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
- Spatial Data needed for Analysis
- Preliminary results





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



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



Using Geographical Weighted Regression (GWR) to explore spatial variations in the relationship between the location of maritime accidents with the factors that presents a risk to Maritime Navigation



Spatial Data Needed for Research

Risk Factors	Aspatial Information		
Vessel Traffic Data	Number of vessel transits per cell		
Flag of the Vessel	Percentage Distribution per cell		
Age of Vessel	Percentage Distribution per cell		
CATZOC	Quality of Charts & Survey Age per cell		
Bathymetry	Depth of Water per cell		
Current Velocity	Average speed of the Current per cell		
Location of AtoNs	Number of AtoNs per cell		
Location of Maritime Incidents	Number of Maritime Accidents per cell		
Location of Navigational			
Hazards	Number of Navigational Hazards per cell		



Determination of Coefficients

Training Data used to identify the Coefficients:

- 1. SAIS Traffic Data
- 2. Location of Maritime Events



Results of GWR

GWR_R1

Predicted -0.207349 - -0.131884 -0.131883 - 0.231554 0.231555 - 0.787099 0.787100 - 1.631192 Ø 1.631193 - 4.883107 Line . 1 • $h_{\rm He}$ ₹ ъ. а Ъ. 94-04 1 ٤, **C** <u> 22.</u>

Coefficients_ AtoNs	Coefficients_ Bathymetry	Coefficients_ CATZOC	Coefficients_ NavHazards	Coefficients_ TrafficDensity	Location
0.342458	0.000658	-0.120938	0.736532	0.937159	Panama Canal
0.114292	-0.000567	0.394616	0.271881	0.724681	St. Vincent and the Grenadines
0.125899	-0.000492	0.337018	0.241723	0.709784	Gulf of Paria
0.636752	0.001207	0.82989	0.054757	0.710434	Virgin Islands
0.008338	0.136374	0.000515	0.231462	0.624871	Venezuela
0.466177	0.000482	0.412672	0.204294	0.617423	St. Kitts and Nevis
0.12169	-0.000536	0.368507	0.25714	0.5347914	Grenada

Findings of GWR

□ GWR produces a surface of parameter estimates.

□ The spatial changes in the magnitude of the parameter estimates across the surface indicate the locally changing influence of a variable on the dependent variable, in some areas the influence might be much stronger than in other areas.

□ Local models using GWR were demonstrated to be suitable for the study

Findings of Marine Risk

□ Additional Spatial Data is needed for a complete analysis

□ Spatial variability of maritime accidents was confirmed;

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.

MARINE AIS
 DIRECTION FINDER

 MARINE AIS
 DIRECTION FINDER

Figure 4 : VTMS (Magnus 2016)

Conclusion

The risk assessment of maritime navigation across the Caribbean Sea is necessary with the use of AIS data and such studies are now feasible:

The Caribbean Sea is a special area and there is need for risk management.

Therefore there is an urgent need to monitor and manage risks to maritime navigation to ensure improved security of the maritime environment.

Questions