A GEOVISUAL FRAMEWORK TO COMPARE AND VISUALIZE DENSITY HOTSPOTS UNDER VARYING WATER LEVELS

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Keywords: automatic identification system, correlation, geovisual application, river water levels, vessel congestion

Abstract

The Automatic Identification System (AIS) transmits a ships' position, along with other variables, via radio frequencies, providing a valuable source of data for examining vessel movement. Understanding how vessel traffic patterns respond to changing inland water levels can provide vital knowledge to stakeholders. Web-based geovisual applications provide an effective means of communicating complex spatial and temporal patterns through interactive dashboards that include maps, text, and dynamic, data-driven visual elements. Thus, this work has created a geovisual framework that combines AIS data with water-level data to examine variations in vessel density across multiple study sites in 2024.

Along the Mississippi river, three sites- St Louis, Cape Girardeau and New Orleans, were chosen for a comparative study. With the AIS data for 2024 downloaded and processed, the data was spatially aggregated within a hexagonal grid of 1,000 square meters, then temporally aggregated per month and per week. Simultaneously, river water level was obtained from water gauges from the United States Geological Survey (USGS) website. For all sites, a 1-mile area around the water gauge was used as the study area. The Pearsons correlation coefficients were calculated for the three study sites for two temporal aggregations.

The web-based application, created using ESRI Experience builder, can be accessed here. Through the application, spatial and temporal vessel-density patterns reveal distinct navigational routes across all three study sites. At St Louis and at New Orleans, vessel density along riverbanks exhibited a positive relationship with water levels. Across all three sites, vessel density at the center of the river exhibited an inverse relationship with water levels, a pattern strongly observed at Cape Girardeau. This inverse pattern suggests that vessels unable to dock at the river terminals during lower-water conditions may contribute to traffic congestion and throughput bottlenecks for vessels travelling beyond each site. Furthermore, in New Orleans, two distinct clusters are observed near the Louisiana Gateway Port Authority. One showing a positive correlation, while the other showing an inverse relationship. These contrasting clusters may reflect current navigational responses and adaptations to fluctuating water levels.

Overall, the findings demonstrate the value of integrating AIS and water-level data within a web-based geovisual framework to identify patterns in vessel density. By

understanding the spatial correlation patterns between changing water-levels and vessel density, stakeholders can identify locations where water level fluctuations have the greatest impact on vessel traffic.