Inland Marine Transportation Casualty Data Analysis

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Introduction

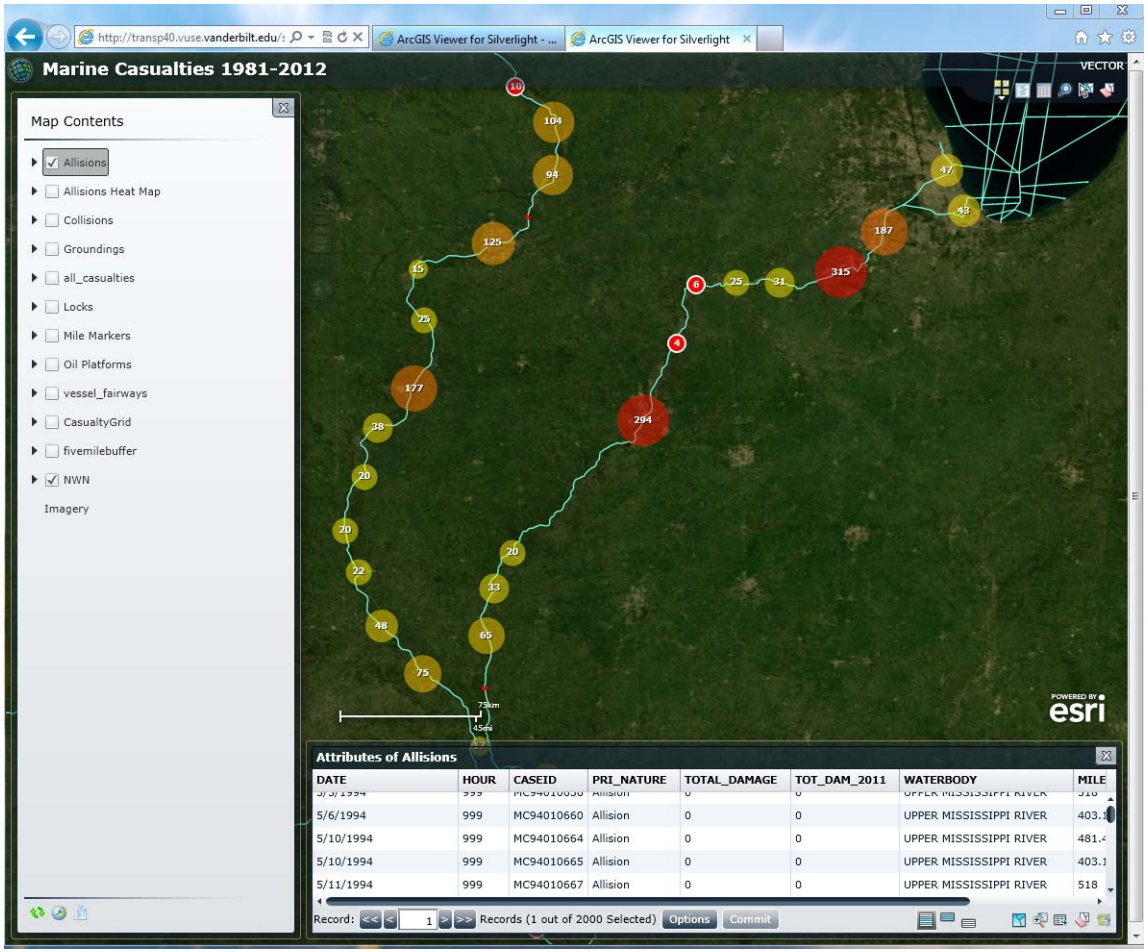
- Marine casualties – allisions, collisions, groundings
- Objectives:
  - Identify most hazardous sections of U.S. inland waterway network (2010)
    - Assess quality and limitations of relevant datasets
  - Determine weather effect (river gage, wind speed, visibility) on inland casualties (2012)

