Risk Assessment and Mitigation Measures of Maritime Navigation in the Caribbean Sea

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Structure of the Presentation

- Introduction into Maritime Navigation
- Importance of conducting Risk Assessment
- Strategies used to reduced risk to navigation
- Preliminary results
- Conclusion

Study Area- The Caribbean Sea

- The Caribbean is a busy shipping maritime environment representing a wide range of shipping activities.

- The shipping activities become more complex as large-scale offshore operations and maritime activities continue to increase.

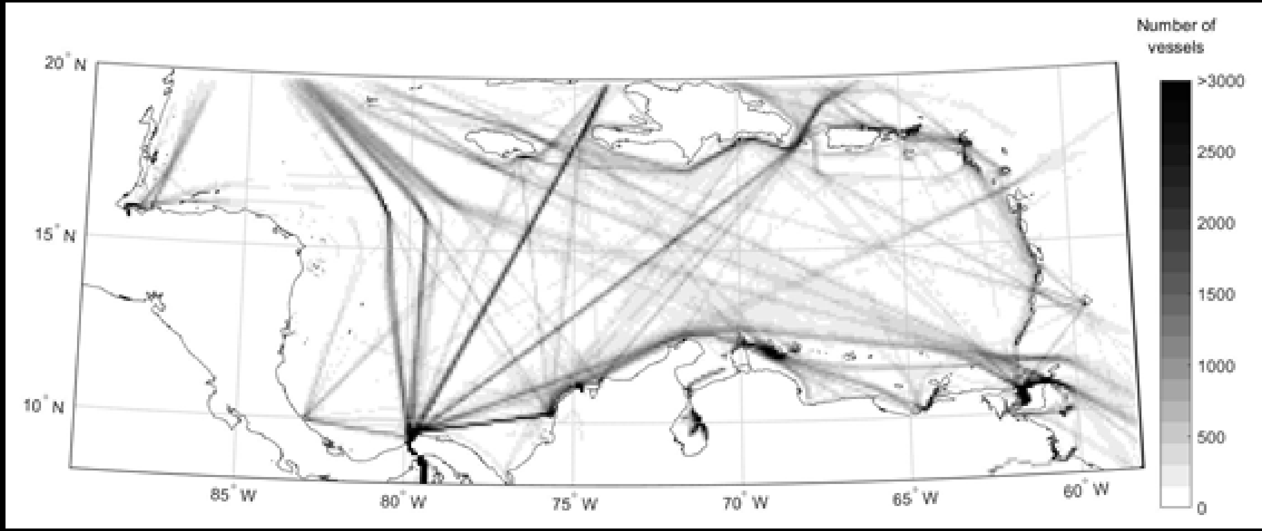
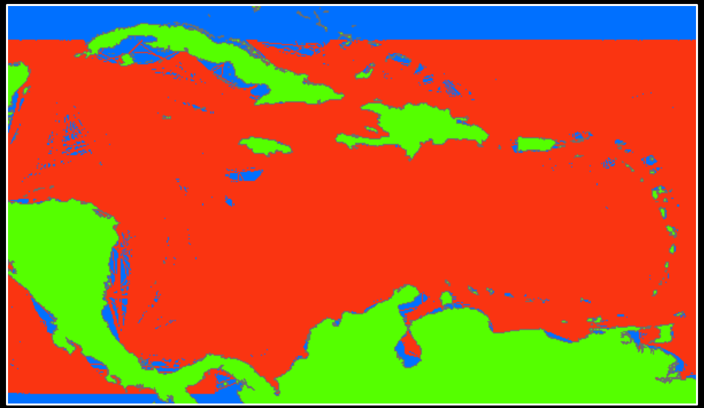
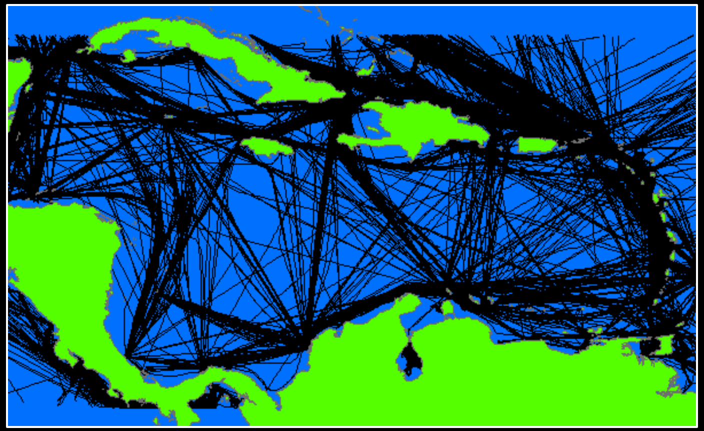


Figure 1 : Marine Traffic across the Caribbean Sea

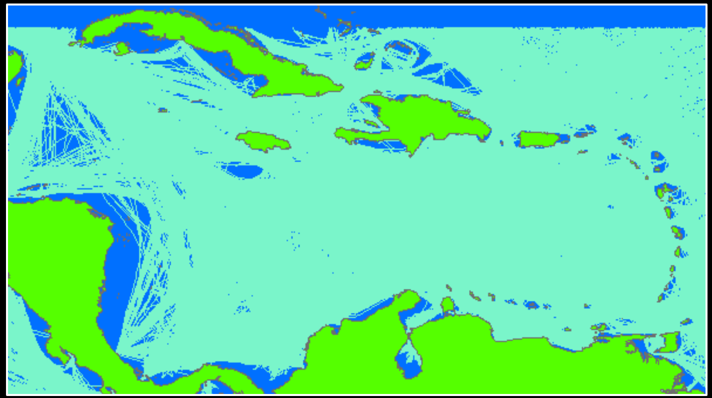
Types of Vessel Traffic: Wider Caribbean Region



Cargo Transits



Passenger Transits



Tanker Transits

Causes of Maritime Accidents

Generic causes of Maritime Accidents:

Meteorological Conditions
Mechanical and Technical Issues
Human Errors
Malfunctioning aids to navigation
Inadequate charting (Bathymetry & Navigational Hazards)
Navigational Complexity

Figure 2: Oil spill vessel accident, Tobago 1979.

