A Quarter Century of Declining Suspended Sediment Fluxes in the Mississippi River

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Gulf Coast Sediment Issues

- **Erosion along the Gulf Coast, particularly in Lousiana, has been extensive; wetland losses in excess of 90 km^2/yr have been estimated.**
- **Landward erosion rates of as much as 20 m/yr also have been recorded.**
- **The impacts of the storm surges from hurricanes and the subsequent flooding of New Orleans over the last several decades are thought to result from a combination of land subsidence and loss of coastal wetlands and barrier islands.**

Gulf Coast Issues (cont.)

- **The growing spatial and temporal extent of the Gulf of Mexico hypoxic zone has been ascribed to nutrient enrichment.**
- **Estimates indicate that Mississippi River suspended sediment carries 85%, 30%, and 50% of the total annual fluxes of P, N, and TOC; hence, changing annual fluxes of suspended sediment could affect Gulf hypoxia.**

History of Mississippi River Annual Flux Estimates

Prior to 1820	~450 Mt/yr
1985 (Meade and Parker)	300Mt/yr
1986 (Keown)	225 Mt/yr
1996 (Moosa)	230 Mt/yr
2001 (Horowitz)	255 Mt/yr
2008 (Thorne)	150 Mt/yr
2008 (Meade and Moody)	150 Mt/yr

The Mississippi River Basin

The Lower Mississippi Basin

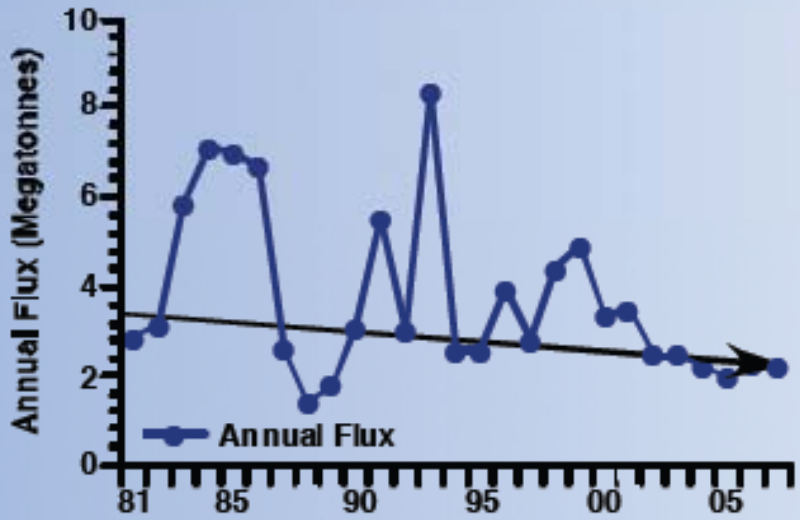
Potential Causes of Reduced Suspended Sediment Fluxes

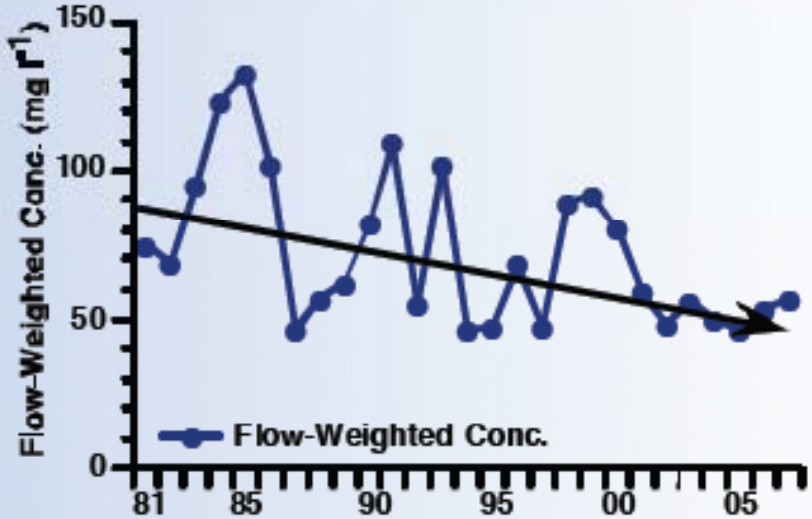
- As early as the 1930's, reduced sediment loads in the Mississippi were observed.
- This was attributed to better agricultural practices, including contour plowing, conservation tillage, bank stabilization, and reforestation.
- Major storms throughout the century may have produced reductions in stored within-channel sediment.

More than a Quarter Century (27 yrs) of Annual Suspended Sediment Fluxes in the Mississippi River Basin

