# Mississippi and Atchafalaya Rivers Sediment Monitoring Programs

Mekong River Commission Workshop
Vientiane, Laos
October 21,22, 2008

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# Sediment Monitoring Programs

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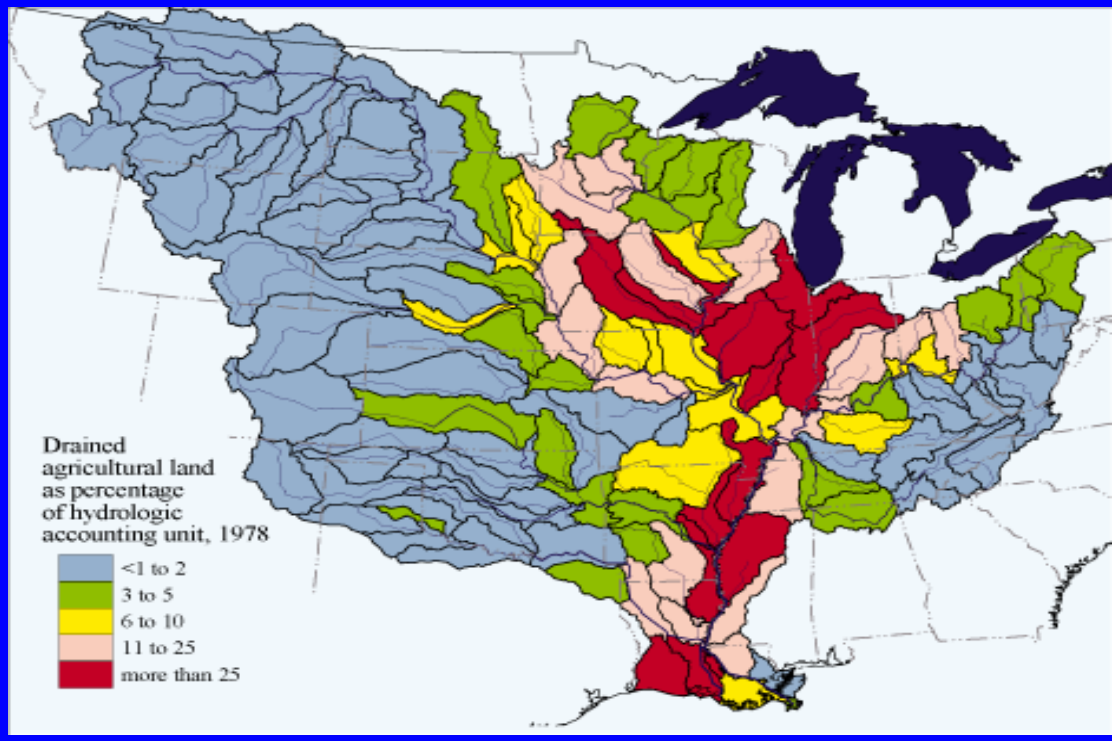
- Largest river in the United States (3,680 km, 19,760 km including tributaries)
- Drains 41 % of contiguous United States and parts of Canada (31 states and 2 Canadian provinces- 3.225 million square km)
- First sediment samples collected in 1830s

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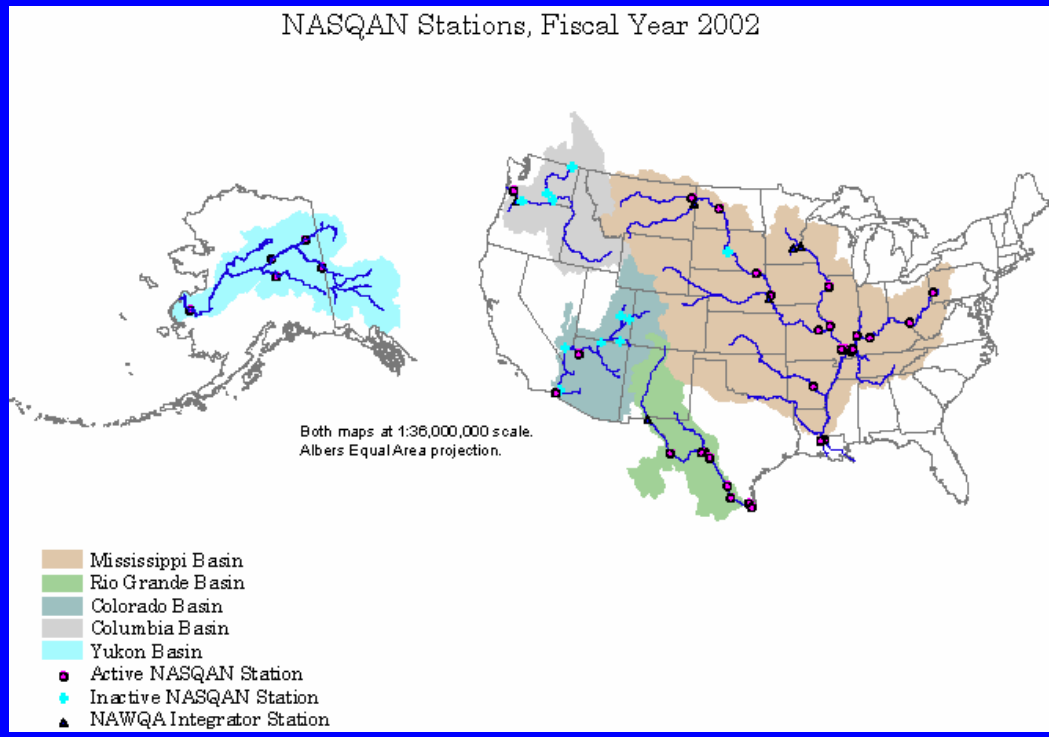
- Reservoirs constructed on the upper Missouri River from 1953 to 1963
- Upper Mississippi and Ohio Rivers have locks and dams
- Old River Control Structure completed in 1963

