IT ALL ENDS UP IN OUR WATER: SAVING OUR COASTAL AND FRESH WATERS FROM LAND AND AIR WASTES

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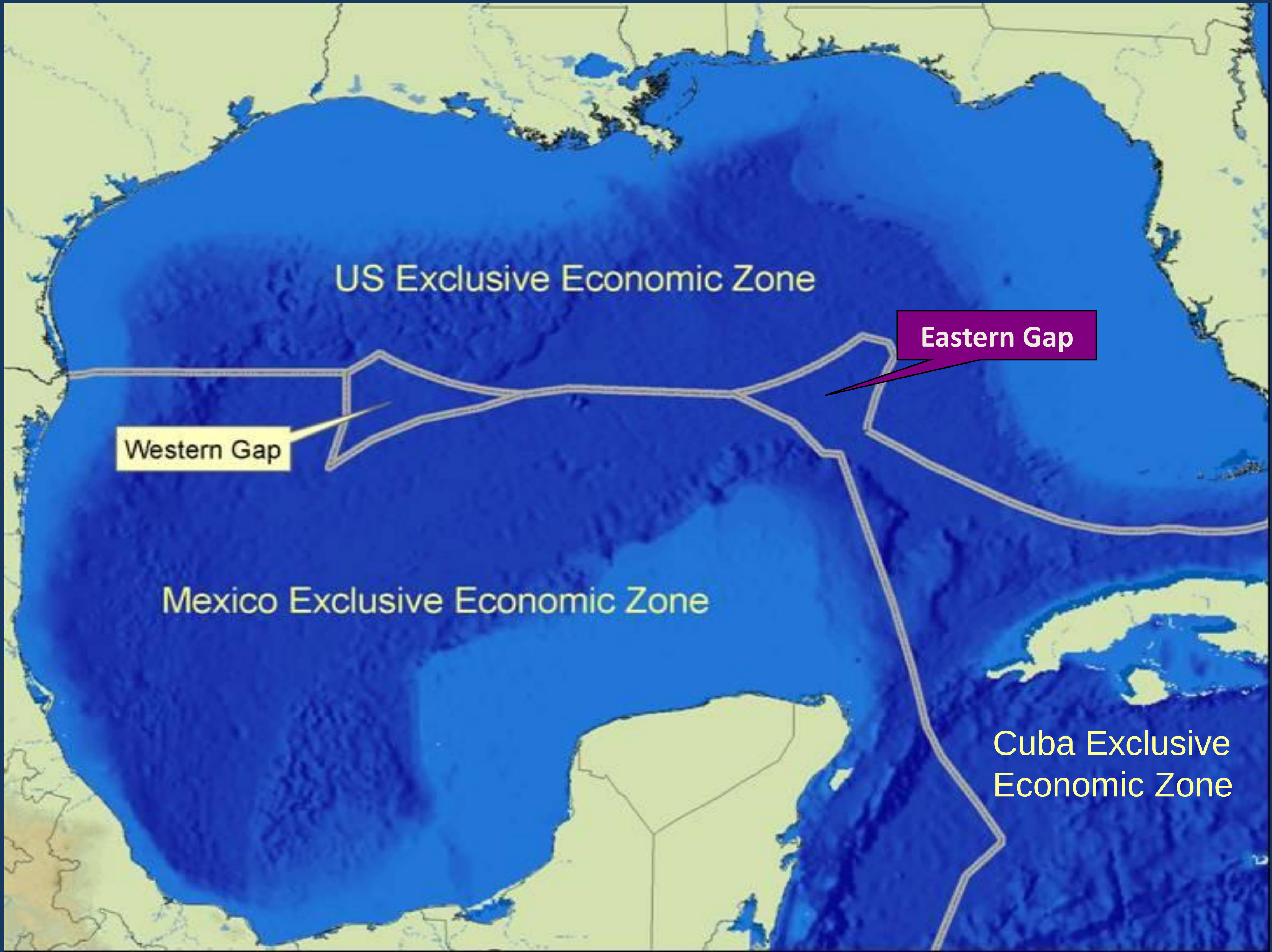
IWC6

6TH BIENNIAL INTERNATIONAL WATERS CONFERENCE

17-20 OCTOBER 2011, DUBROVNIK, CROATIA

Gulf of Mexico LME

Regional Governance in the Gulf of Mexico



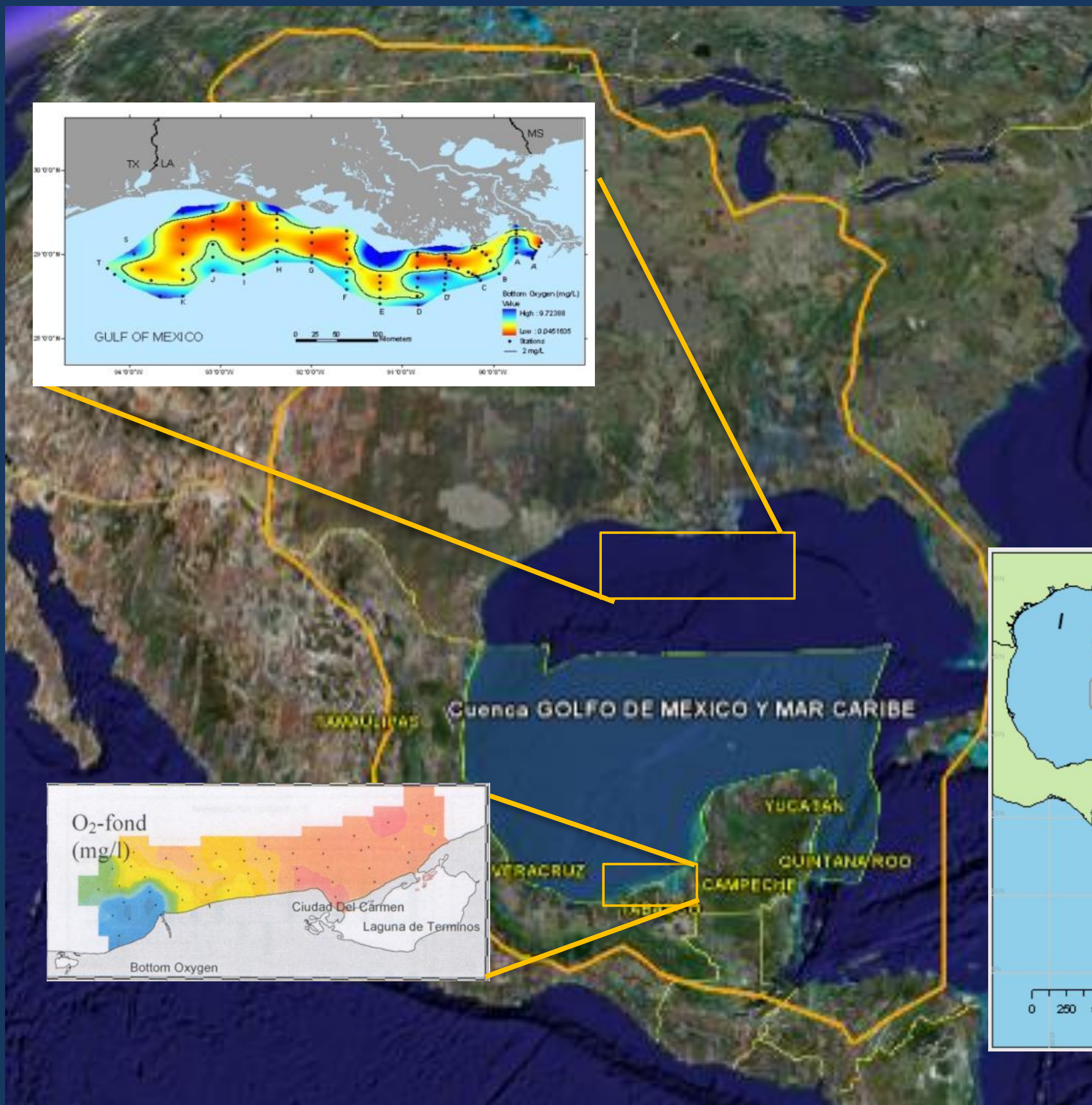
Gulf of Mexico Key Stressors

PRESSURES

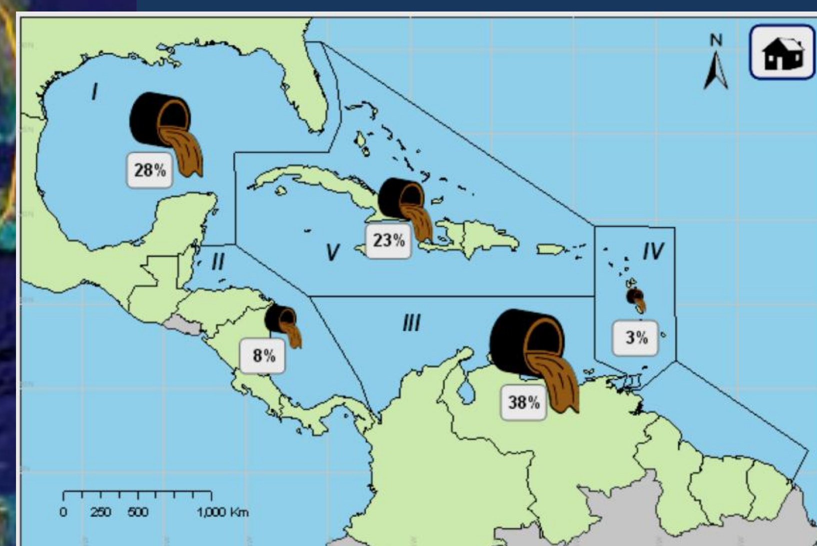
- Deforestation
- Erosion
- Land use change
- Basin deterioration
- Load capacity decrease
- Watershed overexplotation
- Water and basins pollution

- 20 main watersheds draining water into the Gulf 10.6 x10^{11} m^3 x year
- Biodiversity 20,796 spp (340 endemics)
- Productivity: 300gC/m^2/yr
- Population: 55 million living in coastal satates (40 USA, 15 Mex)

Hypoxia, dead zones, nutrient overloading

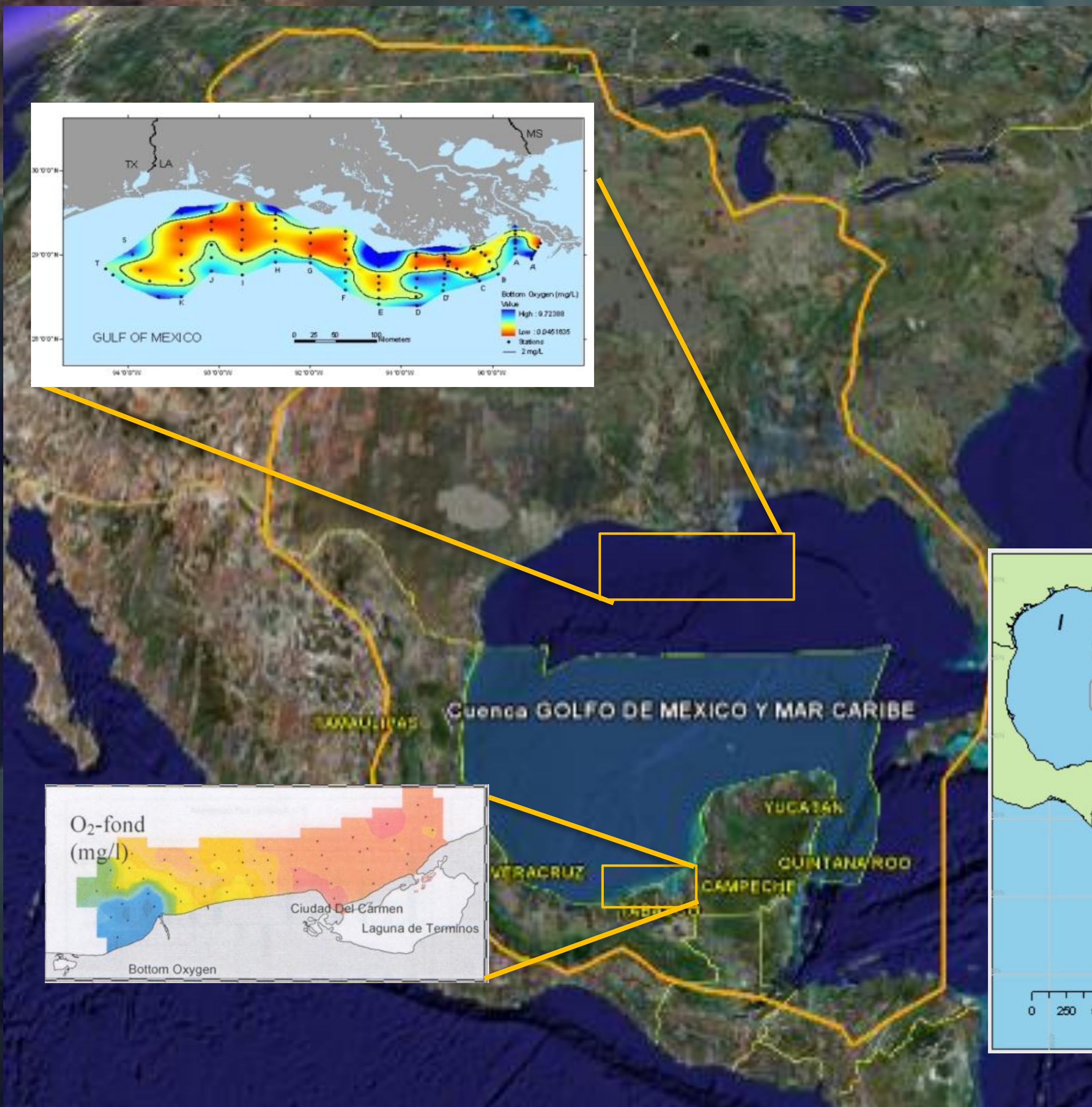


– Coastal Pathogens
– Population Growth & Development
– Wetland/Habitat Loss
– Nutrients & Hypoxia
– Toxics/Contaminants
– Harmful algal blooms
– Oil Spills



sby, 2000.