Mississippi River @ Clinton

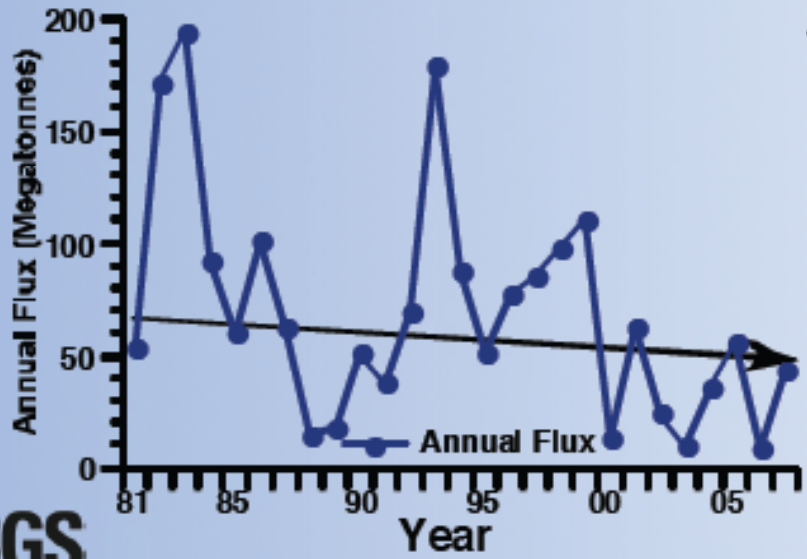
Total Flux = 100 Mt

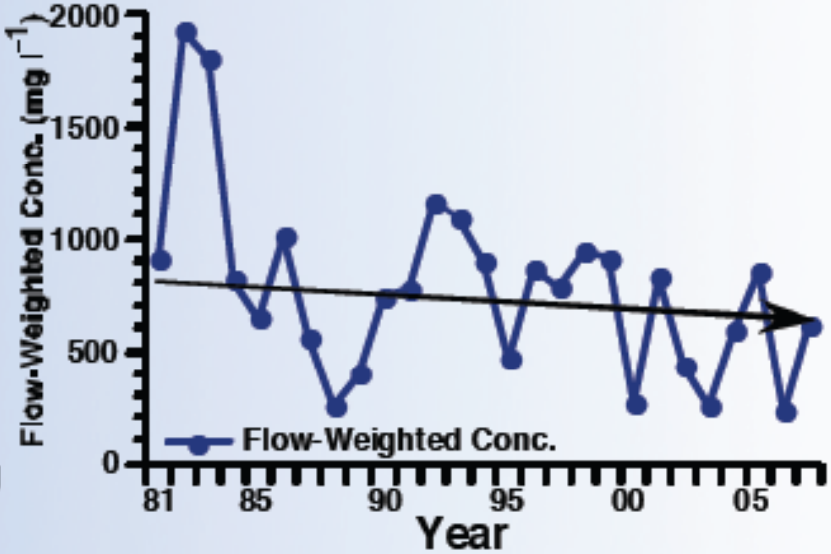




Missouri River @ Hermann

Total Flux = 1,900 Mt

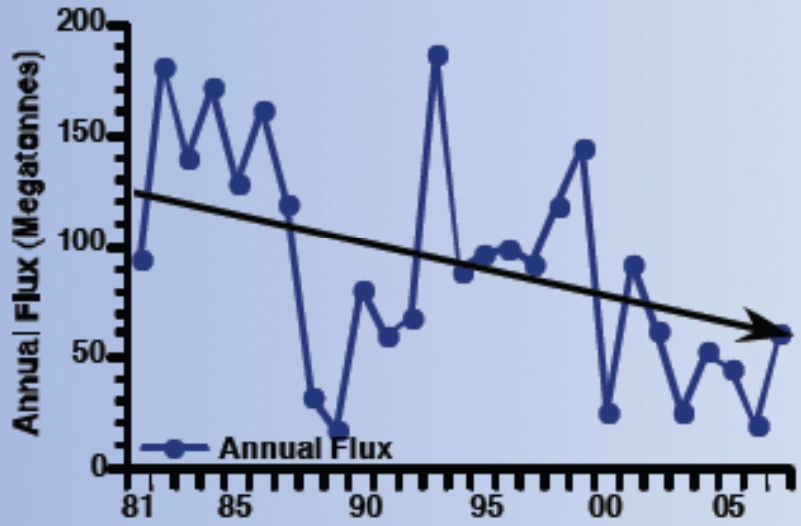


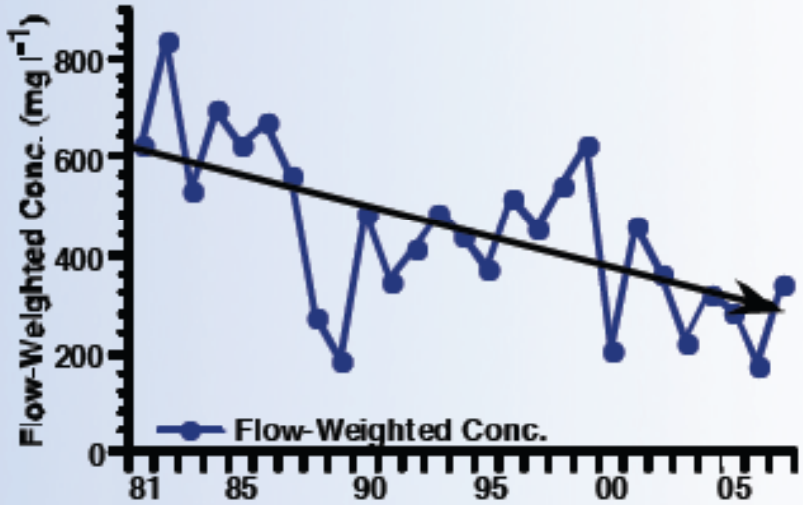


USGS

Mississippi River @ St. Louis

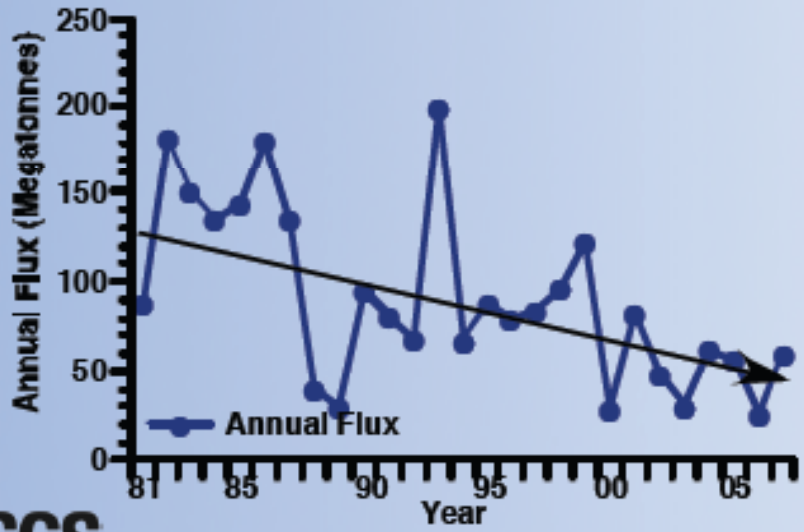
Total Flux = 2,400 Mt

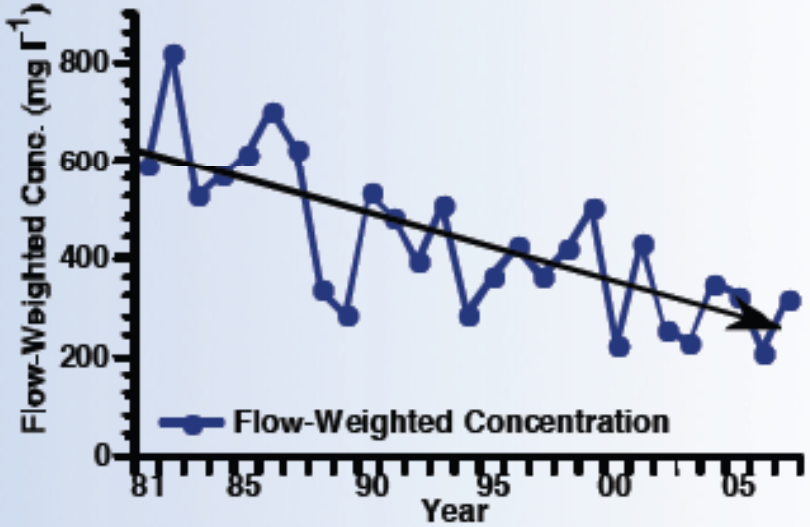




Mississippi River @ Thebes

Total Flux = 2,500 Mt





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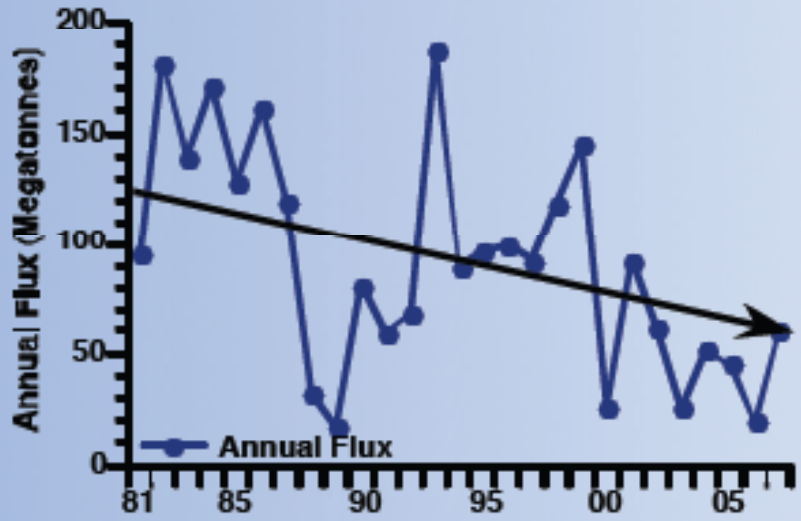

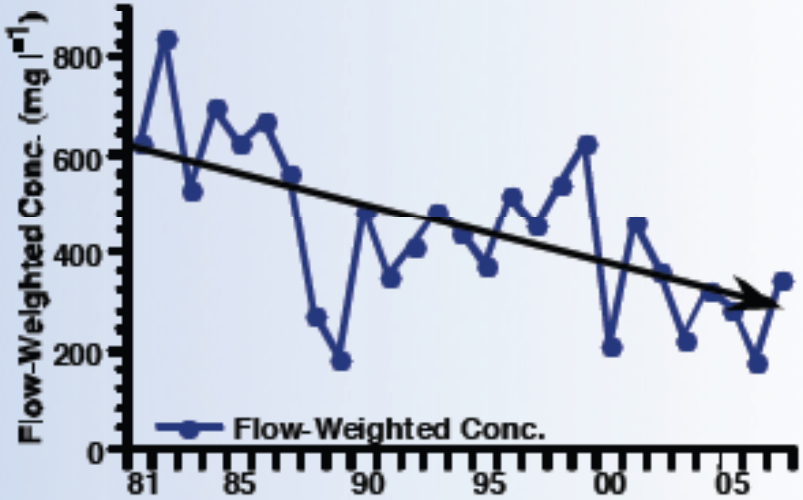

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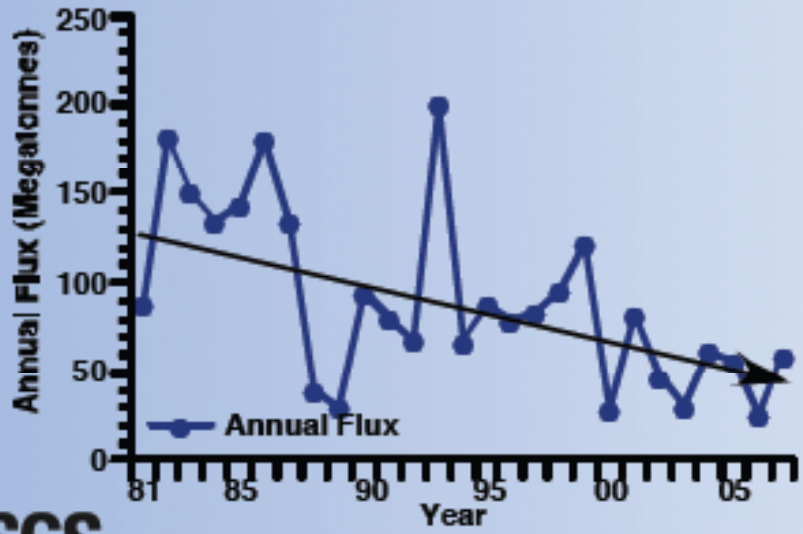

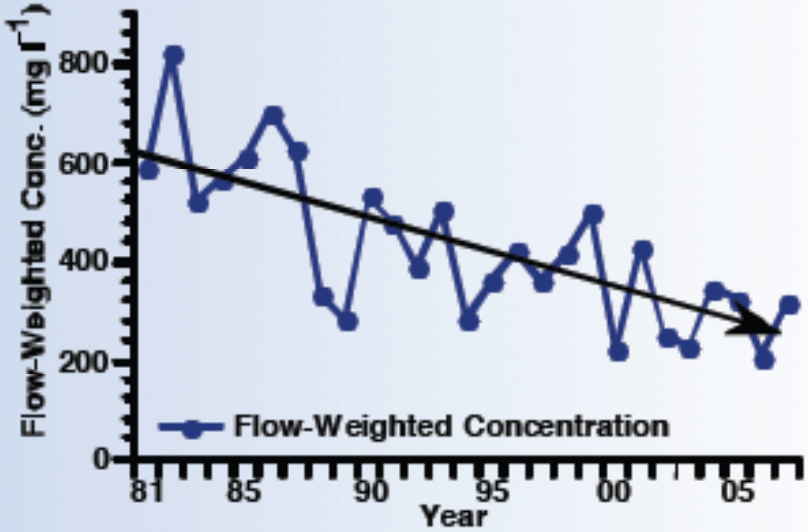

USGS

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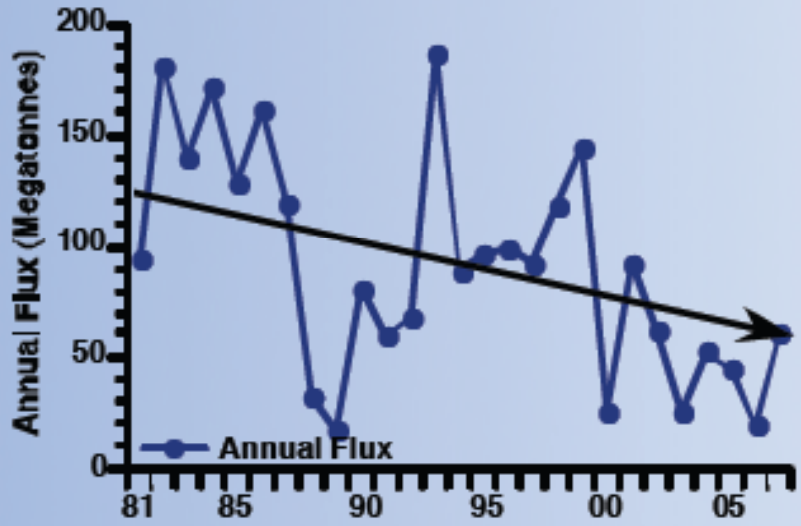

