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Naval Oceanographic and
Atmospheric Research Laboratory

Technical Note 132
August 1991

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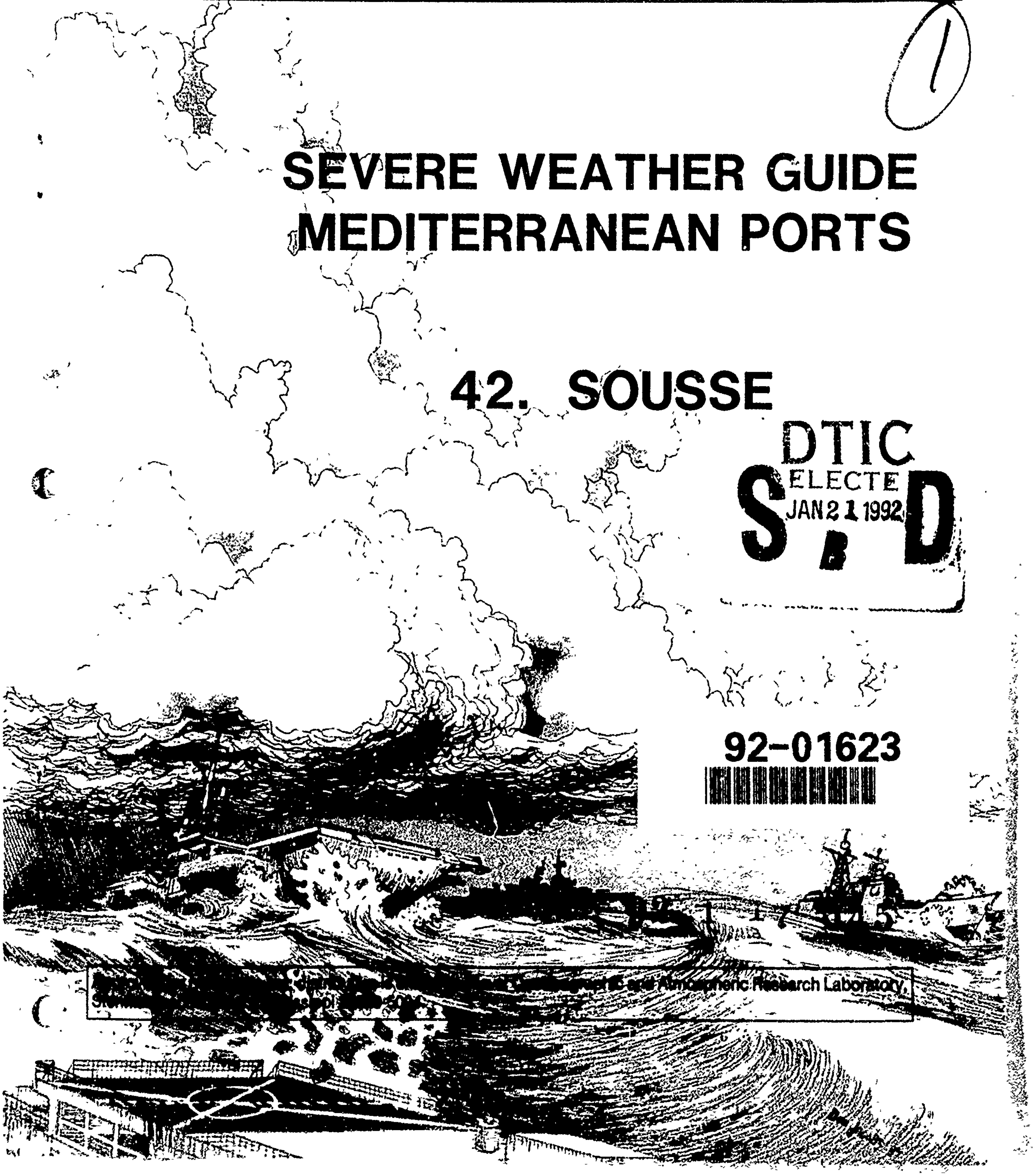
SEVERE WEATHER GUIDE
MEDITERRANEAN PORTS

42. SOUSSE



Atmospheric Research Laboratory

These working papers were prepared for the timely dissemination of information; this document does not represent the official position of NOARL.

ABSTRACT

This handbook for the port of Sousse, one in a series of severe weather guides for Mediterranean ports, provides decision-making guidance for ship captains whose vessels are threatened by actual or forecast strong winds, high seas, restricted visibility or thunderstorms in the port vicinity. Causes and effects of such hazardous conditions are discussed. Precautionary or evasive actions are suggested for various vessel situations. The handbook is organized in four sections for ready reference: general guidance on handbook content and use; a quick-look captain's summary; a more detailed review of general information on environmental conditions; and an appendix that provides oceanographic information.

ACKNOWLEDGMENTS

The support of the sponsors - Naval Oceanography Command, Stennis Space Center, MS: and Fleet Numerical Oceanography Center, Monterey, CA (Program Element O&M,N) - is gratefully acknowledged.

CONTENTS

FOREWORD

This handbook on Mediterranean Ports was developed as part of an ongoing effort at the Atmospheric Directorate, Naval Oceanographic and Atmospheric Laboratory (NOARL), Monterey, to create products for direct application to Fleet Operations. The research was conducted in response to Commander Naval Oceanography Command (COMNAVOCEANCOM) requirements validated by the Chief of Naval Operations (OP-096).

As mentioned in the preface, the Mediterranean region is unique in that several areas exist where local winds can cause dangerous operating conditions. This handbook will provide the ship's captain with assistance in making decisions regarding the disposition of his ship when heavy winds and seas are encountered or forecast at various port locations.

Readers are urged to submit comments, suggestions for changes, deletions and/or additions to Naval Oceanography Command Center (NAVOCEANCOMCEN), Rota with a copy to the oceanographer, COMSIXTHFLT. They will then be passed on to NOARL, Monterey for review and incorporation as appropriate. This document will be a dynamic one, changing and improving as more and better information is obtained.

PORT INDEX

The following is a tentative prioritized list of Mediterranean Ports to be evaluated during the five-year period 1988-92, with ports grouped by expected year of the port study's publication. This list is subject to change as dictated by circumstances and periodic review. Computerized versions of these port guides are available for those ports with an asterisk (*). Contact the Atmospheric Directorate, NOARL, Monterey or NOCC Rota for IBM compatable floppy disk copies.

NO.	PORT
*1	GAETA, ITALY
*2	NAPLES, ITALY
*3	CATANIA, ITALY
*4	AUGUSTA BAY, ITALY
*5	CAGLIARI, ITALY
*6	LA MADDALENA, ITALY
7	MARSEILLE, FRANCE
8	TOULON, FRANCE
9	VILLEFRANCHE, FRANCE
10	MALAGA, SPAIN
11	NICE, FRANCE
12	CANNES, FRANCE
13	MONAÇO
14	ASHDOD, ISRAEL
15	HAIFA, ISRAEL
16	BARCELONA, SPAIN
17	PALMA, SPAIN
18	IBIZA, SPAIN
19	POLLENSA BAY, SPAIN
20	LIVORNO, ITALY
21	LA SPEZIA, ITALY
22	VENICE, ITALY
23	TRIESTE, ITALY
*24	CARTAGENA, SPAIN
*25	VALENCIA, SPAIN
*26	SAN REMO, ITALY
*27	GENOA, ITALY
*28	PORTO TORRES, ITALY
*29	PALERMO, ITALY
*30	MESSINA, ITALY
*31	TAORMINA, ITALY

1991	PORT
*32	TARANTO, ITALY
*33	TANGIER, MOROCCO
*34	BENIDORM, SPAIN
*35	ROTA, SPAIN
*36	LIMASSOL, CYPRUS
*37	LARNACA, CYPRUS
*38	ALEXANDRIA, EGYPT
*39	PORT SAID, EGYPT
*40	BIZERTE, TUNISIA
*41	TUNIS, TUNISIA
*42	SOUSSE, TUNISIA
*43	SFAX, TUNISIA
*44	SOUDA BAY, CRETE
	VALETTA, MALTA
	PIRAEUS, GREECE

1992	PORT
	KALAMATA, GREECE
	CORFU, GREECE
	KITHIRA, GREECE
	THESSALONIKI, GREECE

DELAYED INDEFINITELY
ALGIERS, ALGERIA
ISKENDERUN, TURKEY
IZMIR, TURKEY
ISTANBUL, TURKEY
ANTALYA, TURKEY
GOLCUK, TURKEY

PREFACE

Environmental phenomena such as strong winds, high waves, restrictions to visibility and thunderstorms can be hazardous to critical Fleet operations. The cause and effect of several of these phenomena are unique to the Mediterranean region and some prior knowledge of their characteristics would be helpful to ship's captains. The intent of this publication is to provide guidance to the captains for assistance in decision making.

The Mediterranean Sea region is an area where complicated topographical features influence weather patterns. Katabatic winds will flow through restricted mountain gaps or valleys and, as a result of the venturi effect, strengthen to storm intensity in a short period of time. As these winds exit and flow over port regions and coastal areas, anchored ships with large 'sail areas' may be blown aground. Also, hazardous sea state conditions are created, posing a danger for small boats ferrying personnel to and from port. At the same time, adjacent areas may be relatively calm. A glance at current weather charts may not always reveal the causes for these local effects which vary drastically from point to point.

Because of the irregular coast line and numerous islands in the Mediterranean, swell can be refracted around such barriers and come from directions which vary greatly with the wind. Anchored ships may experience winds and seas from one direction and swell from a different direction. These conditions can be extremely hazardous for tendered vessels. Moderate to heavy swell may also propagate outward in advance of a storm resulting in uncomfortable and sometimes dangerous conditions, especially during tending, refueling and boating operations.

This handbook addresses the various weather conditions, their local cause and effect and suggests some evasive action to be taken if necessary. Most of the major ports in the Mediterranean will be covered in the handbook. A priority list, established by the Sixth Fleet, exists for the port studies conducted and this list will be followed as closely as possible in terms of scheduling publications.

RECORD OF CHANGES

CHANGE NUMBER	DATE OF CHANGE	DATE ENTERED	PAGE NUMBER	ENTERED BY

1. GENERAL GUIDANCE

1.1 DESIGN

This handbook is designed to provide ship captains with a ready reference on hazardous weather and wave conditions in selected Mediterranean harbors. Section 2, the captain's summary, is an abbreviated version of section 3, the general information section intended for staff planners and meteorologists. Once section 3 has been read, it is not necessary to read section 2.

1.1.1 Objectives

The basic objective is to provide ship captains with a concise reference of hazards to ship activities that are caused by environmental conditions in various Mediterranean harbors, and to offer suggestions for precautionary and/or evasive actions. A secondary objective is to provide adequate background information on such hazards so that operational forecasters, or other interested parties, can quickly gain the local knowledge that is necessary to ensure high quality forecasts.

1.1.2 Approach

Information on harbor conditions and hazards was accumulated in the following manner:

A. A literature search for reference material was performed.

B. Cruise reports were reviewed.

C. Navy personnel with current or previous area experience were interviewed.

D. A preliminary report was developed which included questions on various local conditions in specific harbors.

E. Port/harbor visits were made by NOARLW personnel; considerable information was obtained through interviews with local pilots, tug masters, etc; and local reference material was obtained.

F. The cumulative information was reviewed, combined, and condensed for harbor studies.

1.1.3 Organization

The Handbook contains two sections for each harbor. The first section summarizes harbor conditions and is intended for use as a quick reference by ship captains, navigators, inport/at sea OOD's, and other interested personnel. This section contains:

A. a brief narrative summary of environmental hazards,

B. a table display of vessel location/situation, potential environmental hazard, effect-precautionary/evasion actions, and advance indicators of potential environmental hazards,

C. local wind wave conditions, and

D. tables depicting the wave conditions resulting from propagation of deep water swell into the harbor.

The swell propagation information includes percent occurrence, average duration, and the period of maximum wave energy within height ranges of greater than 3.3 feet and greater than 6.6 feet. The details on the generation of sea and swell information are provided in Appendix A.

The second section contains additional details and background information on seasonal hazardous conditions. This section is directed to personnel who have a need for additional insights on environmental hazards and related weather events.

1.2 CONTENTS OF SPECIFIC HARBOR STUDIES

This handbook specifically addresses potential wind and wave related hazards to ships operating in various Mediterranean ports utilized by the U.S. Navy. It does not contain general purpose climatology and/or comprehensive forecast rules for weather conditions of a more benign nature.

The contents are intended for use in both pre-visit planning and in situ problem solving by either mariners or environmentalists. Potential hazards related to both weather and waves are addressed. The oceanographic information includes some rather unique information relating to deep water swell propagating into harbor shallow water areas.

Emphasis is placed on the hazards related to wind, wind waves, and the propagation of deep water swell into the harbor areas. Various vessel locations/situations are considered, including moored, nesting, anchored, arriving/departing, and small boat operations. The potential problems and suggested precautionary/evasive actions for various combinations of environmental threats and vessel location/situation are provided. Local indicators of environmental hazards and possible evasion techniques are summarized for various scenarios.

CAUTIONARY NOTE: In September 1985 Hurricane Gloria raked the Norfolk, VA area while several US Navy ships were anchored on the muddy bottom of Chesapeake Bay. One important fact was revealed during this incident: Most all ships frigate size and larger dragged anchor, some more than others, in winds of over 50 knots. As winds and waves increased, ships 'fell into' the wave troughs, BROADSIDE TO THE WIND and become difficult or impossible to control.

This was a rare instance in which several ships of recent design were exposed to the same storm and much effort was put into the documentation of lessons learned. Chief among these was the suggestion to evade at sea rather than remain anchored at port whenever winds of such intensity were forecast.

2. CAPTAIN'S SUMMARY

The Port of Sousse, Tunisia is located on the North African coast of the Mediterranean Sea at approximately 35°50'N 10°38'E (Figure 2-1).