Hypoxia, dead zones, nutrient overloading



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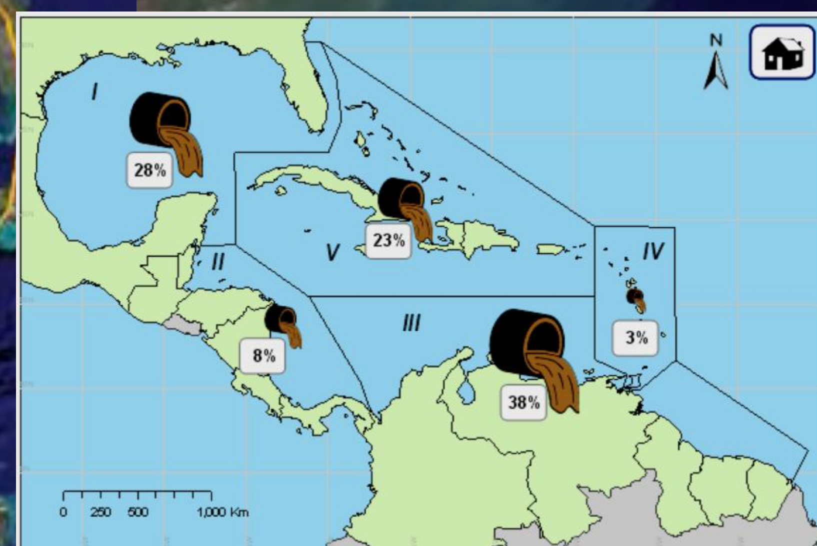


sby, 2000.

Watersheds Trigger Regulatory Mismatches – Gulf Hypoxic Zone is Example

- **Discontinuity**
  - Spatial and temporal difference between cause and effect of problem
- **Fragmentation**
  - Regulatory authority is divided among many laws and jurisdictions

Map courtesy of US Environmental Protection Agency

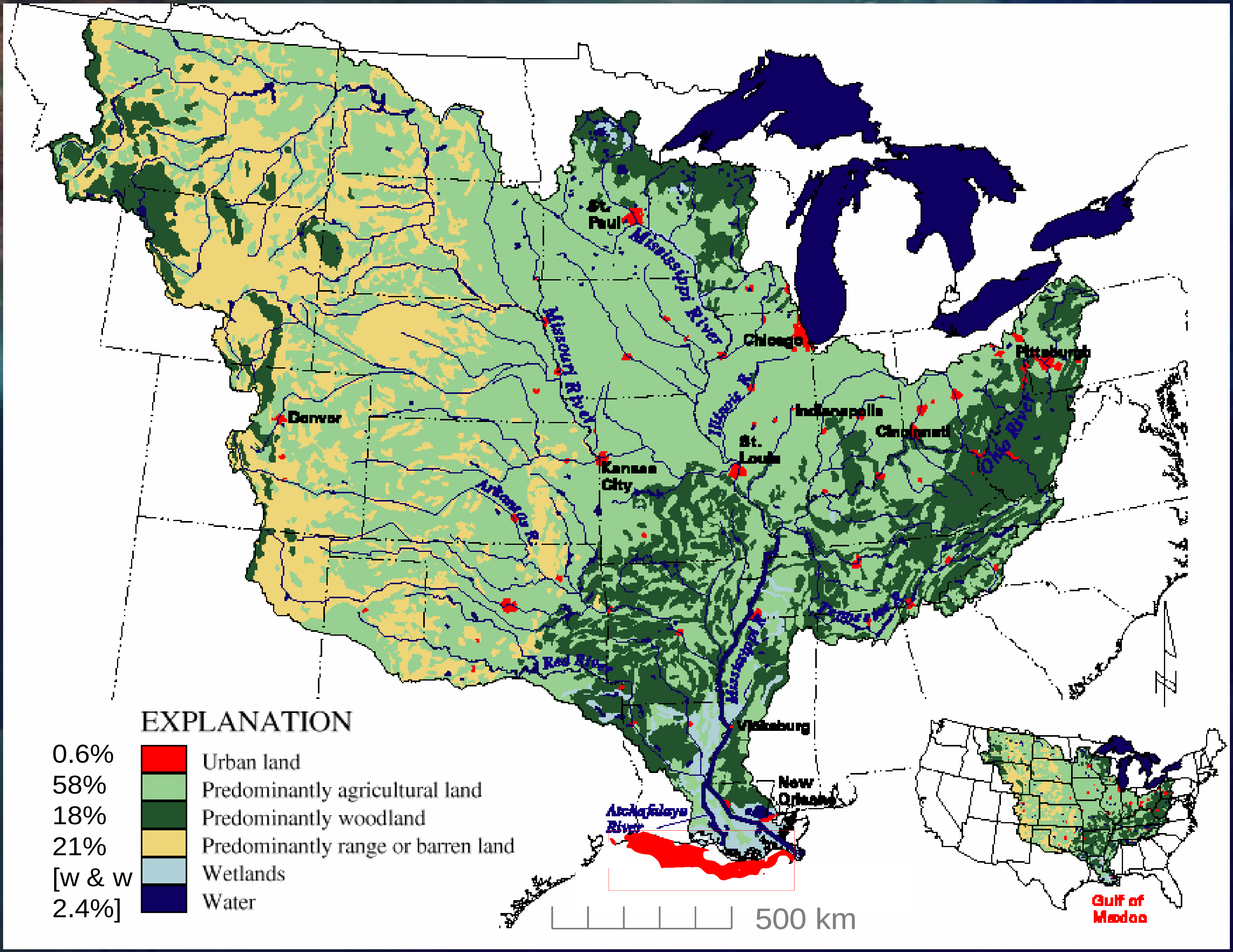
NOT Just a Nutrient & Hypoxia Talk

- Landscape Change and Loss of Carrying Capacity and Natural Functions
- Sediments
- Contaminants
- Pathogens
- Nutrients
- Eutrophication
  - Hypoxia
  - Harmful Algal Blooms

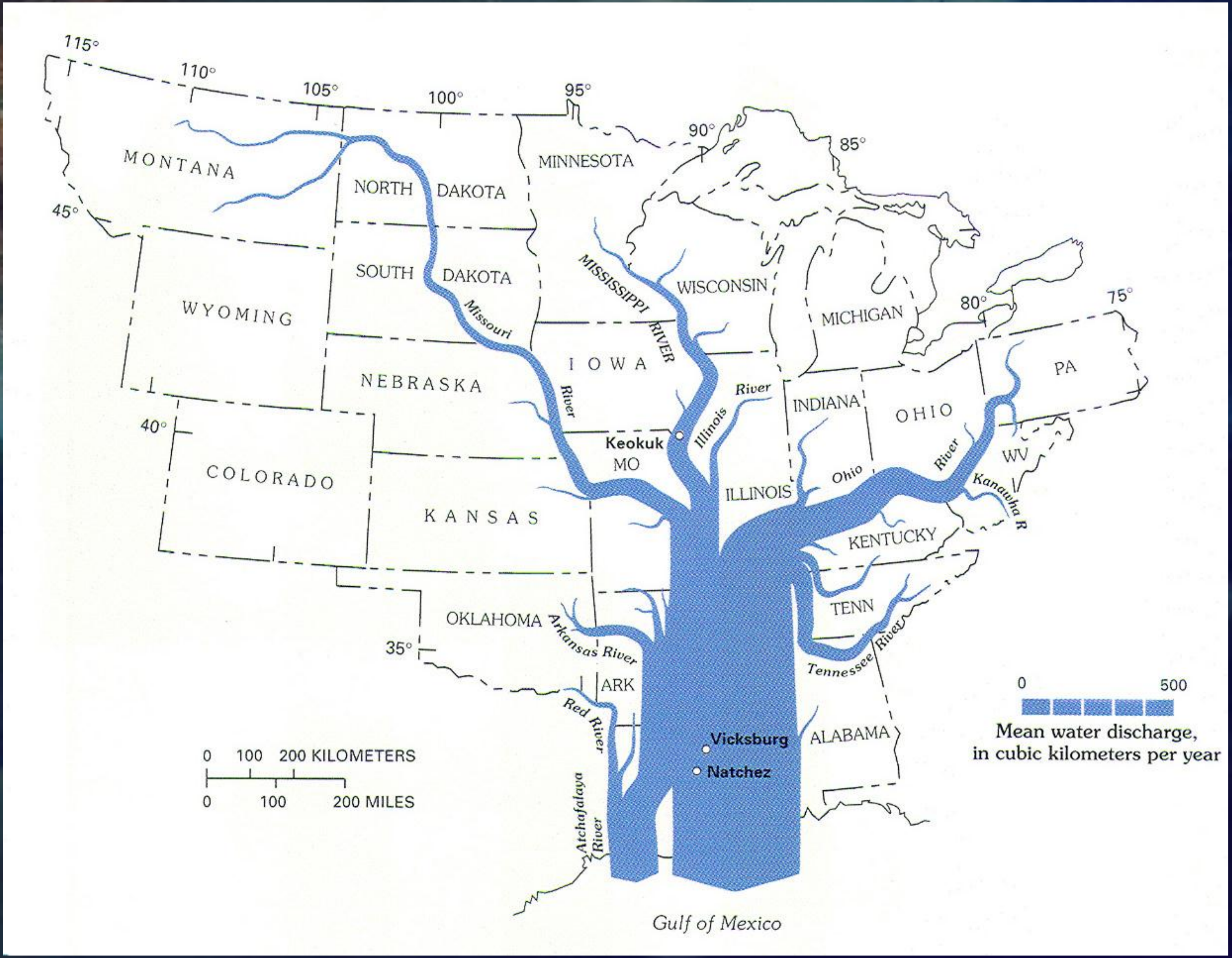
But, YES, the Mississippi River

“Our rivers are too large to have nutrient problems and dead zones”

