting the reach's flow capacity. (Joshi & Xu, 2017; Wang & Xu, 2016)

- ***Channel morphologic and flow capacity changes***

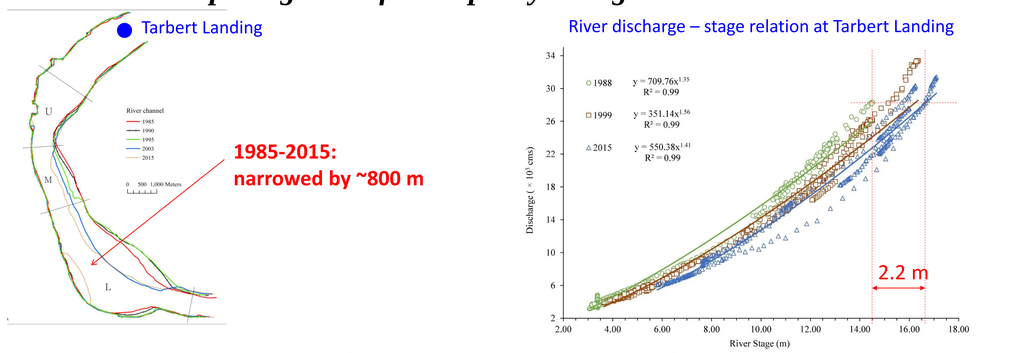


Fig. 4 Channel change downstream of the Old River Control Structure (left) and changes in discharge – stage rating curves at Tarbert Landing gauging station (~10 km downstream the ORCS). (Wang & Xu, 2016)

- ***Backwater effects***

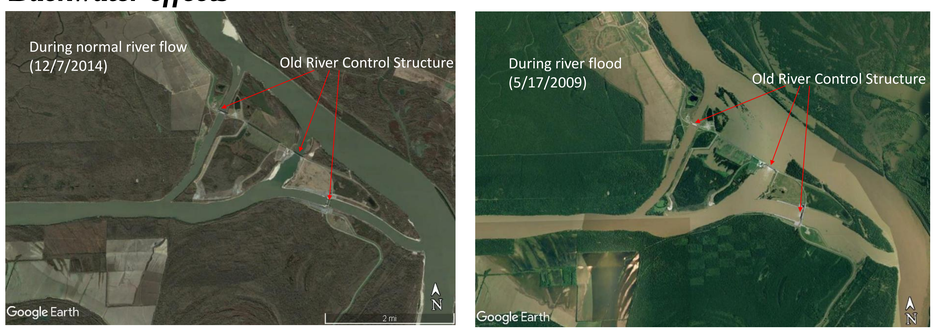
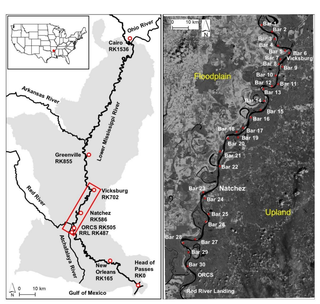


Fig. 5 There have been several major floods in the past decade. Here is just an example showing the Old River Control Structure during the 2009 spring flood.

- ***Future threats***



Sand store on emerged channel bars immediately upstream of the ORCS:

530 MT

Fig. 6 Large sand storage upstream, whose mobilization could accelerate riverbed aggradation. (Wang & Xu, 2017)

781,000 cfs (May 12, 1973)
694,004 cfs (May 23, 2011)
1,498,000 cfs (May 16, 1973)
1,690,000 cfs (May 19/20/21, 2011)

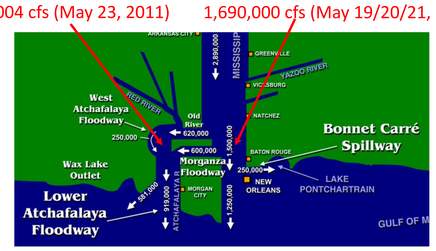
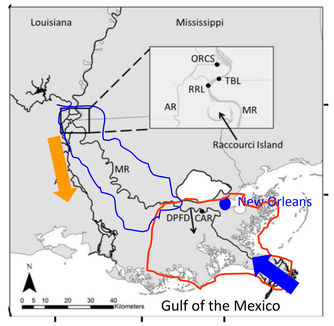


Fig. 7 The Mississippi River flow has been projected to increase by 11%-60% by the end of the 21st century.

Consequences

- ***Saltwater intrusion and drinking water crisis***



Population potentially affected

~2 million

Immediate (surface water):
a) New Orleans – Metairie –Kenner metropolitan area: ~1.25 million
b) Houma-Bayou Cane-Thibodaux metropolitan area: ~0.21 million

Near future (groundwater)
a) Baton Rouge area: ~0.2 million
b) Along the MR between Baton Rouge and New Orleans: ~0.2 million

Fig. 8: Immediately affected area (red line) and near-future affected areas if the Mississippi River changed its course.

- ***Widespread flooding in the Atchafalaya Basin and rapid land creation in the bay***

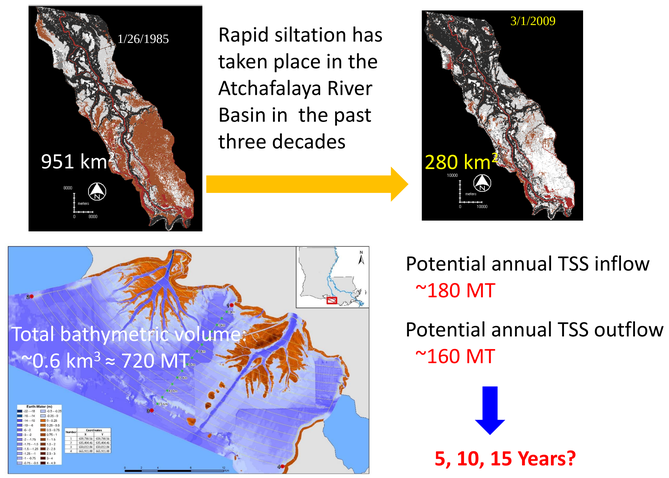


Fig. 9 The Atchafalaya Basin has already silted up (top, Rosen & Xu, 2015) and its bay area would quickly become land if the Mississippi River switched its course to the Atchafalaya (Xu & Mena, in prep).

Closing Thoughts

- Sediment transport has been and will remain the biggest challenge for the management of this large alluvial river system.
- There is a dilemma between the channel aggradation possessing avulsion risk and the high demand on sediment for coastal restoration. Conventional thinking and engineering practices may not have a solution here.
- A thorough assessment on trigger points and socioeconomic effects of a potential Mississippi River course switch is not only necessary, but inevitable (e.g., engineering solutions, risk assessment, emergency preparedness and response, and recovery capabilities).

Acknowledgements

NSF USDA CPRA US Army Corps of Engineers USGS science for a changing world