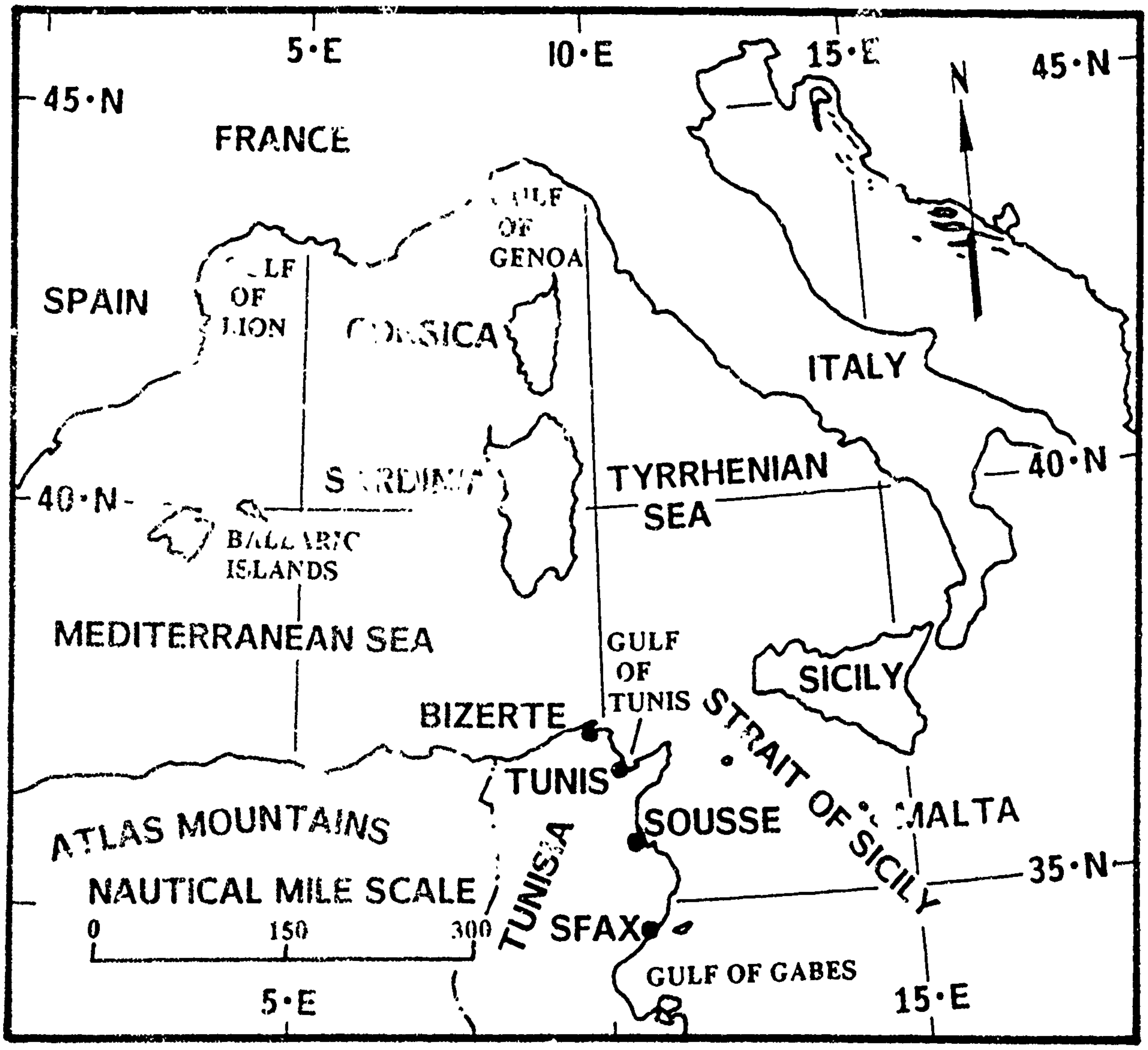


Figure 2-1. West and Central Mediterranean Sea.

Sousse is situated on the southwest shore of the Gulf of Hammamet (Figure 2-2). The terrain near Sousse is mostly low-lying with elevations of 328 ft (100 m) occurring within 8 n mi southwest and west-northwest of the port.

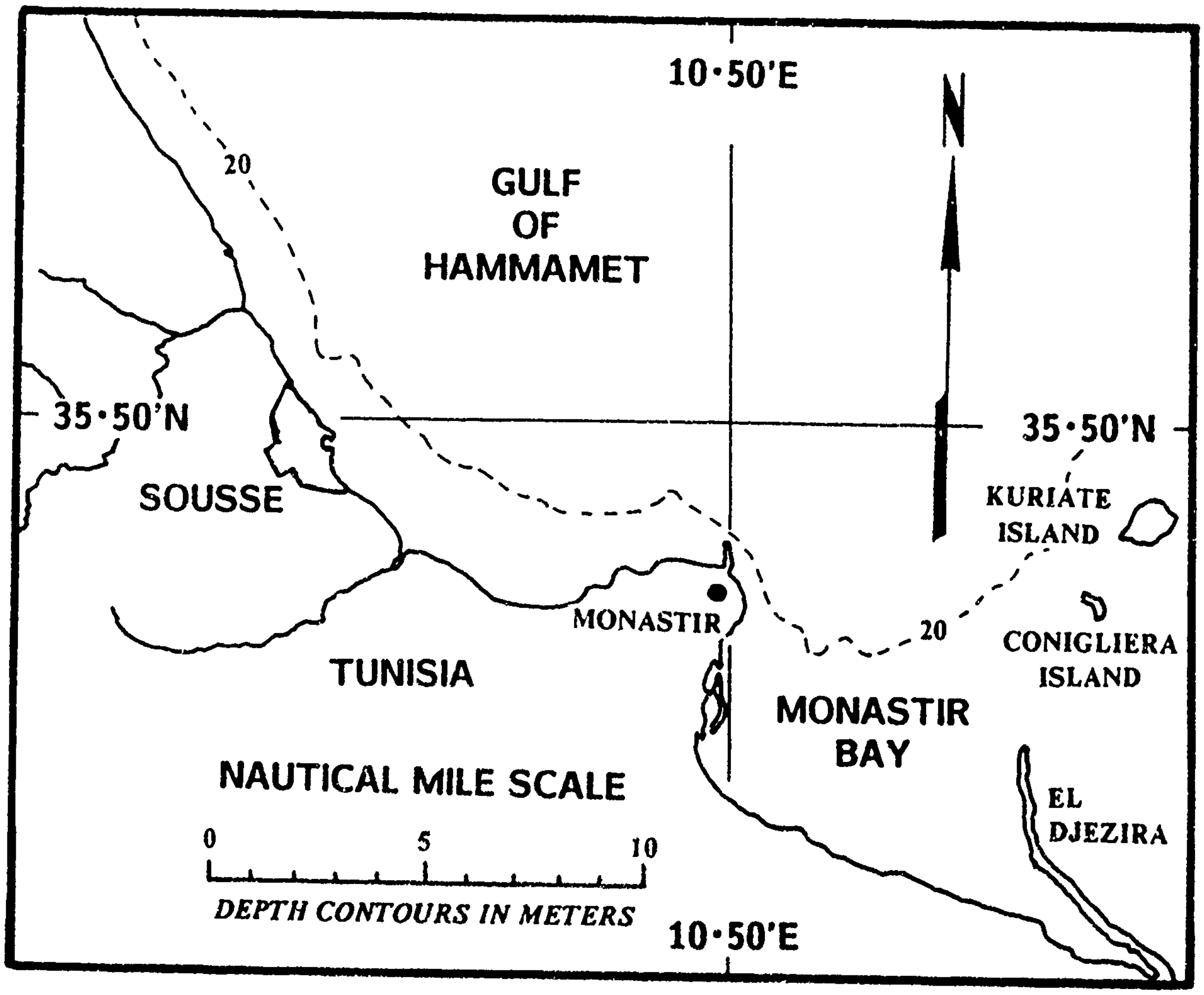


Figure 2-2. Approaches to the Port of Sousse, Tunisia.

The Port of Sousse (Figure 2-3) can accommodate ships to 541 ft (165 m) in length, with drafts limited to 28 ft (8.5 m) or less. The harbor was scheduled to be dredged to a uniform depth of 31 ft (9.5 m) in May 1990.

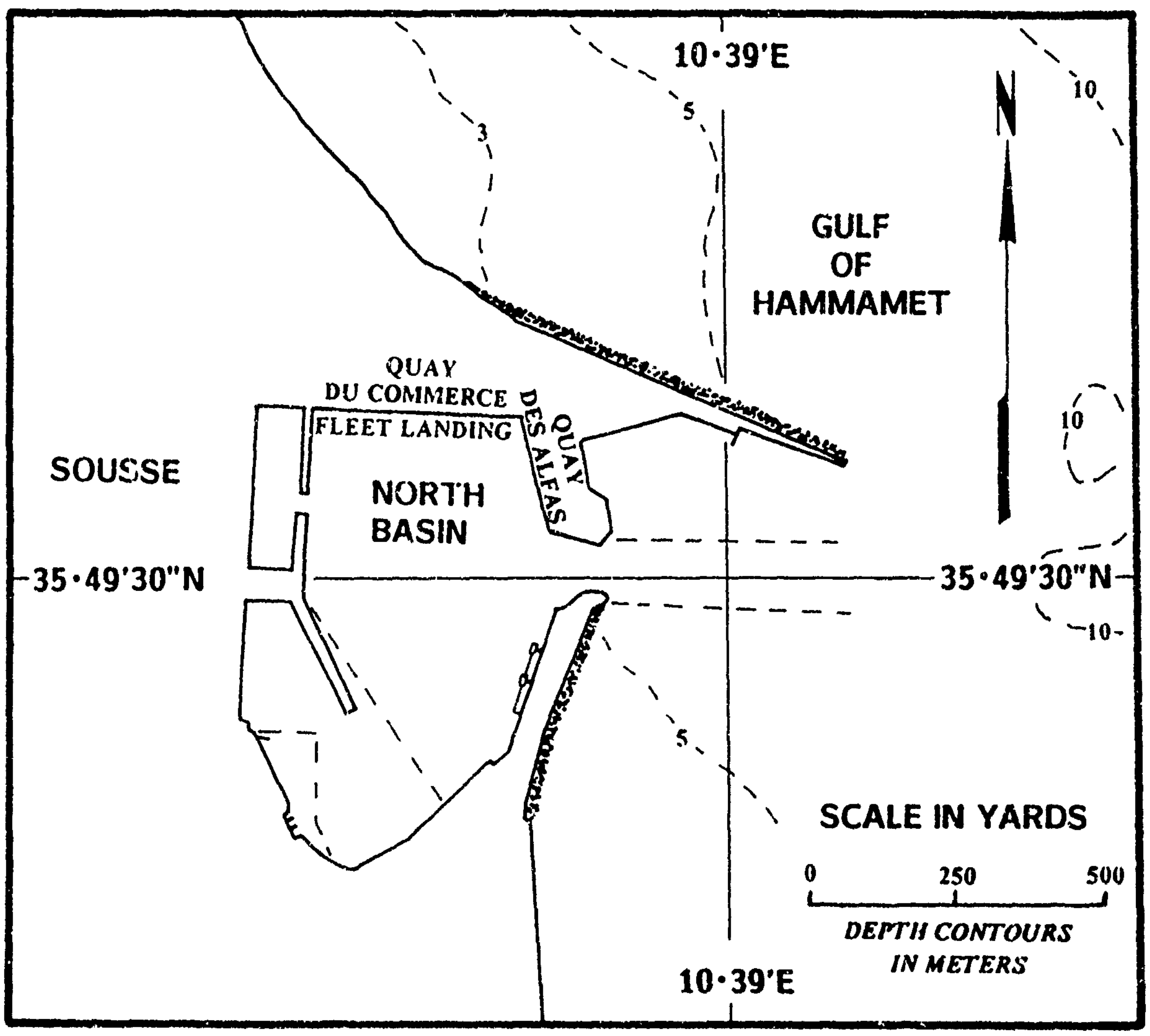


Figure 2-3. Port of Sousse, Tunisia.

The entrance to the harbor is narrow. The usable channel through the breakwater entrance is 55 yd (50 m) wide and 32 ft (9.8 m) deep; there is insufficient room available to keep a tug alongside while passing through the breakwater. Occasional crosswinds from the north after 1000L could require high speed maneuvering. Entry in the early morning when the winds are calm is recommended (FICEURLANT, 1978). The high winds will cause channel marker buoys to be set as much as 750 ft (229 m) south and east of the charted position. Exit from the harbor is difficult due to limitations on maneuvering room. Because of the prevailing east wind, the harbor entrance requires dredging every 1 to 2 years.

There are two large piers available for mooring. Quay du Commerce, on the north side of the basin, is approximately 1,000 ft (305 m) long while the pier on the eastern side (Quay des Alfas) is approximately 500 ft (152 m) long.

Maneuvering room in the north basin (measuring about 1,000 ft (305 m) deep by 800 ft (244 m) wide from the breakwater entrance) is extremely limited. Ships with chin-mounted sonar should exercise extreme caution due to limited depths. Local authorities state that ships must drop anchor immediately upon entering to avoid hitting the seawall on the west side of the harbor. Exit from the harbor is difficult due to limitations on maneuvering room. Additionally, the bottom of the north basin is composed of a mixture of mud and a 3-foot layer of "alpha grass" in varying stages of decay. The grass has been blown into the basin from a loading area on the Commercial Pier (Quay du Commerce). Disturbance of the bottom by backing bells causes large quantities of the grass to float to the surface in large chunks, and ships have suffered a complete loss of power caused by fouling of the main condenser with mud and alpha grass (FICEURLANT, 1978).

The anchorage is located about 0.6 n mi due east of the harbor entrance in a depth of 46 ft (14 m). Local authorities say the holding is good on a mud bottom, but FICEURLANT (1978) states that the area around the roadstead in the vicinity of the fairway buoy provides poor holding on a bottom of mostly sand and grass. Mediterranean Pilot, Volume I, published by the Hydrographic Department in 1963, supports the latter view, by stating that the roadstead of Sousse is not safe, and the holding ground is bad. It further states that the roadstead is exposed to winds from north to southeast, but the waves are deadened by seaweed so that in summer the anchorage may be considered fairly good.

