Environmental Sustainability Dimensions of Freight Transport Considering Highway and Waterway Intermodal Integration

2014 TRB-CMTS: Washington DC, June 24-26, 2014

Waheed Uddin, PhD, PE
Professor and Director CAIT
The University of Mississippi
cvuddin@gmail.com

Seth Cobb, David May
CAIT Research Assistants
Department of Civil Engineering
http://www.olemiss.edu/projects/cait/ncitec/

NCIT National Center for Intermodal Transportation

Dr. Patrick Sherry, NCIT Director, University of Denver

NCITEC National Center for Intermodal Transportation for Economic Competitiveness

Dr. Burak Eksioglu, NCITEC Director, Mississippi State University

Dr. Waheed Uddin, Director CAIT, University of Mississippi

Project Advisor: Dr. Kenneth Ned Mitchell

Research Civil Engineer, US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, Vicksburg

Project Collaborator for AIS data**:**

Maritime Information Systems, MA

CENTER FOR ADVANCED INFRASTRUCTURE TECHNOLOGY
CAIT
The University of Mississippi

NCITEC – Intermodal Integration
UM-DU-MSU : Freight Transport Projects

2012-2014: Supply Chain

2014-2015: Highway-Waterway Freight Integration

Intermodal Optimization for Economically Viable Integration of Surface and Waterborne Freight Transport

Study Objectives

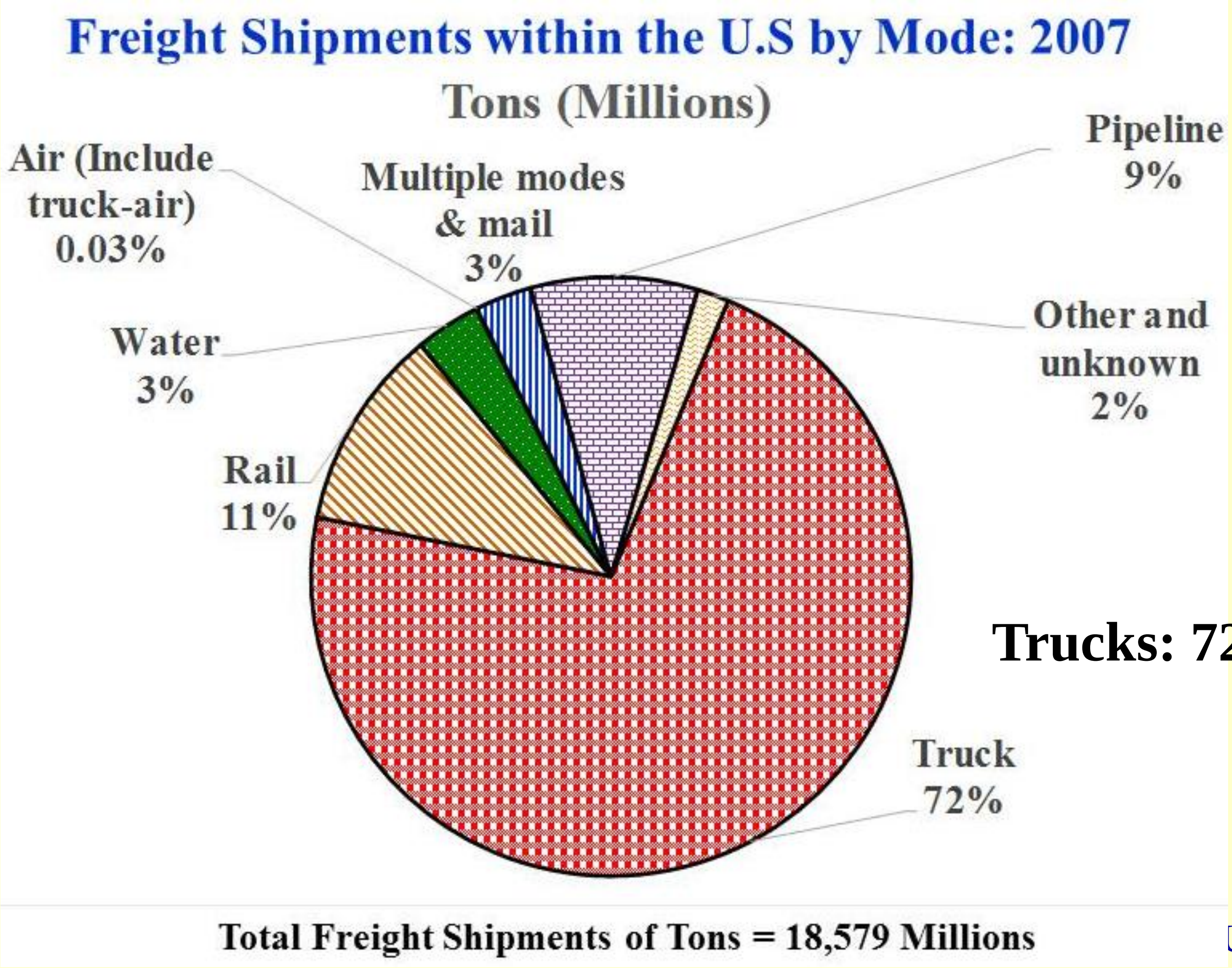
(1) identify major **freight transportation corridors** involving waterways and highway infrastructure assets,

(2) model **transport demand, visualize routing scenarios**, and optimize locations of integrated intermodal terminals, and

(3) evaluate the **economic competitiveness** considering emissions, disaster resiliency, safety, and economic development opportunities over 10-20 years planning period.