Importance of Study- Consequences of Maritime Accidents

- Economic loss - Overall decrease in transhipment of goods and services
- Loss of life
- Environmental Damage to sensitive areas
- Damage to or Loss of property

Gertz 2014

Figure 3: Oil coated the mangroves, as a result of a tanker colliding with another vessel in Bangladesh, on December 9th, 2014

Objectives of the Study

AIM: To develop a strategy that considers likelihood of an incident in relation to **vessel traffic flow** and **navigation information** available to the mariner.

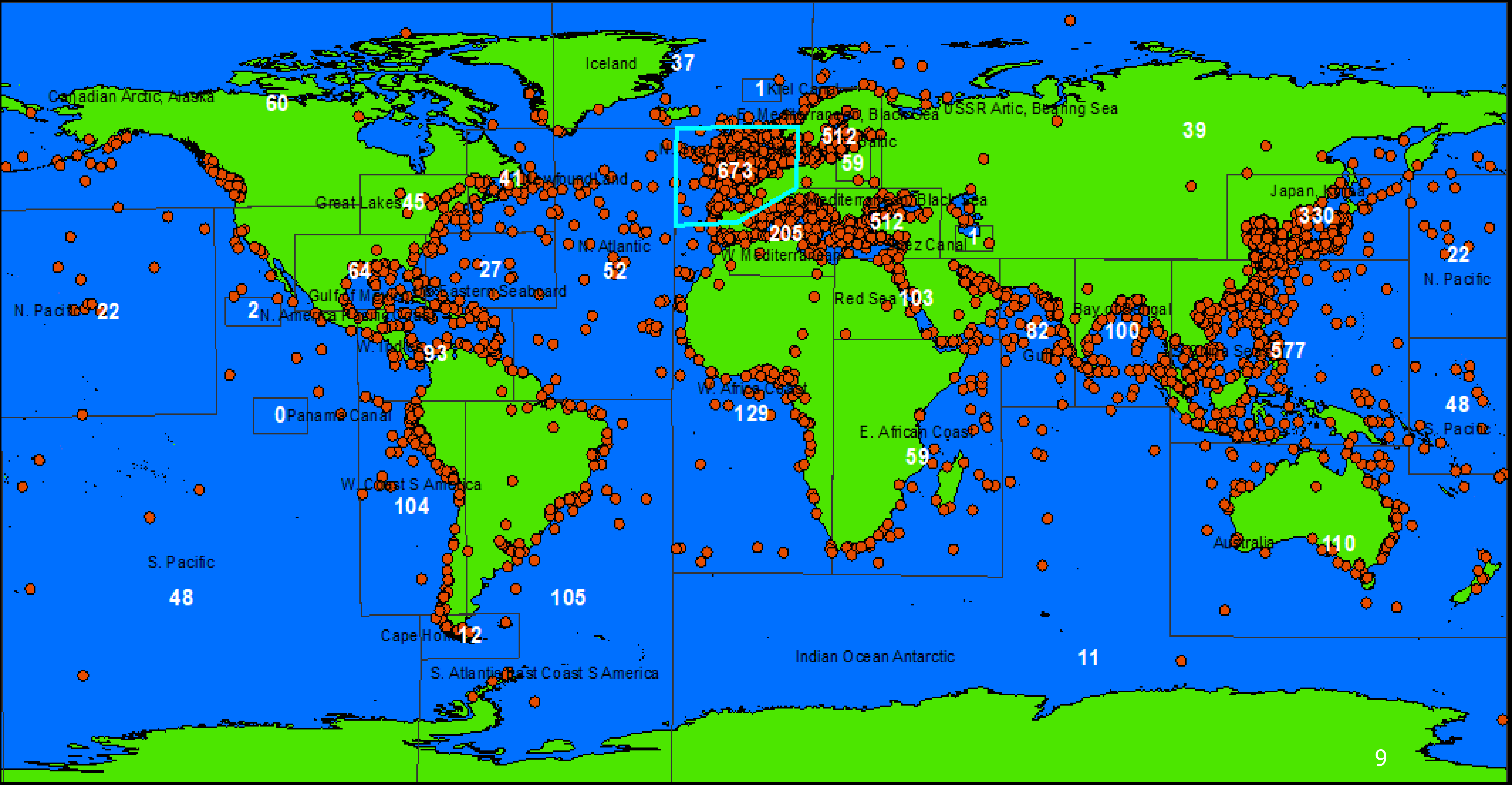
OBJECTIVES:

- Assessment of shipping accidents globally to identify key contributing factors relating to ships and the environment to produce statistical evaluation for use in risk assessment
- Apply mitigation measures such as improved charting and traffic management to re-assess risk
- Strategy for assessment of impact of risk reduction measures through the provision of tools and models that will support port development