Ships anchoring in the roadstead can experience choppy seas and swells from the northwest affecting boating and maneuvering to the anchorage. Because seas can be dangerous and operation of smaller craft particularly hazardous, ships require large liberty boats (U-b[illegible] size) to transport liberty parties, (FICEURLANT, 1978). [illegible] can land easily at any point along the Commercial Pier (Quay [illegible] Commerce) where the fleet landing is located.

The tidal range is about 1 ft. There is a small tidal current, but currents are generally negligible.

Specific hazardous conditions, vessel situations, and suggested precautionary/evasive action scenarios are summarized in Table 2-1.

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Table 2-1. Summary of hazardous environmental conditions fo

HAZARDOUS CONDITION	INDICATORS OF POTENTIAL HAZARD	VESSEL LOCATIO SITUATION AFFEC
1. <u>E'ly winds/waves</u> - Locally called levante. * Most common in winter and spring. * Possible in autumn. * Uncommon in summer. * Winds of 34-47 kt are possible. * Waves of 13 ft (4 m) may enter harbor. * Waves of 20-23 ft (6-7 m) are possible in anchorage.	<u>Advance warning</u>. * Any synoptic situation which indicates that a N African low moving S of the Atlas Mountains will pass S of Sousse before moving E into the Gulf of Gabes.	(1) <u>Moored - in harbor.</u>
		(2) <u>Anchored</u>.
		(3) <u>Arriving/ departing.</u>
		(4) <u>Small boats</u>.

conditions fo hazardous environmental conditions for the Port of Sousse, Tunisia

EL LOCATIO TION AFFEC	ORS OF HAZARD	VESSEL LOCATION/ SITUATION AFFECTED	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
Moored - inr harbor.	situation which t a N African of the Atlas l pass S of moving E into abes.	(1) Moored - inner harbor.	(a) WORST CONDITION FOR THE PORT. THE HARBOR OFFERS NO PROTECTION FROM HEAVY WEATHER. * Ships in port are at risk and should sortie before onset of strong E'ly winds. * Navigating channel during strong winds is dangerous as winds may be moved laterally by wave reflection. * Ships may be forced toward the W seawall by wind force. * Nearest port providing protection from E'ly conditions is the Port of Sfax, Tunisia, about 65 n mi S of Sousse.
Anchored.		(2) Anchored.	(b) WORST CONDITION FOR THE PORT. THE ANCHORAGE OFFERS NO PROTECTION FROM HEAVY WEATHER. * Ships in the anchorage may drag anchor toward shore and should sortie before onset of strong E'ly winds. * Nearest port providing protection from E'ly conditions is the Port of Sfax, Tunisia, about 65 n mi S of Sousse.
Arriving/ departing.		(3) Arriving/ departing.	(c) WORST CONDITION FOR THE PORT. THE HARBOR AND ANCHORAGE OFFER NO PROTECTION FROM HEAVY WEATHER. * Ships in port are at risk and should sortie before onset of strong E'ly winds. * Inbound vessels should not enter port. * Navigating channel during strong winds is dangerous as ships may be moved laterally by wave reflection. * Ships may be forced toward the W seawall by wind force. * Nearest port providing protection from E'ly conditions is the Port of Sfax, Tunisia, about 65 n mi S of Sousse.
Small boats.		(4) Small boats.	(d) WORST CONDITION FOR THE PORT. SMALL BOAT OPERATION SHOULD BE CURTAILED UNTIL CONDITIONS ABATE. * Only those vessels with large boats (U-boat) should consider anchoring.

Table 2-1. (Continued)

HAZARDOUS CONDITION	INDICATORS OF POTENTIAL HAZARD	VESSEL LOCATIO SITUATION AFFE
2. NW'ly winds - Locally called gabale. * Most common in winter and spring. * Possible in autumn. * Uncommon in summer. * Winds of 34-47 kt are possible. * Large waves are not generated due to short fetch area.	Advance warning. * Can be expected at Sousse about 2 days after strong mistral begins in Gulf of Lion. Duration. * Local rules state that gale force NW winds blow for either 3, 6 or 9 days.	(1) Moored - in harbor. (2) Anchored. (3) Arriving/ departing. (4) Small boats.
3. N'ly winds - * Sustained events are most common in winter and spring. * Possible in autumn. * Uncommon in summer. * Daytime winds may occur during late spring, summer, and early autumn after mid-morning.	Advance warning. * Any synoptic situation which indicates that a N African low will pass S of Sousse may produce N'ly winds as the winds back from E to NW. * N'ly winds are possible after passage of NE-SW oriented cold front through Sousse area. * N'ly winds are possible after mid-morning on warm days in late spring, summer and early autumn.	(1) Moored - in harbor. (2) Anchored. (3) Arriving/ departing. (4) Small boats.

-1. (Continued)

SEL LOCATI ATION AFFE	OF ZARD	VESSEL LOCATION/ SITUATION AFFECTED	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
Moored - in harbor.	t Sousse r strong Gulf of	(1) Moored - inner harbor.	(a) Strong event may strain mooring lines and bollards. * Bollards should be inspected for physical integrity and lines should be added/ doubled as necessary. * If a sortie is indicated to avoid strong winds, lee shelter can be found in the N part of the Gulf of Hammamet.
Anchored.	that gale ow for days.	(2) Anchored.	(b) Strong event may cause anchor dragging towards SE. * If a sortie is indicated to avoid strong winds, lee shelter can be found in the N part of the Gulf of Hammamet.
Arriving/ departing.		(3) Arriving/ departing.	(c) The port (harbor and anchorage) offer no protection from the wind. * Departing vessels should get underway prior to wind onset. * If arriving vessels wish to wait until conditions abate prior to entering port, lee shelter can be found in the N part of the Gulf of Hammamet.
Small boats.		(4) Small boats.	(d) In a strong event, safety may dictate that small boat operation be curtailed until winds abate. * Only vessels with large (U-boat) boats should consider anchoring.
Moored - in harbor.	ation which N African f Sousse winds as om E to NW.	(1) Moored - inner harbor.	(a) Strong event may strain mooring lines and bollards. * Bollards should be inspected for physical integrity and lines should be added/ doubled as necessary.
Anchored.	ssible NE-SW ori-	(2) Anchored.	(b) Strong event may cause anchor dragging towards S.
Arriving/ departing.	through ssible on warm ng, summer	(3) Arriving/ departing.	(c) The port (harbor and anchorage) offers no protection from the wind. * Departing vessels should get underway prior to wind onset. * Winds may cause steerage problems in the channel for inbound/outbound vessels. * High speed maneuvering may be required. * Marker buoys may be displaced S and E of charted position.
Small boats.		(4) Small boats.	(d) In a strong event, safety may dictate that small boat operation be curtailed until winds abate.

SEASONAL SUMMARY OF HAZARDOUS WEATHER CONDITIONS

WINTER (November through February)

* Easterly winds and waves.
  * Worst conditions for the port.
  * Ships in harbor should sortie before onset of strong winds.
  * Ships in anchorage may drag anchor and have to sortie.
    * Nearest safe haven is Port of Sfax.
* Northwest winds and waves.
  * Usually occurs 2 days after onset of a strong mistral in Gulf of Lion.
  * Mooring lines/bollards may be strained.
  * Ships in anchorage may drag anchor.
  * Lee shelter may be found in north part of Gulf of Hammamet.
* Northerly winds and waves.
  * Harbor offers no protection from effects of wind and anchorage is fully exposed to winds and waves.
  * Mooring lines/bollards may be strained.
  * Ships in anchorage may drag anchor.
  * Nearest safe haven is Port of Sfax.

SPRING (March through May)

* East and northwest winds and waves continue to be a threat to the port until late in the season.

SUMMER (June through September)

* Summer weather is generally settled, hot, and dry.

AUTUMN (October)

* Short transitional season with winter-like weather returning by month's end.

NOTE: For more detailed information on hazardous weather conditions, see previous table 2-1 in this section and Hazardous Weather Summary in Section 3.

REFERENCES

FICEURLANT, 1978 (Reissued 1987): Port Directory for Sousse, Tunisia. Fleet Intelligence Center Europe and Atlantic, Norfolk, VA.

Hydrographic Department, 1963: Mediterranean Pilot. Volume I. Published by the Hydrographic Department, under the authority of the Lords Commissioners of the Admiralty, London.

PORT VISIT INFORMATION

JANUARY 1990. NOARL Meteorologists R. Fett and Lieutenant M. Evans, U.S. Navy met with Pilots Hochlaf Tayaa, Boubaker Hachem, and Mahfoudhi Amor to obtain much of the information included in this port evaluation.

3. GENERAL INFORMATION

This section is intended for Fleet meteorologists/oceanographers and staff planners. Paragraph 3.5 provides a general discussion of hazards and table 3-1 provides a summary of vessel locations/situations, potential hazards, effect-precautionary/evasive actions, and advance indicators and other information about potential hazards by season.

3.1 Geographic Location

The Port of Sousse, Tunisia is located on the North African coast of the Mediterranean Sea at approximately 35°50'N 10°38'E (Figure 3-1).

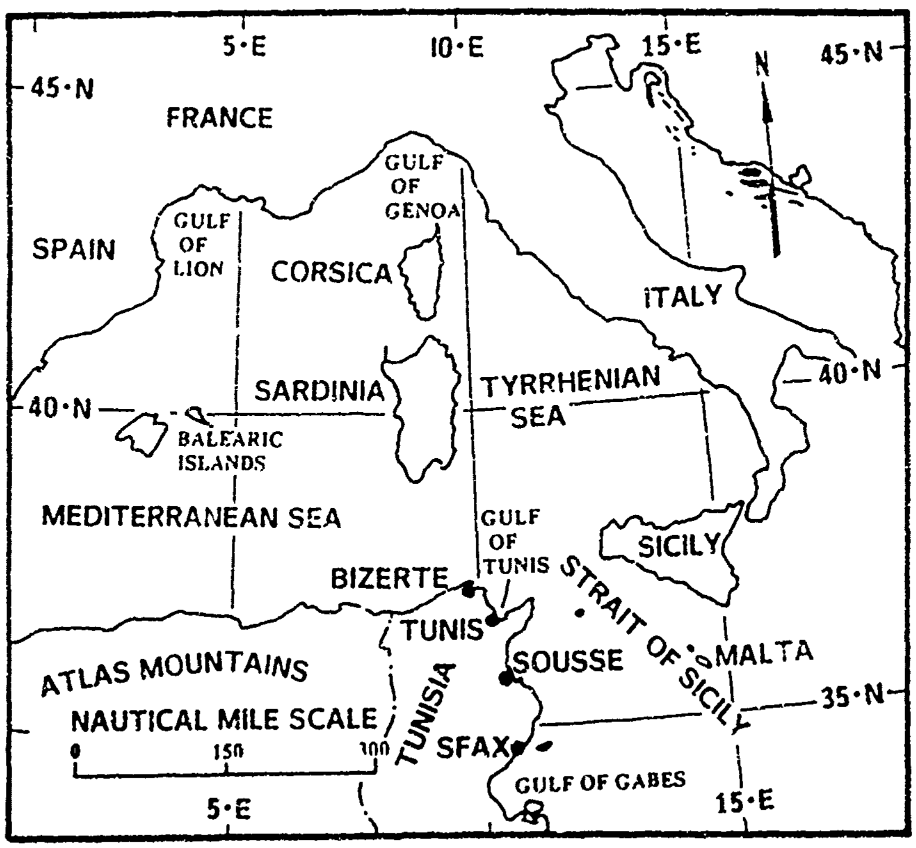

Figure 3-1. West and Central Mediterranean Sea.

Sousse is situated on the southwest shore of the Gulf of Hammamet (Figure 3-2). The terrain near Sousse is mostly low-lying, with the nearest elevations of 328 ft (100 m) or more occurring 8 n mi southwest and west-northwest of the port.

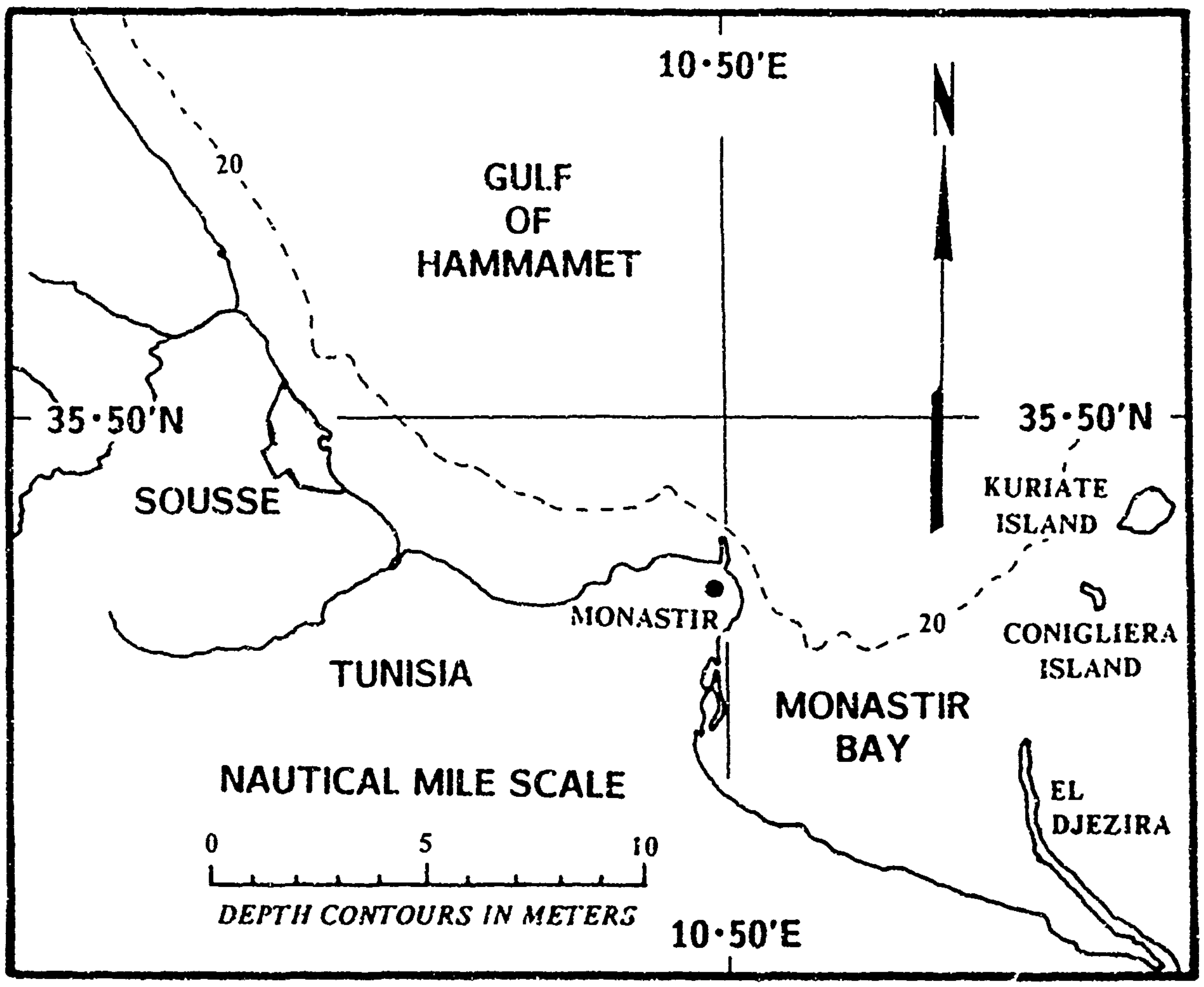

Figure 3-2. Approaches to the Port of Sousse, Tunisia.