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Major sediment issues:

Mississippi River:

1) Decreased sediment loads and potential impacts on coastal erosion and wetland loss

2) Sediment transport characteristics-how and where sediment moves in the system impacts on navigation, restoration projects, and public supply

3) Contaminants associated with sediments

4) Changing grain-size distribution

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# Mississippi and Atchafalaya Rivers Sediment Monitoring Programs

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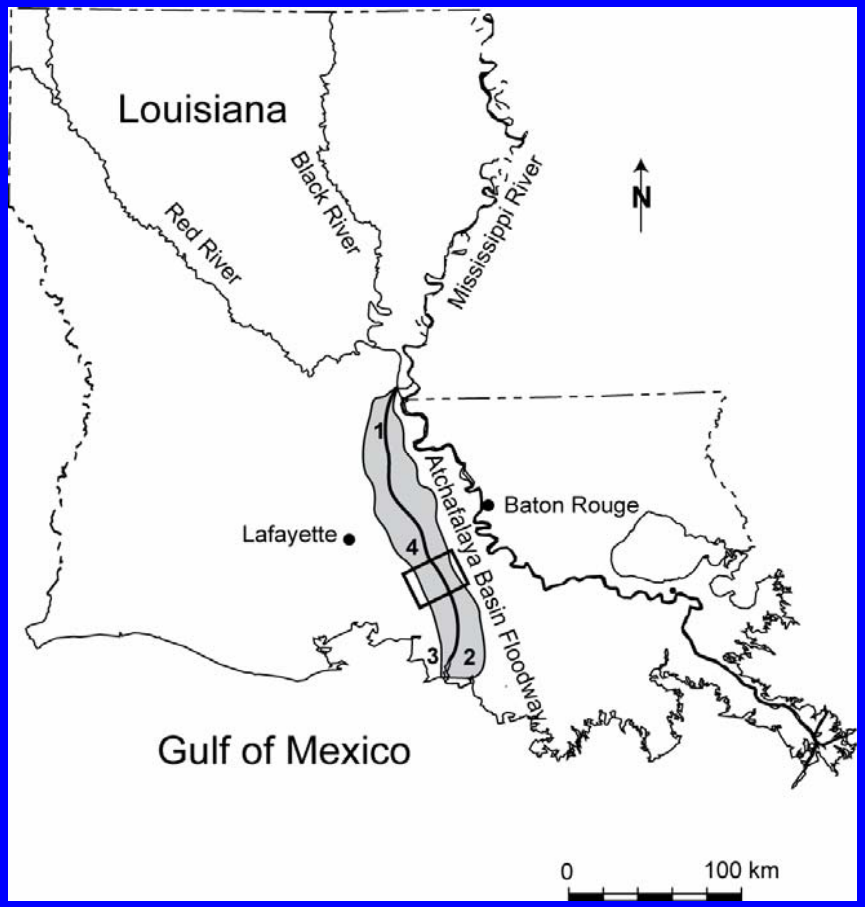
- 5th largest in the contiguous U.S.
- Receives about 25% of the Mississippi River flow annually and all of the Red River flow.
- The Basin wetland (5670 km2) is about 70% forested (largest contiguously forested wetland in the U.S); the remainder is open water and marshland.
- The Basin is about 160 km long and 20 to 30 km wide, which discharges into the Gulf of Mexico (deltaic sedimentation).

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# Mississippi and Atchafalaya Rivers Sediment Monitoring Programs

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Major sediment issues:

Atchafalaya River:

1) Sediment **accretion** and potential impacts on coastal erosion and wetland loss

2) Sediment transport characteristics-how and where sediment moves in the system impacts on navigation, restoration of river swamp

3) Contaminants associated with sediments

4) Changing grain-size distribution

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# Mississippi and Atchafalaya Rivers Sediment Monitoring Programs

Major Mississippi River monitoring agencies:

U.S. Army Corps of Engineers

U.S. Geological Survey

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National and local Programs: U.S.Geological Survey and U.S. Army Corps of Engineers national and local programs are designed to provide data for:

1. **Long term status and trends-** Provides information on how concentrations and loads have changed over time and what the impacts of dam construction and bank stabilization activities have been on sediment transport**-need long term sites**
2. **Flux** or loadings of sediment to the Gulf of Mexico- Information on the sediment loadings over time and chemicals associated with these sediments**-use both long term and new sites dependent on issue addressing**
3. **Sediment transport characteristics** -How does the sediment move in the system-under what conditions? Where does storage occur and when does the material in storage get resuspended? **–use multiple temporary sites with fixed long-term sites**

