INVESTIGATION OF OIL TANKER ACCIDENTS BY USING GIS

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SUMMARY

This study focuses on marine accident data regarding accidents that occurred between the years 1998-2010 for ships within the oil tanker category. Data in the study include accident reports, which are recorded in the Global Integrated Shipping Information System (GISIS) and country reports. Textual accident data in the GISIS database were tabulated, thus creating a systematic database. By using accident data from this database, a marine accidents map for oil tankers was developed via the ArcGIS 10 program, the areas with the highest accident incident rates were determined, and reasons for oil tanker accidents were revealed through the assessment of factors such as accident type, accident incident number, accident scope, ship tonnage, navigational sea area type, and accident's impacts on the environment, economy and personnel. The study showed that very high risk areas for oil tanker marine accidents include *the Singapore Strait* and *Oresund,* and high risk areas are the *Bristol Channel*, *Suez Channel, Strait of Hormuz, Great Belt*, *Piraeus, Hull, İstanbul Strait,* and *Amsterdam,* respectively. The study also established that oil tanker accidents are related to ship tonnage and navigational sea area type.

1. INTRODUCTION

Progress of world trade in recent years has had a positive impact on the maritime industry. This impact led to significant increases in ship and voyage numbers [1]. Over the last decade, international maritime authorities have made significant efforts to promote safety at sea and prevent marine accidents in the shipping transportation industry (such as new regulations or new forms of team training) [2-4]. Despite such efforts, ship accidents continue to be a major and complex issue requiring suggested solutions [4-6]. Among these accidents, oil tanker accidents are of particular importance, due to the fact that when oil tankers are involved in accidents, the consequences of the accidents not only affect the vessel and its crew, but also other living creatures and the environment, and may also cause significant economic losses [7-9].

Maritime accident analyses aim to determine the root causes of accidents and recommend effective ways to prevent similar accidents. Studies on marine accidents serve as a guide in preventing or minimising the possibility of future accidents.

One of the most important sources of data regarding maritime accidents is the geographical location in which they occur. To the specialist investigating an accident, geographical location provides many descriptive information, such as depth, distance to the closest coast line, control of whether the ship was at a proper location, etc. Owing to the Geographical Information System (GIS) program, it is possible to associate the table data of accidents (accident reports) with geographical data (density maps based on data such as accident type, ship tonnage, and ship size) in order to perform comprehensive analyses and assessments; the obtained results can then be visualized using graphs or maps, and be presented as printed material or through the internet. For this reason, it is extremely important to follow and evaluate maritime accidents by taking geographical location into consideration. In this study, we have used the GIS program to analyze maritime accidents involving oil tankers.

2. LITERATURE REVIEW

In recent years, the analysis, evaluation, and management of risks have increased substantially in the industry, becoming a valuable tool for decisions concerning safety [10]. The GIS program is utilized for scientific purposes in many areas, including accident models. GIS is a basic guide that provides interpretation and visualization of accident data on a chart [11]. GIS technology is a very important and comprehensive management tool for traffic safety [12]. It is used for planning and decision making in many scientific fields such as cartography, photogrammetry, remote sensing, statistics, global positioning, and computer science [13]. The use of GIS is the most effective way to examine and evaluate the results of analyses that use a multitude of data and different criteria [14]. GIS facilitates the distribution, classification, and interpretation of multiple accidents' data on a digital map. It is used for accident analysis [11, 14-19]. The use of GIS in the maritime field does not have an extensive history.

In their study, Sigua and Aguilar [21] reviewed marine accidents that occurred in the Philippines territorial waters over the course of 10 years and created a database that revealed the factors that caused the accidents. The database included information such as ship name, company name, accident date, coordinates, accident type, deaths, and injuries. Using this database, they determined that marine accidents that occurred in the Philippines waters involve, in order of priority, sinking, grounding, flooding, fire, and machinery breakdowns, and that human errors are an important factor, specifically in fire and machinery breakdown accidents. Furthermore, using GIS, they positioned marine accidents based on accident type and developed a marine accident map. They identified areas in the Philippines waters with highest accident incident rates [20].

In his study, Akten (2004) reviewed 461 marine accident reports for accidents that occurred in the İstanbul Strait between the years 1953-2002. He positioned accidents that occurred in the İstanbul Strait, based on accident type and identified sea areas with highest accident incident rates. He revealed the basic factors that triggered accidents in sea areas with the highest accident incident rates [5].

In their study, Eliopoulou and Papanikolaou (2007) comprehensively reviewed raw accident data for accidents in the very serious accident category, which occurred between the years 1978-2003, related to oil tankers above 80000 DWT (long range tankers) and evaluated the accidents. On the world map, they positioned accidents that caused oil pollution according to their scope of pollution and determined their grid references. They created an oil pollution map for pollution caused by long range oil tankers [21].

Kujala et al. (2009) analysed marine traffic safety in the Gulf of Finland. For this purpose, they researched marine accidents that occurred in the Gulf of Finland over the course of 10 years. In the first phase of their study, they identified the most common types of accidents by classifying marine accidents and revealed the factors that led to the accidents. In the second phase of their study, they positioned marine accidents with GIS and created a marine accident map. As a result of their study, they concluded that the most common accident types in the Gulf of Finland are grounding and collusion, respectively, and that accident incident rates are high between Helsinki and Tallinn to the west, in the Gogland coasts to the southwest, and in the north from Lavansaari, Peninsaari and Seiskari Islands [22].