The Port of Sousse (Figure 3-3) can accommodate ships to 541 ft (165 m) in length, with drafts limited to 28 ft (8.5 m) or less. The harbor was scheduled to be dredged to a uniform depth of 31 ft (9.5 m) in May 1990.

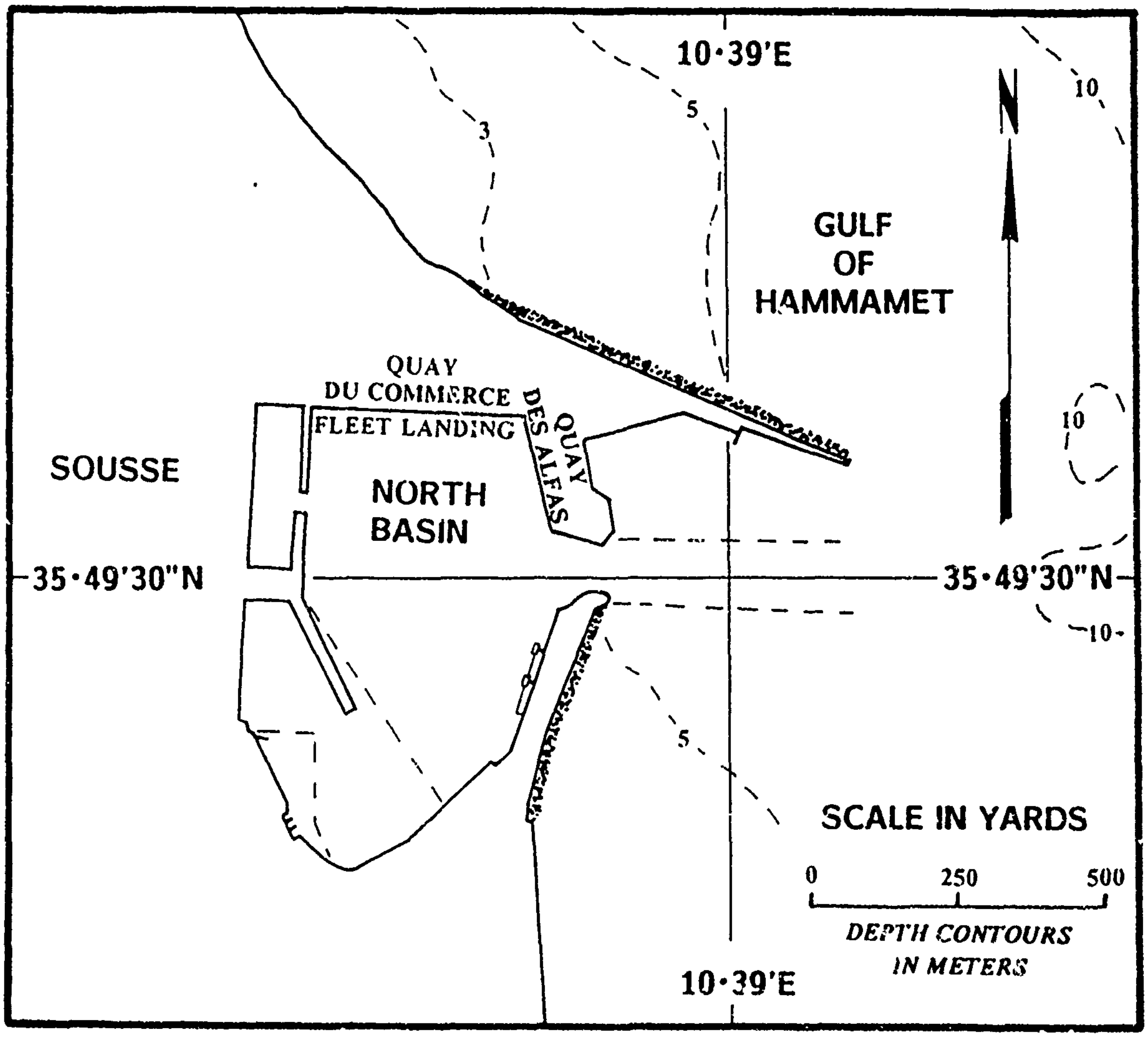

Figure 3-3. Port of Sousse, Tunisia.

The entrance to the harbor is narrow. The usable channel through the breakwater entrance is 55 yd (50 m) wide and 32 ft (9.8 m) deep; there is insufficient room available to keep a tug alongside while passing through the breakwater. Occasional crosswinds from the north after 1000 could require high speed maneuvering. Entry in the early morning when the winds are calm is recommended (FICEURLANT, 1978). The high winds will cause channel marker buoys to be set as much as 750 ft (229 m) south and east of the charted position. Exit from the harbor is difficult due to limitations on maneuvering room. Because of the prevailing east wind, the harbor entrance requires dredging every 1 to 2 years. There are two large piers available for mooring. Quay du Commerce, on the north side of the basin, is approximately 1,000 ft (305 m) long while the pier on the eastern side, Quay des Alfas, is approximately 500 ft (152 m) long.

Maneuvering room in the north basin (measuring about 1,000 ft (305 m) deep by 800 ft (244 m) wide from the breakwater entrance) is extremely limited. Ships with chin-mounted sonar should exercise extreme caution due to limited depths. Local authorities state that ships must drop anchor immediately upon entering to avoid hitting the seawall on the west side of the harbor. Exit from the harbor is difficult due to limitations on maneuvering room. Additionally, the bottom of the north basin is composed of a mixture of mud and a 3-foot layer of "alpha grass" in varying stages of decay. The grass has been blown into the basin from a loading area on the Commercial Pier (Quay du Commerce). Disturbance of the bottom by backing bells causes large quantities of the grass to float to the surface in large chunks, and ships have suffered a complete loss of power caused by fouling of the main condenser with mud and alpha grass (FICEURLANT, 1978).

The anchorage is located about 0.6 n mi due east of the harbor entrance in a depth of 46 ft (14 m). Local authorities say the holding is good on a mud bottom, but FICEURLANT (1978) states that the area around the roadstead in the vicinity of the fairway buoy provides poor holding on a bottom of mostly sand and grass. Mediterranean Pilot, Volume I, published by the Hydrographic Department in 1963, supports the latter view by stating that the roadstead of Sousse is not safe, and the holding ground is bad. It further states that the roadstead is exposed to winds from north to southeast, but the waves are deadened by seaweed, so that in summer the anchorage may be considered fairly good.

Ships anchoring in the roadstead can experience choppy seas and swells from the northwest which affects boating and maneuvering to the anchorage. Because seas can be dangerous and operation of smaller craft particularly hazardous, ships require large liberty boats (U-boat size) to transport liberty parties (FICEURLANT, 1978). Boats can land easily at any point along the Commercial Pier where the fleet landing is located.

3.2 Qualitative Evaluation of the Port of Sousse

Sousse cannot be considered a good foul weather port because many weather scenarios adversely affect port safety and operation. Easterly winds cause the most trouble for the port, making entry and sortie difficult. East to southeasterly winds are the worst for entry to the port; any wind above 20 kt can make it dangerous to enter or leave the port. Both fully loaded and empty ships may experience problems. Once, during a strong east wind, a military ship attempted to leave port without the assistance of tugs, and was nearly grounded against the west breakwater. The captain attempted to compensate for the effects of the wind by zig-zagging towards the entrance to the harbor but the action was not effective and the ship continued to be blown towards the breakwater. The captain finally dropped anchor, and the force of the wind brought the bow into the wind and the ship was able to leave port.

Reflection of easterly swell affects all moorings, but swell of 3 to 7 ft (1 to 2 m) or less usually has little or no effect on the harbor. However, larger does enter the harbor with adverse results. A storm which occurred on 2-3 December 1989 (see Section 3.5.A) resulted in a 13 ft (4 m) swell entering the harbor which caused extensive damage throughout. A cargo ship moored to an unidentified pier broke all moorings, ripped bollards from the pier and was forced to get underway during the storm. It could not return to the port for 36 hours.

Offshore winds are not bothersome, but any wind from the sea causes big problems. Northwesterly winds are considered dangerous, but lee shelter is available to the north in the Gulf of Hammamet. Local authorities state that gale force northwesterly winds tend to blow for either 3, 6, or 9 days. The port is not protected from strong north winds; two ships have broken moorings during strong north wind conditions.

Easterly winds directly affect the anchorage area, as there is no protection from that direction. Winds of gale force (34-47 kt, force 8-9) can cause ships to drag anchor toward the shore. Swell in the anchorage has reached 20 to 23 ft (6 to 7 m), but the normal range for swell is 6 to 10 ft (2 to 3 m)

3.3 Currents and Tides

The tidal range is about 1 ft. There is a small tidal current, but currents are generally negligible.

3.4 Visibility

Visibility is mostly good and presents no problem. Local authorities state that extremes of good visibility implies bad weather and poor visibility implies good weather. Morning fog occurs during summer and usually burns off by 1000 local time.

3.5 Hazardous Conditions

As discussed in section 3.2 above, the Port of Sousse experiences various hazardous weather conditions. The primary hazard is wind and waves from the east, but any wind with an on-shore component causes problems. Local names for various wind directions are:

east - levante, northeast - barane, southeast - slook
northwest - gabale, and southwest - cherch.

Although uncommon, storms having tropical characteristics with fully developed eyes have been observed on at least three occasions in the Mediterranean Basin. During the last occurrence, in September 1983, the storm was first detected, and probably formed, in the Gulf of Gabes (Figure 3-2). Weather conditions at Sousse during the disturbance is unknown, but the forecaster should be aware of the possibility that such a storm may again develop in the area.

More commonly, the cyclonic storms affecting Sousse would be North African lows which develop and move eastward south of the Atlas Mountains before reaching the Mediterranean Sea through the Gulf of Gabes.

Specific seasonal temperature data for Sousse is unavailable. Using weather records from other locations in the country, a typical January daily temperature range would be about 46°F (8°C) to 58°F (14°C), while a typical July/August daily temperature range would be about 72°F (22°C) to 85°F (29°C). Temperature extremes at Sousse would likely range from winter lows in the mid-30°F (2°C) to summer highs near 110°F (43°C).

A seasonal summary of various known environmental hazards that may be encountered in the Port of Sousse follows.

A. Winter (November through February)

Easterly winds. Local authorities state that winds from several directions impact port operations but easterly winds are the most troublesome. Easterly winds of any strength would likely precede the passage of a North African low pressure center. As the season progresses, the possibility of the lows forming increases. The following discussion of North African lows is taken primarily from Brody & Nestor's 1980 document Regional Forecasting Aids for the Mediterranean Basin, NAVENVPREDRSCHFAC Technical Report TR 80-10.

> North African Lows - North African lows develop over the desert region south of the Atlas mountains. The synoptic situation favoring development is the presence of an upper trough lying over Spain with its axis lying northeast-southwest, producing a deep southwesterly flow over northwest Africa. The presence of a cold front is apparently immaterial for the development of a low, but when one is present, development usually occurs before the front reaches the mountain range.
>
> The lows which have the greatest potential to produce strong easterly winds at Sousse follow an easterly track south of the Atlas mountains before moving over the Mediterranean Sea across the coast of Tunisia at or near the Gulf of Gabes. When North African lows occur south of the Atlas Mountains, strong easterly to southeasterly winds are likely over the southern Mediterranean and will result in high seas in the Strait of Sicily.
>
> A North African low is most likely to form over Tunisia when the long-wave trough is oriented northeast-southwest across the Tyrrhenian Sea. Cold continental polar air will be advected in from eastern Europe and a pocket of cold air (-25°C at 500 mb) will form between Sardinia, Sicily and Tunisia. The subtropical jet also will be evident over North Africa. Wind speeds at 500 mb over Tunisia and Libya will be 55 kt or more.
>
> The speed of movement with these systems is related to the time of year in which they develop. During late autumn and early winter, lows moving out of this area are noted for their extremely slow movement due to their association with a cut-off low aloft.