Value of U.S International Merchandise Trade by Mode of Transportation: 2011 (millions of current U.S. dollars)

Waterborne: 47% **Trucks: 17%** **Rail: 4%**



Trucks: 72%

Need for Freight Intermodal Integration

2012 NCFRP Report 14:

- Trillion dollars on freight logistics (10% of U.S. GDP)
- 65% of goods originate or terminate in cities

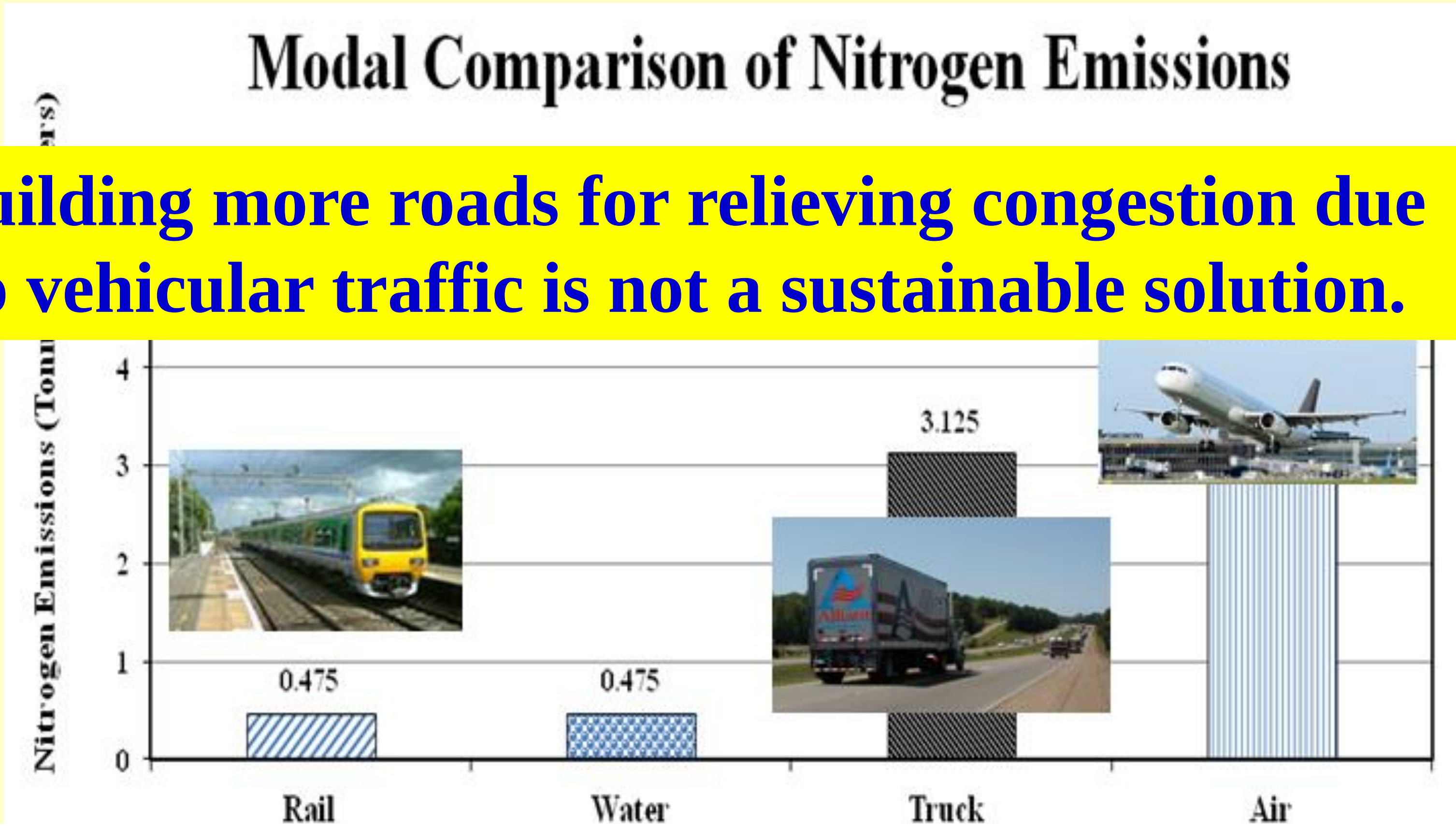
2008 NAFTA study (CEC 2011):

- Trucks transported a larger percentage of the tonnage of US land imports from Mexico compared to Canada from Mexico (74%) than from Canada (25%)
- Rail transported 24% of the tonnage of land imports from Mexico and 33% from Canada.
- Mississippi moves **84% freight by trucks**

Intermodal integration needed to enhance efficiency

Environmental Degradation and Public Health Impacts of Transportation Modes

Modal comparison of freight transport emissions



Building more roads for relieving congestion due to vehicular traffic is not a sustainable solution.

