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Article

Analysis of ship accident resulting from bad weather conditions in the port of Khor Al-Zubair, Iraqi crane accident Aba Thar: a case study

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ABSTRACT

The Arabian Gulf region is regarded as one of the world's most significant commercial areas, with large-scale and continuous marine shipments of commodities and goods to and from the Gulf. Iraqi ports are one of the most important ports in the Gulf, and they are a vital source of revenue for the Iraqi economy because of the money they bring in, as any stoppage of operations or damage to the ports may lead Iraq to lose a significant amount of money and halt shipping operations. Maritime accidents are one of the most significant concerns that have resulted in the suspension of maritime navigation and loading and unloading activities in Iraqi ports since there are various forms of marine accidents and many causes. With this study, we will look at maritime accidents caused by bad weather, as there have been many recent marine mishaps and ship collisions caused by bad weather, resulting in the loss of life and equipment and halting marine activities. We'll look at a few incidents, the meteorological conditions that contribute to them, and the link between them and the most likely cause of the accident. We will study an accident that occurred in the port of Khor Al-Zubair in 2018, which is considered one of the most important ports of Iraq, as it contains berths for importing and exporting goods, as well as on many of the Iraqi oil export berths, the accident of the Iraqi crane, Aba Thar. This report advises Iraqi port officials to limit activity in severe weather to reduce accidents that lead to loss of life and equipment and significant economic losses to the country.

Keywords: Khor Al-Zubair, Maritime accidents, Aba Thar, Bad weather, The Arabian Gulf

INTRODUCTION

The Arabian Gulf is a tropical arm of the Arabian Sea surrounded by eight countries: Iran, Iraq, Kuwait, Saudi Arabia (SA), Bahrain, Qatar, the United Arab Emirates (UAE), and Oman. It has a surface area of 239,000 km2, an average depth of 36 meters, and a volume of 8,630 km3 on average[1]. The Arabian Gulf is considered to have the world's greatest oil reservoir[2]. It covers 239,000 km2, with

an average depth of 36 meters and a volume of 8,630 km3[3]. Each year, 53,000 ships are expected to sail through the Straits of Hormuz into the Gulf for oil transport [5].

During the summer, the dry environment encourages a tropical climate. The winter season lasts from December to March, while the summer season lasts from June to September, with two transition periods in between. Summer air temperatures as high as 51°C (average: 41°C) and winter air temperatures as low as 15°C create a wide annual SST range throughout; northwestern wind events typically last 1 to 5 days and are highly seasonal, occurring in both winter and summer, with the strongest and most persistent events occurring between November and March [6]. They're related to frontal systems in the mid-latitudinal region [7]., particularly in the northern Gulf, can result in sand and dust storms and reduce air temperature[8]. Weather conditions are one of the most important factors affecting maritime navigation, ship movement, and movement in the seas, oceans and ports, as well as loading and unloading operations in ports.

Among the most important weather conditions affecting marine work is the increase in wind speed, wave height, fog limiting visibility, dust storms, rain storms, and others. Harsh weather conditions can lead to many negative things in maritime work, resulting in marine accidents, whether between the ships or between ships and ports. For ship operators and owners, bad weather and collateral effects on ships, from the intensity of sea waves and wind strength, can delay the time of ships' arrival at the desired destination. They can cause a lot of stops and a decrease in ship speed. The captain of the ship and the personnel in command of the ship must be fully aware and have information about the weather for the coming days. Until the time of the ship's arrival at the required port, they must be prepared and take all precautions for the upcoming weather conditions. Wind and waves are major environmental phenomena affecting maritime constructions and ships. Because of their presence, the design of those structures differs greatly from that of structures on land.

MATERIALS AND METHODS

Study Area

It is one of the most important marine areas in Iraq and the Arabian Gulf in terms of economic and strategic importance, as well as being a major site in which goods are transported from the world’s ports to Iraq and thus to the rest of the countries and vice versa as well as the transfer of Iraqi oil from Iraqi ports to the rest of the world by ships. We chose the study area north of the Arabian Gulf in the Iraqi port of Khor Al-Zubair. This site is also widely used for various reasons, including navigation, industry, fishing, oil transportation, and oil production operations. Tidal currents play an important role in various ways, acting as a primary driver of physical processes in the study area and ensuring the continuous exchange of water masses with The Arabian Gulf. The Iraqi ports are among the most important ports in the Arabian Gulf because of their important geographical location, located in the northwest of the Arabian Gulf and is a link between Asia and Europe, where goods are transported from the Gulf to Europe through Iraq and Turkey. Khor Abdullah (KA) and Khor Al-Zubair (KZ), located at the northwest tip of the Arabian Gulf, are the most important parts of Iraqi marine water, used for a variety of purposes, including navigation, industries, fisheries, oil transportation, and more recently, oil production processes in southern Iraq. Iraqi marine waters include the Shatt AL-Arab estuary and various open lagoons such as Khor Al-Kafka, Khor Al-Amaya, and Khor Abdullah, located in the northwestern of the Arabian Gulf[10].

Khor Abdulla channel is about 40 kilometers long and 17 kilometers wide at its confluence with the Arabian Gulf, and it narrows to about 6.5 kilometers south of Warba island when it forms Khor Bobian, which connects it to Khor Al-Subia and Khor Al-Zubair, which extend to the northwest of Iraqi territory[12]. The region's environment is characterized by an arid desert climate with two distinct seasons: summer, which is hot and lengthy, and winter, which is cold and wet. The area has two prevalent winds: northwest winds, which generate dust storms in the summer and are known locally as Al-Shammal, a region feature, and southeast winds, which are quite warm and wet and occasionally bring rainy clouds[13]. Tidal currents play an essential role in various ways, serving as the primary driver of physical processes in the study region and ensuring the continual interchange of water masses with the Arabian Gulf [12]. Whereas the accident of the Aba Thar crane in the port of Khor Al-Zubair at the position 30°11'27.69"N, 47°53'29.10"E.

Accident Date	Accident Name	The Accident Location	Weather Station Name
4/12/2018	Iraqi crane accident Aba Thar	Khor Al Zubair port 30°11'27.69" N, 47°53'29.10"E	Hay Al-Hussein Station

Table 1. The information about ship accidents in this study.

