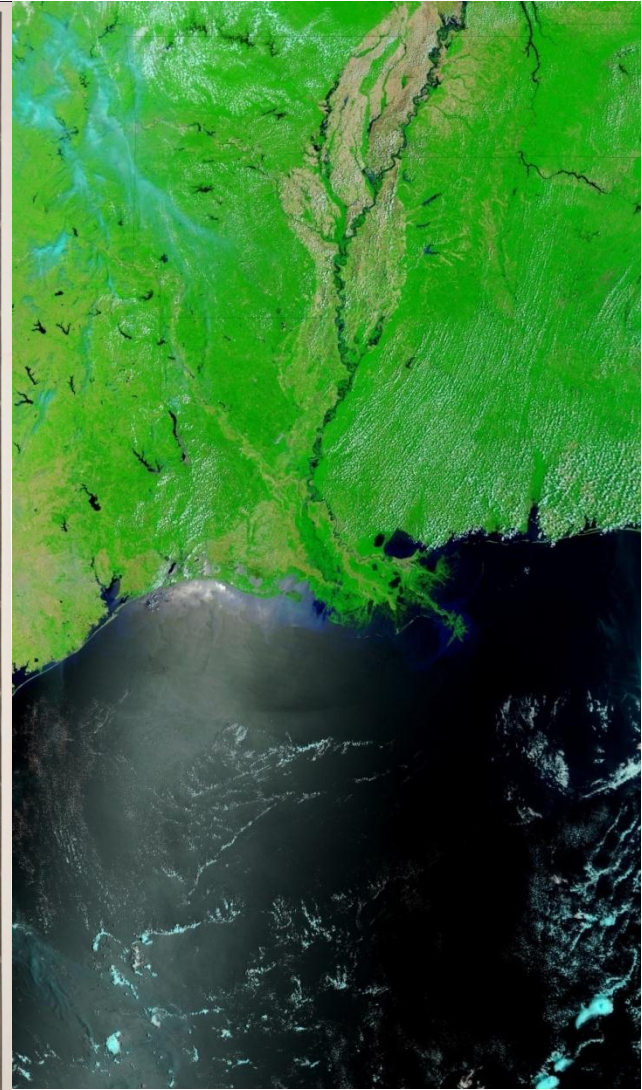
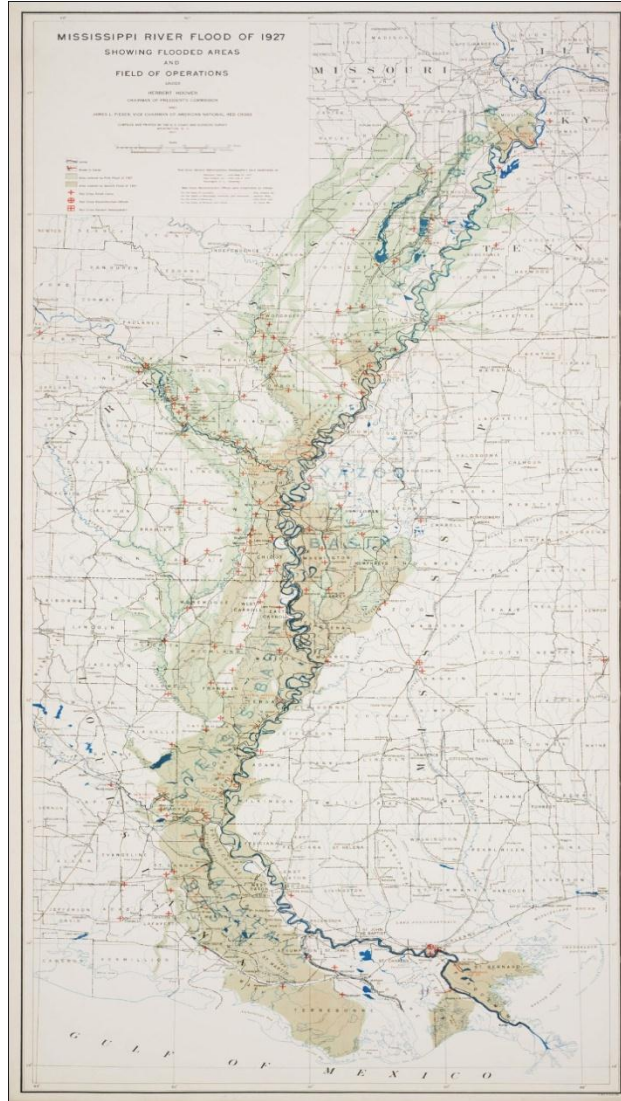