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- Current U.S.G.S and USCOE monitoring activities on the Mississippi and Atchafalaya Rivers:
  - **NASQAN-** (1973-present) suspended sediment, discharge, water chemistry, bacteria, carbon, T,pH,DO, SC; -26 sites throughout the drainage Basin
  - Mississippi River at Baton Rouge **only** real-time velocity, discharge, turbidity,In-situ parameters (T,pH,DO, SC) on lower Mississippi River
  - **Long term sites**: Mississippi River at Thebes (daily suspended sediment ( 1980), at St. Louis (1948), Vicksburg and Tarbert Landing(1920s), Mississippi River at St. Francisville (1973) and Atchafalaya River at Melville (1977)

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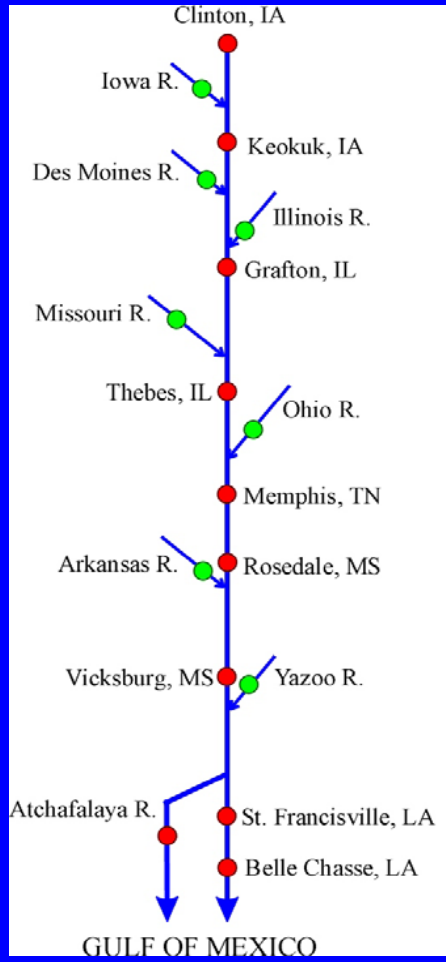
- Lagrangian transport studies on main stem to determine transport characteristics-
- 1983-1985 (lower Mississippi)
- 1987-1992 (entire Basin) Meade and others, 1987-1992 Mississippi River Sediment and Water Quality Study

- Periodically since 1996 as part of NASQAN




| Sampling Site | Travel time (hours) |
|---|---|
| Clinton, IA | 0 |
| Iowa R. | 24 |
| Keokuk, IA | 42 |
| Des Moines R. | 44 |
| Missouri R. | 72 |
| Illinois R. | 91 |
| Grafton, IL | 95 |
| Thebes, IL | 145 |
| Ohio R. | 137 |
| Memphis, TN | 195 |
| Rosedale, MS | 240 |
| Arkansas R. | 249 |
| Vicksburg, MS | 306 |
| Yazoo R. | 311 |
| Atchafalaya R. | 381 |
| St. Francisville, LA | 381 |
| Belle Chasse, LA | 477 |

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- U.S.C.O.E. 2005-6 ROMA Projects:
  - Repeat 1990 bed-material grain size study by Bill Emitt-thalweg sample every 3.2 km
  - Repeat 1985 suspended-sediment transport characteristic study by Demas and Curwick

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# Mississippi and Atchafalaya Rivers Sediment Monitoring Programs –