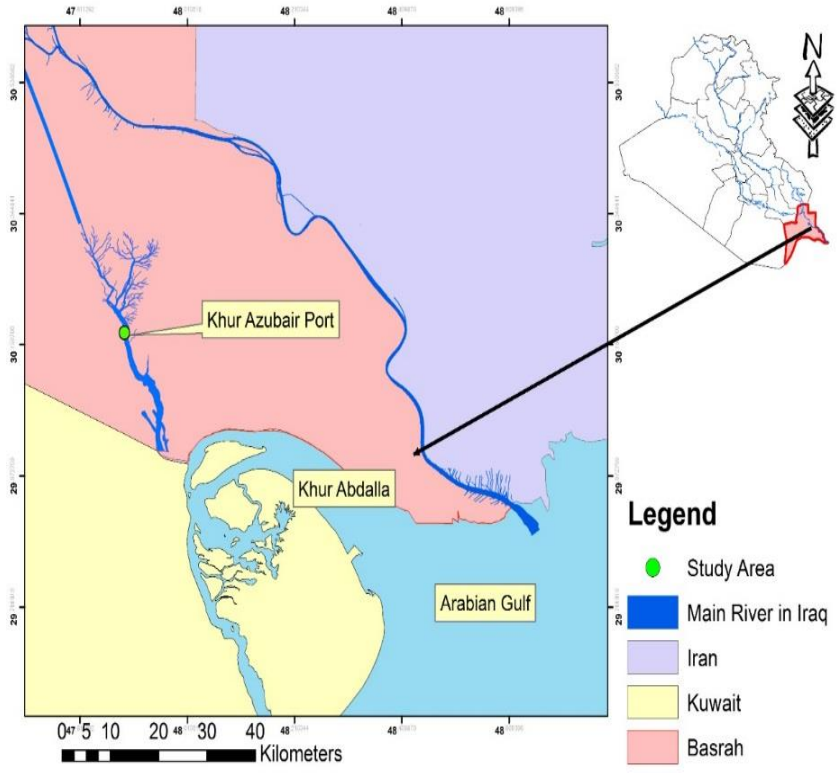


Figure 1. A map showing the location of the Khor Al-Zubair port in the city of Basra.

Data Analysis

Umm, Qasr coastal station is considered one of the most important stations in the Iraqi ports, located in the northern port of Umm Qasr. Its importance lies in the information, weather bulletins and navigational warnings it provides to local and foreign ships located in Iraqi ports, and its work includes the weather forecast that is prepared by the Division of Meteorology and Maritime Monitoring Affiliated to the General Company for the Iraqi ports through

Forecasters and monitoring devices are located in the two extreme stations of the Meteorological Division, which are Al-Hussein Station and Al-Faw Station. The weather forecast arrives by e-mail from the weather stations to the Umm Qasr coastal station. The weather forecast is downloaded into the navtex transmitter and sent to ships 6 times a day every 4 hours and received through the navtex receiver on the ships. Thus, the bulletin can be read by the device's display screen and pulled out on paper. Weather conditions are one of the most important things that must be known to workers on board ships to take important precautions and measures to avoid bad weather, as it is impossible to sail and navigate the seas only after a sailing plan is drawn up. The weather conditions are known for the next destination. Meteorological data from the General Company for Ports of Iraq / Hay Al Hussein station were used. The data of Basra, where the Iraqi ports are located, were taken for three days for each accident: before the day of the accident, the day of the accident and the day after it. Hourly weather data includes wind speed and direction, temperature, sea surface pressure, relative humidity, visibility, dew, wet thermometer temperature, vapor pressure, and daily and monthly frequency data for rainstorms, dust storms, raised dust, and fog. In this study, the data is analyzed to determine the extent of its impact on the movement of ships and its relationship to marine accidents in Iraqi ports.

RESULTS

In this study, we will analyze the weather conditions associated with an accident in the port of Khor Al-Zubair in 2018, where this accident was recorded according to the occurrence of weather factors and their impact on maritime navigation:

Iraqi crane accident Aba Thar

Weather conditions worsened on 4/12/2018 in the port of Khor Al-Zubair (30°11'27.69"N, 47°53'29.10"E and the wind speed increased until it reached a rate of 80 to 90 knots according to the reading of the wind gauge located In The crane. The Aba Thar crane was fixed on four hooks near the target to be transferred to the ship cemetery in the port of Khor Al-Zubair, and due to the storm and tidal current, the crane drifted to the side of the docks at a speed of 5 knots, and the tugs contributed to saving the situation with minimal losses. However, the crane This was prevented by strong winds, storms and tidal currents until it collided with the tanker Tian E Zuo, resulting in a hole in the hull of the ship and leakage of water from the stabilization tanks without access to the oil tanks, a pollution disaster could have occurred in the waters, see Figure 2 (a, b).

(A)

(B)

Figure 2. a) The Iraqi crane, Aba Thar, b) the moment the crane collided with the ship.

Date	Average wind direction	Average wind speed (m/s)	Average temperature (ºC)	Average pressure at the sea surface (mbar)	Average relative humidity (RH %)	Average visibility (Km)	The dust (Number of hours per day)	thunderstorm with rain (Number of hours per day)
4/11/2018	101	5.6	27.4	1008.4	51.8	9.5	2	0
4/12/2018	152	3.5	22.2	1008.3	69.4	9.3	0	2
4/13/2018	339	2.3	25.3	1010.1	50.4	10.0	0	0

Table 2. The daily averages (three days) of meteorological data for accident Aba Thar.

3.1. Frequency of weather conditions for Iraqi crane accident Aba Thar

Hourly and daily frequencies were taken during the months of the year 2018 for dust storms, as well as for dust raised, rainy thunderstorms and fog for the city of Basra (study area) from the Al-Hussain neighborhood station in order to study these phenomena in the history of the accident 4/12/2018, where the focus was on harsh weather conditions affecting navigation Marine and ship accidents in the port of Khor Al Zubair. Figure 3 shows the daily frequency of dust storms, with one storm occurring in Basra in December 2018.