The 1927 Crevasse at Caernarvon: Implications for Restoration



Jaye Cable¹,
John Day², and
Paul Kemp³

¹UNC, ²LSU,
³NAS

1927 Flood

2011 Flood

Mississippi River Watershed

Missouri River:
7 major dams

Mississippi River:
28 lock and dams
9 dams
3 spillways

Arkansas River:
18 lock and dams

Ohio River:
21 lock and dams

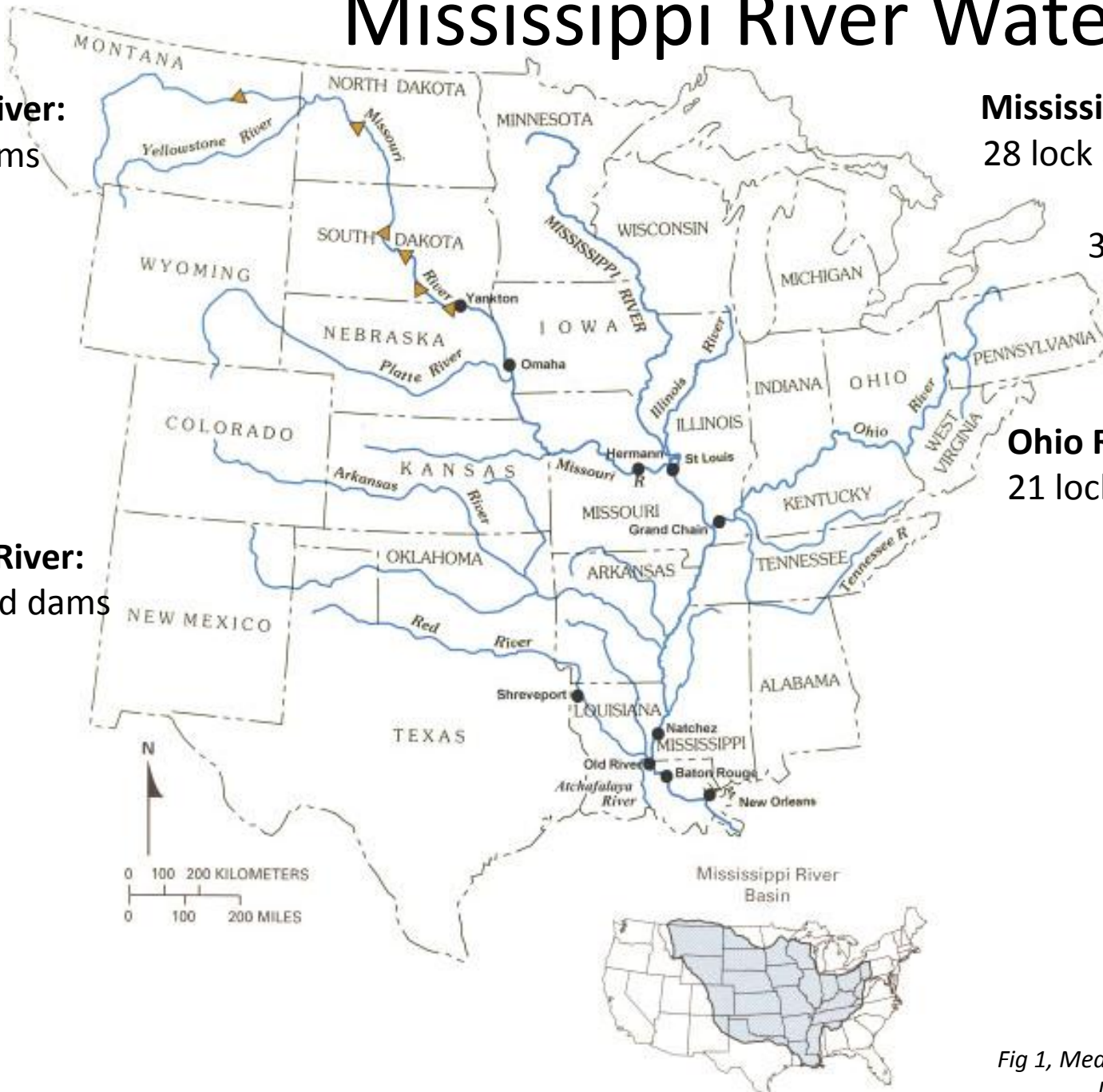
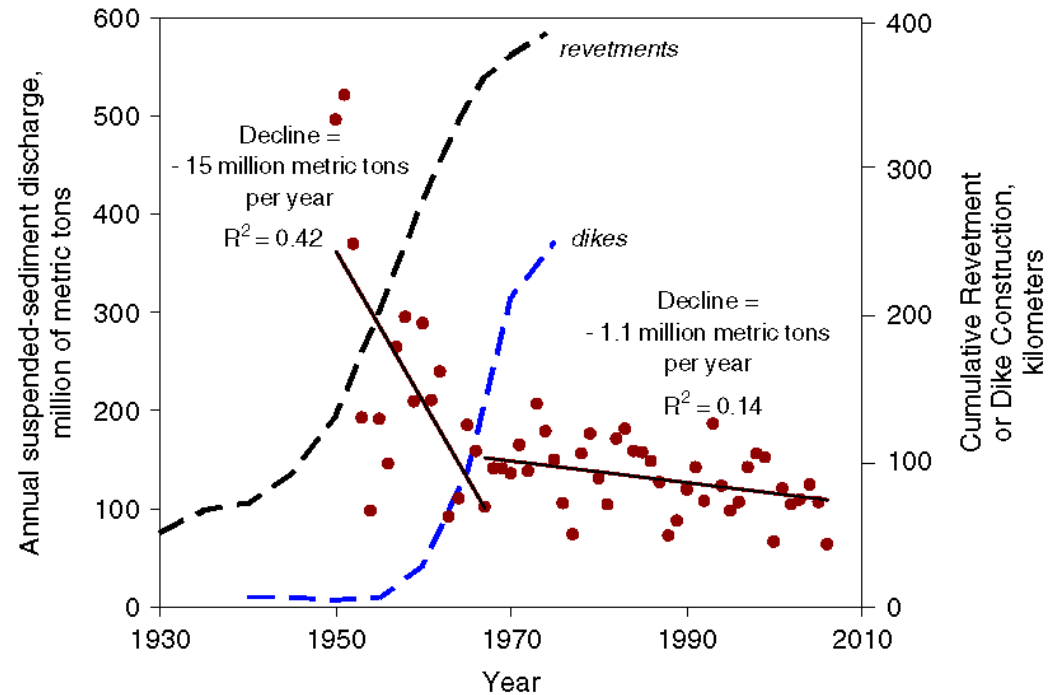
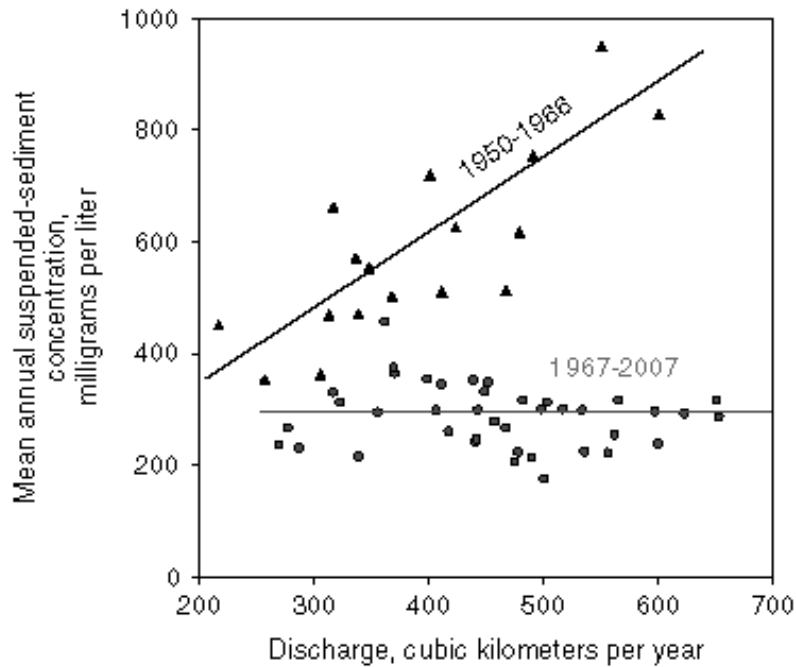


