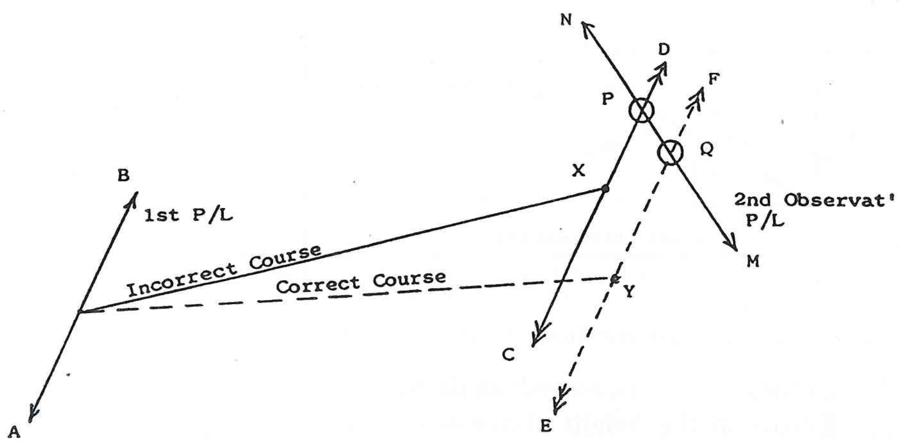
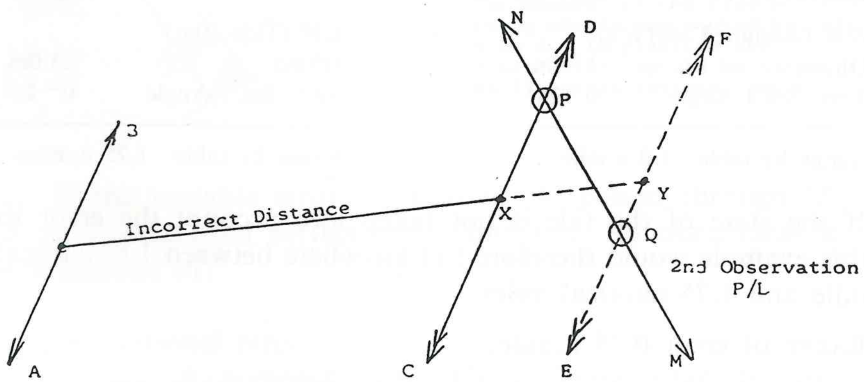
Example 4 Errors in the use of transferred position lines.

1. Errors arising from an incorrect course being used. Incorrect course used because of wind effects or unknown currents, compass fault etc.



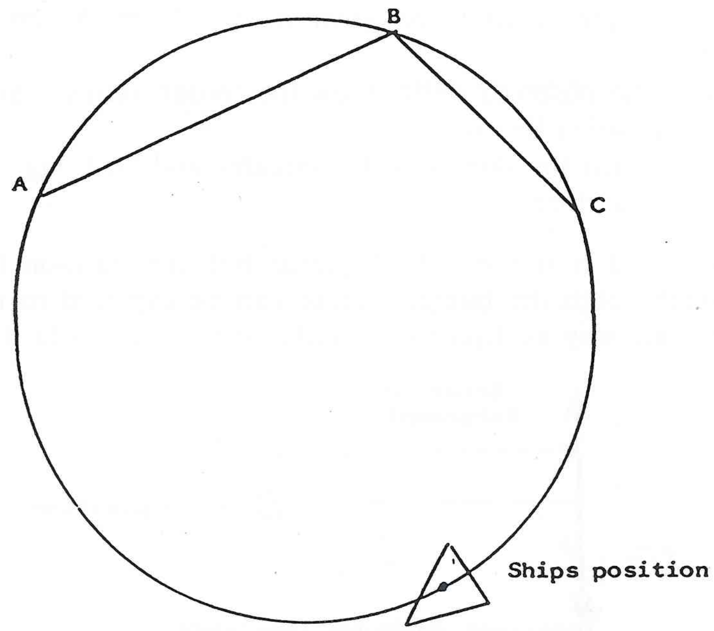
Transferred P/L incorrectly drawn through position 'X'. If correct course is used, transferred P/L should pass through 'Y'. Error in the fix is 'PQ' where position 'Q' is correct fix.

2. Errors arising from incorrect distance being employed between 1st/2nd P/L's.



The Use of Horizontal Sextant Angles

The impossible fix — when the three objects and the ship, all lie on the same position circle, (con-cyclic). Both constructed position circles would be coincident.



Notable errors when employing horizontal sextant angles:

1. Errors in angular measurement from instrument.
2. Plotting errors, (especially when angles exceed 90°).
3. Errors due to the three objects not being in the same plane.

Unsatisfactory fixes:

1. When the distance to the middle object is large, (from the ship).
2. When the angle of cut of the position circles is small.
3. Using the compass for obtaining difference in bearings when the ship is rolling heavily and the compass is unsteady.

Example 6 Errors in astronomical position lines

1. An error in GMT at time of observation:

   An error in the GMT will cause an error in the GHA value. e.g. A 4 second error in GMT causes 1' error in GHA, therefore in Longitude,

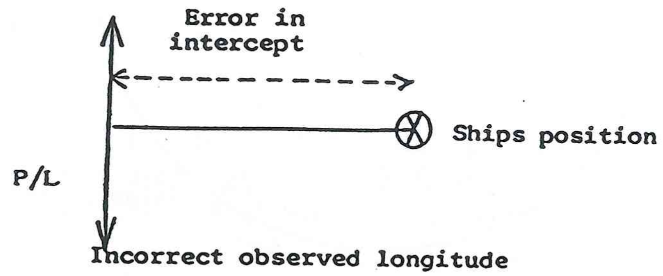
   Longitude = LHA ~ GHA

   This would result in an error of 1 mile in the intercept, when

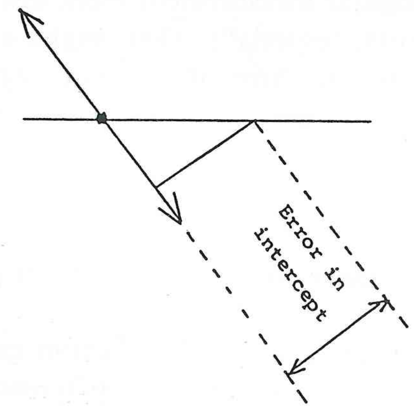
   (a) The observed body is on the 'prime vertical' and the position line is N/S.

   (b) When the ship is on the equator and D. Long = departure.

If the vessel is not on the Equator but the position line is still north/south the intercept error can be expected to reduce in the same way as departure is reduced for a given D. Long.

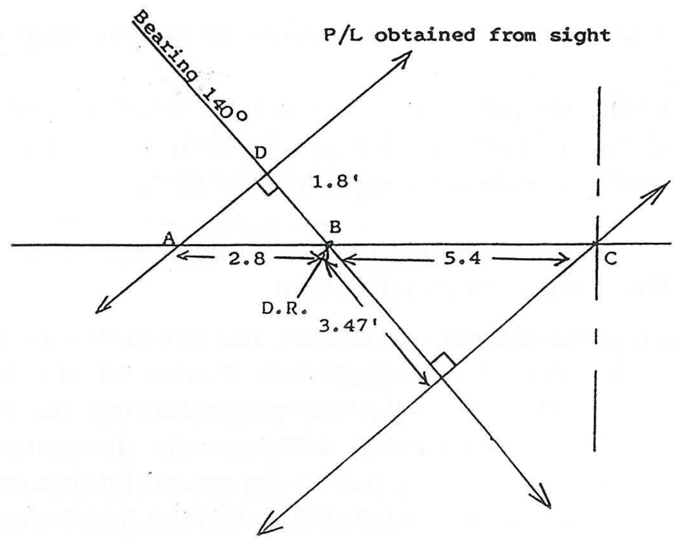


For the same error in GMT the intercept error would be further reduced when the position line is not north/south.



2. In working a sight the chronometer error was taken as 20 seconds slow instead of 20 seconds fast, when in DR position latitude 35° 00' N longitude 70° 00' W. The bearing of the body was 140°T and the obtained intercept was 1.8' away. What was the correct intercept?

   Scale 1 cm = 1'



Correct P/L if the only
error is GMT.

Long (W) = GHA − LHA

Error is 40 seconds fast

Therefore GHA is 10' to large.

Therefore observed longitude is 10' too large.

By traverse tables or right angled trigonometry in lat. 35°N:
D. Long. 10'; Departure = 8.2'.

In Triangle ABD, Angle 'D' is a right angle.

Angle A = Course 40°, DB = 1.8', AB = 2.8'

Therefore BC = 5.4'

Correct intercept = 3.47' towards.

Position fixing — Errors and reliability

In all passage plans the action of monitoring the plan is essential and the use of navigational instruments plays a major part. It is especially so when visual fixes are not possible either because of poor visibility or extreme range of targets. The use of instruments as an aid has become normal practice but navigators should beware of human error and the overall standards of accuracy when they are employed.

Many instruments operate in conjunction with the ships speed and this must be an accepted variable depending on the conditions. Higher standards of accuracy are also desired at different stages of the voyage:

i.e. Harbour entrances and approaches as to open deep waters.

If mid-ocean navigation is compared to the ships navigation when making a landfall, then the availability of any system together with its accuracy should be considered.

Example 7 — Astronomical navigation compared to Loran 'C' and satellite navigation in mid ocean.

Astronomical Navigation	Restricted and will vary with weather conditions. Clarity of the horizon and the availability of the celestial body will determine the possibility of a fix. Cloud cover and density could well obscure the sun, planets and stars when most needed.

Loran 'C' Not available in large areas of ocean.

Satellite Navigational System	Position fixing may not always be available due to satellite or system faults. Otherwise availability of GPS is considered good for all areas.

The accuracy of these systems will vary but in general the following figures may be considered reasonable:—

Astronomical navigation, in good conditions, should deliver a fix within +/− 5 nautical miles. Considered adequate for mid-ocean passage but cannot be relied upon for landfall position fixing, at a specific time.

Satellite navigation system should provide fixes to +/− 100 metres. This accuracy is obtainable in all areas irrespective of position.

Loran 'C' is not a world wide operation but where it is active good fixes can be obtained up to 1200 miles (ground wave) from station. Sky wave fixes are also possible. A degree of skill is required by the observer to gain improved accuracy. Accuracy of ¼ − 1 nautical mile is usually achievable with groundwave reception; this accuracy falls dramatically when only skywave transmissions are received.

Example 8 Use of Decca Navigator.

The Decca Navigation System operates on medium frequency continuous wave (CW) transmissions. The navigator requires a Decca receiver on board together with the relevant Decca Lattice charts. The apparatus being installed and maintained by the manufacturers.

The system is extremely popular and widely used at sea, even though the range is limited to about 250 nautical miles from the master transmitting stations. The Decca Fix is highly accurate and is well used as either the primary or secondary fixing method aboard the vessel. The theoretical accuracy is given to approximately 1/100 of a Decca-Lane width. (About 7 metres when on the base line, lane widths also vary depending on area).

When in operation navigators are advised that both 'fixed' and 'variable' errors exist and corrections need to be applied from information gained from the 'Decca Data Sheet'. Any disturbance in the power supply can also cause malfunction by way of lane-slip. Other causes of this may be in the form of irregular transmissions, interference from other Decca Stations, strong atmospherics, damage to aerial or simultaneous reception of ground and sky waves.

Example 9 — Omega

The Omega system operates with eight world wide transmitting stations, of which any pair may be used to generate a 'line of position' (L.O.P.). Transmission frequency for basic operation is 10.2 kHz which provides a lane width of 8 nautical miles.

Additional frequencies of 11.3 and 13.6 KHz are also employed and are used for lane identification purposes.

The system requires the operator to insert an 'estimated position' and this requires an accuracy of up to 4 n.miles. The possibility of lane slip may exist due to any interruption of the transmission but some receivers are fitted with chart recorders which provide indication of broken transmissions.

Additional errors may be caused by 'Ionospheric disturbance', i.e. solar activity causing X-Ray emissions may cause a shift of phase at the Omega Receiver. Error values could range from 0.8 to 1.6 miles. Another known error is 'polar cap absorption' caused by the magnetic poles attracting charged particles associated with 'solar flares'. Range of errors could be from 0.8 to 4.0 n.miles. Heavy rain showers can also affect transmissions in both Omega and Decca systems which may result in 'lane slip' occurring.

Accuracy is expected at about 1 to 2 miles but in practice it is realistically about 2 to 5 miles with an acceptable probability of error.

Omega requires its own charts and has world wide coverage when stations are operating at full power. Coastal monitoring stations advise vessels in their areas of known Omega errors. Operating recommendations are such that stations closer than 650 miles should not be used as transmitted signals in close to the station may be confused.

Navigation Through the English Channel and Dover Straits.

Introduction

The English Channel and the approaches to the Dover Straits is probably the busiest of waterways in the world. General advice on navigation practice is detailed in the two channel sailing directions and a further volume is concerned directly

with the area of the Dover Straits themselves. Relevant information is also found in Ocean Passages for the World (NP136) and relevant 'M' notices also apply.

The need for extreme caution when either inbound or outbound to UK or continental ports is obvious when one considers the sheer volume of traffic. Therefore there is a need to carry out detailed navigation in accord with the Regulations for the Prevention of Collision at Sea, and monitor the ships progress continually during transit. Special reference being made to Admiralty Chart No. 5500.

Particular attention of mariners, is drawn to the many traffic separation schemes operating inside the confines of the English Channel. Especially those which lead into and pass through the Dover Straits. Radar surveillance is in operation in this area and vessels contravening traffic control directions can expect to be monitored. Masters and ships officers, of through traffic are further advised by charted warnings that:

"While vessels using the traffic lanes must in particular comply with Rule 10, of the International Collision Regulations, they are not thereby given any right of way over crossing vessels. The other steering and sailing rules still apply in all respects, particularly if risk of collision exists".

The reality of navigation in this area is one which can be somewhat daunting to even the most experienced mariner and potential hazards are highlighted in the following text. The need for flexible and comprehensive passage planning to cope with not only established dangers but also to cater for changing 'natural conditions' is essential.

Traffic separation schemes and deep water routes, Dover Strait and approaches, Southern North Sea

DEPARTMENT OF TRANSPORT

MERCHANT SHIPPING NOTICE No. M.1448

Observance of Traffic Separation Schemes

Notice to Owners, Masters, and all concerned with Navigation of sea-going vessels

This Notice supersedes Notice No. M.1281

1. Rule 10 of the International Regulations for Preventing Collisions at Sea 1972 as amended, governs the conduct of all vessels in and near Traffic Separation Schemes which have been adopted by the International Maritime Organisation (IMO).

2. Rule 10(d), as amended by the IMO Resolution A678 (16), enters into force on 19 April 1991. The Department wishes to draw attention to the implications of the Rule 10(d) amendment and some of the other Rule 10 provisions, and also to those of Rule 8(f) which relate to a vessel's obligation not to impede, in relation to the use of traffic separation schemes. Rule 10 is reproduced at Annex I.

3. Application

Rule 10(a). It is important to note that this Rule only applies to schemes which have been adopted by IMO. In other schemes local regulations may apply, and these may modify not only Rule 10 but also, in some cases, other Steering and Sailing Rules. Admiralty charts show schemes established by competent national authorities but do not differentiate between IMO-adopted schemes and unadopted ones. The charts carry a note to this effect, advising mariners to refer to Annual Notice to Mariners No. 17, which lists all charted schemes and indicates which are IMO-adopted. Changes to ANM No. 17 are promulgated in the weekly editions of Admiralty Notices to Mariners. The charts also have notes referring to the existence of special provisions associated with certain schemes which may govern their use by certain classes of vessel. Sailing Directions should be consulted for these special provisions. Masters of deep-draught vessels should note that the existence of a scheme does not imply that the traffic lanes have been adequately surveyed.* Charted depths and source data diagrams (if available) should be studied when planning a passage where depths are critical.

* For Schemes introduced or amended, after April 1989 the IMO have needed to be satisfied with the adequacy of hydrographic surveys before adopting such schemes.

Traffic Separation Schemes are usually sited where there is a heavy concentration of shipping. Mariners are therefore reminded of the particular importance of strictly adhering to Rules 5–8 which refer to Look-out, Safe Speed, Risk of Collision, and Action to Avoid Collision. Mariners are also reminded that, except where there are special local rules to the contrary, the other Steering and Sailing Rules—those of Section II when vessels are in sight of one another and that of Section III in restricted visibility—apply within a scheme as they do elsewhere at sea. By virtue of using the traffic lane through vessels do not have any priority over crossing or joining traffic.

4. Procedure within a Traffic Lane

Rule 10(b) and (c). All vessels using a traffic lane must conform to the essential principles of routeing. If they are following the lane they must proceed in the general direction of traffic flow and if they are crossing it they must do so on a heading as nearly as practicable at right angles to that direction. Vessels should normally join or leave a traffic lane at its termination, however they may join or leave from either side of a lane provided they do so at as small an angle as possible to the general direction of traffic flow. The same procedure with certain exemptions, as stated in Rule 10(k) and (l), applies to vessels which are within a lane for purposes other than for passage through or across it, such as vessels engaged in fishing, if they are making way; it is appreciated that such vessels cannot always maintain a steady course and speed but their general direction of movement must be in accordance with this principle. Any substantial departure from this direction by any vessel is only allowed if it is required by overriding circumstances, such as the need to compy with other Steering and Sailing Rules or because of extreme weather conditions. Particular attention is drawn to the requirement that vessels which must cross a traffic lane shall do so on a heading as nearly as practical at right angles to the direction of traffic flow. Steering at right angles keeps the time a crossing vessel is in the lane to a minimum irrespective of the tidal stream, and leads to a clear encounter situation with through vessels.

5. Inshore Zones
Rule 10(d). Vessels other than those of less than 20 metres in length, sailing vessels, vessels engaged in fishing, and vessels en route to or from a destination within an Inshore Traffic Zone, should if it is safe to do so use the appropriate adjacent traffic lane. It does not preclude traffic under stress of weather from seeking protection of a weather shore within such a zone nor does it impose any specific behaviour on vessels within an inshore zone and traffic heading in any direction may be encountered. Within the context of this Rule it is the Department's view that the density of traffic in a lane is not sufficient reason by itself to justify the use of an inshore zone, nor will the apparent absence of traffic in the inshore zone qualify as a reason for not complying with this Rule.

6. Anchoring within a Separation Zone
Rule 10(e) and (g). The question has arisen as to whether a vessel which needs to anchor because, for example, of an engine breakdown or bad visibility, may do so in a separation zone. In the Department's view this would be a seamanlike manoeuvre and is allowed for under paragraph (e) (i).

7. Vessels not Using a Scheme
Paragraph (h). The existence of a Scheme does not mean that it is obligatory to use it, if it's use appears unsafe due to prevailing conditions or the size or state of the vessel. In these circumstances the Master should consider an alternative route and avoid the Scheme by as wide a margin as is practicable.

8. Fishing Vessels
Rule 10(b), (c), (e) and (i). Vessels fishing within a Scheme are considered to be using the Scheme and must therefore, when working in a traffic lane, conform to the essential principles laid down in Rules 10(b) and (c) as discussed above. When fishing in a separation zone they may follow any course. The requirement that vessels fishing must not impede through traffic means that they must not operate in such a manner that they, or their gear, seriously restrict the sea room available to other vessels within a lane. Rule 8(f) places further obligations upon fishing vessels with regard to their responsibility not to impede vessels following a traffic lane and this obligation remains in a developing situation where risk of collision is involved. When taking any action they must however take account of the possible manoeuvres of the vessel which is not to be impeded.

9. Sailing Vessels and Small Craft
Rule 10(j). Vessels of less than 20 metres in length and sailing vessels shall not impede traffic following a traffic lane and the same obligations as are set out for fishing vessels in paragraph 8 similarly apply to them. No specific mention is made in the Rule of a sailing vessel having an auxiliary engine, but it is the Department's view that if such a vessel cannot follow the routeing procedures under sail because of light or adverse winds, then she should make use of her engines in order to do so.

10. Vessels engaged in Safety of Navigation Operations
Rule 10(k). Vessels engaged in operations for the safety of navigation of the Scheme eg buoy laying, wreck removing, or hydrograhpic surveying if restricted in their ability to manoeuvre, are exempt from the provisions of Rule 10 to the extent necessary to carry out the operation. This exemption does not extend to vessels engaged in other survey activities in a Scheme.

11. Cable Laying Operations
Rule 10(l). Vessels engaged in cable operations, if restricted in their ability to manoeuvre, are exempt from the provisions of Rule 10 to the extent necessary to carry out the operation.

12. Precautionary Areas
Many Schemes have precautionary areas associated with them where traffic lanes cross or converge so that proper separation of traffic is not possible. Precautionary areas are not part of a traffic separation scheme and Rule 10 is not generally applicable. Ships should navigate with particular caution within such areas. Precautionary areas should be avoided, if practicable, by ships not making use of the associated Schemes or deep-water routes.

13. Signal—YG
The Department considers it important that any vessel observed in a Scheme which appears to be navigating otherwise than in accordance with the established principles of such Schemes is advised of the fact at the time. A special signal exists for this purpose: the two letter signal YG meaning "you appear not to be complying with the traffic separation scheme".

The master of any vessel receiving this signal by whatever means should take immediate action to check his course and position and take any further steps which appear to him appropriate in the circumstances.

14. The amendment to Rule 10(d) is intended to clarify how inshore traffic zones should be used. Merchant Shipping Notice M.1449 (Navigation in the Dover Strait) is complementary to this notice.

Department of Transport
Marine Directorate
London WC1V 6LP
May 1991

Position Fixing Methods

There is generally no shortage of navigational landmarks for the purpose of position fixing throughout the length of the channel. The use of visual bearings, provided the state of visibility permits, remains adequate on both the French and English sides, especially when vessels are engaged in the Inshore Traffic Zones.