Technologies

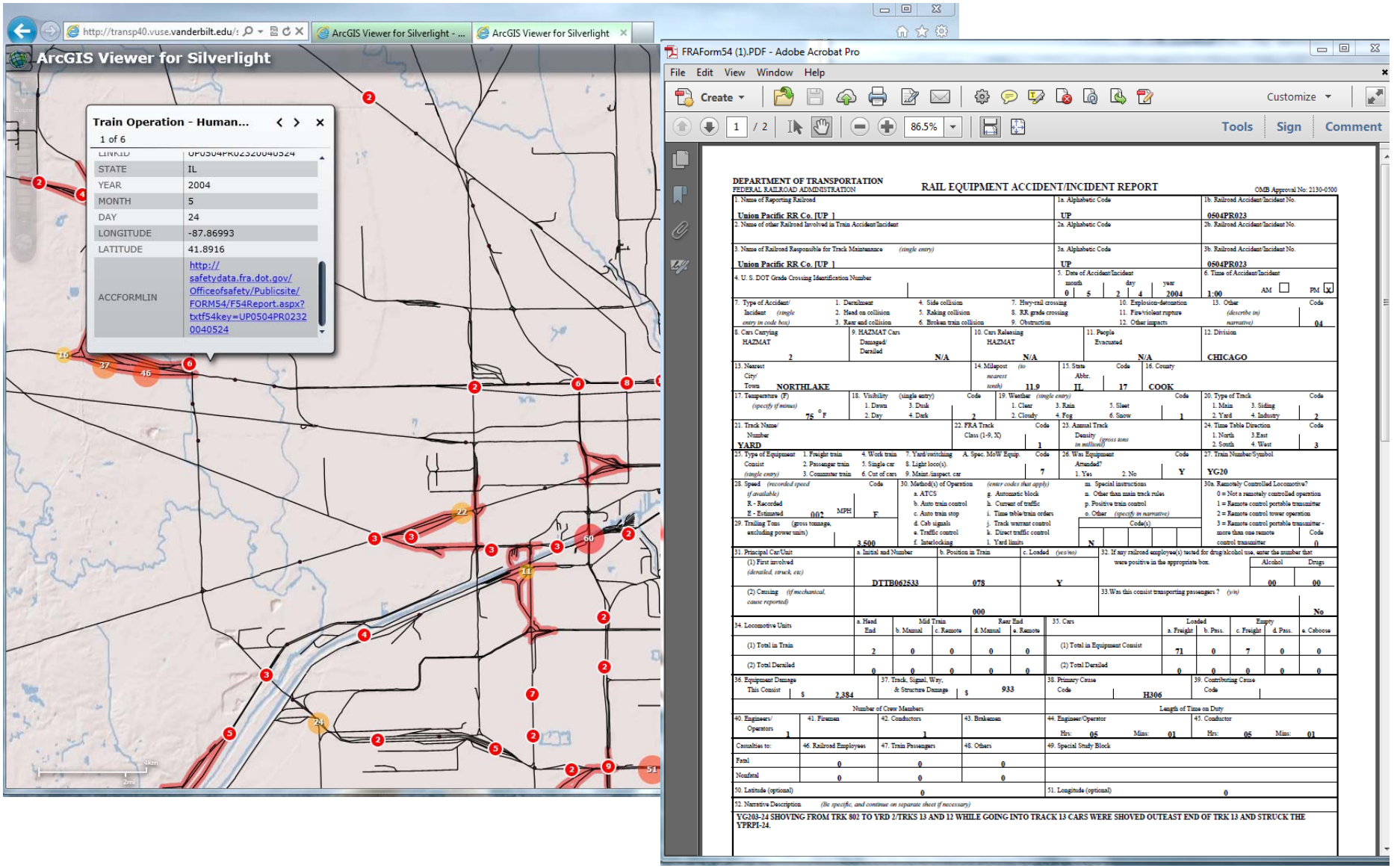
- Geographic information systems (GIS)
  - Cluster analysis and spatial joins
- Database management systems (DBMS)
  - Manage and relate historical data
- Data visualization/analytics
  - Discover trends in data, ad-hoc drill-down into details, animate events

Internet GIS

- GIS functionality through browser
- Advantages
  - Centralized
  - Easy to use
  - Report management