Fig 1, Meade and Moody, 2010
Data, Horowitz, 2009

Sediment Loads over Time in Context of Closure Structures



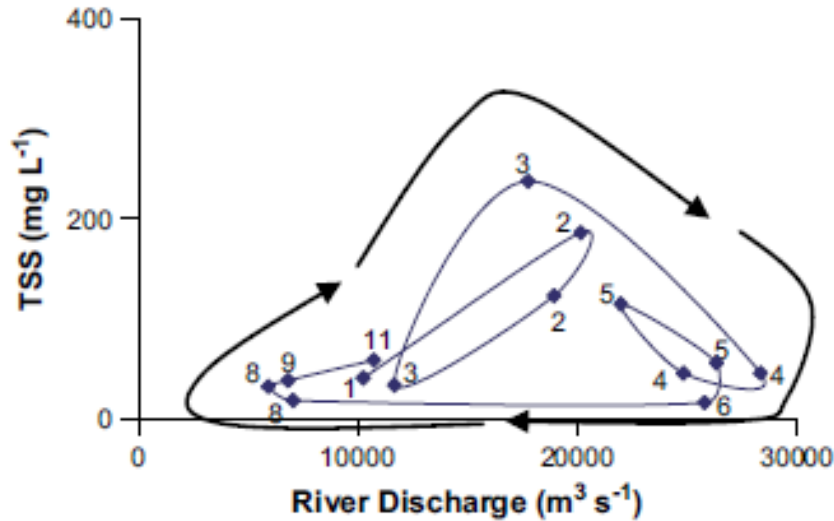
Two slopes in the reduction are observed: **100-150 million metric tons/year trapped**

1a. Sediment loads are reduced by closure of river by dams and locks.

1b. Revetments and dikes have cutoff the floodplain and altered the river erosional patterns

2. Subsequent decreases are due to progressive remobilization and gradual depletion of river beds downstream of dams

Suspended Sediment Load Hysteresis



Suspended sediment collected at Belle Chase in Mississippi River surface waters for 2002 (top) and 2003 (bottom)

Sediment concentrations vary with discharge in a loop effect

Sediment concentrations are

- highest on rising and cresting stages
- lowest on falling and troughs in river stage

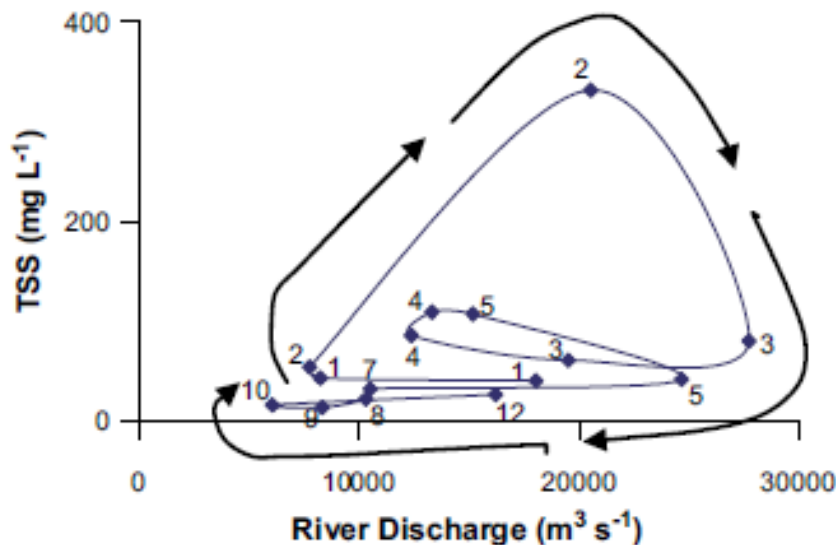
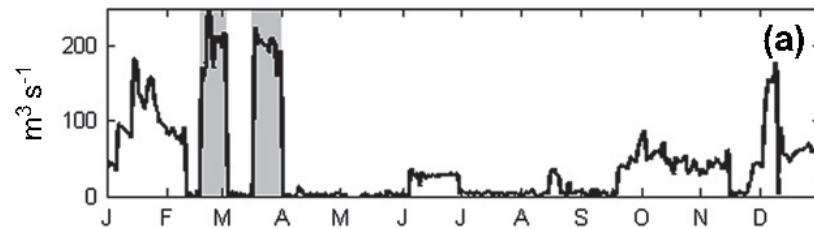
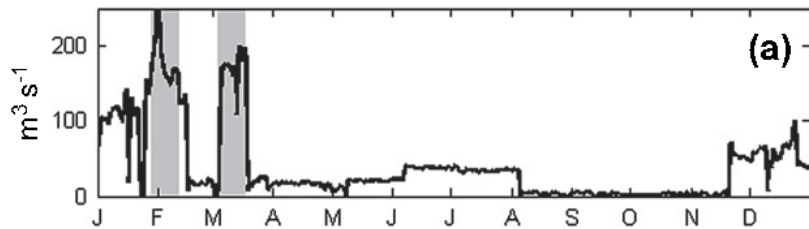