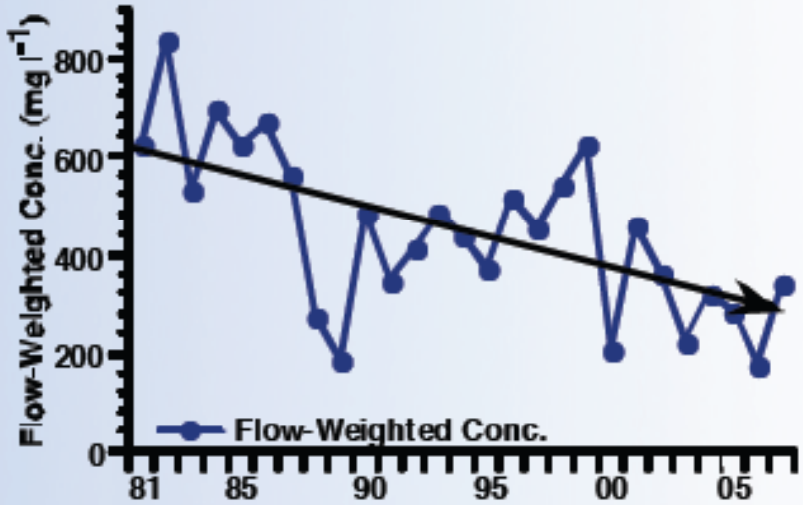

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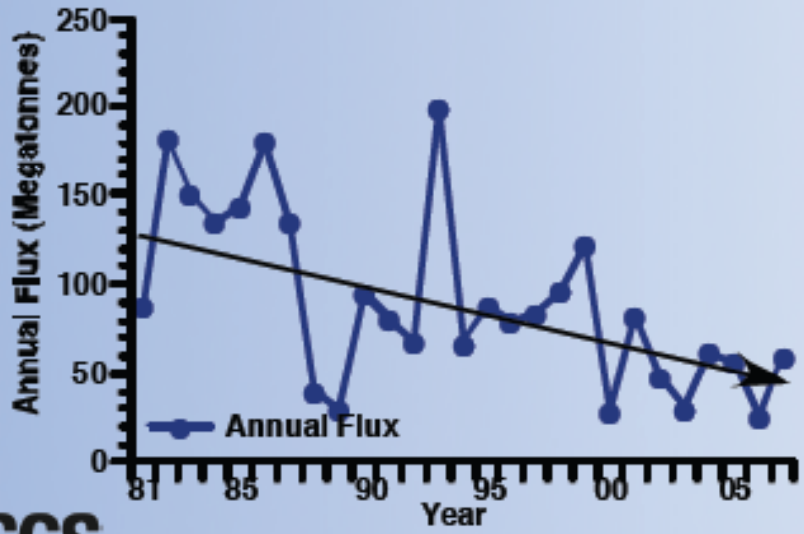

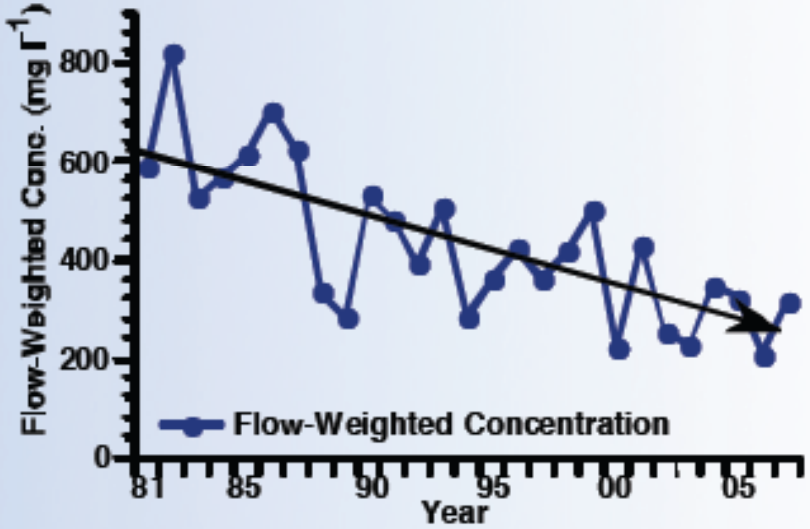

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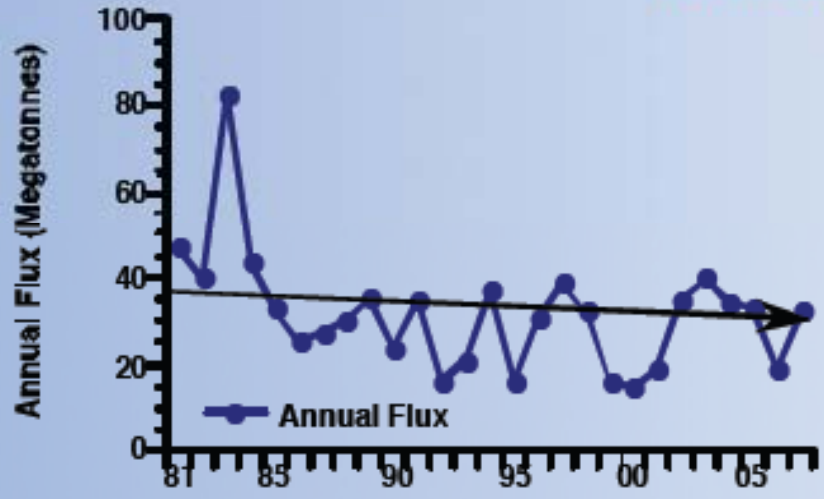
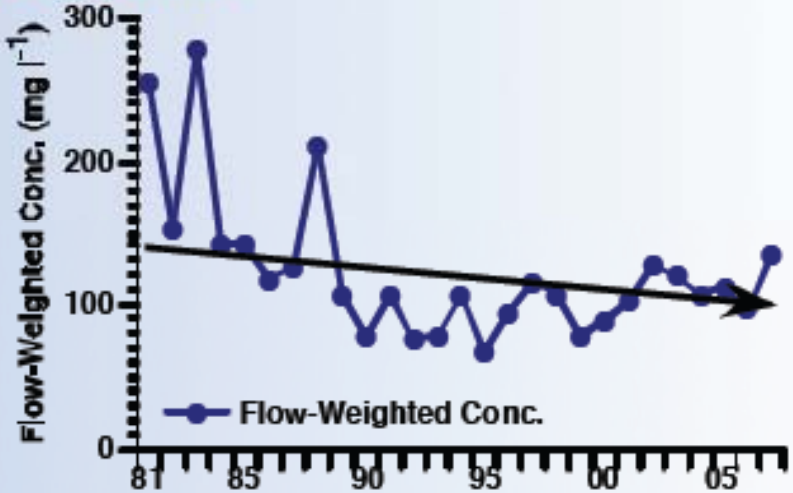
Ohio River @ Grand Chain

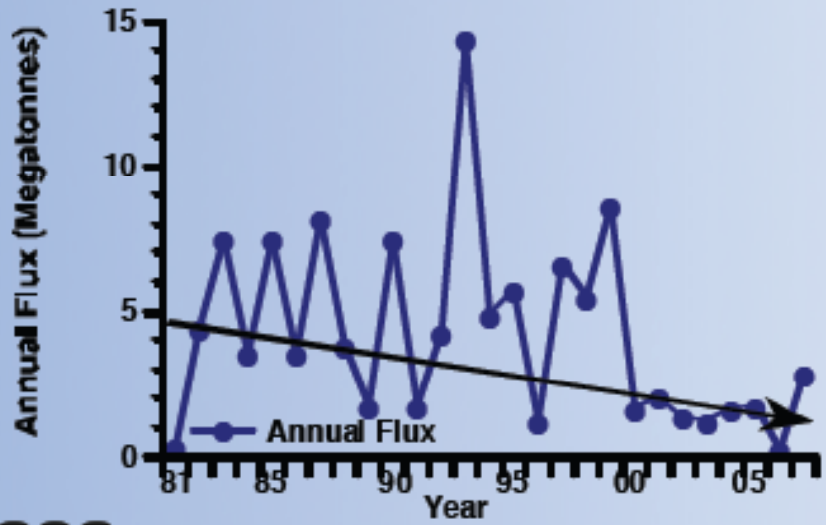
Total Flux = 860 Mt

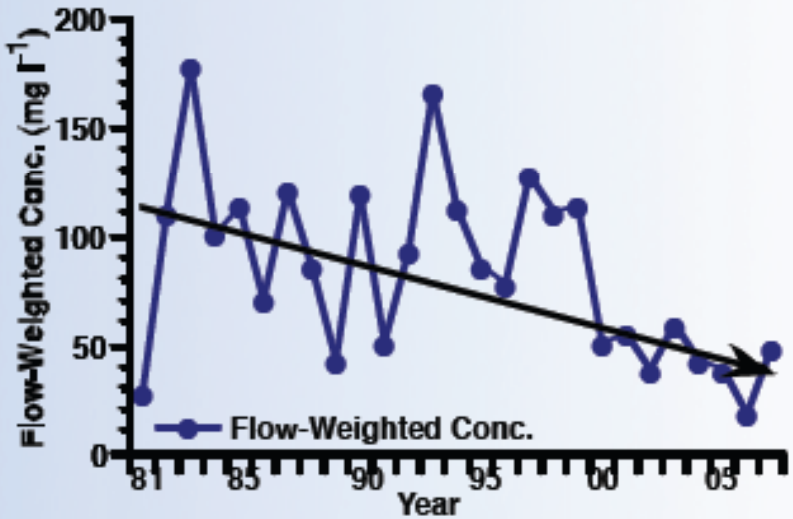




Arkansas River @ David Terry Dam

Total Flux = 110 Mt





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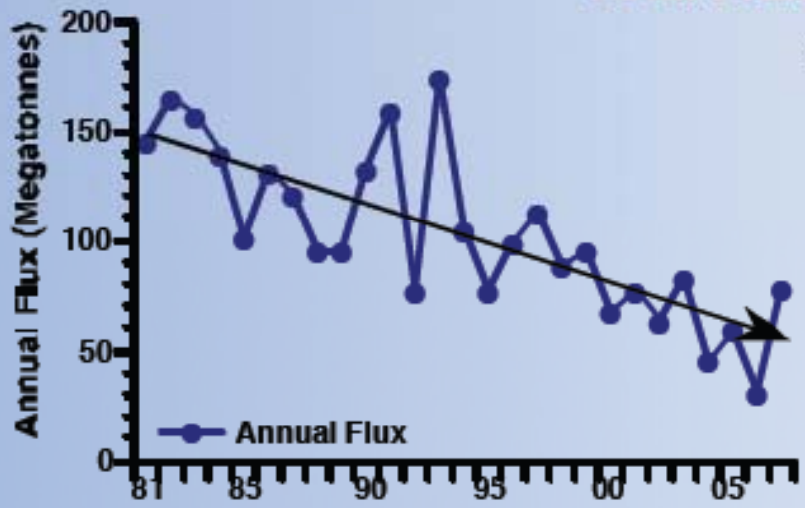
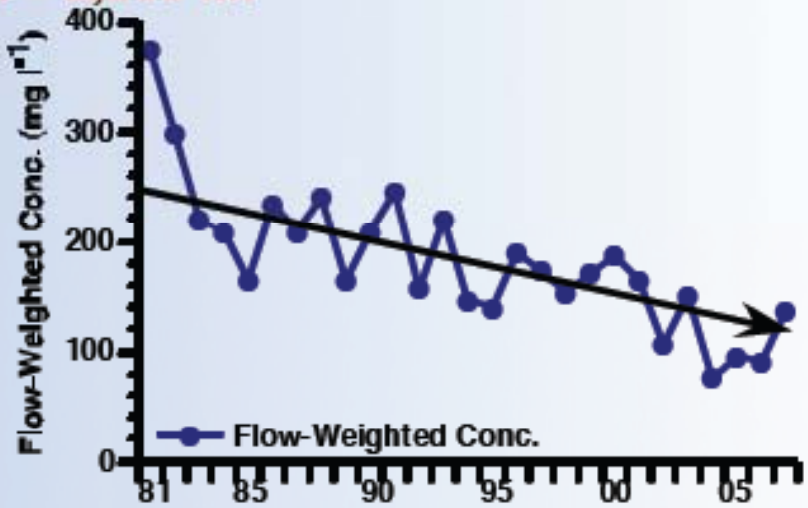
Mississippi River @ Vicksburg