3. METHOD

In the study, accident analyses were performed for ships within the oil tanker category. The ArcGIS2010 program was used for accident analysis. ArcGIS2010 is a computer program that provides descriptions for regions of the world, stores data, and uses the stored data. This program also enables integrated storage of non-graphic data pertaining to spatial data [23].

Accident data in the study included accident reports and country reports for 379 oil tanker accidents that occurred between the years 1998-2010, and recorded in the GISIS system. The GISIS is an accident module on the International Maritime Organization’s (IMO) website, comprising marine accidents and their related data. The accident data were submitted to the IMO by Flag State, and analysed by IMO experts then put into the accident module. The purposes for collecting information in the GISIS accident module are to identify potential issues by classifying accidents, and to provide advice with the intent of preventing the reoccurrence of such accidents. 94% of the accidents that were analyzed in the study fell within the very serious and serious accident categories. In this study, high risk areas for oil tanker marine accidents were determined and factors that trigger such accidents were shown using the ArcGIS2010 program.

In the study, GIS implementations were analysed in three phases (Figure 1). During the first section, which is the data acquisition phase, accident data were digitized in a MS Access database. In the second section, digitized accident coordinates and accident information were transferred to the ArcGIS2010 program. In the third section, marine accident data were positioned and grid references were determined on the existing world map and evaluated.

4. GEOGRAPHICAL INFORMATION SYSTEM

Geographical Information System (GIS) is an important decision support tool capable of operating and analyzing different types of spatial data to determine the appropriate landfill site. GIS examines the results under different conditions and considers the economic, technical, sociological, and environmental conditions in the process [14, 24-28].

The most important characteristic of a GIS is that it allows for the organization of local data in a data management system. GIS also contributes to the gathering the spatial data on a shared platform. GIS can be used for the investigation, analysis, and presentation of the data. This contribution not only includes graphical or non-graphical data, but also supports data sharing among different institutions and administrations [29-31].

GIS incorporates five important components including hardware, software, data, human, and methods. Efficient usage of GIS depends on the organized use of all of these components. Among these components, the data component is the most substantial, requiring the most time and cost [32]. In order to realize a GIS project, data with the appropriate structure must be available. To accurately determine the factors causing the accidents, a detailed analysis of the data pertaining to the accidents is required. Therefore, it is important that details pertaining to accidents are included in the accident report. Examples for such details may be accident coordinates accident type, accident date, accident scope, ship tonnage, accident result, accident reason, and the ship’s flag.

5. GIS IMPLEMENTATIONS

GIS in this study is used to identify high risk sea areas for oil tanker marine accidents and to interpret the distribution of such accidents. Marine accidents were reviewed in the ArcGIS 10 program in three phases. In the first phase, marine accident data were entered into the ArcGIS 10 program and marine accidents were spatially positioned. Figure 2 indicates the distribution of marine accidents according to accident type. In the second phase, grid references were determined to facilitate the interpretation of marine accidents. For this purpose, the world map was divided into polygons by 10 degrees.

The point density analysis method was used in this study to evaluate the accident data. The point density analysis method is used for determining and observing the point density distribution of samples within the study area. In this method, analysis is performed by evaluating the number of points within each pixel or defined cell [33].
In the study, marine accident areas were described as very high risk, high risk, moderate risk, and low risk sea areas. This was performed in the current study by considering the number of accidents for each polygon. Therefore, polygons with 10 or more accident occurrences refer to very high risk (VHR), polygons with 6-9 accident occurrences refer to high risk (HR), polygons with 3-5 accident occurrences refer to moderate risk (MR) and polygons with 1-2 accident occurrences refer to low risk (LR) sea areas.

Figure 3 shows risky marine accident areas according to different risk groups. The marine accident map shows the distribution of very serious accidents, serious accidents and collision-grounding accidents. In this study, while determining high risk accident areas, not only the total accident number was taken into account, but also very serious accident numbers, serious accident numbers, and collision-grounding accident numbers were also considered. Table 1 illustrates spatial distribution of oil tanker accidents according to risk category.

In the third phase, very high risk and high risk marine accident areas were focused on and coding was performed for these accident areas. The coded sea areas were divided into polygons by 2 degrees and a comprehensive accident analysis was conducted (Figure 4 a-b). This process is required to determine marine accident locations. The maps that were created enable the evaluation of the locations of marine accidents. In this study, sea area code A included the Bay of Biscay, English Channel, North Sea, Irish Sea, and the Baltic Sea, and channels and rivers connected to these seas.
Sea area code B included the Mediterranean Sea, Black Sea, and the sea and channels surrounding the Arabian Peninsula. Sea area code C included the Indian Ocean, Bay of Bengal, South China Sea, Strait of Malacca, and Strait of Singapore. Sea area code D included the South China Sea, East China Sea, and Sea of Japan.

Finally, the created marine accident maps were evaluated and interpreted. In order to ensure comprehensibleness for the evaluation, polygons with high accident incident rates were numbered (Figure 4). Table 2 indicates the numeric distribution for marine accidents according to polygon number.