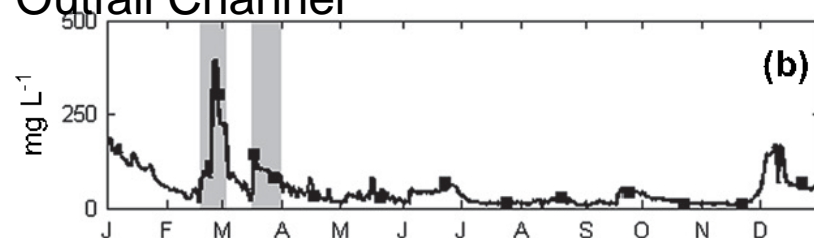
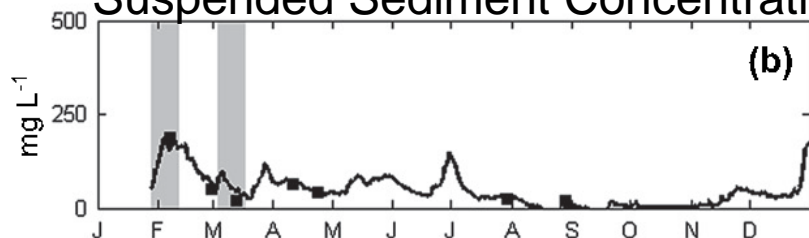
Fig. 7. Relationship between water discharge and suspended sediment concentration in the Mississippi River at Belle Chase for 2002 (top) and 2003 (bottom). Numbers next to data points indicate month of year in which samples were collected.

Experimental Discharges to understand how river flow, diversion discharge, and sediment flux are connected.

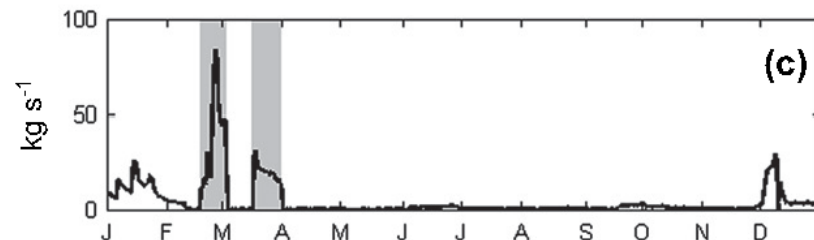
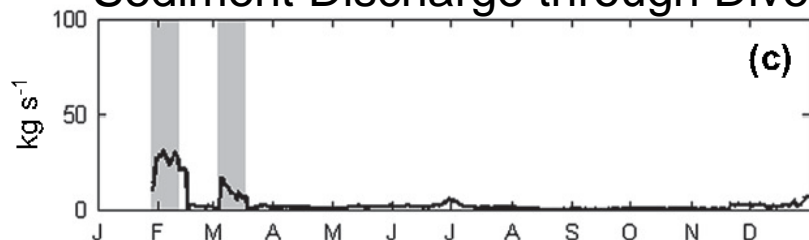
Caernarvon Discharge from Outfall Channel



Suspended Sediment Concentration in Outfall Channel



Sediment Discharge through Diversion



Mississippi River Q (line) and TSS (dots)

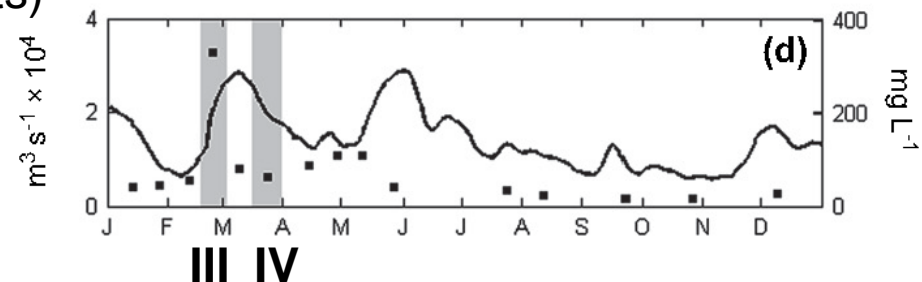
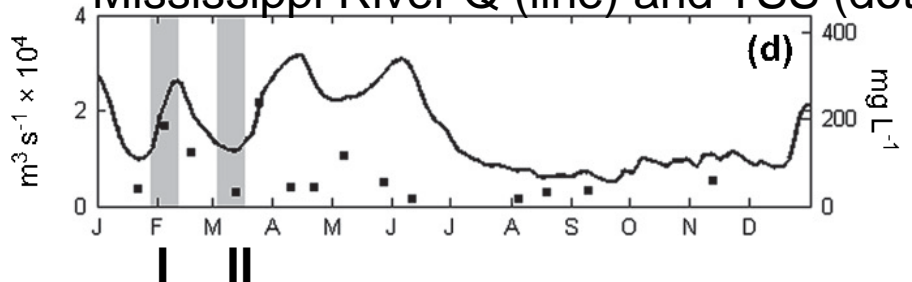
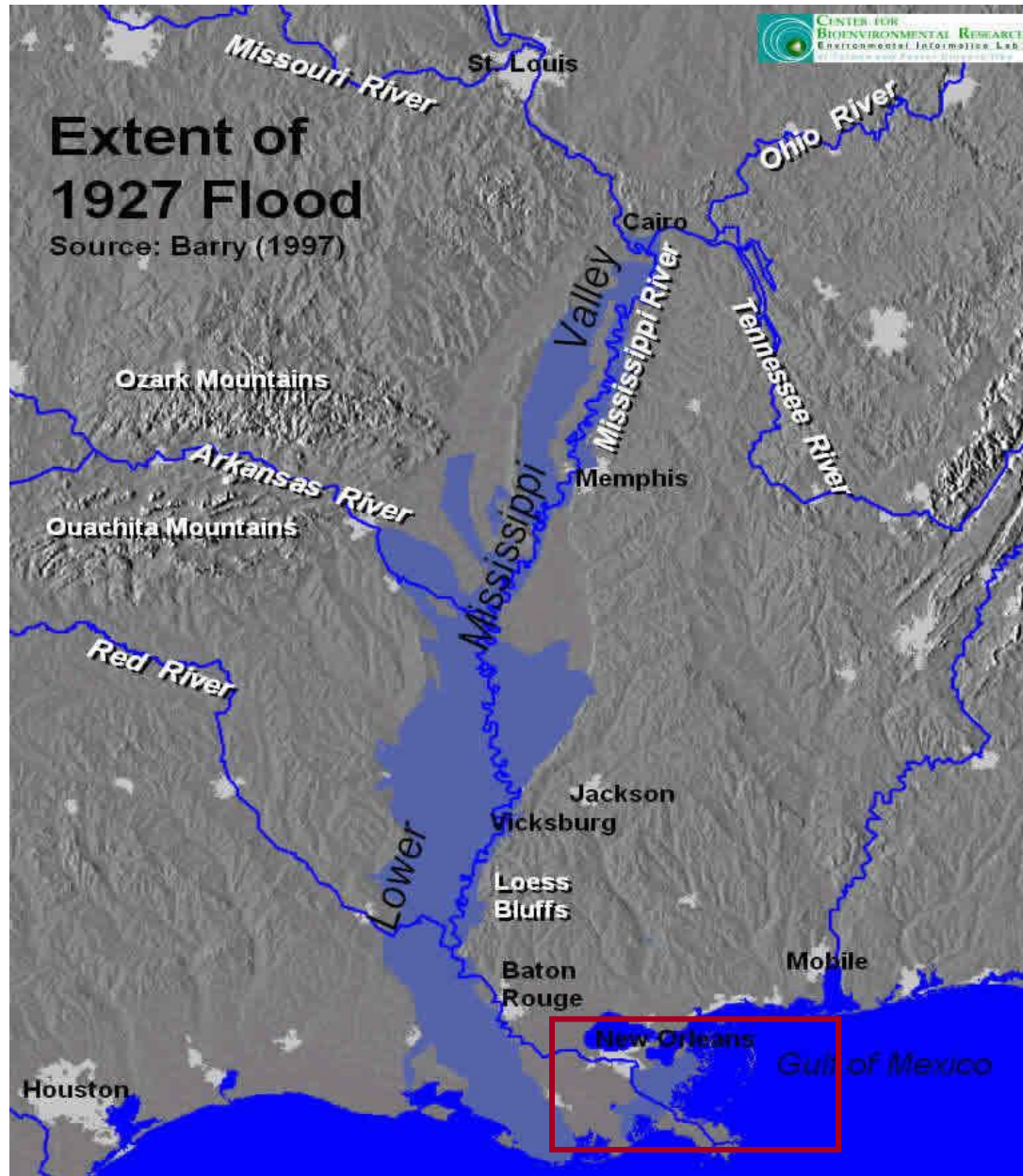