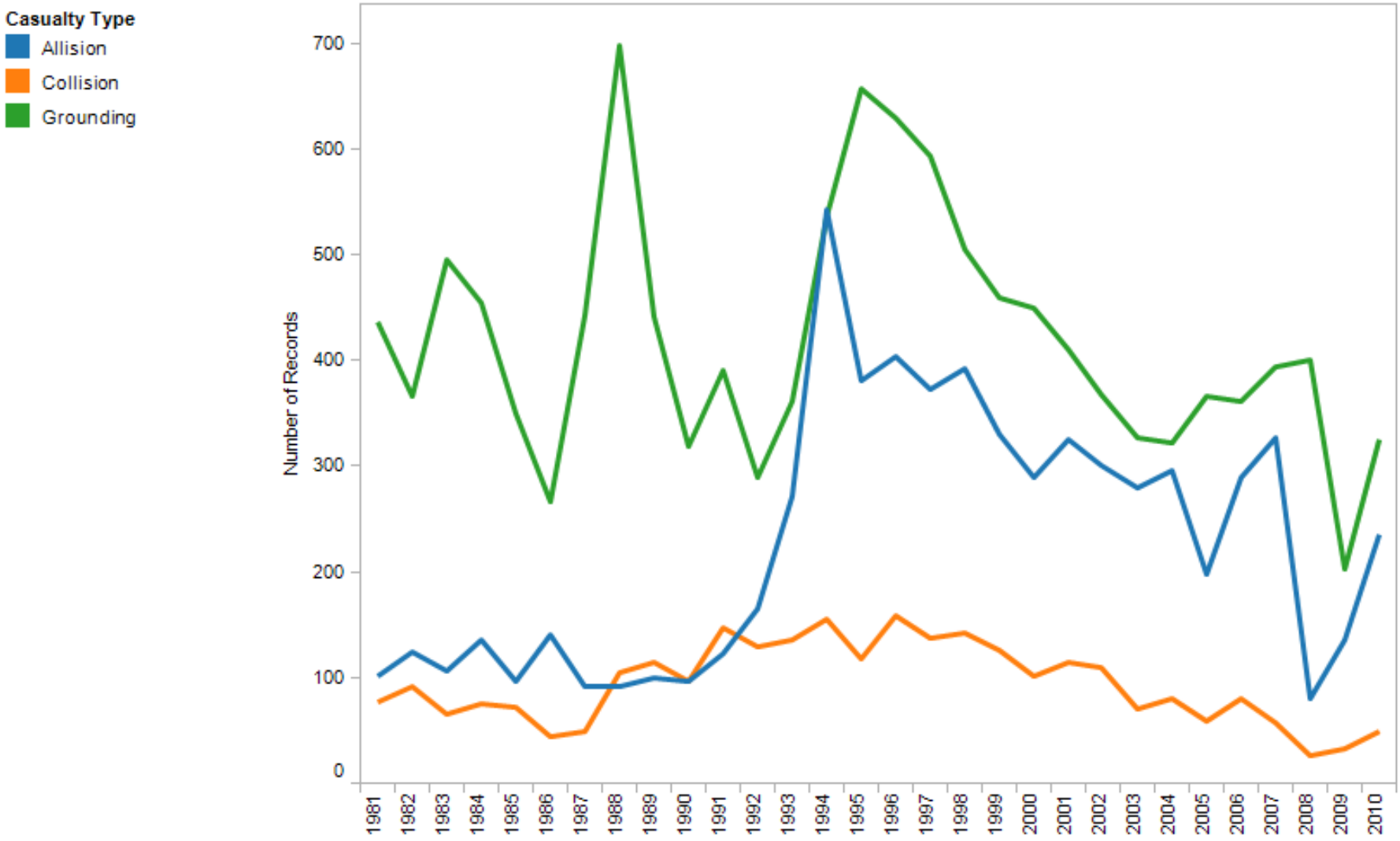
Internet GIS – Report Management



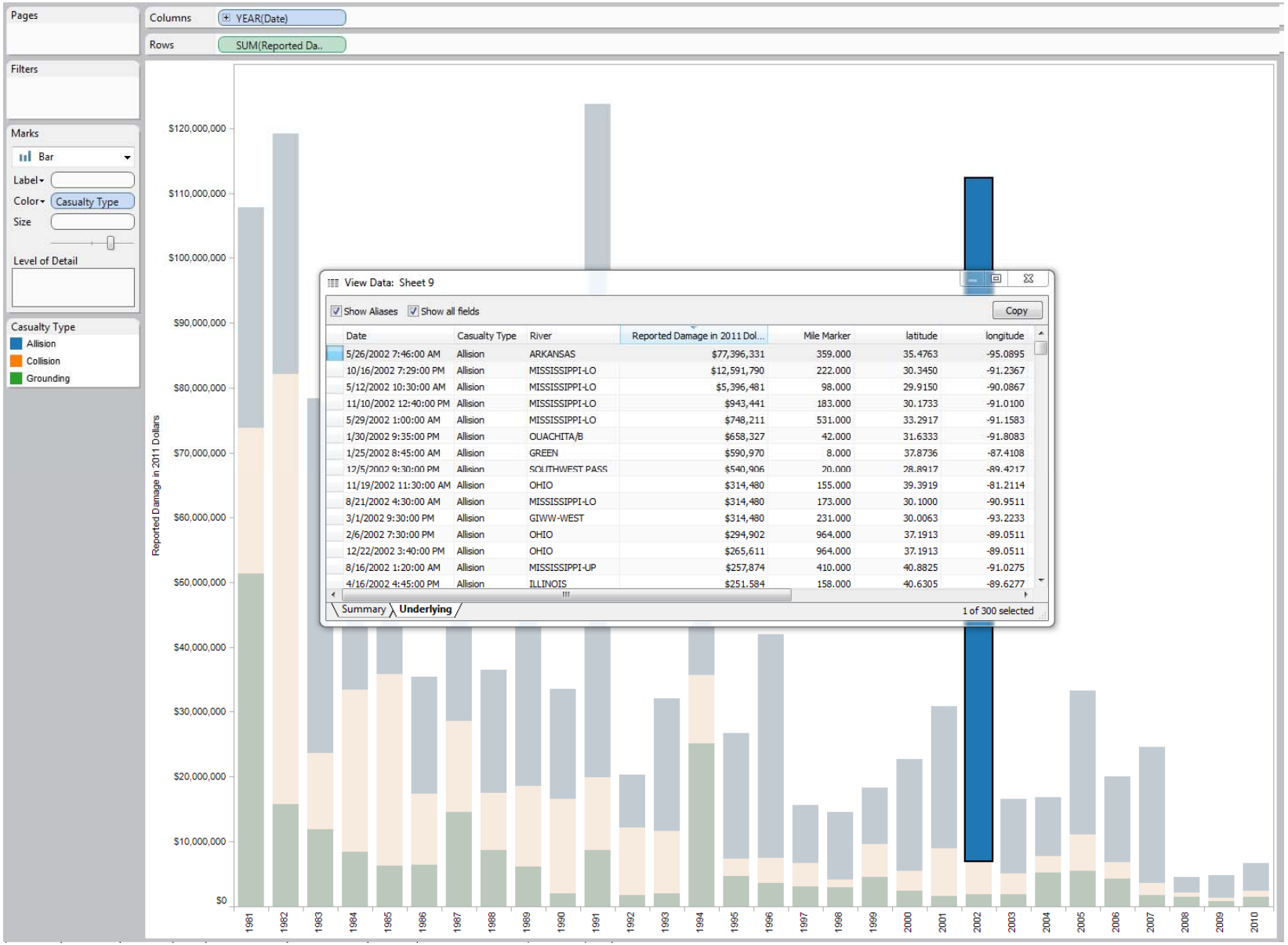
Data

- 1981-2012: 3 USCG reporting systems
  - CASMAIN/MSIS (1981 - 1991)
  - MINMOD (1992 - 2001)
  - MISLE (2002 - present)
- Merged into common data structure
  - Attributes: Date, casualty type, damage, lat/long
  - Other attributes retained, but not used
    - Vessel(s) involved, vessel type, fatalities, injuries, contributing factors

Marine Casualty Data Visualization (By Year)