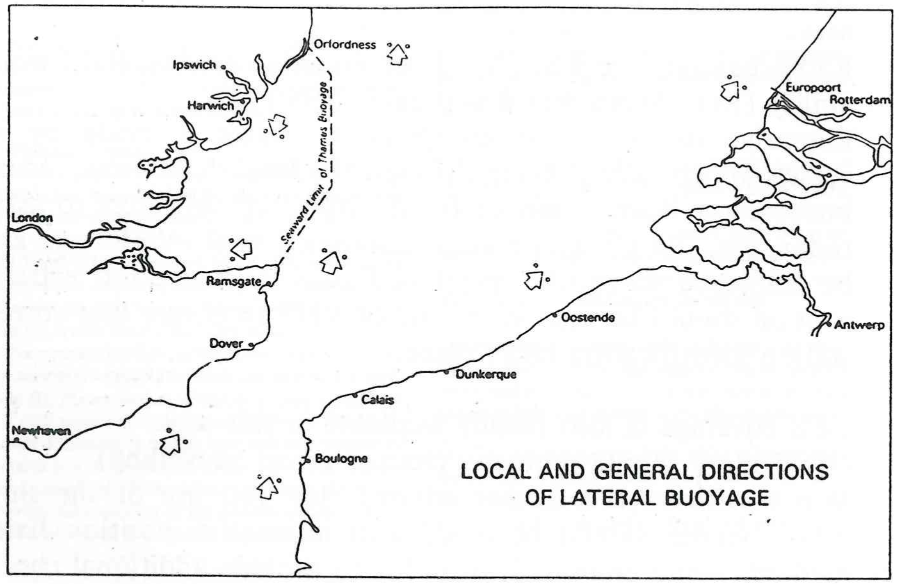
IMO also recommends that all ships of 300 grt and over which use the English Channel/Dover Straits should be fitted with electronic position fixing equipment.
Decca Coverage is extremely good (Ref ALRS Vol. 5) and because of the overlap of Decca Chains, cross chain fixing is also possible. Although mariners are strongly advised to check the Decca Data Sheets respective to the time and navigational area.
Radio beacons are well placed for direction finding (DF) availability (Ref. ALRS Vol 2 and chart 5500).
Extensive use of radar conspicuous targets is made by all vessels which take passage through the English Channel. Many buoys carry Racons and/or fitted with radar reflectors to assist radar use. Radar surveillance combined with VHF can also be employed to provide position fixing assistance but extreme caution should be used in the use of VHF to ensure that correct station identification takes place.

GPS coverage is also readily available in this area.
(Navigators should note any charted errors prevailing)
Watch officers are further advised that full use of the ships echo sounder should be used, with alternative position fixing methods being employed, in order to provide additional checks on fixes.
Traffic separation schemes are generally well charted and marked clearly by the IALA 'A' buoyage scheme. Masters and navigators should, however, note that vessels inbound to the Thames/London area can expect to encounter both local and general directions of buoyage.

Prevailing weather conditions may make the use of dead reckoning (D.R.) necessary. The reliability of the use of D.R. must

be questionable because of the variable current flow either side of high water time Dover. This is not to say that D.R. cannot be employed with other position fixing methods. It should also be realised that current stream values are predictions in both inshore areas and mid-channel areas. The exactness of such predictions can expect to fluctuate with changing conditions of the day.
Use of the Admiralty Tidal Stream Atlas for the English Channel is recommended to navigators engaged on passage planning or projecting ETA's.

BUOYAGE – Approaches to London, Thames Estuary



Local and general direction of buoyage

Communications

Extensive communications exist for the benefit of marine traffic in transit through or towards ports in the English Channel. A

ship reporting system is in operation known as MAREP and is a voluntary system for vessels using the Traffic Seperation Schemes around Ouessant, Casquets, Dover Strait and Inshore Traffic Zones. It is applicable to the following vessels: —

a) Laden tankers and vessels carrying dangerous cargoes in bulk, as specified by the International Convention for the Prevention of Pollution from ships (MARPOL '73)
b) Any vessel which finds herself in a 'not under command' situation or which finds she has to anchor in a TSS or inshore traffic zone.
c) Any vessel which is defined as being 'restricted in ability' to manoeuvre.
d) Any vessel with defective navigational aids/equipment.

French regulations that all tankers defined in (a) report via CROSSMA Cape Gris-Nez, when navigating north eastward through the Dover Strait or when using the inshore traffic zone. Tankers are also required to maintain continuous VHF listening watch when in French territorial waters.
Ref. Cht 5500, ALRS Vol.6., & Channel Sailing Directions.

Channel Navigation Information Service (CNIS)

The information service provides scheduled broadcasts together with additional information on request in an area from the Greenwich Meridian upto the West Hinder Lightship (Lat 51° 23' N Long 2° 26' E). Ref. ALRS Vol. 6.
The contents of broadcasts includes navigational & traffic information. Cross channel ferry activity is not normally mentioned.
Sources of the information are varied but may include aircraft reports concerning vessels navigating in contravention of the traffic seperation schemes.

The CNIS also provides a storm/tide warning service when tidal levels are expected to be 1 metre or more below the astronomically predicted levels. Applicable to Thames Estuary, Southern North Sea, and the Dover Strait areas.

Navtex also covers these broadcasts and details of this and other services can be found in ALRS Vol. 3.

In addition to the MAREP and the CINS operations normal VHF communications are ongoing between ship to shore stations, and ship to ship where appropriate. i.e. Pilotage communications.

Additional communications from marine organisations such as the Coastguard (HMCG) on Channel 67, Coast Radio Stations, Port & Harbour control authorities and Marinecall. Any involvement in SAR activity could also involve Royal National Lifeboats Institution (RNLI) as well as military air and surface contacts.

Important navigational warnings may be transmitted at any time with a prefix "SECURITE" (SAY-CUAE-E-TAY) R/T or by TTT by W/T by any ship.

Channel Passage and Associated Hazards

A passage through the English Channel is not always doom and gloom and the fact remains that good seamanship practice, however that can be interpreted, does tend to prevail. One might suggest that it is an area where the Masters role is extensive and the need for 'bridge teamwork' comes to the fore.

A typical transit could expect to encounter a variety of potential hazards. However, prudent planning and effective communications coupled with common sense will usually result in an incident free passage and safe docking.

An awareness of the ship, especially its draught, and its manoeuvring capabilities would be considered a necessity. This information is particularly important for deep draughted vessels, when it is realised that advice from publications warns of:—

(a) Charted depths in offshore areas may be compiled from scanty information and as such errors of unknown magnitude possibly as much as 1 metre may prevail.

(b) Storm surges in the area due to abnormal meteorological conditions could cause water levels to rise up to 3m or fall to 2m below predicted heights, in the southern part of the North Sea.

(c) Controlling depths are known to exist in traffic lanes.
Example: 21 m SW & NE of Sandettie Bank (Lat 51° 13' N Long 1° 55' E — 1980)
Example: TSS off WEST HINDER — East going traffic lane 16.5m Lies between Kwinte Bank and the Akkaert Bank. (See Admiralty Chart 125)
also, 11.2m (1980) was charted 4 cables off the north end of the Kwinte Bank. (Lat 51° 21' N Long 2° 43' E)

(d) Shoal depths may occur over wrecks which may have been disturbed by strong tidal streams, or which have become recently uncovered in newly formed channels.

(e) The dangers of ships "Squat" should not be minimised and its relationship to ships speed should be taken into account when considering the recommended underkeel clearance as being not less than 4.0m in the Dover Strait. (IMO recommended 1982)

English Channel — Collision Risks

Cross Channel Ferries.
The number of through movements via the Dover Straits is a large variable when compared with other regions of the world. The fact that this through traffic must expect to encounter extensive crossing traffic is a matter of record. Numerous cross channel ferries route across the straits, (Dover-Calais, Dover-Boulogne, & vice versa). Other routes from Portsmouth-Caen, Portsmouth-Cherbourg/Le Havre, and vice versa are but a few of the well plied alternatives. Neither are all the cross ferries the norm. Many routes are used by hovercraft or high speed hydrofoils or similar catamarans.

Leisure Craft.
The region is also well used by the yachting fraternity and many similar leisure craft. A notable increase in small craft can be

expected during the summer months and commercial vessels are advised to keep a diligent lookout, bearing in mind that small wooden or fibre glass hulls make very poor radar targets. These craft must be expected to appear in any area, without exception inside the confines of the English Channel.

Warships.
Warships are another specific group of ships which are regularly encountered in the area. Military exercises, inclusive of submarine activity, are not uncommon to the area and evasive action to avoid close quarters situations must be considered prudent, when the circumstances of the case admit. Submarine exercise areas are charted and all Admiralty Charts so effected carry relevant warnings to mariners.
Main ports of military activity include: Portsmouth, Plymouth, and around the Portland Bill.

Fishing Vessels.
Many fishing vessels of differing nationalities are also regular users of the English Channel. These may include factory ships which may carry bold deck lighting. Watch officers may subsequently have difficulty in discerning navigation lights and they should subsequently exercise extreme caution and avoid close quarters situations.

Deep Draughted Vessels.
Many routes towards continental ports employ deep water approaches. These approaches may cause certain vessels to cross traffic lanes to gain access to the deep water channels and an obvious danger could materialise for other traffic navigating within the lane.
Consideration for other traffic and the prudent use of a vessels speed could be an effective way of relieving a potentially hazardous situation. (Ref. to M1448 and to Regulation 10, of the Regulations for the Prevention of Collision at Sea is recommended)

English Channel Navigation

Contingency situations may make it a requirement for a vessel to go to anchor, either for adverse weather, or traffic or dock-

ing delays. In this event a careful chart inspection should be made prior to anchoring the vessel. Many areas carry restrictions on the use of anchors due to wrecks or cable areas or other obstructions.
A recommended anchorage for deep draughted vessels lies in position lat 52° 03' N long 03° 04' E on routes for Eurogeul. Special attention is drawn to vessels navigating in this area that liquid cargo transfer occasionally takes place in the SW part of this anchorage. Deep draught vessels proceeding towards Deutsche Bank (Ref. North Sea (East) sailing directions) should also note that 'Two way-deep water routes' are employed in this area. Careful chart inspection is to be recommended.

Pilotage Operations
Advance communications of up to 48 hours in some cases is required by pilotage agencies in the United Kingdom or in European countries. Deep sea pilots may be obtained prior to entering the traffic seperation schemes of Dover and the southern part of the North Sea, from several ports inclusive of:

Brixham, Cherbourg, Le Havre, Boulogne, Folkestone, Calais and Dunkerque.
The option of helicopter transfer of the marine pilot is also available through pilotage agents.
Information regarding communications between vessels and pilot stations can be found in ALRS Vol.6.

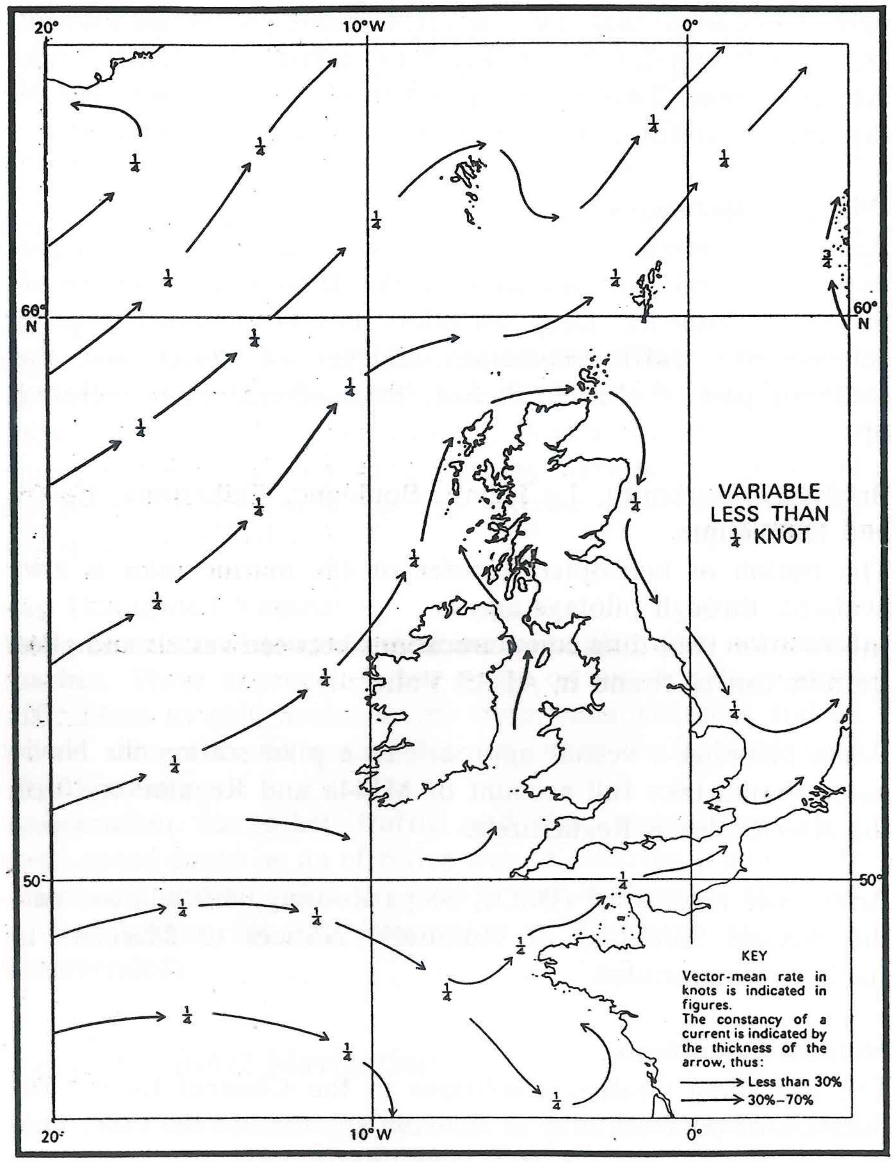
When planning a vessels approach to a pilot station the Navigator should take full account of M1448 and Regulation 10 of the Anti-Collision Regulations.

Additional reading of (IMO), Ships Routing, 4th edition, and the Annual Summary of Admiralty Notices to Mariners is further recommended.

Natural Conditions
The prevailing weather conditions in the Channel have a reputation of poor visibility at virtually any time of the year. This may be caused by light rain conditions or showers as well as

fog which is common to the area. Gales are frequent during the winter months and the prevailing direction is from the west or north west. The shipping forecast as issued by the BBC provides weather information daily at approx six hourly intervals. BBC Radio 4, 198 kHz, 1515 m Long Wave at:—

0033, 0555, 1355, & 1750 hrs.



Average surface currents throughout the year

Navigation of English Channel (Chart 5500)

In order to enhance navigation within the Channel, a special chart number 5500, has been devised to assist officers planning a passage into or through this highly active region. The chart is concerned with the safe transit of vessels and informs Masters and navigators of the following points of concern:—

1. Passage planning — How the principles of effective passage planning should be employed to ensure a safe passage through the Channel. Advice is given on the aspects of: appraisal, planning, execution and monitoring of the vessels progress. Particular attention is drawn to the use of a 'sea pilot' and the special requirements that some vessels may require, e.g. deep-draught ships.
   Mariners are also advised that a voluntary ship movement, reporting system is in operation (MAREP) and certain categories of vessels are invited to participate.
2. Routing, general recommendations — With the extensive traffic separation scheme in operation through the Dover Straits and at prominent focal points, Masters are advised of their legal obligations under the COLREGS, in section (2) of the chart.
3. Routing, specific regulations — Any special regulations which might apply to traffic separation schemes are summarised within the passage plan charts. Recommendations for vessels of 300 GRT are such that electronic position fixing equipment should be fitted on board to improve navigation methods. It is also stated that respective charts for this region are overprinted with lattice for Decca use.
4. Passage planning (special classes of vessel) — Specific reference is made for 'deep draught vessels' and those bound for Europoort. Instructions for tankers and other ships carrying dangerous cargoes are required to adhere to French regulations after rounding 'Ouessant'. Particular attention of mariners is drawn to the need for adequate under keel clearance and additional references for ships 'constrained by their draught', is also featured in this section of the charted notes.

5. Oil and dangerous cargoes — This section of the notes contains a list of oils and noxious substances that require to be reported under EC regulations. Compulsory reporting within the MAREP recommendations is necessary for any tanker over 1600 GRT which is carrying chemicals, gas or oil, where tanks are not free of vapours from these cargoes.
6. Radio reporting systems (through traffic) — Detailed information is given regarding MAREP ship movement and reporting methods adopted in the Channel. The voluntary communication system which effects such areas as:

   Ushant, Casquets and the Dover Strait is designed to monitor traffic movements within the Channel.

   The type of reports required, namely:

POSREP	—	For vessels with no defects.
DEFREP	—	For NUC vessels or with defects to navigational aids.
CHANGEREP	—	For vessels amending proposed plans.

   A compulsory report system is in operation for all vessels carrying oils or hydrocarbons, which intend to enter French territorial waters.

   Additional detail on specific communications is included in this section of the notes.
7. Radio reporting procedures to a port of destination — Advance communications and in particular projected ETA for all tankers, together with relevant ship details appropriate to cargo and the vessels navigation capabilities.
   Masters will also be advised of an appropriate tanker check list and be liable to produce the various certificates of the vessel for the respective authorities.
8. Maritime radio services — Details of stations/frequencies and the times of transmission of specific messages including:— navigational warnings, weather reports and storm warnings.
   Details of the NAVTEX service is also included.
9. Radio beacon service — Includes an illustration of radio beacons and their groupings, together with frequency and station identification. The beacons effective range and service which is being offered is also included.

10. Tidal information and services — Offshore tidal data with an illustration/example of the use of co-tidal, co-range lines. Maximum tidal stream rates in relation to HW Dover are included in this section.
11. Pilotage service — Details of requests for deep-sea pilots for respective ports and the relevant communications required. Rendezvous points for helicopter/pilot transfer and procedural actions.

Additionally mariners are advised that respective 'M' notices are in force, for vessels navigating in or through the English Channel and these should be brought to the attention of all watch officers.

MSA
MARINE SAFETY AGENCY

MARINE GUIDANCE NOTE

MGN 29 (M+F)

Navigation in the Dover Strait

Note to Shipowners, Masters and all concerned with the Navigation of Seagoing Vessels

This note supersedes Merchant Shipping Notice M.1449

Introduction

1. The Dover Strait and its approaches are among the busiest shipping lanes in the world and pose serious problems for the safety of navigation. The traffic separation scheme, its associated inshore traffic zones, the Ship Movement Reporting (MAREP) scheme and the Channel Navigation Information Service (CNIS) have been designed to assist seafarers to navigate these waters in safety. There is, therefore, a need for careful navigation in the area in accordance with the International Regulations for Preventing Collisions at Sea 1972 (as amended) and for use to be made of the MAREP scheme and the CNIS. MGN 28 contains guidance on the observance of traffic separation schemes in general. Details of the MAREP scheme and CNIS are contained in the Admiralty List of Radio Signals Vol 6 Part 1 and the Mariner's Routeing Guide, English Channel and Southern North Sea (BA Chart No. 5500). The International Regulations for Preventing Collisions at Sea are to be found in Merchant Shipping Notice No. M1642/ COLREG 1.

2. The number of collisions in the Dover Strait and its approaches has declined since the introduction of the traffic separation scheme and its application becoming mandatory for all ships in 1977. Never the less the risk of collision is ever present and heightened if vessels do not comply with the requirements of the scheme, and Rule 10. Non compliance subsequently causes an increase in "end on" ship/ship encounters and heightened collision risks.

Inshore Traffic Zones

3. The French inshore traffic zone extends from Cap Gris Nez in the north to a line drawn due west near Le Touquet in the south. The English inshore traffic zone extends from a line drawn from the western end of the scheme to include Shoreham to a line drawn due south from South Foreland. These end-limits are charted.

4. A vessel of less than 20 metres in length, a sailing vessel and vessels engaged in fishing may, under all circumstances, use the English and the French inshore traffic zones. With respect to the application of Rule 10(d) to other vessels, it is the view of the MSA that where such a vessel commences its voyage from location beyond one limit of either zone and proceeds to a location beyond the further limit of that zone and is not calling at a port, pilot station or destination or sheltered anchorage within that zone, it should, if it can safely do so, use the appropriate traffic lane of the traffic separation scheme unless some abnormal circumstances exist in that lane. In this context reduced visibility in the area is not considered by the MSA as an abnormal circumstance warranting the use of the zone.

5. Traffic surveys in the area show that, in general, the interests of safety are best served by excluding from the EITZ as many vessels, other than those with a clear need or right to use it, as possible. Accordingly, the MSA will consider action against SW-bound vessels in the EITZ (other than those exempted by Rule 10(d) and NE-bound vessels proceeding to Continental ports). NE-bound vessels voyaging to the Thames or East Coast ports are required to use the north bound lane of the scheme where they can safely do so. A ruling on whether in any particular case a Master of a NE-bound vessel was justified on safety grounds in choosing to use the EITZ rather than the north-bound lane is for the Courts to decide in the light of individual circumstances.

It should be noted that neither CNIS, nor HM Coastguard has authority to interpret the Collision Regulations or grant permission for vessels to use the EITZ in contravention of Rule 10(d). Masters deciding that circumstances warrant their use of the EITZ should report their decision to CNIS.

Passage Planning/Crossing Traffic Lanes

6. Radar surveillance surveys show that many vessels proceeding from the NE Lane towards the Thames and East Coast ports use the MPC buoy as a turning point irrespective of the traffic present in the SW Lane. Masters are reminded that crossing the lane in compliance with Rule 10(c) can be made anywhere between the Ridge and Sandettie Bank. In selecting the crossing point regard should be given to traffic in the SW Lane and the need to avoid the development of risk of collision situations with such traffic. Surveillance surveys also indicate that risk of collision increases if cross channel traffic, leaving Dover or the Calais approach channel, assume courses without due regard to the traffic situation in the adjacent lane. Vessels proceeding along the traffic lanes in meeting their obligations under Rules 15 and 16 are often observed making substantial course alterations and their actions are frequently complicated when bunching of traffic exists in their lane. Attention is therefore drawn to the need for cross channel traffic to consider this possible situation arising when passage planning and ultimately selecting the point where a lane is to be crossed so that the collision risk situations can be anticipated and are not allowed to develop.

Regulations for Prevention of Collisions - General

7. Use of the scheme in accordance with Rule 10 does not in any way alter the over-riding requirement for vessels to comply with the other Rules of the Regulations. **In particular, vessels, other than those referred to in Rule 10(k) and (l), do not by virtue of using the traffic lanes in accordance with Rule 10 enjoy any privilege or right of way that they would not have elsewhere.** In addition, vessels using the traffic separation scheme are not relieved of the requirement to proceed at a safe speed, especially in conditions of restricted visibility, or to make course and/or speed alterations in accordance with Rule 8.

Crossing Traffic

8. Mariners are reminded that there is a concentration of crossing ferry traffic in the Strait. These vessels may make course alterations outside the lanes in order to cross them at right angles.