6. ACCIDENT OCCURRENCES RELATED TO OIL TANKERS

According to the database created during the study, the most common accident types related to oil tankers were collision, grounding, fire/explosion, ship equipment damage, sinking/flooding, occupational accidents, and accidents in another category, respectively. Among these accidents: 127 were very serious, 230 were serious, and the remaining 22 were less severe marine accidents (Table 3). 73.8% of marine accidents related to oil tankers resulted in economic loss, 20% resulted in death/injury, and 6% resulted in environmental pollution. In 260 of 280 accidents that resulted in economic loss, the ship was either lost completely or became inadequate for navigation. Oil tanker accidents are accidents resulting in serious losses.

6.1 FACTORS THAT TRIGGER MARINE ACCIDENT OCCURRENCES RELATED TO OIL TANKERS

6.1 (a) Navigational sea area type

Oil tankers navigate in many areas. In order to evaluate the impact of navigational sea area type on oil tanker accidents, six sea areas were described, namely, open sea, coastal waters, channel, berthing-unberthing manoeuvring area, port and anchorage (Figure 5).

The port is the ship's berthed location. The berthing-unberthing manoeuvring area comprises the areas of the sea between the pilot station and the berth, while the anchorage area comprises the areas where ships drop anchor. The channel area comprises narrow passages, straits, and channels. Coastal waters include the areas of the sea other than the ones mentioned above, and encompass the area extending up to 12 miles away from the closest coast. Within the context of this study, areas of the sea that are more than 12 miles away from the closest coast are described as open sea. Table 4 indicates the distribution of oil tanker accidents according to the type of navigational sea area.

Accidents that occurred in coastal areas may be described as accidents that occurred while in channel passage, berthing-unberthing manoeuvring area, anchorage, and port and coastal waters. Accordingly, the total number of accidents that occurred in coastal areas is 289, and the total number of accidents that occurred in open sea is only 90. Therefore, it may be concluded that the highest risk areas for oil tanker marine accidents are coastal areas, and among these areas, the navigational sea area with highest accident incident rates were channels.

6.1 (b) Ship Tonnage

In the study, the association between marine accidents involving oil tankers and ship tonnages was also evaluated. For this purpose, oil tankers were divided into six groups based on their tonnages, namely, small tankers, Handysize tankers, Handymax tankers, Panamax tankers, Aframax tankers and Suezmax tankers. An analysis of marine accidents data revealed that 42% of accidents involving oil tankers were related to small tankers. Oil tankers with this tonnage are designed for product transportation and economically they are tankers that are used for short sea shipping. 14.7% of marine accidents involve Handysize tankers. Handysize tankers are mainly engaged in the transportation of oil products, although they can be employed in short haul crude oil transportation as well [34-35] In this study, it was determined that small tankers and Handysize tankers have the highest marine accident rates (Table 5). These ship types are also of important in terms of their voyage regions. Economically, these types of ships are engaged in short sea shipping. Consequently, it may be concluded that oil tanker accident incident rates are high for tankers engaged in short sea shipping.

6.1 (c) Collision

The collision is an accident category with the highest risk involving oil tankers. Regarding accidents related to oil tankers, 31.6% are very serious accidents and 60.8% are serious accidents. Navigation areas with highest risk for collision accidents are channels, berthing-unberthing maneuvering areas and open seas, respectively. 77% of factors that lead to collision accidents are human-induced. According to marine accident reports, the most important factors that lead to collision accidents involving oil tankers include the breach of COLREG look-out (Rule 5), safe speed (Rule 6), efficient usage of bridge navigation equipment to avoid collision (Rules 6,7,8,19), sufficient sea room to avoid collision (Rule 8), manoeuvring of vessels on head on situation (Rule 14), crossing situation (Rule 15), manoeuvring and warning signals for avoid collision (Rule 34), and sound signals is to be used in restricted visibility (Rule 35). In addition to above COLREG rules environmental restrictions (such as shallow water, strong coastal lights, narrow passageways and bad weather conditions) are also negatively affect navigation [9]. 37.5% of collision accidents involving oil tankers are related to small tankers and 14% are related to Handysize tankers.

6.1 (d) Grounding

Grounding is an accident category with second-degree risk related to oil tankers. Regarding accidents related to oil tankers, 15.8% are very serious accidents and 79.2% are serious accidents. Navigational sea area types with highest risk for grounding accidents are channels, coastal waters, and berthing-unberthing manoeuvring areas, respectively. Although pilotage services are received during berthing-unberthing manoeuvres, berthing-unberthing manoeuvres rank among risky navigation types both for collision and grounding accidents. The primary reason for this is the lack of coordination and communication by the bridge resource management (BRM). 81% of factors that lead to grounding accidents are human-induced. The most important factors that lead to grounding accidents involving oil tankers include lack of communication and interpretation errors by the BRM, machinery breakdowns, bad weather conditions, environmental restrictions that affect navigation, inappropriate map usage, and keeping echosounder in the off position in shallow waters [9]. 33% of grounding accidents involving oil tankers are related to small tankers and 22% are related to Handysize tankers.

6.1 (e) Fire and Explosion

The fire and explosion is an accident category with third-degree risk related to oil tankers. 59% of fire and explosion accidents related to oil tankers are very serious accidents and 39.3% are serious accidents. Therefore, it is seen that the consequences of fire and explosion accidents related to oil tankers are great. Fire and explosion accidents related to oil tankers frequently occur during operations at ports. Key factors that lead to fire and explosion accidents involving oil tankers include the inappropriate use of equipment, hot work, inflammable gas accumulation, cargo leakage, and sparks.