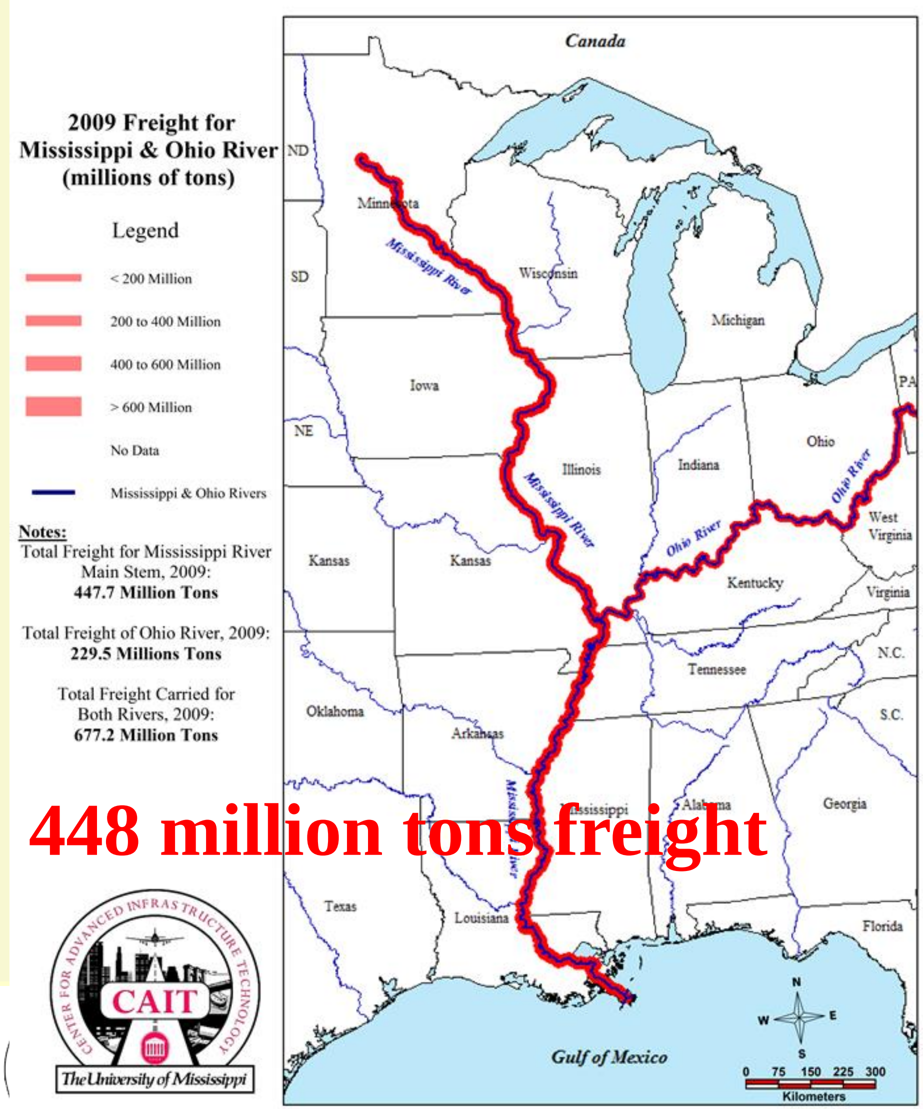
TTI's Modal comparison of net **freight ton-mile per gallon** (NTMG) of diesel: 155 for truck, 413 for rail, and 576 for barge