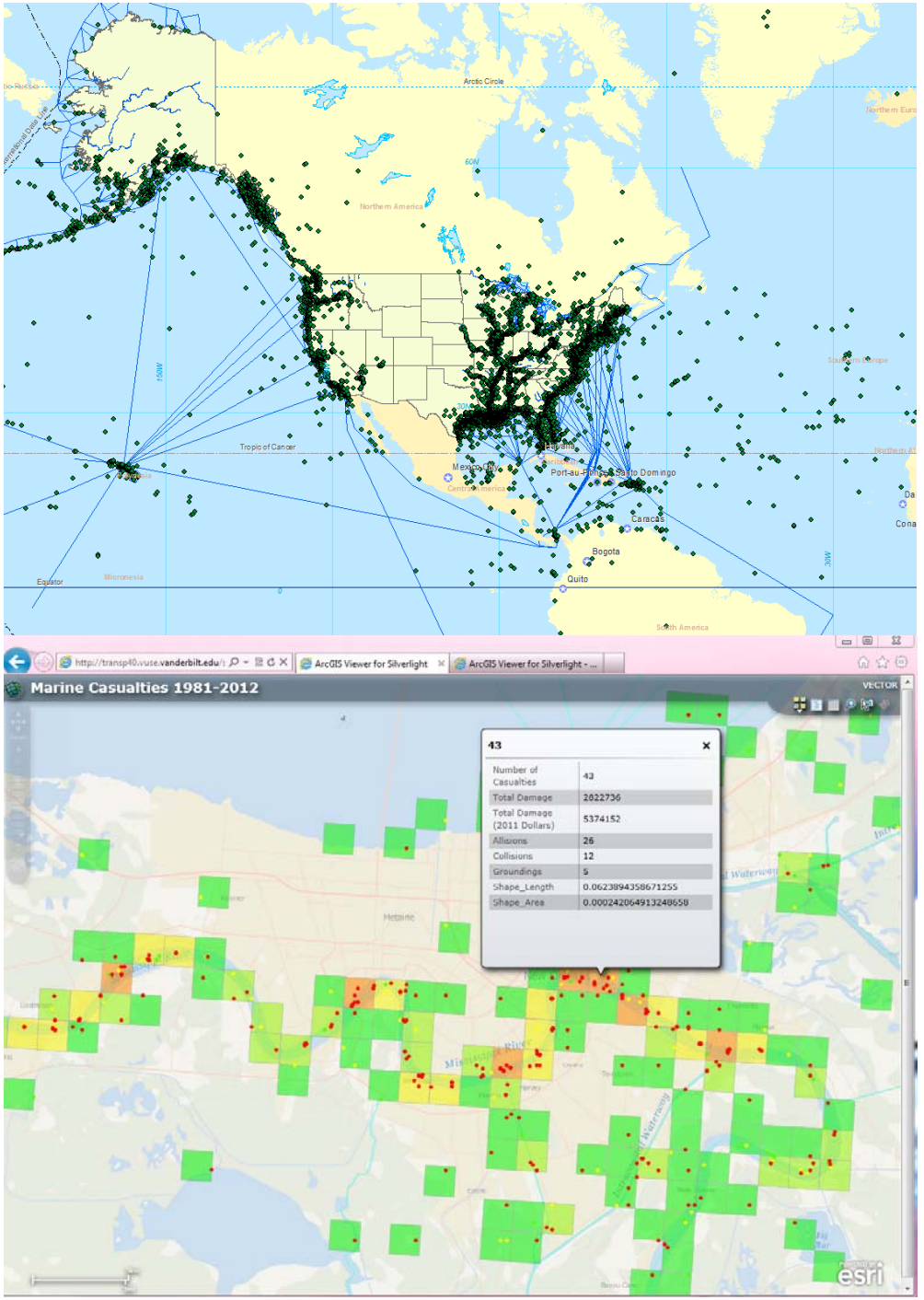


Damage by Year (drill-down)