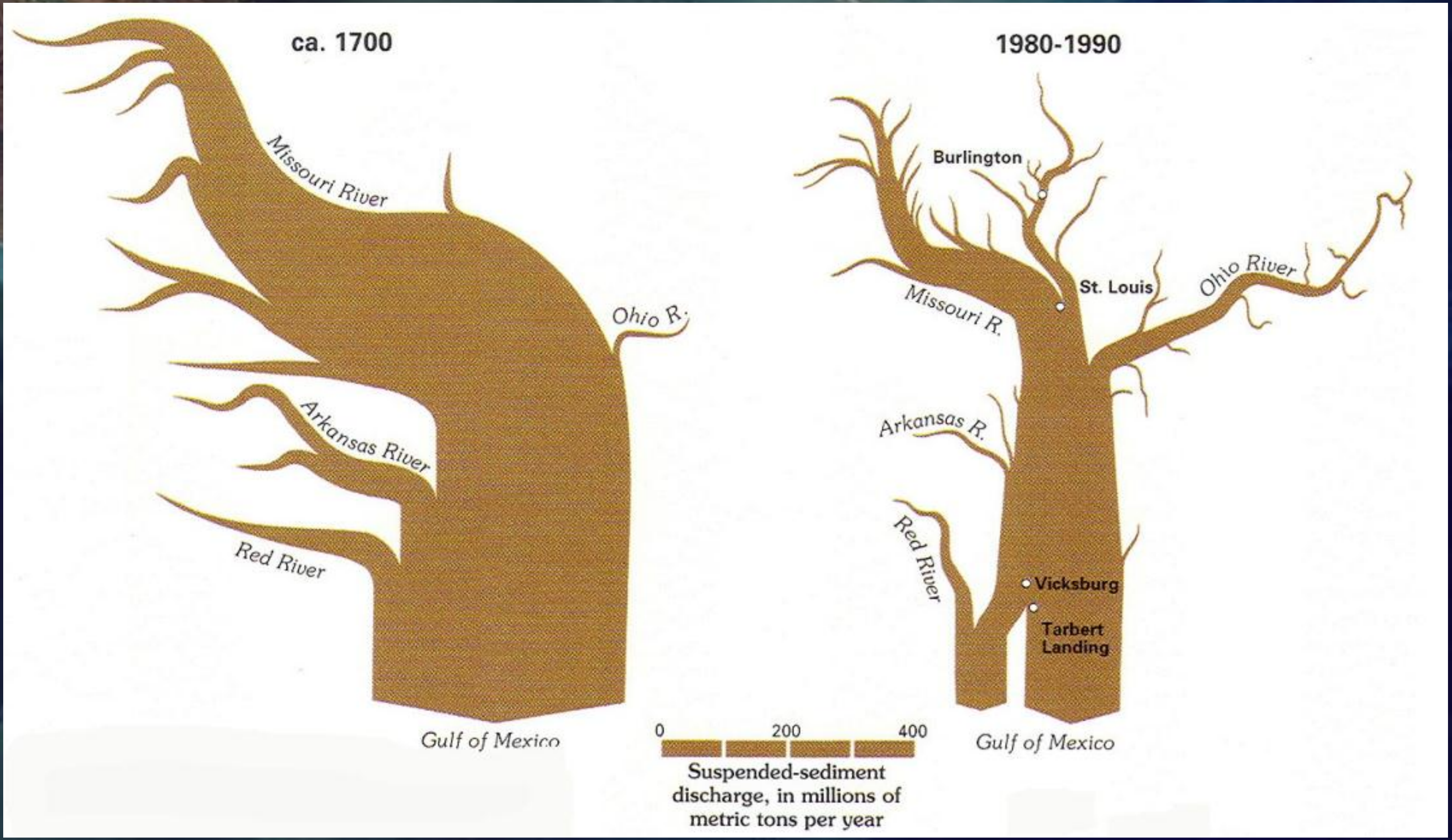
Land-Ocean Interactions in the Coastal Zone (LOICZ/IGBP) Open Science Meeting, Bahia Blanca, Argentina, November 1999



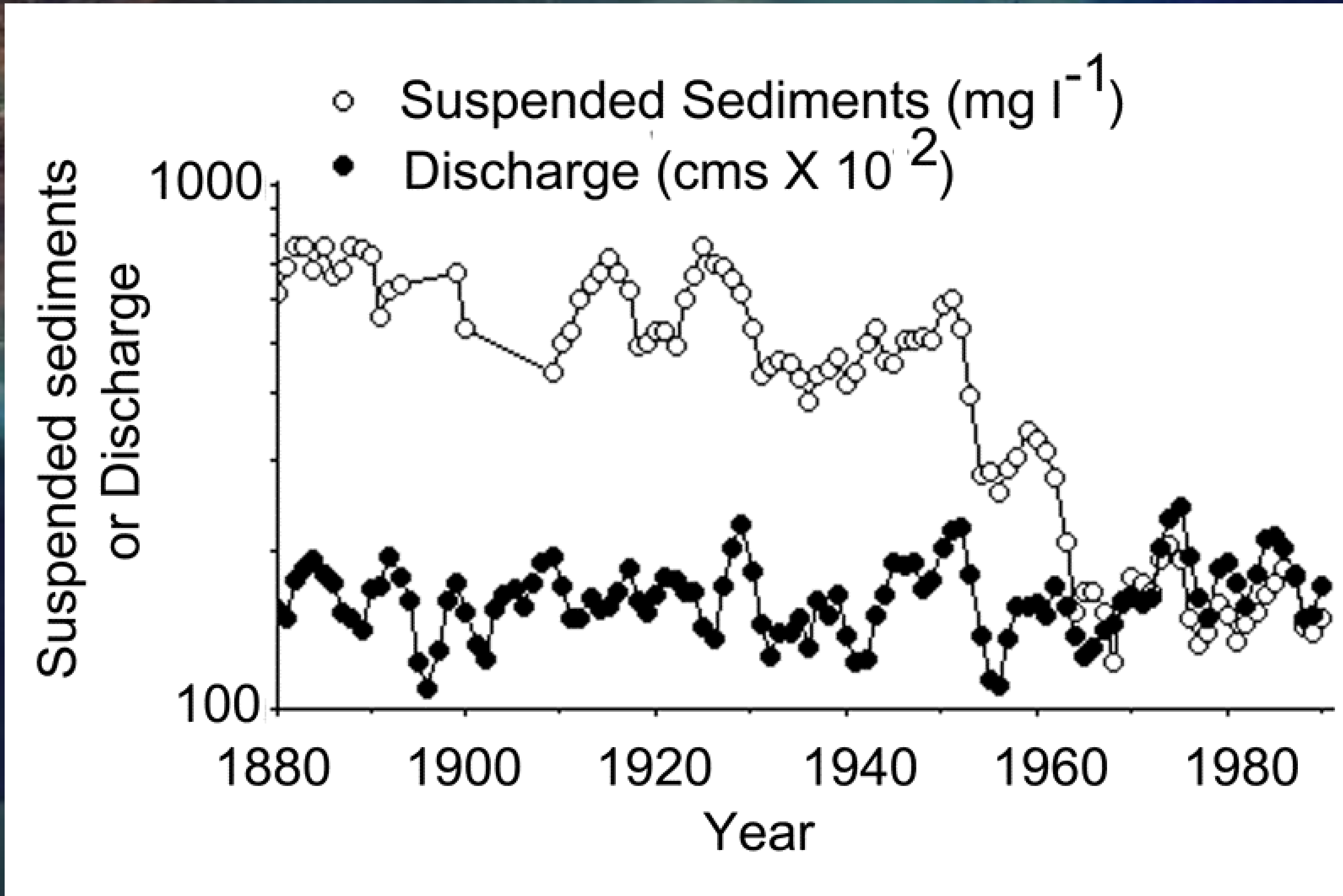
Mississippi River drainage basin, major tributaries, and land uses, and the 1999 Gulf of Mexico hypoxic area. Source: Goolsby, 2000.



Relative freshwater discharge of Mississippi River tributaries to the amount delivered to the northern Gulf of Mexico. Widths of the river and its tributaries are exaggerated to indicate relative flow rates. Source: Meade, 1995.

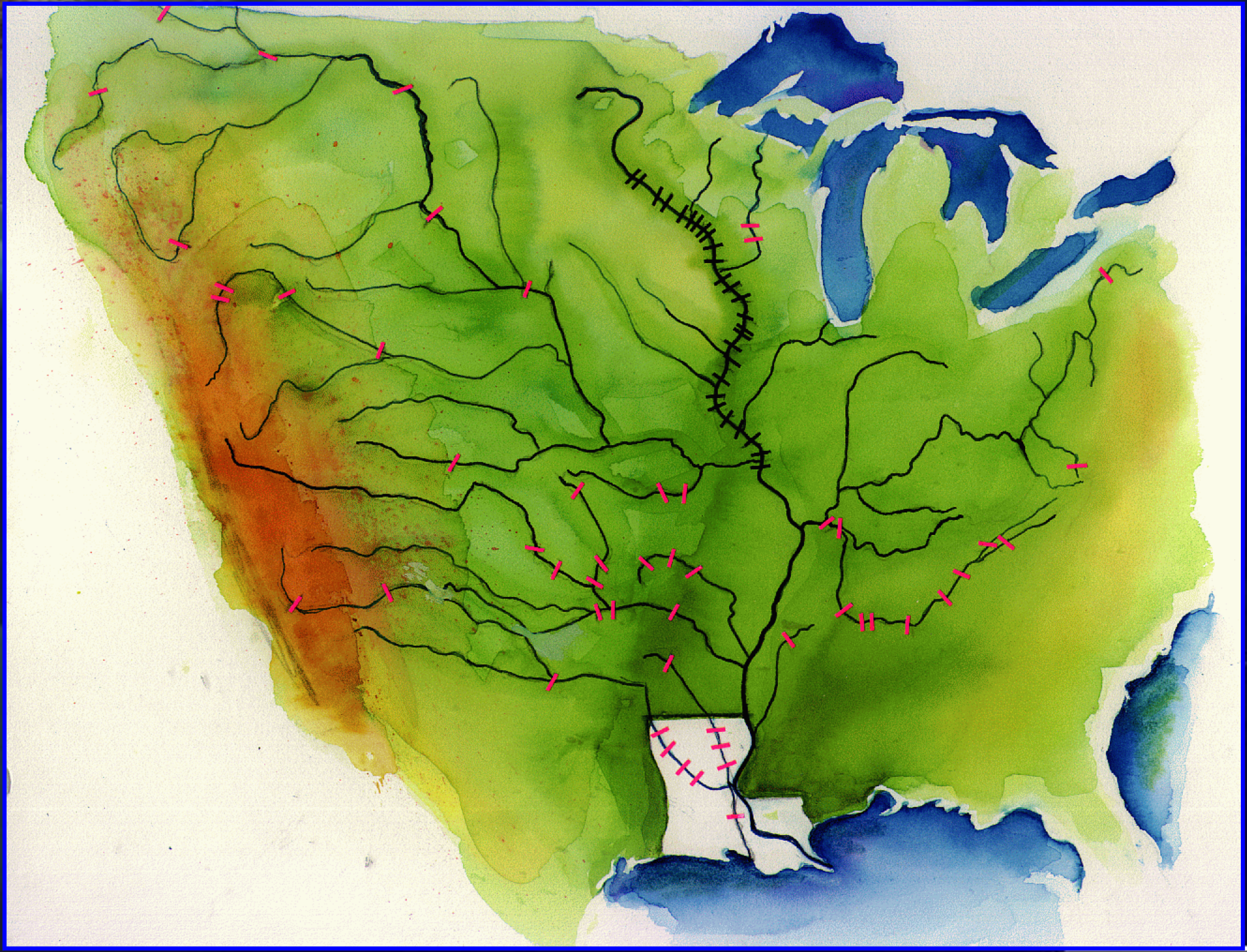


Mississippi River suspended sediment discharge, ca. 1700 (estimated) and 1980-1990. Values in millions of metric tons per year. Widths of the river and its tributaries are exaggerated to reflect relative sediment loads. Source: Meade, 1995.



The average annual concentration of suspended sediments (mg l^{-1}) at New Orleans (from Turner and Rabalais 2003) and the annual discharge of the Mississippi River at Vicksburg, MS (cms X 10^2). Note: the gradual decline in suspended sediments from 1880 to the early 1950s (the rise before 1880s is not shown); the more rapid decline in suspended sediments in the 1950s and early 1960s; the fluctuations in river discharge around an average value from 1880 to 1990.