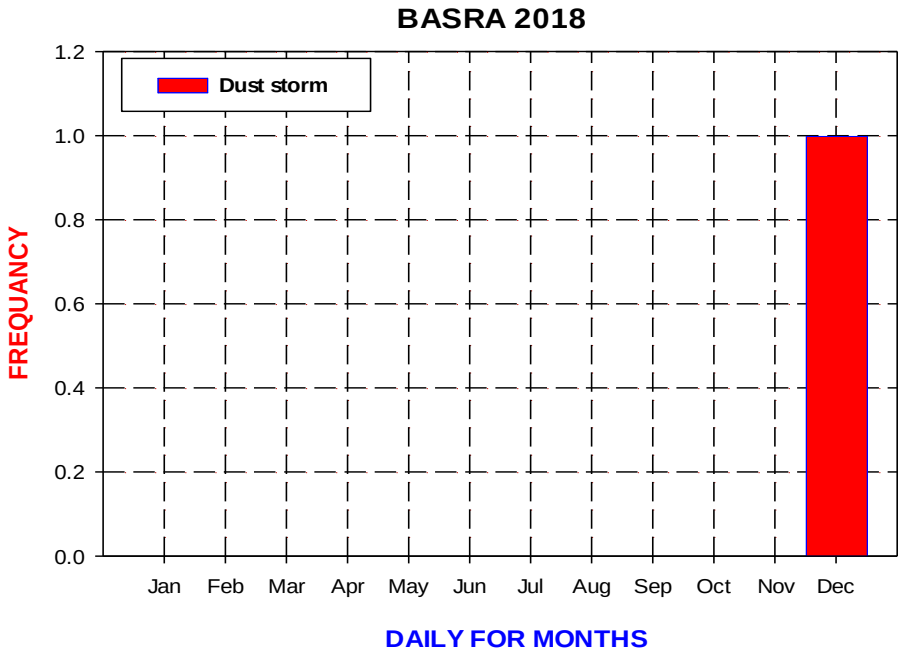


Figure 3. The daily frequency of dust storms for the city of Basra for 2018.

Figure 4 (a) shows the daily frequencies of dust raised during the months of the year, as it is clear that there are many cases of dust occurrence in months Jan, Feb and Mar; dust raised occurred once in each month and in month Apr dust occurred 5 times, which recorded in this month the highest According to him, in May, and Jul there was a case of dust raised 4 times, during the year of the accident of the crane collision in Aba Thar in 2018. Figure 4 (b) indicates the hourly frequencies of dust raised during the days, where the most frequent occurrences of dust raised were recorded on 4/27/2018, where dust frequencies reached 11 times during that day, and the lowest incidence of dust raised was on days 5/8 /2018 and 6/27/2018 where there was dust raised once a day.

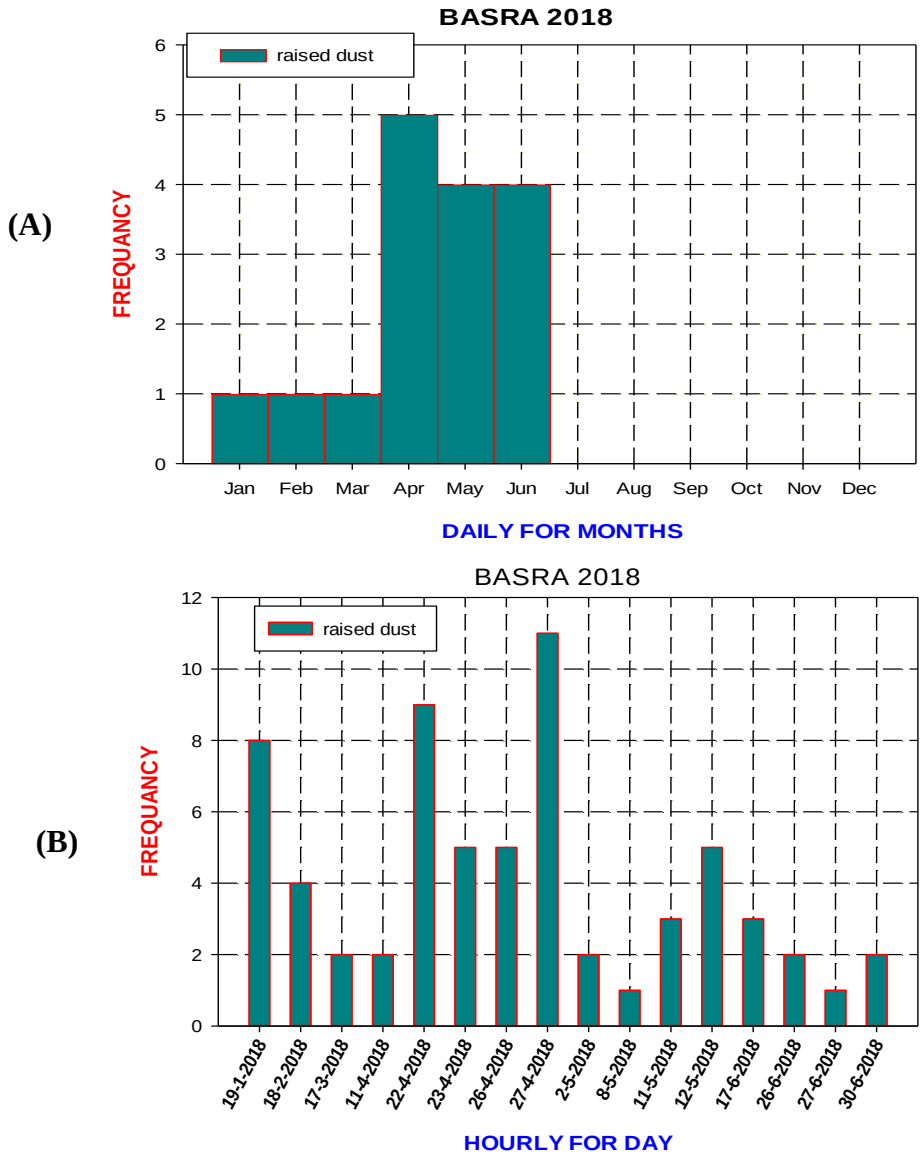
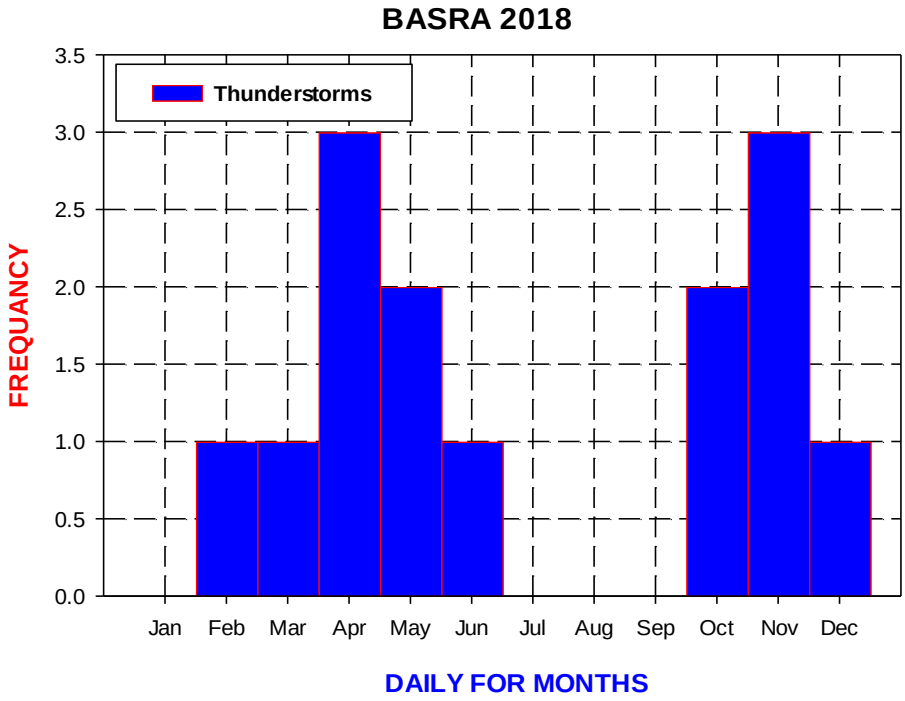