Rules 10(b)(ii) and 10(b)(iii)

9. In conclusion, the MSA wishes to draw attention to Rule 10(b)(iii) which requires vessels normally to join and leave a traffic lane at the termination of the lane. This rule does not preclude a vessel from joining a lane from the side at a small angle to the general direction of traffic flow. Consequently, vessels bound SW from locations in the EITZ are advised to join the SW lane as soon as it is safe and practicable to do so. All vessels are advised to keep clear of boundary separation lines or zones in accordance with Rule 10(b)(ii); failure to observe this rule has been one cause of repeated damage to the CS4 buoy. This buoy is protected by a charted "area to be avoided" by all vessels.

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August 1997

[MSA File Ref: MNA 5/50/294]

Safe Ships Clean Seas

An executive agency of
THE DEPARTMENT OF THE ENVIRONMENT, TRANSPORT AND THE REGIONS

CARRIAGE OF NAUTICAL PUBLICATIONS

The requirements for effective passage planning to take place aboard the vessel will require the use of navigational publications by the navigator. Reference should be made to the Annual Summary of Notices to Mariners (Not.18) which recommends the following publications to be carried by U.K. registered ships (exception being vessels less than 12 metres in length and fishing vessels).

International Code of Signals - Merchant Shipping Notices ('M') Notices - The Mariners' Handbook (NP100) - Weekly Notices to Mariners - Nautical Almanac - Nautical (Navigational) Tables - Admiralty List of Radio Signals - Admiralty List of Lights - Sailing Directions - Tide Tables - Tidal Stream Atlases - Operating and Maintenance instructions for navigational aids carried.

Additionally: A full set of navigational charts for the relevant areas of navigation of the vessel.
A well found ship will also carry, in addition to those stated above, any or all of the following:
A copy of the Regulations for the Prevention of Collision at Sea. (Copy of the same contained inside Mariners' Handbook)

A copy of Chart Abbreviations (No. 5011) - The Merchant Ship Search and Rescue Manual (MERSAR) - Ships' Routing (IMO) - Ocean Passages of the World (NP136) - Chart Catalogue - Relevant Statutory Instruments - Sight Reduction Tables (NP401) - Distance Tables (NP 350) (3 volumes) - Guide to Port Entry - Routing Charts - Ice Charts - Ocean Current Charts - Star Finder & Identifier (NP323) - Echo Sounding Correction Tables (NP139) - Chart No. 5500 English Channel MAREP information - Guide to Helicopter/Ship Operations (ICS)

Supplements and updates for nautical publications are issued by Hydrographer of the Navy at suitable intervals, e.g. Admiralty Sailing Directions (one and a half to two years intervals), supplements being cumulative so that each successive supplement supersedes the previous one.

Chapter Four

OCEAN PASSAGE PLANNING

Introduction

Since the early voyages of discovery, ocean passages have been determined by economics. With today's fuel costs, the most economical route remains a high priority with shipowners.
One may be excused for thinking that the shortest route is always the most economical. Great circle sailing, for example, is the shortest distance between two points on the earth's surface, but the passage may involve high risk and damage to ship or cargo, so when comparisons are made the shortest distance route may not be the most economical.

When planning any passage due consideration must be made to the economics, but in these more informed times, the safety aspects of a voyage can expect to influence the route adopted.
The time of year and the anticipated weather conditions are assessed with potential hazards such as 'ice' or 'storm frequency' before a final route is set.
The distance by 'rhumb line' is often to be compared with the great circle or composite great circle tracks, and these distance figures will be a major consideration but not limited to their influence alone.

GREAT CIRCLE SAILING

A great circle is defined as a circle on the earth's surface whose plane passes through the centre of the earth.

For navigation purpose:

1. The shortest distance between two places on the earth's surface is a great circle track
2. Great circles appear as straight lines on gnomonic charts.
3. Every great circle has two vertices (vertex), one in the northern hemisphere, the other in the southern hemisphere.
4. The course of the great circles, at the vertex, is due EAST/WEST (090 degrees/270 degrees). This provides a 90 degree angle for use with Napier's Rules.
5. The vertex of a great circle is that point nearest the pole.
6. The meridian that passes through the vertex is at right angles to the great circle.

USE OF GNOMONIC CHARTS

Once a ship's Master has orders to plan a voyage he is under obligation to investigate not only the most economical route but also the safest route. In any event the distance of each and every possible track needs to be investigated. The great circle distance, being the shortest distance, will therefore be a high priority. The following is an example of how the gnomonic chart is used in conjunction with the mercator chart.

Example

On the gnomonic chart of the North Atlantic plot the Great Circle track from:

Lat. 52° 00' N Long. 55° 00' W
to: Lat. 56° 30' N Long. 15° 00' W

Transfer this track to the Mercator Chart of the North Atlantic showing positions for every 10 degrees of longitude from the initial position.

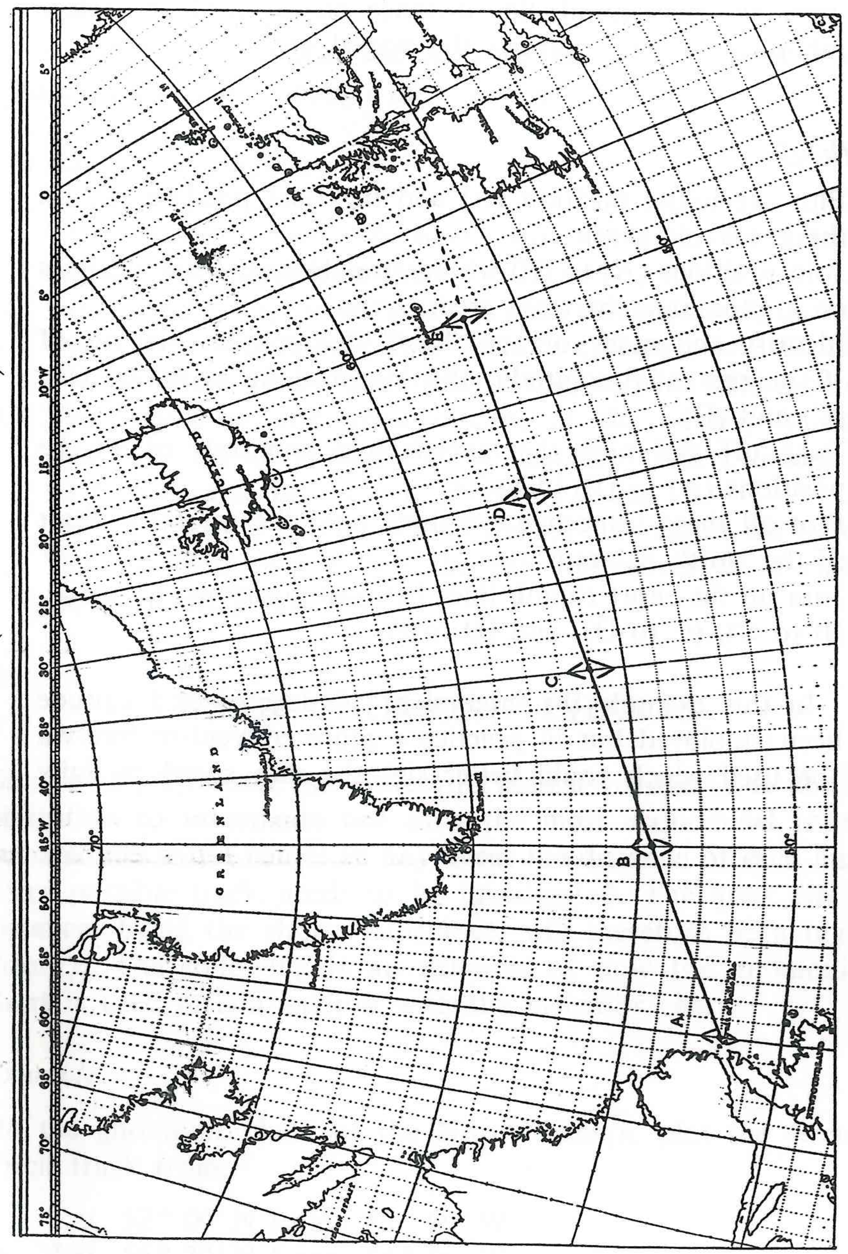
Compare the great circle distance with the rhumb line (direct) distance.
Compare also the rhumb line distance on the four short legs (rhumb lines) which comprise the staged great circle track.

Method

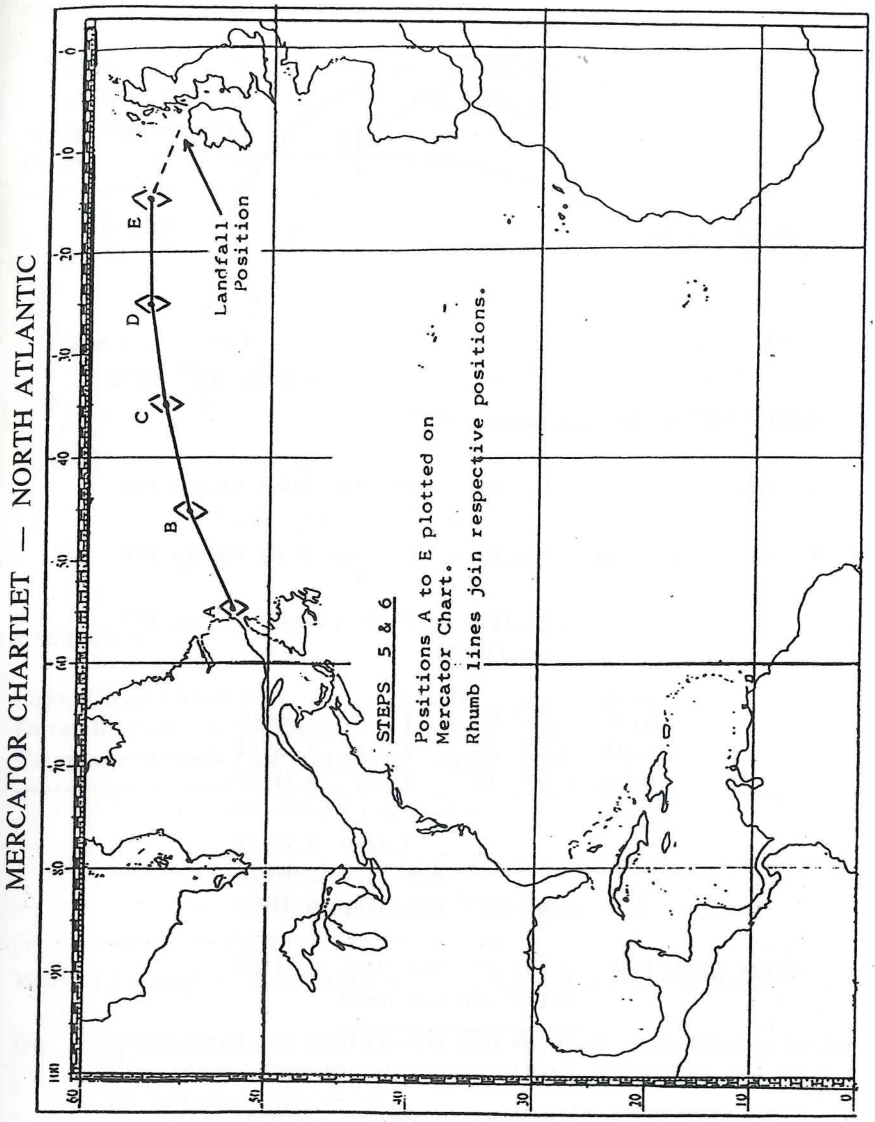
1. Plot the initial position (A) and the final position (E) on the gnomonic chart.
2. Join positions (A) to (E) with a straight line, (Straight lines on a gnomonic chart are great circles)
3. Identify and mark off on the G.C. track at intervals of 10 degrees of Longitude, the intermediate positions (B), (C) and (D).
4. Take off and note the latitude and longitude of all the positions (A) to (E) inclusive.
5. Plot all these respective positions onto the mercator chart of the North Atlantic.
6. Join up the short rhumb lines between positions: (A to B), (B to C), (C to D), and (D to E).

NB: In this example the interval of 10 degrees of longitude has been employed but in practice a more convenient interval may be used which could better suit the ship speed or daily run.

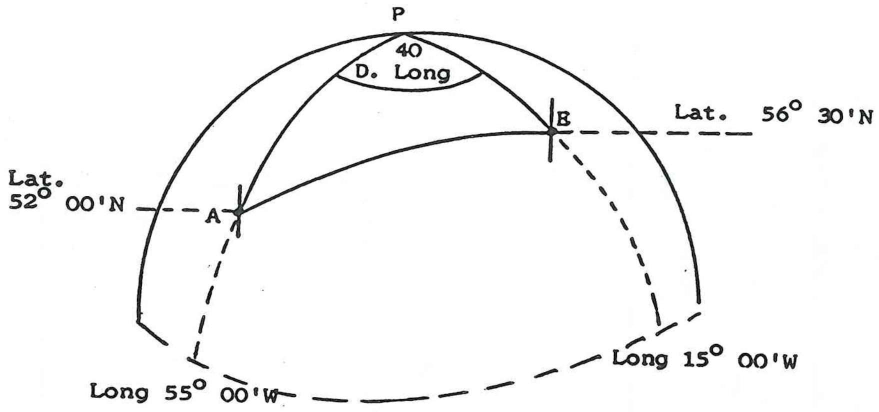
NORTH ATLANTIC (GNOMONIC CHART)



MERCATOR CHARTLET — NORTH ATLANTIC



Great Circle Distance — Example Calculation



Basic Formula: Hav AB = hav(PA ~ PB) + hav $\hat{P}$ sin PA sin PB.

Example Formula: Hav AE = hav(PA ~ PE) + hav $\hat{P}$ sin PA sin PB.

= hav(38° ~ 33° 30') + hav 40° sin 38° sin 33° 30'

Hav $\hat{P}$	= 40° 00'	L.Hav	9.06810
sin PA	= 38° 00'	L.sin	9.78934
sin PE	= 33° 30'	L.sin	9.74189
		L.Hav	8.59933
		Nat. Hav	0.03975
(PA ~ PE)	= 4° 30'	Nat. Hav	0.00154
Great Circle Dist	= 23° 27'	Nat. Hav	0.04129
	= 1407 nautical miles		

Rhumb Line Summary & Direct Rhumb Line Comparison

1st Leg (A – B)	Distance = 391.73'
2nd Leg (B – C)	Distance = 351.9'
3rd Leg (C – D)	Distance = 335.6'
4th Leg (D – E)	Distance = 331.3'

Total Distance = 1410.5' nautical miles

Direct Rhumb Line Distance

Lat A. 52° 00' N	MPs 3646.74	Long 55° 00' W
Lat E. 56° 30' N	MPs 4108.37	Long 15° 00' W
D.Lat 4° 30' N	DMP 461.63	D.Long 40° 00' E
= 270'		= 2400'

$$\text{Tan Co.} = \frac{\text{D.Long}}{\text{DMP}} = \frac{2400}{461.63} = \text{N79° 6.8' E}$$

Distance = D.Lat × Sec Co.
= 270' × Sec 79° 6.8'
= 1429.6' Nautical Miles

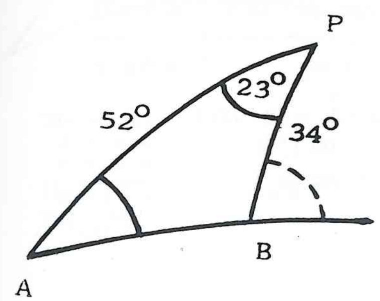
Comparisons: —

Great Circle Distance	= 1407 nautical miles
Direct Rhumb Line Distance	= 1429.6 nautical miles
Composite Rhumb Line Distance	= 1410.5 nautical miles

Great Circle Sailing —

Worked Example to find: Initial & final courses & the GC distance

Qu. Find the initial and final courses and the great circle distance between position 'A' (Lat. 38° 00' N. Long. 124° 00' W) and position 'B' (Lat. 56 00' N Long. 101° 00' W)



'A' Lat 38°	PA = 52°	Long 124° W	
'B' Lat 56°	PB = 34°	Long 101° W	
PA ~ PB	= 18°	Angle $\hat{P}$ = 23°	

To find the GC Distance

$$\text{Hav AB} = (\text{hav } \hat{P} \sin PA \sin PB) + \text{hav}(PA \sim PB)$$
$$= (\text{hav } 23° \sin 52° \sin 34°) + \text{hav } 18°$$

Nos	Logs
Log Hav 23°	8.59931
L.sin 52°	9.89653
L.sin 34°	9.74756
	8.24340
Nat Hav	0.01751
Nat Hav 18°	0.02447
hav AB	0.04198

AB = 23° 38.9'
× 60

Dist = 1418.9 n/miles

PA = 52° 00'
AB = 23° 38.9'

PA ~ AB = 28° 21.1'

PB = 34° 00'
AB = 23° 38.9'

PB ~ AB = 10° 21.1'

To find the Initial Course

$$\text{Hav } \hat{A} = \text{hav } PB - \text{hav}(PA \sim AB) \text{ cosec } PA \text{ cosec } AB$$
$$= (\text{hav } 34° - \text{hav } 28° 21.1') \text{ cosec } 52° \text{ cosec } 23° 38.9'$$

Nos	Logs
Nat Hav 34° 00'	0.08548
Nat Hav 28° 21.1'	0.05998
Nat Hav	0.02550
Log Hav	8.40650
L.cosec 52°	0.10347
L.cosec 23° 38.9'	0.39673
Hav Â =	8.90670

Angle Â = 33° 00.1'

Initial Course = N 33° 00.1' E

Check by ABC
A = 1.84 S
B = 3.79 N
C = 1.95 N
= 32.9

To find the final course

$$\text{Hav } \hat{B} = (\text{hav } PA - \text{hav } PB \sim AB) \text{ cosec } PB \text{ cosec } AB$$
$$= (\text{hav } 52° - \text{hav } 10° 21.1') \text{ cosec } 34° \text{ cosec } 23° 38.9'$$

Nos	Logs
Nat Hav 52° 00'	0.19217
Nat Hav 10° 21.1'	0.00814
Nat Hav	0.18403
Log Hav	9.26489
L.cosec 34° 00'	0.25244
L.cosec 23° 38.9'	0.39673
Hav B̂ =	9.91406

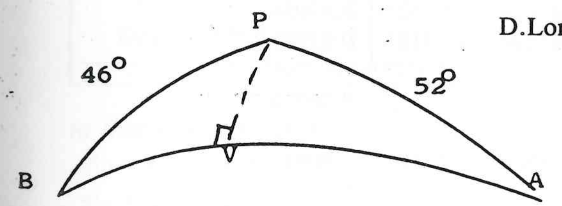
Angle B̂ = 129° 51.6'

Final Course = N 50° 08.4' E

Check by ABC
A = 3.49 S
B = 2.00 N
C = 1.49 S
= 50.4

EXAMPLE *Use of A, B & C Tables in Great Circle Sailing*

Find the initial course and final courses and the great circle distance from 'A' 38° 00' N 124° 00' W to 'B' 44° 00' N 164° 00' E, by use of A,B,C, Tables.



D.Long = 288° 00' E
= 72° 00' W

L.Hav 72°	9.53844
L.sin 52°	9.89653
L.sin 46°	9.85693
	9.29190
	0.19584
	0.00274
	0.19310

$$\text{Hav AB} = \text{Hav } \hat{P} \sin PA \sin PB - \text{hav}(PA \sim PB)$$
PA ~ PB = 6° 00'

= 52° 8.1' = 3128.1'

= 3175.6'

WRONG.

Initial Co.

Hour Angle 72°

A = .25 S (Use Lat 38°)
B = 1.02 N (Use lat 44°)

C = .77 N (Use lat 38°) = N58¾W

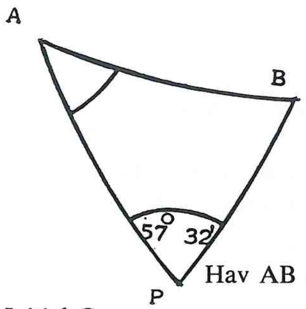
Final Co.

A = .31 S (Use Lat 44°)
B = .82 N (Use lat 38°)

C = .51 N (Use lat 44°) = N69.9E
Final Co. = S69.9W = 249.9 = 250° (T)

EXAMPLE *Great Circle Sailing & Use or A,B, & C. Tables*

Calculate the distance by Great Circle from 20° 52' S 57° 37' E to 32° 12' S 115° 09' E. and find the initial & final courses by ABC tables.



Dep.Long. –	57° 37'
Arr.Long. –	115° 09'
D.Long	57° 32'

$$\text{Hav AB} = \text{Hav } \hat{P} \cos 20° 52' \cos 32° 12' + \text{hav } 11° 20'$$

Initial Co.

A = .243 N
B = .747 S

C = .504 S = S64¾E

= 115¼° (T)

L.Hav 57° 32'	9.36473
L.cos 20° 52'	9.97054
L.cos 32° 12'	9.92747
	9.26274
	.18312
(N.hav 11° 20')	.00975
	.19287 = 52° 06'

Distance = 3126'

Final Co.