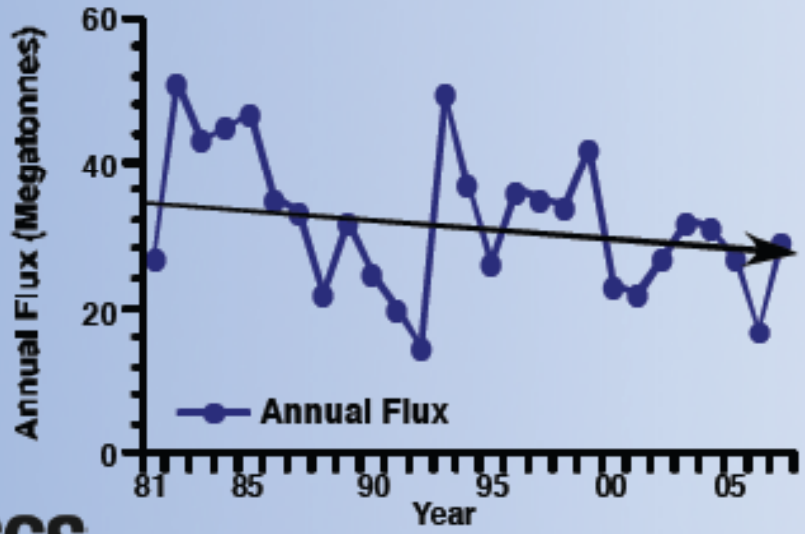
Total Flux = 2,800 Mt

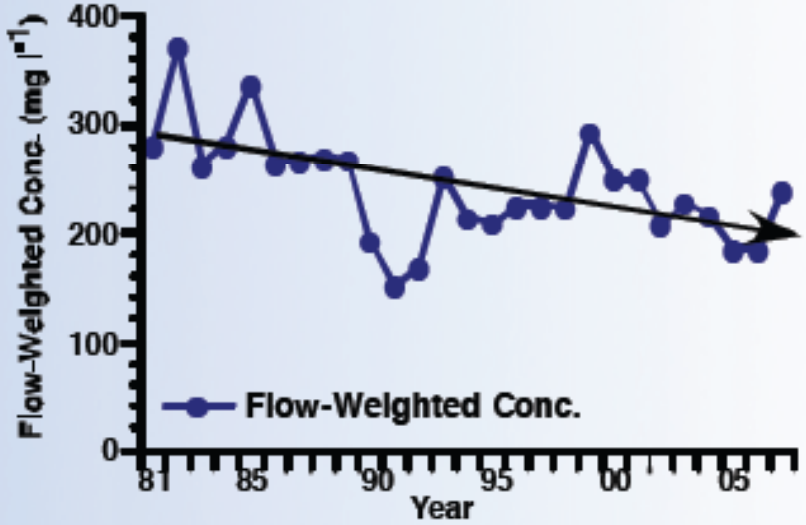




Old River Outflow Channel @ Knox Landing

Total Flux = 860 Mt





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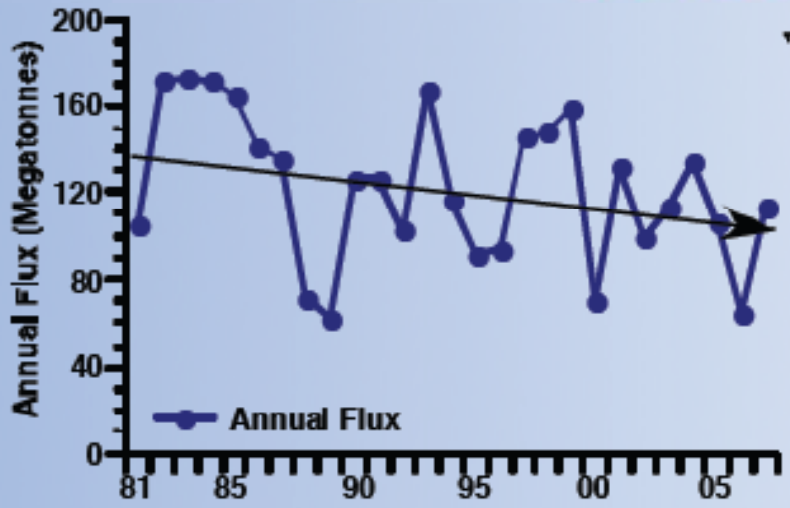
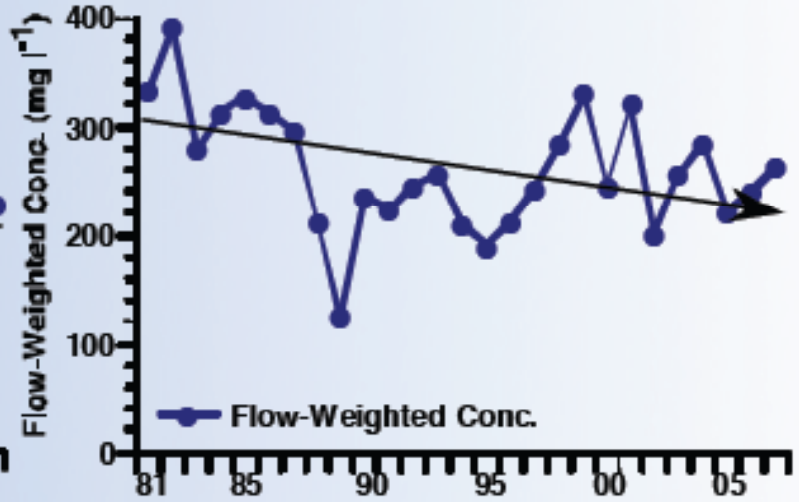
Mississippi River @ Tarbert Landing

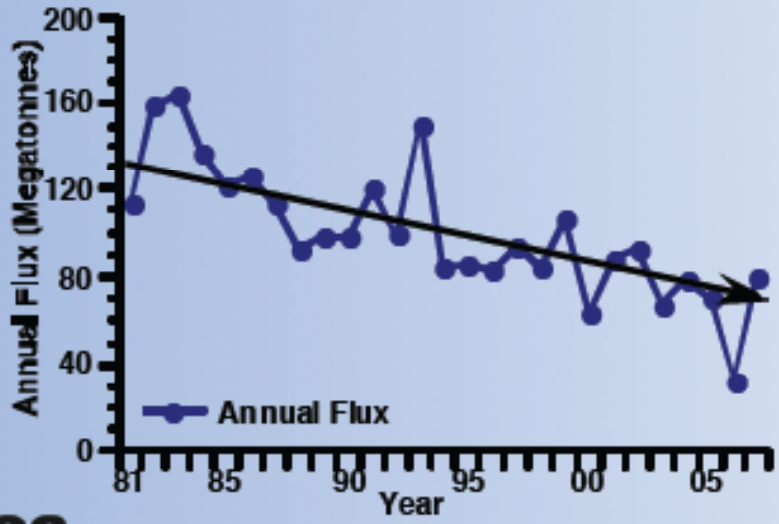
Total Flux = 3,300 Mt

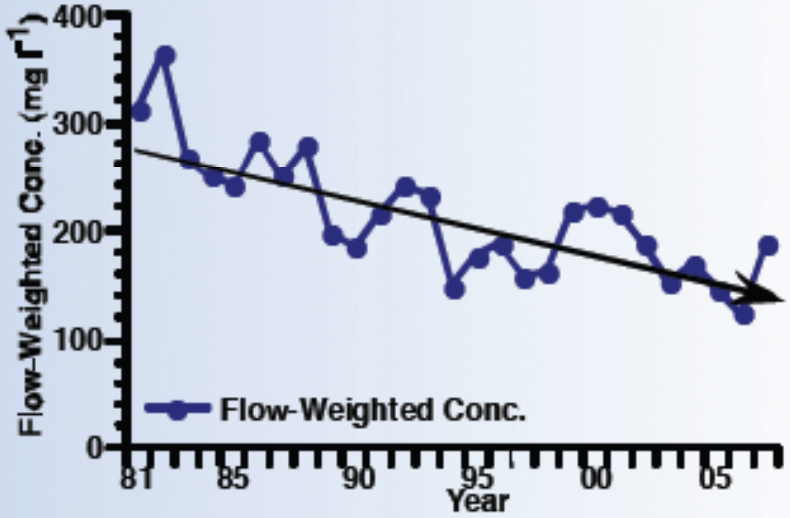




Mississippi River @ St. Francisville

Total Flux = 2,500 Mt





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The Great Flood of 1993

Chronology of 1993 Flood

- Rainfall around 300 percent above normal in April and May saturated soils and filled streams to capacity in the midwest.
- Additional heavey rainfall in June flooded Wisconsin and Minnesota.
- By July, the mainstem of the Mississippi and its major tributaries were flooding.