Figure 4. Frequencies of raised dust (a) daily and (b) hourly for Basra for 2018.

Figure 5 (a) shows the frequency of rainy thunderstorms daily throughout the year. According to the figure, one thunderstorm occurred in the following four months of 2018 (Feb-Mar-Jan-Dec), while a thunderstorm occurred in the next two months (May-Oct). In addition, the largest incidence of thunderstorms was observed in months (Apr and Nov), when the storms occurred three times a month. Strong thunderstorms occurred in April, which was also the month of the Aba Thar crane tragedy, indicating the scope and importance of these storms on seafaring and ship accidents. Figure 5 (b) shows the frequencies of rainy thunderstorms raised by the hour during the days, as the most frequent occurrence of thunderstorms was recorded on 5/9/2018, as rainstorms reached 6 times during that day. On the day of the accident, 4/12/2018, Twice thunderstorms occurred during the day and at the time of the accident, which led to the occurrence of high winds and heavy rain, which led to the loss of control of the crane, and the crane stuck with the oil tanker.

(a)



(b)

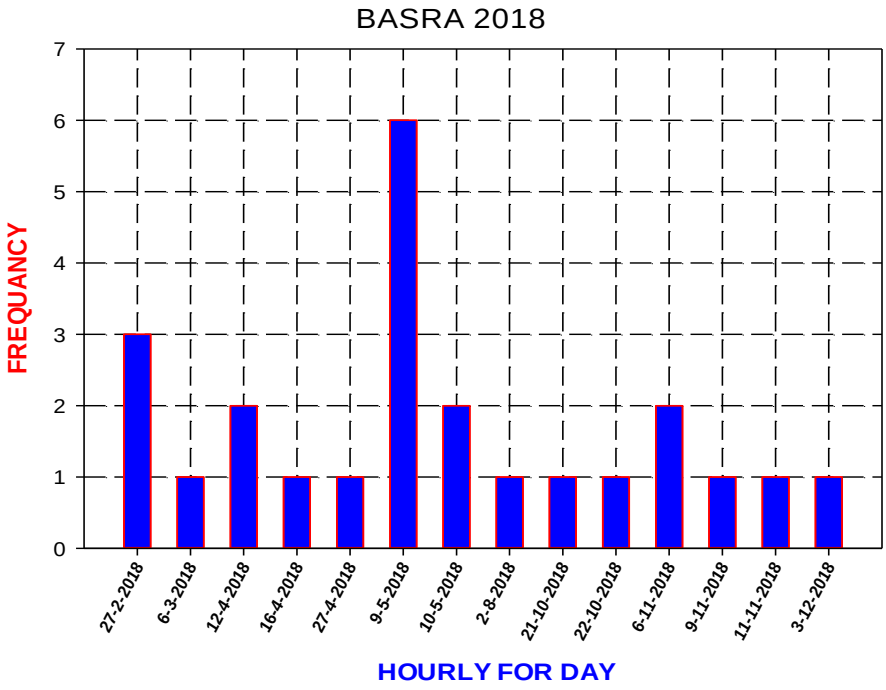
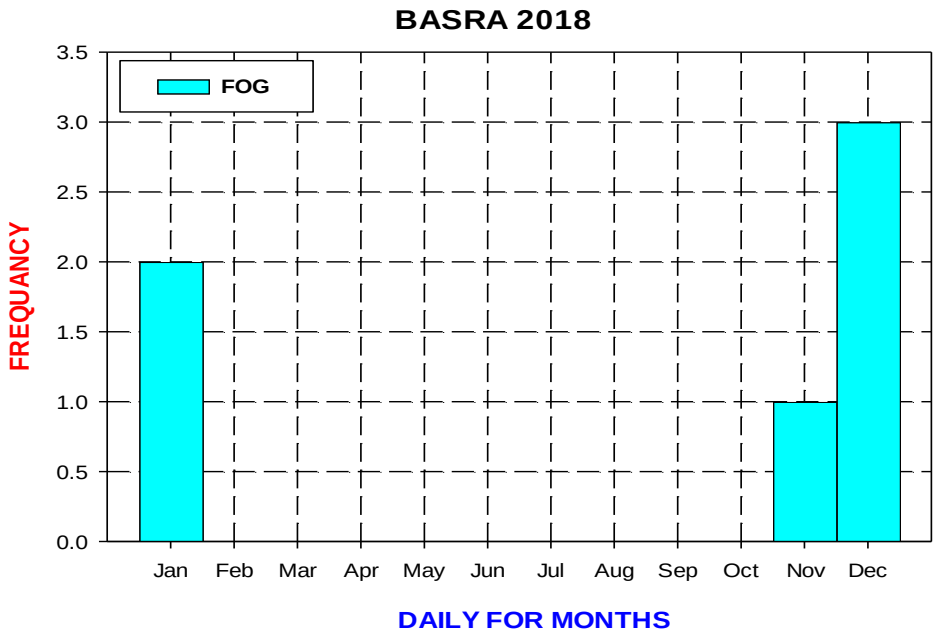


Figure 5. Frequencies of rainy thunderstorms (a) daily and (b) hourly for the city of basra for 2018.