> During late winter and early spring, as the number of North African cyclones increases, North Africa becomes the primary cyclogenesis area for the region. Unlike lows developing early in the winter, these lows are generally associated with open, short wave troughs. They produce little precipitation, but frequently produce high winds in close proximity to their centers. Their increased speed of movement compared with the early winter systems also make them unique. Some lows have been noted to move eastward out of North Africa at 40 to 50 kt. With the scarcity of reports along the cyclogenesis area, the use of satellite data over the region may be the only clue to the presence of a developing low.

COMSIXTHFLT ltr 3140 Ser N312/003 (4 Jan 1990) addresses a specific weather event that took place on Malta (Figure 3-1) during 30 November-3 December 1989, the period of the well publicized Bush-Gorbachev talks. Although Malta is located on the eastern end of the Strait of Sicily about 200 n mi east of Sousse, the storm resulted in easterly conditions at Sousse, discussed above in Section 3.2. A résumé follows.

> The USS Belknap was anchored in "Pretty Bay," Marsaxlokk, Malta from 26 November through 4 December 1989. The Soviet Navy cruiser, Slava, anchored about 500 yds southeast of Belknap on 28 November. The synoptic situation that caused the "Malta Meeting storm" was a classic "Gregale" existing in conjunction with an Adriatic and Aegean bora as defined in Chapter V, paragraph 2.4 of Brody and Nestor (1980). A strong omega block dominated the European weather pattern from late November through the period of the Bush-Gorbachev meetings on 2-3 December. A strong ridge with 500 mb height maximum centered near Austria/Czechoslovakia separated a cut-off low west of the Iberian Peninsula from a major long-wave trough over the western Soviet Union. A ridge of high pressure extended south across Italy and the Strait of Sicily from the center over the continent. Winds at Malta were east-southeasterly about 20 kt on 29 and 30 November.
>
> A short-wave trough and jet max rotating around the eastern Europe long-wave trough moved south across Italy on 30 November/1 De-

cember. At the same time, a weak Tunisian low formed south of the Atlas mountains and moved east to the Gulf of Gabes. When it reached the water on 1 December, it intensified in response to the energy source of the warm water and the approaching short wave. About 020230Z winds backed to northeast and increased to 28-30 kt. Belknap dragged her stern anchor and the Slava dragged her stern buoy.

The low moved south of Malta and pressure began to rise at 020000Z. However, infrared pictures from METEOSAT showed an indication of a second circulation in the Gulf of Gabes. At 020900Z the pressure began to fall rapidly as winds increased and rain showers became nearly continuous. Minimum pressure was reached at 021200Z, but the gradient between the low and the strong ridge to the north maintained gale force winds throughout the afternoon. Once again satellite data showed a possible circulation center developing on the east coast of Tunisia.

The third low pressure center in the Gulf of Gabes further increased the northeast gradient on the evening of 2 December. Between 1800Z and 2000Z the wind rarely decreased below 40 kt. Maximum strength was reached about 1840Z, with sustained winds of 48 kt gusting to 55 kt for about 15 minutes. After 1855Z, winds began to slowly diminish, settling in the 30-35 kt range until 030500Z, when they decreased to 20-25 kt with higher gusts in precipitation.

Strong easterly winds at Sousse can also be caused by complex low pressure systems with multiple centers at the surface which are a common event in the western Mediterranean basin. One center usually can be found in the Gulf of Genoa, and another over North Africa; a weak pressure gradient exists between the two systems. Which of these lows will develop depends greatly on the movement of an upper-level (500 mb) shortwave trough (SD minimum). If, for example, the SD minimum moves to the North African coast, the low center in that region will develop; this rapidly increases the pressure gradient, and causes easterly gales over the southern and central portions of the Mediterranean (Brody & Nestor, 1980).

Northwesterly winds. Northwest winds at Sousse are also considered to be dangerous, but due to the limited fetch area, large waves and swell would not be generated near Sousse. Northwesterly winds may have other causes, but strong northwesterlies are likely caused by downstream effects of a strong mistral that originates over the Gulf of Lion (Figure 3-1). A visit to the Port of Bizerte revealed that strong northwesterlies at Bizerte can be anticipated two days after the onset of a mistral in the Gulf of Lion. It was not mentioned in Sousse, but the same approximate advance warning time should also apply to Sousse.

Brody and Nestor's Regional Forecasting Aids for the Mediterranean Basin thoroughly discusses mistral events. To enable the forecaster visiting Sousse to better understand the threat of northwesterly conditions, the following information is excerpted from Brody and Nestor's document.

> Mistral. The mistral is a cold, strong northwesterly to north-northeasterly offshore wind along part or all of the coast of the Gulf of Lion. Its influence occasionally extends beyond the Gulf of Lion to affect the weather of the entire Mediterranean basin.
>
> The mistral is the result of a combination of the following factors:
>
> (1) The basic circulation that creates a pressure gradient from west to east along the coast of southern France. This pressure gradient is normally associated with Genoa cyclogenesis.
>
> (2) A fall wind effect caused by cold air associated with the mistral moving downslope as it approaches the southern coast of France and thus increasing the wind speed.
>
> (3) A jet-effect wind increase caused by the orographic configuration of the coastline. This phenomenon is observed at the entrance to major mountain gaps such as the

Carcassonne Gap, Rhone Valley, and Durance Valley. It is also observed in the Strait of Bonifacio between Corsica and Sardinia.

(4) A wind increase over the open water resulting from the reduction in the braking effect of surface friction (as compared to the braking effect over land).

Mistral wind speeds often exceed 40 kt and occasionally have reached 100 kt in gusts along the coastal region from Marseille to Toulon. Over the open water in the Gulf of Lion, mistral wind speeds locally greater than 40 kt occurred in nearly 8% of total observations.

The strongest winds associated with a mistral generally occur over the Gulf of Lion, decreasing southeastward. However, synoptic situations producing severe mistrals will often produce associated strong wind regimes extending as far as North Africa, Sicily and Malta. Although the mistral is prevalent during all seasons, severe cases are most common during winter and spring.

Weather associated with mistral events is generally good near the mistral source, but as the cold air moves out over the warmer water, convective cloudiness increases. Very poor atmospheric visibilities also have been reported up to a height of 98 ft (30 m) during cases of extremely strong mistrals because of a layer of spray that extends above the water surface.

Another potential cause of strong northwest to north winds at Sousse is a North African low which moves northeastward across the coast of Tunisia toward Sicily. Strong winds are likely to the west of the northeastward tracking low, especially when the low is accompanied by a tongue of cold air aloft (evident at 500 mb) (Brody & Nestor, 1980).

FICEURLANT (1978) states: "Winds from northwest to northeast are strong and should be watched closely. Winds up to 30 kt from 7 kt in less than an hour have been experienced." Local authorities at Sousse relate that, once blowing, gale force northwesterly winds tend to last for either 3, 6, or 9 days.

B. Spring (March through May

The early spring season is much the same as winter. See section 3.5.A above. North African lows, the common cause of strong easterly winds at Sousse are at their yearly maximum frequency of occurrence during spring. But after April, the events become more infrequently observed, and by the end of May summer weather usually prevails. The cause of strong northwesterly winds at Sousse, the mistral over the Gulf of Lion, is observed through May.

By late season, a sea/land breeze regime with wind speeds of about 11-21 kt (force 4-5) should become established at Sousse. Small boat operations may be affected.

C. Summer (June through September

Summer weather is generally settled with the more hazardous weather events occurring only rarely. Strong mistral events in the Gulf of Lion do not normally occur from June through August so strong northwesterly winds are uncommon during most of the summer at Sousse. North African low activity is also infrequent. By September, however, the possibility of strong mistral events over the Gulf of Lion increases, and the commensurate threat of strong northwesterly winds at Sousse also increases.

Local authorities state that there is a sea/land breeze regime at Sousse, with wind speeds of about 11-21 kt (force 4-5). The ɪ ɔrt Directory (FICEURLANT, 1978) mentions ocean breezes from the east as great as 25 kt prevailing during daylight hours of the summer months. Small boat operations may be affected.

D. Autumn (October)

Autumn, a short, transitional season in the Mediterranean Basin, lasts only for the month of October, and it results in an abrupt change from summer weather to the unsettled weather of winter (Brody and Nestor, 1980). North African lows, which move eastward south of the Atlas Mountains before moving into the central or eastern Mediterranean Sea, are increasingly frequent as winter approaches so strong easterly winds are again possible at Sousse. The probability increases for strong mistral events over the Gulf of Lion with resultant strong northwesterly winds potentially affecting the Port of Sousse. See section 3.5.A above.

3.6 Harbor Protection

As detailed below, the harbor offers little protection from hazardous weather conditions.

3.6.1 Winds

Any wind above 20 kt, with east to southeasterly winds being the worst, can make it dangerous to enter or leave port. Strong easterly winds make entering and leaving the harbor difficult. Both fully loaded and empty ships may experience problems. Ships must drop anchor immediately upon entering the harbor to avoid hitting the seawall on the west side of the harbor.

Northwesterly winds are also considered dangerous, but there is lee shelter available to the north in the Gulf of

Hammamet. The port is not protected from strong northerly winds, and ships have broken moorings during northerly events.

Offshore winds cause no problems, but, according to local authorities, any wind from the sea causes big problems.

3.6.2 Waves

Waves and swell enter the harbor even during locally calm conditions. Reflection of easterly swell affects all moorings and causes ships in the harbor entrance to move laterally. The December 1989 storm generated 13 ft (4 m) swell which entered the harbor and caused extensive damage throughout.

Swell of 3 to 6 ft (1 to 2 m) or less usually has little or no effect on the harbor.

3.7 Protective and Mitigating Measures

3.7.1 Moving to More Protected Waters

Relief from strong northwesterly conditions can be found by moving to the north portion of the Gulf of Hammamet. There is no nearby shelter from strong winds and/or high seas from north clockwise through southeast. The Port of Sfax, approximately 65 n mi south of Sousse, offers the closest protection from most weather scenarios.

3.7.2 Scheduling

Entry to the harbor should be scheduled for early morning, when winds are lightest.

3.8 Local Indicators of Hazardous Weather Conditions

Local authorities state that extremes of good visibility implies bad weather and poor visibility indicates good weather.

Forecasters should be alert for the development of weather scenarios as discussed in section 3.5.A above and briefly addressed below.

East to northeast winds - North African lows have the potential to cause east to northeast winds at Sousse as they move eastward south of the Atlas Mountains prior to their passage through the Gulf of Gabes.

Northwest winds - Strong northwest winds (40 or 50 kt potential) can be expected to occur two days after a strong mistral event is observed in the Gulf of Lion during the September to June period. Local authorities indicate that northwesterly winds tend to blow for either 3, 6 or 9 days at gale force (34-47 kt).

Another potential cause of strong north to northwesterly winds at Sousse is a North African low which moves northeastward across the coast of Tunisia toward Sicily. Strong winds are likely to the west of the northeastward tracking low, especially when the low is accompanied by a tongue of cold air aloft (evident at 500 mb) (Brody and Nestor, 1980).

3.9 Summary of Problems, Actions, and Indicators

Table 3-1 is intended to provide easy-to-use seasonal references for forecasters on ships using the Port of Sousse. Table 2-1 (Section 2) summarizes Table 3-1 and is intended primarily for use by ship captains.

Table 3-1. Potential problem situations at the

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTION
1. <u>Moored - Inner Harbor</u>. Most common in Winter & Spring, uncommon in Summer, possible by Autumn.	a. <u>E'ly winds/waves</u> - May result from E passage of N African low through Gulf of Gabes or deepening low center over N Africa. Winds of 34-47 kt and waves to 13 ft (4 m) may enter the harbor.	a. <u>WORST CONDITIONS FOR THE PORT</u>. THE PORT FERS NO PROTECTION FROM E'LY CONDITIONS. in port are at risk, and should sortie prio wind onset, because navigating the entrance nel during high winds is dangerous. Ships moved laterally by wave reflection in addit being forced toward the W seawall by wind f The nearest port known to offer any protect from E'ly conditions is the Port of Sfax, a 65 n mi S of Sousse.
Most common in Winter & Spring, uncommon in Summer, possible by Autumn.	b. <u>NW'ly winds</u> - Most likely the result of a strong mistral over the Gulf of Lion. May reach port area, but do not generate hazardous waves. Winds tend to blow for either 3, 6, or 9 days at gale force (34-47 kt).	b. NW'ly winds are considered to be dangerou but effect is limited to wind only. If a st event is expected and a sortie is indicated, shelter can be found in the N part of the G Hammamet. Ships remaining in port should double/add mooring lines as necessary, and spect bollards to ensure they are secure.

s at the I Table 3-1. Potential problem situations at the Port of Sousse, Tunisia - ALL SEASONS em si