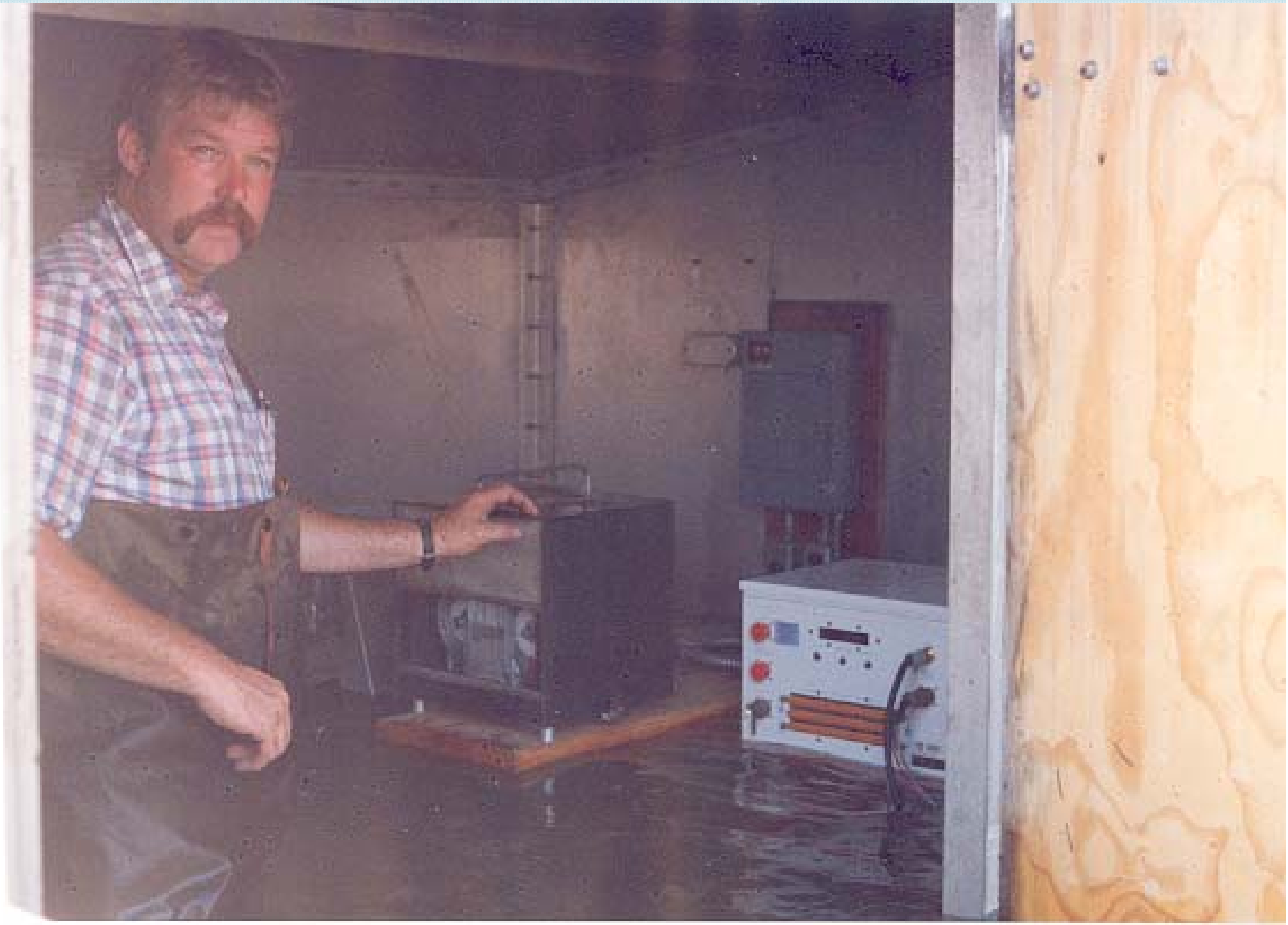
Alton, Illinois

Grafton, Illinois

Confluence of the Mississippi and Missouri Rivers

Jefferson City, Missouri

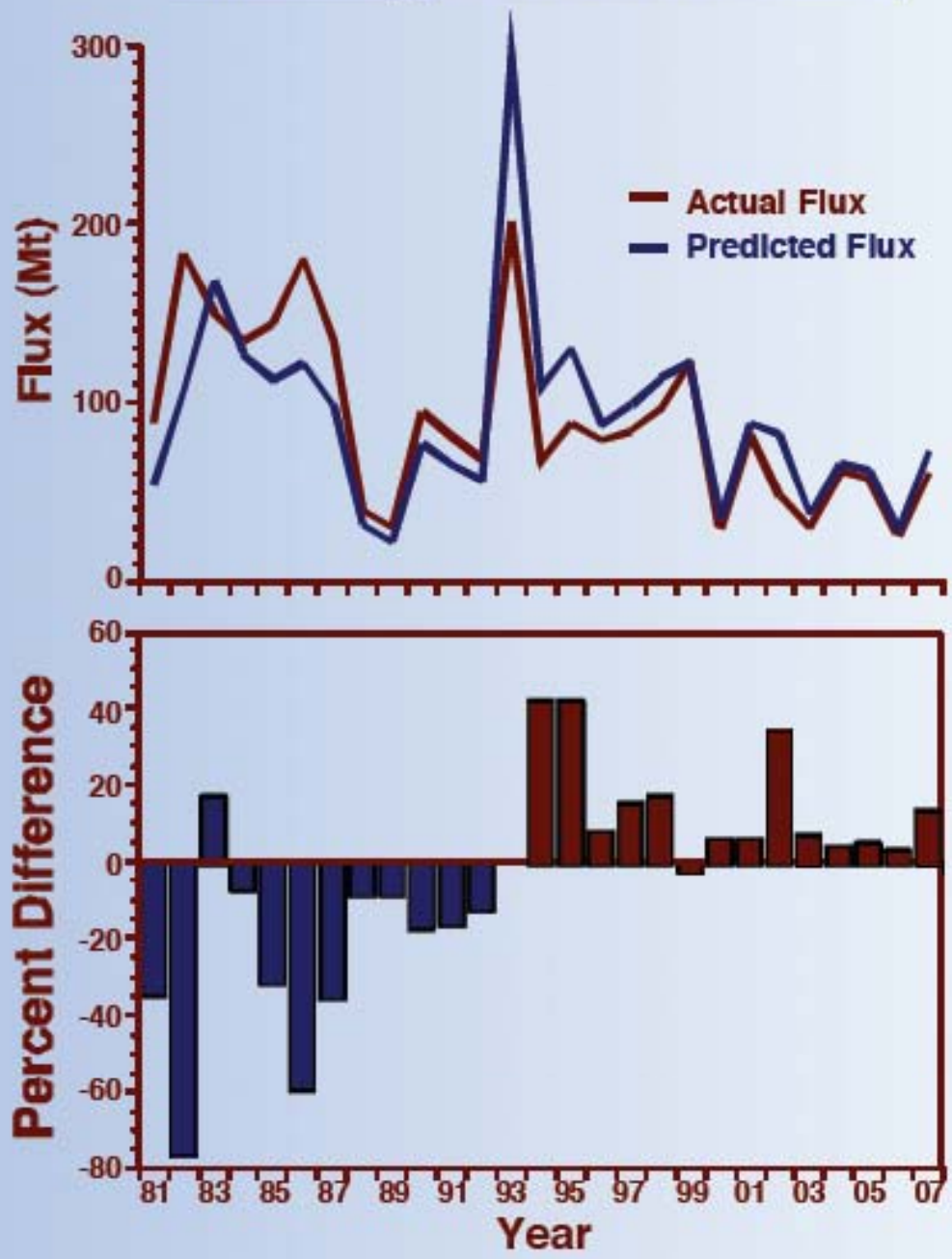
Jefferson City, Missouri



Annual vs. Predicted Flux

- Using relation between discharge and suspended sediment fluxes, predictions of suspended sediment fluxes are under-predicted prior to the 1993 flood and over-predicted after the flood.
- Indicates a step-function in the long-term decline in suspended sediment flux.

Mississippi River @ Thebes



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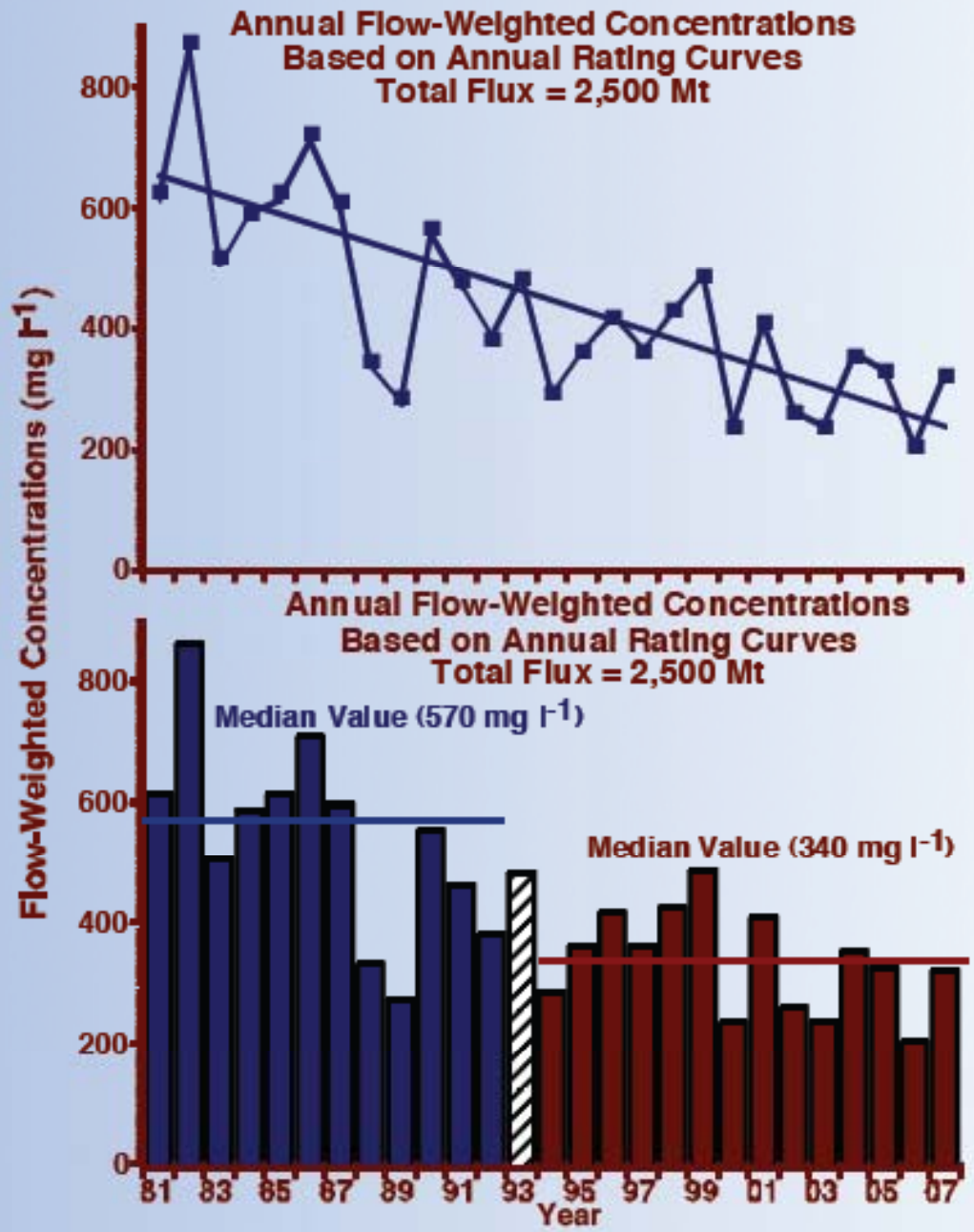
Mississippi River @ Thebes