6.1 (f) Damage to Ship or Equipment

Damage to Ship or Equipment is an accident category with fourth-degree risk related to oil tankers. Damage to Ship or Equipment includes accidents such as mechanical and steering failure that render the ship unsuitable for navigation. Nearly 95% of these accidents have resulted in economic losses. Sea areas where incident rates for such accidents are high are open seas. Basic factors that lead to accidents include bad weather conditions, worn-out/deformed ships, equipment structure, and machinery breakdown.

7. RESULTS AND DISCUSSION

Determining very high and high risk marine accident areas is crucial to identify the necessary safety measures to avoid the occurrence of such accidents in these accident areas. However, moderate risk marine accident areas should not be underestimated since these accident areas are candidates to host high risk accidents. As a result, this study contributed to the determination of risky sea areas for oil tankers. According to the results, very high risk areas for oil tanker marine accidents include the *Singapore Strait and Oresund*, and high risk areas are the *Bristol Channel, Suez Channel, Straits of Hormuz, Great Belt, Piraeus, Hull, İstanbul Strait*, *and* Amsterdam, respectively.

The study also established that oil tanker accidents are related to ship tonnage and navigational sea area type. In terms of navigational sea area type, it may be concluded that for oil tankers: channels are a high risk marine accident areas for collision and grounding accidents, ports are high risk marine accident areas for fire explosion, and open sea is a high risk marine accident area for sinking and flooding, ship equipment damage and for accidents in another category. In terms of accident consequences, the highest risk accident type in terms of economic loss and sea pollution is collision, and the highest risk accident type in terms of deaths and injuries are fire and explosion.

In terms of marine accidents related to oil tankers, risky ship tonnages include small tankers and Handysize tankers. 56.2% of accidents related to oil tankers involve small tankers and Handysize tankers. In terms of economy, these tankers are mostly engaged in short sea shipping. Thus it may be assessed that short sea shipping is one of the factors that impacts marine accident occurrences related to oil tankers.

8. CONCLUSION

The greatest danger in oil tanker transportation is the transported cargo and the consequences of accidents that may be destructive. For this reason, the determination of high risk accident areas is vital to prevent the occurrence of such accidents since the probability for oil tanker accidents to occur in risky marine accident areas is high. The fact that marine accident incident rates are high in risky marine accident areas reveals an association between accidents and their causes. Determining and analyzing areas with high accident incident rates [35] is an important step that aims to prevent the occurrence of marine accidents.

GIS results showed that the most marine accidents occurred at North European areas (%25). The most accidents in North Europe were happened at *Baltic Sea, Bristol Channel and English Channel* respectively. The most seen accident types were as follows collision and grounding respectively. As a result of this study, it can be concluded that oil tanker accidents were concentrated coastal areas such as *Oresund, Great Belt, Piraeus, Hull and Amsterdam,* and narrow waters such as *Singapore Strait, Bristol Channel, Suez Channel, Strait of Hormuz and İstanbul Strait.*

GIS are an important tool in tracking and mapping marine accidents. Accordingly, it is required that the utilization of GIS in the maritime area is generalized, and more detailed studies are conducted based on accident incident rates and types

In this study, high risk marine accident areas with high accident incident rates related to oil tankers were determined and common factors which trigger accident occurrences were shown. As a result of this study, it was found that oil tanker accidents are associated with ship tonnages and navigation types. 52% of collisions and 55% of groundings were made by small and handy size tankers. Therefore, it can be concluded that short sea shipping is the most risky shipping type.