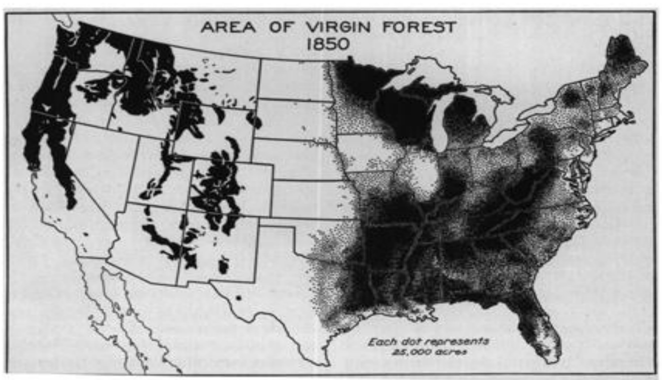
Along with levees, locks and dams built in the Mississippi River watershed have reduced sediment deposition by 80% since 1850



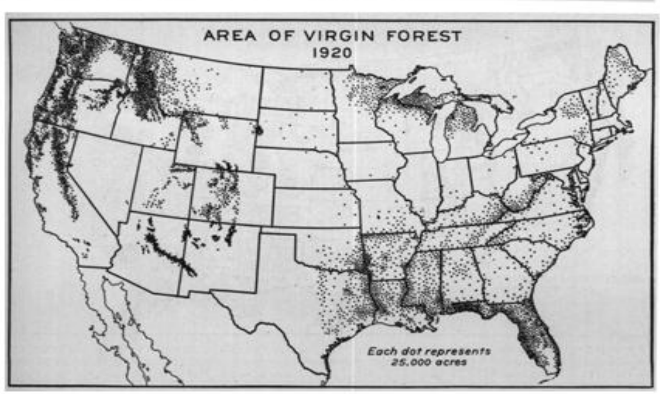
Watershed Landscape Change

Loss of Virgin Forests

1620

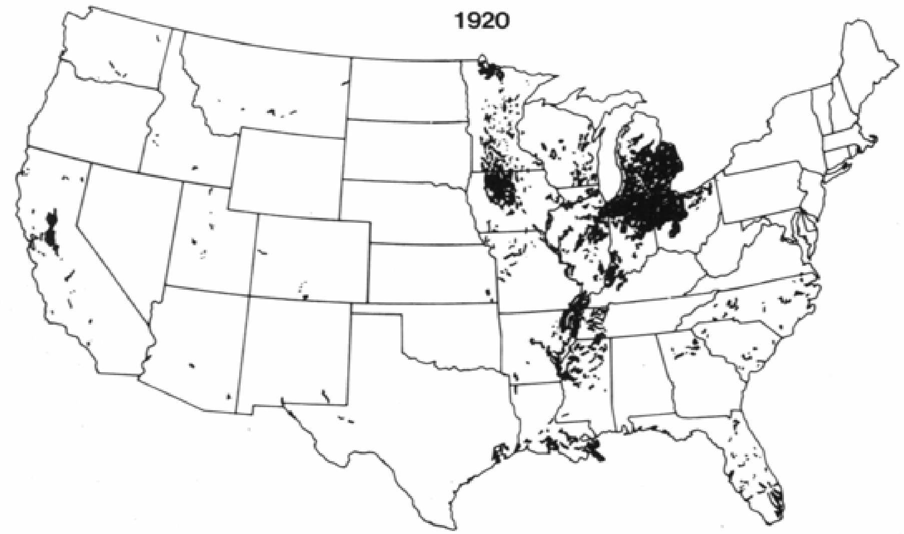


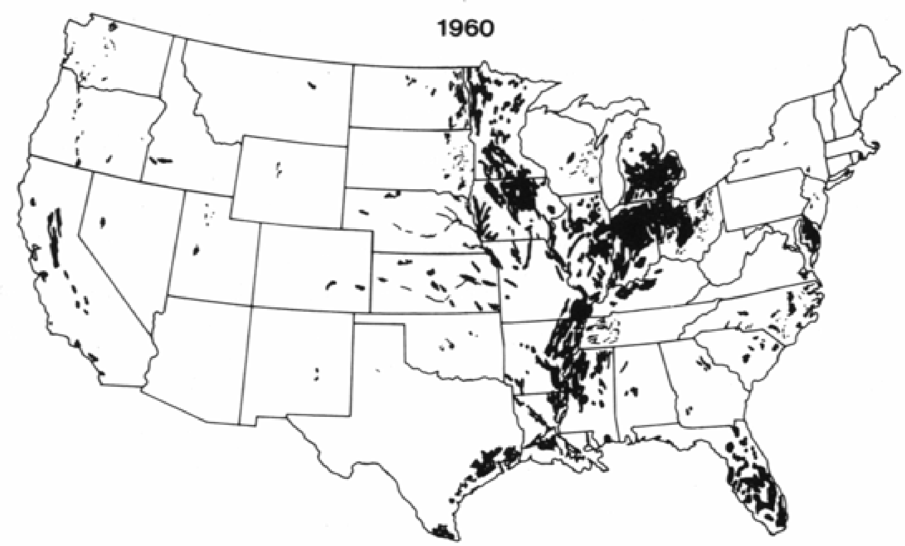
1850

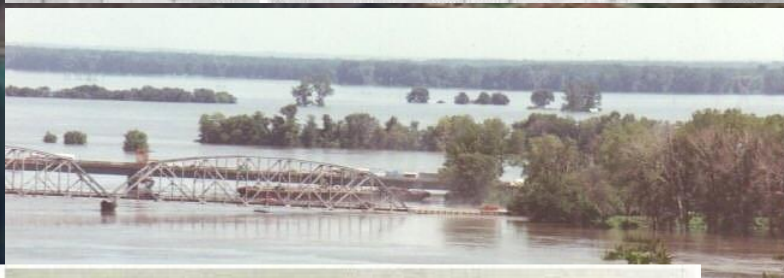


1920

Drainage of Land, Tile Drains







Longitudinal Changes in Mississippi River Floodplain Structure

by
Robert L. Delaney[1] and Mary R. Craig[2]

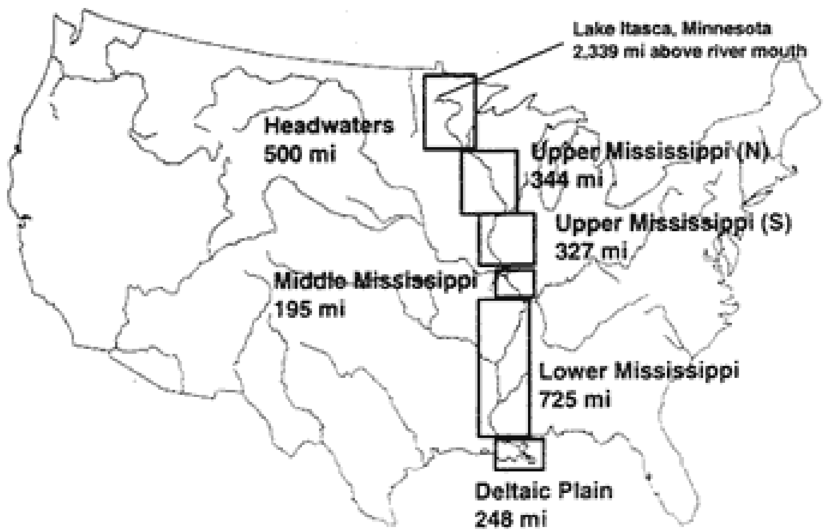


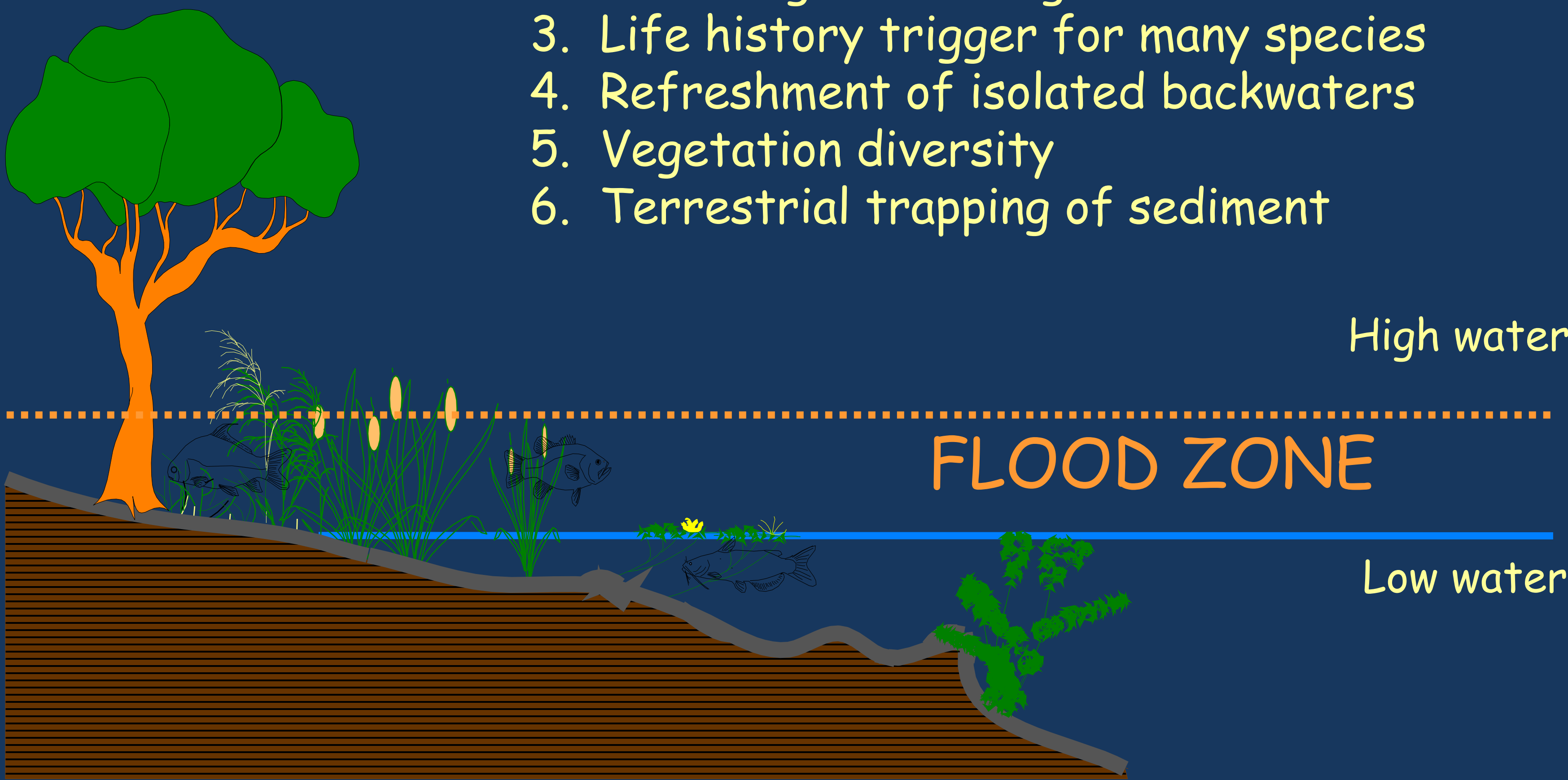
Figure 1. Mississippi River Segments

Table 1. Mississippi River Floodplain

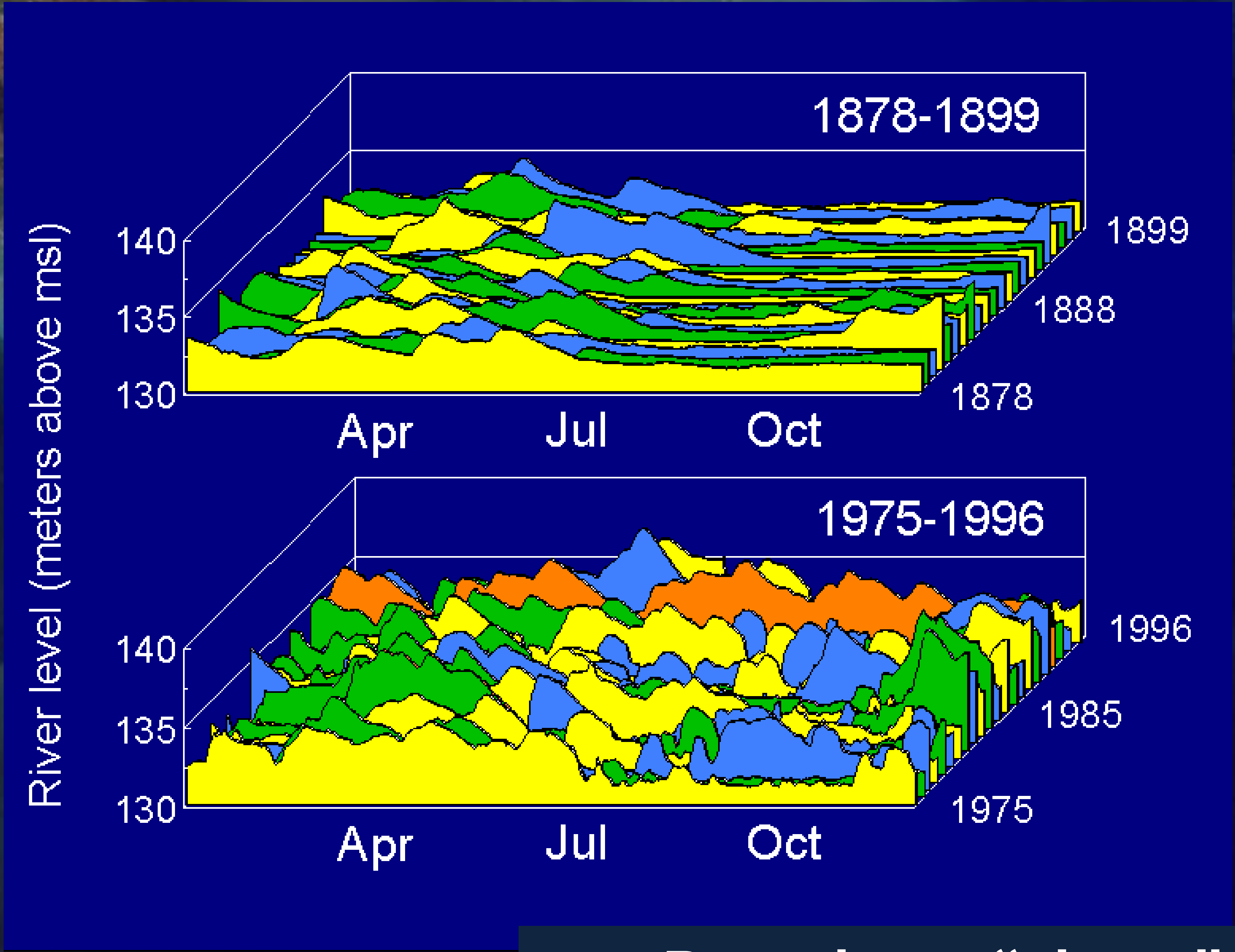
River Segment	*Approximate Floodplain Acres in 1,000s*	*Percent of Floodplain Behind Levees*
Headwaters	328	<0.01%
Upper Mississippi (N)	496	3%
Upper Mississippi (S)	1,006	53%
Middle Mississippi	663	82%
Lower Mississippi	25,000	93%
Deltaic Plain	3,000	96%
TOTALS	30,493	90%