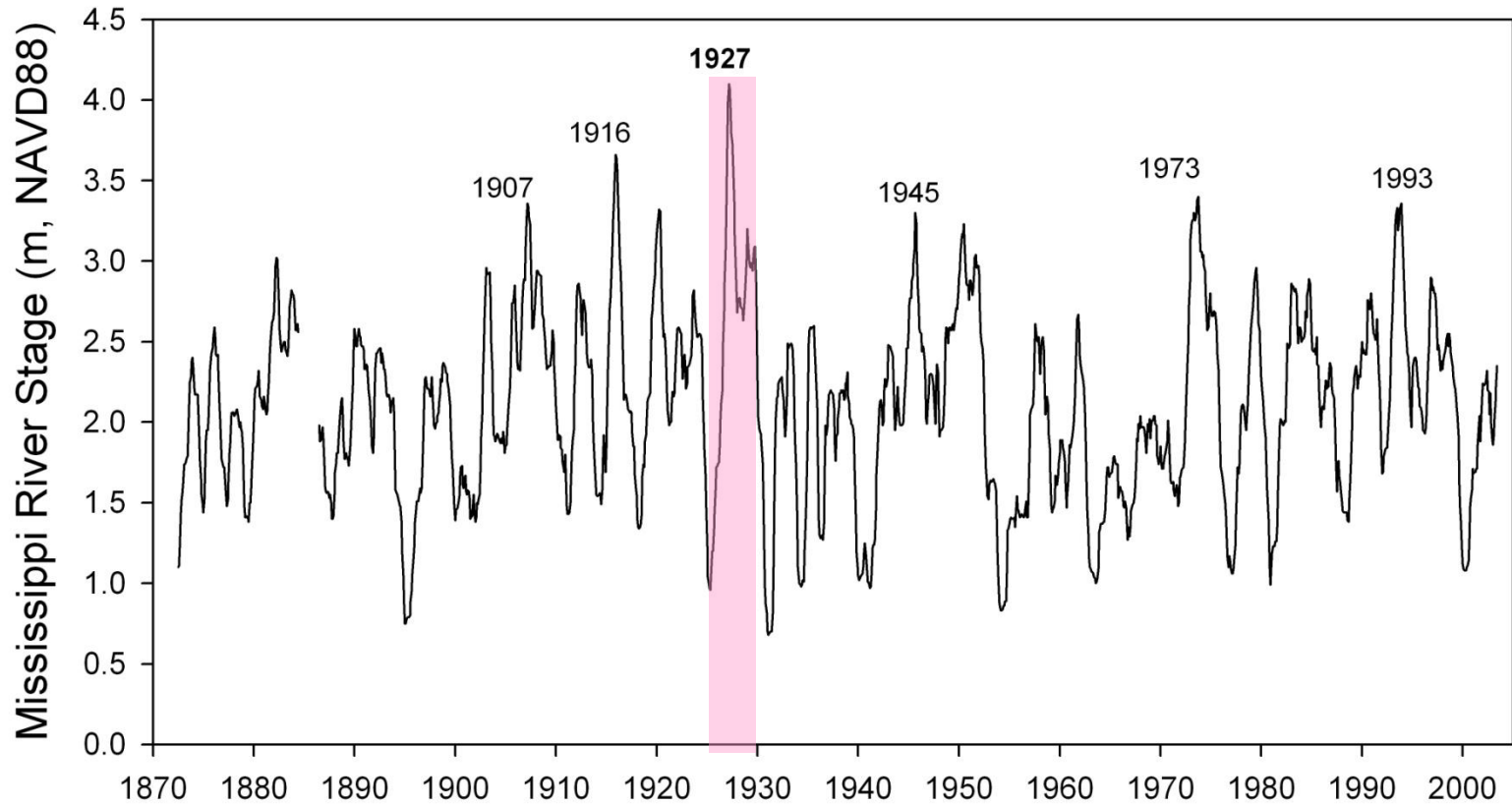
Fig. 5, Snedden et al. 2007

Flooding of the lower Mississippi River Valley



- 153 consecutive days of flood stage
- 700,000 km² of adjacent land under water
- ~ 700,000 people displaced from their homes

