Sediment in the Mississippi River: The "Supply-Side" of Coastal Restoration

Mead Allison and Jeffrey Nittrouer and John Galler

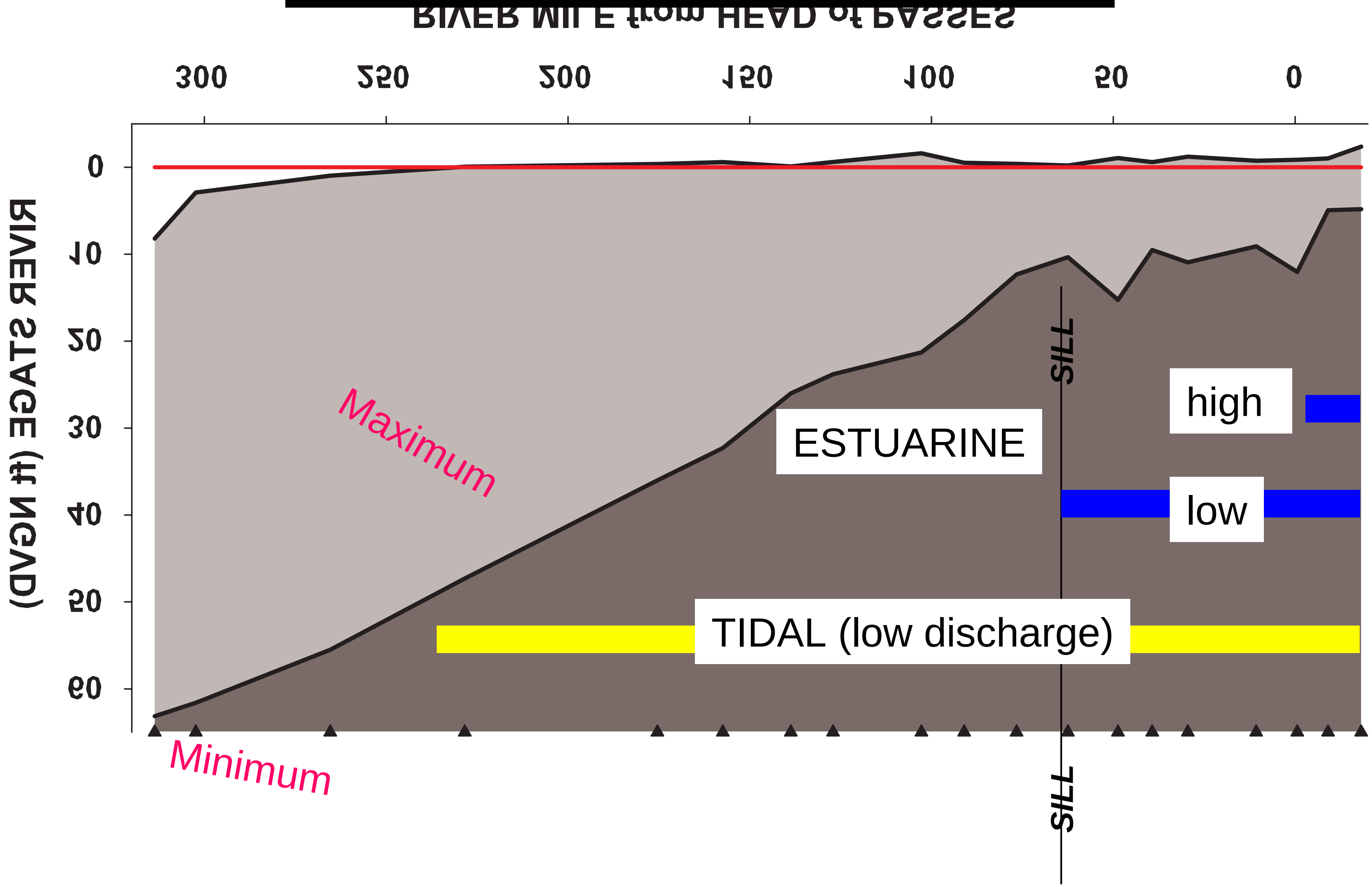
Dept. of Earth & Env Sciences, Tulane University

Richard Campanella

Tulane-Xavier Center for Bioenvironmental Research

Funding provided by Tulane-Xavier CBR (LEAG and MIRIR), NOAA, USGS, ONR

LOWER (LA) MISSISSIPPI RIVER WATER SURFACE ELEVATION



Engineering for Coastal Restoration in Louisiana:

1. Large freshwater-sediment diversions (10,000-250,000 cfs) – suspended load

2. Long-distance pipeline conveyance -- bedload/stored suspended/relict source

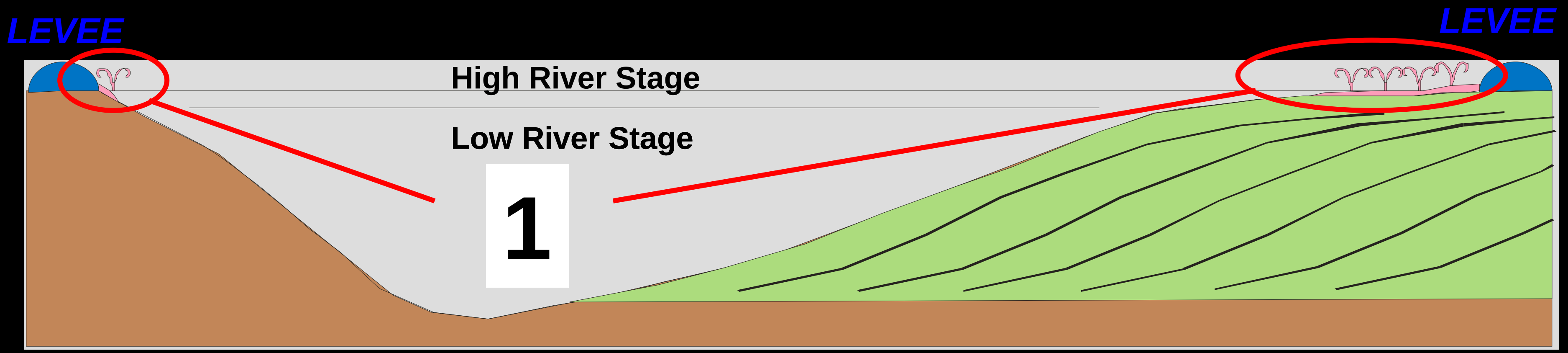
Supporting Science Questions:

1. What non-renewable and renewable sediment resources are available for use in coastal restoration within the levees?

2. What do we still need to know to adequately manage the resource?

3. How does the sedimentological/hydrological/rheological character of the system control potential extraction methods?

NON-RENEWABLE SEDIMENT RESOURCES FOR RESTORATION



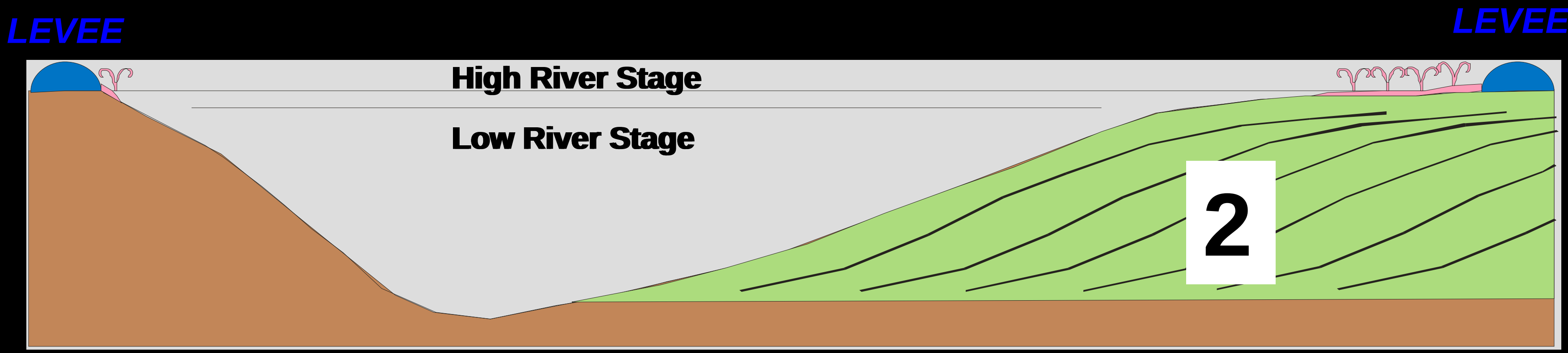
Deep Meander Reach

(1) Post-Levee Batture

-relatively high quality sand

-limited sediment volume
-already mined for local projects including levee reinforcement
-removal by land mining