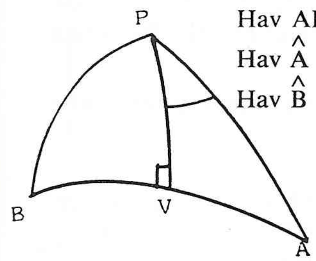
A = .401 N
B = .450 S

C = .049 S = N87.7E 087¾° (T)

EXAMPLE *Great Circle Sailing* *(Obtaining Vertex Position)*

Find the distance, initial course and the position of the vertex on the Great Circle: —

from 'A' Lat 51° 23' N Long 9° 36' W — Lat 46° 00' N Long 49° 00' W



$$\text{Hav AB} = \text{Hav } \hat{P} \text{ SinPA SinPB} + \text{Hav}(\text{PA} \sim \text{PB})$$
$$\text{Hav } \hat{A} = \text{HavPB} - \text{Hav}(\text{AB} \sim \text{AP}) \text{ Cosec AB Cosec AP}$$
$$\text{Hav } \hat{B} = \text{HavPA} - \text{Hav}(\text{AB} \sim \text{BP}) \text{ Cosec AB Cosec BP}$$

From △PVA where V = 90°

$$\text{Cos Lat V} = \text{Sin } \hat{A} \text{ Sin AP}$$
$$\text{Cot APV} = \text{Tan } \hat{A} \text{ Cos AP}$$

to find: — AB	$\hat{A}$	$\hat{B}$
(PA ~ PB) = 5° 23'	(AB ~ AP) = 12° 23.5'	(AB ~ BP) = 17° 46.5
Hav $\hat{P}$ = 9.05551	Hav PB = 0.14033	Hav AP = 0.10933
Sin PA = 9.79526	Hav	Hav
Sin PB = 9.84177	(AB ~ AP) = 0.01165	(AB ~ BP) = 0.02386
	0.12868	0.08547
8.69254	9.10948	8.93182
0.04926	Cosec AB = 0.35468	Cosec AB = 0.35468
Hav (PA ~ PB) 0.00221	Cosec AP = 0.20476	Cosec BP = 0.15823
0.05147	9.66890	9.44473
AB = 26° 13.5'	$\hat{A}$ = 86° 10'	$\hat{B}$ = 63° 41.8'
Dist = 1573.5 nm.	Int. Co. 273° 50'	Fin. Co. 243° 41.8'

to find Lat of V

Sin AP = 9.79526
Sin VAP = 9.99903

9.79429

Lat of V = 51° 29' N

to find $\widehat{APV}$

Cos AP = 9.89284
Tan $\hat{A}$ = 1.17390

1.06674

D.Long A to V = 4° 54' W

Position of vertex Lat 51° 29' N Long 14° 30' W

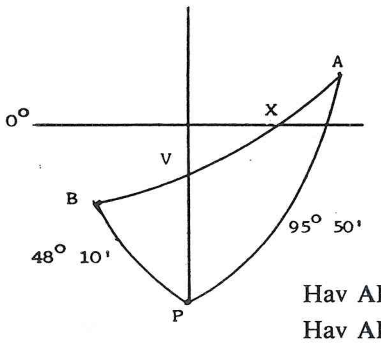
EXAMPLE — *Great Circle Sailing — Crossing the Equator*

Find the great circle distance, the position of the vertex and the course of the vessel as it crosses the equator on the G.C. track from: —

position 'A' Latitude 05° 50' N. Longitude 81° 10' W.
to pos'n 'B' Latitude 41° 50' S. Longitude 175° 40' E.

NB: Construct the spherical triangle APB, in the usual manner and show the pole 'P' in the hemisphere of the greater latitude. e.g. Lat 41° 50' south hemisphere.

Mariners should also note that the co-lat of the vertex is equal to the course at the equator.



$$PA = 95° 50'$$
$$PB = 48° 10'$$
$$PA \sim PB = 47° 40'$$
$$\hat{P} = 360° - (81° 10' + 175° 40') = 103° 10'$$

To find distance AB: —

$$\text{Hav AB} = \text{Hav } \hat{P} \sin PA \sin PB + \text{hav}(PA \sim PB)$$
$$\text{Hav AB} = \text{Hav } 103° 10' \sin 95° 50' \sin 48° 10' + \text{hav}(47° 40')$$

Nos	Logs
Log Hav 103° 10'	9.78809
Log sin 95° 50'	9.99775
Log sin 48° 10'	9.87221
Log hav.	9.65805
Nat hav.	0.45504
Nat hav. (47° 40')	0.16328
Nat hav. AB =	0.61832

AB = 103° 41.3'
Dist = 6221.3 miles

> In order to use Napiers Rules to resolve △PVA it is necessary to obtain more information.
>
> i.e. Initial Course A
>
> Though not specifically asked for in the question.

To find the Initial Course $\hat{A}$: —

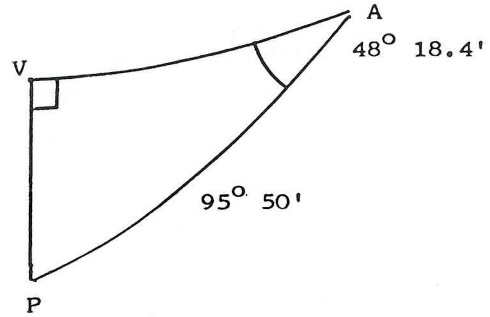
$$\text{Hav } \hat{A} = \frac{\text{hav PB} - \text{hav}(PA \sim AB)}{\sin PA \sin AB}$$

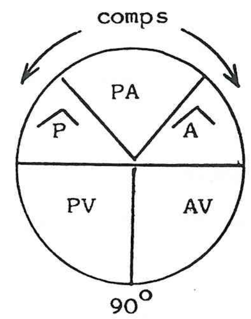
$= \text{hav } 48° 10' - \text{hav } 7° 51.3' \times \text{cosec } 95° 50' \text{ cosec } 103° 41.3'$

Nos	Logs
Nat Hav 48° 10'	0.16652
Nat hav 7° 51.3'	0.00469 (PA – AB)
Nat hav	0.16183
Log Hav	9.20906
Log cosec 95° 50'	10.00226
Log cosec 103° 41.3'	10.01251
Log Hav A	9.22383

$\hat{A}$ = S48° 18.4' W

Position of the Vertex





To find PV (Co-Lat of vertex): —
Sin PV = cos comp PA × cos comp $\hat{A}$
Sin PV = sin 95° 50 × sin 48° 18.4

Log sin 95° 50'	= 9.99775
Log sin 48° 18.4'	= 9.87316
Log sin PV	= 9.87091

PV = 47° 58.6 = *NB: Course at the equator*

Therefore lat/vertex = 42° 1.4' S.

To find angle $\widehat{APV}$ (Longitude of V from A): —

Sin comp PA = tan comp $\hat{P}$ × tan comp $\hat{A}$

Cot $\hat{P}$ = cos 95° 50' × tan 48° 18.4'

Log cos 95° 50'	9.00704
Log tan 48° 18.4'	10.05024
Log cot $\hat{P}$	– 9.05728

$\hat{P}$ = 83° 29.5'
(2nd quadrant) P = 96° 30.5'
Long. of 'A' = 81° 10.0' W

Long. of vertex = 177° 40.5'

Position of vertex — Latitude 42° 1.4' S
Longitude 177° 40.5 W

Course at Equator S 47° 58.5' W (228°)

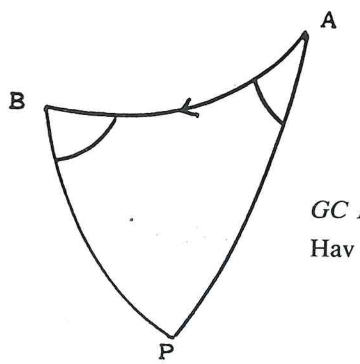
Example *Great Circle Sailing* *(Use of Natural Logrithams)*

NB: The use of natural logarithms to resolve great circle calculations is not uncommon and has become popular with navigators who regularly use a calculator as opposed to employing nautical tables.

Example

Find the great circle distance, the initial course and the final course from: —

Position 'A'	Latitude 34° 00' S	Longitude 18° 00' E.
to,		
Position 'B'	Latitude 36° 00' S	Longitude 56° 00' W.



$PA = 90° - 34° = 56°$
$PB = 90° - 36° = 54°$
Angle $\hat{P} = 18°E + 54°W = 74°$
$PA \sim PB = 56° - 54° = 02°$

GC Distance

$$\begin{aligned} \text{Hav } AB &= \text{hav}(PA \sim PB) + \text{hav } \hat{P} \sin PA \sin PB \\ &= \text{hav } 02° + \text{hav } 74° \sin 56° \sin 54° \\ &= .00030 + 0.36218 \times 0.82904 \times 0.80902 \\ &= 0.243216 \\ &= 59° 06' = AB = 3546 \text{ miles} \end{aligned}$$

Initial course

$$\begin{aligned} \text{Hav } \hat{A} &= [\text{hav } PB - \text{hav}(PA \sim AB)] \quad \text{cosec } PA \text{ cosec } AB \\ &= [\text{hav } 54° - \text{hav } 03°06'] \quad \text{cosec } 56° \text{cosec } 59° 06' \\ &= [0.20611 - 0.00073] \times 1.40574 \\ &= 0.288711 = \hat{A} = S65.2°W \end{aligned}$$

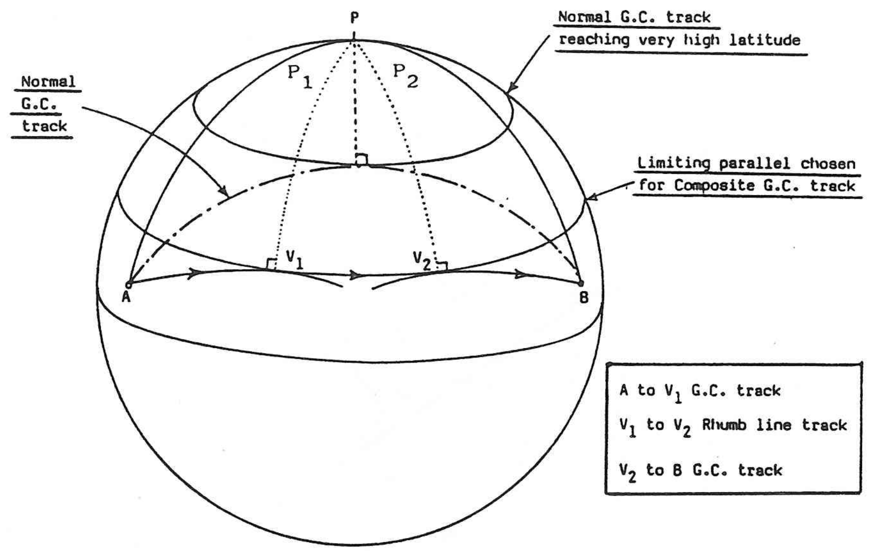
Initial course $= 245.2°$ (T)

Final Course

$$\begin{aligned} \text{Hav } \hat{B} &= [\text{hav } PA - \text{hav}(PB \sim AB)] \quad \text{cosec } PB \text{ cosec } AB \\ &= [\text{hav } 56° - \text{hav } 05° 06'] \quad \text{cosec } 54° \text{ cosec } 59° 06' \\ &= [0.22040 - 0.00198] \times 1.44053 \\ &= 0.314641 \\ &= 68° 14.4' = \hat{B} = N68° 14.4' W \end{aligned}$$

Final course $= 291° 45.6'$ (T)

A composite great circle track



The objective of the composite great circle track is for a vessel to travel the maximum distance on a great circle between the places concerned, without passing poleward of a given latitude.

The problem can be easier to resolve than an ordinary great circle track because of the use of Napiers Rules only.

where 'A' is the initial position.
'B' is the final position.

& V_1 & V_2 are the vertices, each on the limiting latitude.

Method to resolve the problem is achieved by: —

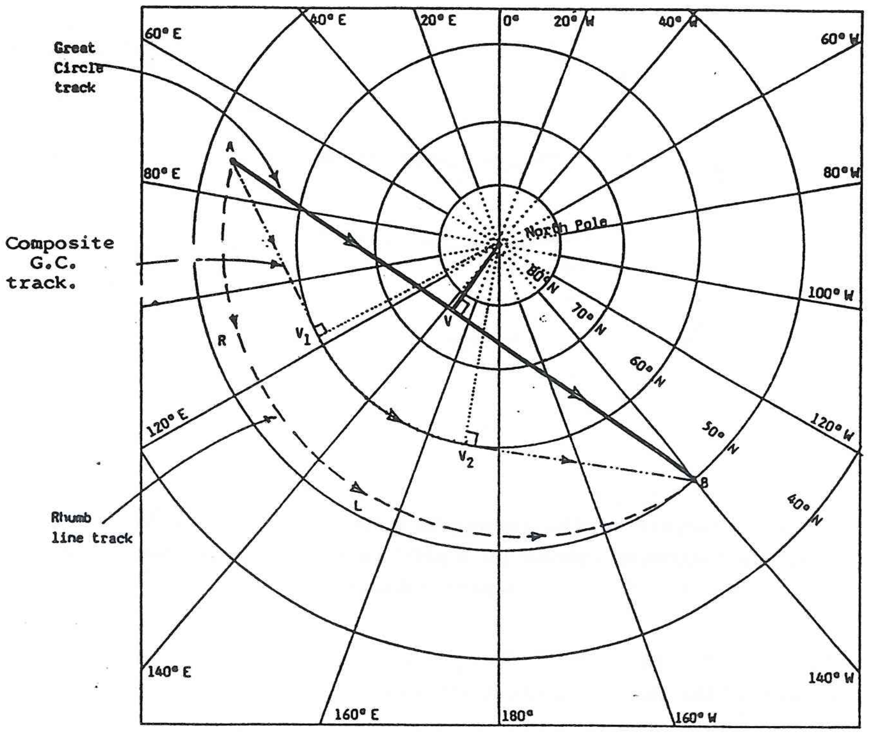
Solve the spherical triangles PAV_1 and PBV_2 where PA, PB and PV are all known.

The longitudes of each vertex can then be found.

The total distance can then be resolved by:
$AV_1 + V_1V_2$ (parallel sailing) $+ V_2B$.

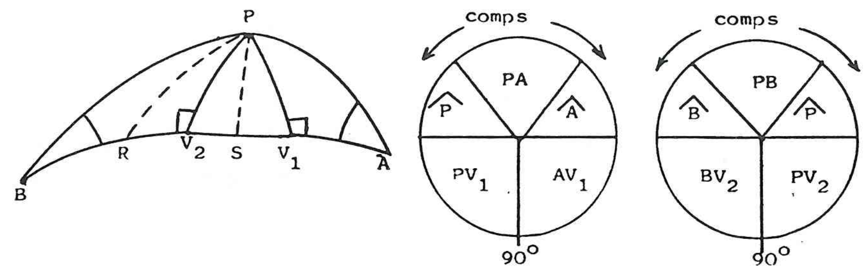
Determination of composite great circle track

POLAR GNOMONIC CHART



Limiting latitude = 60° N	First great circle log = AV_1
Initial position = A[52° N, 73° E]	Parallel sailing log = V_1V_2
Final position = B[50° N, 140° W]	Final great circle log = V_2B
Straight line AVB = true great circle track	TANGENTS to 60° N arc AV_1 and V_2B
Vertex of great circle track = V = [77° N, 144° E]	Approximate Rhumb line track = ARLB
AV_1V_2B = composite great circle track	

The Composite Great Circle
Resolution Method



Resolution by Napiers Rules:

(i) Sin mid part = tan adjacent × tan adjacent

(ii) Sin mid part = cos opposite × cos opposite

In $\triangle PAV_1$		In $\triangle PBV_2$	
Find $\hat{A}$	= Initial course	Find $\hat{B}$	= Final course
Find AV_1	= Distance	Find BV_2	= Distance
Find $\hat{P}$	= D.Long from A.	Find $\hat{P}$	= D.Long from B.

To find distance V_1V_2 — Use "Parallel sailing formula"

Departure = D.Long. × Cos. Latitude ('V' limiting lat.)

To find 'Total Distance'

$= AV_1 + BV_2 + V_1V_2$

To find latitude where great circle meets a given longitude: —

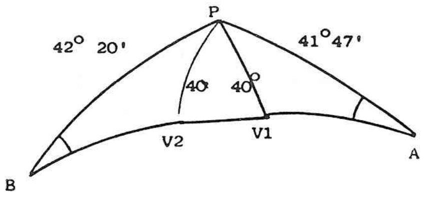
Work as for great circle sailing employing Napiers Rules.

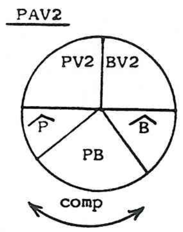
If for example the longitude of 'R' is given, between B & V_2 use the D.Long from V_2 and $\triangle PV_2R$
Latitude being obtained from (90° – PR)

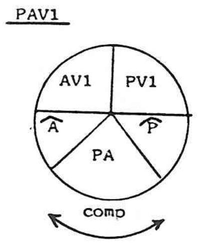
If given a longitude of 'S' which lies between V_1 & V_2 then the limiting latitude is already known.

EXAMPLE *Composite Great Circle* *N. Hemisphere*

Calculate the total distance along the composite great circle track from 48° 13' N 5° 07' W to 47° 40' N 52° 26' W, given a limited latitude of 50° N. Also calculate the initial course by A, B, C tables.







To find BPV2

Sin comp $\hat{P}$ = Tan comp 42° 20' × tan 40°

cos $\hat{P}$ = cot 42° 20' × tan 40°

cot 42° 20' = 0.04048
tan 40° = 9.92381

L.cos $\hat{P}$ = 9.96429
BPV2 = 22° 55'

To find APV1:—

sin comp $\hat{P}$ = tan comp 41° 47' × tan 40°

cos $\hat{P}$ = cot 41° 47' × tan 40°

L.cot 41° 47' = 0.04887
L.tan 40° = 9.92381

L.cos P = 9.972680
APV1 = 20° 6.7'

D. Long between V1 & V2

APV1 20° 6.7'
BPV2 22° 55.0'

43° 1.7'

Long of B 52° 26' W
Long of A 05° 07' W

D.Long 47° 19'
43° 1.7

D.Long V1V2 04° 17.3' = 257.3'

D.Long 257.3'
M.Lat 50°

Dep. = 165.4
(by Tr/Tables)

To find AV1

Sin Cp 41° 47' = Cos 40° × cos AV1
Cos AV1 = Cos 41° 47' × Sec 40°

L.Cos 41° 47' 9.87255
L.Sec 40° 0.11575

L.Cos AV1 = 9.98830
AV1 = 13° 14.5'
AV1 = 794.5'

To find V2B

Sin Cp 42° 20' = Cos 40° × cos V2B
cos V2B = Cos 42° 20' × Sec 40°

L.Cos 42° 20' = 9.86879
L.Sec 40° = 0.11575

L.Cos V2B = 9.98454
V2B = 15° 12.0'
V2B = 912'

Total Dist = 794.5 + 912.0 + 165.4 = 1871.9 nm.

Initial course: A = 3.08 S
B = 3.48 N

C = 0.40 N

A = 75°.1 = N75.1 W = 284.9 (T).

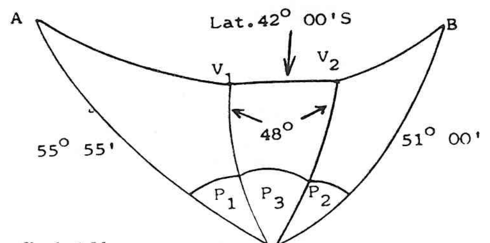
By Napiers Rules Int Co. = 74° 44'
= N74° 44' W.

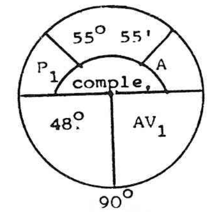
EXAMPLE *Composite Great Circle* *Southern Hemisphere*

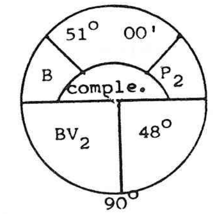
A vessel is expected to depart from Port Elizabeth (South Africa) to arrive at Melbourne (Australia). The Master intends to follow a composite great circle track with a limiting latitude of 42° S. from:—

Departure position — Latitude 34° 05' S Longitude 26° 00' E
Landfall position — Latitude 39° 00' S Longitude 143° 50' E.

The pilotage distance from Port Elizabeth to departure point is 45 miles, and from landfall to berth Melbourne is 84 miles. Calculate the total distance of the voyage?







To find AV1:—
sin comp 55° 55' = cos AV1 × cos 48°

$$\text{Cos AV}_1 = \frac{\cos 55°\ 55'}{\cos 48°}$$

AV1 = 33° 7.4'
= 1987.4 miles

To find BV2:—
sin comp 51° = cos 48° × cos BV2

$$\text{Cos BV}_2 = \frac{\cos 51°}{\cos 48°}$$

BV2 = 19° 51.8'
= 1191.8 miles

To find P1:—
Sin comp P1 = Tan comp 55° 55' × Tan 48°

$$\text{Cos P}_1 = \frac{\text{Tan } 48°}{\text{Tan } 55°\ 55'}$$

$\hat{P}_1$ = 41.282°

To find P2:—
Sin comp P2 = Tan comp 51° × Tan 48°

$$\text{Cos P}_2 = \frac{\text{Tan } 48°}{\text{Tan } 51°}$$

$\hat{P}_2$ = 25.926°

Tot D.Long = 117° 50'
$\hat{P}_1 + \hat{P}_2$ = 67° 12'

$\hat{P}_3$ = 50° 38'
D.Long = 3038'

Dep = 3038 × cos 42°
V_1V_2 = 2257 miles

Tot. Dist: AV1 = 1987.4
V_1V_2 = 2257
BV2 = 1191.8

Pilotage = 45'
Pilotage = 84'

Total Dist. = 5565.2'

Resolution of Great Circle Sailings
(With use of calculator)

Since the 'calculator' is a product of todays world it is only natural that its employment within the marine industry is recognised. With their origins in Napiers Rules, the following formula may be of interest to navigators generally, and would I expect be useful to marine students under examination against the clock.

For distances: $\text{Cos A } V_1 = \dfrac{\text{Sin Lat A}}{\text{Sin limiting latitude}}$

$$\text{Cos B } V_2 = \frac{\text{Sin Lat B}}{\text{Sin limiting latitude}}$$

For finding the Initial Course: $\text{Sin A} = \dfrac{\text{Cos limiting latitude}}{\text{Cos Lat A}}$

$$\text{Sin B} = \frac{\text{Cos limiting latitude}}{\text{Cos Lat B}}$$

For finding the Angle at the Pole: $\text{Cos } P_1 = \dfrac{\text{Tan Lat A}}{\text{Tan lat. of vertex}}$

$$\text{Cos } P_2 = \frac{\text{Tan Lat B}}{\text{Tan lat. of vertex}}$$

Use of the above formula is considerably faster than use of tables, but the marine student is warned that careful manipulation of the calculator is essential to acquire a correct result. Once so obtained results should always be re-checked, to ensure accuracy.

Use of the above formula on the examples within the text would prove a useful exercise to marine students

NB. Minor discrepancies may occur between the use of logs/formula.

Chapter Five

OCEAN ROUTING

The Shipowner's Preference

The Shipowner will very often provide guidelines to Masters as an aid in establishing a most suitable route and in line with company policy. The Master should therefore include these considerations in his choice of suitable route. The shipping company's preference would probably include: —

1. *Speed of passage* — Short passage time is usually a major consideration especially for regular trades.
2. *Economy* — Fuel costs are high and engines should be operated at their most cost effective speed.
3. *Safety of vessel* — Preferred good weather to avoid damage to ship and cargo.
4. *Comfort* — Comfort of passengers and/or deck cargoes on routes to avoid heavy weather.
5. *Dependability* — A record of reliability, coupled with speed and safety when operating a regular service.
6. *Design of vessel* — Is the vessel suitable for the route in question i.e. Ice strengthened for transit through ice regions, or sufficient power to outrun TRS.

possible for the sake of passengers, cargo, and safety. Alternatives to avoid adverse winds should be employed whenever practical.