Figure 6 (a) shows the daily frequency during the months of fog, where the occurrence of fog was recorded in three different months during the year 2018, the months (1-11-12), and Figure 6 (b) shows the hourly frequency of fog during the day, where the highest frequency of fog was recorded On 1/13/2018, fog

occurred six times on this day, and the lowest frequency was recorded on two days, 1/14/2018 and 12/26/2018, where fog occurred once during these days.

(a)



(b)

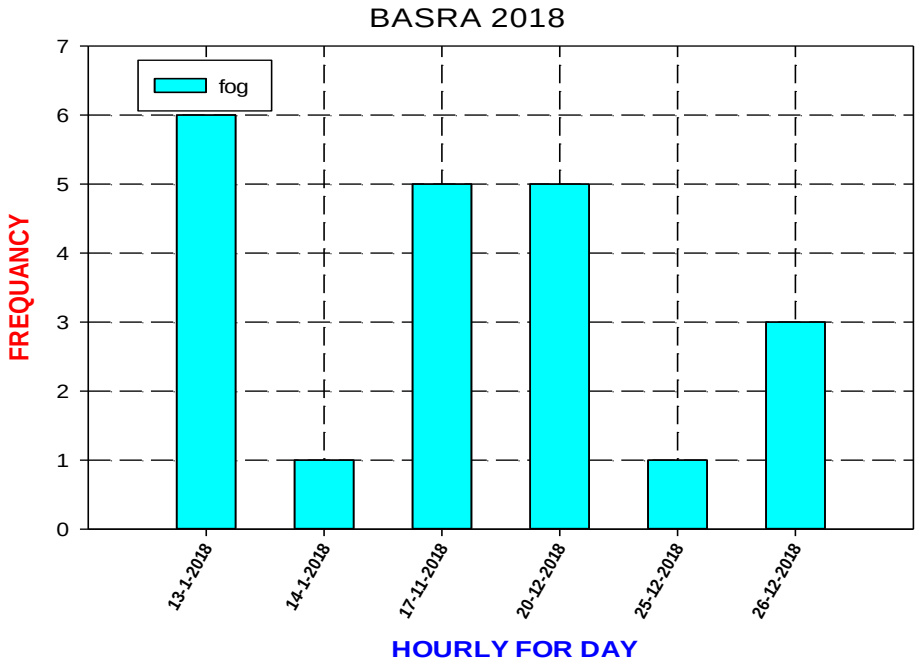


Figure 6. The fog's frequency is (a) daily and (b) hourly for the city of Basra for the year 2018.

Figure 7 shows the change in wind speed and direction during 2018 for the city of Basra, where it is clear that the lowest value of wind speed was between (0.8-1.6 m/s) and in the direction of the southwest, and the highest value of wind speed was in the direction of west-northwest, ranging between (4-4.8 m/s) It is also clear in the figure that the prevailing winds in the study area (Basra) are in a southwesterly direction.

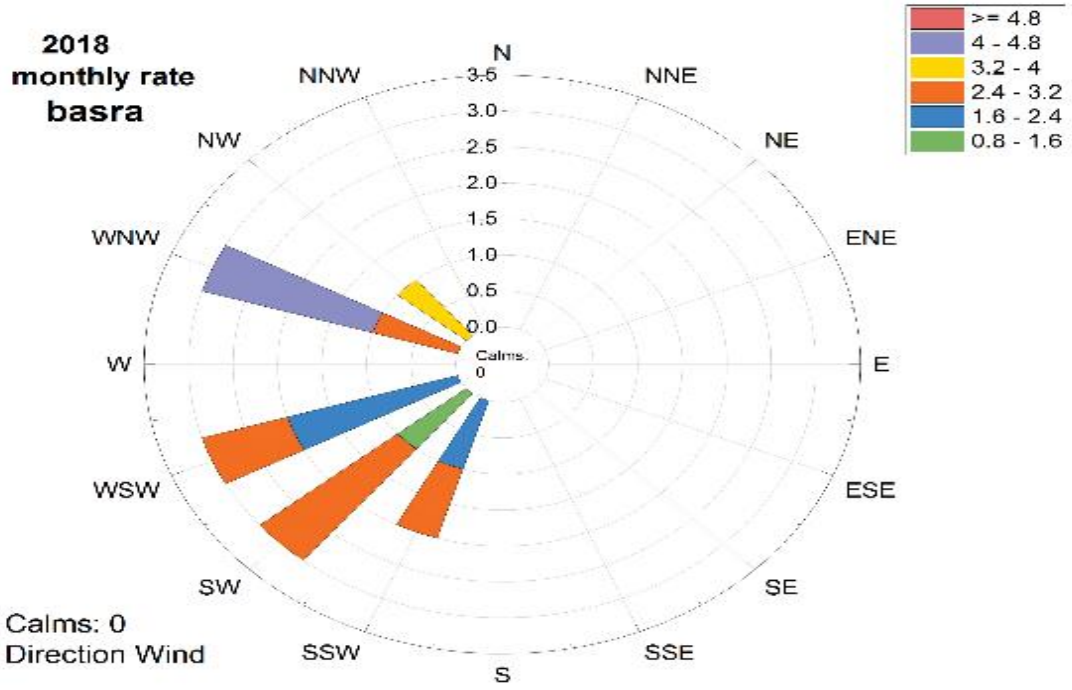


Figure 7. shows the analysis of the monthly wind speed data and direction for 2018 using the Wind Rose program.