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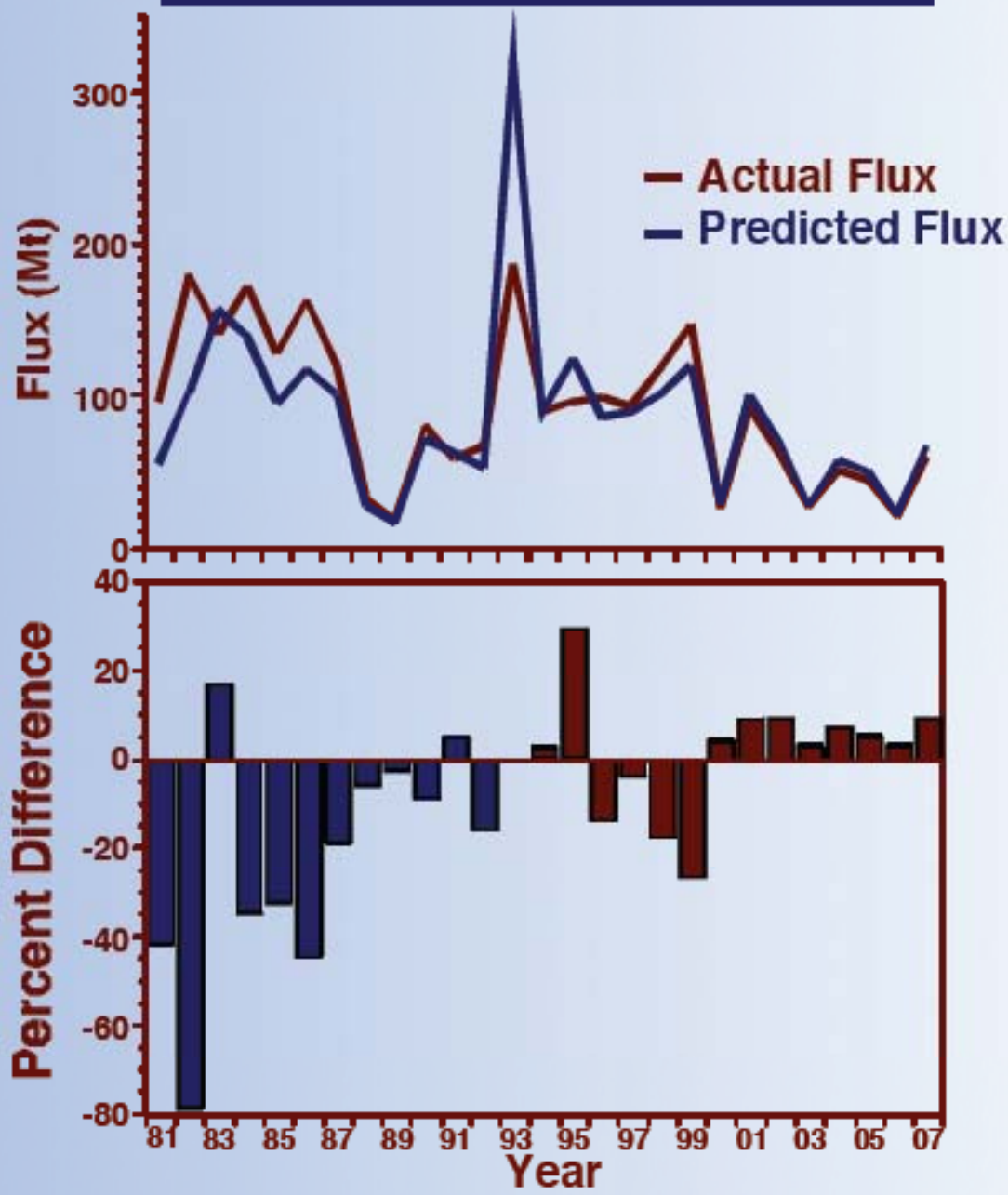
Mississippi River @ St. Louis



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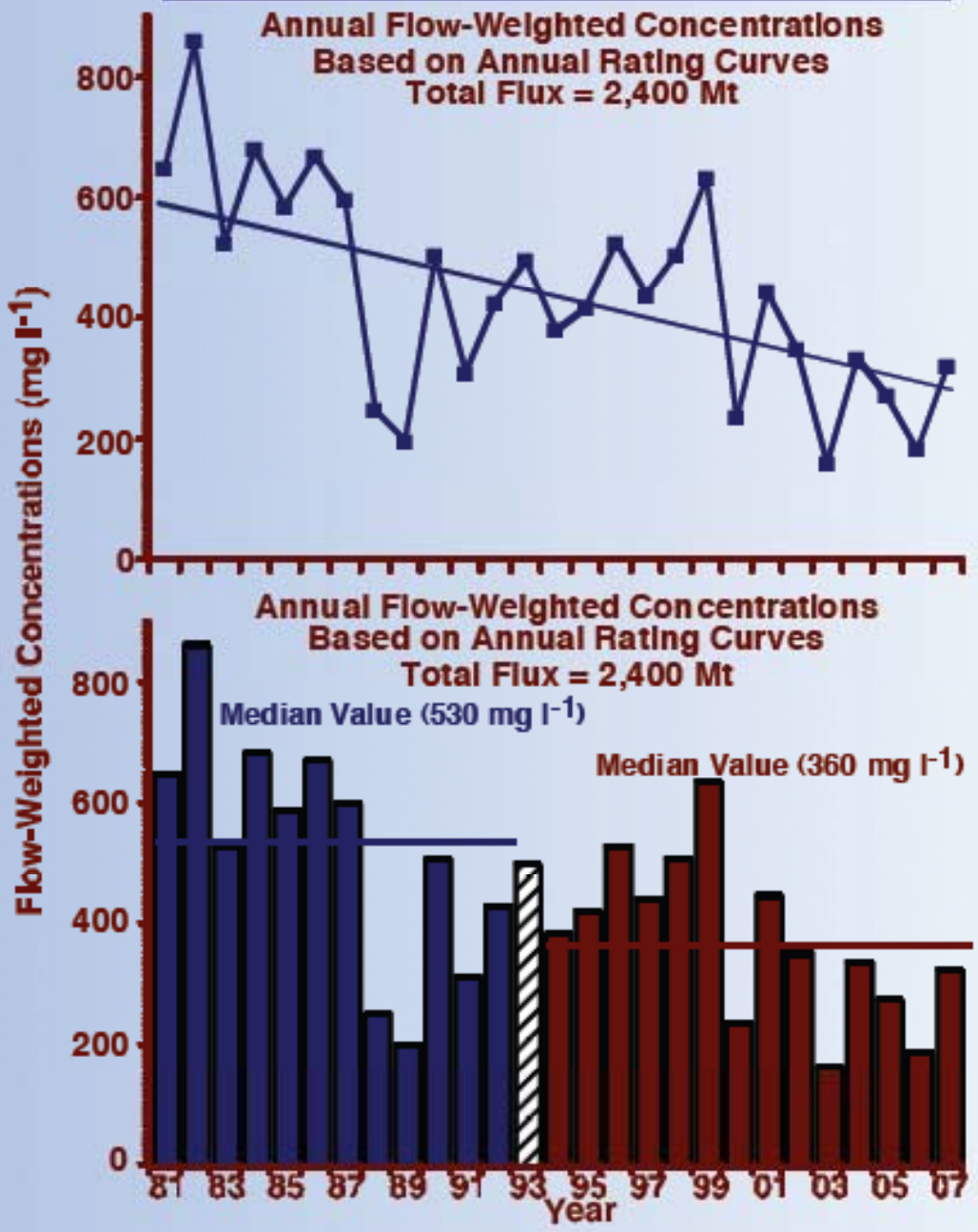

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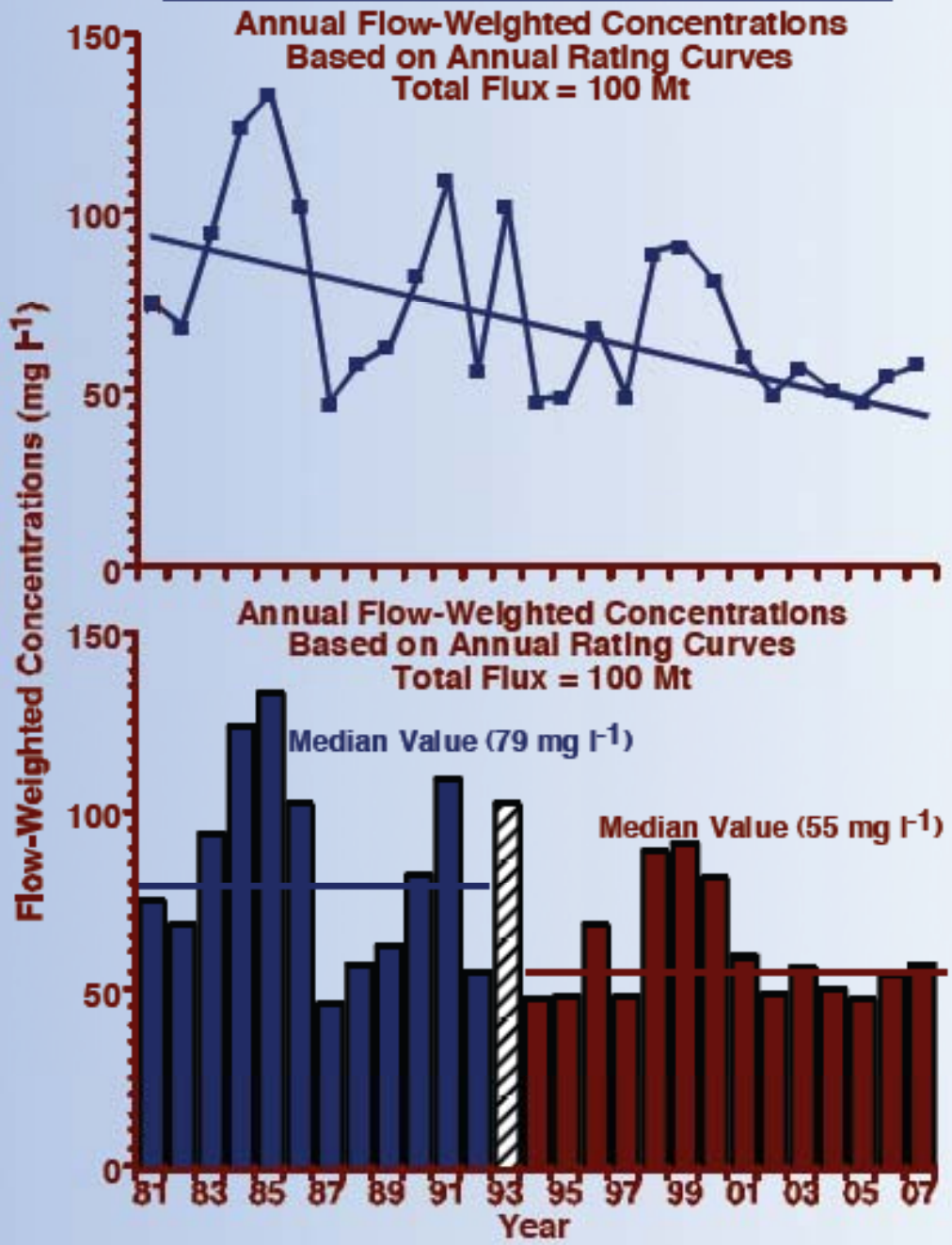
Mississippi River @ Clinton