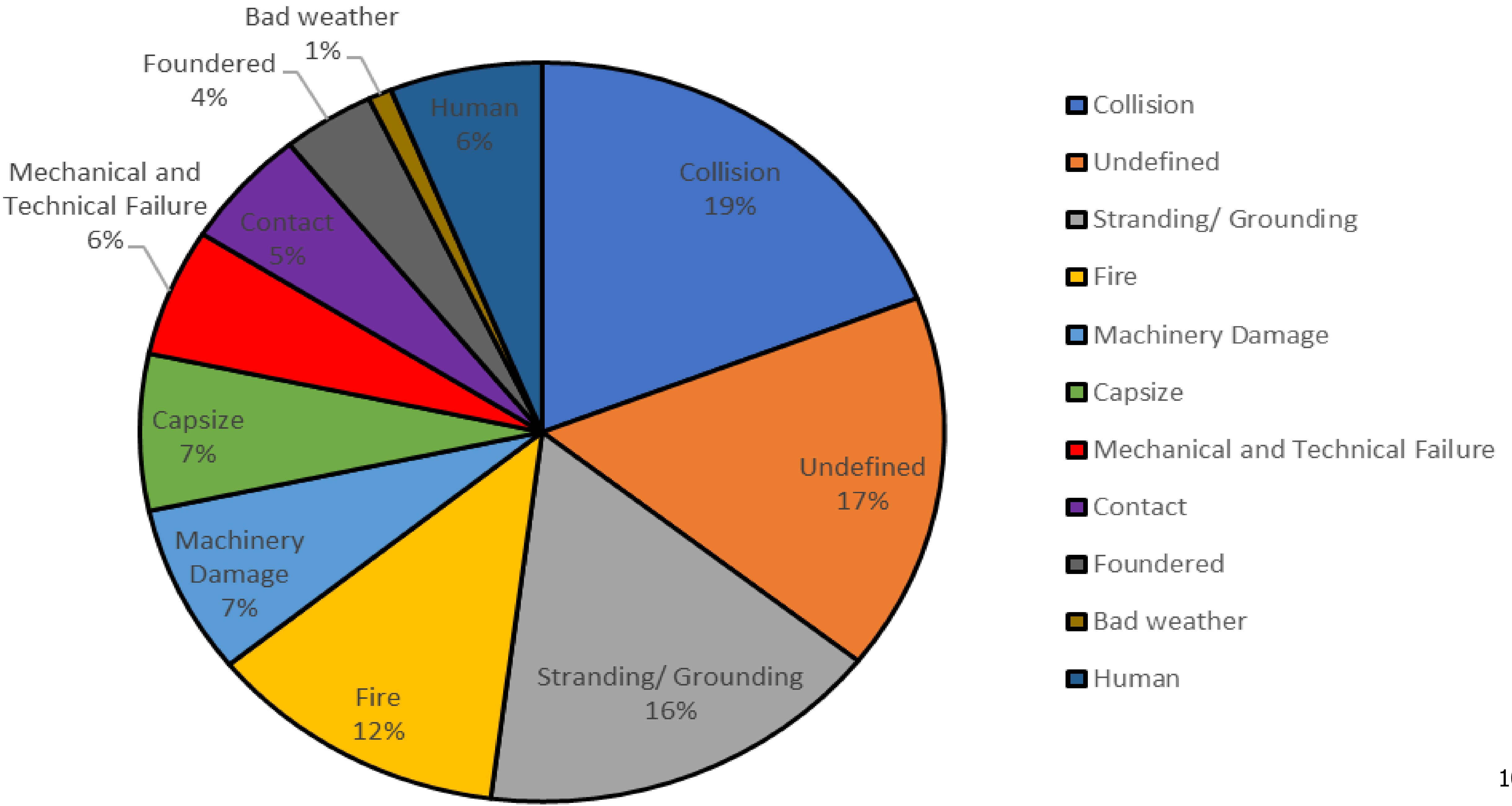
Preliminary Results

Quantitative Analysis of Maritime Causalities and Incidents

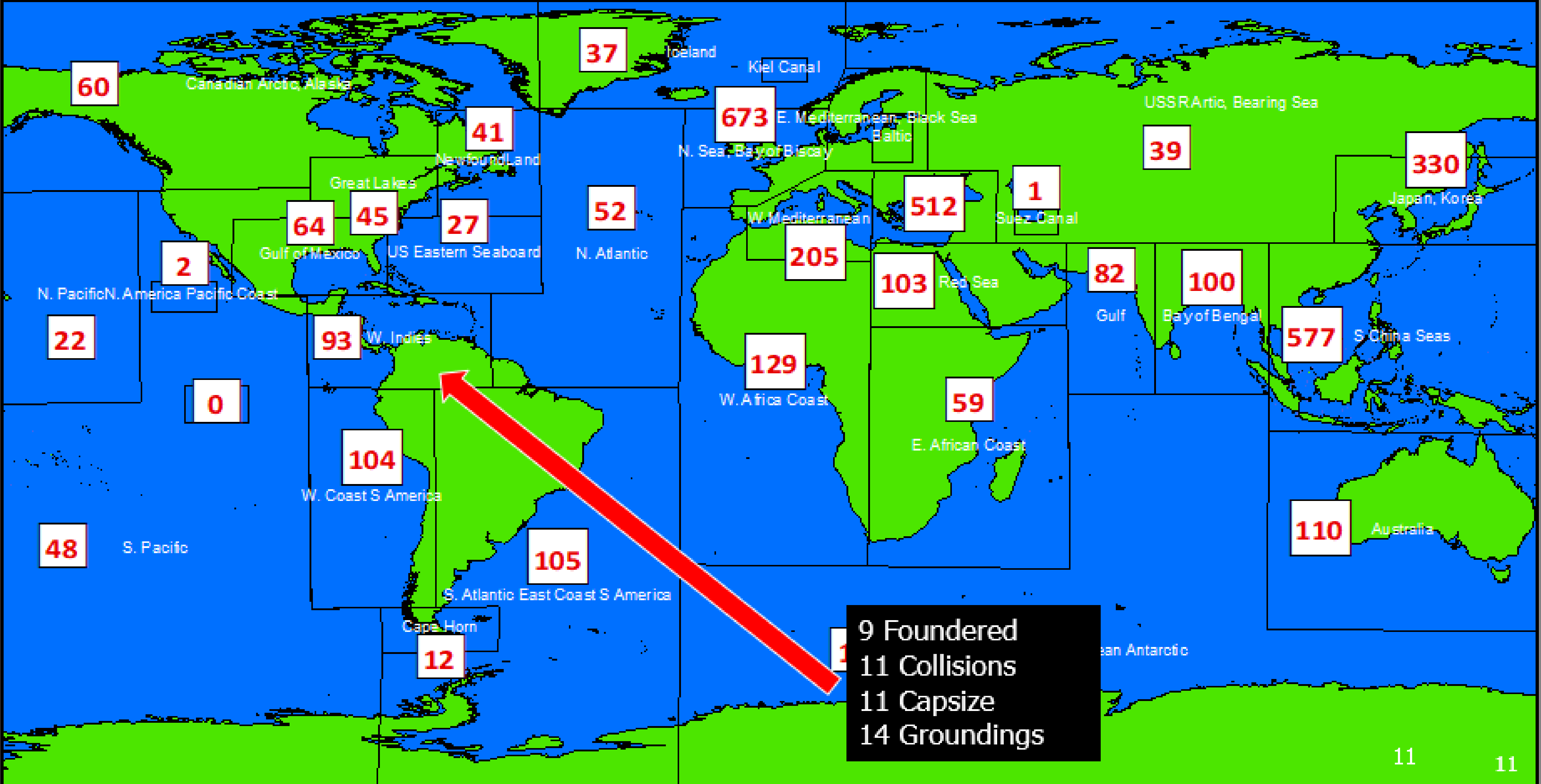
Location of Maritime Causalities and Incidents