Health and Environmental Impacts of Petroleum Fuel used for Freight Transport

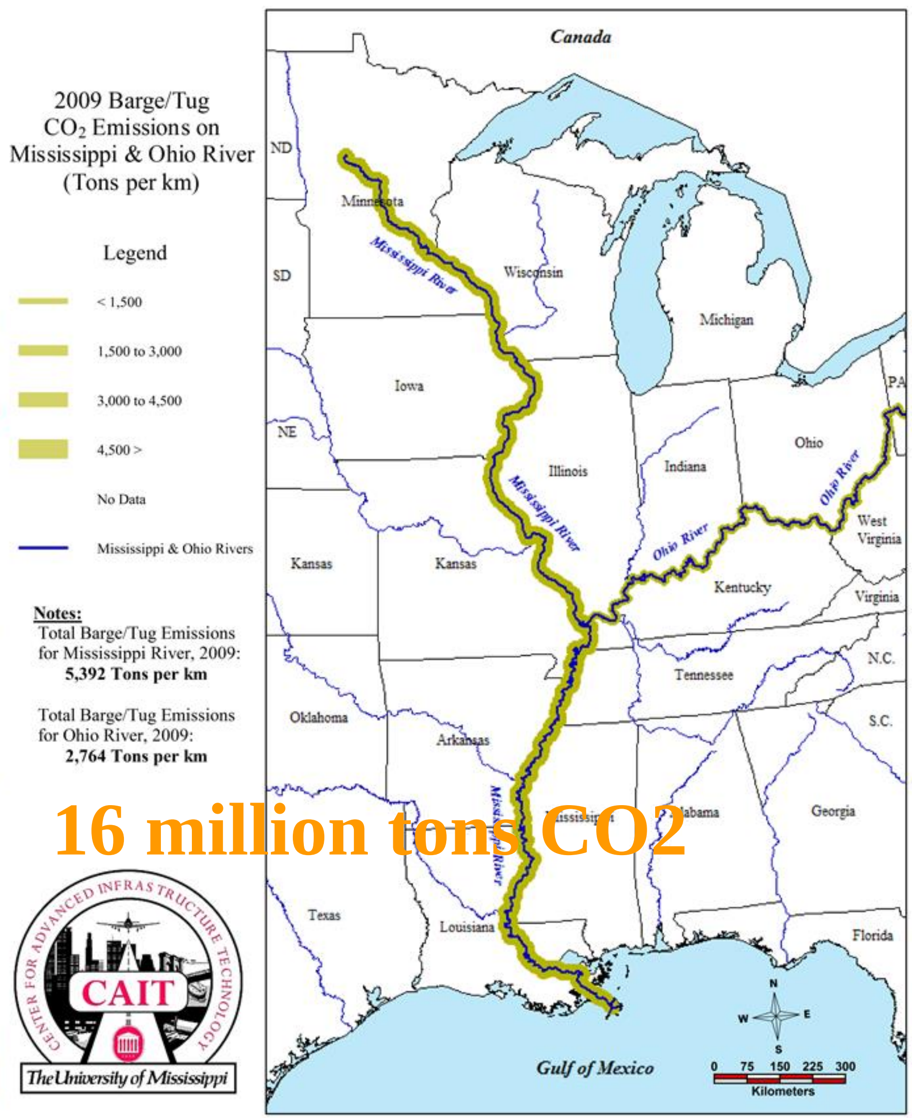
- Burning of petroleum- based fuel emits :
  - hydrocarbons or volatile organic compounds, carbon monoxide, nitrogen oxides
  - Primary source of carbon emissions
- Effects of emitted gases:
  - pollute ground-level air and cause GHG emissions and global warming
  - create smog (ground level ozone and NO_2) and problems of
    - cancer
    - lung disease
    - respiratory disease

Intermodal integration can reduce emissions

Highway-Waterway Intermodal Integration to Enhance Economic Competitiveness of Global Supply Chain