Ecological values of annual flood pulse

1. Fish spawning, feeding, growth
2. Heron/egret feeding
3. Life history trigger for many species
4. Refreshment of isolated backwaters
5. Vegetation diversity
6. Terrestrial trapping of sediment



After a century of human alteration:



Post-dam: “chaos”

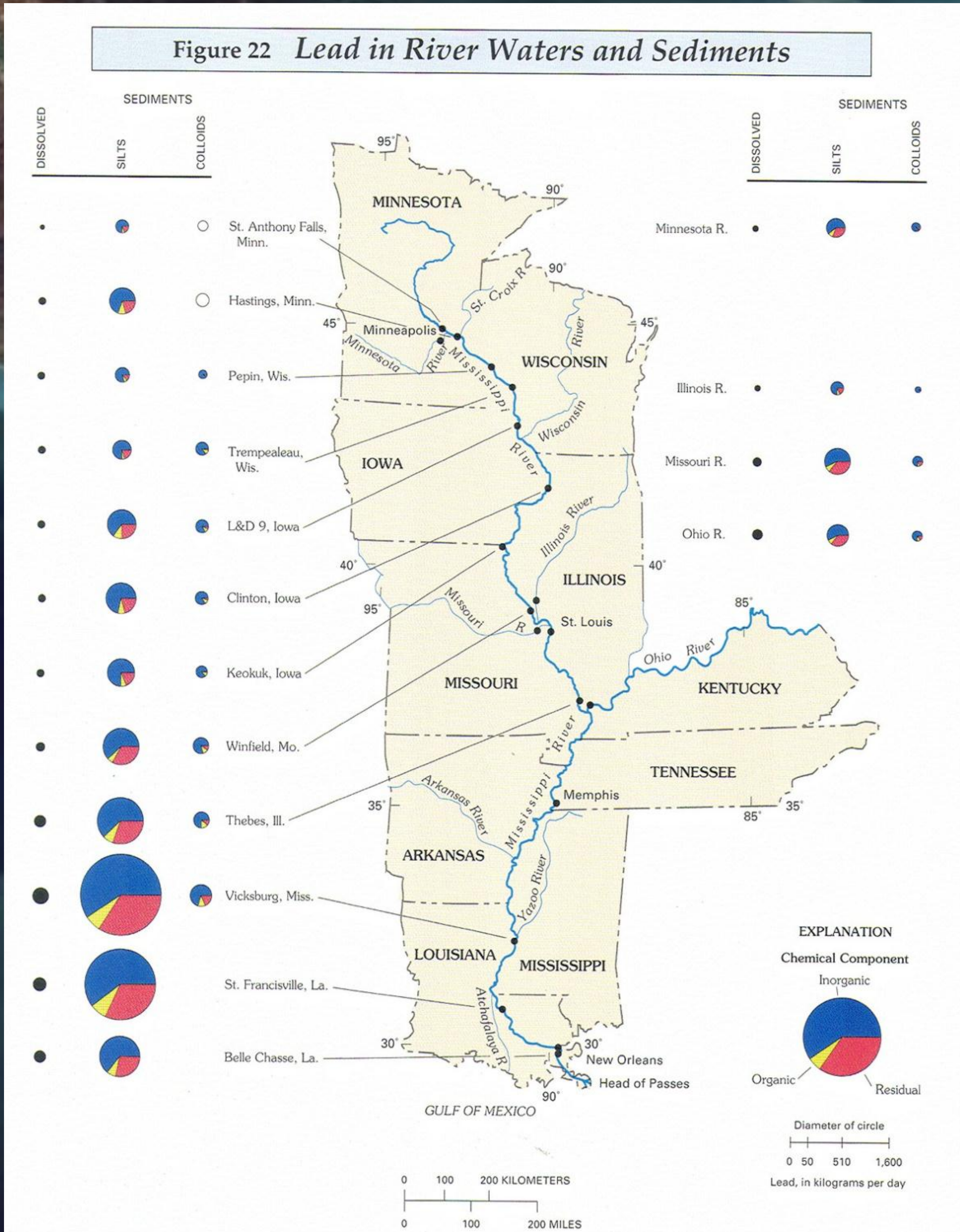


Figure 22 *Lead in River Waters and Sediments*

Source: Garbarino et al., 1995.

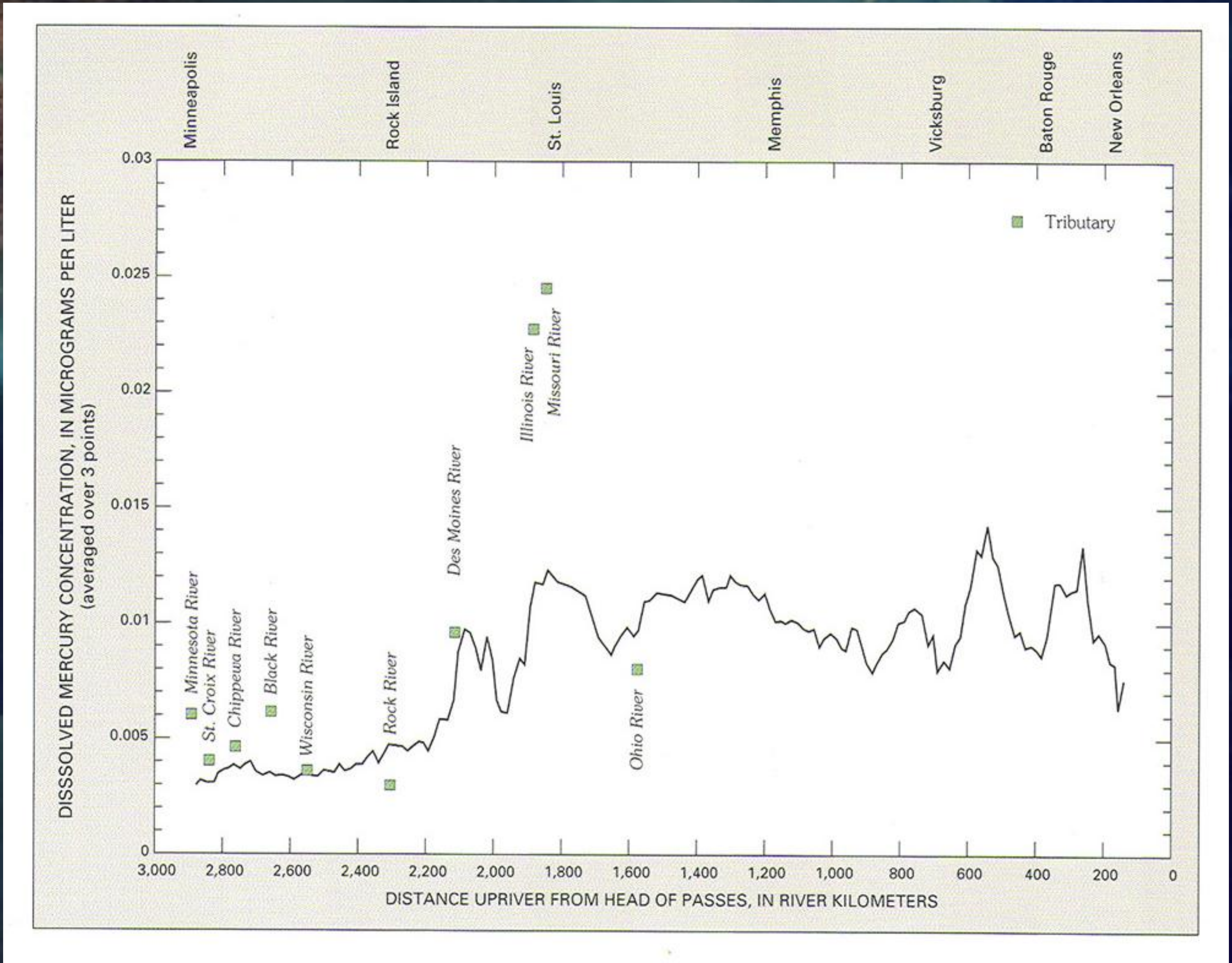
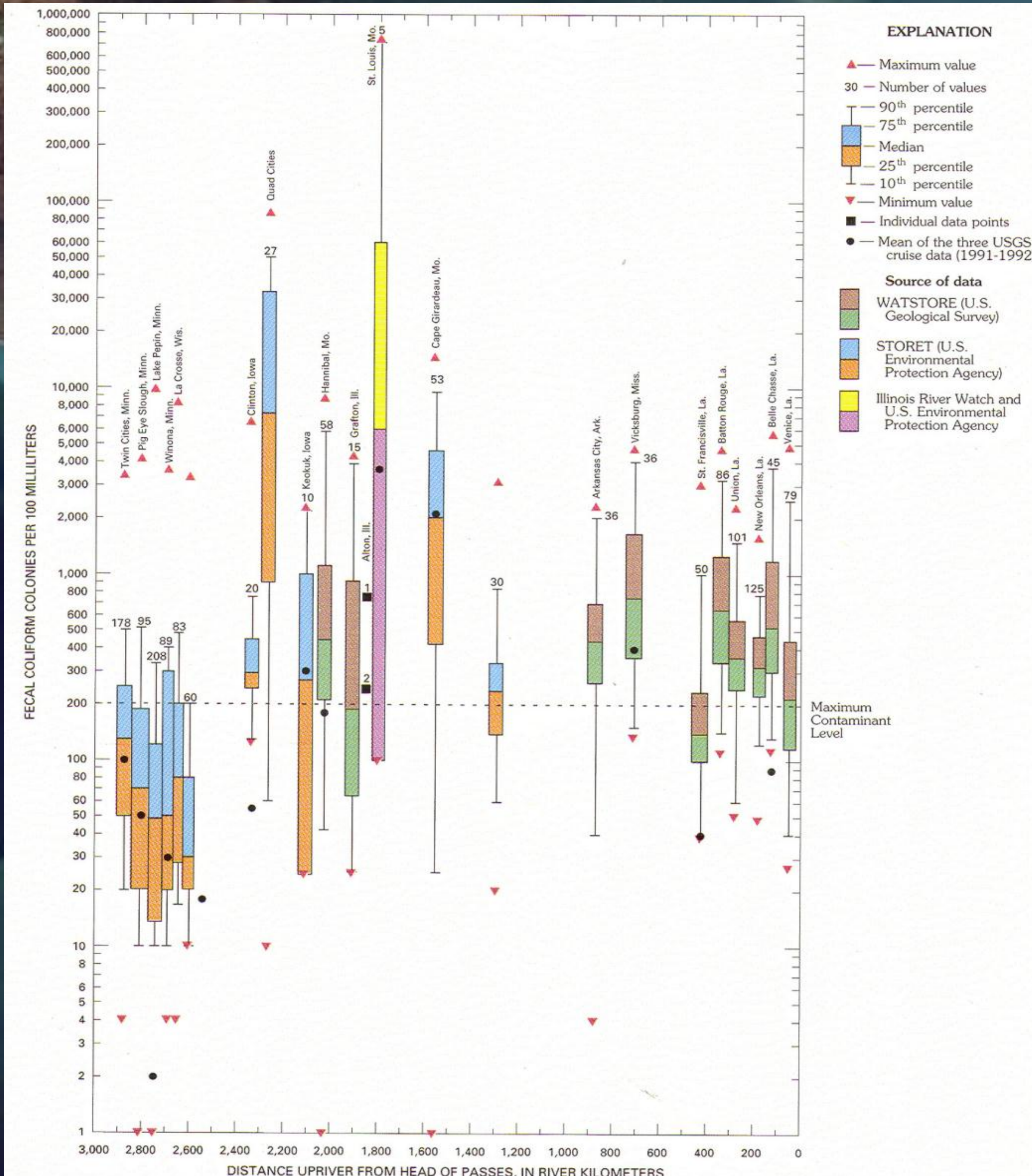


FIGURE 2-15 Mercury dissolved in Mississippi River water. Source: Garbarino et al., 1995.