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10. FIGURES AND TABLES

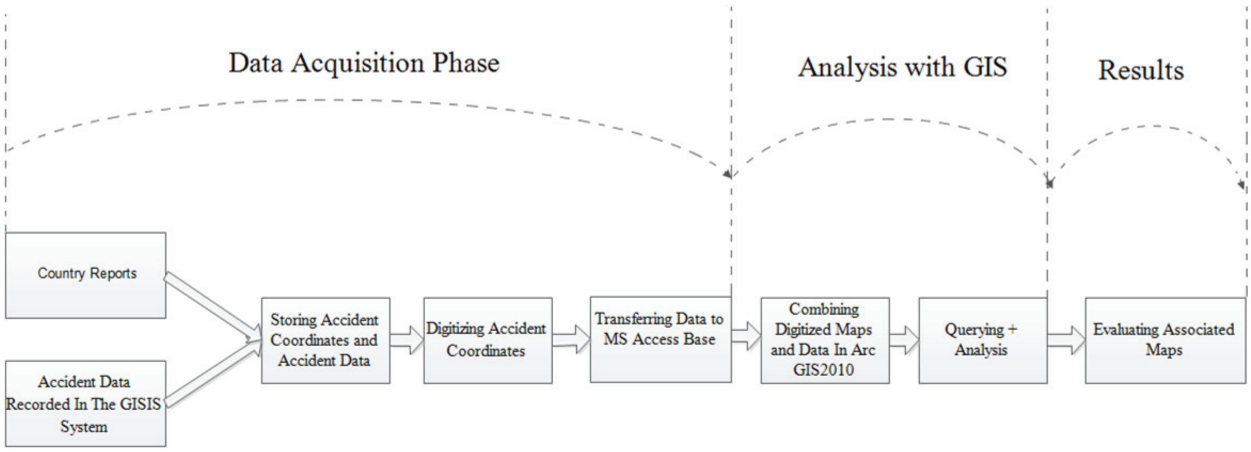


Figure 1. Phased implementation of GIS

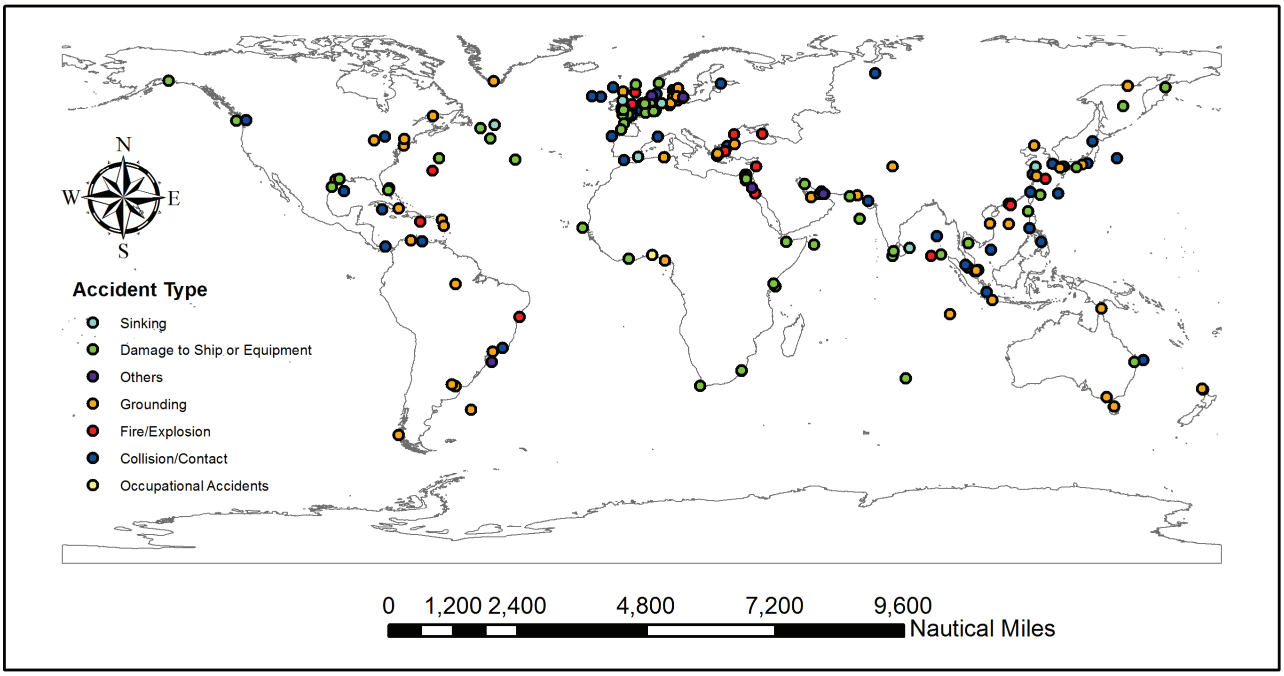