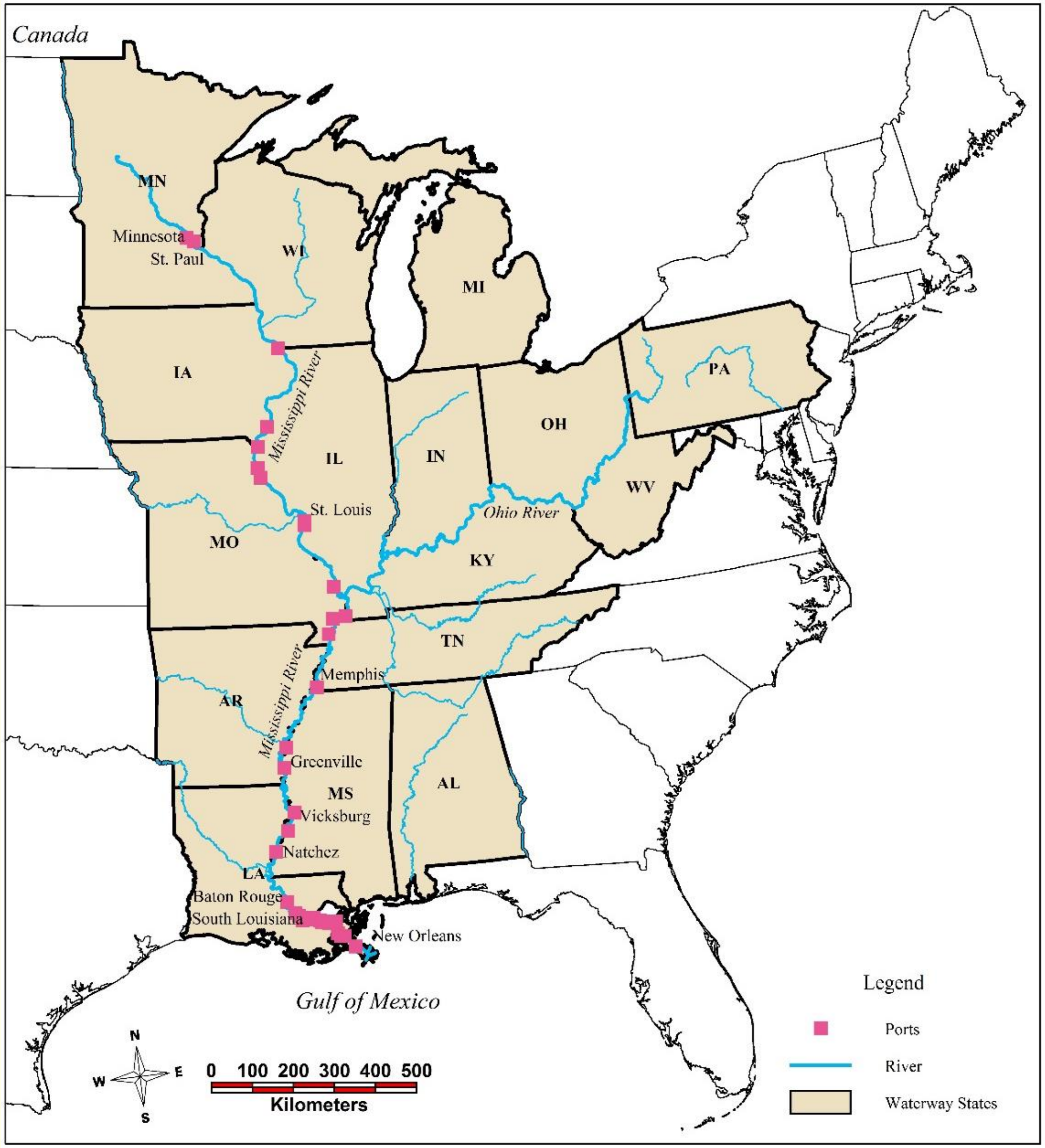


448 million tons freight



16 million tons CO2

Mississippi River Waterway and Freight Ports



Port of Baton Rouge to:

Port of Memphis = 516.3 km

Port of Minneapolis = 2,436 km

Average Speed of Vessels:

Downbound 8 knots

Upbound 4 knots

(1 knot=1.15078 mph)

Travel Time from Memphis:

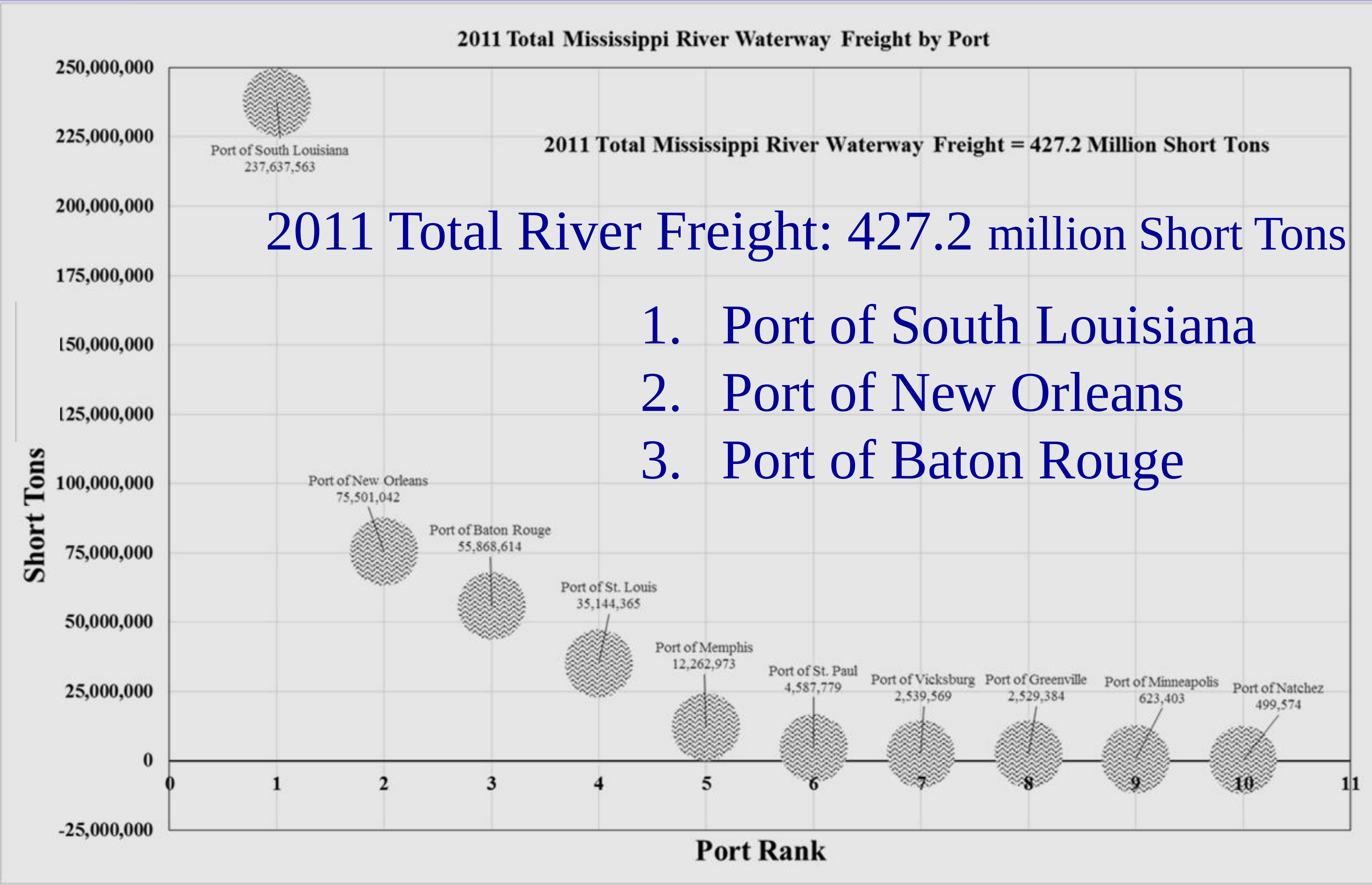
285 miles on MS River

Downbound 34.4 h

Upbound 52.1 h

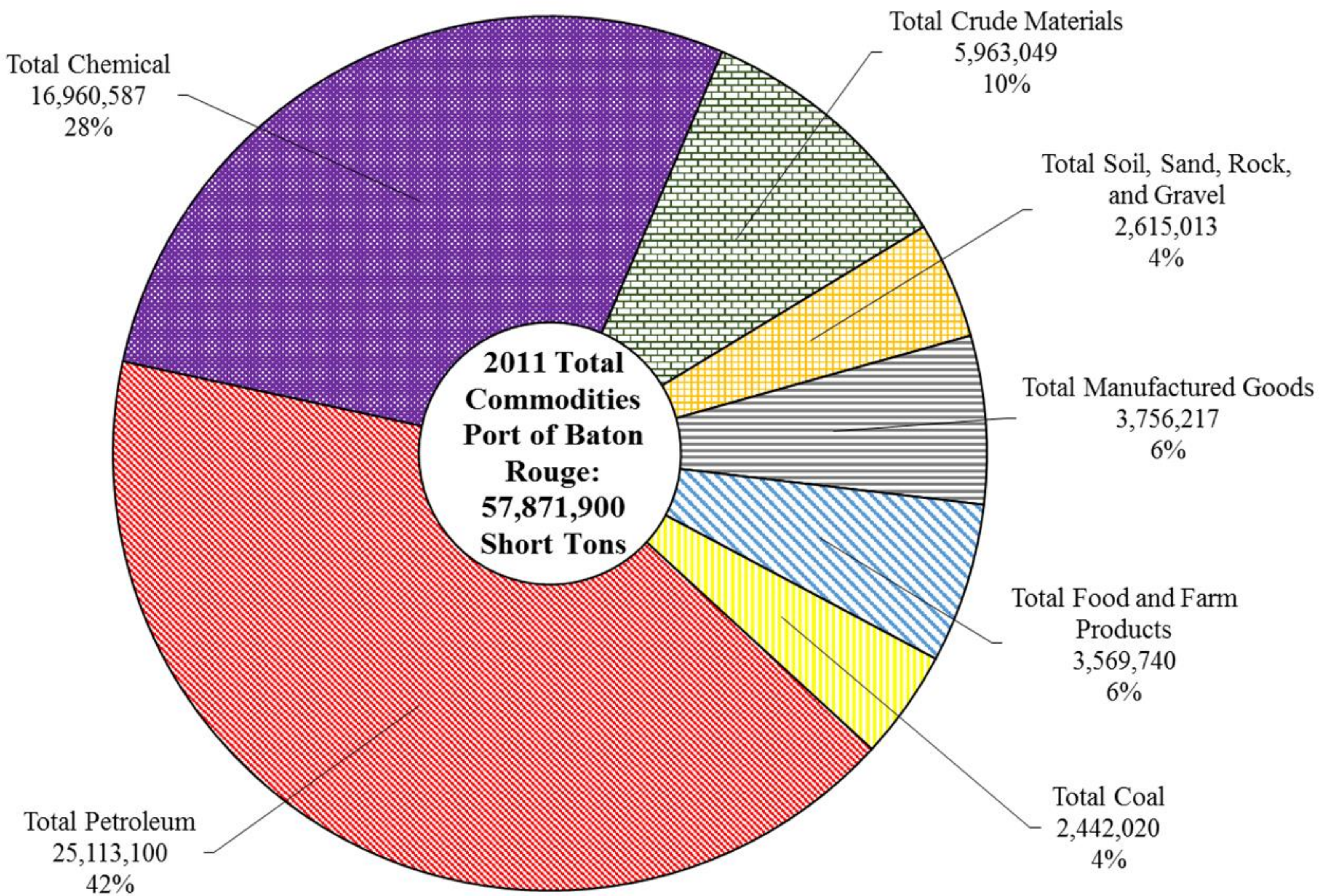
W. Uddin

