An Assessment of the Impact of Weather Upon Shipping Patterns using AIS Data and Weather APIs

Program: MSc Geospatial Analysis

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Objectives & Methods

Aim: (pg. 12)

To assess the influence of extreme weather on the spatial distribution and operational characteristics of the North Sea shipping network using AIS and weather API data.

Research Questions: (pg. 12)

1. How does extreme weather impact shipping and port activity within the North Sea?
2. How does extreme weather impact the spatial distribution of vessel traffic within the North Sea?
3. How does extreme weather impact the network characteristics of the North Sea shipping network?

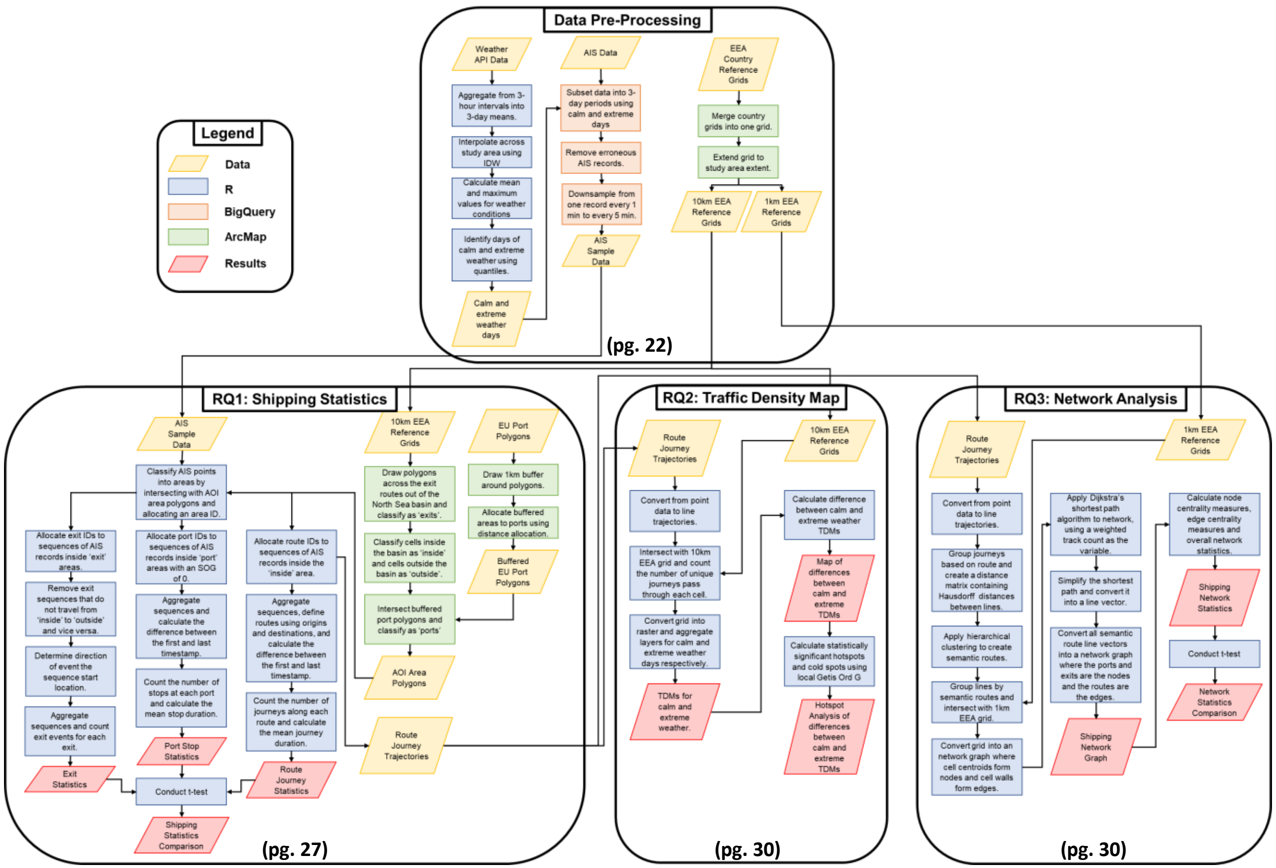

Figure 1: Flow chart of the methods used in this investigation. **(pg. 21)**

AIS Message Data		
Dynamic	**Static**	**Journey**
MMSI	IMO Number	Vessel Draught
Timestamp	Vessel Name	Destination
Longitude	Call Sign	ETA
Latitude	Vessel Type	
COG	Vessel Dimensions	
SOG		
Heading		
ROT		
Navigation Status		