NON-RENEWABLE SEDIMENT RESOURCES FOR RESTORATION



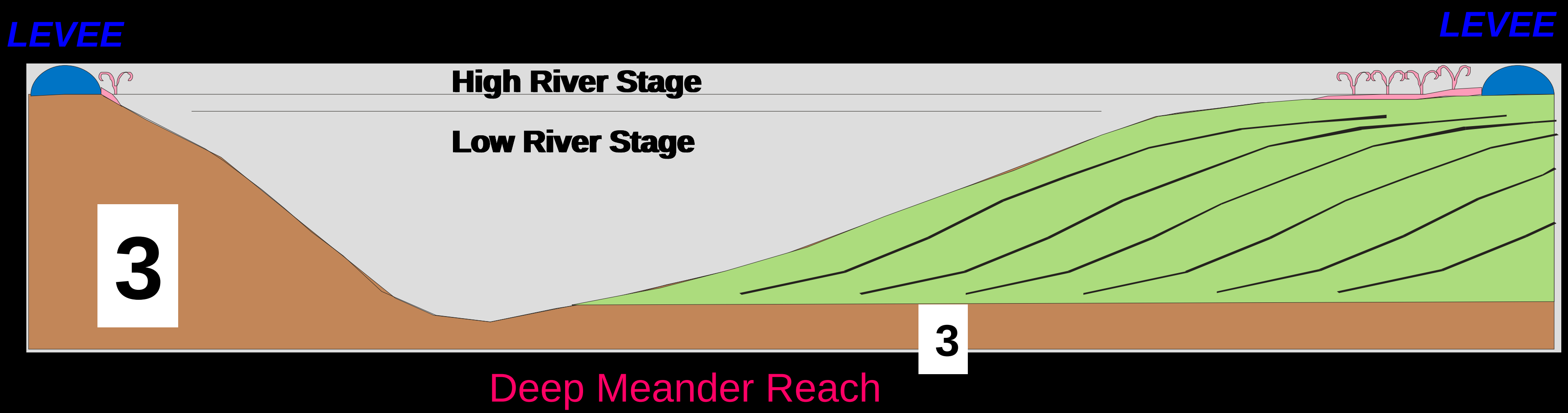
Deep Meander Reach

(2) Pre-Levee Point Bars

-high quality sand

-few in number in lower river
-removal will affect downriver hydrodynamics
-difficult to transport to site (removal method, consolidation)?

NON-RENEWABLE SEDIMENT RESOURCES FOR RESTORATION



(3) Relict Incised Strata

-variable, layer-specific composition (sand, mud, peat)
-fluvio-deltaic origin
-range in age from Plaquemine-Balize lobe to Pleistocene
-increase in age with depth in channel and upriver
(strata dip seaward)

-highly consolidated
-difficult to remove and transport
-suitable for marsh restoration substrate?

Supporting Science Questions:

1. What non-renewable and renewable sediment resources are available for use in coastal restoration within the levees?

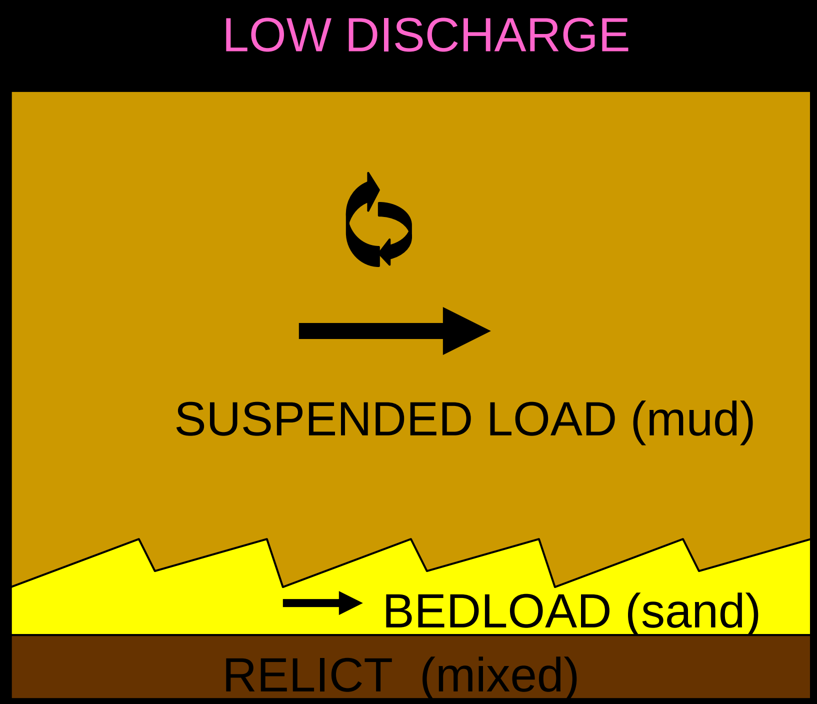
***Suspended** Sediment Loads of the Lower Mississippi-Atchafalaya*

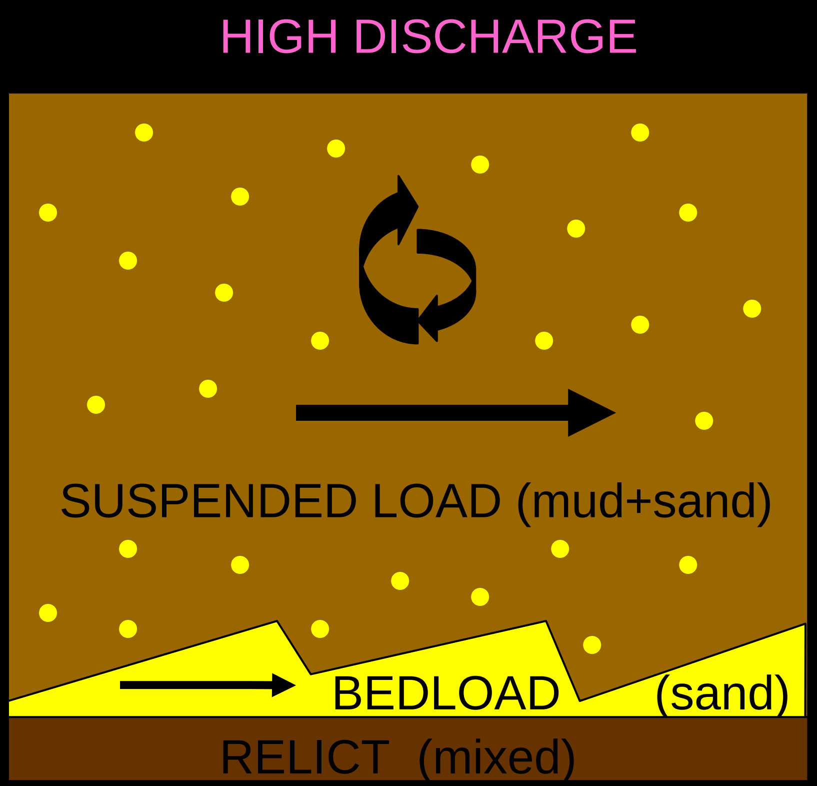
400 mt *(Pre-1850; Kesel et al., 1988)*
394 mt *(Pre-1963; Keown et al., 1986)*

Dams, Soil Conservation, Elimination of Bank Caving, etc.

230 mt *(Pre-1993 + Red; Horowitz et al., 2001)*
190 mt *(Post-1993 + Red; Horowitz et al., 2001)---**124 mt** in Miss*