Quantitative Analysis of Maritime Causalities and Incidents



Number of Maritime Causalities and Incidents



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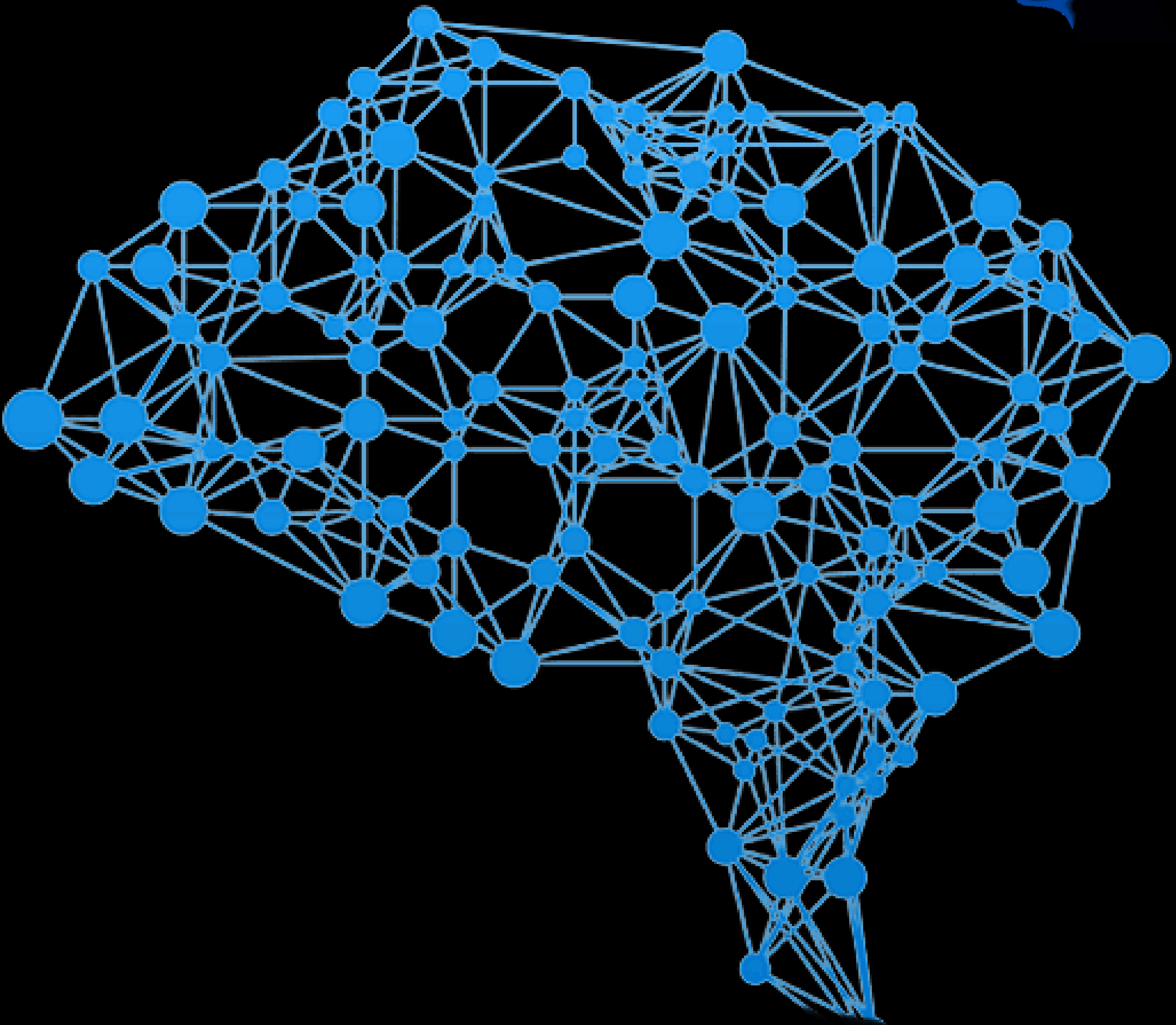
Predicting Maritime Events with ANN