Mississippi River Waterway and Freight Ports



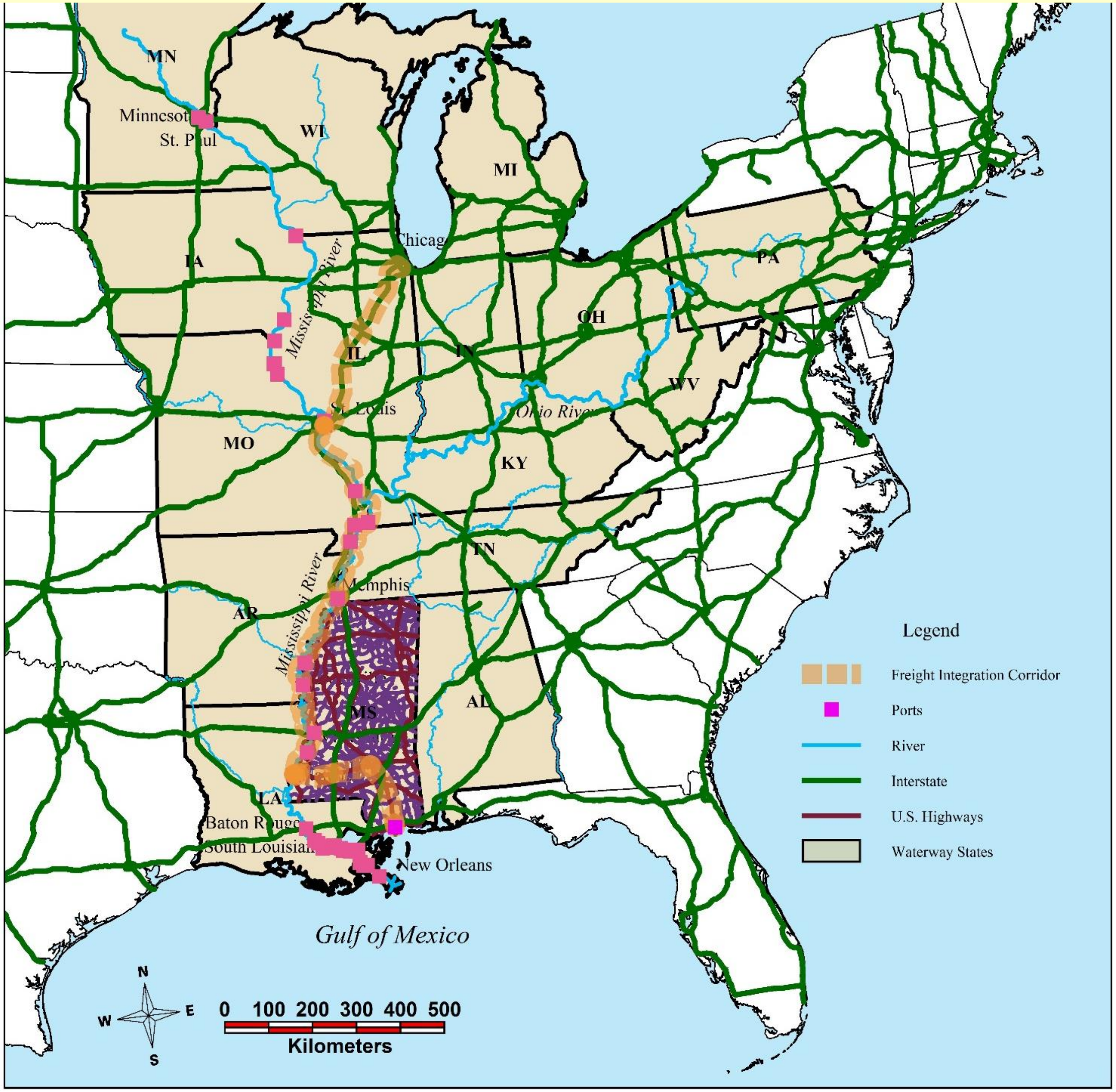
2011 Total River Freight: 427.2 million Short Tons