Carrollton gauge, New Orleans



extensive flooding as
local levees failed



NOAA Photo Library (www.noaa.gov)



NOAA Photo Library (www.noaa.gov)

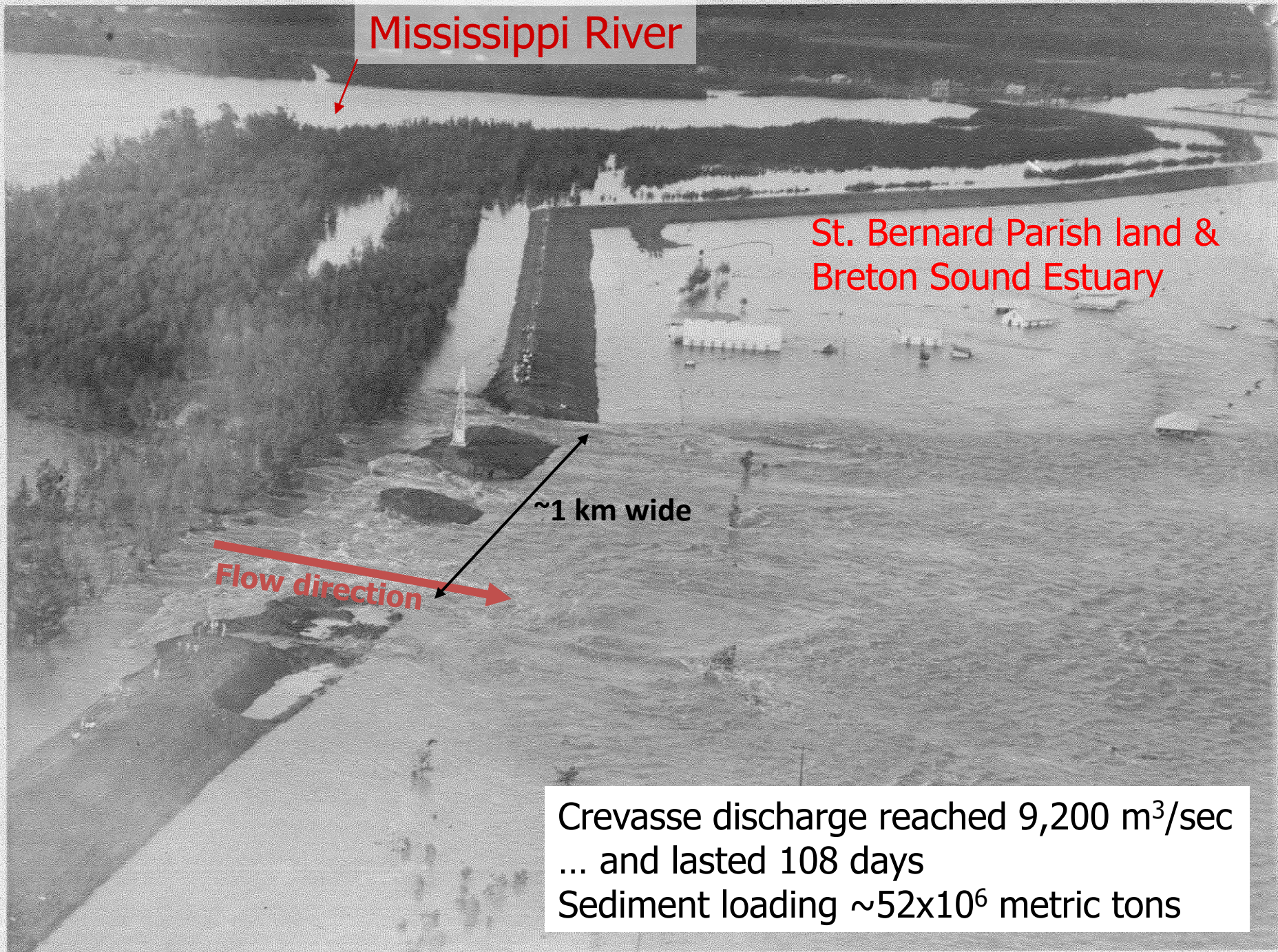
Mississippi River

St. Bernard Parish land &
Breton Sound Estuary

~1 km wide

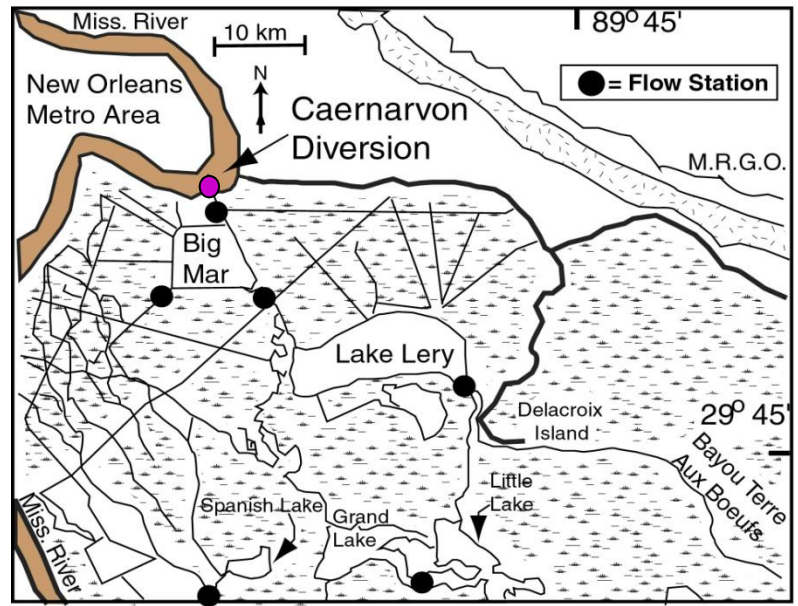
Flow direction

Crevasse discharge reached $9,200 \text{ m}^3/\text{sec}$
... and lasted 108 days
Sediment loading $\sim 52 \times 10^6$ metric tons