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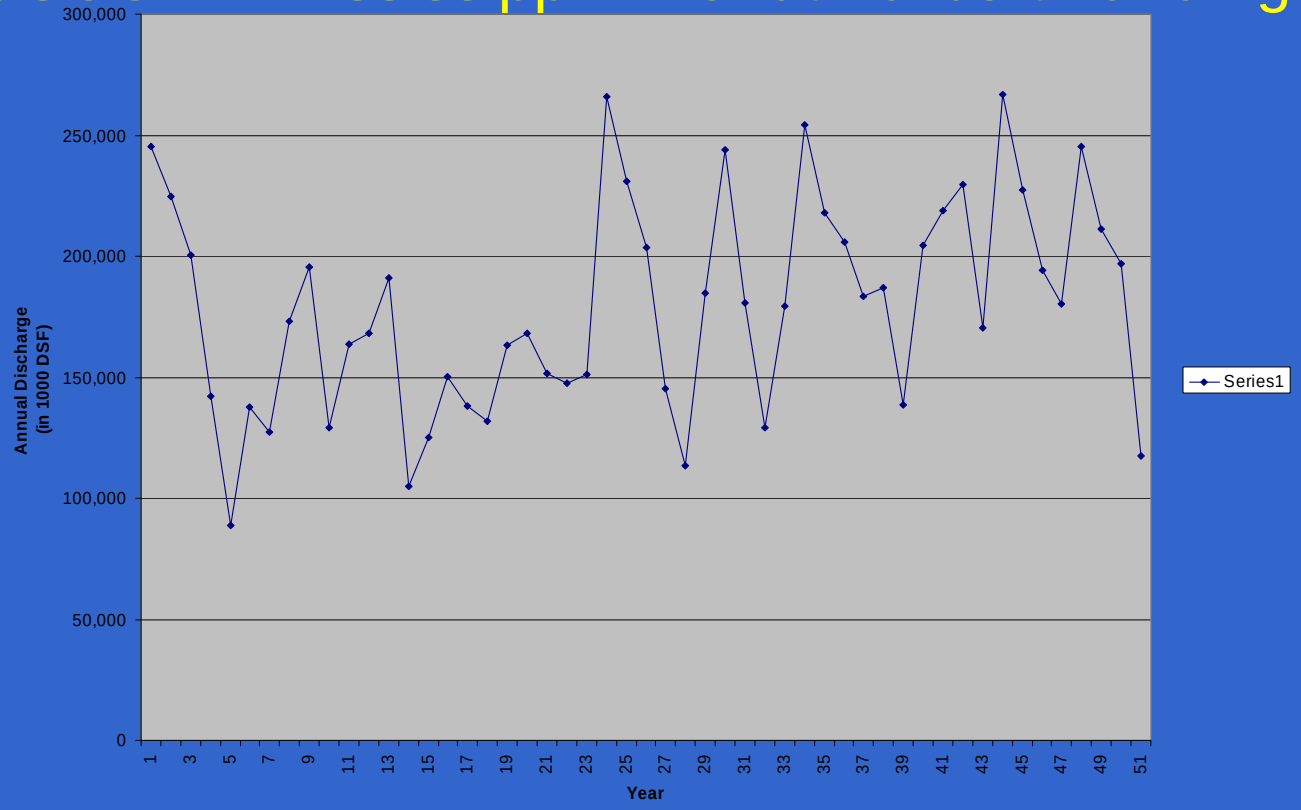
## Annual Discharge 1950-2000 Water Years

## USCOE – Mississippi River at Tarbert Landing

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# Mississippi and Atchafalaya Rivers Sediment Monitoring Programs :

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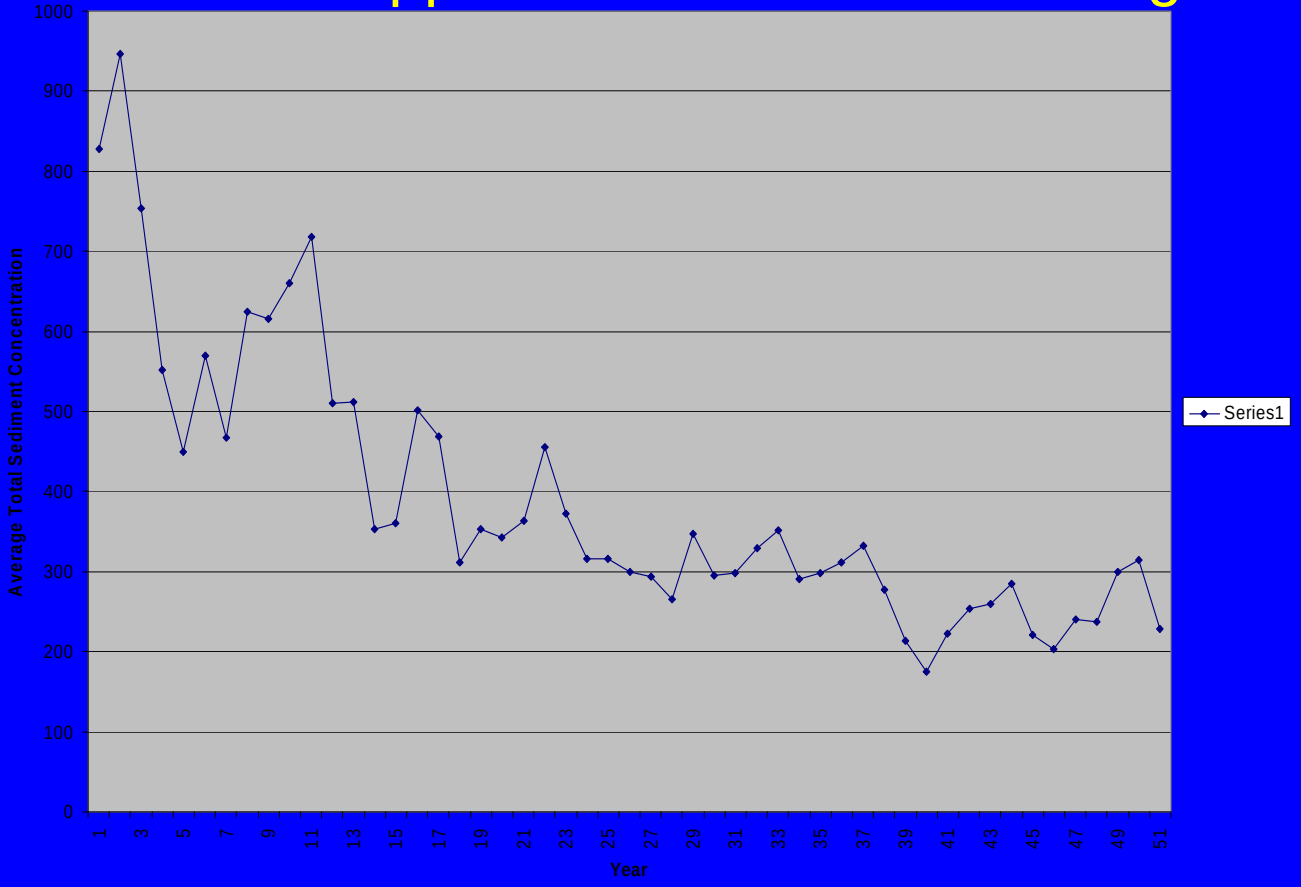
## Average Sediment Concentration