Figure 2: Table showing the data components of an AIS message. **(pg. 15)**

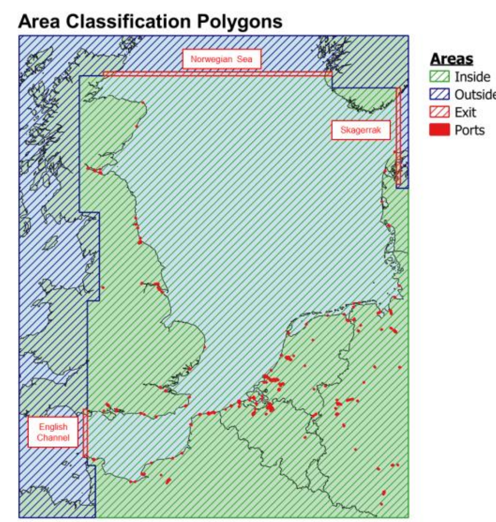

Figure 3: Map of study area and polygons for shipping statistics. **(pg. 28)**

Findings & Practical Value

RQ1: Shipping Statistics (pg. 53)

- Activity skewed to the right, suggests Hub-and-Spoke model.
- Overall count **decrease** for exit/entry events, port stops and route journeys.
- Overall duration **increase** for port stops and duration **decrease** in journey.

RQ2: Traffic Density Maps (pg. 54)

- Shipping density highest in the southern North Sea from the English Channel to Skagerrak.
- Overall **decrease** in traffic density, especially in the southern North Sea.
- Small pockets of **increased** traffic density on the northern coast of the Netherlands and eastern coast of the UK.

RQ3: Network Statistics (pg. 56)

- Activity skewed to the right, suggests Hub-and-Spoke model.
- Overall **decrease** in network size, complexity and connectivity.
- Overall **decrease** in node and route degree centrality and betweenness centrality.

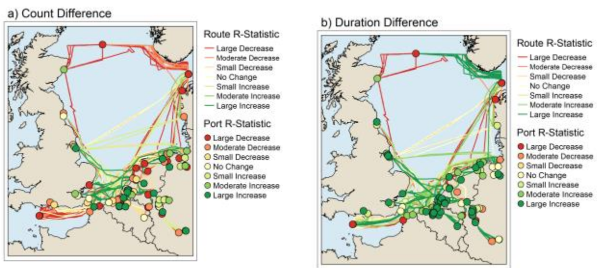

Figure 4: Maps showing entry/exit event, port stop and route journey (a) count and (b) duration. **(pg. 33)**

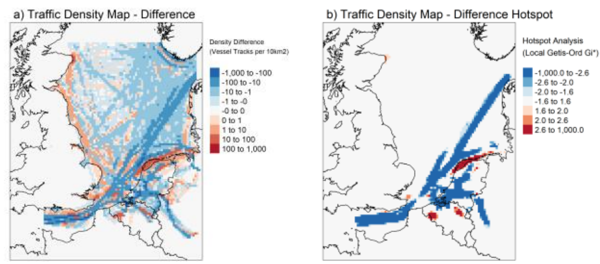

Figure 5: Maps showing the (a) traffic density difference and (b) hotspots. **(pg. 41)**

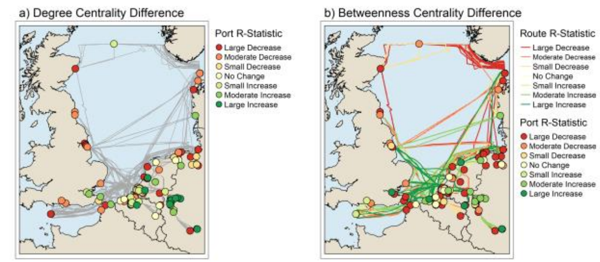

Figure 6: Maps showing the port and route (a) degree and (b) betweenness centrality. **(pg. 43)**

Limitations (pg. 57)

- Assumes that shipping only fluctuates with weather.
- Exit polygons too small to capture all entry/exit events.
- Port polygons are arbitrary and may not capture anchorages.
- The definition of traffic density can vary based on method used.
- AIS terrestrial receivers are limited to a range of 40km, resulting in blind spots (northern North Sea).
- Cluster methodology for network creation could improve.
- Dijkstra's shortest path algorithm is a complex and resource intensive method.
- Ship and port characteristics and their impact on shipping were not considered.

Practical Potential (pg. 62)

- Offers an effective exploration of how extreme weather influences shipping activity within the North Sea.
- Could help understand the economic repercussions of extreme weather and support hazard mitigation planning.
- Developed a workflow that converts raw AIS data into useful data products.
- The statistics produced can act as precursors for further analysis.
  - Establishing clear relationships between shipping activity and various covariates.
  - Predict the potential impacts of different conditions on shipping activity.
- Improves the visualisation of AIS data and aids in its interpretation.

Interactive Dashboard: https://jdfj3.shinyapps.io/Dissertation/