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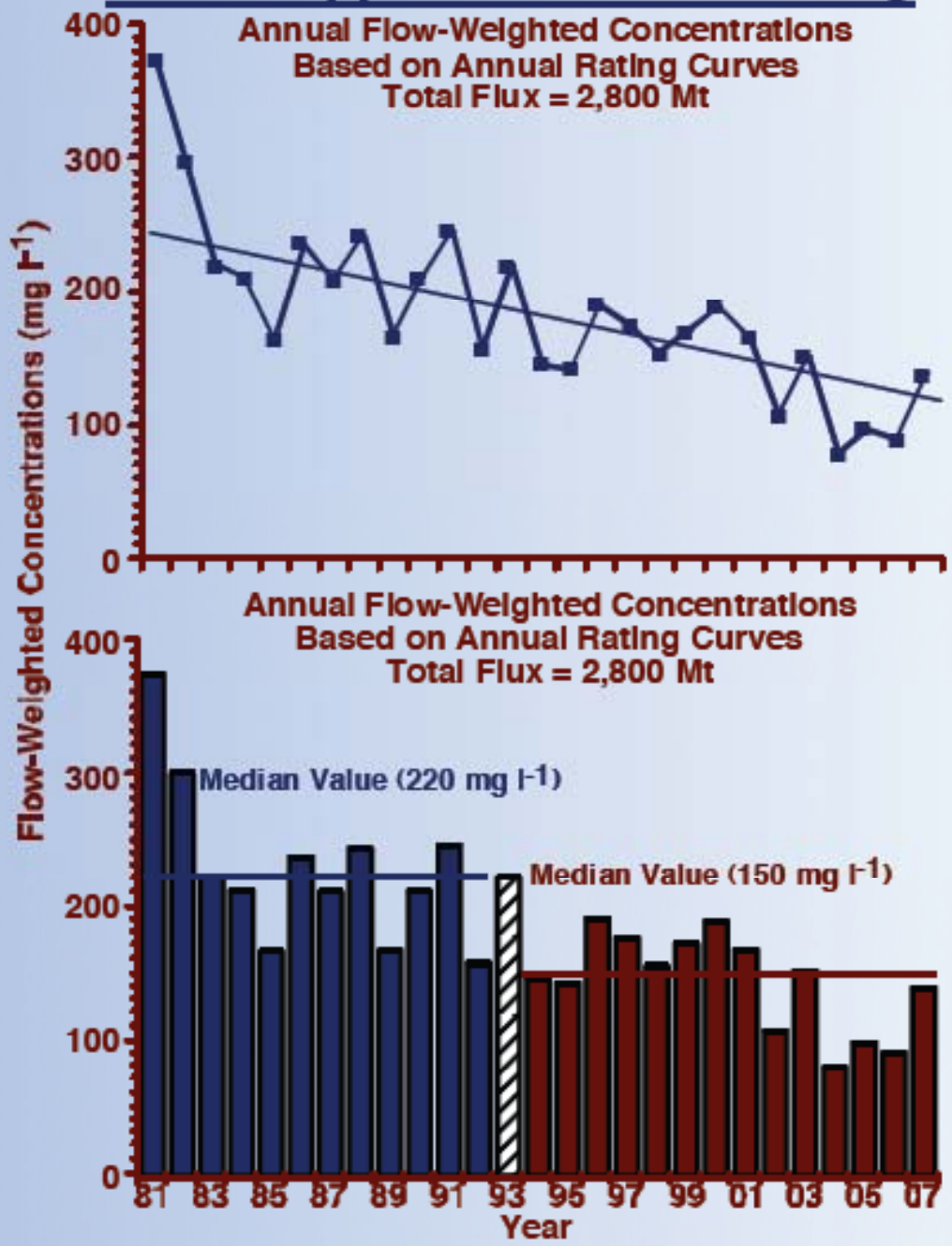
Mississippi River @ Vicksburg



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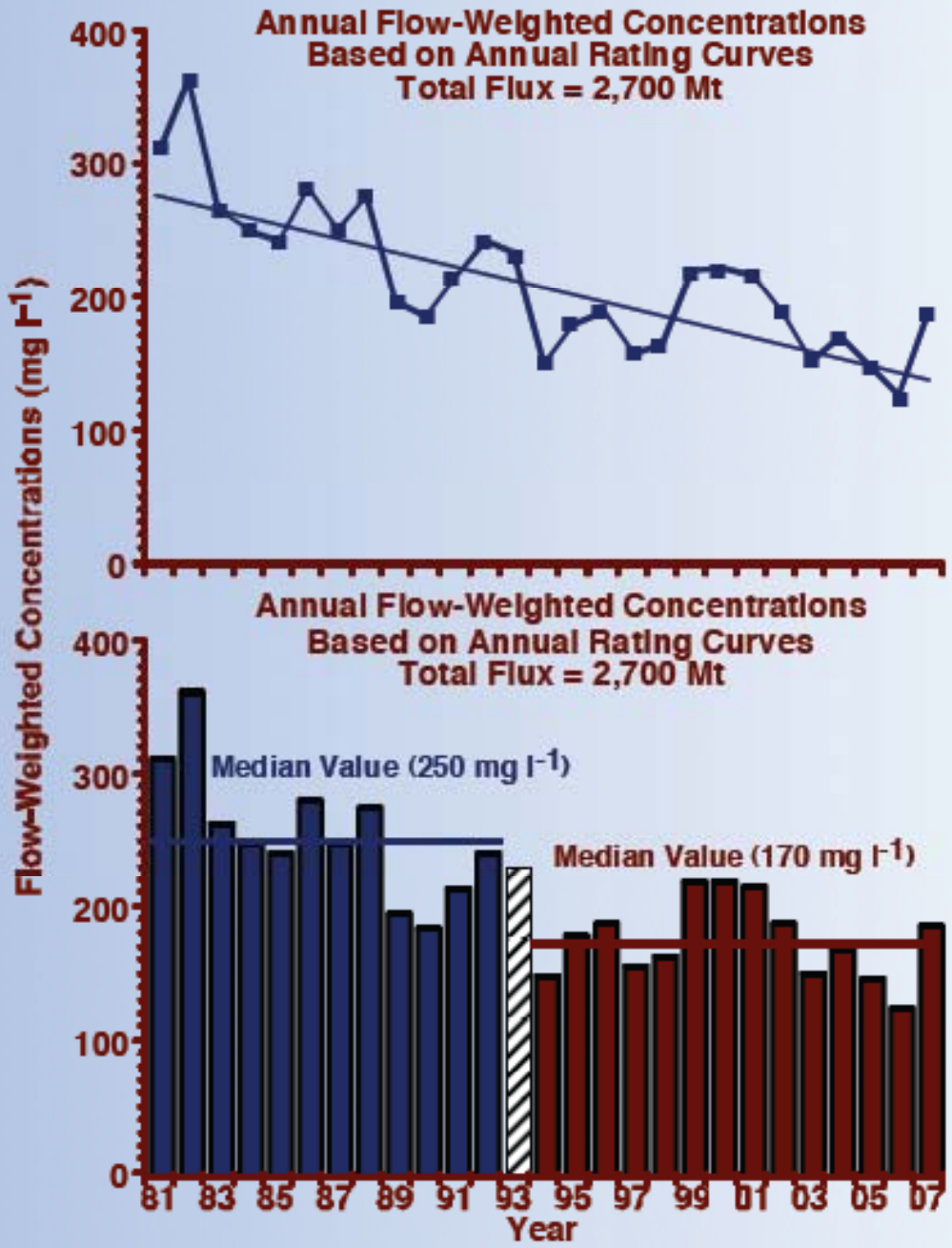
Mississippi River @ St. Francisville