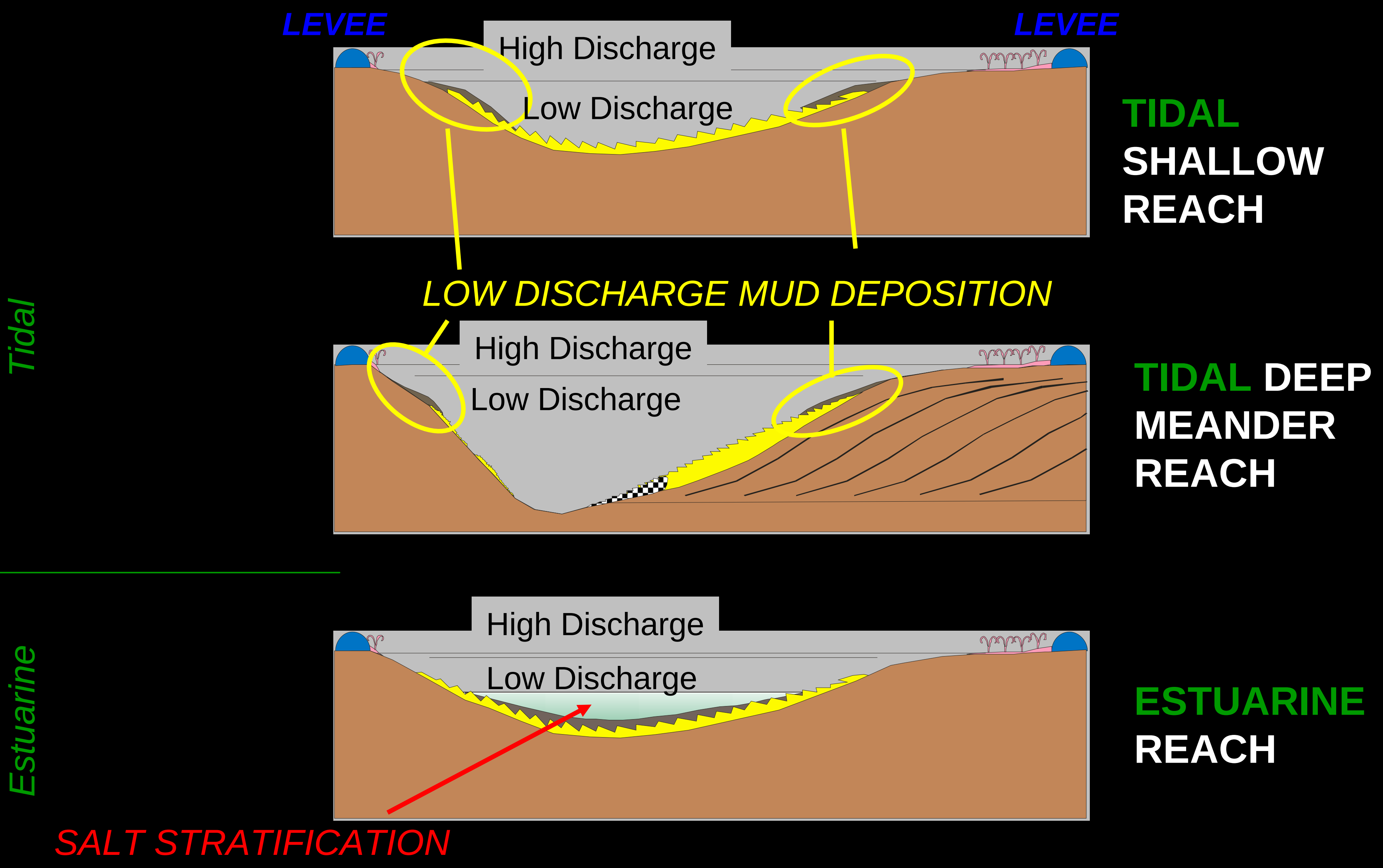
LOWER MISSISSIPPI RIVER SEDIMENT CYCLE





LOCAL VS UPSTREAM SEDIMENT SOURCES?

RENEWABLE (BED) SEDIMENT RESOURCES FOR RESTORATION



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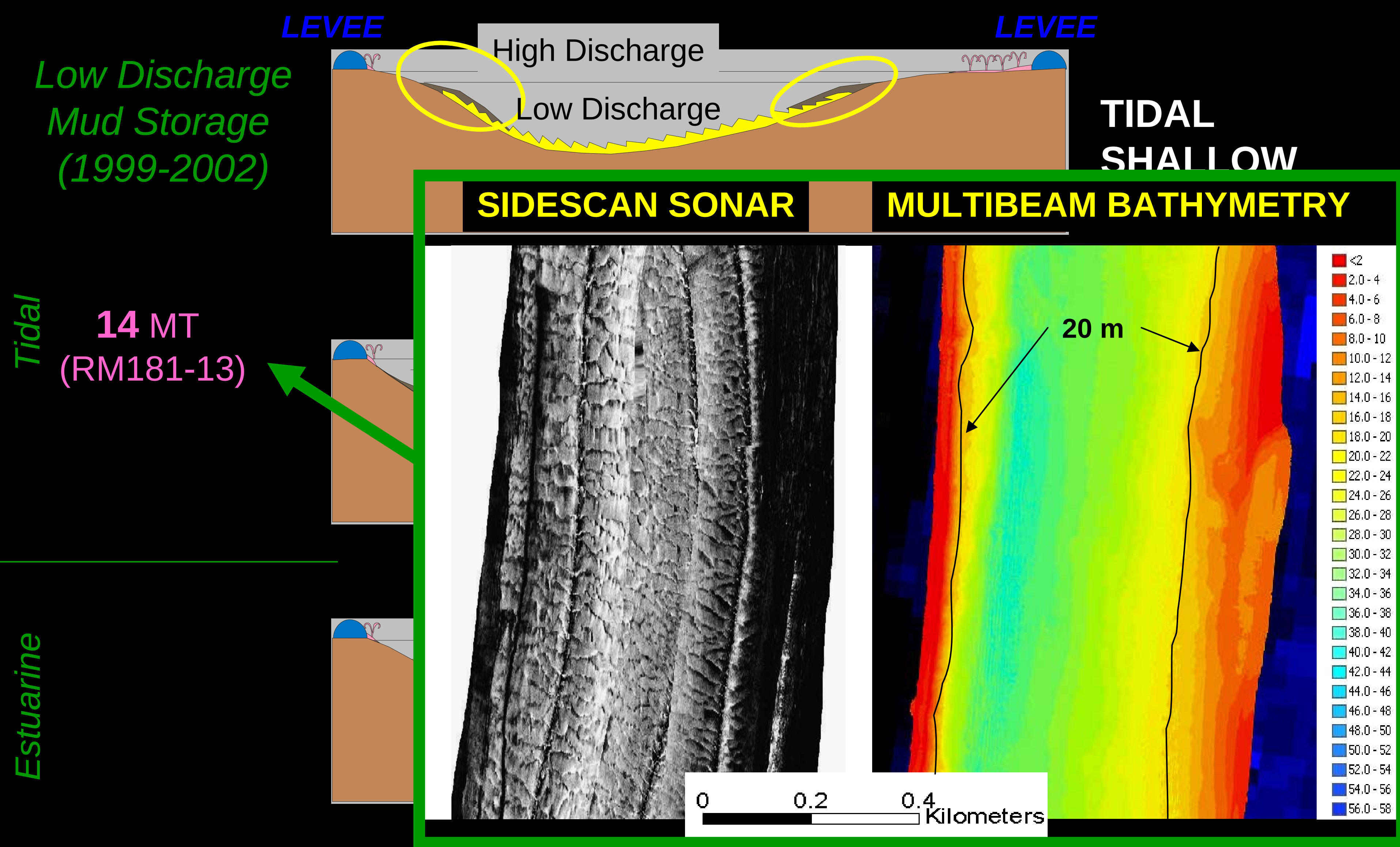


RENEWABLE (BED) SEDIMENT RESOURCES FOR RESTORATION

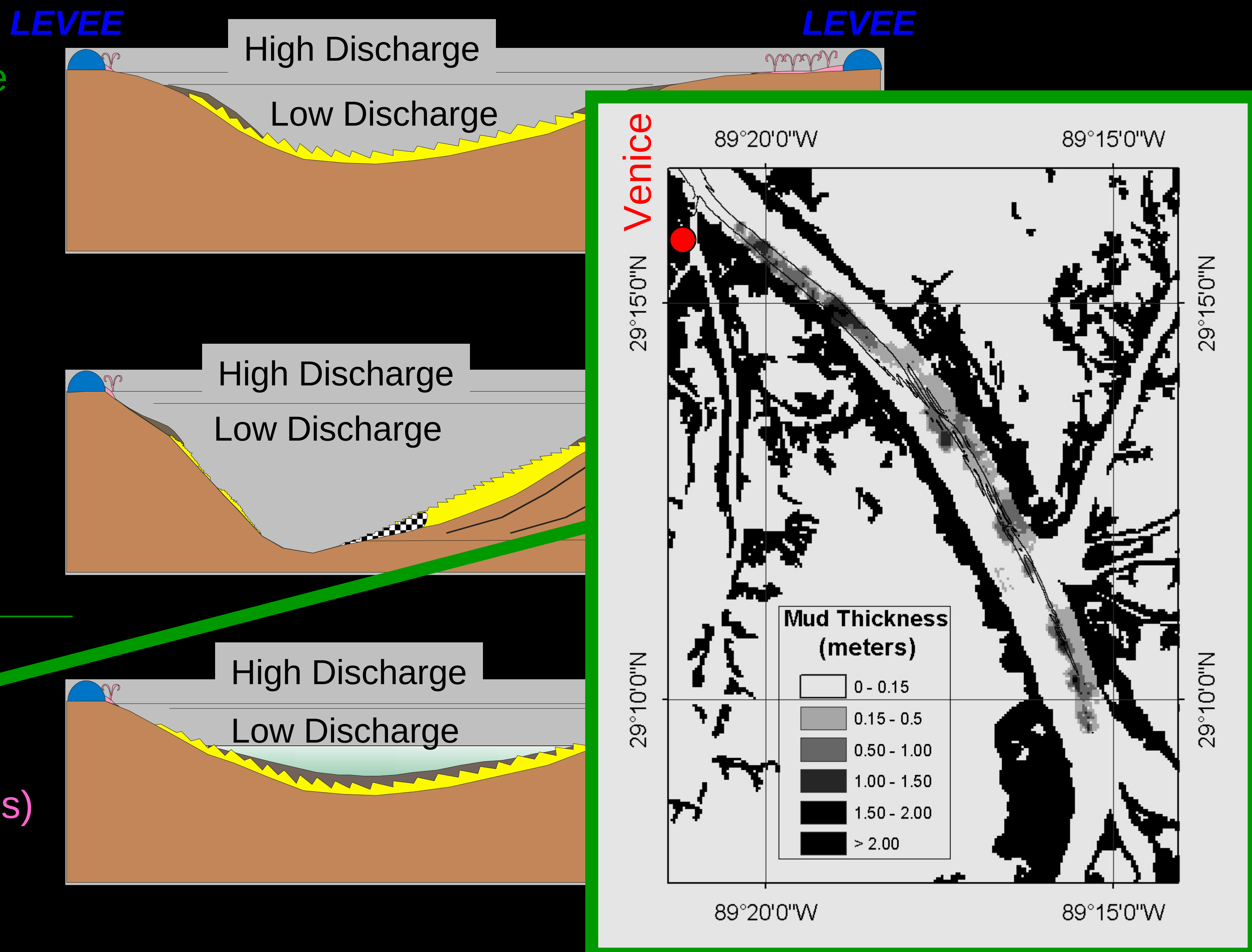
Low Discharge
Mud Storage
(1999-2002)