Chemical pollutants
from
human activities

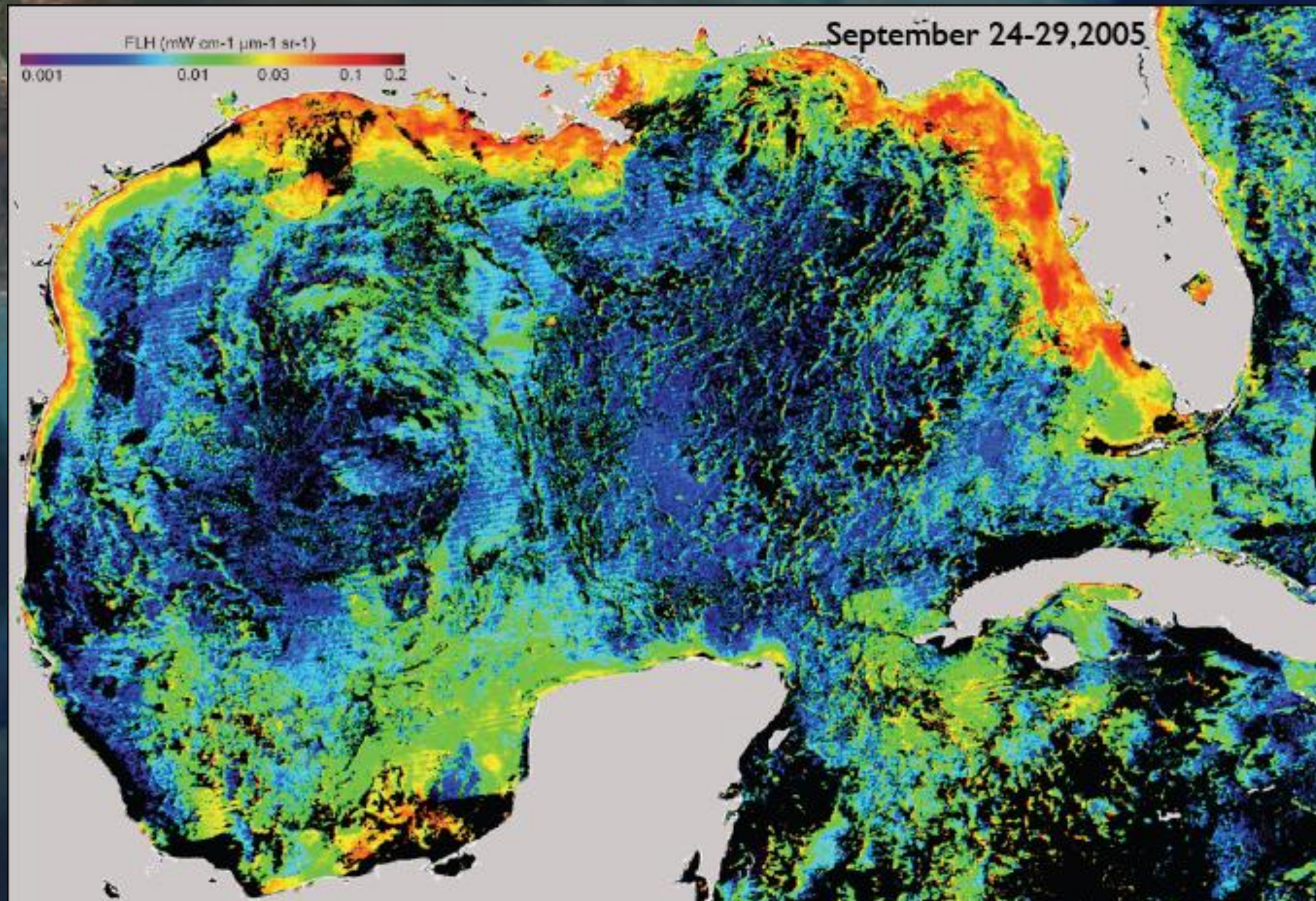


Fecal coliform concentrations along the Mississippi River from 1982 to 1992 (U.S. Environmental Protection Agency, STORET data base; U.S. Geological Survey WATSTORE data base; Illinois River Watch; specific samples from the 1991-1992 USGS study). The bar-and-whisker plots represent the median and 10, 25, 70, 90 percentiles. Source: Barber et al., 1995, erratum resulted in this corrected figure 53 from Barber et al., 1995.