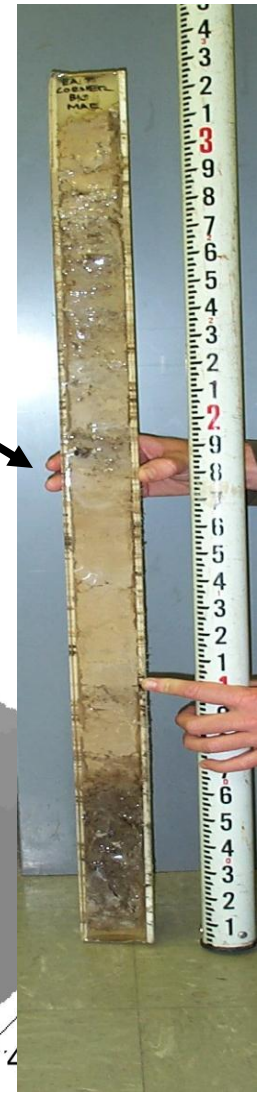
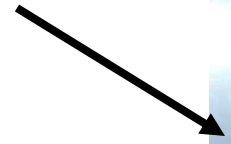


where did the sediment go?

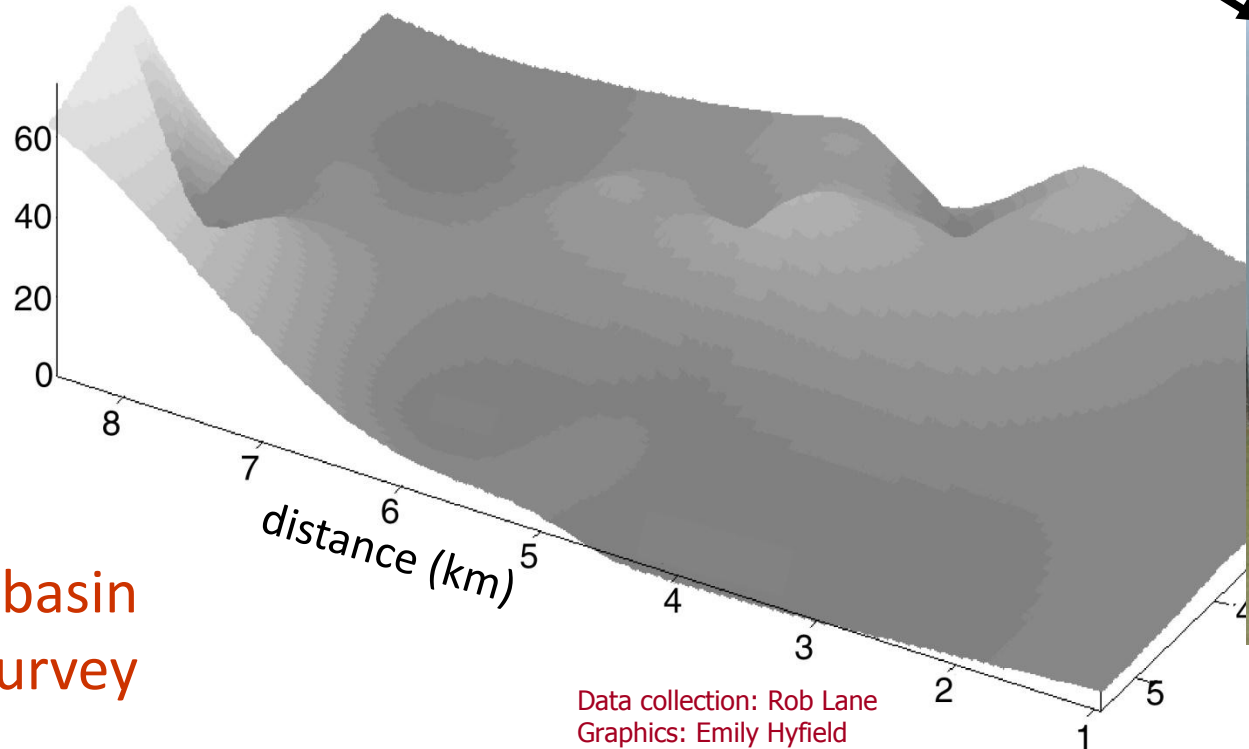
Post 1927 flood deposition rate is about 2.6 to 3.0 mm/year



1930 ± 5 yrs



thickness (cm)