## USCOE – Mississippi River at Tarbert Landing 1950-2001

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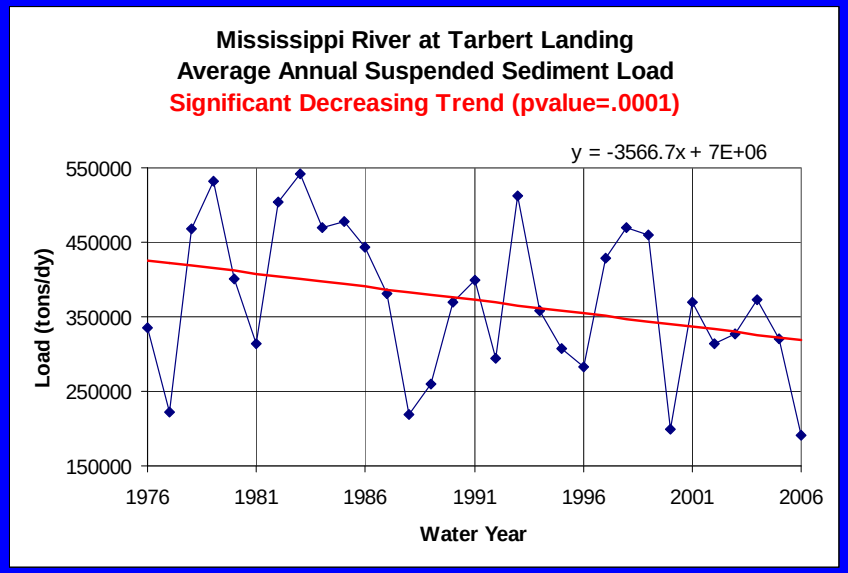
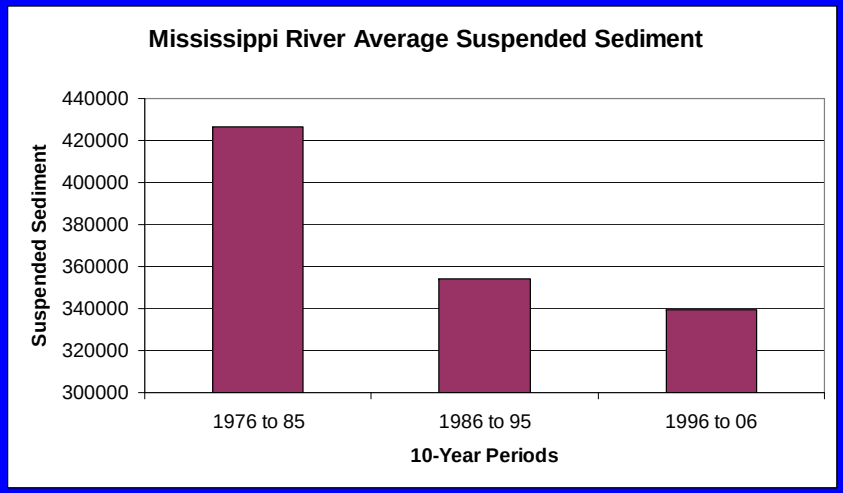
## Change in sediment load

