Puerto Rico contains three major seaports. They are San Juan Port, the Port of Ponce, and the Port of Mayaguez. In 2017, these ports were disrupted by the wind and waves Hurricane Maria brought to the coast of Puerto Rico. Hurricane Maria devastated the island and its 3.4 million residents. This storm registered as a category 4 hurricane that brought 155 mph winds and 10.5 ft storm surges on the eastern coast, and left the entire island without power. Hurricane Maria was said to be the most devastating storm to hit Puerto Rico in 80 years. The ports along the coasts of the island suffered severe damage from the rising sea-levels and strong winds making landfall over them.

The performance of maritime transportation systems struggle to remain reliable and resilient during times of disruption. Major disruptions at a port may result from external threats such as storms, terrorist attacks, and oil or hazardous material spills as well as multiple catastrophic events. The extent of the disruption and damage to a port, and the duration of the disruption depend on the severity of the threat, the degree to which the port is vulnerable to it, and the decisions that are made in responding to the disruption. Resiliency of a port is defined in terms of the severity of the threat, the extent of the disruption to a performance measure such as port capacity, as well as in terms of the duration of the impact on the performance measure.

The contribution of this research is to empirically show how port clusters rely upon each other during disruptive events to increase the overall resiliency of water borne commerce. The disruptions caused by Hurricane Maria in Puerto Rico, had both short-term and long-term impacts to the affected region. In the short-term, Puerto Rico experienced an inability for freight vessel to access any of the three port on the island territory, delaying millions of dollars worth of goods. Long-term, the economic impact and the recovery process of this region will likely be affected by the devastating storm.

RESULTS
In general, the results of the research are expected showed the benefits of quantifying resiliency and how the information gained from such analysis can be beneficial when evaluating the impact of disruptive events on regional port clusters. The quantitative assessment of resiliency provides meaning, context, and relevance to port stakeholders which may not be readily apparent at face value. The independent nature of the maritime transportation systems requires redundancies and therefore the impact of disruptive events must be viewed from a holistic approach. It is not possible to see the entire regional impact of freight transportation by exploring the hindrance of one port. It is necessary to see the forest through the trees and develop methods and means to analyze these networks, systematically.

This research will also show that Automatic Identification System (AIS) data can be utilized to create new metrics and methods for the assessment of resiliency in maritime systems. This research may show, in quantifiable terms, reductions in performance resulting from a simulated disruption. On a broader level, research will be provided as first steps toward the development of standardized metrics for quantifying MTS operational resiliency. The use of AIS data, which collects information from nearly all commercial vessels on a semi-continuous basis, is a rich data source with many applications in disaster science. The methods developed and applied here incorporate an algorithm that is to quantifying resiliency in navigable waters and can be applied across a range of temporal and spatial scales.

REFERENCES

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