2. Historical records of heavy seas, and swell conditions should be investigated when deciding on the proposed route. For similar reasons as stated, improved sea state conditions should be sought out and used where appropriate.
3. Sea and air temperatures could also influence routing choice when a vessel is in transit with critical temperature controlled cargoes.

Selection of an Optimum Route

In addition to climatic considerations, Masters will need to consider a number of factors when selecting an ocean passage route. Not only operational and safety considerations, but also commercial influences will need to become essential elements of the chosen route.

Combined climatic/operational considerations could include all of the following: —

1. Recommendations obtained from reference to the publication 'Ocean Passages of the World'.
2. Type of vessel, draught and state of loading. Also the underkeel clearance at various stages of the voyage.
3. Time of year and the expected weather/sea conditions.
4. The possibility of encountering gale force winds causing subsequent delays or damage to the vessel.
5. The likelihood of encountering ice or fog causing delays or deviations from the planned route.
6. Whether the vessel is ice strengthened and suitably equipped for ice regions.
7. Strength and direction of currents being either adverse or favourable to the ships course.
8. Ability to carry out operational tasks such as hatch cleaning.

Commercial Influences on Choice of Route

These could include any or all of the following items:

1. The terms as specified by the charter-party.
2. Owners or charterers direct instructions.
3. The entering or avoiding load line zones and the acceptance or rejection of extra cargo.
4. The distance of alternative routes considered against fuel costs and time.
5. Costs of employing 'shore routing services'.
6. Costs of delays incurred by use of a 'least-time' route as compared with a 'least-weather' route.

The options available to the Master will invariably conflict and final selection will be towards that route which maintains the safety of the ship and the crew above other commercial alternatives.

Shipboard Routing

This cannot be as detailed as a 'shore routing service' because it will lack the most up-to-date information that a shore side facility will provide. Although considerable information sources are available to the mariner aboard his own vessel it is unlikely that he will have the back-up computer facilities of shore based operators. The ship will most certainly not have access to the many informative contacts, or all of the required communication equipment necessary, to complete a comprehensive routing plan. However, an experienced mariner would be expected to produce a reasonable ocean passage plan from limited sources.

Shorebased Routing

Shore routing tends to be comprehensive, but it is expensive. Some benefits will be achieved in fuel economy and possible

reductions in heavy weather damage will be visible. Masters will need to advise the service of ships particulars and also of company's preferences. The Master gains voyage planning from the start of a passage and receives regular weather and routing advice while on passage.

'Metroute' (Shorebased Routing Advice)

The 'Metroute' system was established by the British Meteorological Office in 1968, to provide ship Routing services to vessels crossing the Atlantic Ocean. Since this time the service has expanded considerably and now provides advice for the following areas:
Atlantic, Pacific and Indian Oceans. The Mediterranean Sea, and linked routes from NW, Europe, South Africa, Arabian Gulf and certain South American countries on the east coast.

Additional services are provided on a worldwide basis for, weather reports, tropical storm monitoring, full voyage analysis, tugs and towing on request and a sea ice service, on request.

Advantages of Shorebased Routing

Masters and ship owners who employ a 'Metroute' system can expect to obtain some advantage over vessels which operate their own ship routing schedule, greatest delays have been found, by experience, to be caused by Masters changing their course to avoid bad weather. Distinct benefits can be gained by the use of a well tried and tested routing organisation. Additional advantages would be in the form of: —

1. Savings in fuel and time. (Possibly 10–15 hours N. Atlantic, westbound).
2. Reductions in ship and cargo damage, with reduced wear on main engine propulsion systems.
3. Passengers could be expected to experience greater comfort.

4. Maintenance at sea is usually possible in better weather.
5. Possibility of reduced insurance premiums.

Types of Routes Available

In order to advise on a route one of the principle objectives must be met, that is to provide a route that the vessel will attain her destination by the most economical passage that will avoid ship and cargo damage. To this end the climatic routes east/west will probably be devised under the following types:

1. Least time.
2. Least time with least damage.
3. Least damage.
4. Constant speed.

These would be associated with additional criteria for vessels which require:

1. Ice free route because of no ice classification.
2. Deep water route for vessels which are compromised by deep draught.
3. An all weather route for special cargoes or passengers.

Least time	The objective being to reduce time on passage and is usually applicable to 'tanker' vessels. This type of vessel is less likely to sustain hull damage and will not suffer the possibility of cargo damage.
Least time with least damage	The objective with this option is to reduce and minimise damage costs. This objective is probably the most widely used by vessels engaging in weather routing service.

Least damage	The objective being to sustain absolutely minimum damage, an option for vessels with particularly sensitive cargoes e.g. livestock, vehicles etc.
Constant speed	A requirement often stipulated by 'charter parties' is that the vessel maintains a given speed through out the period of passage. Failure to achieve this speed could incur financial penalties.
Fuel saving option	With today's cost of living increased fuel costs have become significant to ship owners when choosing the optimum route. Prudent weather routing can become an important consideration regarding the economics of a voyage.

Ship Examples Employing 'Met-Routing'

'Met-Routeing' is suitable for all ships, but especially appropriate for the following types of vessels which may encounter typical problems:

1. Container, car carriers, high sided ferries — all of which can be expected to experience considerable windage and subsequent leeway effects.
2. Passenger or roll on/roll off vessels, all weather routes in order to reduce excessive rolling.
3. Tankers, OBO's, vessels constrained by deep draughts requiring deep water routes.
4. All vessels without Ice classification, which carry no ice strengthening or only part ice strengthening which would require an ice free route.

Procedure for 'Met-Routing'

A request for routing advice and recommendations should be made 48 hours prior to departure. Communication being by means of telephone, telex, cable or fax, and should include the following items of information:

- Name of ship and call sign.
- Port of departure and estimated time of departure (ETD).
- Destination.
- Estimated voyage speed.
- Summer deadweight, whether loaded or in ballast. Nature of cargo.
- Weather and sea conditions to be avoided if possible.
- Whether maintenance is being carried out en route which requires a fair-weather passage.
- If a selected weather observation ship or not.
- Name and telephone number, fax and/or telex of local agent.

Prior to Sailing

The Meteorological Office will then despatch provisional advice to the ship. In the event that the vessel is using the service for the first time, and she is berthed in a United Kingdom port, a routing officer may well visit the ship to discuss routing particulars.

On Sailing

The Master should advise the Metroute Office of the departure time (GMT). In return confirmation or update of routing information is given by the Met-Office together with the latest weather information. Weather reports are updated as necessary during the passage, usually at 48 hour intervals.

On Passage

Daily position reports, (noon positions) and GMT are dispatched with relevant wind and sea conditions. These reports may be in reduced format as per ALRS Vol. 3.

Alternative reports for meteorological observing vessels can be transmitted via recognised coast radio stations and in such a case position reports are not required additional to meteorological observations.

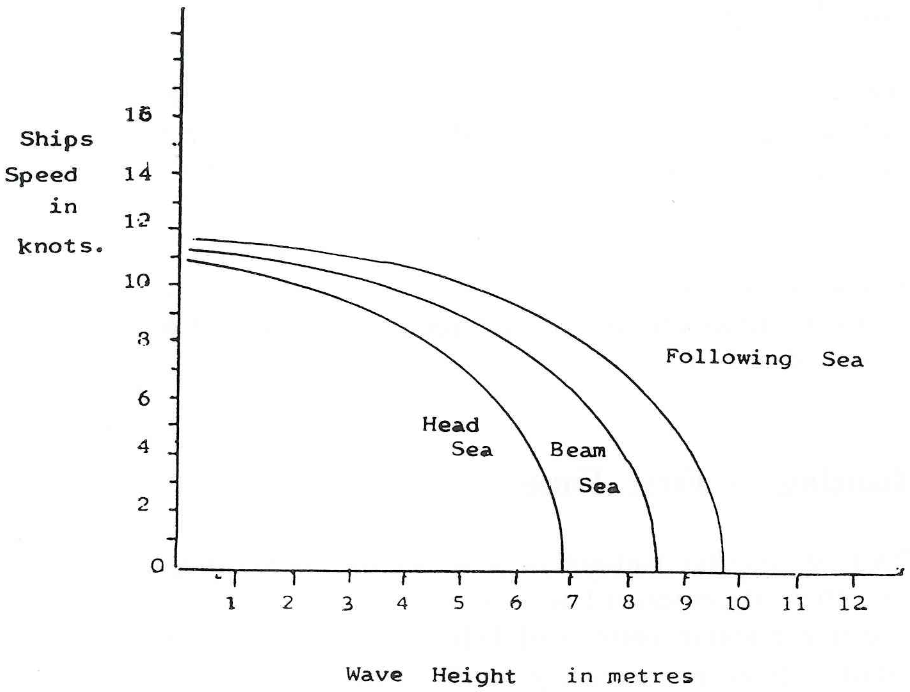
Routing – First Time

Prior to weather routing of a vessel the Meteorological Office (or other organisation) will obtain relevant information as to how a particular vessel will behave over a range of draughts, obtained from previous 'log books', theoretical data from trials, or from observation tests.

Ship Performance Curves

Once relevant data has been acquired regarding the stability information, roll angle and period at various draughts, pitch angle and GM etc.

Then graphs may be constructed to show the ships speed against wave height for various sea states and respective headings i.e. head, beam and following seas.



Ships performance curves employed to determine how far the vessel will travel during the next 12 or 24 hours. Used in conjunction with surface analysis and prognostic charts relevant at the time of the voyage.

Any such figures derived from their use are estimates and should be used as such.

'METROUTE'
Meteorological Office
London Road Bracknell Berkshire RG12 2SZ

METROUTE

WORLD WIDE SHIP WEATHER ROUTEIN

METROUTE OPERATIONAL PROCEDURE WORLD-WIDE

BEFORE DEPARTURE — Preferably 24 to 48 hours before, by any of the following:
Telephone: (0344) 854904/5
Telex: 849801 WEABKA G
Cable: METBRACK LONDON
FAX: (0344) 854411

Using the following format:
AA — Name of ship and call sign
BB — Port of departure and ETD
CC — Destination
DD — Estimated voyage speed
EE — Summer deadweight, whether loaded or in ballast, nature of cargo, weather and sea conditions to be avoided if possible, if repairs and maintenance being carried out *en route* requiring a fair-weather route
FF — If Selected weather observing ship
GG — Name, telephone, telex and fax number of local agent.

ON RECEIPT OF THE FOREGOING — we will dispatch provisional advice. If possible, and when sufficient notice is given, one of our routeing officers will visit the ship (normally UK ports only) to discuss routeing, particularly if using service for the first time.

ON SAILING — advise us of your DEPARTURE TIME PILOT IN GMT. We will then confirm or update routeing advice, together with the latest weather information, and will re-advise as necessary during passage, usually every 48 hours.

DAILY POSITION REPORTS — If a Selected weather observing ship, there is no need to send separate position reports, provided your meteo obs are transmitted via recognized coast radio stations. If not Selected, send your daily noon position in GMT, together with wind and sea conditions, or in reduced form (as per *Admiralty List of Radio Signals*, volume 3) which can be transmitted at no cost to ship.

COMMUNICATIONS — essential for good weather routeing.
Suggest radio stations:
N. ATLANTIC: Portishead Radio GKA; Chatham Radio (USA) WCC, west of 40°W.
N. PACIFIC: San Francisco Radio KPH to dateline or Japan, then Singapore Radio 9VG.
OTHER AREAS AND OTHER RADIO STATIONS BY MUTUAL AGREEMENT.
INMARSAT, MARITEX AND TELEX-OVER-RADIO, direct to this Office.

2/90

'METROUTE'
Meteorological Office
London Road Bracknell Berkshire RG12 2SZ

Telephone (0344) 420242 Ext. 4904/5
(0344) 854904/5

Telex 849801 WEABKA G
Fax (0344) 854411/2

METROUTE

WORLD WIDE SHIP WEATHER ROUTEING

VOYAGE ASSESSMENT INFORMATION

1. Preliminary Voyage Analysis; Voyage Abstract; Routeing Chart (Example 1–3)

After each routeing our customer is sent a Preliminary Voyage Analysis, a Voyage Abstract and a Routeing Chart.

The Preliminary Voyage Analysis (Example 1) is a descriptive account of the route which explains the reasons for the choice of advised route and gives a summary of relevant weather conditions. It also shows the average speed and "performance speed" of the vessel. The performance speed is our estimate of the average speed the vessel would have achieved had it not been affected by weather and ocean currents.

The voyage Abstract (Example 2) lists the ship's noon positions along the route and the weather experienced, giving estimates of how weather and currents would have affected the vessel's progress.

The Routeing Chart (Example 3) is a plot of the route taken by the ship showing its noon positions and the weather encountered.

2. Hindcast Charts (Example 4, 4a, 4b)

Hindcast Charts can be provided on request on completion of a routeing. They compare weather and progress along the Metroute advised route with that likely to have been experienced/achieved along an appropriate alternative route e.g. the 'least distance' route, or the 'least time' route with hindsight. The comparisons show how much time the ship has saved by following our advised route, and the time saving can then be related to a saving in fuel and money.

3. Voyage Analysis (Example 5, 5a)

A Voyage Analysis can be provided on request for any voyage, whether or not it has been routed by Metroute. It is similar to the Voyage Abstract but is designed specifically to be of use in speed or bunker claims. Metroute assessments of the weather experienced are used in conjunction with ship performance curves to determine the expected progress of the vessel day by day. The estimated time of arrival after allowing for weather and currents can then be compared with the actual time of arrival.

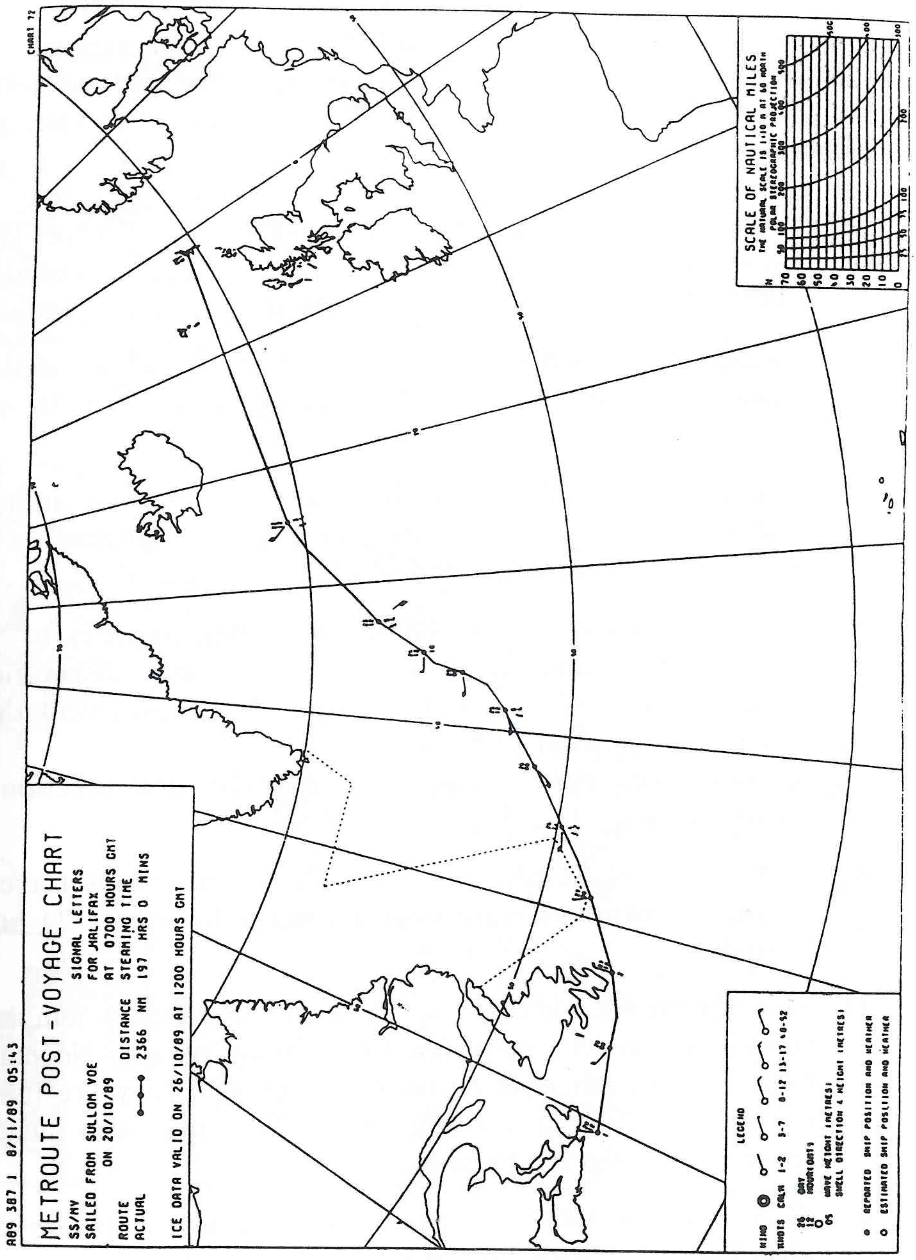
4. Routeing Summaries (Example 6, 7)

A seasonal summary of your routeings can be prepared on request to assist in assessing the benefits of using our Metroute Service. The example given lists each individual routeing with an estimate of the time saving achieved — it also shows where a vessel has lost time by not taking Metroute's advice!

5. Customer Requirements

Although Metroute have a standard set of products which are sent to customers routinely or on request, our aim is to provide the best possible service. If you would like us to provide either extra information or information presented in a different way, please contact us again.

Example of Hindcast Chart



Radio Facsimile Transmissions

Many meteorological services worldwide provide daily radio-facsimile transmissions of weather charts. Examples of some maritime navigation transmissions are included and the following break down provides a brief insight to what they may contain.

a) SURFACE WEATHER ANALYSIS — These show weather patterns based on synoptic surface observations. They are normally made a few hours before transmission.

b) SURFACE WEATHER PROGNOSIS — These indicate future weather patterns for either a 24 hour or 36 hour outlook for specific regions.

c) EXTENDED SURFACE PROGNOSIS — These indicate forecast positions of fronts and pressure systems at the surface for a projected period of 2 to 5 days.

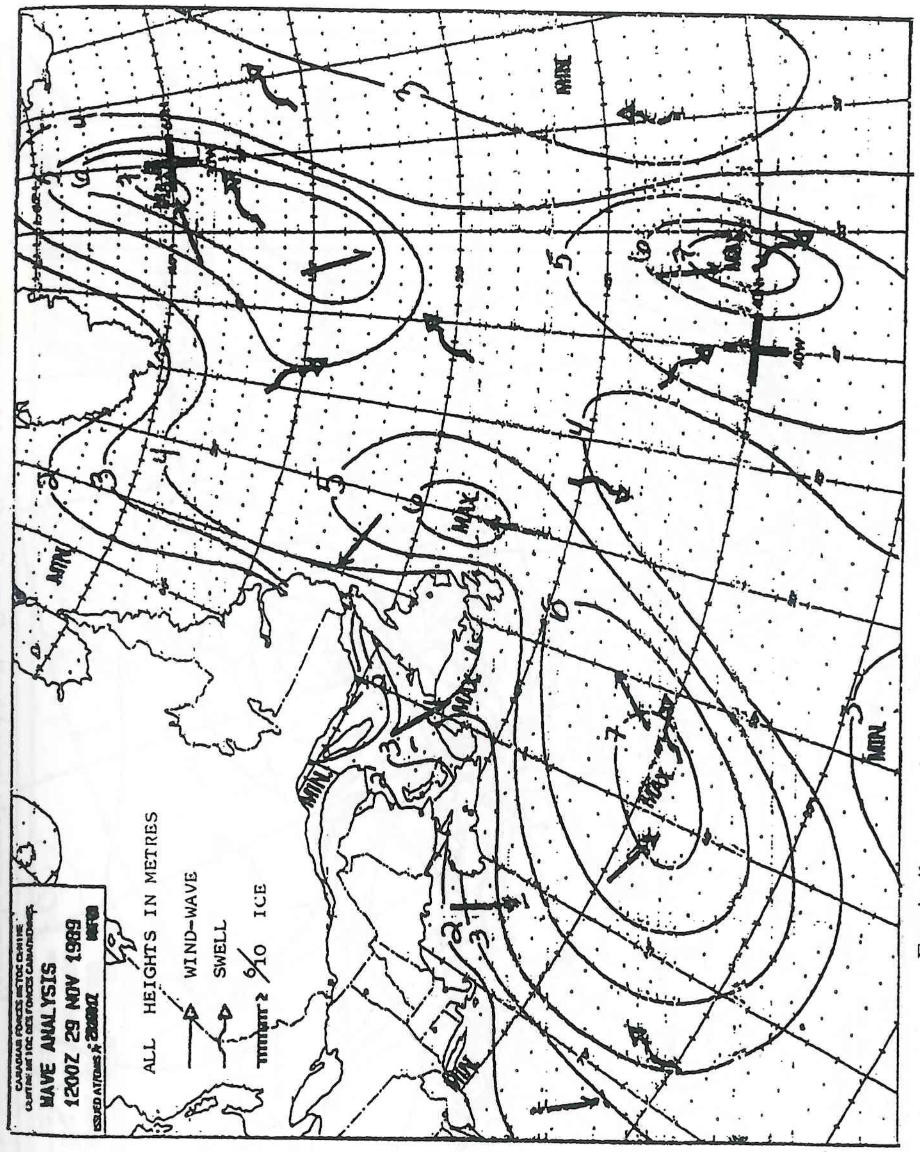
d) WAVE ANALYSIS — These show characteristics of 'sea waves'. They are based on synoptic wave observations made shortly before transmission, or based on calculations derived from wind and wave patterns.
Lines connect points of equal wave heights and direction of movements.

e) WAVE PROGNOSIS — These charts provide a forecast of the positions of wave systems, normally over a 24 hour period.