1. Port of South Louisiana
2. Port of New Orleans
3. Port of Baton Rouge

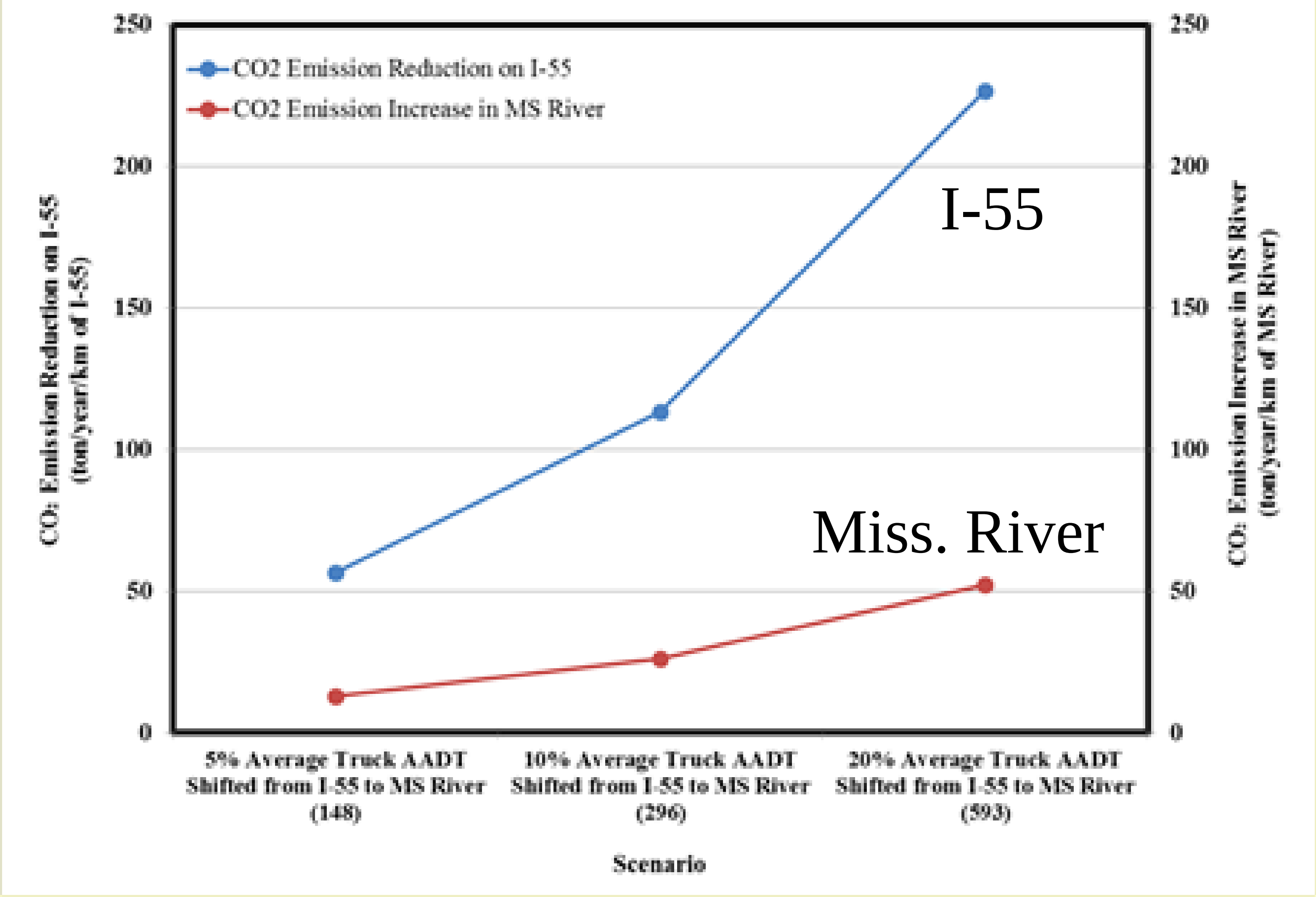


MS_River_Doughnut_Commodities_DM14

Integrated Freight Corridor: I-55 & Miss. River



CO_2 Emissions on I-55 and MS River due to Freight Truck Diversion from I-55 in Mississippi



I-55 & Miss. River Freight Intermodal Integration

- Diverting 5%, 10%, and 20% fractions of **long-haul truck** traffic on I-55 highway in Mississippi to a similar segment of the Mississippi River.
- **Barge transport reduces** number of trucks on the highway and decreases harmful emissions.
- **Barge carbon dioxide emission** increases only 1/4th of the corresponding reduction in CO2 truck emissions for the same freight ton-km traveled.
- **Travel time by barge will be more**. Good solution only for non-perishable and not time sensitive commodities.

Conclusions and Future Work

Freight Intermodal Integration

1. Contributes to **sustainable freight transportation** and **disaster resiliency** in domestic supply chain.
2. Eases **congestion on highways**.
3. Minimizes **greenhouse gas emissions**, and reduce overall **air pollution**.
4. Preliminary results of partial **I-55 freight trucks** diverted to **Mississippi River barges** support these conclusions.
5. **Future work:** Computer simulations of freight truck on I-55 integrated with barges on Mississippi River;
6. AIS data for Level-of Service modeling