Tidal

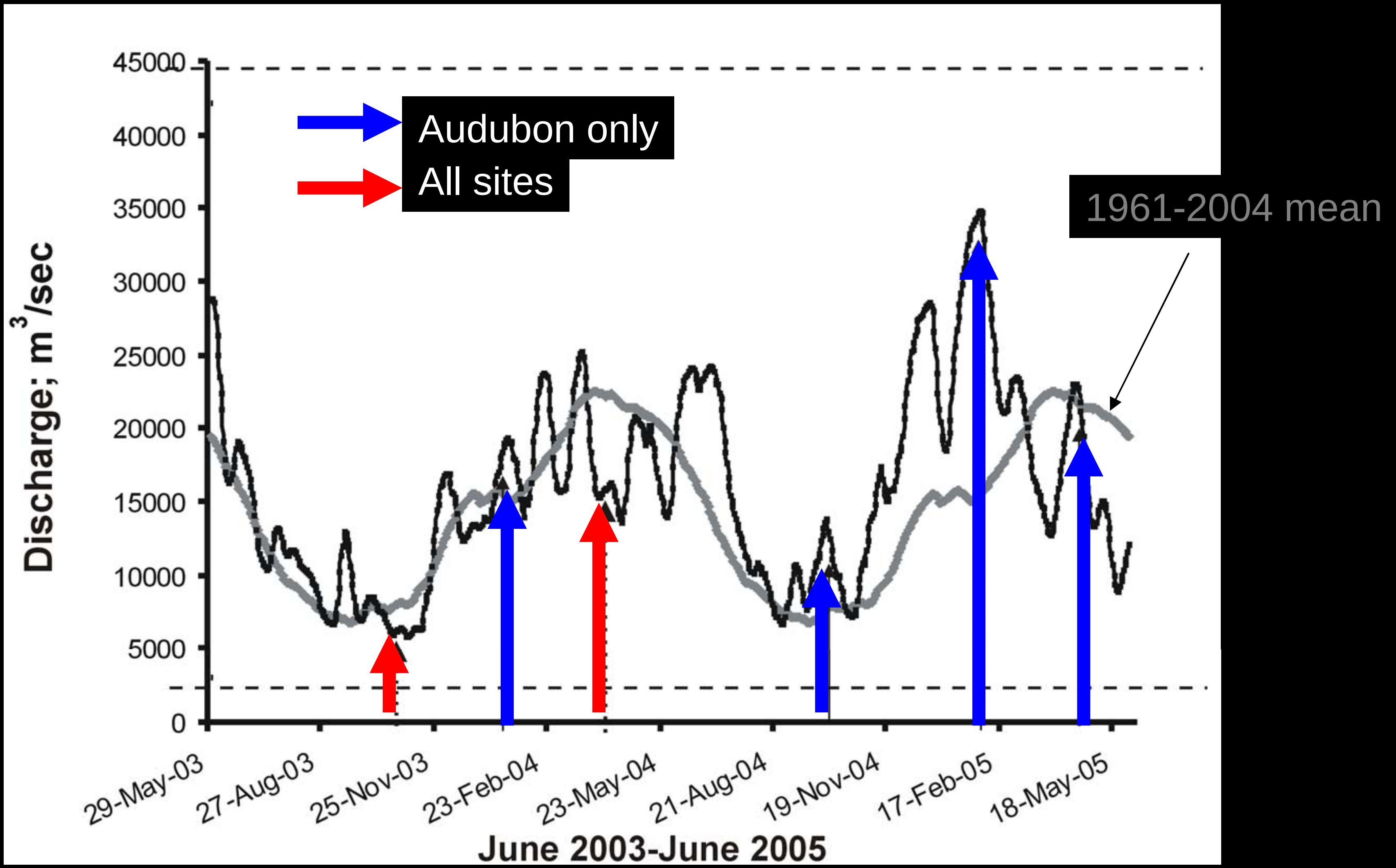
14 MT
(RM181-13)

Estuarine

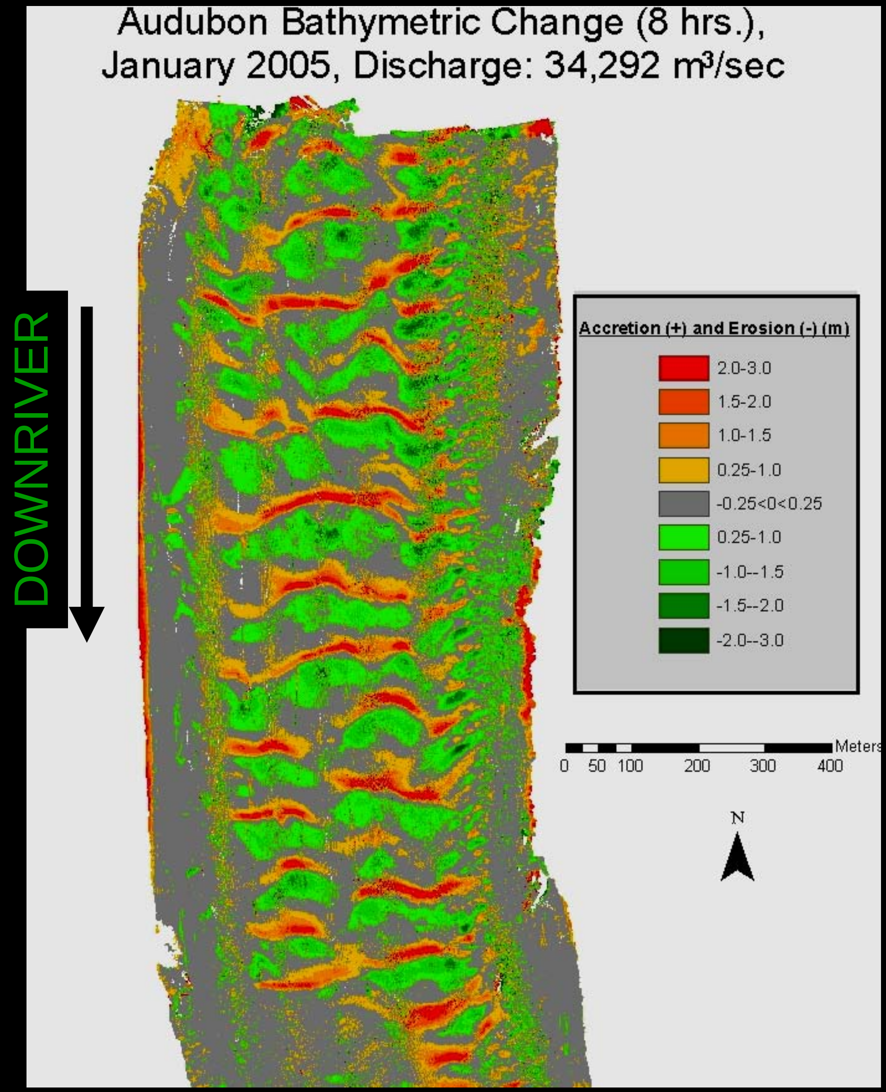
10 MT
(RM13-Passes)



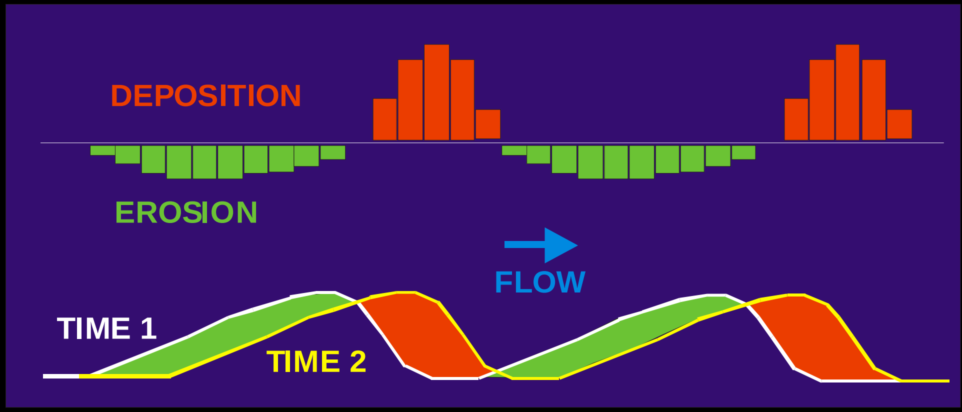
Mississippi River Discharge at Tarbert Landing, MS 2003-2005