Pathogen Contamination

Disease-causing organisms

Harmful Algal Blooms in the Gulf of Mexico

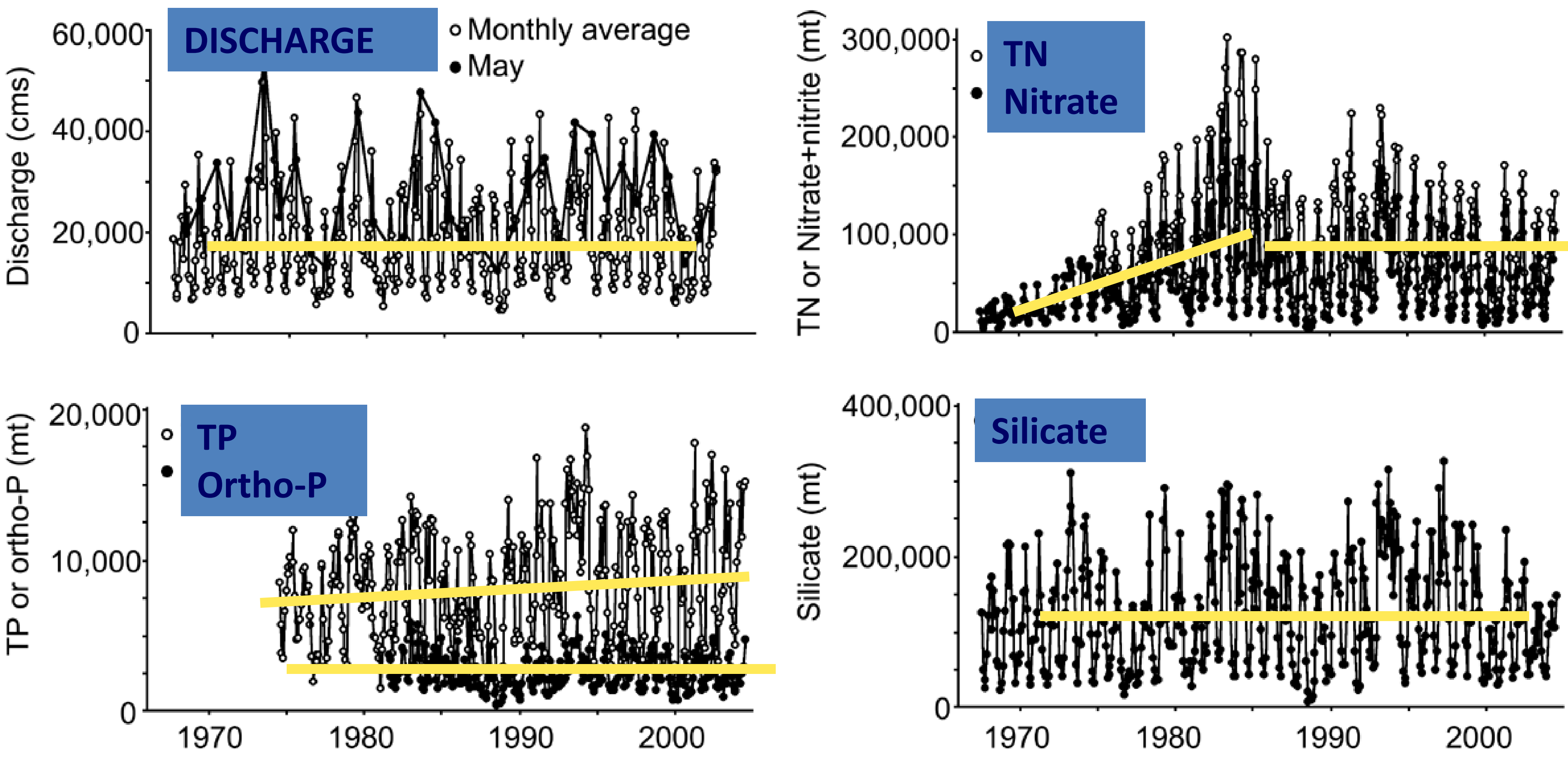


Karenia brevis Blooms in 2005 - Reported from Tamaulipas to Florida

300% increase in N load

80% due to NO_3^- concentration ↑

20% due to discharge ↑

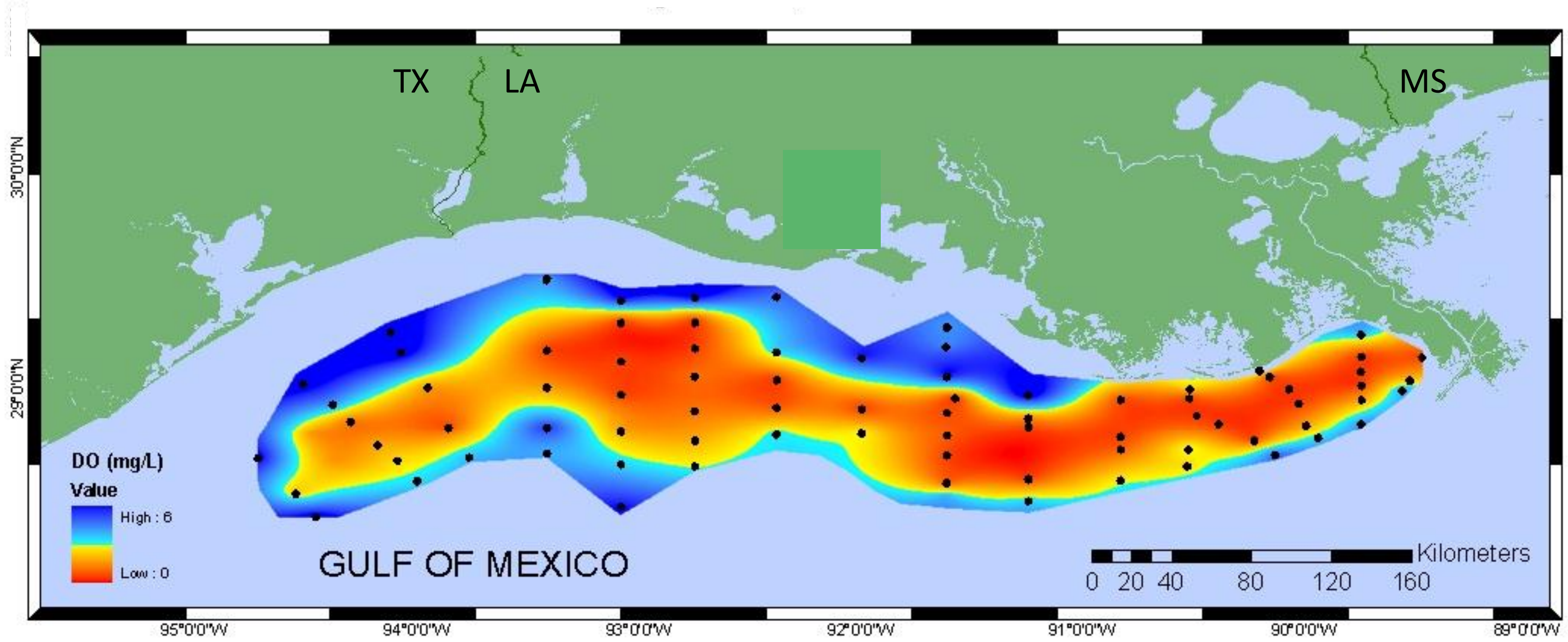


Turner et al. 2007

Mississippi River – Gulf of Mexico Ecosystem Continuum

Effects are more far reaching than suspended sediment plume, esp. N & somewhat P

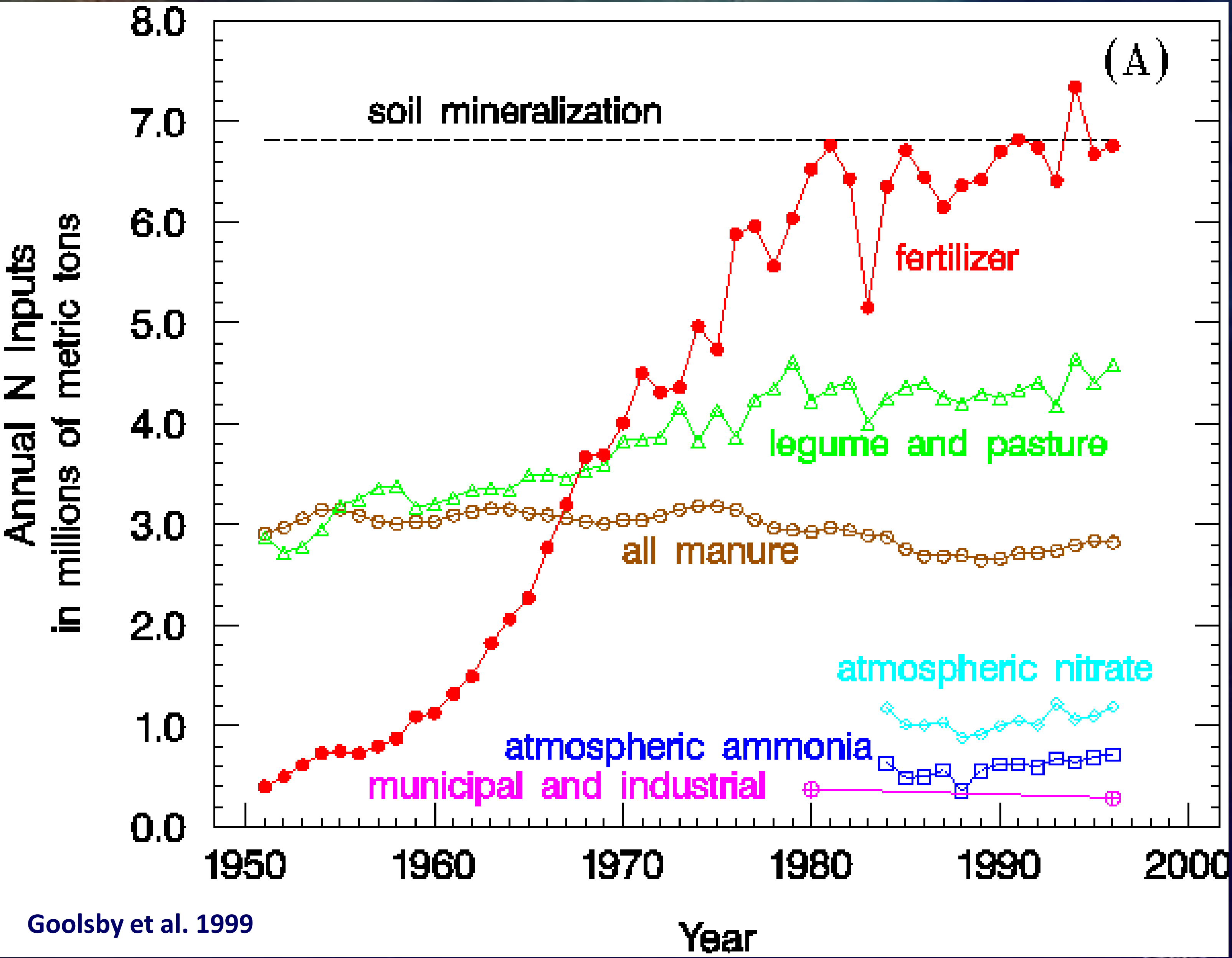
Extensive, Severe Low Oxygen Waters



Source: N. Rabalais, LUMCON

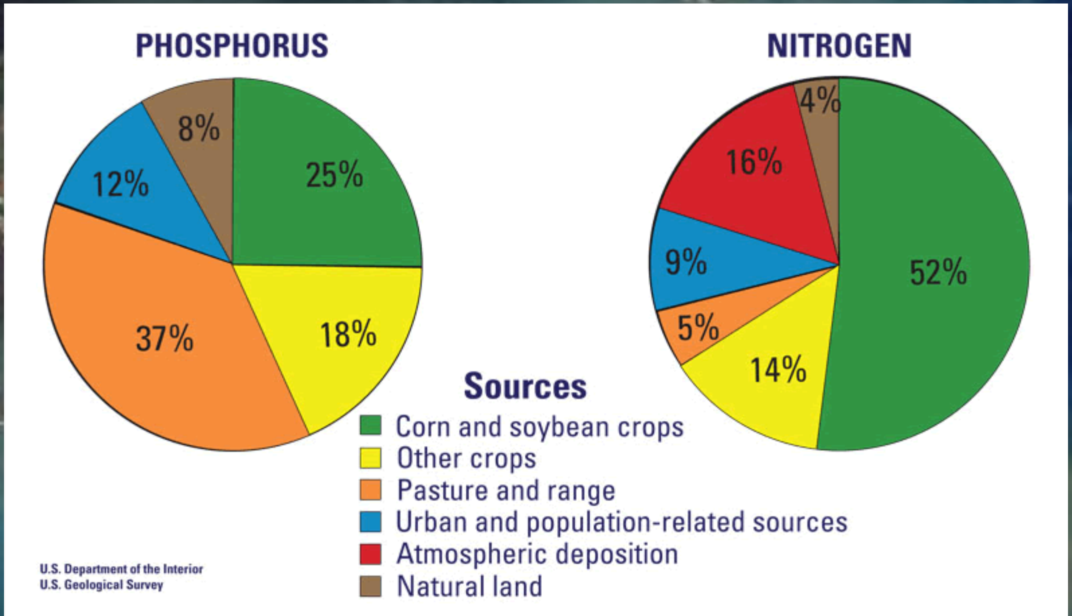
- up to 22,000 km^2
- 4 - 5 m nearshore to 35 - 45 m offshore
- 0.5 km nearshore to 100^+ km offshore
- widespread and severe in Jun – Sep

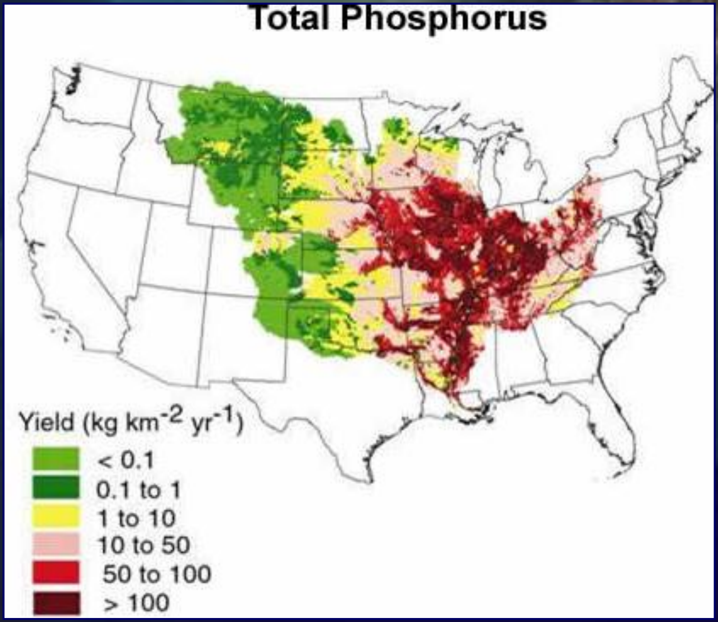
Nitrogen Inputs to the Mississippi Watershed

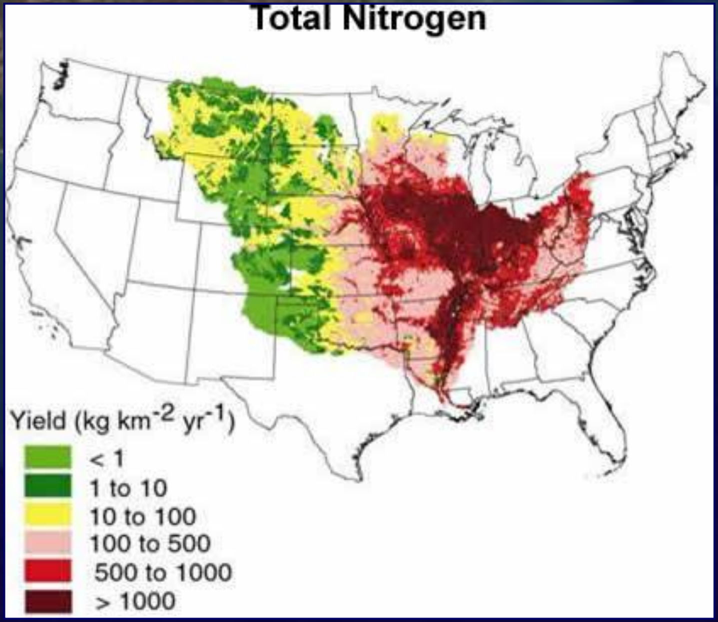


Goolsby et al. 1999

Nutrients Delivered to GoMx







Alexander et al. 2008 & ıttp://water.usgs.gov/nawqa/sparrow/gulf_findings/

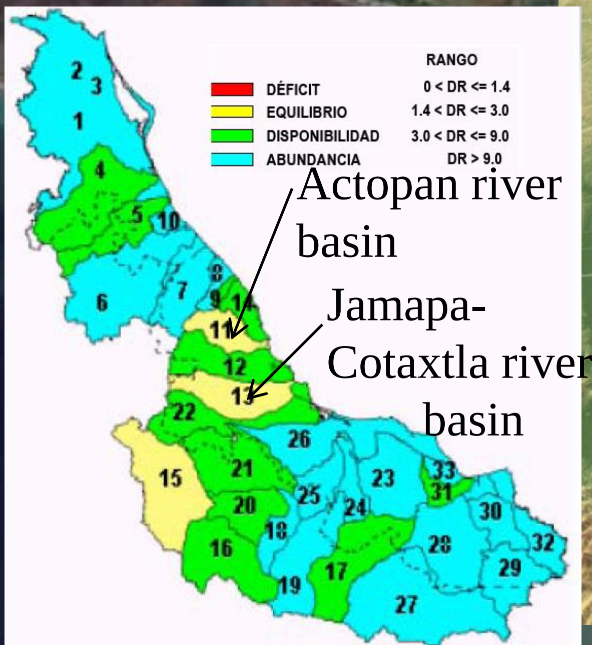
The Future

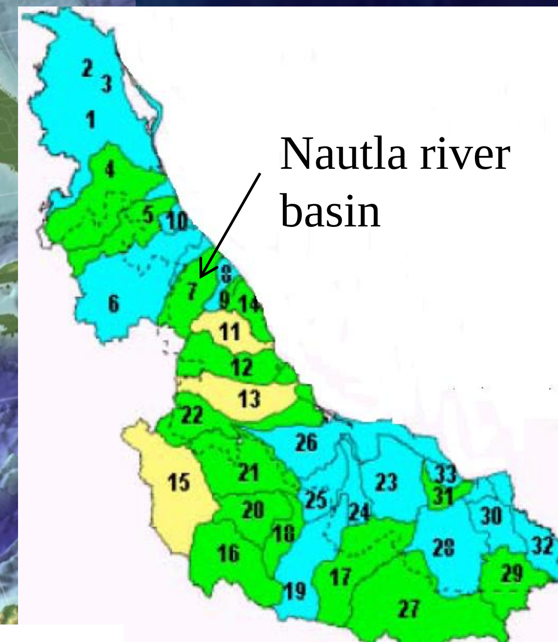
Climate Change
Biofuels
Increased Population
Increased Agribusiness
Increased Atmospheric Deposition