SIVE ACITIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFO ABOUT POTENTIAL HAZARD	NAF
THE PORT s/waves - May result IONS. ge of N African low tie prio of Gabes or deepen- entrance er over N Africa. Ships 47 kt and waves to in addit may enter the ha - y wind f protect Sfax, a	a. WORST CONDITIONS FOR THE PORT. THE PORT OFFERS NO PROTECTION FROM E'LY CONDITIONS. Ships in port are at risk, and should sortie prior to wind onset, because navigating the entrance channel during high winds is dangerous. Ships may be moved laterally by wave reflection in addition to being forced toward the W seawall by wind force. The nearest port known to offer any protection from E'ly conditions is the Port of Sfax, about 65 n mi S of Sousse.	a. E moving N African lows moving S of t Mountains prior to their passage S of So the Mediterranean Sea at about 35°N are mary sources of strong E or NE winds at N African lows develop over the desert r of the Atlas mountains. The synoptic si favoring development is the presence of trough lying over Spain with its axis ly SW, producing a deep SW'ly flow over NW The presence of a cold front is apparent terial for the development of a low, but is present, development usually occurs b front reaches the mountain range. Strong E'ly winds can also be caused plex low pressure systems with multiple at the surface. One center is usually i Gulf of Genoa, with another over N Afric short wave trough (SD minimum) moves ove African low, it will deepen, causing E'l over the S and central portions of the M nean.	THE E'LY sho gati dan refl W se o of the
dangerous ds - Most likely the If a st strong mistral over dicated, ion. May reach f the Gu ut do not generate hould ves. Winds tend to y, and ner 3, 6, or 9 days cure. e (34-47 kt).	b. NW'ly winds are considered to be dangerous, but effect is limited to wind only. If a strong event is expected and a sortie is indicated, lee shelter can be found in the N part of the Gulf of Hammamet. Ships remaining in port should double/add mooring lines as necessary, and inspect bollards to ensure they are secure.	b. Strong NW winds can be expected at Bi days after a strong Mistral event occurs Gulf of Lion. Because of the close prox Sousse to Bizerte, the same basic time r ship should apply to Sousse. The mistra result of a combination of the following (1) The basic circulation that create sure gradient from W to E along the coas France. This pressure gradient is norma ciated with Genoa cyclogenesis. (2) A fall wind effect caused by cold associated with the mistral moving downs it approaches the S coast of France and increasing the wind speed. (3) A jet-effect wind increase caused orographic configuration of the coastlin (4) A wind increase over the open wat sulting from the reduction in the braking of surface friction (as compared to the effect over land). The strongest winds associated with a generally occur over the Gulf of Lion, de SE. However, synoptic situations produci vere mistrals will often produce associat strong wind regimes extending as far as N Sicily and Malta. Although the mistral is prevalent duri seasons, severe cases are most common dur winter and spring. A diurnal variation i tral strength is noted, with over-water v ties tending to be strongest during the n Another possible cause of strong NW wi Sousse is the passage of a N African low across the coast of Tunisia towards Sicil Strong winds are likely W of the NE track especially when the low is accompanied by tongue of cold air aloft (evident at 500	ered wind orti he N g in as n they

em situations at the Port of Sousse, Tunisia - ALL SEASONS

ER INFO)	NARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
g S of t S of So 5°N are inds at desert r optic si ence of axis ly over NW apparent low, but occurs b . caused ltiple sually i N Afric oves ove sing E'l of the M	THE PORT. THE PORT OF- E'LY CONDITIONS. Ships should sortie prior to gating the entrance chan- dangerous. Ships may be reflection in addition to W seawall by wind force. o offer any protection the Port of Sfax, about	a. E moving N African lows moving S of the Atlas Mountains prior to their passage S of Sousse to the Mediterranean Sea at about 35°N are the primary sources of strong E or NE winds at Sousse. N African lows develop over the desert region S of the Atlas mountains. The synoptic situation favoring development is the presence of an upper trough lying over Spain with its axis lying NE-SW, producing a deep SW'ly flow over NW Africa. The presence of a cold front is apparently immaterial for the development of a low, but when one is present, development usually occurs before the front reaches the mountain range. Strong E'ly winds can also be caused by complex low pressure systems with multiple centers at the surface. One center is usually in the Gulf of Genoa, with another over N Africa. If a short wave trough (SD minimum) moves over the N African low, it will deepen, causing E'ly gales over the S and central portions of the Mediterranean.
ed at Bi t occurs ose prox c time r e mistra ollowing t create the coas is norma by cold ng downs nce and e caused coastlin open wat e braking to the b with a Lion, de produc associat far as N ent duri mmon dur iation i -water v ng the n ng NW wi can low ds Sicil NE track anied by at 500	ered to be dangerous, wind only. If a strong sortie is indicated, lee the N part of the Gulf of g in port should as necessary, and in- they are secure.	b. Strong NW winds can be expected at Bizerte 2 days after a strong Mistral event occurs in the Gulf of Lion. Because of the close proximity of Sousse to Bizerte, the same basic time relationship should apply to Sousse. The mistral is the result of a combination of the following factors: (1) The basic circulation that creates a pressure gradient from W to E along the coast of S France. This pressure gradient is normally associated with Genoa cyclogenesis. (2) A fall wind effect caused by cold air associated with the mistral moving downslope as it approaches the S coast of France and thus increasing the wind speed. (3) A jet-effect wind increase caused by the orographic configuration of the coastline. (4) A wind increase over the open water resulting from the reduction in the braking effect of surface friction (as compared to the braking effect over land). The strongest winds associated with a mistral generally occur over the Gulf of Lion, decreasing SE. However, synoptic situations producing severe mistrals will often produce associated strong wind regimes extending as far as N Africa, Sicily and Malta. Although the mistral is prevalent during all seasons, severe cases are most common during winter and spring. A diurnal variation in mistral strength is noted, with over-water velocities tending to be strongest during the night. Another possible cause of strong NW winds at Sousse is the passage of a N African low NE across the coast of Tunisia towards Sicily. Strong winds are likely W of the NE tracking low, especially when the low is accompanied by a tongue of cold air aloft (evident at 500 mb).

Table 3-1. (Continue

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASI	PC
Sustained events are most common in winter & spring, uncommon in summer and are possible by autumn. Daytime winds may occur during late spring, summer, and early autumn after mid-morning.	c. <u>N'ly winds</u> - May be caused by N African low moving NE across Tunisia toward Sicily, or by sea breeze effects on warm days.	c. N'ly winds pose a hazard to moore Ships remaining in port should doubl lines as necessary, and inspect boll sure they are secure.	'ly rica sia ze e
2. <u>Anchored</u>. Most common in Winter & Spring, uncommon in Summer, possible by Autumn.	a. <u>E'ly winds/waves</u> - May result from E passage of N African low through Gulf of Gabes or deepening low center over N Africa. Winds of 34-47 kt and waves to 20-23 ft (6-7 m) are possible in anchorage.	a. <u>WORST CONDITIONS FOR THE ANCHORAG</u> DRAG ANCHOR TOWARDS SHORE, AND SHOUL PRIOR TO WIND ONSET. The port offer tion from E'ly conditions. The near known to offer any protection from E tions is the Port of Sfax, about 65 Sousse. It is recommended that only sessing a U-boat be anchored out due ardous conditions for small craft.	'ly E p ugh low s of 3 ft drag
Most common in Winter & Spring, uncommon in Summer, possible by Autumn.	b. <u>NW'ly winds</u> - Most likely the result of a strong mistral over the Gulf of Lion. Gale force winds (34-47 kt) reach anchorage, but do not generate hazardous waves due to short fetch area. Winds tend to blow for either 3, 6, or 9 days at gale force (34-47 kt).	b. Strong event may cause anchor drag SE. If a strong event is expected a is indicated, lee shelter can be foun part of the Gulf of Hammamet. It is that only ships possessing a U-boat b out due to the hazardous conditions f craft.	W'ly it o Gulf s (3 but wave . Wi er 3 e (3

Table 3-1. (Continued)

POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTH ABOUT POTENTIAL HAZAR
'ly winds - May be caused by rican low moving NE across sia toward Sicily, or by sea ze effects on warm days.	c. N'ly winds pose a hazard to moored vessels. Ships remaining in port should double/add mooring lines as necessary, and inspect bollards to ensure they are secure.	c. Strong N'ly winds may result f of a N African low S of Sousse, a from E to NW. See 1.b above. Strong post-frontal N winds ma strong NE-SW oriented cold front over Tunisia passes E through Sou Also, N winds strong enough to vering in the entrance channel ar experienced after 1000, likely du breeze effect.
'ly winds/waves - May result E passage of N African low ugh Gulf of Gabes or deepen- low center over N Africa. s of 34-47 kt and waves to 3 ft (6-7 m) are possible in rage.	a. WORST CONDITIONS FOR THE ANCHORAGE. SHIPS MAY DRAG ANCHOR TOWARDS SHORE, AND SHOULD SORTIE PRIOR TO WIND ONSET. The port offers no protection from E'ly conditions. The nearest port known to offer any protection from E'ly conditions is the Port of Sfax, about 65 n mi S of Sousse. It is recommended that only ships possessing a U-boat be anchored out due to the hazardous conditions for small craft.	a. E moving N African lows moving Mountains prior to their passage the Mediterranean Sea at about 35 mary sources of strong E or NE wi N African lows develop over the d of the Atlas mountains. The syno favoring development is the prese trough lying over Spain with its SW, producing a deep SW'ly flow o The presence of a cold front is a terial for the development of a l is present, development usually o front reaches the mountain range. Strong E'ly winds can also be plex low pressure systems with mu at the surface. One center is us Gulf of Genoa, with another over short wave trough (SD minimum) mo African low, it will deepen, caus over the S and central portions o nean.
W'ly winds - Most likely the t of a strong mistral over Gulf of Lion. Gale force s (34-47 kt) reach anchor- but do not generate hazard- waves due to short fetch . Winds tend to blow for er 3, 6, or 9 days at gale e (34-47 kt).	b. Strong event may cause anchor dragging toward SE. If a strong event is expected and a sortie is indicated, lee shelter can be found in the N part of the Gulf of Hammamet. It is recommended that only ships possessing a U-boat be anchored out due to the hazardous conditions for small craft.	b. Strong NW winds can be expecte days after a strong Mistral event Gulf of Lion. Because of the clo Sousse to Bizerte, the same basic ship should apply to Sousse. The result of a combination of the fo (1) The basic circulation that sure gradient from W to E along t France. This pressure gradient i ciated with Genoa cyclogenesis. (2) A fall wind effect caused associated with the mistral movin it approaches the S coast of Fran increasing the wind speed. (3) A jet-effect wind increase orographic configuration of the c (4) A wind increase over the o sulting from the reduction in the of surface friction (as compared effect over land). The strongest winds associated generally occur over the Gulf of SE. However, synoptic situations vere mistrals will often produce strong wind regimes extending as Sicily and Malta.

-1. (Continued)

AND OTH L HAZARI	NARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
result f Sousse, a bove. winds ma ld front rough Sou enough to iannel ar likely du	zard to moored vessels. should double/add mooring inspect bollards to en-	c. Strong N'ly winds may result from the passage of a N African low S of Sousse, as the winds back from E to NW. See 1.b above. Strong post-frontal N winds may result if a strong NE-SW oriented cold front which extends over Tunisia passes E through Sousse. Also, N winds strong enough to affect maneuvering in the entrance channel are occasionally experienced after 1000, likely due to a sea breeze effect.
vs moving passage about 35 or NE wi er the d The syno he prese ith its y flow o ont is a t of a l usually o n range. also be with mu er is us er over imum) mo en, caus. rtions o	THE ANCHORAGE. SHIPS MAY RE, AND SHOULD SORTIE he port offers no protec- ns. The nearest port ection from E'ly condi- ax, about 65 n mi S of ded that only ships pos- hored out due to the haz- mall craft.	a. E moving N African lows moving S of the Atlas Mountains prior to their passage S of Sousse to the Mediterranean Sea at about 35°N are the primary sources of strong E or NE winds at Sousse. N African lows develop over the desert region S of the Atlas mountains. The synoptic situation favoring development is the presence of an upper trough lying over Spain with its axis lying NE-SW, producing a deep SW'ly flow over NW Africa. The presence of a cold front is apparently immaterial for the development of a low, but when one is present, development usually occurs before the front reaches the mountain range. Strong E'ly winds can also be caused by complex low pressure systems with multiple centers at the surface. One center is usually in the Gulf of Genoa, with another over N Africa. If a short wave trough (SD minimum) moves over the N African low, it will deepen, causing E'ly gales over the S and central portions of the Mediterranean.
expecte al event the clo me basic se. The f the fo ion that along t adient i nesis. caused al movin of Fran . increase of the c er the o n in the ompared t sociated Gulf of I tuations produce ding as	se anchor dragging toward s expected and a sortie r can be found in the N amet. It is recommended ng a U-boat be anchored conditions for small	b. Strong NW winds can be expected at Bizerte 2 days after a strong Mistral event occurs in the Gulf of Lion. Because of the close proximity of Sousse to Bizerte, the same basic time relationship should apply to Sousse. The mistral is the result of a combination of the following factors: (1) The basic circulation that creates a pressure gradient from W to E along the coast of S France. This pressure gradient is normally associated with Genoa cyclogenesis. (2) A fall wind effect caused by cold air associated with the mistral moving downslope as it approaches the S coast of France and thus increasing the wind speed. (3) A jet-effect wind increase caused by the orographic configuration of the coastline. (4) A wind increase over the open water resulting from the reduction in the braking effect of surface friction (as compared to the braking effect over land). The strongest winds associated with a mistral generally occur over the Gulf of Lion, decreasing SE. However, synoptic situations producing severe mistrals will often produce associated strong wind regimes extending as far as N Africa, Sicily and Malta.