Additional Audubon surveys in August 2005, February 2006



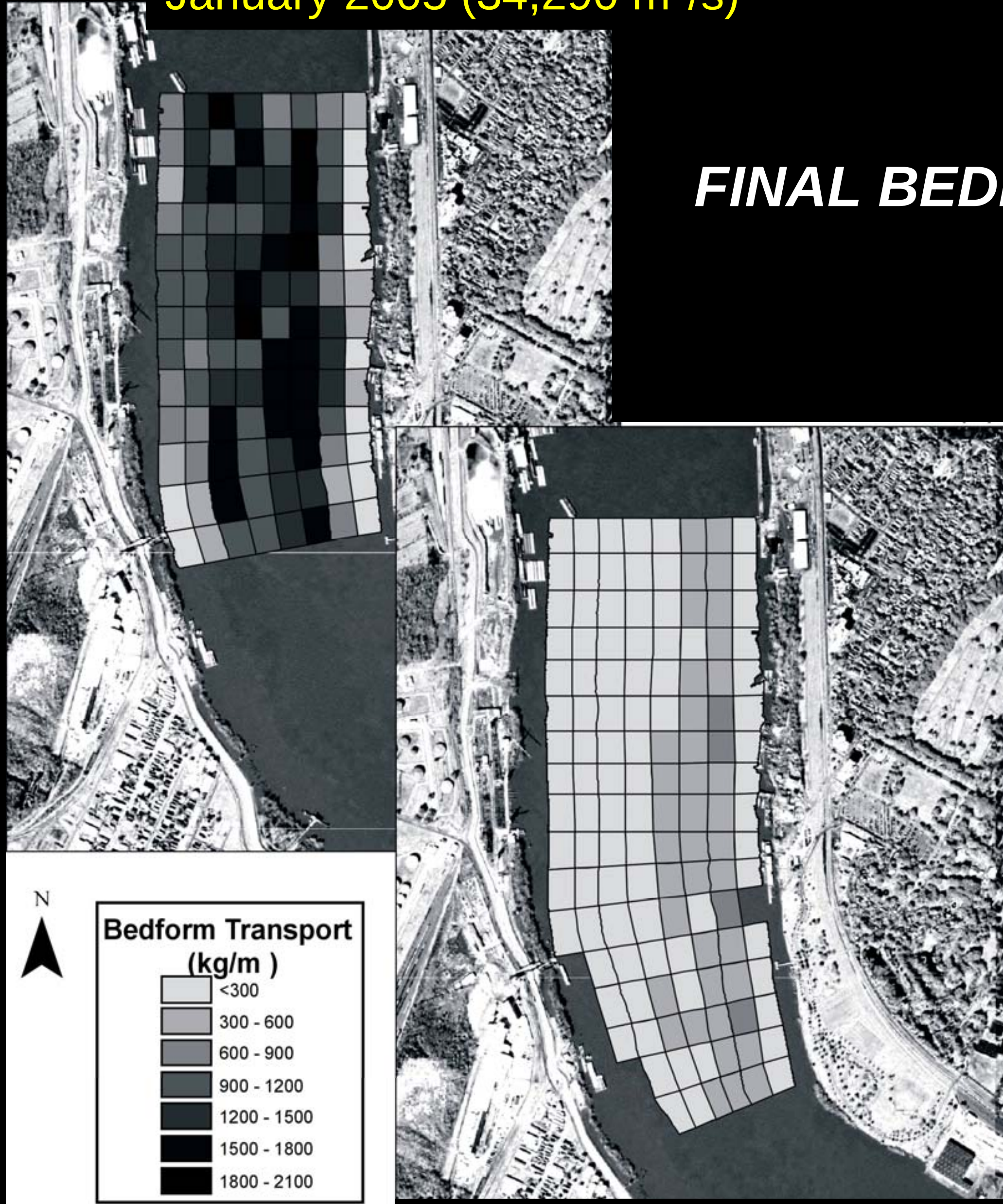
Evaluation of Bedload (bedform) Sand Flux Using Multibeam Resurvey Method (2 or more surveys over 8-24 hrs)



January 2005 (34,290 m³/s)

FINAL BEDLOAD TRANSPORT RATES

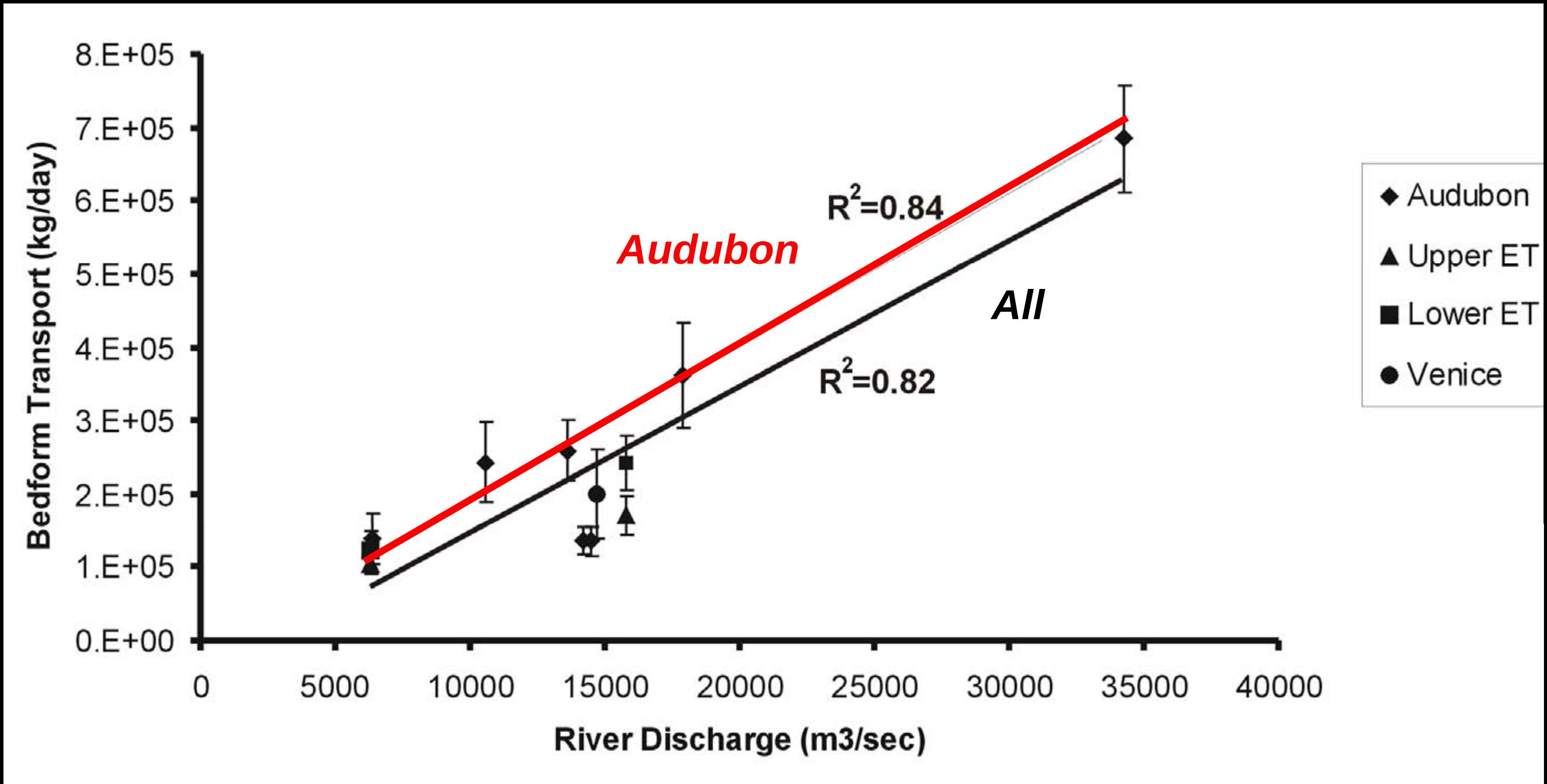
Audubon Park (2 of 8 dates)