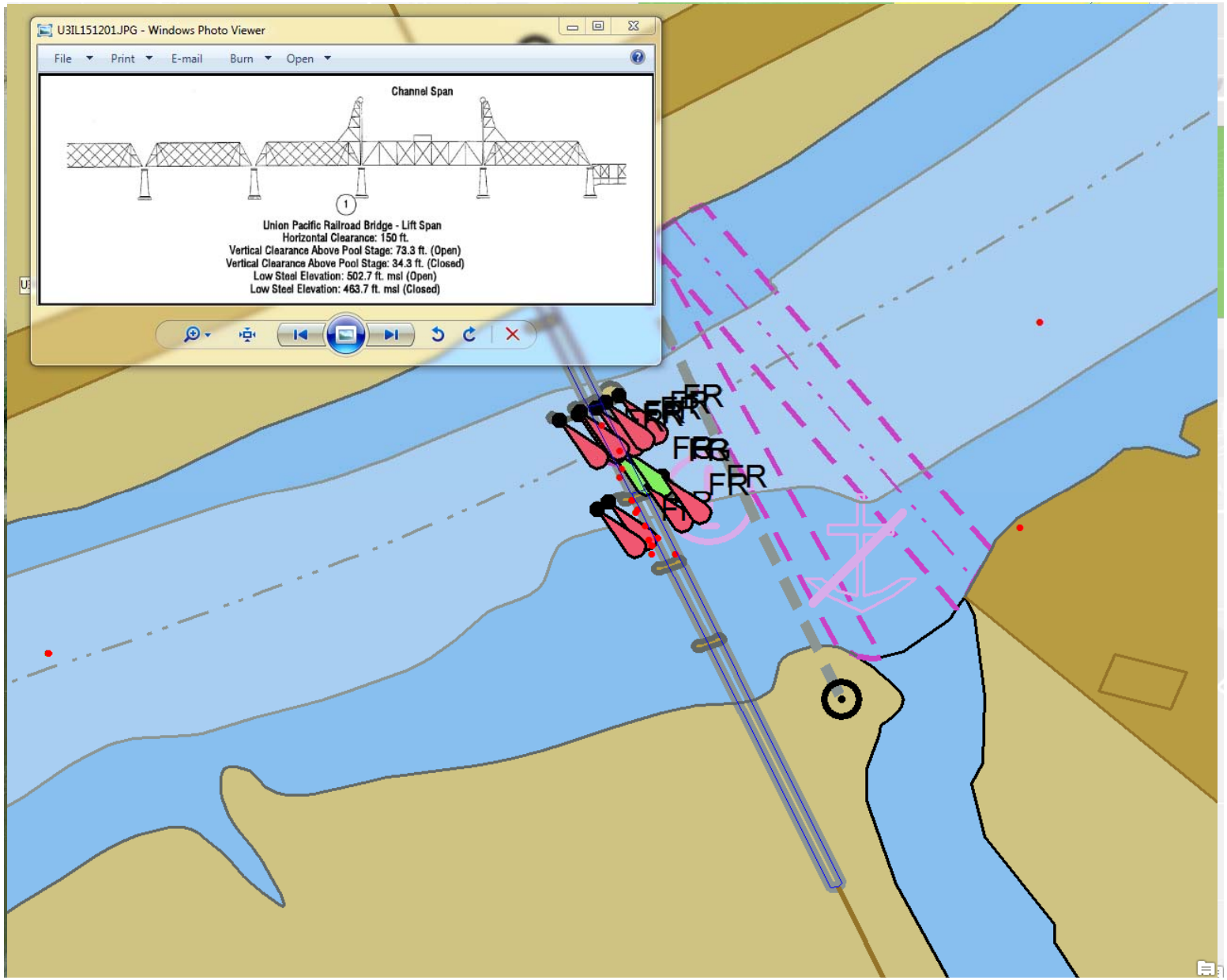


Methodology

- Entire dataset contains 51,458 ACGs (1981-2012)
  - Inland approx. 54%
- Compute casualties by mile marker
- One-mile square grid to detect clusters



Illinois River – MM151



Issues and Limitations

- Casualty data quality
  - Coordinate typos prevent identification of specific bridge piers and lock walls that present hazard
- Lack of detailed trip data (USACE)
  - Necessary for rate calculation
  - Aggregation performed due to confidentiality concerns

Results: Hotspots

- Validated with river industry personnel
- Allisions
  - Illinois River bridges
- Collisions
  - Lower Miss. near Southwest Pass
- Groundings
  - Memphis, St. Louis
- Overall:
  - Galveston Bay and Gulf Intracoastal Waterway West

Intersection of Gulf Intracoastal Waterway West and Houston Ship Channel

Weather Data

- Weather attributes inconsistently populated in casualty datasets
- Weather data (NOAA)
  - 29,266 stations worldwide
  - Wind speed, visibility
  - Hourly observations

North American Weather Stations (NOAA)

River Gage Data

- USGS (175 stations)
- USACE (84 stations)
- Daily gage readings (7am)
- Flood level categories not available for all gages
  - Gage readings normally distributed
  - Used percentiles instead of flood categories

Green = USACE gages
Purple = USGS gages

Weather Results

- Wind speed data unreliable
- Restricted visibility does not appear to be a factor in inland casualties
- Groundings occur primarily between 11pm-5am
- Allisions occur primarily between 8am-4pm
- Allisions and groundings correlated with seasons
- Allisions and river gage levels correlated

	River Gage Distribution Function									
	0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
Allision	6%	5%	6%	6%	6%	9%	10%	10%	19%	23%
Collision	11%	11%	11%	11%	6%	6%	13%	9%	17%	6%
Grounding	24%	15%	13%	9%	7%	8%	7%	7%	6%	4%

Future Research

- Closely examine corridor and specific hotspots
- Automatic Identification System (AIS):
  - Combine with lockage data to generate precise trip data
  - Detect near-miss events
  - Correlate with “black box” data (engine rpm, rudder angle) to detect difficult maneuvering areas

Conclusions

- Combination of GIS, DBMS, data visualization tools is powerful
- GIS can make spatial linkage between seemingly unrelated datasets
  - Possible to reconstruct events using external data sources
- Internet GIS can be effective as a casualty data maintenance platform

Questions?

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