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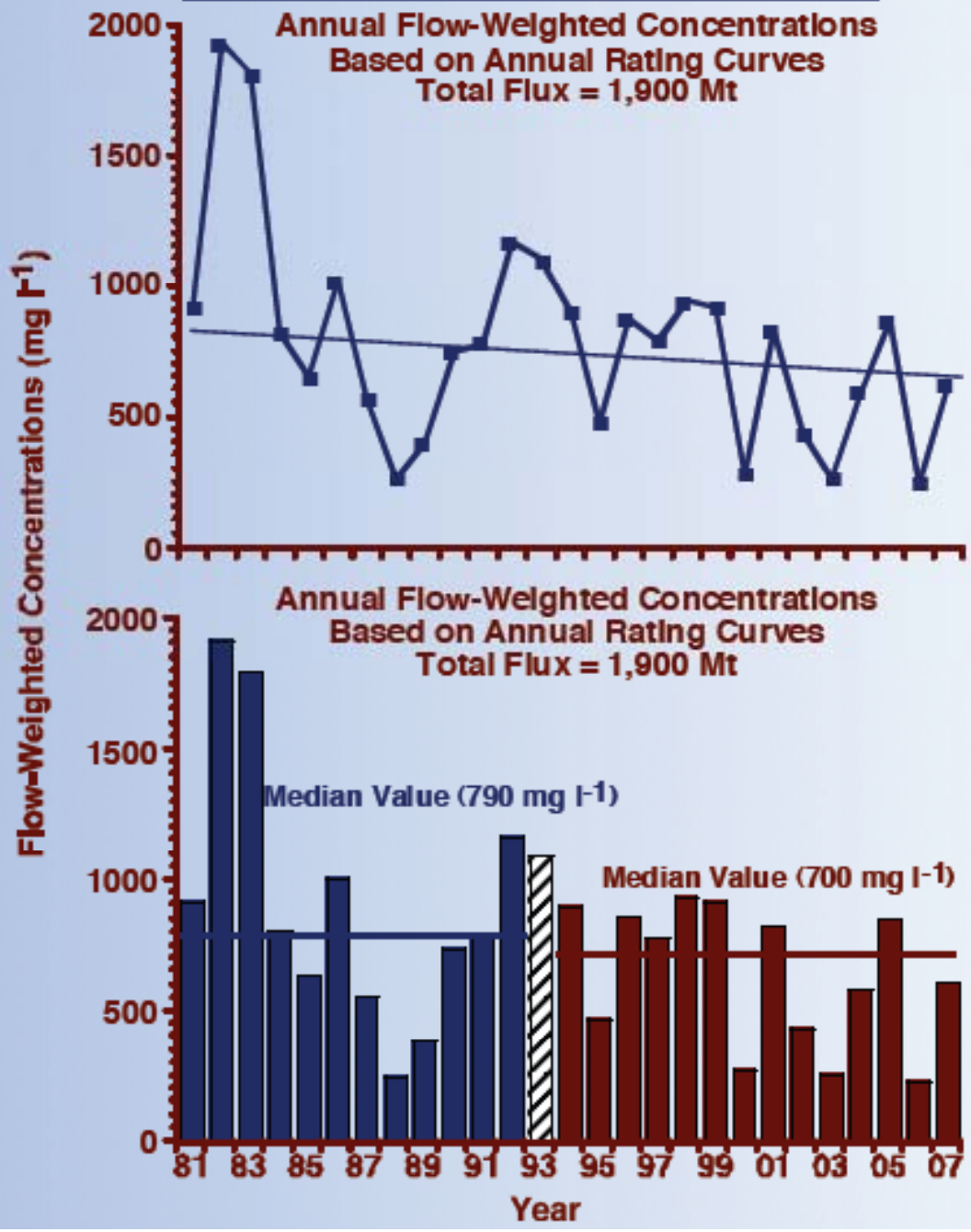
Missouri River @ Hermann



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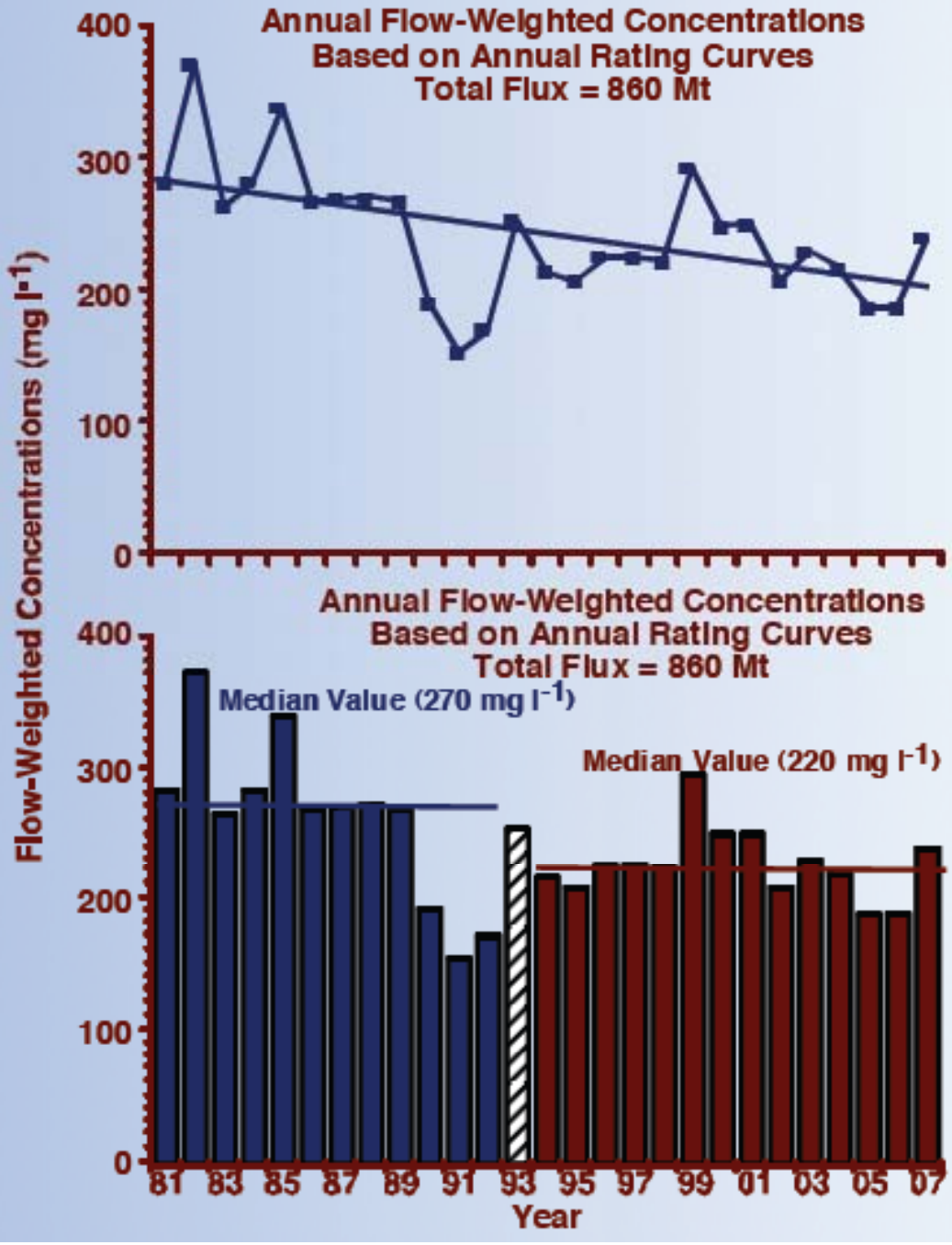
Mississippi River @ Knox Landing



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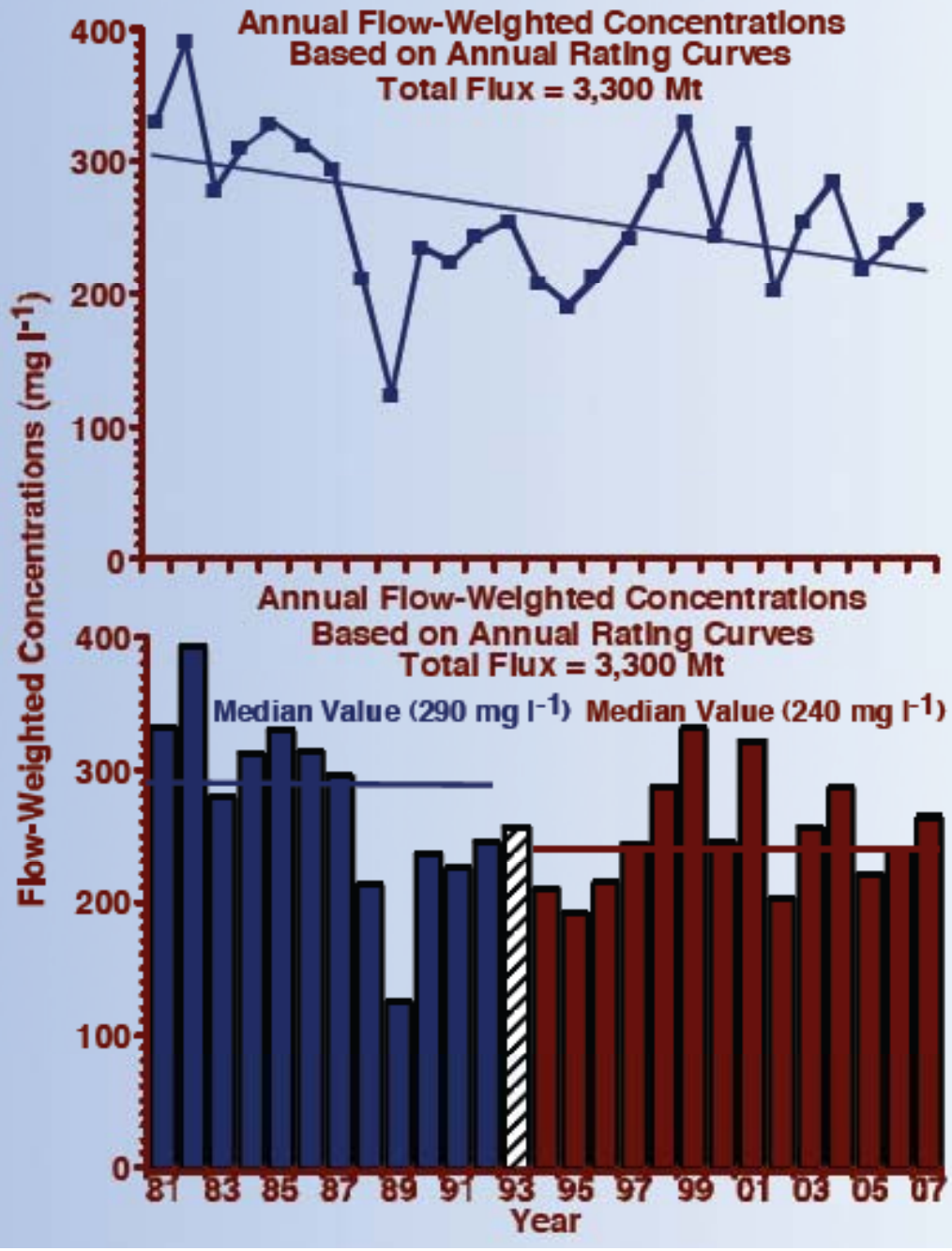
Mississippi River @ Tarbert Landing



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Conclusions

- Long-term declines in annual suspended sediment fluxes were observed throughout 1981-2007.
- The Great Flood of ‘93 resulted in a step-function in long-term suspended sediment flux.
- Some sites do not exhibit this function as clearly which may result from local influences and lack of sufficient resolution data.

Conclusions cont.

- **Flow-weighted concentration declines throughout the period and step-function in fluxes indicate that long-term declines in suspended sediment fluxes result from decline in sediment supply rather than changes in stream discharge.**

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