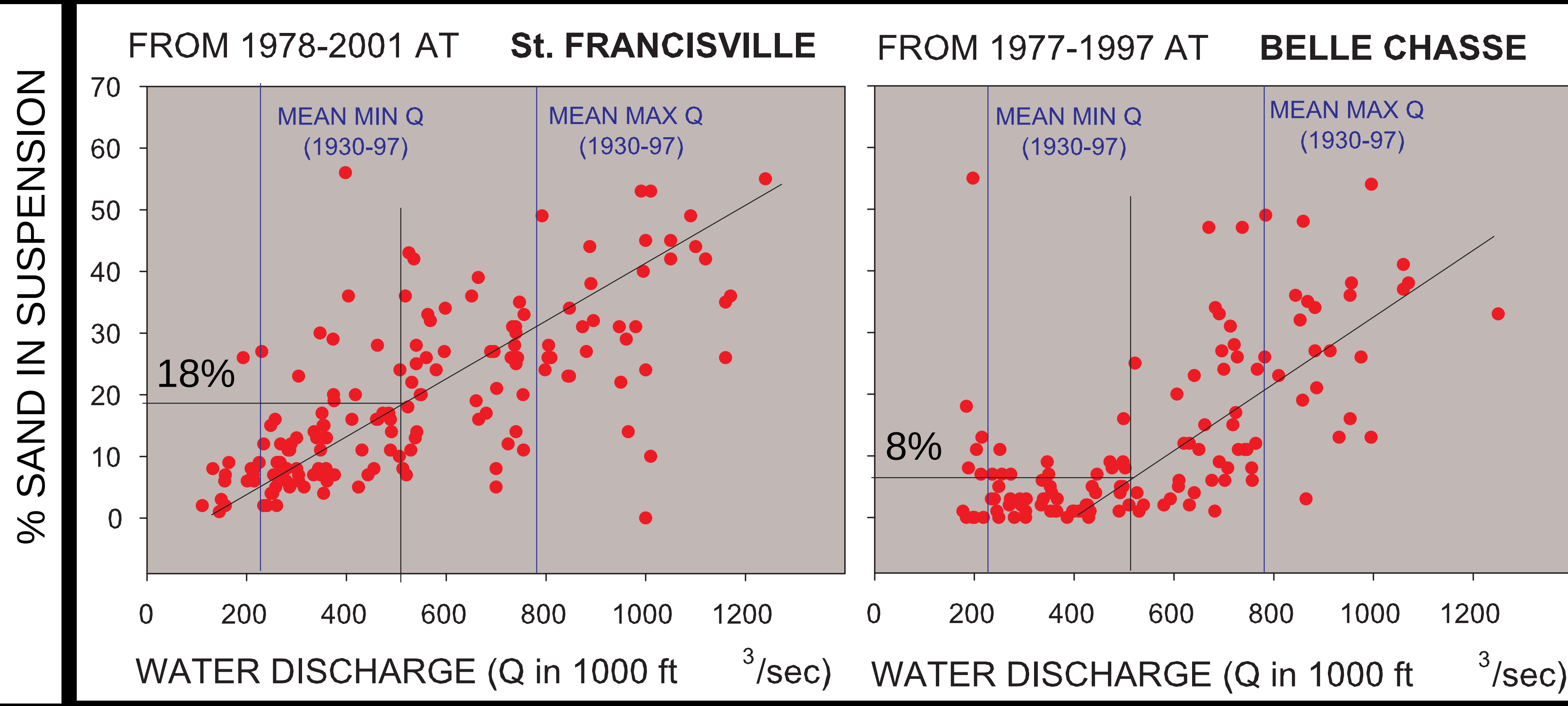
February 2004 (14,200 m³/s)

1 km

BEDLOAD TRANSPORT VS RIVER DISCHARGE

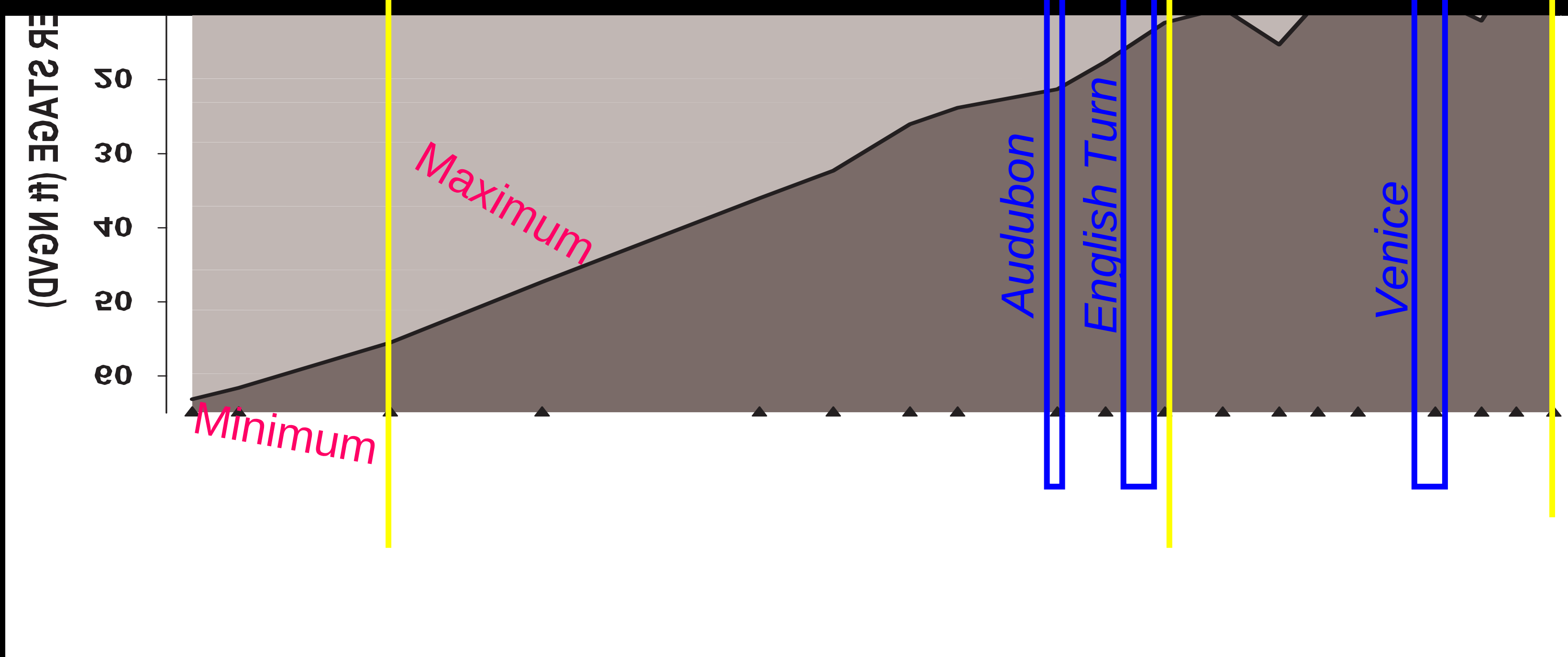


How Much Sand is Transported in Suspension?



% Sand (<62 microns) in Suspension
(*from USGS Water Quality Data*)

	St. Francisville	Belle Chasse	SW Pass
Total Suspended load	**124** mt (post-1993)* **153** mt (pre-1993)	same?	Annual Nav Dredging 10-15 myd^3 = **4.1-6.2** mt of Sand
Suspended Sand Load	**22.3** (18% of above)	**9.9** (8% of above)	
Bedload (sand)	?	**0.1** **0.1**	**0.1**



*From Horowitz et al. (2001; pers. Comm)