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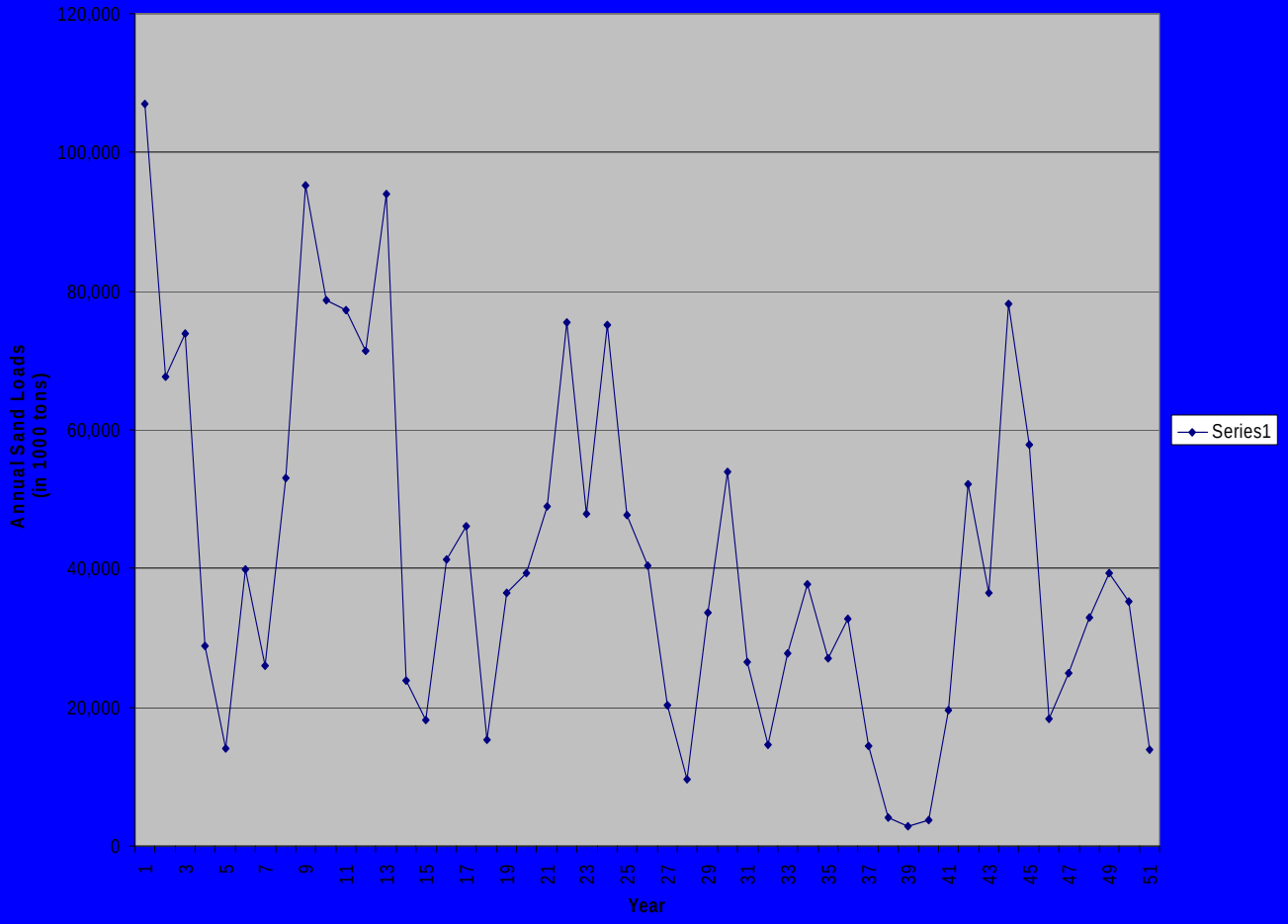
## Total Measured Sand Load

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# Mississippi and Atchafalaya Rivers Sediment Monitoring Programs

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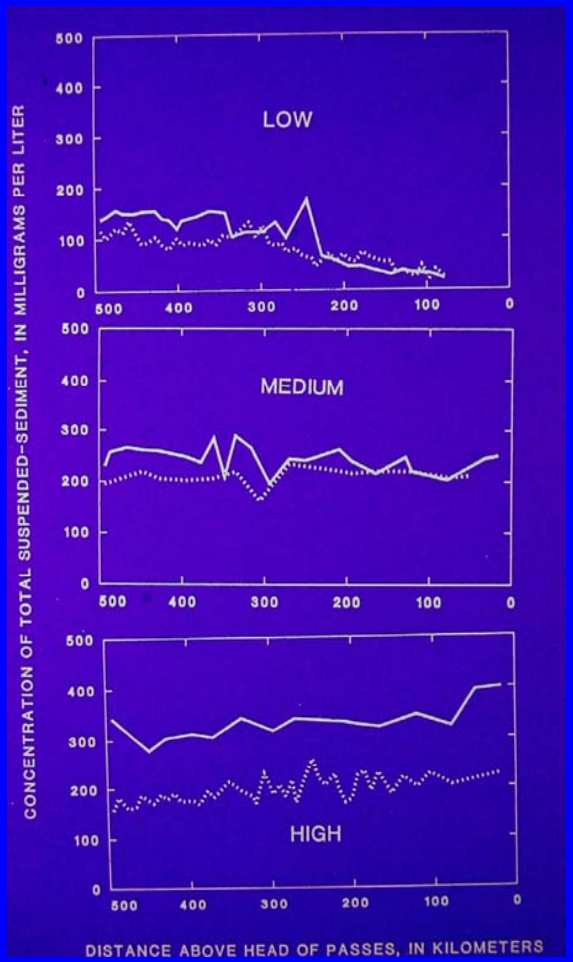
- Suspended-sediment concentrations decreased by as much as 85% in a downstream direction during steady flow conditions <14,160 $m^3/s$ and increased by as much as 44% in a downstream direction at flows >19820 $m^{3/s}$