Table 3-1. (Continued)

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE
Sustained events are most common in winter & spring, uncommon in summer and are possible by autumn. Daytime winds may occur during late spring, summer, and early autumn after mid-morning.	c. <u>N'ly winds/waves</u> - May be caused by N African low moving NE across Tunisia toward Sicily, or by sea breeze effects on warm days.	c. Strong event may cause anchor drag S. It is recommended that only ships a U-boat be anchored out due to the h conditions for small craft.
3. <u>Arriving/ departing.</u> Most common in Winter & Spring, uncommon in Summer, possible by Autumn.	a. <u>E'ly winds/waves</u> - May result from E passage of N African low through Gulf of Gabes or deepening low center over N Africa. Winds of 34-47 kt and waves to 20-23 ft (6-7 m) may reach anchorage and waves to 13 ft (4 m) may enter harbor.	a. <u>WORST CONDITIONS FOR THE PORT</u>. THE FERS NO PROTECTION FROM E'LY CONDITION in the harbor are at risk, and should if prior to wind onset, because navigatin trance channel during high winds is da Ships may be moved laterally by wave in addition to being forced toward the by wind force. Ships in the anchorage anchor towards shore. The nearest por offer any protection from E'ly conditi Port of Sfax, about 65 n mi S of Souss
Most common in Winter & Spring, uncommon in Summer, possible by Autumn.	b. <u>NW'ly winds</u> - Most likely the result of a strong mistral over the Gulf of Lion. Gale force winds (34-47 kt) may reach inner harbor and anchorage, but do not generate hazardous waves due to short fetch area. Winds tend to blow for either 3, 6, or 9 days at gale force (34-47 kt).	b. NW'ly winds are considered to be da but effect is limited t ind only. I event is expected, ship can find lee f the N part of the Gulf of Hammamet. vessels should sortie prior to wind on navigating through the entrance channe gerous during high winds. Ships arriv wind onset should inspect bollards to are secure and add/double mooring line sary. Ships inbound to the anchorage aware of potential for anchor dragging

ntinued)

Table 3-1. (Continued)

Y/EVASIVENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER IN ABOUT POTENTIAL HAZARD
		Although the mistral is prevalent dur seasons, severe cases are most common du winter and spring. A diurnal variation tral strength is noted, with over-water ties tending to be strongest during the Another possible cause of strong NW Sousse is the passage of a N African lo across the coast of Tunisia towards Sic. Strong winds are likely W of the NE tra especially when the low is accompanied tongue of cold air aloft (evident at 50
chor dragnds/waves - May be nly ships N African low moving to the h Tunisia toward Sicily, breeze effects on warm	c. Strong event may cause anchor dragging toward S. It is recommended that only ships possessing a U-boat be anchored out due to the hazardous conditions for small craft.	c. Strong N'ly winds may result from the of a N African low S of Sousse, as the from E to NW. See 1.b above. Strong post-frontal N winds may resu strong NE-SW oriented cold front which over Tunisia passes E through Sousse. Also, N winds strong enough to affect vering in the entrance channel are occas experienced after 1000, likely due to a breeze effect.
PORT. THEnds/waves - May result CONDITIONsage of N African low d should lf of Gabes or deepen- navigatinnter over N Africa. nds is da4-47 kt and waves to by wave r6-7 m) may reach an- toward thed waves to 13 ft (4 m) anchorageharbor. earest por y conditi of Souss	a. <u>WORST CONDITIONS FOR THE PORT</u>. THE PORT OFFERS NO PROTECTION FROM E'LY CONDITIONS. Ships in the harbor are at risk, and should sortie prior to wind onset, because navigating the entrance channel during high winds is dangerous. Ships may be moved laterally by wave reflection in addition to being forced toward the W seawall by wind force. Ships in the anchorage may drag anchor towards shore. The nearest port known to offer any protection from E'ly conditions is the Port of Sfax, about 65 n mi S of Sousse.	a. E moving N African lows moving S of t Mountains prior to their passage S of So the Mediterranean Sea at about 35°N are mary sources of strong E or NE winds at N African lows develop over the desert of the Atlas mountains. The synoptic s favoring development is the presence of trough lying over Spain with its axis l SW, producing a deep SW'ly flow over NW The presence of a cold front is apparent terial for the development of a low, but is present, development usually occurs front reaches the mountain range. Strong E'ly winds can also be caused plex low pressure systems with multiple at the surface. One center is usually Gulf of Genoa, with another over N Afric short wave trough (SD minimum) moves ove African low, it will deepen, causing E'l over the S and central portions of the M nean.
to be dainds - Most likely the only. Ia strong mistral over find lee f Lion. Gale force mamet. 047 kt) may reach inner o wind on anchorage, but do not ce channeazardous waves due to ips arrivh area. Winds tend to lards to ather 3, 6, or 9 days ring linerce (34-47 kt). anchorage dragging	b. NW'ly winds are considered to be dangerous, but effect is limited to wind only. If a strong event is expected, ships can find lee shelter in the N part of the Gulf of Hammamet. Outbound vessels should sortie prior to wind onset because navigating through the entrance channel is dangerous during high winds. Ships arriving before wind onset should inspect bollards to ensure they are secure and add/double mooring lines as necessary. Ships inbound to the anchorage should be aware of potential for anchor dragging to the SE.	b. Strong NW winds can be expected at 3 days after a strong Mistral event occurs Gulf of Lion. Because of the close prox Sousse to Bizerte, the same basic time r ship should apply to Sousse. The mistra result of a combination of the following (1) The basic circulation that create sure gradient from W to E along the coas France. This pressure gradient is norma ciated with Genoa cyclogenesis. (2) A fall wind effect caused by cold associated with the mistral moving downs it approaches the S coast of France and increasing the wind speed.

Continued)

HER IN RD	RY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
nt dur mon du ation water g the ng NW can lo ds Sic. NE trac anied at 50		Although the mistral is prevalent during all seasons, severe cases are most common during winter and spring. A diurnal variation in mistral strength is noted, with over-water velocities tending to be strongest during the night. Another possible cause of strong NW winds at Sousse is the passage of a N African low NE across the coast of Tunisia towards Sicily. Strong winds are likely W of the NE tracking low, especially when the low is accompanied by a tongue of cold air aloft (evident at 500 mb).
rom th s the resu which sse. affect occas to a	anchor dragging toward only ships possessing ue to the hazardous .	c. Strong N'ly winds may result from the passage of a N African low S of Sousse, as the winds back from E to NW. See 1.b above. Strong post-frontal N winds may result if a strong NE-SW oriented cold front which extends over Tunisia passes E through Sousse. Also, N winds strong enough to affect maneuvering in the entrance channel are occasionally experienced after 1000, likely due to a sea breeze effect.
S of t of S N are ds at esert tic si ce of xis l er NW parent w, but curs aused tiple ally Afric es ove ng E'l the M	PORT. THE PORT OF- Y CONDITIONS. Ships and should sortie e navigating the en- winds is dangerous. y by wave reflection toward the W seawall he anchorage may drag nearest port known to 'ly conditions is the S of Sousse.	a. E moving N African lows moving S of the Atlas Mountains prior to their passage S of Sousse to the Mediterranean Sea at about 35°N are the primary sources of strong E or NE winds at Sousse. N African lows develop over the desert region S of the Atlas mountains. The synoptic situation favoring development is the presence of an upper trough lying over Spain with its axis lying NE-SW, producing a deep SW'ly flow over NW Africa. The presence of a cold front is apparently immaterial for the development of a low, but when one is present, development usually occurs before the front reaches the mountain range. Strong E'ly winds can also be caused by complex low pressure systems with multiple centers at the surface. One center is usually in the Gulf of Genoa, with another over N Africa. If a short wave trough (SD minimum) moves over the N African low, it will deepen, causing E'ly gales over the S and central portions of the Mediterranean.
at Bi occurs e prox time mistra lowing create e coas norma y cold downs e and	red to be dangerous, nd only. If a strong n find lee shelter in Hammamet. Outbound to wind onset because rance channel is dan- Ships arriving before bollards to ensure they mooring lines as neces- e anchorage should be or dragging to the SE.	b. Strong NW winds can be expected at Bizerte 2 days after a strong Mistral event occurs in the Gulf of Lion. Because of the close proximity of Sousse to Bizerte, the same basic time relationship should apply to Sousse. The mistral is the result of a combination of the following factors: (1) The basic circulation that creates a pressure gradient from W to E along the coast of S France. This pressure gradient is normally associated with Genoa cyclogenesis. (2) A fall wind effect caused by cold air associated with the mistral moving downslope as it approaches the S coast of France and thus increasing the wind speed.

Table 3-1. (Continued)

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASI
Sustained events are most common in winter & spring, uncommon in summer and are possible by autumn. Daytime winds may occur during late spring, summer, and early autumn after mid-morning.	c. N'ly winds/waves - May be caused by N African low moving NE across Tunisia toward Sicily, or by sea breeze effects on warm days.	c. Strong event may cause steerage pro the channel for inbound and outbound v High speed maneuvering may be require N'ly winds will cause channel marker b set as much as 750 ft (228.6 m) S and ed position. Upon arriving, ships cre inspect bollards to ensure they are se add/double mooring lines as necessary. inbound to the anchorage should be awa tential for anchor dragging to the S.
4. Small boats. Most common in Winter & Spring, uncommon in Summer, possible by Autumn.	a. E'ly winds/waves - May result from E passage of N African low through Gulf of Gabes or deepening low center over N Africa. Winds of 34-47 kt and waves to 20-23 ft (6-7 m) may occur in anchorage and waves to 13 ft (4 m) may enter harbor.	a. Small boat operations to/from the a may be curtailed due to high winds/wav cially after mid-morning. Only ships a U-boat sized small craft should atte boat operations during any significan event.

Table 3-1. (Continued)

TENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER ABOUT POTENTIAL HAZARD
		(3) A jet-effect wind increase ca orographic configuration of the coas (4) A wind increase over the open sulting from the reduction in the br of surface friction (as compared to effect over land). The strongest winds associated wi generally occur over the Gulf of Lic SE. However, synoptic situations pr vere mistrals will often produce ass strong wind regimes extending as far Sicily and Malta. Although the mistral is prevalent seasons, severe cases are most commc winter and spring. A diurnal variat tral strength is noted, with over-wa ties tending to be strongest during Another possible cause of strong Sousse is the passage of a N Africar across the coast of Tunisia towards Strong winds are likely W of the NE especially when the low is accompan tongue of cold air aloft (evident at
inds/waves - May be N African low moving ss Tunisia toward Sicily, breeze effects on warm	c. Strong event may cause steerage problems in the channel for inbound and outbound vessels. High speed maneuvering may be required. Strong N'ly winds will cause channel marker buoys to be set as much as 750 ft (228.6 m) S and E of charted position. Upon arriving, ships crews should inspect bollards to ensure they are secure and add/double mooring lines as necessary. Ships inbound to the anchorage should be aware of potential for anchor dragging to the S.	c. Strong N'ly winds may result fro of a N African low S of Sousse, as t from E to NW. See 1.b above. Strong post-frontal N winds may strong NE-SW oriented cold front wh over Tunisia passes E through Sousse Also, N winds strong enough to a vering in the entrance channel are experienced after 1000, likely due t breeze effect.
winds/waves - May result ssage of N African low ulf of Gabes or deepen- center over N Africa. 34-47 kt and waves to (6-7 m) may occur in e and waves to 13 ft (4 nter harbor.	a. Small boat operations to/from the anchorage may be curtailed due to high winds/waves, especially after mid-morning. Only ships possessing a U-boat sized small craft should attempt small boat operations during any significant wind event.	a. E moving N African lows moving Mountains prior to their passage S the Mediterranean Sea at about 35°N mary sources of strong E or NE wind N African lows develop over the des of the Atlas mountains. The synopt favoring development is the presenc trough lying over Spain with its ax SW, producing a deep SW'ly flow ove The presence of a cold front is app terial for the development of a low is present, development usually occ front reaches the mountain range. Strong E'ly winds can also be ca plex low pressure systems with mult at the surface. One center is usua Gulf of Genoa, with another over N short wave trough (SD minimum) move African low, it will deepen, causin over the S and central portions of nean.

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D OTHER HAZARD	:Y/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
crease ca the coas the open in the br pared to ciated wi lf of Lic ations pr oduce ass ng as far prevalent ost commc al variat h over-wa t during f strong N Africar towards f the NE accompan: vident at		(3) A jet-effect wind increase caused by the orographic configuration of the coastline. (4) A wind increase over the open water resulting from the reduction in the braking effect of surface friction (as compared to the braking effect over land). The strongest winds associated with a mistral generally occur over the Gulf of Lion, decreasing SE. However, synoptic situations producing severe mistrals will often produce associated strong wind regimes extending as far as N Africa, Sicily and Malta. Although the mistral is prevalent during all seasons, severe cases are most common during winter and spring. A diurnal variation in mistral strength is noted, with over-water velocities tending to be strongest during the night. Another possible cause of strong NW winds at Sousse is the passage of a N African low NE across the coast of Tunisia towards Sicily. Strong winds are likely W of the NE tracking low, especially when the low is accompanied by a tongue of cold air aloft (evident at 500 mb).
sult fror sse, as t e. nds may r front wh: gh Sousse ugh to a! nel are ely due t	ɜerage problems in ɔutbound vessels. ə required. Strong ı marker buoys to be m) S and E of chart- ships crews should ney are secure and necessary. Ships uld be aware of po- to the S.	c. Strong N'ly winds may result from the passage of a N African low S of Sousse, as the winds back from E to NW. See 1.b above. Strong post-frontal N winds may result if a strong NE-SW oriented cold front which extends over Tunisia passes E through Sousse. Also, N winds strong enough to affect maneuvering in the entrance channel are occasionally experienced after 1000, likely due to a sea breeze effect.
moving S assage S oout 35°N r NE wind r the des ne synopt e presenc th its ax flow ove nt is app of a low ually occ range. lso be ca with mult t is usua r over N um) move , causin tions of	from the anchorage winds/waves, espe- nıy ships possessing hould attempt small ıgnificant wind	a. E moving N African lows moving S of the Atlas Mountains prior to their passage S of Sousse to the Mediterranean Sea at about 35°N are the primary sources of strong E or NE winds at Sousse. N African lows develop over the desert region S of the Atlas mountains. The synoptic situation favoring development is the presence of an upper trough lying over Spain with its axis lying NE-SW, producing a deep SW'ly flow over NW Africa. The presence of a cold front is apparently immaterial for the development of a low, but when one is present, development usually occurs before the front reaches the mountain range. Strong E'ly winds can also be caused by complex low pressure systems with multiple centers at the surface. One center is usually in the Gulf of Genoa, with another over N Africa. If a short wave trough (SD minimum) moves over the N African low, it will deepen, causing E'ly gales over the S and central portions of the Mediterranean.

Table 3-1. (Continued)

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASI
Most common in Winter & Spring, uncommon in Summer,possible by Autumn.	b. <u>NW'ly winds</u> - Most likely the result of a strong mistral over the Gulf of Lion. Gale force winds (34-47 kt) may reach inner harbor and anchorage, but do not generate hazardous waves due to short fetch area. Winds tend to blow for either 3, 6, or 9 days at gale force (34-47 kt).	b. Small boat operations to/from the may be curtailed due to high winds. possessing a U-boat sized small craf attempt small boat operations during cant wind event.
Sustained events are most common in winter & spring, uncommon in summer and are possible by autumn. Daytime winds may occur during late spring, summer, and early autumn after mid-morning.	c. <u>N'ly winds/waves</u> - May be caused by N African low moving NE across Tunisia toward Sicily, or by sea breeze effects on warm days.	c. Small boat operations to/from the may be curtailed due to high winds/w cially after mid-morning. Only ship a U-boat sized small craft should at boat operations during any significa event.