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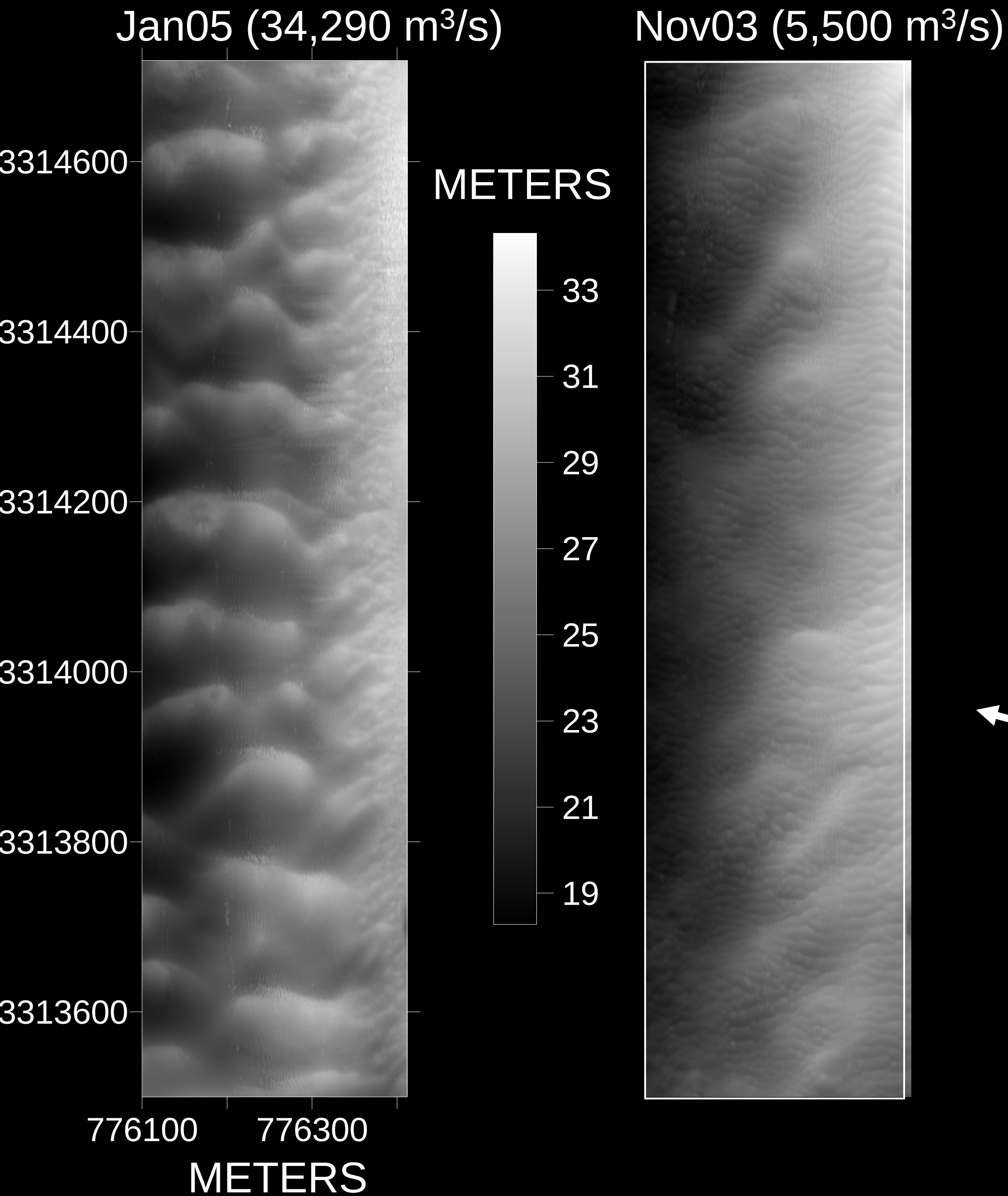
Why the Difference?

1. Bed aggradation between RM266 and RM76 (see Galler et al., 2003)
2. Limited # of measurements and no near-bed sampling
3. Reach-scale variability in bedload-suspended load cycling

AUDUBON SAND LOSS

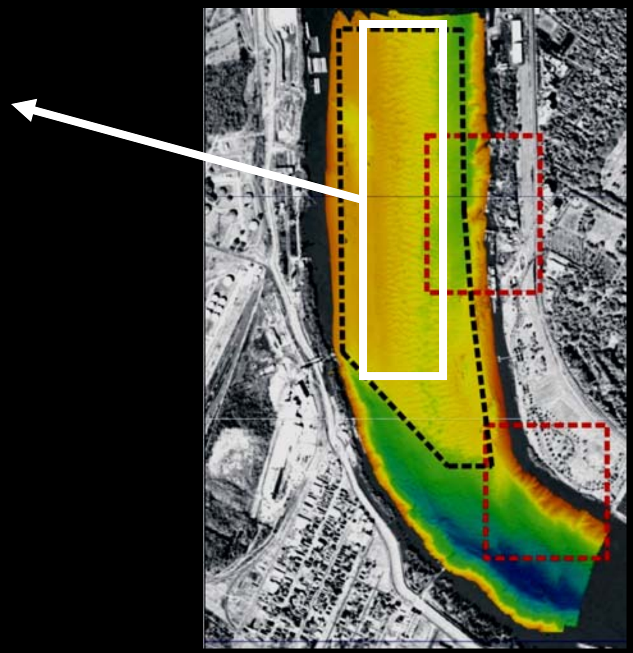


Elevation Differencing (Nov-Jan)

Loss to suspension of

327,600 tons

Equivalent to a layer 0.32 m thick



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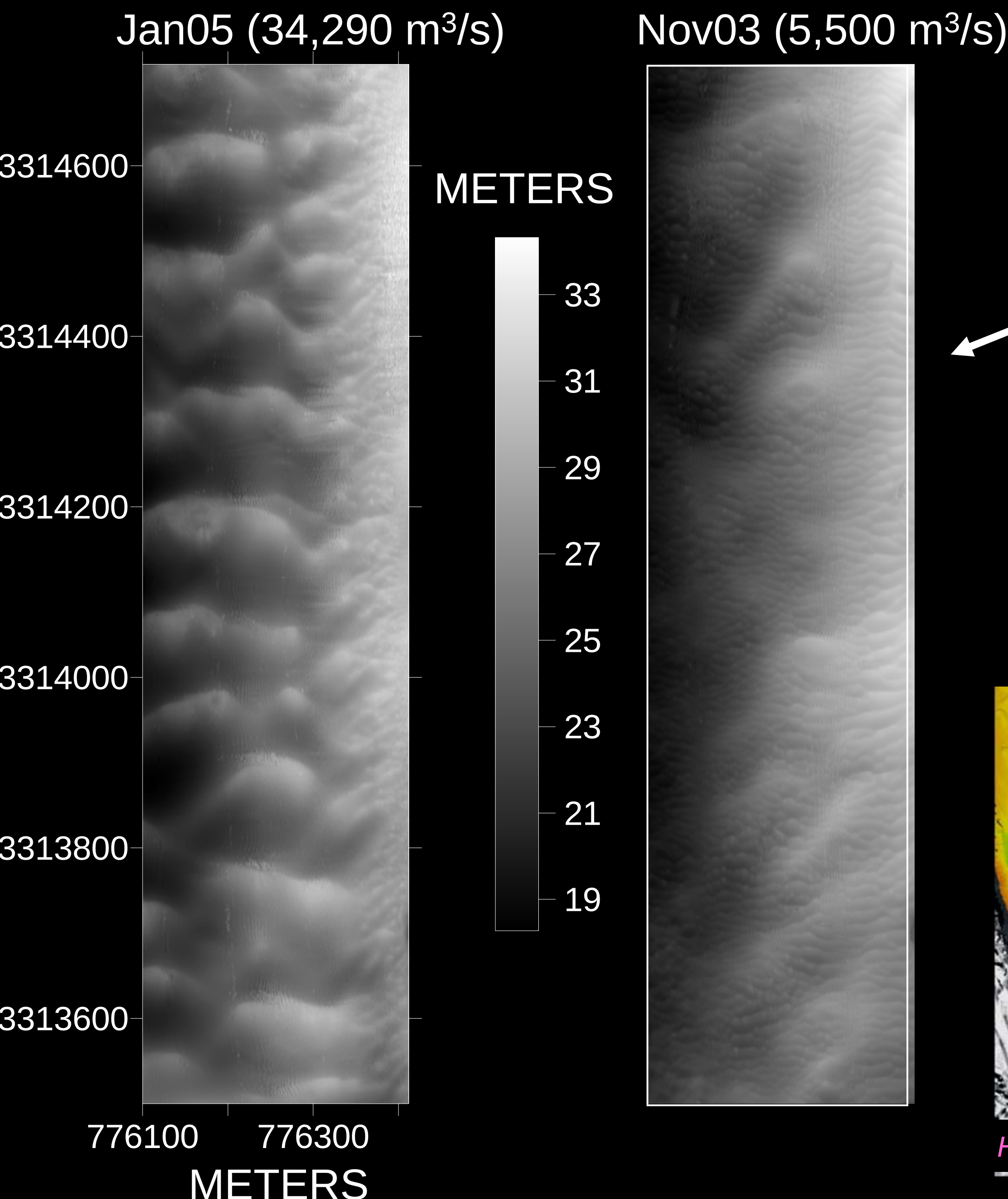