Theory of Artificial Neural Network

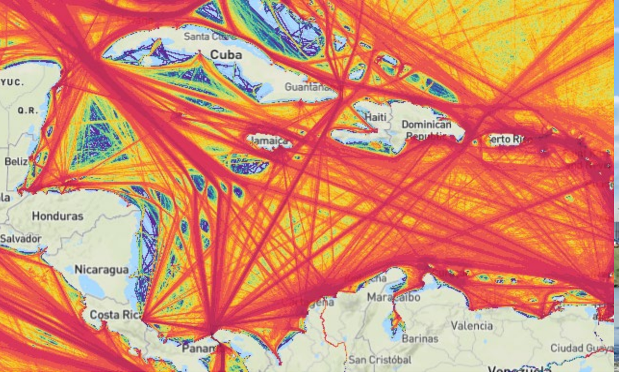


- Neural networks reflect the behavior of the human brain, allowing computer programs to recognize patterns and solve common problems in the fields of AI, machine learning, and deep learning.

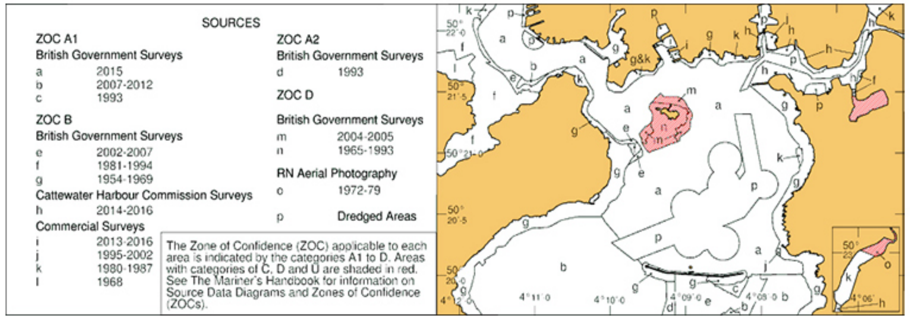
- Neural Networks is a series of algorithms that seek to identify relationships in a dataset via a process that mimics how the human brain works.

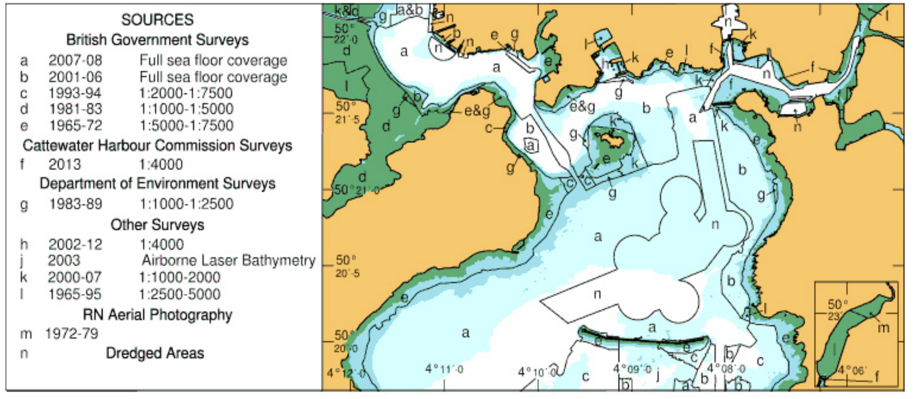
Structure of Deep Neural Network

- Artificial neural networks (ANNs) are comprised of a node layers, containing an input layer, one or more hidden layers, and an output layer. Each node, or artificial neuron, connects to another and has an associated weight and threshold.
- If the output of any individual node is above the specified threshold value, that node is activated, sending data to the next layer of the network. Otherwise, no data is passed along to the next layer of the network.