upper basin sediment survey

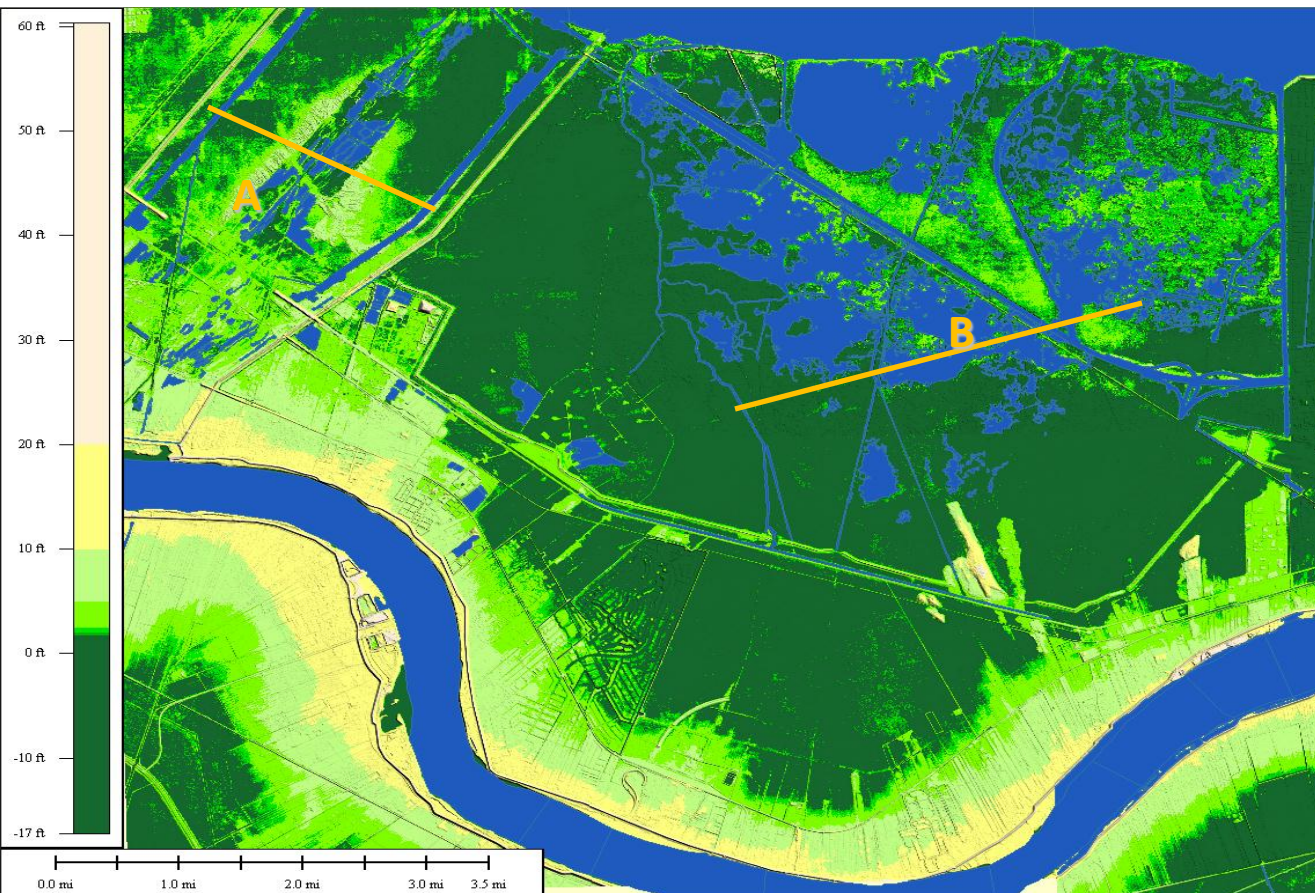
Data collection: Rob Lane
Graphics: Emily Hyfield

Post-1927 Accretion at Caernarvon

Method	Deposition Rate	Citation
Sediment Traps	22 mm/yr	Wheelock, 2003
^{210}Pb and ^{137}Cs Dating	2.6 to 3.0 mm/yr	these data
Sediment Discharge	5.6 to 8.4 mm/yr	Snedden et al 2007
Mean soil height (29cm) above clay layer in 72 years	40 mm/yr	unpub data

Recent deposition captured by sediment traps is uncompacted surficial deposition.

Mean soil height above flood deposit is more representative of organic matter accretion.

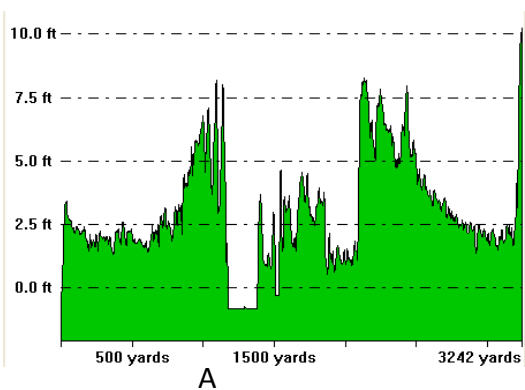


Bonnet Carre
Floodway

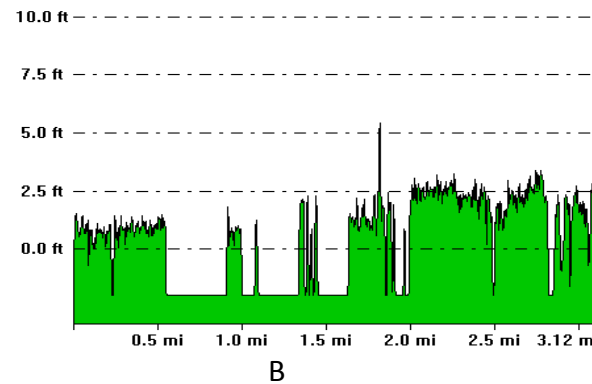
- Accretion 2.8 cm/yr
- Bulk density 1.0

LaBranche
Wetlands

- Accretion 0.38 cm/yr
- Bulk density 0.2-0.3



Bonnet Carre Spillway



LaBranche Wetlands

Hundreds of
Natural
Crevasses since
1700s

Sediment Delivery to Wetlands

Causes	(mm)	Citation
Historical event deposition Crevasses	+26 to +89 (mm/event)	Kesel (1989)
Modern deposition Caernarvon	+ 5.6 to 8.4 (mm/yr)	Snedden et al. (2007)
Modern deposition Bonnet Carre'	+ 28 (mm/yr)	John Day data

Note here the depositional rates are different (per event vs per year).

Summary

- Timing of diversion discharge to capture higher river sediment loads is key. (configuration of the diversion is also important)
- Awareness of discharge required to get sediment over marshes without drowning the marshes is important
- Reality is prolonged flood events with high $Q_{sediment}$ are more effective at land-building
- Short pulsed floods, such as the Caernarvon, are instructive for demonstrating the processes involved but are not effective land-builders