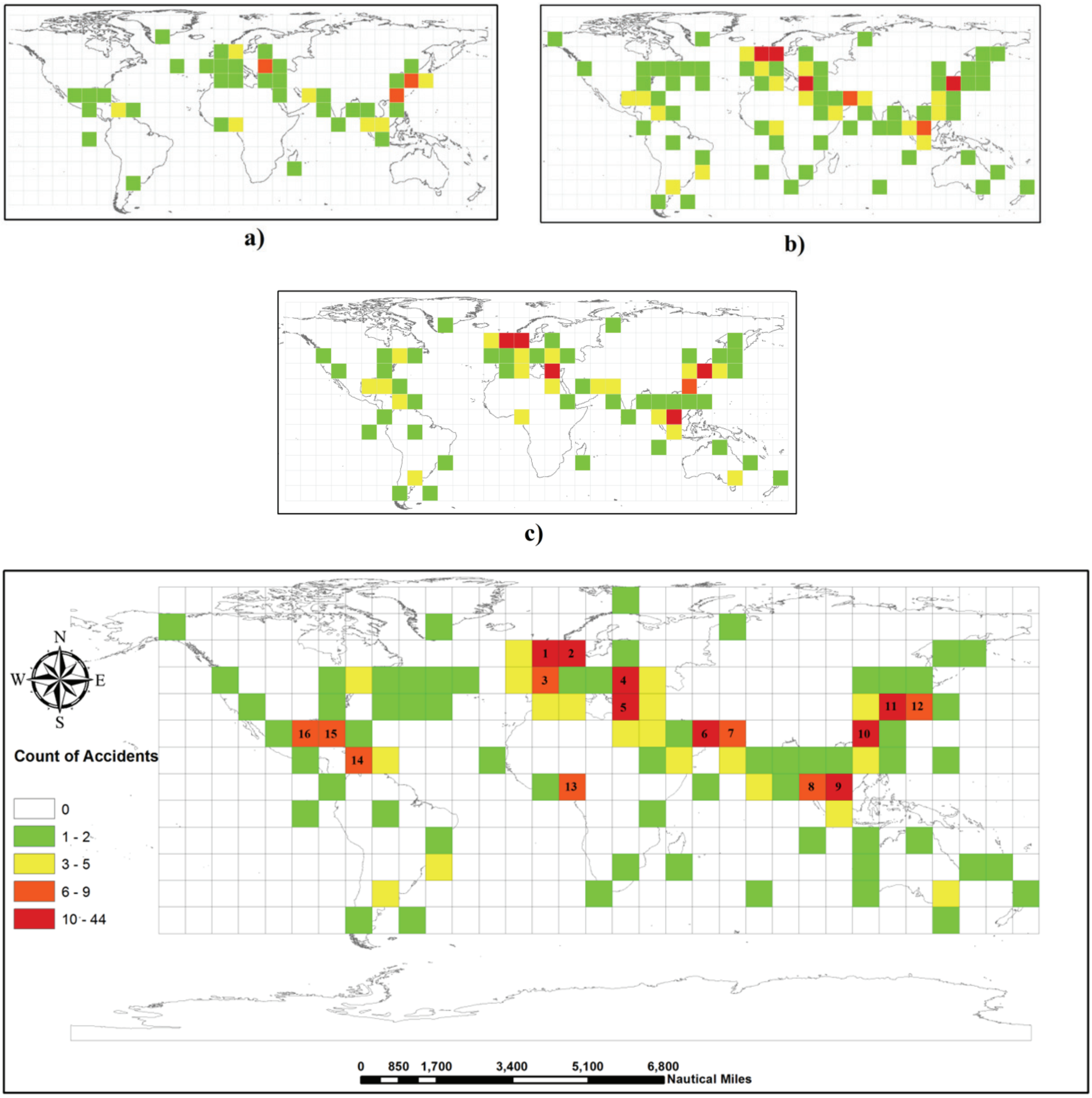
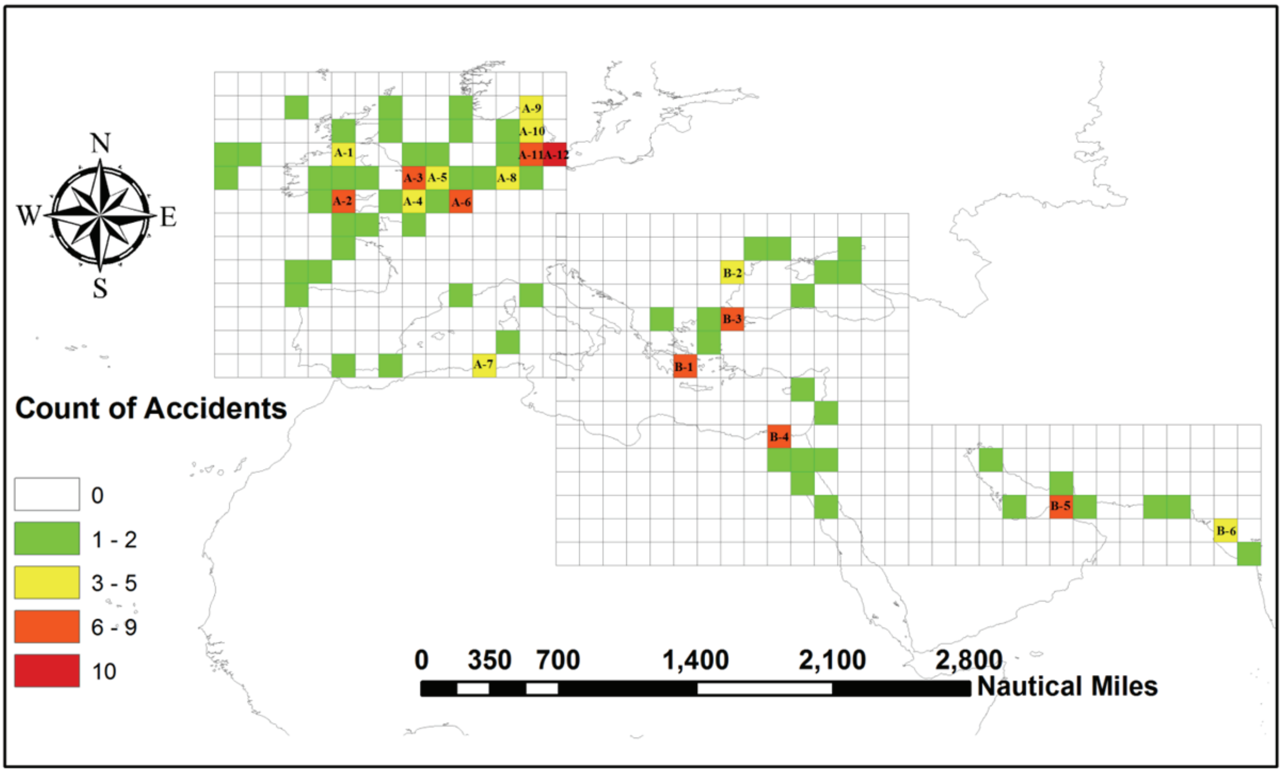


Figure 2. Spatial distribution of oil tanker accidents according to accident type