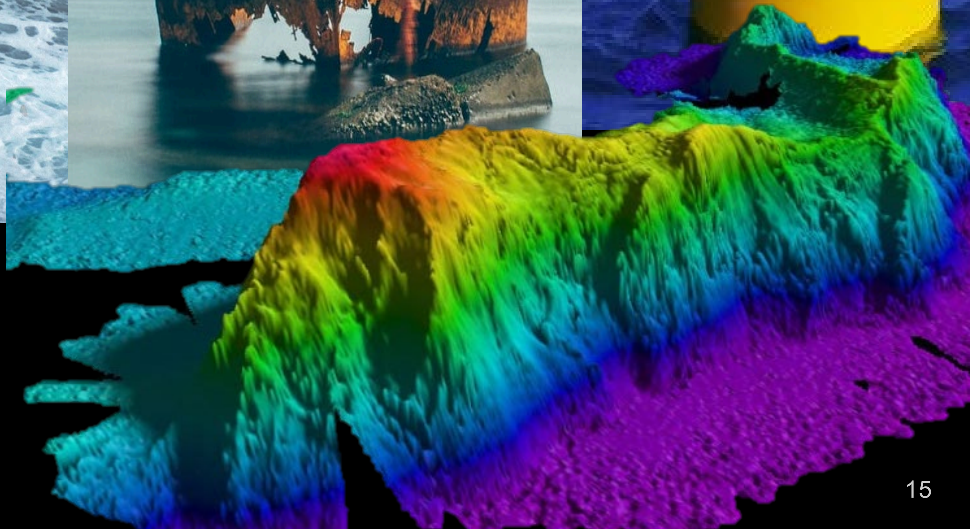






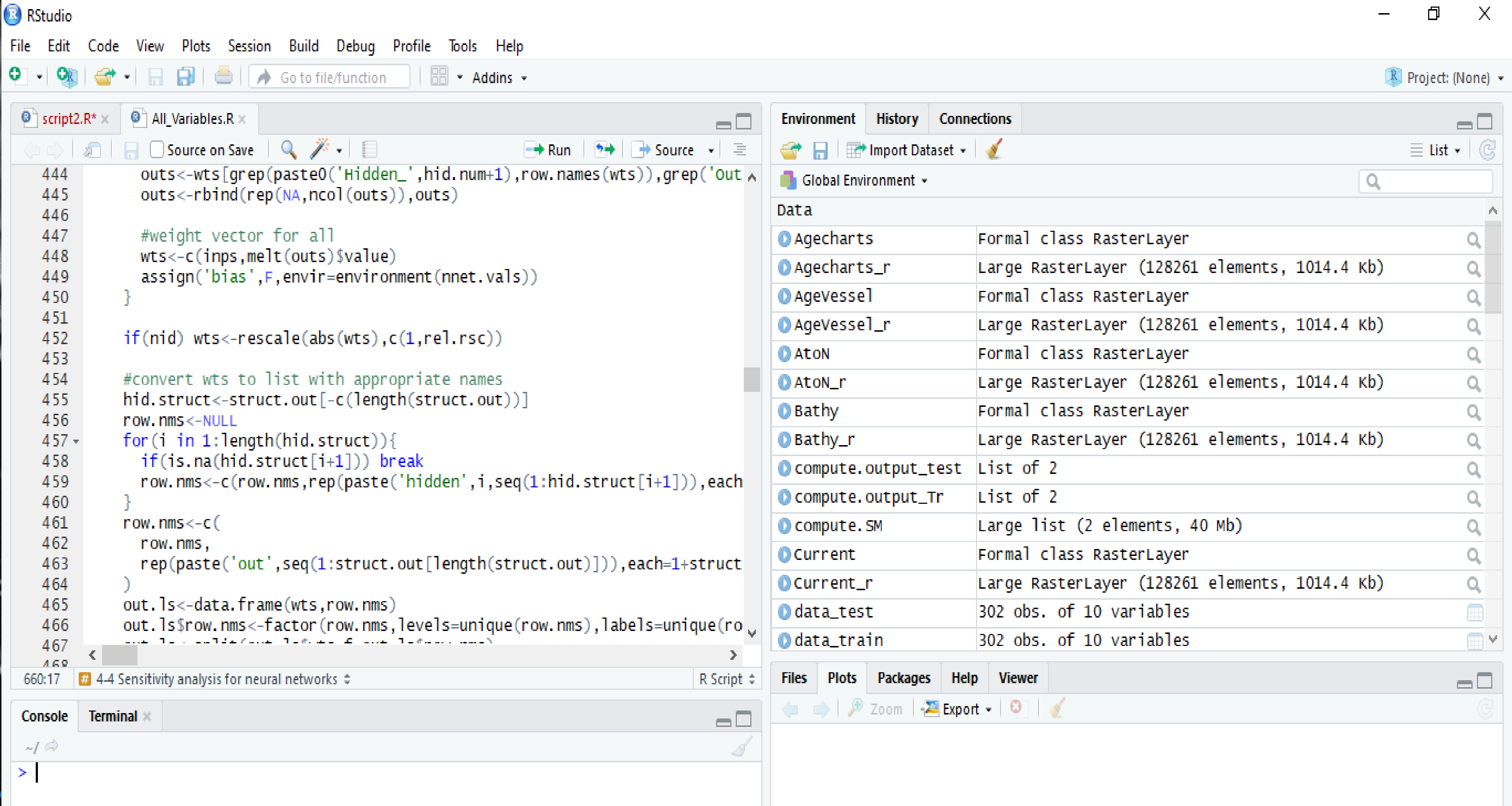




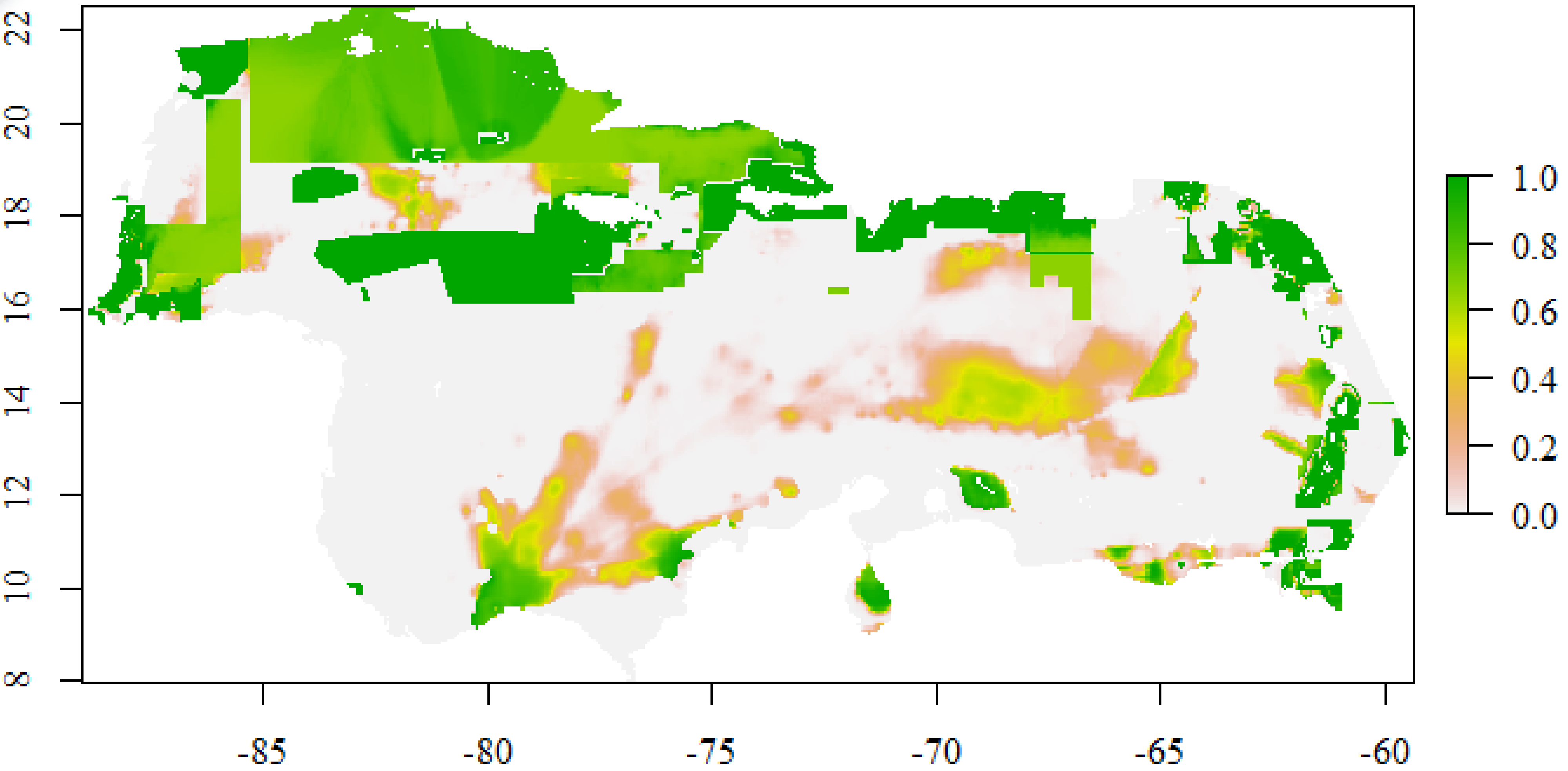
Data Preparation

-Selection of Risk Factors

Scripting in R



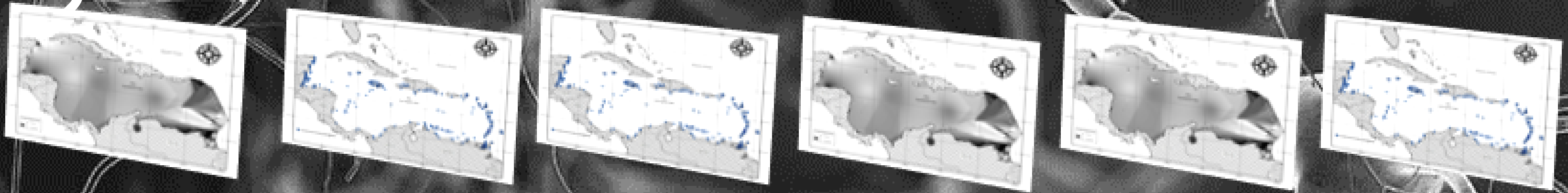
Preliminary Results



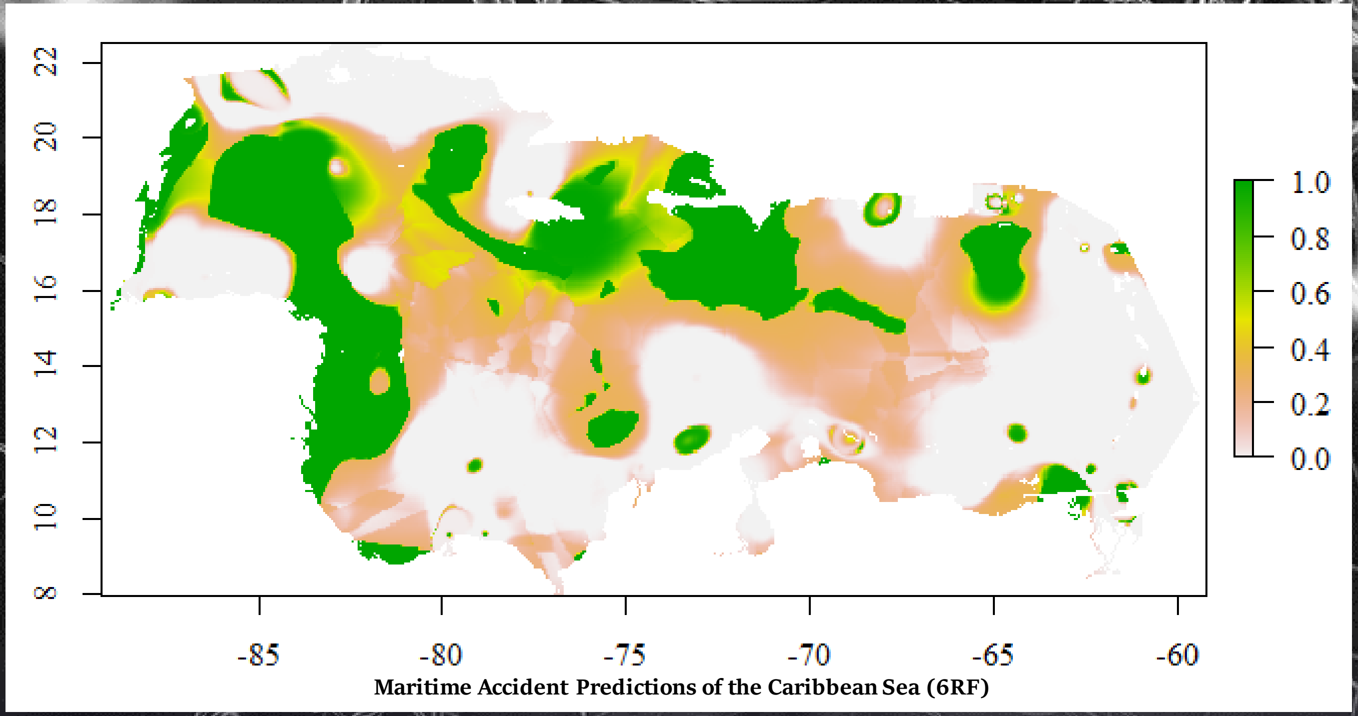
Maritime Accident Predictions of the Caribbean Sea (9RF)

Simulations

Simulation 2



6 Risk Factors



Summary of Findings