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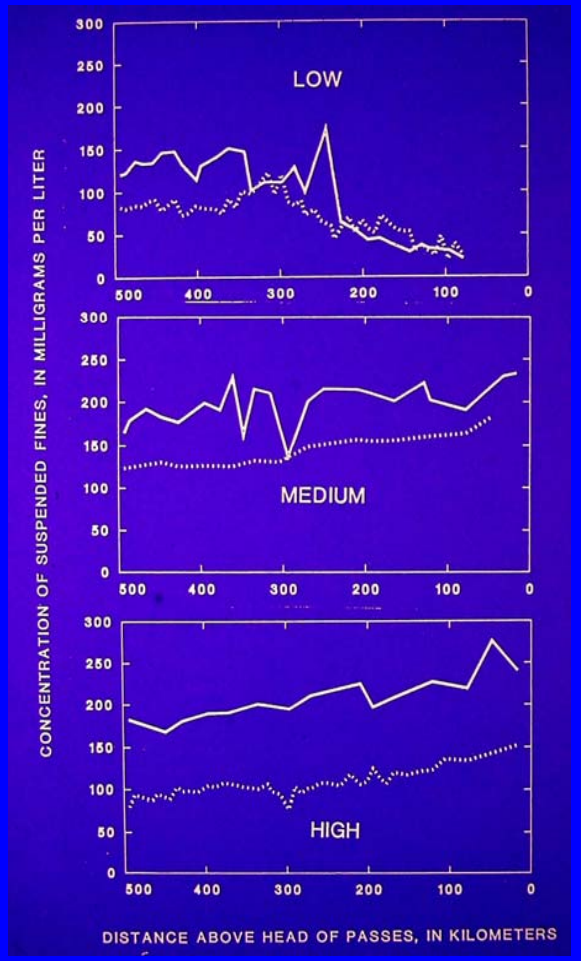
# Mississippi River suspended-sediment transport, 1983-85

- Major downstream fluctuations in concentration of total suspended sediment were caused by changes in fine concentrations

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- Data indicate that the bed of the lower Mississippi River in the study reach serves as a sink and a reservoir for suspended sediment during flows <14,160 $m^3/s$ and as a source of suspended sediment (fines) during flows > 14,160 $m^3/s$ .

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# Mississippi River suspended-sediment transport, 1983-85

- Particle-size distributions of suspended sediment showed no apparent relation to discharge and are probably determined by antecedent hydrologic conditions which determines the source of the material available

# Mississippi and Atchafalaya Rivers Sediment Monitoring Programs

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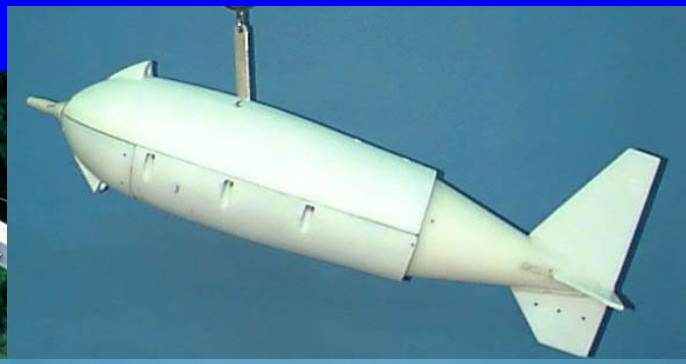
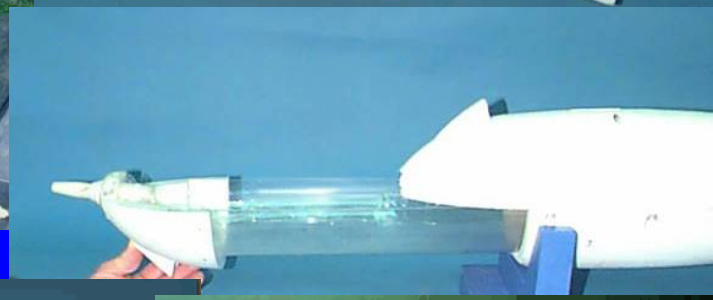
- Suspended-sediment samplers: depth integrated (8 L bag sampler, D-96, D-99) vs point samplers (P-61, P-63, horizontally oriented Van Dorns)





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# Mississippi and Atchafalaya Rivers Sediment Monitoring Programs

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- Suspended-sediment samplers: horizontally oriented Van Dorns) for velocities below 0.609 m/S

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# Mississippi and Atchafalaya Rivers Sediment Monitoring Programs