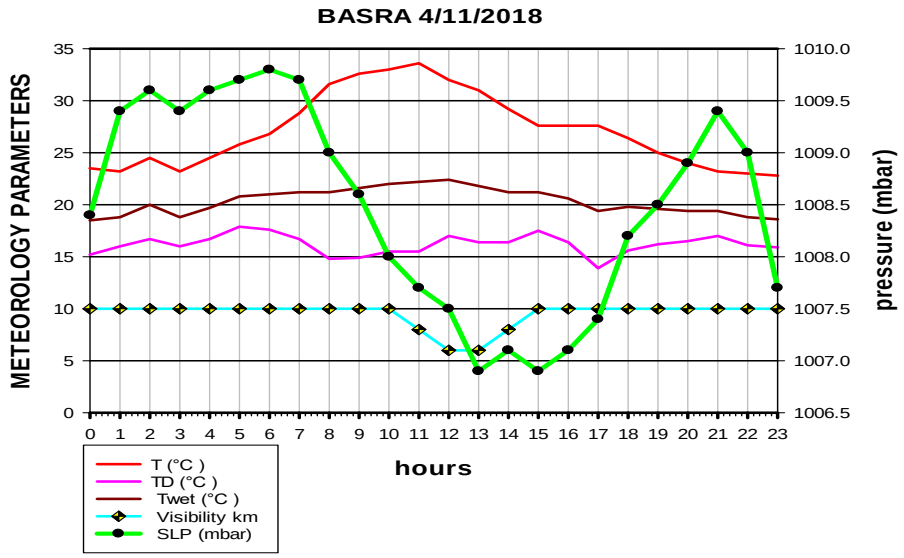
Hourly Change of Meteorological Factors for Iraqi Crane Accident Aba Thar Marine activities might be suspended or fully affected due to adverse weather, ranging from heavy rain to heat/cold waves, hail to fog and high winds. Accidents, delays, cruise cancellations, and other negative repercussions, such as increased costs and lower reliability, can all result from such situations. The following meteorological variables were investigated and evaluated (temperature °c- dew point temperature °c - wet thermometer temperature °c - visibility km - sea surface pressure mbar - Wind speed m/s and direction). Before the accident, on the day of the accident, and after the accident (11-12-13/4/2018), the hourly average of these factors was recorded. To clarify the difference or change in these weather factors between the three days, as a change in these factors is one of the primary causes of severe weather conditions such as thunderstorms, dust storms, fog, and raised dust, which obstruct vision and cause marine operations to be halted, as well as the possibility of collisions between ships within the ports and channels of the navy and seas.

Figure 8 (a)(b)(c) shows the analysis of the hourly changes of weather factors during three days, where (a) represents the hourly changes of weather factors before the day of the accident. We note the highest value of the sea level pressure was recorded at 0700 hrs, and it was 1009.8 mbar, and the lowest value was 1006.8 mbar at 1300 and 1500 hrs; we notice changes in pressure during one day. The average visibility was approximately 10 km during the day's hours, except in the hours 1200 and 1300 before the average visibility decreased to approximately 5 km; it is clear that the rate of vision decreases with the decrease in the pressure level. The highest value of the wet thermometer temperature was recorded at 1200 o'clock, where it was approximately equal to 22°c, and the lowest value was 18°c at 2300 o'clock. The value was 16°c at 1700, and the dew temperature measures atmospheric humidity. While the air temperature was at 1100 o'clock, it reached a degree of 33°c, and the lowest value was 23°c at 2300 o'clock.

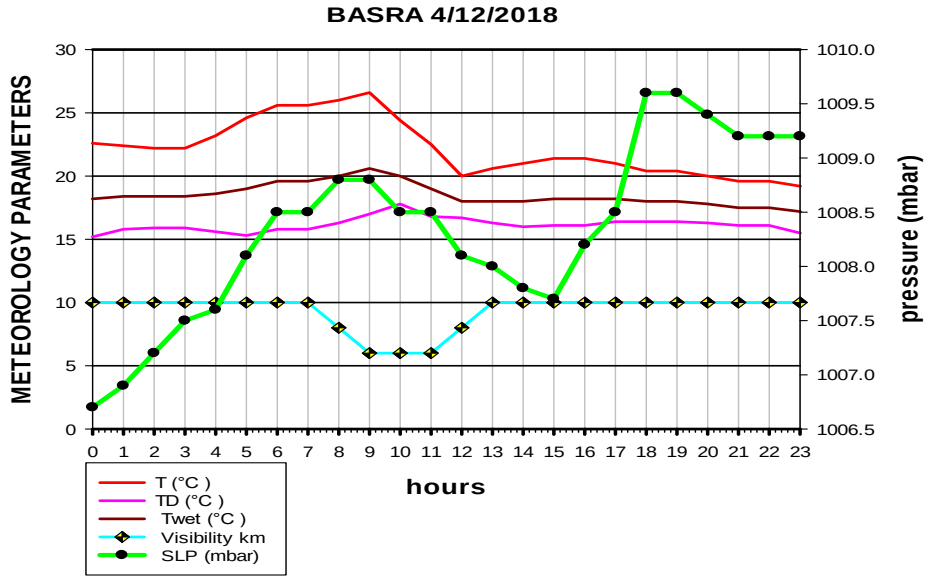
Figure 8 (b) depicts the hourly changes in weather factors on the day of the accident, where we can see that the sea level pressure has continued to fall since

the previous day, reaching a low of approximately 1006.7 bar at 0000 o'clock, which is similar to the previous day, and then rising to a high of approximately 1009.7 bar at 1800 o'clock. We can see that there are pressure changes in one day. The visibility rate continued at the same level on the previous day, approximately 10 km, during the first seven hours of the day of the accident. At 0800 hrs, the rate of vision decreased to approximately 8 km, and then at 0900, 1000 and 1100 hours became Approximately 5 km. Then, the average visibility returned to 10 km until the end of the day; that is, at 1000 hrs, the visibility rate decreased. There was also a decrease in sea level pressure, where the pressure reached approximately 1008.2 mbar, and also recorded at this time the highest dew temperature during this day, which reached almost 17°c Consequently, a high wind speed and a rainy thunderstorm occurred, which resulted in the crane drifting and moving uncontrollably towards the berths of Khor Al-Zubair port and colliding with the tanker anchored on the berth and causing a hole in the hull carrier. The highest value of the wet thermometer temperature was recorded during the day at 1000 o'clock, where it was approximately equal to 20°c, and the lowest value was 17°c at 2300 o'clock. The air temperature continued the same as the previous day and recorded its highest value at the time of the accident at 1000 hrs, and the lowest value was 15°c at 2300 hrs. On the third day, i.e., after the accident occurred on 4/13/2018, and as shown in figure (c), the sea level pressure continued at the same last hour on the previous day, where its value was approximately equal to 1009.5 mbar at 0000 hrs. The pressures continued to rise gradually to The highest value where the sea level pressure was 1011.7 mbar at 0800 hrs. The visibility rate continued at the same value as the last hours on the day of the accident until the end of this day, and its value was 10 km. The highest values were recorded during the day concerning (temperature Wet thermometer 19°c, dew temperature 16 °c and air temperature 32°c) at different times.