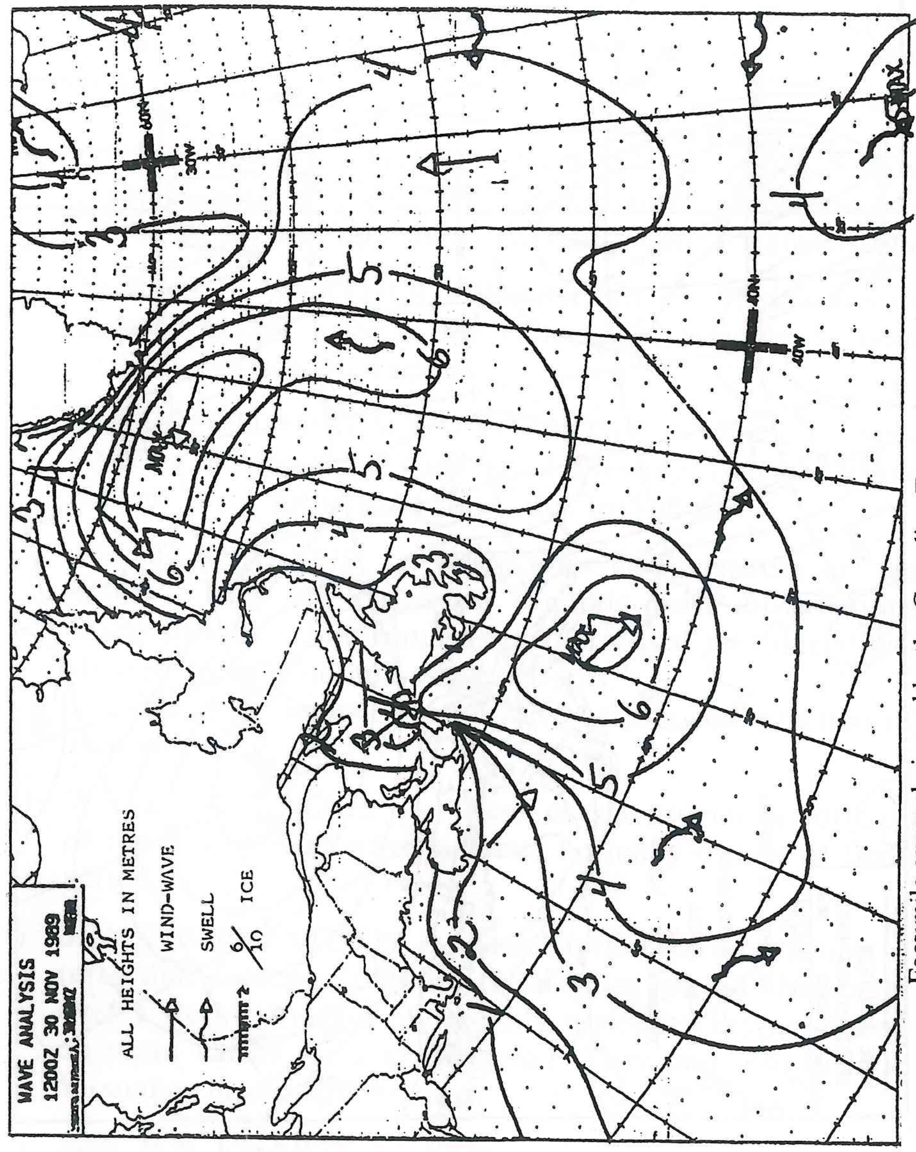
f) SEA TEMPERATURE — These reflect surface temperatures and forecast contours for a given period. Normally over 1 week, ten days or monthly periods. They are based on mean values for a given period. They may also include anomalies in sea temperatures.

g) SEA ICE CHARTS — Snow and sea ice areas are depicted together with known positions of icebergs.

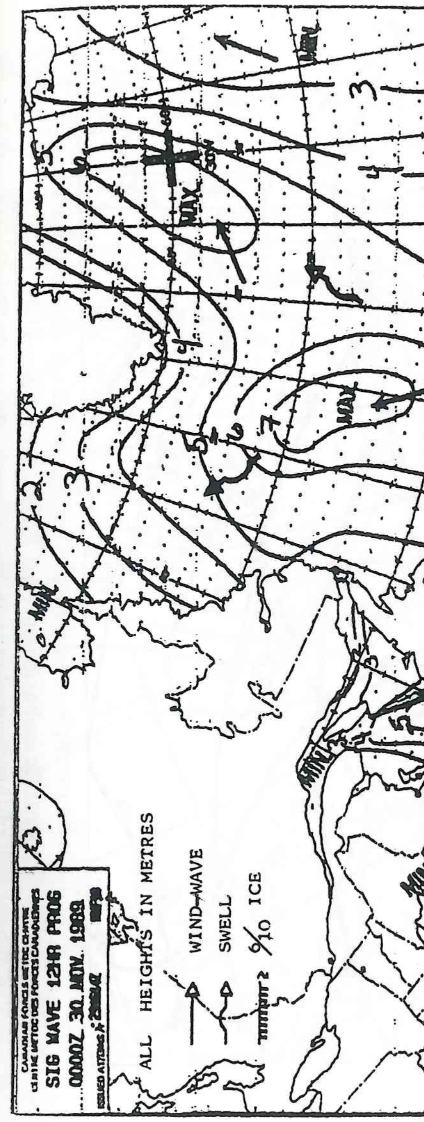
h) SATELLITE WEATHER PICTURES — Show cloud cover, tropical cyclones, and the positions of any disturbances in weather patterns.



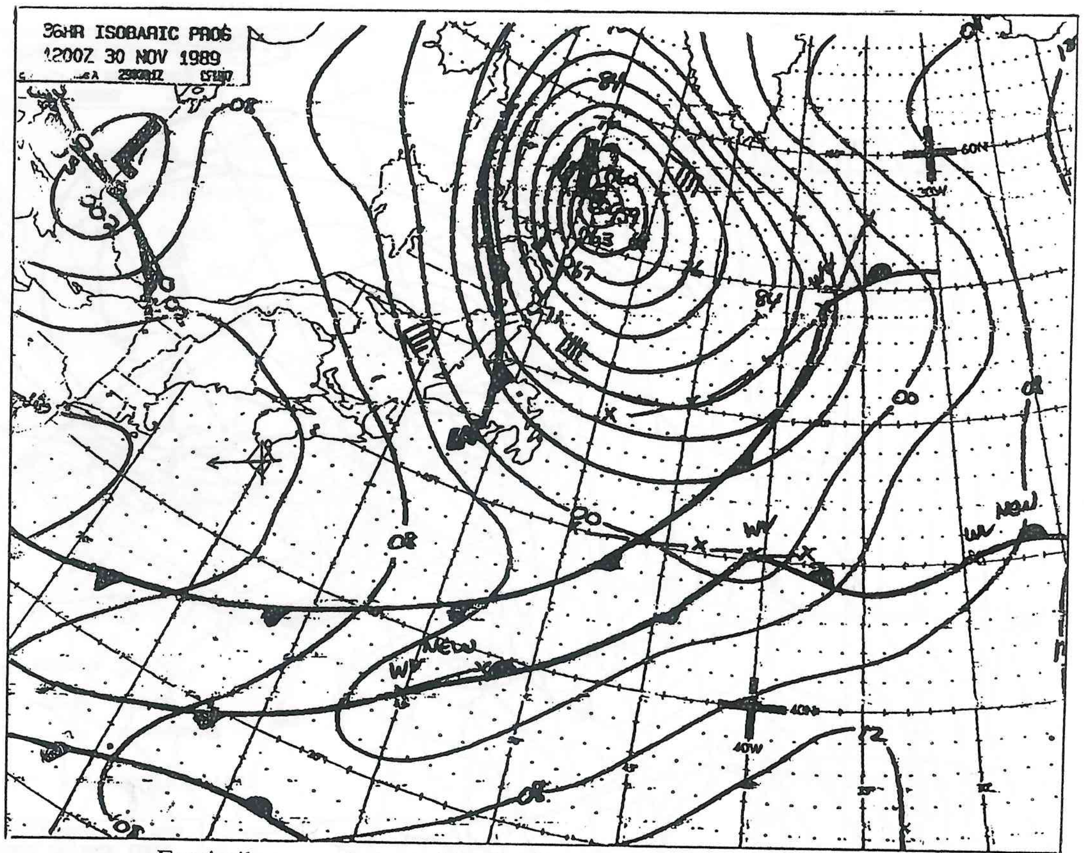
Facsimile example issued by the Canadian Forces Metoc Centre wave analysis for 1200z 29th November, 1989



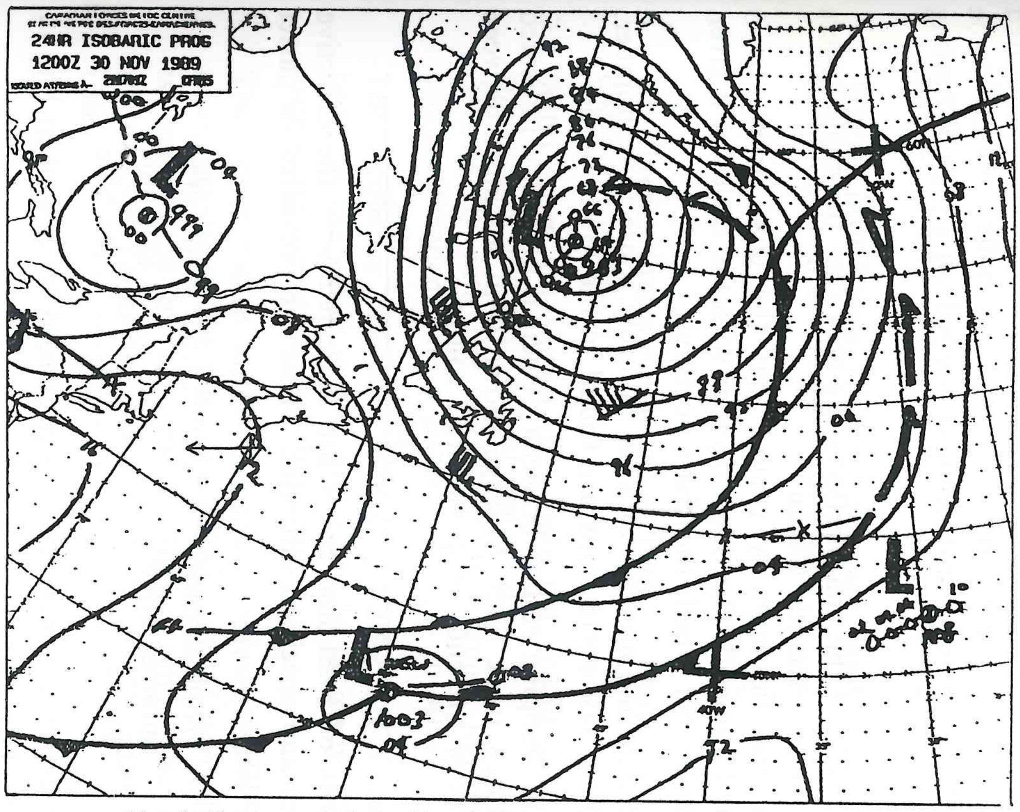
Facsimile example issued by the Canadian Forces Metoc Centre
wave analysis for 1200z 30th November, 1989



Facsimile example issued by the Canadian Forces Metoc Centre
Prognostic wave condition for 30th November, 1989



Facsimile example issued by the Canadian Forces Metoc Centre
Prognostic isobaric chart for 1200z 30th November, 1989
Comparison of this example for 36 hrs as opposed to the 24 hour projection.



Facsimile example issued by the Canadian Forces Metoc Centre
Prognostic isobaric chart for 1200z 30th November, 1989

NB. Position of vessel inserted on the chart to allow interpretation of the expected weather that the vessel can be expect to encounter. vessel westbound, in a position south of Nova Scotia. 1200z 30/11/89.

Routing Charts — Relevant Information and Usage

Any navigator, when planning a passage either coastal or ocean, should avail himself of all the available data relevant to the specific area of the passage. A major source of information which could well effect the planned route could be located on respective routing charts. Mariners should therefore be aware of the contents and detail contained on a typical routing chart: —

1. The title of the chart reflects the area that the chart covers i.e. South Atlantic Ocean.
   The specific monthly period that the chart refers to is stated alongside the title, together with the scale for a given latitude, for which the chart portrays.
2. The date and number with the monthly consecutive number, and the last corrections are found in the lower border.
3. Main shipping routes between principal ports are indicated as black track lines. Mileage shown is in sea miles between ports or the ends of great circle routes.

   ——<—— 4541 ——>——

4. Limits of load line zones are indicated with the effective dates and specified latitudes. These are presented in pastel colours: —

Tropical zone	Light green
Summer zone	Light pink
Winter zones	Light blue

5. The extreme iceberg limit is presented by a broken line in a pale red colour:

   ——— + ——— + ——— + ———

   Maximum limits of pack ice are also shown in the same colour but with a distinctive broken line pattern:

   ——— .. ——— .. ——— .. ———

6. Ocean currents are presented in 'green' and reflect the predominant direction of sea-surface currents for the quarter year prior to the monthly date of the chart.

   Constancy being indicated by presentation of lines:

   25 — 50% — — — — — >

   51 — 74% ————————>

   75 — 100% ════════>

   Where insufficient observations are made the probable direction is shown as the following:

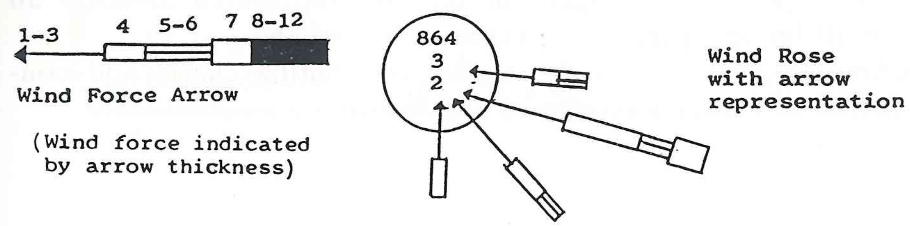
   . . . . >

   All figures indicate the mean rate in knots in the predominant direction.

7. Wind roses are shown in a pale red colour and will be shown over the majority of sea areas.
   Arrows fly with the wind and their length indicates percentage frequency on a given scale (0% to 50%).

   The frequency scale is 2 inches to 100%. From the arrow head to the circle is 5% and provides a ready means of estimating the percentage frequency.

   The upper figure inside the circle represents the number of observations, the percentage frequency of variable winds is represented by the middle figure, while the number of observed calms are indicated by the lower figure of each rose.



8. Meteorological information is also presented by a number of smaller insets into the chart and include information on:
   (a) Percentage frequency of winds, beaufort force '7' and higher.
   (b) Mean air temperature °F and mean air pressure in millibars.
   (c) Mean sea temperature °F and dew point temperature °F
   (d) Percentage frequency of low visibility of less than 5 miles and percentage frequency of fog, where visibility is less than 1/2 a mile.
9. In addition to the above stated items, prominent geographic places and landmarks are indicated with sea passages and respective course alteration points.

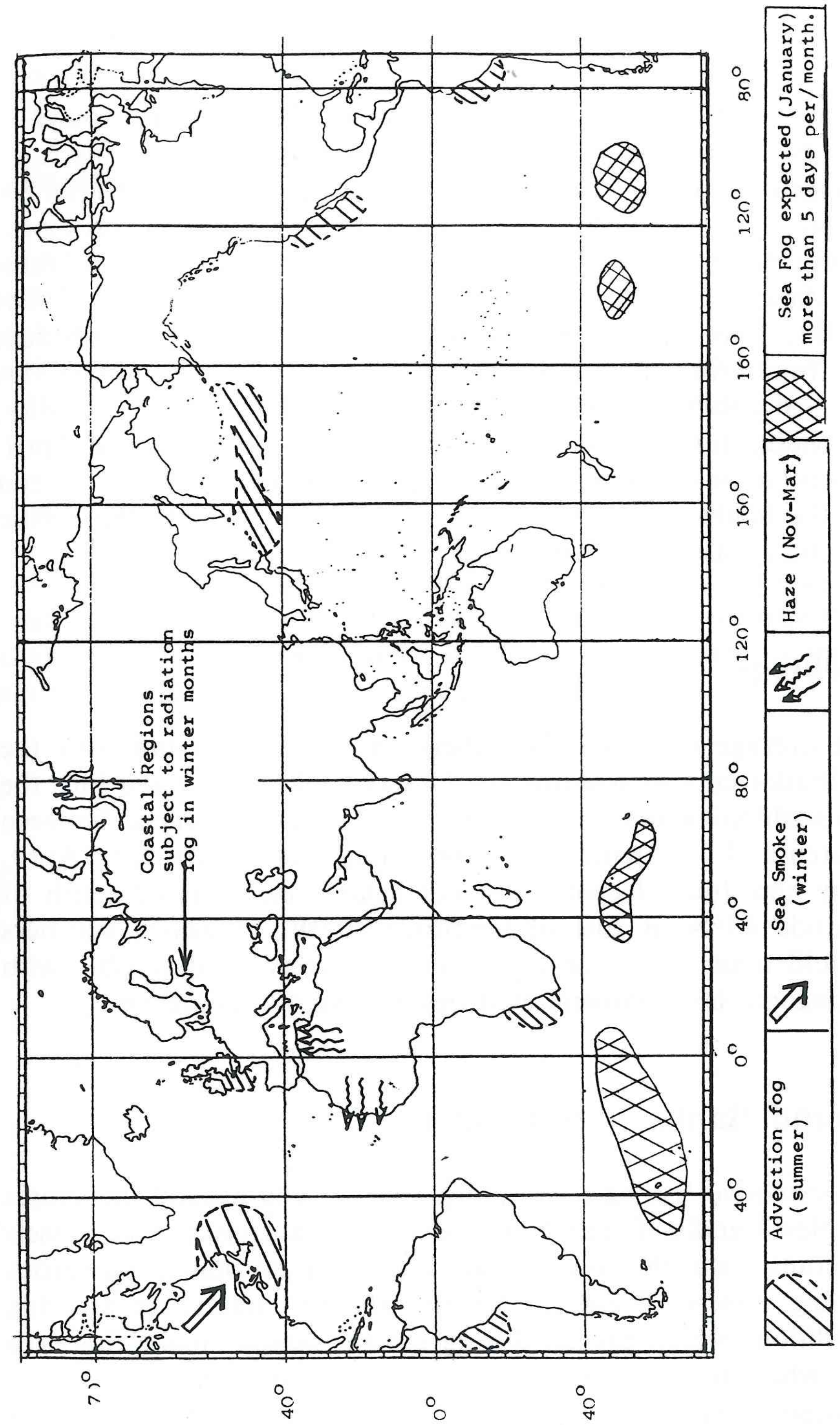
Weather Routing

Marine students seem to have a misconception about the term Weather Routing as say opposed to Met Routing or Climatogical Routing.
It should be clear that Weather routing is carried out by the mariner himself when planning a passage and employs the actual weather and additionally that weather that is forecast in the vicinity of the proposed route.

Met-Routing is an alternative method of weather routing which is specific in the fact that it is carried out by a weather routing organisation, on behalf of the Master/Ship.
e.g. The meteorological Officer.

NB. Climotological Routing is a routing method which gainfully employs the use of prevailing currents and winds. This route may be somewhat longer but may be anticipated to allow an overall higher speed to be made by the vessel.
Climotological Routes are shown on routing charts and considered in Ocean Passages of the World.

THE WORLD (Areas of impaired visibility)



NORTH ATLANTIC

Some of the busiest shipping routes of the world are found in the Northern Atlantic waters. They are also some of the most dangerous routes with problems of fog and ice hazards on approaches to North American Ports. Main routes from North European ports to the eastern seaboard of the United States of America and to the Gulf of Saint Lawrence, (via Cabot Strait) pass close to the Grand Banks. This area is prevalent for fog during late spring and early summer. It is also notorious for ice conditions which tend to exist from January to May, extending furthest south during the months of March and April. On occasions pack ice may be experienced just south of the end of the banks but it is more usual for floes to break up before reaching latitude 45° north.

Icebergs

An average of about 70 icebergs a year drift south with the Labrador current towards the Grand Banks region and into the main shipping lanes. The worst season is experienced between March and July with the greatest frequency occurring in April, May and June. Icebergs are not usually encountered south of latitude 40°N or east of longitude 40°W. However, mariners should note that these limits must be considered flexible with occasional bergs encountered beyond the 40° guidelines.

Grand Banks – Summary

An extensive fishing community exists in and around the shores of Newfoundland and Nova Scotia. As a consequence vessels in transit via this region can expect to encounter numerous fishing vessels. These combined with the climatic ice and fog conditions which prevail during certain seasons make this area one which requires extreme caution for navigators.
Masters should consider reduction of speed and/or stopping if encountering ice conditions which could endanger the vessel.

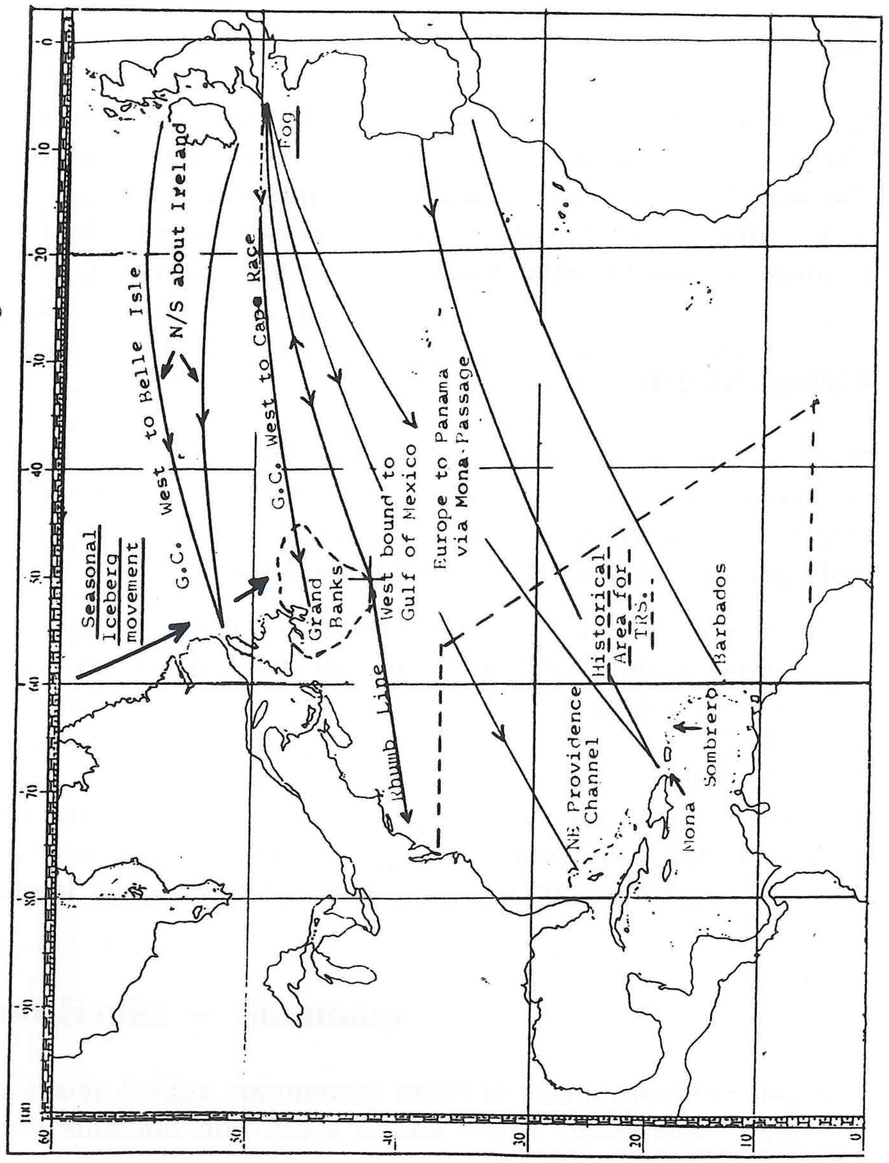
The use of double watch keepers may also be a prudent action in certain circumstances.