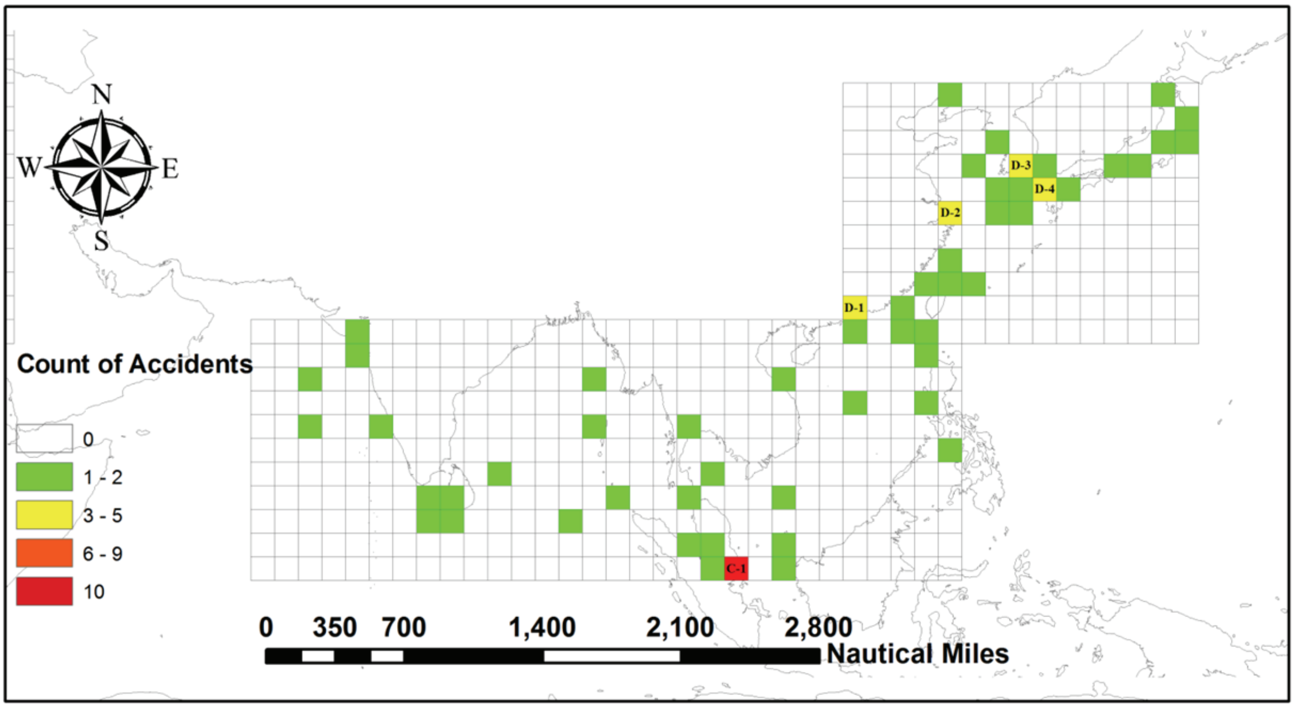


d)

Figure 3. Risky marine accident areas: a) very serious accidents b) serious accidents c) collision and grounding accidents and d) total number of accidents



a)



b)

Figure 4. Determination of risky marine accident positions for a) A and B coded marine accident areas b) C and D coded marine accident areas