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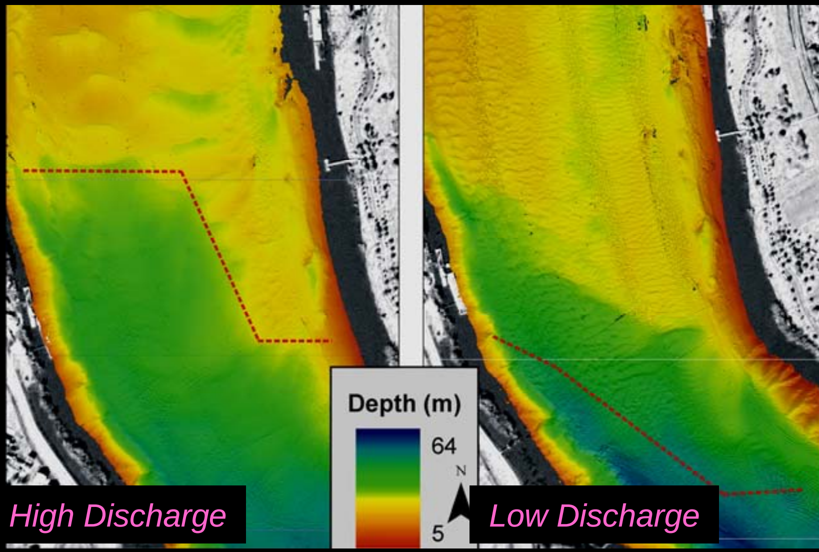
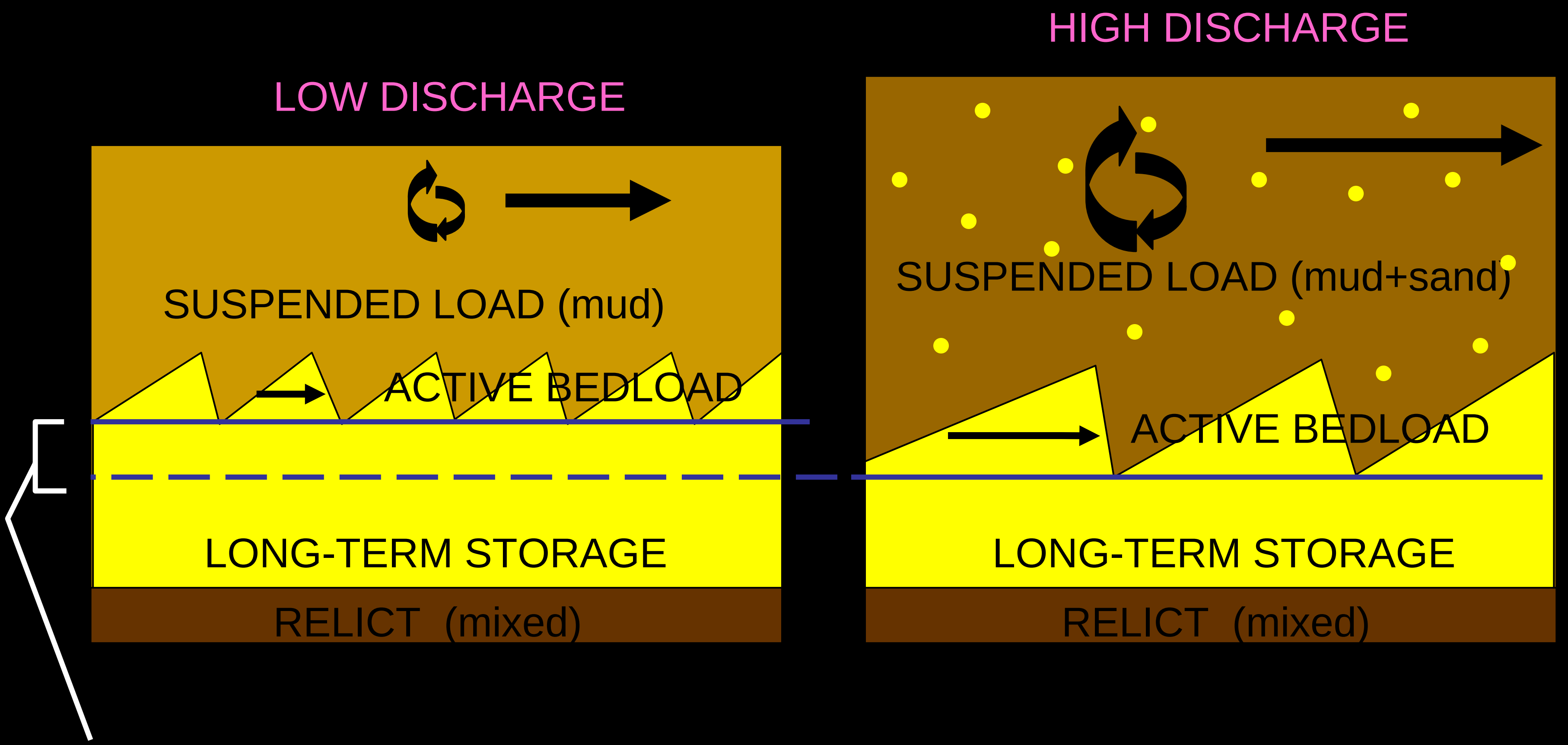


Transition Area to Suspension

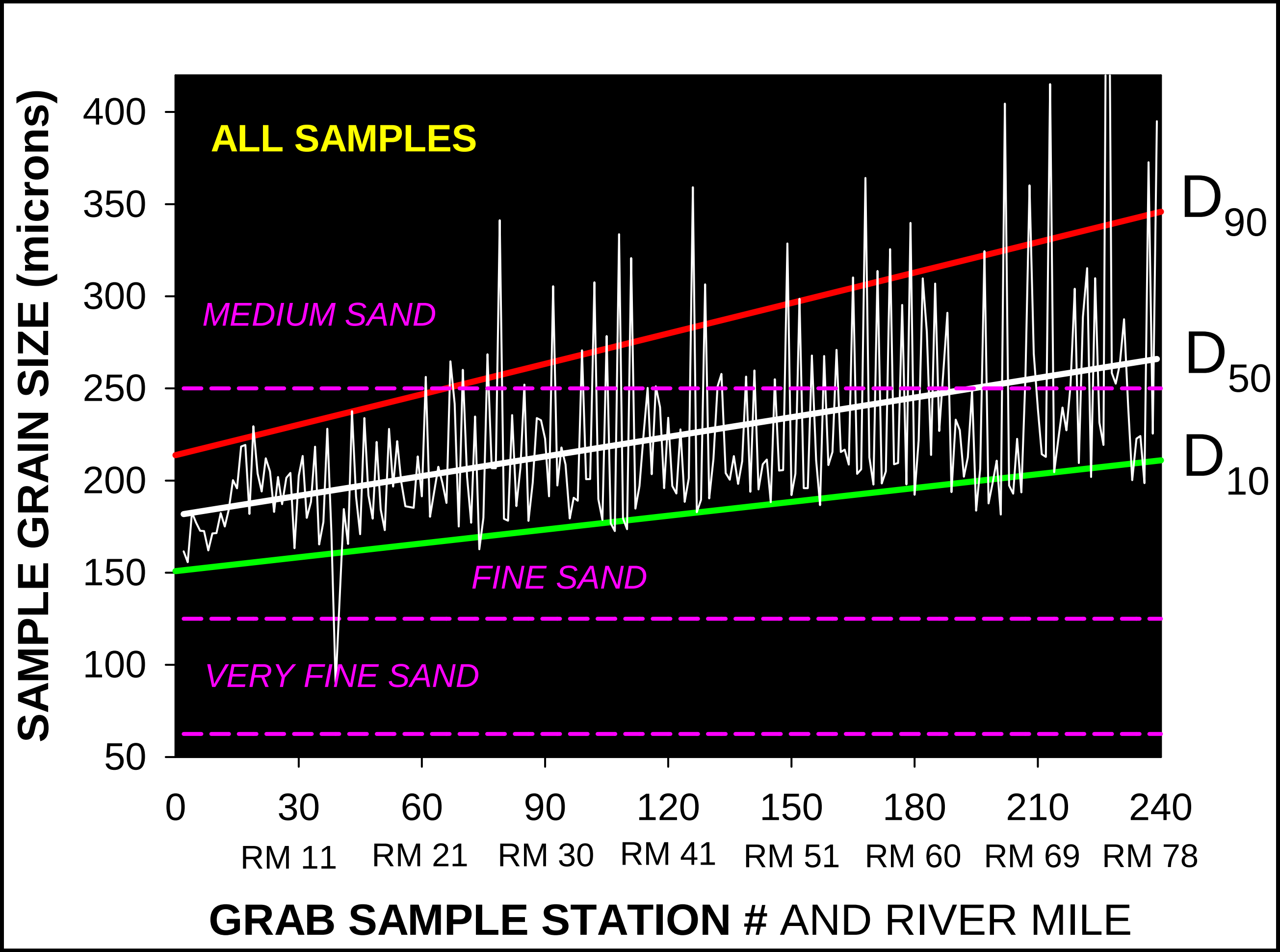
LOWER MISSISSIPPI RIVER SEDIMENT CYCLE



Difference from: 1) Increased size of dunes
2) Loss to suspension

RENEWABLE (BED) SEDIMENT RESOURCES FOR RESTORATION

Low Discharge
Sand Storage
(Nov 2003 Bed Survey)



So: Hydraulic Energy Decreases Downstream Even in the Lower River

2. What do we still need to know to adequately manage the resource?

A. River observatories to provide comprehensive sediment monitoring (bed and susp)

B. Establish a 10-20 river mile long experimental transect to facilitate 3-D numerical model development (CWPPRA Scofield Island?)

Tulane/LUMCON AUDUBON RIVER OBSERVATORY

http:\\weather.lumcon.edu

SINCE 2003
- **water quality (nitrate,temperature chlorophyll, turbidity)**
- **bedload transport (multibeam)**
- **particle-reactive radiotracers (pumped)**

BEGINNING 2006
- **suspended concentration**
- **suspended grain size**
- **bed grain size**
- **x-sectional discharge (ADCP)**
- **floc size (LISST)**

FUTURE
- **discharge (H-ADCP)**
- **sand sheet thickness (CHIRP)**
- **CDOM (backscat)**