Belle Isle Straits

Due to prevailing ice conditions the Belle Isle Straits are generally not navigable from late December until June. Visibility in this area is often impaired and vessels intending to pass via the straits may find use of the echo sounder invaluable if the position is questionable when approaching from the east.

Cabot Straits

With pack ice as far south as Cape Race by the end of January, navigation is usually limited to between April and February. Heavy ice concentrations would normally be expected in the early part of the year from January to April.



NORTH ATLANTIC – Trans-Ocean Routeing

Trans-Ocean Routes (North Atlantic)

Recommended west bound routes between Europe and the east coast of the United States of America is by great circle via Cape Race, or via the way position latitude 42½ °N, longitude 50 °W, during the ice season. Great circles are also recommended to and from the Belle Isle Straits (when Belle Isle is navigable), and to St. John's Newfoundland from Norway, British Isles, Bay of Biscay and west coast of Portugal and Spain.

West bound routes to the Gulf of Mexico from Europe are recommended via the NE Providence Channel. The east bound routes are recommended via the Florida Straits. This east bound route takes advantage of the gulf stream and the North Atlantic drift as well as the predominantly following winds. Routes to Panama from the European continent are great circles towards the Mona Passage, Turks Island Passage or the Sombrero Passage.

Additional Area Information – North Atlantic

Western Approaches to the English Channel — Traffic separation schemes are in operation for vessels on passage through the English Channel. Use of Chart 5500 Mariners Routing Guide should be consulted. A high incidence of 'fog' in the vicinity of Ile d'Ouessant can be expected and the use of soundings is recommended when making landfalls in this area.

Gibraltar Straits — A traffic separation scheme exists within the Straits of Gibraltar. Variable eddies and currents persist in the area of Cape St Vincent towards the straits. While inside the straits a strong westerly wind could result in a tidal stream of up to 6 knots.
(Distance Ile d'Ouessant to Gibraltar Straits — 930 miles).

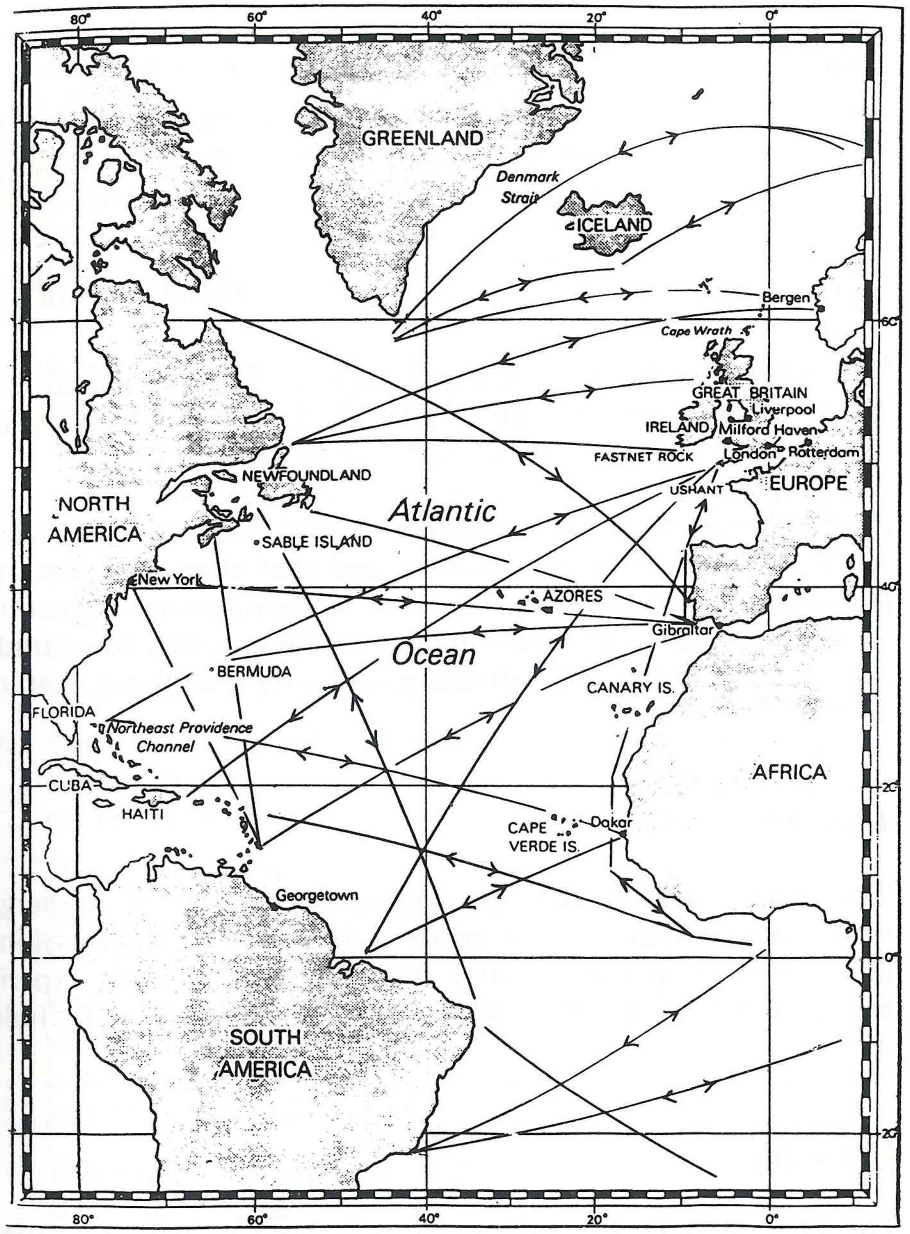
Norwegian Coast Ports — Main ports on the west coast of Norway are not restricted by ice. However, the closure of Oslo, can occur on rare occasions.

Denmark Strait — An area which is generally navigable throughout the year, with the eastern side usually free of ice. Although icebergs may be encountered on either side of the straits at any time. Occasionally the straits may be closed due to ice conditions extending from Greenland, as occurred in spring 1968.

Hurricanes

These occur in the western part of the ocean and effect the Caribbean Sea, Gulf of Mexico, Bahamas and the Bermuda Islands. Their greatest frequency is during the months of August to October. They have however, been experienced from May to December (see tropical revolving storms).

NORTH/SOUTH ATLANTIC Example Routes



SOUTH ATLANTIC

Climatic Information

With the continuous passage of depressions from west to east strong winds and high seas dominate this vast ocean expanse. The wind pattern, although similar to the North Atlantic, differs in a way that circulation is anti-clockwise, with the oceanic anti-cyclone centred about latitude 20° S to about latitude 28° S.

The worst conditions which are likely to be experienced will occur between latitudes 40° S and 50° S. While a heavy swell may also be encountered especially up to latitude 60° S.

Tropical storms do not form in this area because of the cool surface waters. This condition is one that does not generate an accumulation of water vapour necessary for the formation of a TRS. Gales are frequent and common south of latitude 40° S, even during the summer months. Fog is also a feature of the summer months.

Icebergs

The most southerly shipping routes are effected by icebergs which can be found as far north as latitude 31° S. Occasionally, abnormal movement may result in icebergs being experienced even further north than this. (One reported at latitude 26° S).

Pack ice

The limit of pack ice tends to average between latitudes 60°S and 54°S, but the position of the edge (4/8 ths concentration) fluctuates depending on the severity of the season. The limit prevents the use of great circle sailing between Cape of Good Hope and Cabo de Hornos, except during March through to May.

Trans Ocean Routes (South Atlantic)

West bound routes are usually by rhumb line sailing. The main reason for this is that the adverse effects from head winds and currents are reduced, while east bound tracks usually combine great circle and rhumb line when south of latitude 25° S.

Example Routes

1. Great circle sailing in both directions is recommended between Rio de la Plata (River Plate) and ports on the African coast north of lat. 25° S.
2. Rio de la Plata towards Cape Town/Indian Ocean is recommended by great circle, but parts of the track lie within the extreme iceberg limits.
   Cape Town towards Rio de la Plata is a recommended rhumb line to position, lat. 35° S, long. 40° W, then a second rhumb line towards destination.
3. Cape Town to Falkland Island or Straits of Magellen.
   Routes are by rhumb line to lat. 35°S, long. 40° W then on by rhumb line to destination.

   Distance reference:
   Cape Town to Port Stanley (Falklands) 4170 miles
   Cape Town to Magellan Straits 4510 miles

   Low powered vessels: Alternative routing for low powered vessels is recommended via lat. 27° S, long. 20° W, then by a second rhumb line to the way point for the Falklands and Magellan Straits.

   This route takes full advantage of lighter winds and favourable currents, although the distance is slightly longer by about 150 miles. (Low-powered vessels — less than 10 kts)

   NB: When on passage via the Straits of Magellan, low powered vessels are warned that they may experience strong cross tidal streams and may subsequently be at a disadvantage when prudent manoeuvrability is required.

Violent and unpredictable squalls are also common to this area. Masters should therefore consider their passage plan with care if intending to pass through this region which has the usual hazards of a narrow waterway coupled with a reputation for bad weather.

4. Cape Town to Panama Canal (via Galleons Passage). Recommended routes are by great circle to a position North of Recife (lat. 4° 40' S, long. 34° 35' W) then coastal towards Colon via 'Galleons Passage'.

Indian Ocean – Entering

Mariners have a choice of keeping inshore from Cape Agulhas and thus keeping inshore of the Agulhas current or passing to the south of the current via a position some 145' south of the Cape of Good Hope.

Indian Ocean – Leaving

Masters should obtain a position which favours the Agulhas Current and one which avoids the abnormal waves and dangerous seas which are common to the area.

NORTH INDIAN OCEAN

The weather patterns of the North Indian Ocean are influenced by the seasonal monsoon winds which result from the heating and cooling of the Asiatic land mass.

SOUTH WEST MONSOON

From June to September a low pressure area is established over the north west part of India, because of the rising temperature over the land at this time. This results in a south westerly wind being experienced. The origins of this are derived from the south west trade winds being drawn over the Equator and then

deflected by the rotation of the earth. The winds then join up with the cyclonic circulation about the low pressure area to become what is known as the south west monsoon. This subsequently effects not only the North Indian Ocean but also the Bay of Bengal and the Arabian Sea.

Variable Wind Strengths

The south west monsoon has been observed to be strongest in an area approximately 250 miles east of Suqutra during the month of July. Wind speeds being noted up to force 7 or more, at this time. It is also recorded as being strong in the western part of the Arabian Sea, with average forces of 6 to 7 being the norm at the height of the monsoon season.
In the Bay of Bengal the average wind force is about 4 to 5 but may reach 7 during the months of July and August.
The north eastern area (Karachi/Bombay) the weather is generally better with wind speeds averaging about force 4.
From the Equator to about 5° north latitude and east of longitude 60° east, average wind speeds are about force 3, though their direction is more variable.

General Weather

Over most of the North Indian Ocean the weather outlook remains cloudy and unsettled with considerable rainfall during the south west monsoon season. The west coast of India and Burma experiencing particular heavy rainfall at this time.
Normally visibility is quite good except when impaired by heavy rain. Exception to this may be found in the northern and western parts of the Arabian Sea where surface visibility may be reduced during July and August, because of dust haze.

Malacca Straits

An area which is well known to many seafarers experiences usually light winds which vary in both direction and force. The straits being often influenced by land and sea breezes with occasional strong winds reaching gale force. Squalls are also a feature of this area, notably at night and usually from the west.

Malacca Strait
This is probably the main seaway used by vessels on route from Europe, or India towards Malaysian ports, Japanese ports and onwards. In addition to what has already been stated about this very busy shipping channel the following may be found useful when navigating through the area:

Depths in the channel are liable to change and the least depth in the fairway is about 25 metres. Deep draught vessels should take special note of the most recent reports regarding the least depths in and around the fairway. Vessels which exceed a draught of 19.8 metres should not use the channel.

Distances up to about 600 nautical miles require particular vigilance by watch keeping officers. The area is well used by fishing vessels and strong tidal streams must be anticipated. The width of the Straits vary from 8.4 nautical miles in the south to about 140 miles in the north. Although larger vessels will have to negotiate a narrow channel of around 2 miles in width. (One Fathom Bank)

Traffic density is heavy and large vessels need to proceed with extreme caution. About 140 vessels daily pass through the Straits, the alternative passage towards Japan would be via the Lombok Strait, which adds about 1200 n/miles to the journey.

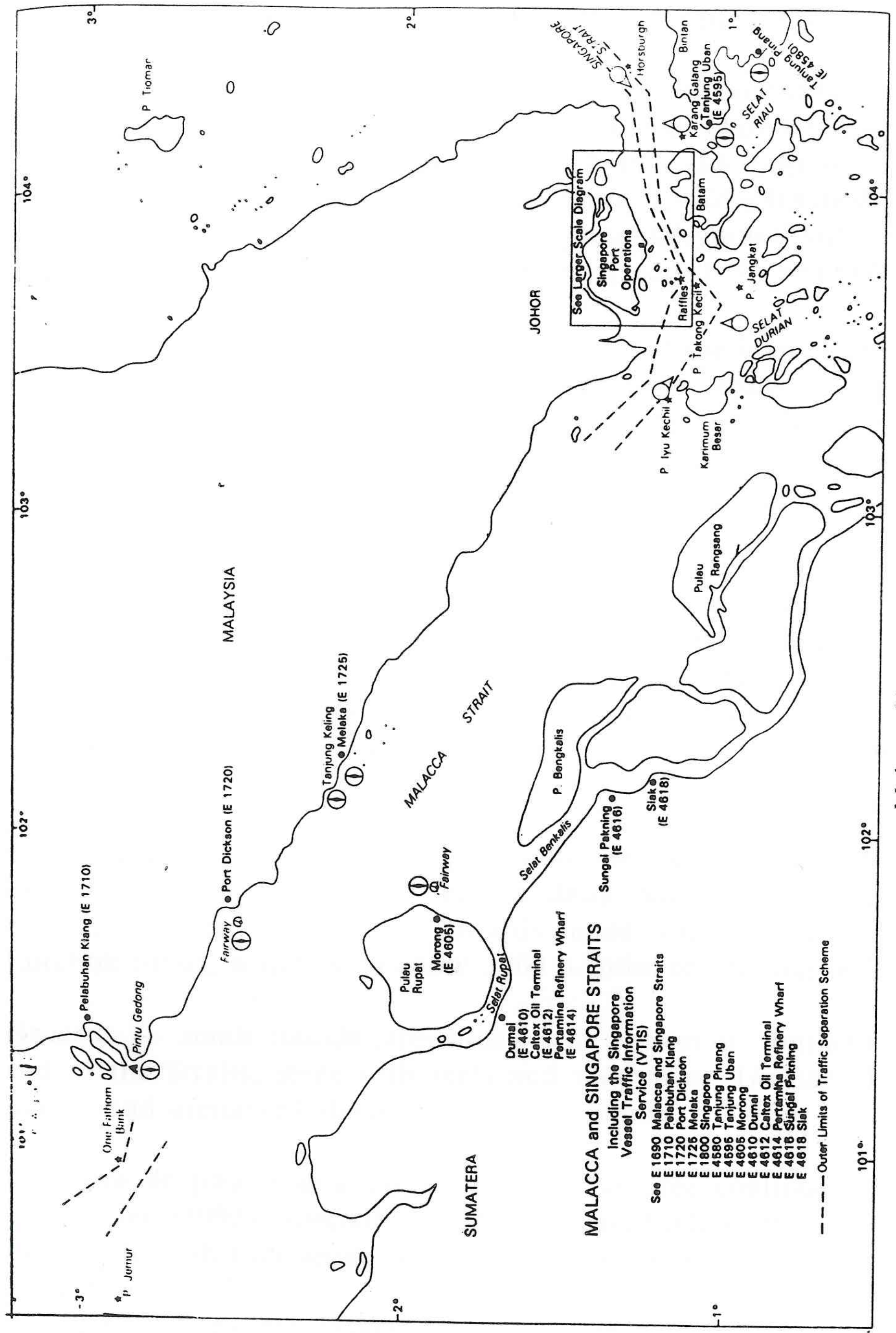
Hazards — small islands are situated at the most southern end of the Straits, some with reefs and sandwaves. Uncharted wrecks and unmarked shoals are not uncommon.

Incidence of pirates boarding vessels in this area continue to be reported (1992) especially noted in the southerly traffic lane passing through Indonesian waters of the Singapore Strait.

Weather patterns are influenced by the north east monsoon (northern winter) and the south east monsoon (northern

summer). Winds are generally light and variable in direction but squalls often reaching gale force are common to the area. Rainfall is heavy in the region, and may impair visibility.

Publications for use when passage planning through the Malacca Strait should include:
Admiralty Lists of Lights (Vols., F & K), Chart Catalogue, Admiralty Navigational Charts, Routing Charts, Ocean Passages of the World, Admiralty List of Radio Signals, Sailing Directions Volume 44, (Malacca Strait Pilot).



Malacca Singapore Straits

NORTH EAST MONSOON

From November to March the areas of the Arabian Sea, the Bay of Bengal and the Northern Indian Ocean will experience a north easterly wind, (NE monsoon).

The average wind strengths over the greater part of the area are about force 3 to 4 and these are generally accompanied by fine weather with little or no rain. On rare occasions the wind force may reach force 7. However, during the months of December/January considerable rainfall can be expected in the Bay of Bengal, south of latitude 5 ° north.

Visibility during this season is usually-very good with the exceptions being in the north and eastern regions of the Arabian Sea which may be effected by dust haze. The northern regions of the Bay of Bengal may also experience some reduced visibility from the prevailing northerly winds bringing smoke haze and land mists seaward.

INTER-MONSOON SEASONS

These occur in the period April, May and October. Weather varies considerably with winds over open sea areas reaching force 7, only occasionally. It is often cloudy with squally conditions, accompanied by heavy showers and thunderstorms. Fine weather periods are equally just as common.

Visibility is generally quite good except in heavy rain conditions or when impaired by dust haze on the northern and eastern shores of the Arabian Sea, (April/May). The Malacca Strait has occasional squalls (Sumatras) during these periods.

Tropical Storms (Cyclones)

These occur in the Arabian Sea during the inter monsoon periods mainly during May/June, and October/November. The greatest frequency occurring in the months of June and November.

In the Bay of Bengal most storms occur from May to November, with the greatest frequency in the months of May, June, October and November.

NB: Tropical cyclones are rare in the Gulf of Aden, only 3 or 4 being recorded over the last 50 years.

The Gulf of Oman suffers dust storms and sandstorms throughout all seasons but they are noted as being more frequent during the months of June and July. Visibility is effected and can be reduced to as little as 500 metres.

ROUTES – NORTH INDIAN OCEAN, BAY OF BENGAL AND ARABIAN SEA

The prevailing monsoon conditions influence routes across the Bay of Bengal and the Arabian Sea. The directional flow of currents which is reversed due to seasonal changes, must be considered by Masters when carrying out the planning and execution of their passage plan.

Navigation via Suqutra (SW Monsoon Period)

Vessels east bound, from the Gulf of Aden are advised to route north of Suqutra and then through the 'Eight Degree Channel' (Ref. latitude 7° 30' N longitude 72° 45' E) because of rough sea conditions which exist in this vicinity during the SW monsoon.
Vessels west bound from 'Dondra Head' (Sri Lanka) towards Aden via the Eight Degree Channel have an option of either north or south about Suqutra and then on past Raas Caseyr into the Gulf of Aden. The more southern route is generally preferred as vessels are less likely to meet the need to reduce speed for bad weather.

(NE Monsoon Period)

Routes from Aden to the Eight Degree Channel pass south of Suqutra during the NE monsoon period. While west bound vessels have options to the north or south of Suqutra.

Seasonal Routes

Vessels on voyages from South African ports Cape Town, Durban etc. for Bombay, Karachi, Bay of Bengal or Colombo may consider routing via the Mozambique Channel. However, Masters should note that navigational hazards in the form of shoals and islands are present in the north approaches to this channel. These may impose movement restrictions especially if tropical storms (TRS) are encountered.

Mozambique Channel – Currents

The Mozambique Current sets SSW and follows the coast line to what is thought to be some 50 miles off during most of the year. This current effect extends to about 100 miles offshore during the months of June to August. The strongest rate is experienced from October to February when rates of 4 knots are attained. Some inshore counter currents may also be encountered and the boundaries and rates stated cannot be relied upon.

Routes to Aden via the Mozambique Channel

These are normally made coast wise in both directions.

NB: The East African Current flows northward continually and gives way to the Somali Current in about 2°S Latitude.
The Somali Current sets SW from December to February at rates up to 4 knots. From May to September a NE current is established which may have rates as much as 7 knots.

SOUTH INDIAN OCEAN

The weather patterns of the South Indian Ocean are influenced by the movement of the monsoon into the Southern Hemisphere from November to February and its subsequent return north during the months of June to September.

NW Monsoon

Experienced between November to March when a north to north westerly wind meets the South East Trades in about latitude 10 °S. (An area known as the Equatorial Trough Winds) are generally light and variable in direction becoming more north easterly towards the African coastline.

Squalls are common often in association with tropical storms but wind force 7 or above is only recorded occasionally. Frequent showers and unsettled weather is the norm. Visibility is generally good except in heavy rain.

Mozambique Channel

Experiences a northerly wind between 15 ° S and 17 ° S latitudes known as the Northern Monsoon (November to March). Southern Monsoon occurs the length of the channel (April to September) when the wind blows south to south easterly.

General Weather

The oceanic high pressure area is situated about 35 ° S latitude in summer and around 30 ° S in the winter.

The Trade Winds, strongest in spring, suffer little variation in direction throughout the year, average strength in summer being 3 to 4 and in the winter being 4 to 5. Over open ocean areas the weather is mostly fair to fine with half covered skies. Some showers may be encountered.