Hypoxia, dead zones, nutrient overloading in Southern Gulf of Mexico

Grijalva-Usumacinta River Basin

Whereas in Mexico: Tuxpan-Jamapa Veracruz

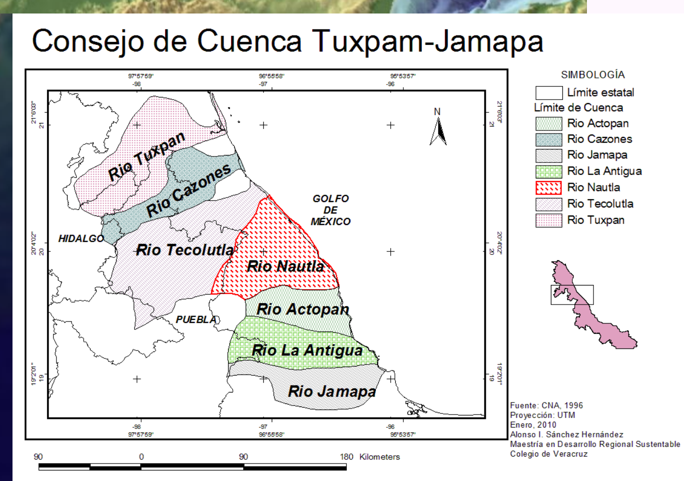


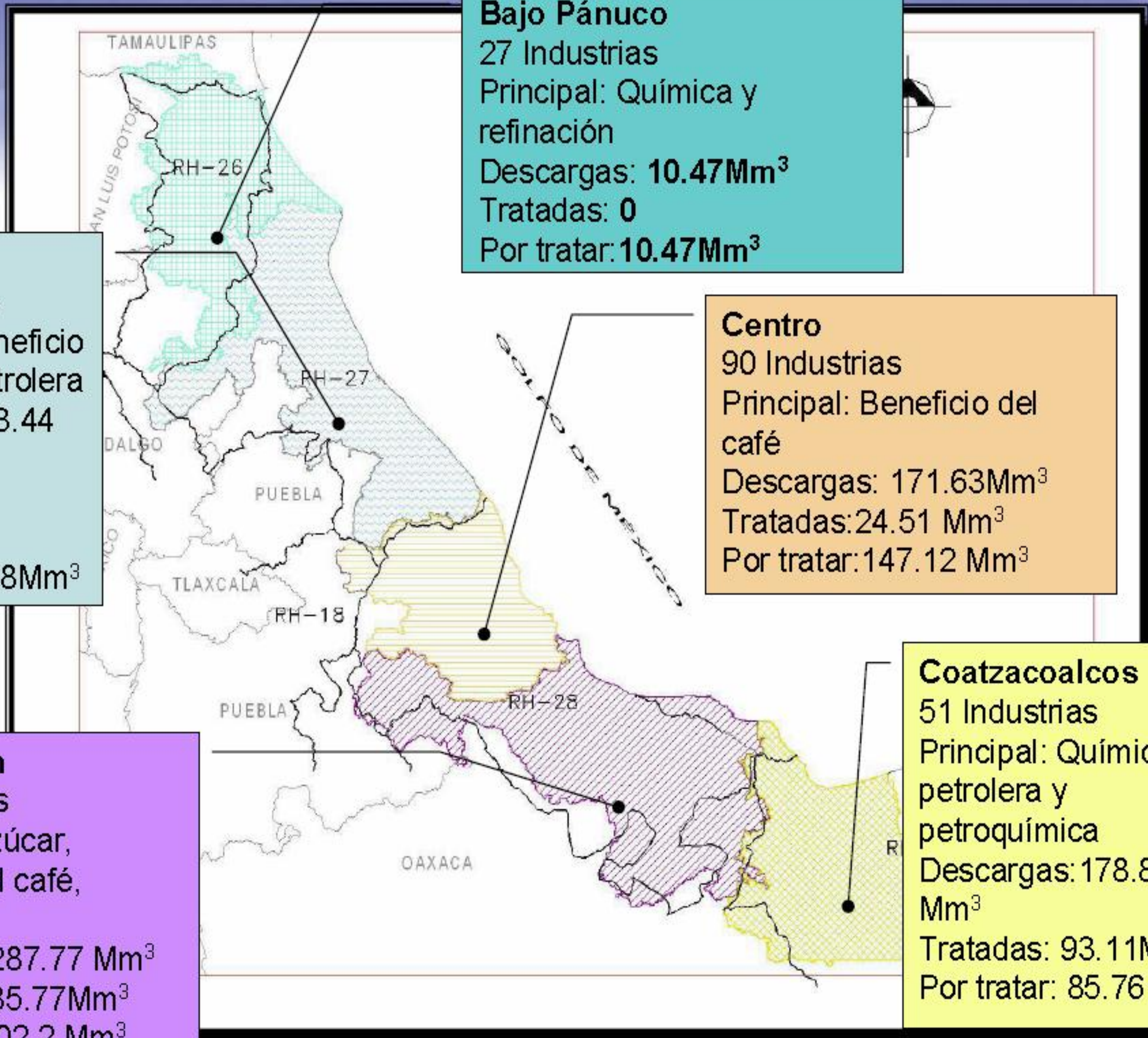


Water availabilty, 2004

Forecast 2025

Deficit of 60.42% in domestic water supply





Bajo Pánuco
27 Industrias
Principal: Química y refinación
Descargas: **10.47Mm^3**
Tratadas: **0**
Por tratar: **10.47Mm^3**

Norte
60 Industrias
Principal: Beneficio del café y petrolera
Descargas: 23.44 Mm^3
Tratadas: 17.46Mm^3
Por tratar: 5.98Mm^3

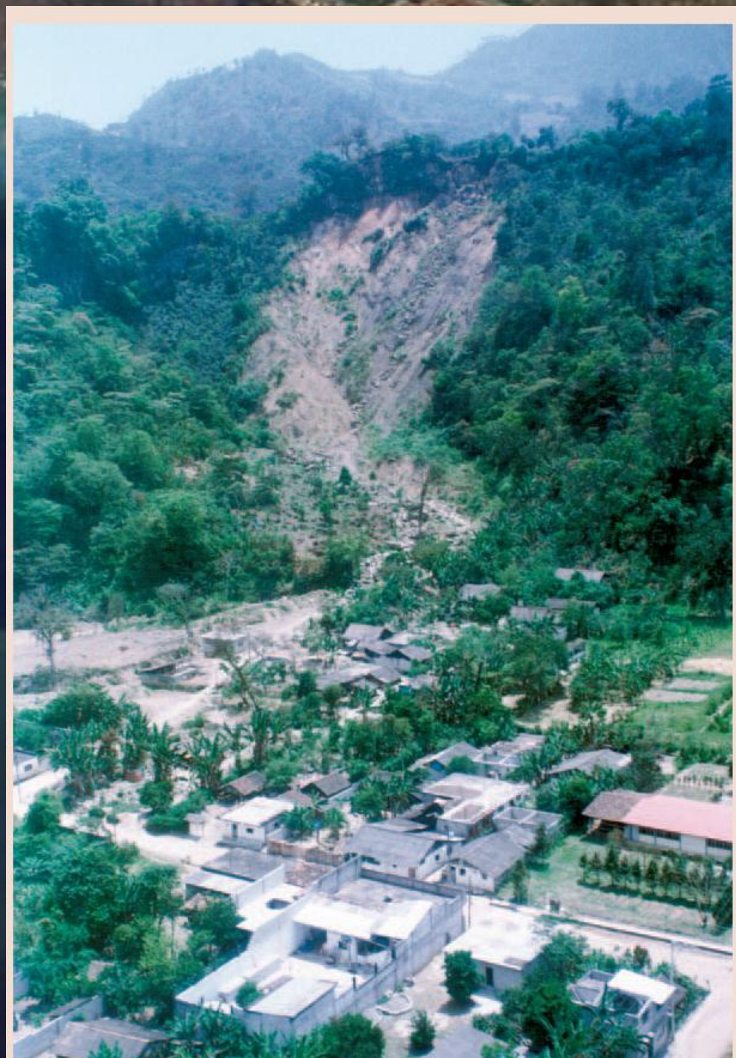
Centro
90 Industrias
Principal: Beneficio del café
Descargas: 171.63Mm^3
Tratadas: 24.51 Mm^3
Por tratar: 147.12 Mm^3

Papaloapan
72 Industrias
Principal: Azúcar, beneficio del café, alcohol
Descargas: 287.77 Mm^3
Tratadas: 185.77Mm^3
Por tratar: 102.2 Mm^3

Coatzacoalcos
51 Industrias
Principal: Química y petrolera y petroquímica
Descargas: 178.87 Mm^3
Tratadas: 93.11Mm^3
Por tratar: 85.76 Mm^3

Floodings: Heavy rain + headwater deforestation

In 2005 (Puebla-Veracruz), precipitation of 743-844 mm in 4 days. Land use change + deforestation caused 40% of total failure. 263 casualties

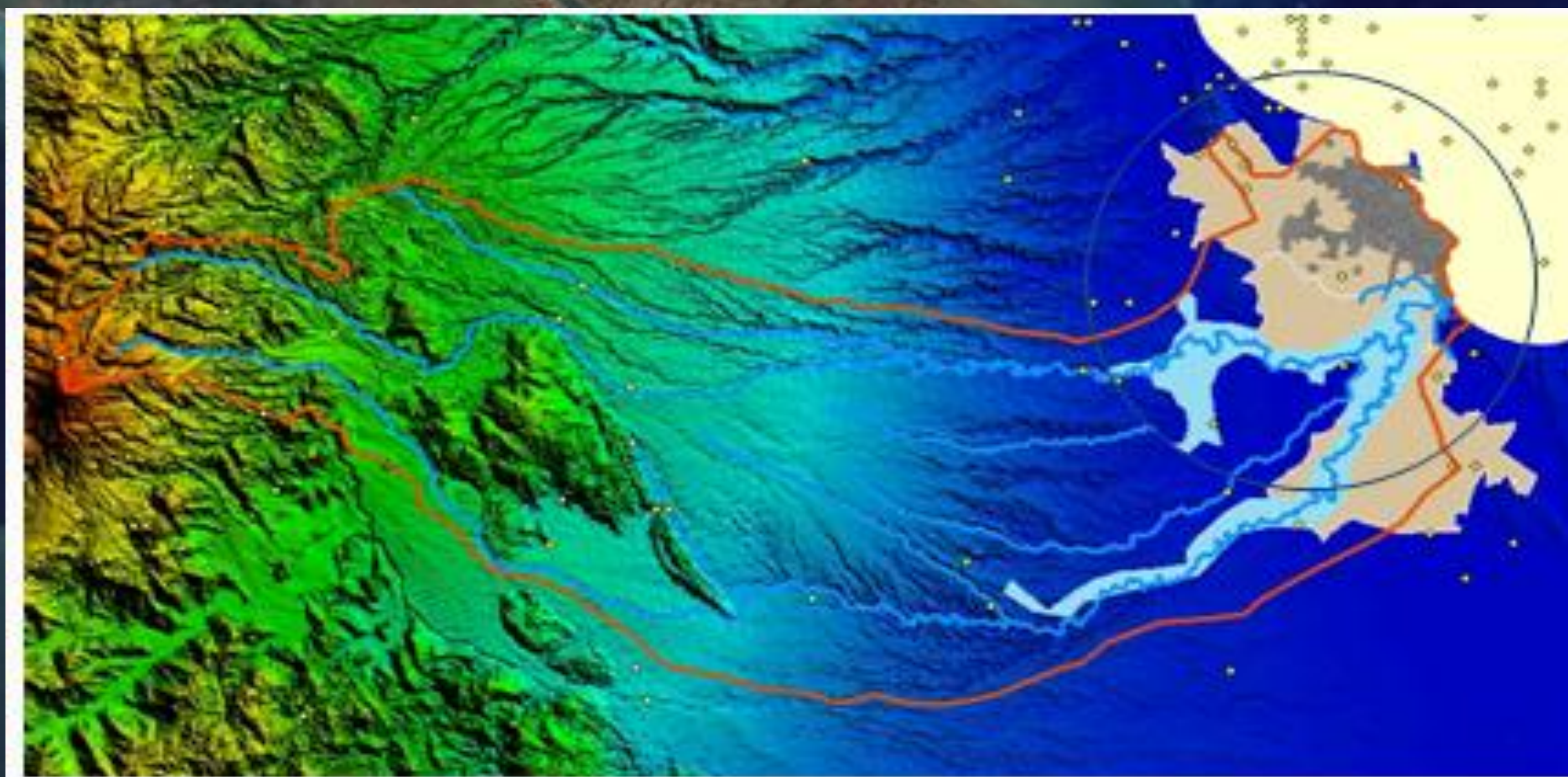


Landscape of Veracruz Hills and Coastal Plains
15 years = -5 million has. of forests

Veracruz (>30,000 has/yr)…. Gulf of Mexico

15km

Jamapa Cotaxtla Watershed
Veracruz Boca del Río Urban Zone



8,000 has/yr

20,000,000 tons

15km

Clear cutting mainly for subsistence agriculture and shepperding (80%)

Photo: N. Rabalais, LUMCON

INTEGRATED ASESSMENT AND MANAGEMENT OF THE GULF OF MEXICO

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