(A)



(B)



(C)

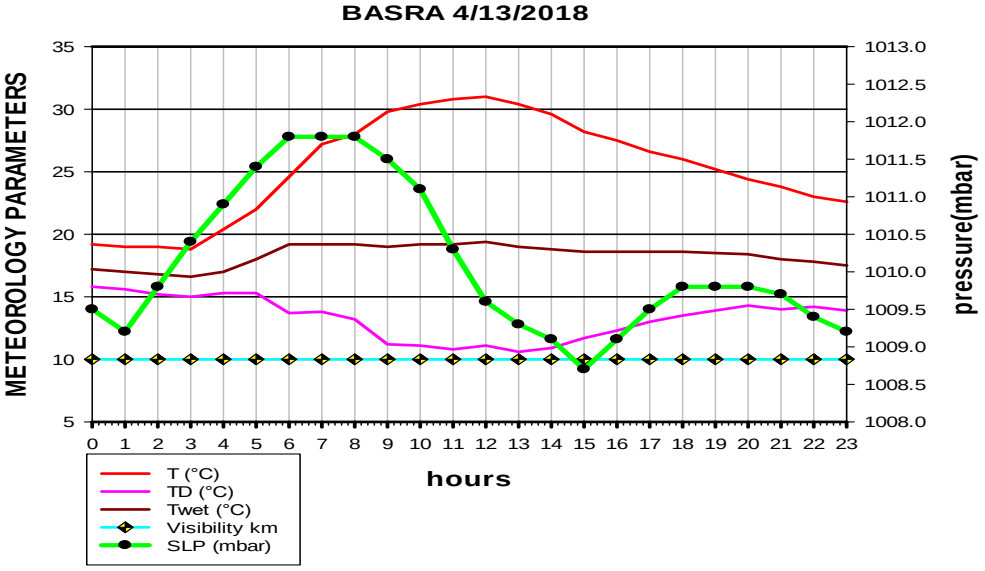
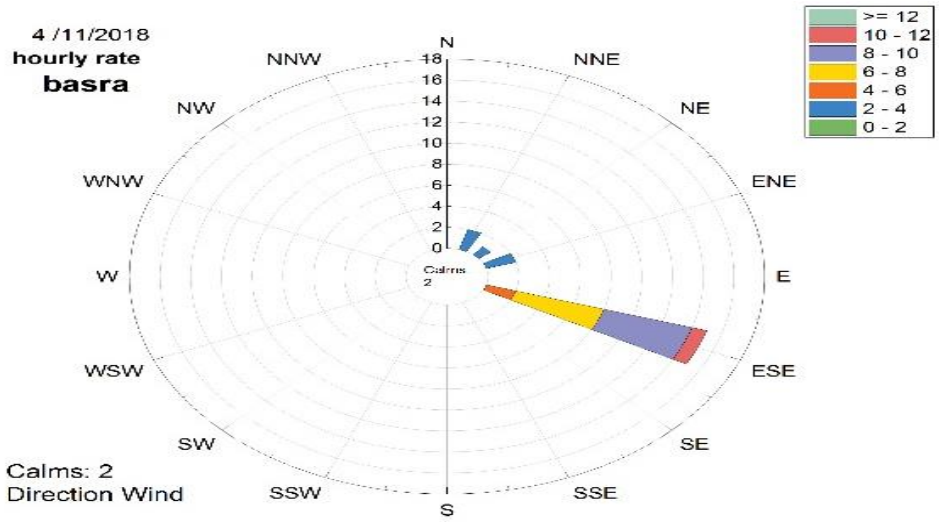
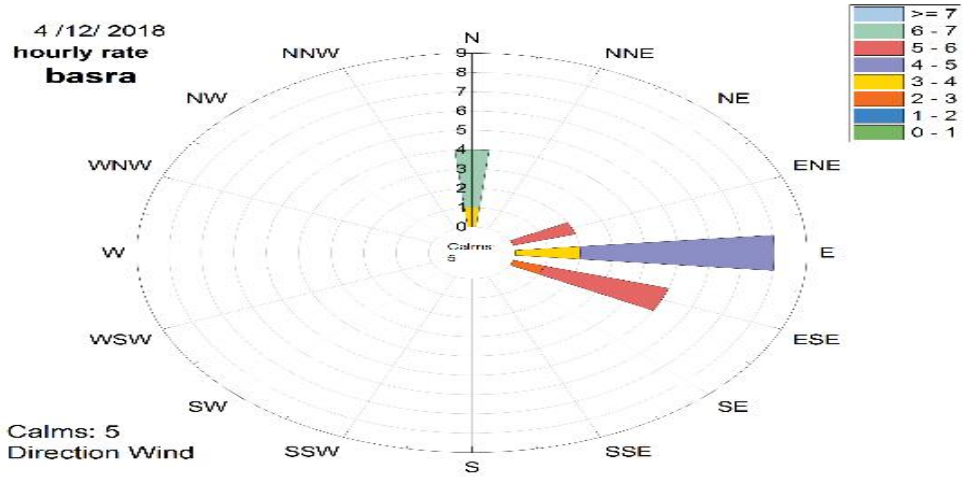


Figure 8. The hourly average analysis of weather factors for the days (11, 12, 13) April 2018.

(a)



(b)



(c)

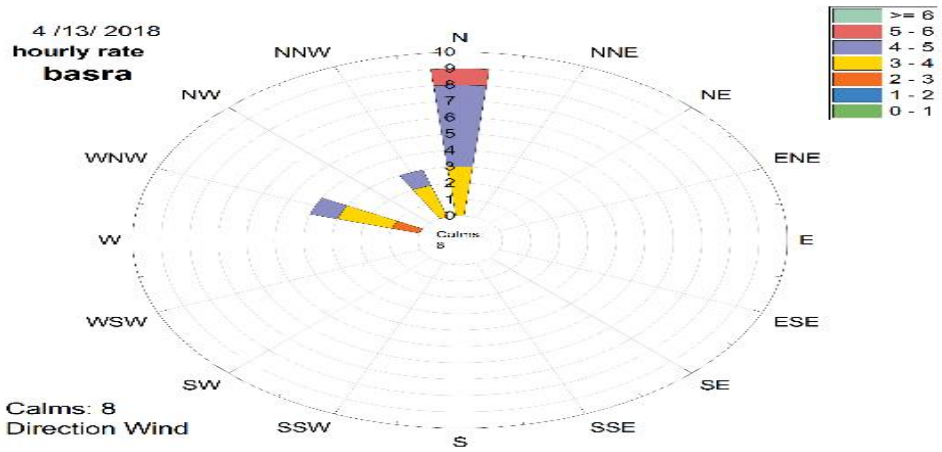


Figure 9. The analysis of the hourly data of wind speed and direction for the days (11, 12, 13) April 2018 using the wind rose program.