(Continued)

Table 3-1. (Continued)

NARY/EVASI	ENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER ABOUT POTENTIAL HAZARD
. to/from the high winds. 'd small craf tions during	winds - Most likely the a strong mistral over of Lion. Gale force -47 kt) may reach inner d anchorage, but do not hazardous waves due to ch area. Winds tend to either 3, 6, or 9 days orce (34-47 kt).	b. Small boat operations to/from the anchorage may be curtailed due to high winds. Only ships possessing a U-boat sized small craft should attempt small boat operations during any significant wind event.	b. Strong NW winds can be expected days after a strong Mistral event oc Gulf of Lion. Because of the close Sousse to Bizerte, the same basic t ship should apply to Sousse. The mi result of a combination of the follo (1) The basic circulation that cr sure gradient from W to E along the France. This pressure gradient is n ciated with Genoa cyclogenesis (2) A fall wind effect caused by associated with the mistral moving d it approaches the S coast of France increasing the wind speed. (3) A jet-effect wind increase ca orographic configuration of the coas (4) A wind increase over the open sulting from the reduction in the br of surface friction (as compared to effect over land). The strongest winds associated wi generally occur over the Gulf of Lic SE. However, synoptic situations pr vere mistrals will often produce ass strong wind regimes extending as far Sicily and Malta. Although the mistral is prevalent seasons, severe cases are most commo winter and spring. A diurnal variat tral strength is noted, with over-wa ties tending to be strongest during Another possible cause of strong Sousse is the passage of a N African across the coast of Tunisia towards Strong winds are likely W of the NE especially when the low is accompani tongue of cold air aloft (evident at
to/from the high winds/w . Only ship ft should at ny significa	nds, waves - May be N African low moving Tunisia toward Sicily, breeze effects on warm	c. Small boat operations to/from the anchorage may be curtailed due to high winds/waves, especially after mid-morning. Only ships possessing a U-boat sized small craft should attempt small boat operations during any significant wind event.	c. Strong N'ly winds may result fro of a N African low S of Sousse, as t from E to NW. See 1.b above. Strong post-frontal N winds may r strong NE-SW oriented cold front wh over Tunisia passes E through Sousse. Also, N winds strong enough to af vering in the entrance channel are o experienced after 1000, likely due t breeze effect.

(Continued)

NARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
s to/from the anchorage high winds. Only ships ed small craft should ations during any signifi-	b. Strong NW winds can be expected at Bizerte 2 days after a strong Mistral event occurs in the Gulf of Lion. Because of the close proximity of Sousse to Bizerte, the same basic time relationship should apply to Sousse. The mistral is the result of a combination of the following factors: (1) The basic circulation that creates a pressure gradient from W to E along the coast of S France. This pressure gradient is normally associated with Genoa cyclogenesis. (2) A fall wind effect caused by cold air associated with the mistral moving downslope as it approaches the S coast of France and thus increasing the wind speed. (3) A jet-effect wind increase caused by the orographic configuration of the coastline. (4) A wind increase over the open water resulting from the reduction in the braking effect of surface friction (as compared to the braking effect over land). The strongest winds associated with a mistral generally occur over the Gulf of Lion, decreasing SE. However, synoptic situations producing severe mistrals will often produce associated strong wind regimes extending as far as N Africa, Sicily and Malta. Although the mistral is prevalent during all seasons, severe cases are most common during winter and spring. A diurnal variation in mistral strength is noted, with over-water velocities tending to be strongest during the night. Another possible cause of strong NW winds at Sousse is the passage of a N African low NE across the coast of Tunisia towards Sicily. Strong winds are likely W of the NE tracking low, especially when the low is accompanied by a tongue of cold air aloft (evident at 500 mb).
s to/from the anchorage high winds/waves, espe- g. Only ships possessing aft should attempt small any significant wind	c. Strong N'ly winds may result from the passage of a N African low S of Sousse, as the winds back from E to NW. See 1.b above. Strong post-frontal N winds may result if a strong NE-SW oriented cold front which extends over Tunisia passes E through Sousse. Also, N winds strong enough to affect maneuvering in the entrance channel are occasionally experienced after 1000, likely due to a sea breeze effect.

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PORT VISIT INFORMATION

JANUARY 1990. NOARL Meteorologists R. Fett and Lieutenant M. Evans, U.S. Navy, met with Pilots Hochlaf Tayaa, Boubaker Hachem, and Mahfoudhi Amor to obtain much of the information included in this port evaluation.

APPENDIX A

General Purpose Oceanographic Information

This section provides some general definitions regarding waves and is extracted from H.O. Pub. No. 603, Practical Methods for Observing and Forecasting Ocean Waves (Pierson, Neumann, and James, 1955).

Definitions

Waves that are being generated by local winds are called "SEA". WAVES that have traveled out of the generating area are known as "SWELL". Seas are chaotic in period, height and direction while swell approaches a simple sine wave pattern as its distance from the generating area increases. An in-between state exists for a few hundred miles outside the generating area and is a condition that reflects parts of both of the above definitions. In the Mediterranean area, because its fetches and open sea expanses are limited, SEA or IN-BETWEEN conditions will prevail. The "SIGNIFICANT WAVE HEIGHT" is defined as the average value of the heights of the one-third highest waves. PERIOD and WAVE LENGTH refer to the time between passage of, and distances between, two successive crests on the sea surface. The FREQUENCY is the reciprocal of the period ($f = 1/T$); therefore as the period increases the frequency decreases. Waves result from the transfer of energy from the wind to the sea surface. The area over which the wind blows is known as the FETCH, and the length of time that the wind has blown is the DURATION. The characteristics of waves (height, length, and period) depend on the duration, fetch, and velocity of the wind. There is a continuous generation of small short waves from the time the wind starts until it stops. With continual transfer of energy from the wind to the sea surface the waves grow with the older waves leading the growth and spreading the energy over a greater range of frequencies. Throughout the growth cycle a SPECTRUM of ocean waves is being developed.

A Beaufort Scale table with related wave effects is shown on the following page.

BEAUFORT SCALE

Beaufort Number	Wind Speed Knots	Wind Speed MPH	Seaman's term	Effects observed at sea	Term and height of Waves in meters
0	Under 1	Under 1	Calm	Sea like mirror.	Calm, glassy, 0
1	1-3	1-3	Light air	Ripples with appearance of scales; no foam crests.	
2	4-6	4-7	Light breeze	Small wavelets; crests of glassy appearance, not breaking	Rippled, less than 0.5
3	7-10	8-12	Gentle breeze	Large wavelets; crests begin to break; scattered whitecaps.	Smooth, 0.5
4	11-16	13-18	Moderate breeze	Small waves, becoming longer; numerous whitecaps.	Slight, 1.0
5	17-21	19-24	Fresh breeze	Moderate waves, taking longer form; many whitecaps; some spray.	Moderate, 1.0-2.5
6	22-27	25-31	Strong breeze	Larger waves forming; whitecaps everywhere; more spray.	Rough, 2.5-4.0
7	28-33	32-38	Moderate gale	Sea heaps up; white foam from breaking waves begins to be blown up in streaks.	Very rough, 4.0-6.0
8	34-40	39-46	Fresh gale	Moderate high waves; edges of crests begin to break; foam is blown in steaks.	
9	41-47	47-54	Strong gale	High waves; sea begins to roll; dense streaks of foam; spray may reduce visibility.	
10	48-55	55-63	Whole gale	Very high waves with overhanging crests; sea takes white appearance as foam is blown in very dense streaks; rolling is heavy and visibility reduced.	High, 6.0-9.0
11	56-63	64-72	Storm	Exceptionally high waves; sea covered with white foam patches; visibility still more reduced.	Very high, 9.0-13.5
12 13 14 15 16 17	64-71 72-80 81-89 90-99 100-108 109-118	73-82 83-92 93-103 104-114 115-125 126-136	Hurricane	Air filled with foam; sea completely white with driving spray; visibility greatly reduced. Winds of force 12 and above very rarely experienced on land; usually accompanied by widespread damage.	Phenomenal, greater than 13.5

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21A1	CINCLANTFLT
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24D1	Surface Force Commander LANT
24E	Mine Warfare Command
24G1	Submarine Force Commander LANT
26QQ1	Special Warfare Group LANT
28A1	Carrier Group LANT (2)
28B1	Cruiser-Destroyer Group LANT (2)
28D1	Destroyer Squadron LANT (2)
28J1	Service Group and Squadron LANT (2)
28K1	Submarine Group and Squadron LANT
28L1	Amphibious Squadron LANT (2)
29A1	Guided Missile Cruiser LANT
29B1	Aircraft Carrier LANT
29D1	Destroyer LANT (DO 931/945 Class)
29E1	Destroyer LANT (DO 963 Class)
29F1	Guided Missile Destroyer LANT
29G1	Guided Missile Frigate (LANT)
29I1	Frigate LANT (FF 1098)
29J1	Frigate LANT (FF 1040/1051 Class)
29K1	Frigate LANT (FF 1052/1077 Class)
29L1	Frigate LANT (FF 1078/1097 Class)
29N1	Submarine LANT #SSN)
29Q	Submarine LANT SSBN
29R1	Battleship Lant (2)
29AA1	Guided Missile Frigate LANT (FFG 7)
29BB1	Guided Missile Destroyer (DDG 993)
31A1	Amphibious Command Ship LANT (2)
31B1	Amphibious Cargo Ship LANT
31G1	Amphibious Transport Ship LANT
31H1	Amphibious Assault Ship LANT (2)
31I1	Dock Landing Ship LANT
31J1	Dock Landing Ship LANT
31M1	Tank Landing Ship LANT
32A1	Destroyer Tender LANT
32C1	Ammunition Ship LANT
32G1	Combat Store Ship LANT
32H1	Fast Combat Support Ship LANT
32N1	Oiler LANT
32Q1	Replenishment Oiler LANT
32S1	Repair Ship LANT
32X1	Salvage Ship LANT

32DD1	Submarine Tender LANT
32EE1	Submarine Rescue Ship LANT
32KK	Miscellaneous Command Ship
32QQ1	Salvage and Rescue Ship LANT
32TT	Auxiliary Aircraft Landing Training Ship
42N1	Air Anti-Submarine Squadron VS LANT
42P1	Patrol Wing and Squadron LANT
42BB1	Helicopter Anti-Submarine Squadron HS LANT
42CC1	Helicopter Anti-Submarine Squadron Light HSL LANT
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24F	Logistics Command
24H1	Fleet Training Command LANT
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29B2	Aircraft Carrier PAC (2)
29R2	Battleships PAC (2)
31A2	Amphibious Command Ship PAC (2)
31H2	Amphibious Assault Ship PAC (2)
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Istituto Di Meteorolgia E
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Via Amm, Acton, 38 Italy

NOARL-W
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SMM/Documentation
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France

Meteorologie Nationale
1 Quai Branly
75, Paris (7)
France

Ozeanographische
Forschungsantalt Bundeswehr
Lornsenstrasse 7, Kiel
Federal Republic of Germany

Institut fur Meereskunde Der
Universitat Hamburg
Heimhuderstrasse 71
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Federal Republic of Germany

Consiglio Nazionale Delle
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Istituto Talassografico Di
Trieste, Viale R. Gessi 2
34123 Trieste, Italy

Centro Nazionale Di Meteorolo.
E Climatologia Aeronautica
Piazzale Degli Archivi 34
00144 Roma, Italy

Director, SACLANT ASW
Research Centre
Viale San Bartolomeo, 400
I-19026 La Spezia, Italy

Mr. Dick Gilmore
2145 N. Fairway Ct.
Oak Harbor, WA 98277

Director of Naval Oceano.
& Meteorology
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Old War Office Bldq.
London, S.W.1. England

Belgian Air Staff
VS3/CTL-MET
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29275 - Brest Cedex, France

Direction De La Meteorologie
Attn: J. Dettwiller, MN/RE
77 Rue De Sevres
92106 Boulogne-Billancourt
Cedex, France

Institut fur Meereskunde
An Der Universitat Kiel
Dusternbrooker Weg 20
23 Kiel
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Tauschstelle, Postfach 220
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Chief, Marine Sci. Section
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Commander
NAVSURFWEACEN, Code R42
Dr. Katz, White Oaks Lab
Silver Spring, MD 20903-5000

Drector, Atlantic Marine
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Coast & Geodetic Survey,
9 W. York St.
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Asst. SECNAV (R&D)
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& Limnology
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Code 1122AT, Atmos. Sciences
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Jefe del, Servicio de Aplica.
Aeronauticas y Maritimas
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Calle Universitaria
Apartado 285, 28071 Madrid
Espana SPAIN

The Joint Staff (J-3/ESD)
Environmental Services Div.
Operations Directorate
Washington, DC 20318-3000

Danish Defence Weather Serv.
Chief of Defence
P.O. Box 202
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Federal Coord. for Meteoro.
Servs. & Sup. Rsch. (OFCM)
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Director
National Oceano. Data Center
E/OC23, NOAA
Washington, DC 20235

Science Applications
Intl. Corp. (SAIC)
205 Montecito Ave.
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D.C. Perryman (NOARL)

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Science Applications International Corporation (SAIC)
205 Montecito Ave., Monterey, CA 93940

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This handbook for the port of Sousse, one in a series of severe weather guides for Mediterranean ports, provides decision-making guidance for ship captains whose vessels are threatened by actual or forecast strong winds, high seas, restricted visibility or thunderstorms in the port vicinity. Causes and effects of such hazardous conditions are discussed. Precautionary or evasive actions are suggested for various vessel situations. The handbook is organized in four sections for ready reference: general guidance on handbook content and use; a quick-look captain's summary; a more detailed review of general information on environmental conditions; and an appendix that provides oceanographic information.

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