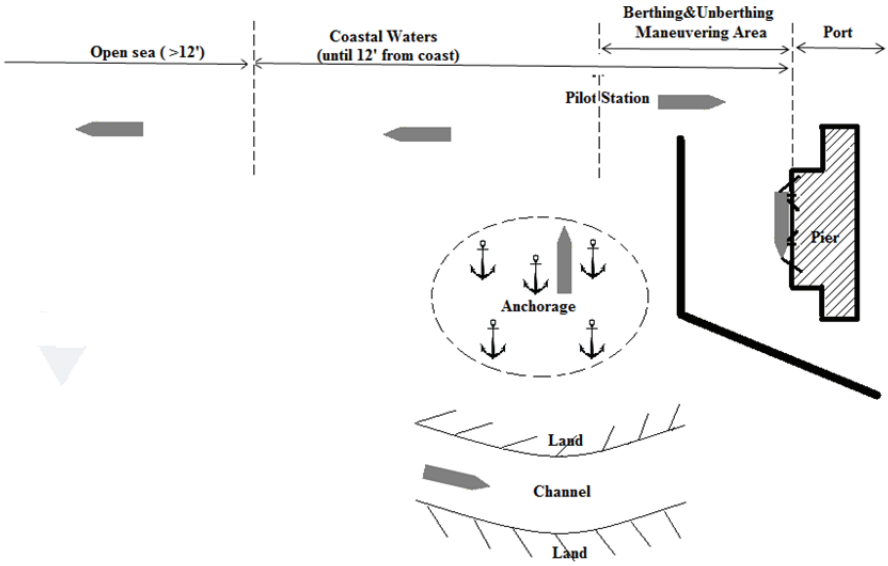


Figure 5. Description of navigational sea areas

Table 1. Distribution of oil tanker accidents according to risk category

		Accident Category			
Polygon Number	*Marine Accident Area*	*General*	*Collision& Grounding*	*Very Serious Accident*	*Serious Accident*
1	*North West Europe*	*VHR*	*VHR*	*MR*	*VHR*
2	*North Europe*	*VHR*	*VHR*	*LR*	*VHR*
3	*West Europe*	*HR*	*LR*	*LR*	*MR*
4	*Black Sea*	*VHR*	*MR*	*HR*	*MR*
5	*East* Mediterranean	*VHR*	*VHR*	*LR*	*VHR*
6	*Arabian Peninsula*	*VHR*	*MR*	*MR*	*HR*
7	*Arabian Sea*	*HR*	*MR*	*LR*	*MR*
8	*Off the coast of Malaysia&Indonesia*	*HR*	*MR*	*MR*	*MR*
9	*Off the coast of Singapore*	*VHR*	*VHR*	*MR*	*HR*
10	*Off the coast of* Taiwan&Hong Kong	*VHR*	*HR*	*HR*	*MR*
11	*Off the coast of South Korea-Japan* (West Coast)	*VHR*	*VHR*	*HR*	*VHR*
12	*Off the coast of South Korea-Japan* (East Coast)	*HR*	*MR*	*MR*	*LR*
13	*South West Africa*	*HR*	*MR*	*MR*	*MR*
14	*Caribbean Sea*	*HR*	*MR*	LR	*MR*
15	*Gulf of Mexico (East Coast)*	*HR*	*MR*	LR	*MR*
16	*Gulf of Mexico (West Coast)*	*HR*	*MR*	LR	*MR*

Table 2. Distribution of marine accidents according to polygons

Polygon	*Polygon Number*	*Marine Accident Area*	*Accident Risk*	*Polygon Number*	*Marine Accident Area*	*Accident Risk*
A	*A-1*	*Belfast*	*MR*	*A-7*	*Skikda*	*MR*
	A-2	*Bristol Channel*	*HR*	*A-8*	*Hamburg*	*MR*
	A-3	*Hull*	*HR*	*A-9*	*Skagerrak*	*MR*
	A-4	*Dover Channel*	*MR*	*A-10*	*Kattegat*	*MR*
	A-5	*North Part of Dover Channel (North Sea)*	*MR*	*A-11*	*Great Belt*	*HR*
	A-6	*Amsterdam*	*HR*	*A-12*	*Oresund*	*VHR*
B	*B-1*	*Piraeus*	*HR*	*B-4*	*Suez Chanel*	*HR*
	B-2	*Constanta*	*MR*	*B-5*	*Hormuz Chanel*	*HR*
	B-3	*İstanbul Strait*	*HR*	*B-6*	*Ahmedabad*	*MR*
C	*C-1*	*Strait of Singapore*	*VHR*			
D	*D-1*	*Hong Kong*	*MR*	*D-3*	*Busan*	*MR*
	D-2	*Shanghai*	*MR*	*D-4*	*Kanmon Strait*	*MR*

Table 3. Distribution of oil tanker accidents according to accident results and scopes

Accident Category	Type of Accident	Economic Loss	Death-Injury	Pollution	TOTAL
Collision/Contact	Very Serious Accidents	23	11	4	38
	Serious Accidents	67	5	3	75
	Less Serious Accidents	9	--	--	9
Grounding	Very Serious Accidents	8	1	4	13
	Serious Accidents	64	--	3	67
	Less Serious Accidents	4	--	--	4
Fire/Explosion	Very Serious Accidents	8	28	--	36
	Serious Accidents	21	3	--	24
	Less Serious Accidents	1	--	--	1
Sinking/Floading	Very Serious Accidents	6	6	6	18
	Serious Accidents	7	--	--	7
	Less Serious Accidents	--	--	--	--
Damage to Ship or Equipment	Very Serious Accidents	3	--	--	3
	Serious Accidents	47	2	1	50
	Less Serious Accidents	4	--	--	4
Occupational Accidents	Very Serious Accidents	--	12	--	12
	Serious Accidents	1	3	--	4
	Less Serious Accidents	--	--	--	--
Others	Very Serious Accidents	3	4	--	7
	Serious Accidents	6	--	1	7
	Less Serious Accidents	--	--	--	--
TOTAL		282	75	22	379

Table 4. Distribution of oil tanker accidents according to navigational sea area type

	Types of navigational sea area					
		Coastal Area				
Accident Category	Open Sea	Coastal Waters	Channel	Berthing Unberthing Manoeuvring Area	Anchorage	Port
Collision/Contact	27	18	37	27	11	--
Grounding	1	19	33	18	9	2
Fire/Explosion	11	9	4	--	7	30
Sinking/Floading	13	7	4	--	1	--
Damage to Ship or Equipment	27	14	7	1	5	3
Occupational Accidents	5	3	--	1	1	9
Others	6	3	1	2	--	3
TOTAL	90	73	86	49	34	47

Table 5. Distribution of oil tanker accidents according to ship tonnage

Types of Casualties	Types of Ship					
	Small Tankers	Handysize Tankers	Handymax Tankers	Panamax Tankers	Aframax Tanker	Suezmax Tanker
Collision	45	17	13	12	14	19
Grounding	27	18	12	14	10	1
Fire and Explosion	27	13	8	5	3	5
Sinking and Flooding	15	5	1	2	-	2
Damage to Ship or Equipment	24	8	6	7	6	6
Occupational Accidents	5	5	3	2	3	1
Others	3	1	3	3	3	2
Total	146	67	46	45	39	36