Figure 9 (a)(b)(c) shows the analysis of the hourly change in wind speed and direction during three days, as figure (a) represents the changes before the day of the accident, 4/11/2018. The lowest value of wind speed was between (2-4 m/s) and in the north-east direction. The wind direction was most east-southeast, which is the prevailing wind in the region for today, and the highest value of wind speed in the same direction ranged between (10-12 m/s). Figure (b) represents the changes in wind speed and direction on the day of the accident, 4/12/2018. It is clear that the prevailing winds on this day are in the east direction, and the highest value was (6-7 m/s), and the lowest value of wind speed ranged between (0-1 m/s). Figure (c) represents the changes after the accident on 4/13/2018. It is clear that the prevailing winds on this day are north, and their highest value in this direction was between (5-6 m/sec).

Figure 10 shows an isobaric map on a surface in the study area for the day of the accident, 4/12/2018. The behavior of the isobaric line on the day of a rainy thunderstorm with a pressure gradient and the study area falls under the influence of low atmospheric pressure. This low pressure comes from the Southwest direction and enters the study area.

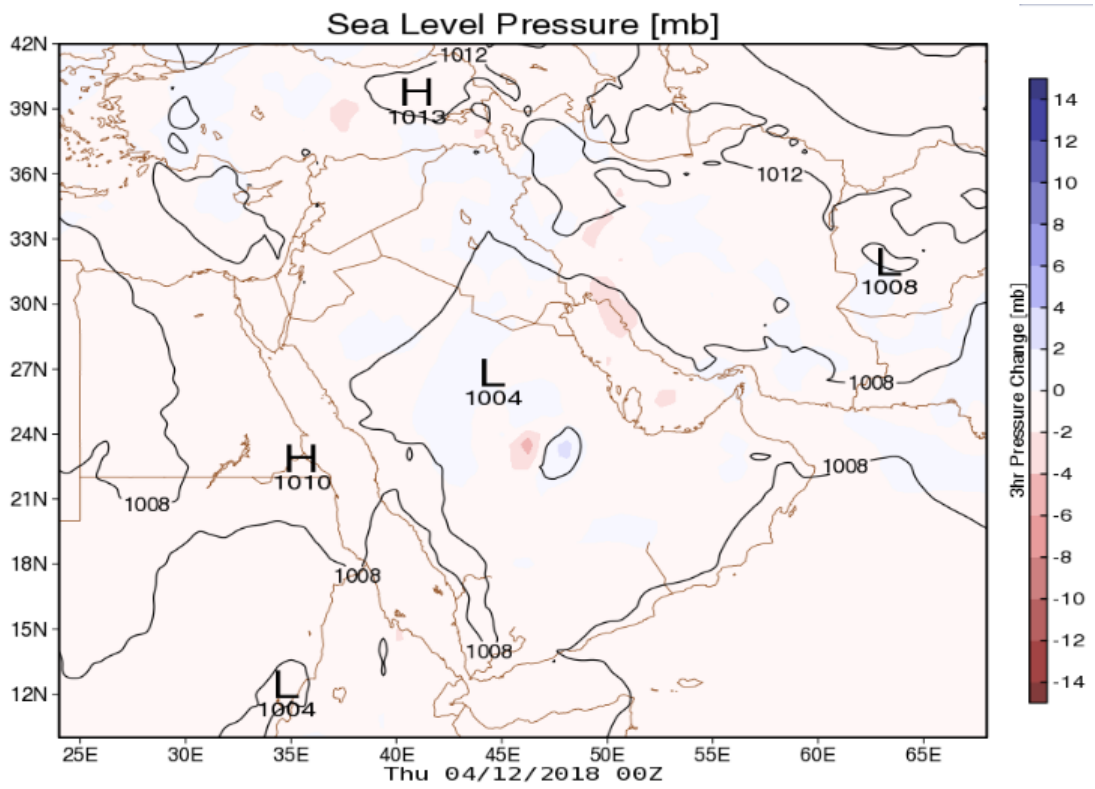


Figure 10. Shows isobaric map on a surface for the Middle East for the day of the accident, 4/12/2018

DISCUSSION

The Gulf has more than half of the world's oil and natural gas reserves, and the related industrial infrastructure and activities have had major impacts on the region's marine systems[4].

It's difficult to fully comprehend wind and waves' fundamental character and behavior because they're such complex and variable phenomena[9]. Moreover, Khor Abdullah is shallow water, with depths ranging from 7 to 14 meters and an

average of around 10 meters, and is defined by its funnel form. It is bounded on one side by the Al-Faw peninsula and on the other by Bobian Island, with vast intertidal zones on both sides [11]

CONCLUSIONS

The conclusions of this research are the study and analysis of weather factors and extreme weather phenomena such as dust storms, rain thunderstorms, fog and rising dust for the study area (Basra city) for the year 2018, which is the period during which the Aba Thar crane accident occurred, where there was a significant impact of weather factors that we studied on navigation Naval and ship traffic. The weather in the offshore area can be unpredictable, which is why forecasting is important. Although the prediction is imperfect, it helps navigators and other crew members make better course decisions. The most common types of weather that can cause marine accidents include high winds, storms, waves or swells. Marine weather forecasting organizations provide important information to avoid storms and other weather-related hazards. Failure to apply, refuse, misuse or miscalculate this information may result in serious consequences.

On the day of the accident, there was a rainy thunderstorm and high-speed winds that had a great impact on the movement of ships and navigation, which led to the movement of the crane after standing on the anchor towards the berths of Khur Al-Zubair port and colliding with the tanker anchored on the quay.

The change in weather factors such as pressure, temperature and dew has an important effect and an indicator of the arrival of a rainy thunderstorm. When these factors are known, necessary measures must be taken to avoid accidents.

According to the attached weather map, there was also a drop in pressure on the day of the accident that the study area was exposed to.

In future work, there must be determinants of maritime work in seaports and channels. Attention should be paid to the weather conditions during work. The Iraqi port administration must issue strict decisions in light of bad weather conditions and the circulation of weather forecasts in ships and ports. There is a coastal station in Umm Qasr port, which sends weather data to ships daily every 6 hours, which must be adhered to and followed up to avoid loss of lives and equipment as a result of severe weather work.

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Conflicts of Interest

The authors declare no conflict of interest.

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