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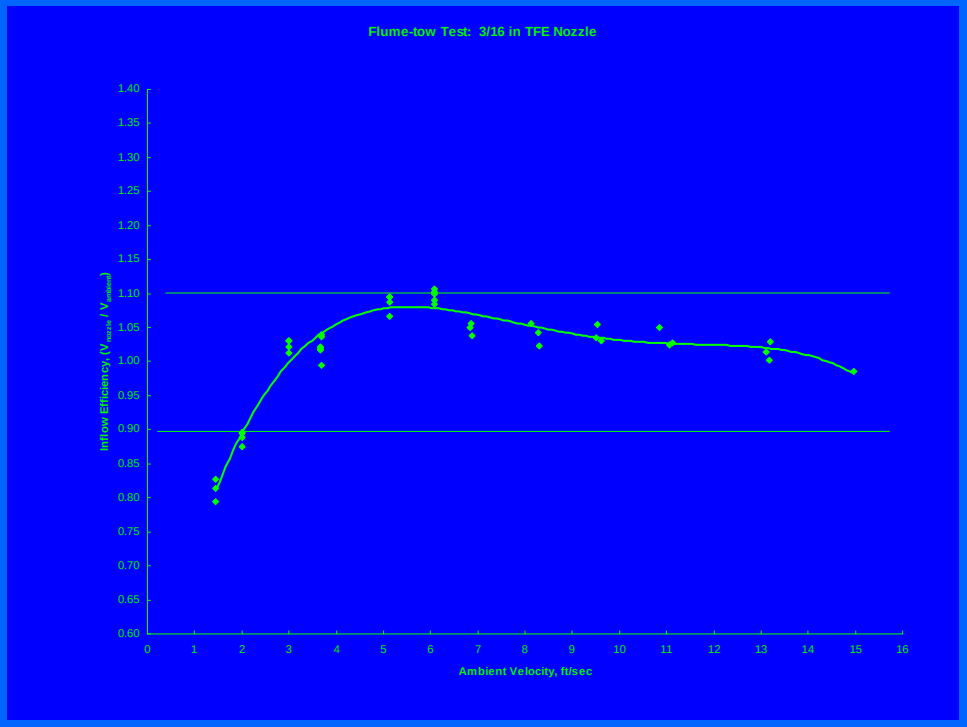
- Suspended-sediment samplers: When selecting a sampler you must consider sampler efficiency (most are not for use below 0.609 m/S), sample volume needed for analyses, and if you need to determine size distribution in the vertical

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- Suspended-sediment samplers: When selecting a depth-integrating sampler you should use a variable speed control for the cable motor to ensure sampling speed for different water velocities


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- Bed-sediment samplers : choice based on sampler weight vs velocity of river, volume of sample needed (grain size and chemistry)
- Samplers used include: Shipek, BM-54

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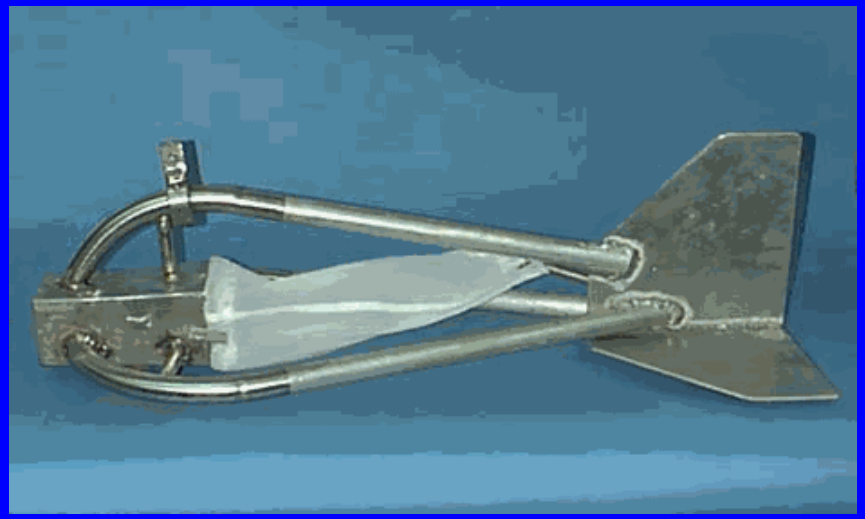
- Bed-load samplers :
- US-BL-84, does not work well on large sand-bed rivers. The lower Mississippi River has sand dunes up to 5 m in height. No samplers have been used successfully on the lower Mississippi River



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- What additional data needs to be collected?
  - Cross sectional-depth profile
  - In-situ data such as temperature (effects bag sampler efficiency), specific conductance (determines if a dissolved solid correction is needed on sediment concentration data)
  - Velocities: cross-sectional average, cross-sectional profiles (ADCP), point
  - Discharge

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# Mississippi and Atchafalaya Rivers Sediment Monitoring Programs

- Data storage and accessibility needs:
  - Are individual point or vertical data stored/needed?
  - Sediment-grain size data-how do we make it more accessible?

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# Mississippi River Sediment Monitoring and Modeling Needs

- Are sampling techniques similar?
  - Equal width technique vs equal discharge technique
  - Depth integrated vs point samples-point samplers take longer to use and costs more (more samples to analyze, less sample volume if need grain size)
  - Isokinetic samplers used-P-63/61, D-99/96, 8 L bag sampler
  - Non-isokinetic samplers/dip samples
  - Optical/acoustic samplers- are being tested
  - Are data collected using different samplers comparable?

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- Sediment analyses
  - Current methods only record inorganic, disaggregated sediment-size fractions, does not measure organic matter
  - What level of analyses should long-term monitoring programs use? Complete grain-size (sand and fines), sand/fines split, total concentrations, Loss on Ignition (measure of organic carbon)?
  - What analytical technique/instruments-sedigraph vs conventional balance/sieves/pipette-bottom withdrawal?
  - Use of reference samples for QA/QC

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- Questions for researchers and managers:
- Must Review Programs on a regular basis
  - What questions do we need to answer and do our monitoring programs provide sufficient data to answer these questions?
  - Can we develop a better relationship between suspended load and bed load?
  - How often do we need to repeat sediment studies?

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