- The presentation presents application of the ANN modeling with GIS technology to predict the potential incident location of maritime events based on several combination of selected risk factors.
- The results indicate that the neural network based-GIS modeling can be powerful alternative approach toward automated spatial decision making.

Research Plan

On going research:

- Assessment of reasons for incidents and shipping traffic in the Caribbean
- With the traffic information and likelihood, events will be modelled and the rules of conduct within the waterways will be changed, with the aim of reducing risk.

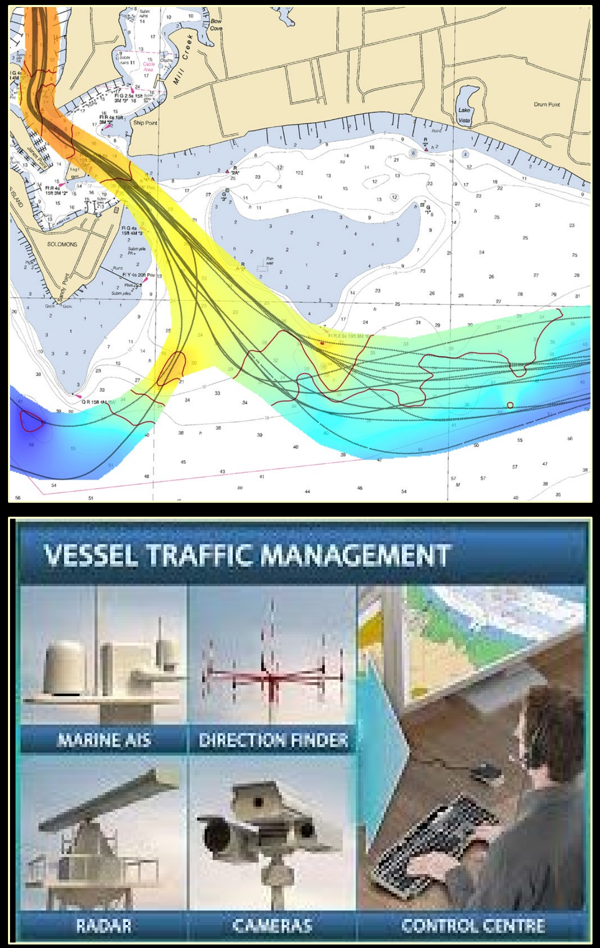


Figure 4 : VTMS (Magnus 2016)

Novelty of this Research

- Global Quantitative Analysis of Maritime Casualties and Incidents for the past 19 years.
- Regional Assessment of Maritime Accident Hotspots across the Wider Caribbean Region.
- The development of a predictive model using Artificial Neural Networks