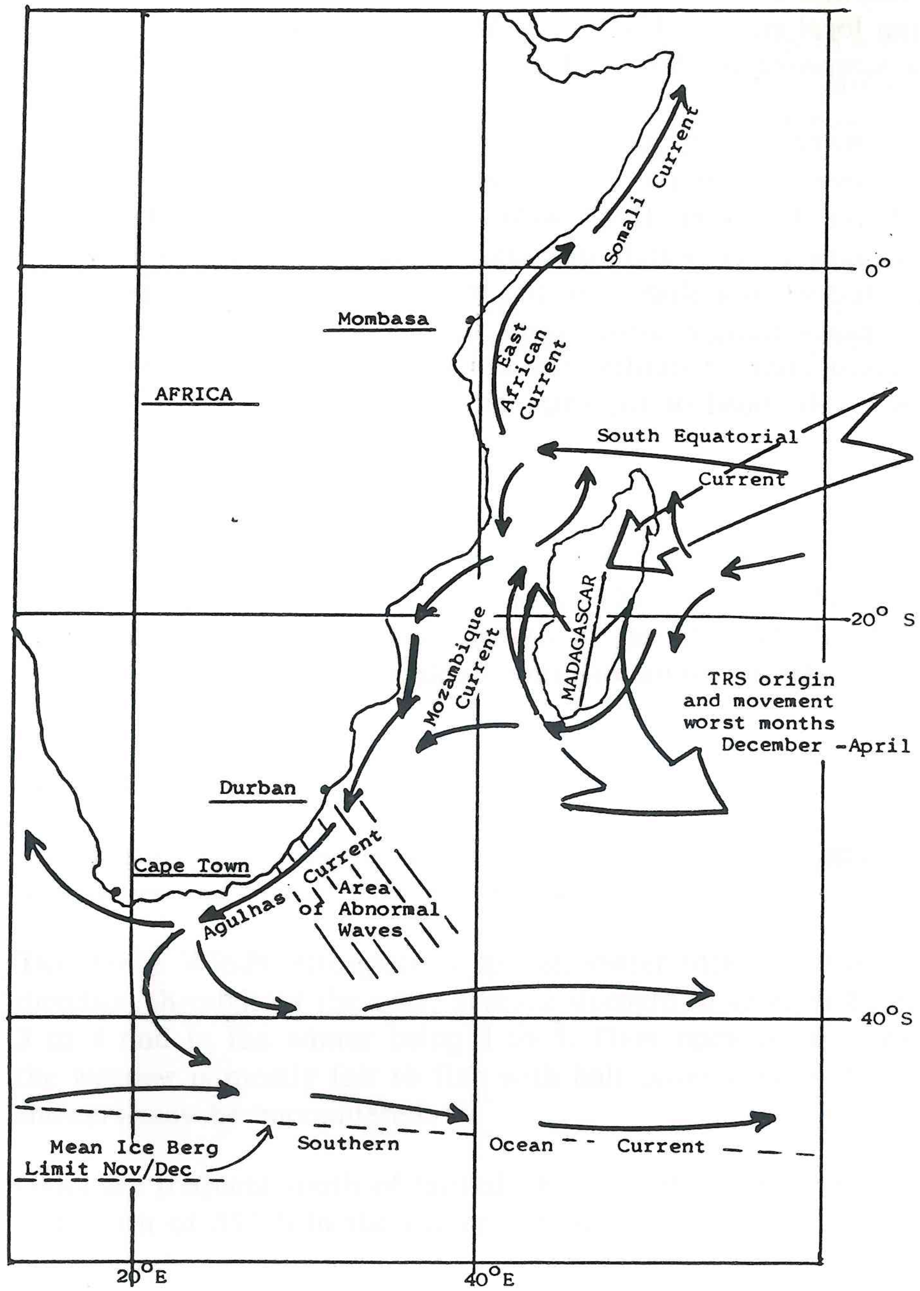
Gales are frequent south of latitude 40 ° S in the summer period and south of 35 ° S in the winter period.

Abnormal Waves

Mariners navigating off the South African coast, especially those vessels on a south westerly heading may encounter ab-

normal waves. They are thought to be generated in the southern ocean and combine with other distant wave patterns and waves from local storms. They meet the Agulhas Current head on and are steepened or shortened as a swell might be.

Such waves may be preceded by an exceptionally deep 'trough'. Although rare, ships could founder into this 'hole in the sea', with the following freak wave crashing down onto the ship. The danger for watch officers, is that the condition is only detected when a ship is on the brink of such a trough prior to the vessel plunging downwards. Evasive action should therefore be considered on sighting the much higher and distinctive wave crests well ahead of the ships movement.



Currents & Weather Phenomena Around Cape Aqulhas

Ice Conditions of the South Indian Ocean

The extension of pack ice (4/8 ths concentration) is at its furthest during the months of August to September, reaching up to about latitude 58° S in way of longitude 50° east.

Icebergs of the 'Tabular Type' — The mean limits for icebergs during the worst months of November and December should be considered from about latitude 44° S longitude 20° E to 48° S latitude at about 120° E longitude, then passing south of Tasmania.

NB Mariners should note that ice limits must be considered extremely flexible and are known to differ year by year depending on the severity of the season.

Trans-Ocean Routes

Great circle routes between Australia and South African ports are not normally followed. The reasoning for this is that a greater part of the passage could expect to experience areas of extreme bad weather and the additional risk of encountering pack ice is also present. West bound routes could also expect considerable delays due to strong adverse currents i.e. southern ocean drift, setting eastward.
Vessels usually take advantage of an area of light and variable winds which lie between the South East Trades and the Roaring Forties when planning an ocean passage. The axis of this zone lies at about 33° S latitude in (S) summer and about 30° S in (S) winter.

East bound routes to the South and West Australian coastlines often employ a composite route with a limiting latitude to suit the season, namely Latitude 40° S (S/summer) or latitude 35½° S (S/winter).

West bound routes generally keep well north and so avoid head winds and adverse currents.

Route North or South of Australia

The choice of whether to go north or south about Australia will depend on comparable distance and the season. The climatic conditions on each alternative would also influence the Masters choice.

Northern routes are normally set via the Torres Strait and southern routes by the Bass Strait.

Regional Routing Information

North Pacific Ocean

Trans-ocean routes in the North Pacific often employ a high-latitude alternative and provide a distinct saving on distance. However, some disadvantage may be experienced from weather and currents.

West Bound (Recommended) San Francisco to Yokohama

A seasonal option recommends a great circle during the summer months where as in the winter, a rhumb line to latitude 35° N, longitude 140° W and then on to Yokohama.

East Bound (Recommended) Yokohama to San Francisco

A great circle route both in winter and summer, direct is recommended.

Alternatives — West bound vessels may prefer a route north of the Aleutian Islands. The reason for such preference being that many storms pass south of the Aleutians and vessels in the Bering Sea would experience following winds and seas. Currents are generally weak north of this group of islands and

fog is less likely, neither is 'ice' normally encountered in the vicinity of the islands.

The main northern route suggested is via a 'great circle' to the 'Unimak Pass' then through the 'Bering Sea' passing out north of 'Attu Island' and finally resuming the great circle track to 'Nojima Saki'.

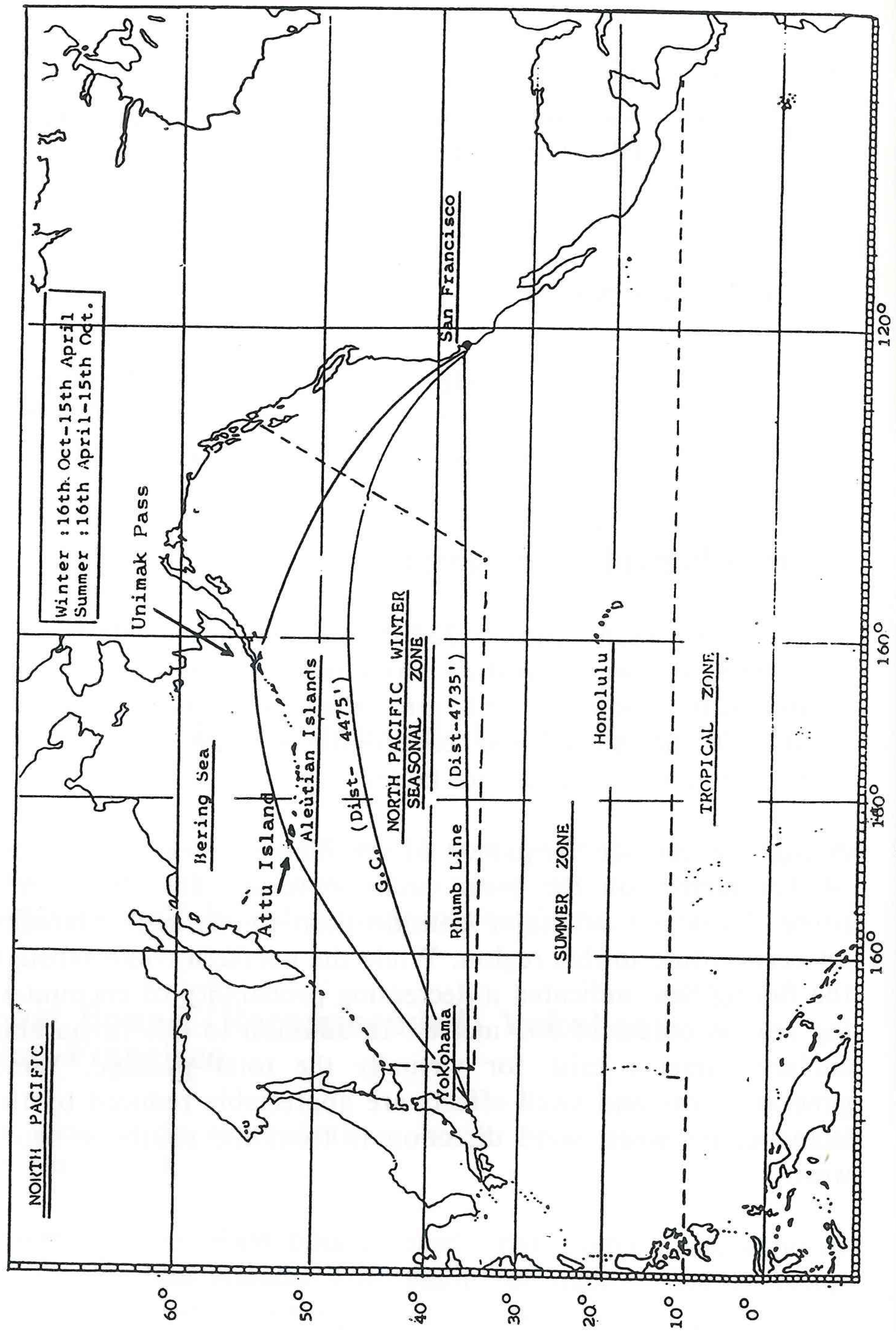
Distance Comparison

Direct great circle route	4475 miles
Direct rhumb line	4735 miles (excess 260 miles)
Northern route (N or Aleutian)	4540 miles (excess 65 miles)

Climatological Considerations

The area between latitude 32° N and 48° N would appear to average the worst weather from the point of view of west bound traffic. South of this area, there is a notable improvement in weather and sea conditions generally, but adverse currents remain a concerning factor.

A high percentage frequency of encountering waves in excess of 3½ metres on the great circle route and the rhumb line route should be of major consideration to mariners planning an ocean route in this region. While the northern route through the Bering Sea, indicated a decreasing probability of encountering seas in excess of 3½ metres. In addition to this favourable surface currents exist for virtually the total passage. Wind generated seas and swell effects are appreciably reduced by the island chain when wind direction is from the south or south west.



Comparison ocean routes North Pacific

SOUTH PACIFIC OCEAN

Trans-Ocean routes in the more southerly regions of the South Pacific tend not to employ great circle tracks on either east or west bound passages. The reason for this is that the extreme limit of icebergs extends to approximately latitude 40° S. at all times of the year, and adverse weather can also be expected with continued regularity.

West Bound Passages

Vessels tend to track following the parallel of 30° S Latitude between Longitudes 120° to 150° W.

Example tracks from Panama, and South American ports via way points on Latitude 30° S and then on to Australia or New Zealand ports.

East Bound Passages

Vessels tracking towards Cape de Hornos and beyond, must expect to encounter icebergs in all seasons when taking the southern route from ports in Australia and New Zealand. Mid-Pacific routed (east bound) may find the central route advantageous especially for vessels bound for Panama. This route being joined at suitable positions from various departure ports and makes use of the Equatorial Countercurrent (approximately 5° N latitude).

Example Routes/Distances

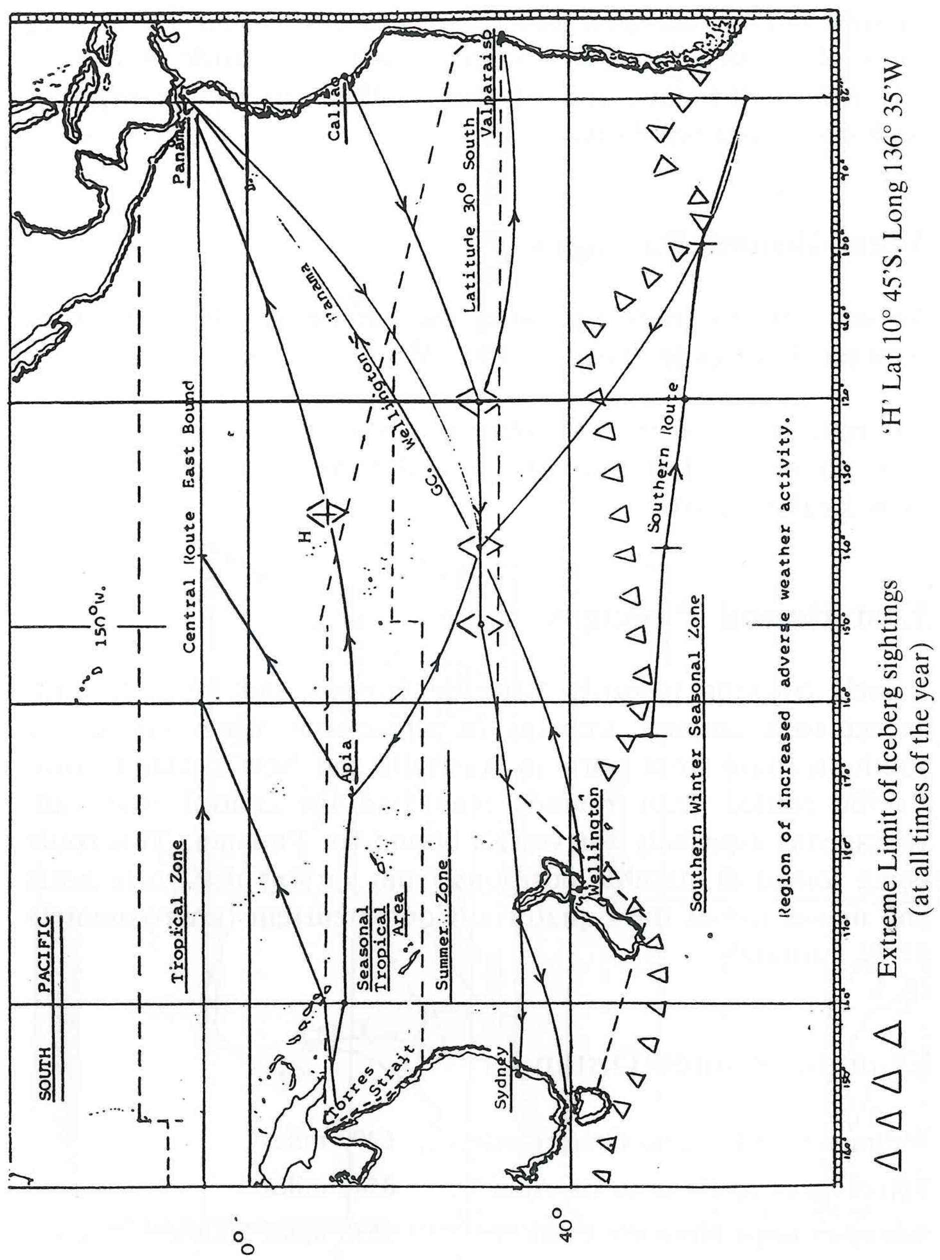
Wellington to Panama Great Circle ..... 6490 miles

Torres Strait to Panama via Apia .... 8540 miles

Sidney to Cape Horn via Cook Str ..... 5850 miles Southern Route.

Hobart to Panama via Snares Islands .. 7640 miles (GC from Snares)

Torres Strait to Valparaiso .... 7800 miles GC Alternative



Climatological Considerations

Pack ice limits are advanced in July and up to 5/10 ths could be experienced between latitudes 60° S and 65° S (worst scenario). Icebergs can be sighted up to latitude 40° S just east of New Zealand but may be experienced on the southern route in all seasons.

Gale frequency on the most southern routes is greater than 10 days per month and in January fog may also be cause for concern. Fog is also a notable feature of the Peruvian coast between the months of March/April. There is less likelihood of fog in October in this region.

NB: When employing own ship routing methods, detailed reference to Ocean Passages of the World, and to respective routing charts is essential for this region. Careful study of Admiralty Sailing Directions is also highly recommended.

METEOROLOGICAL ROUTING INFORMATION

Sources of Information:

1. **Surface Synoptic Analysis Chart** — this provides a picture of the existing conditions at the proceeding synoptic hour and shows the position of isobars and other synoptic detail such as fronts and troughs etc. It may also include ship and land reports.
2. **Surface Prognostic Charts** — These charts provide a projection of synoptic conditions ahead in time and cover periods of 12, 18, 36 and 72 hours.
3. **Change of Pressure Charts** — Charts which show 'isobaric lines', i.e. Lines joining places of equal pressure.

   These charts help to forecast the movement of depressions.
4. **Wave Charts** — Present sea analysis and isopleuths of constant wave height together with the direction of wave groups indicated by arrows. Prognosis charts can be produced from this information.

5. **Ice Charts** — Show the amount and the boundaries of icebergs, pack ice and leads for selected areas, e.g. NW Atlantic, Gulf of St Lawrence.

6. **Upper Air Charts** — Not intended for use by mariners but are in use by shore based meteorologists. They are employed to obtain information on the movement of depressions and other expected weather conditions. They include factual charts of:
   (a) Constant pressure providing analysis and prognostic detail e.g. at 700 mb, 500 mb.
   (b) Cloud thickness charts.
   (c) Wind force and direction for upper levels.

7. **Nephanalysis Charts** — Satellite information charts providing information on cloud pattern and cloud thickness. They assist in the identification of meteorological features like tropical revolving storms.

8. **Hindcast Charts** — These compare weather and progress along the selected 'Metroute' as advised by the Meteorological Office with that weather and progress that would have been experienced and/or achieved along an appropriate alternative route.

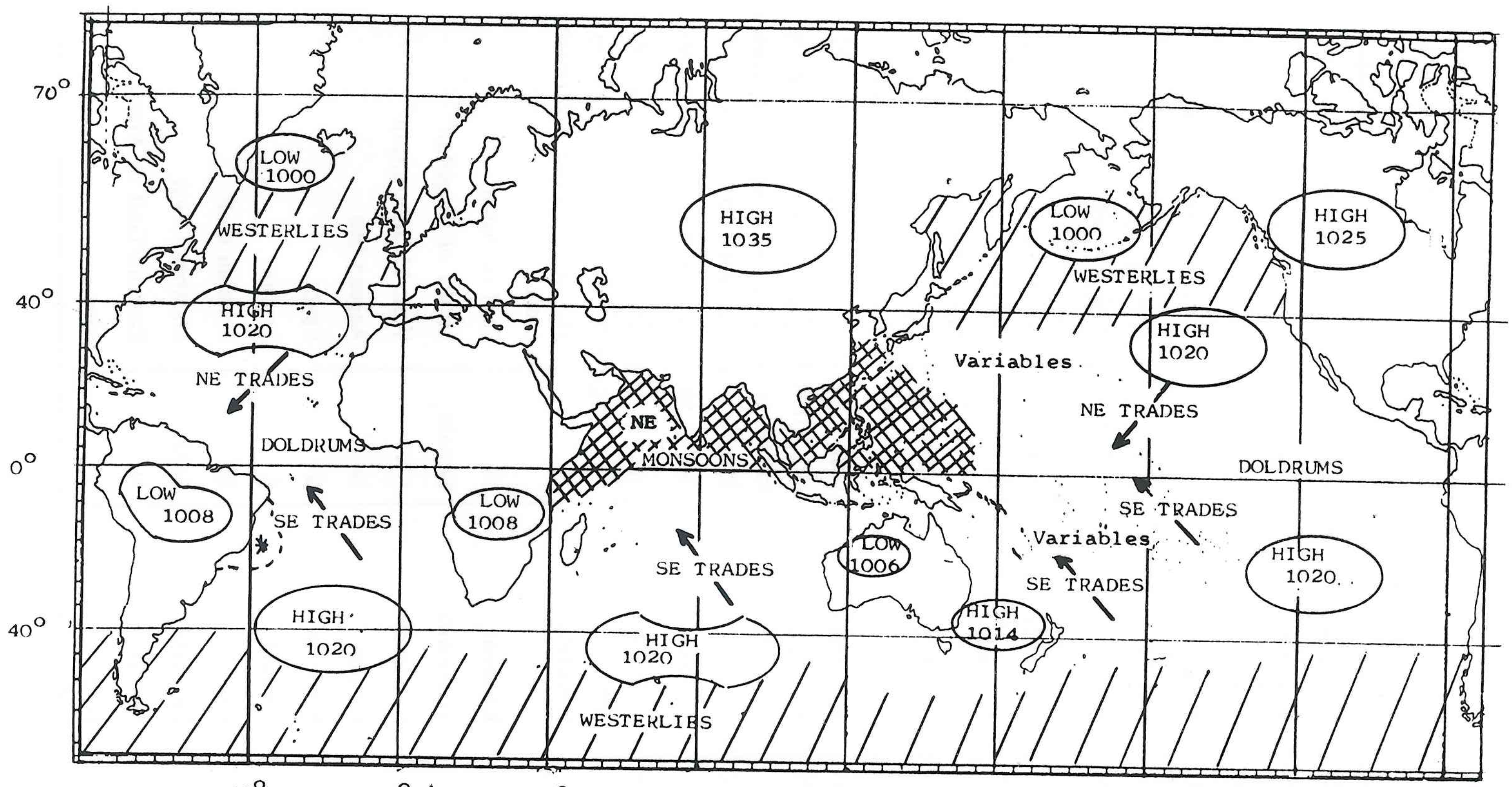
   As with past log books these can provide useful information especially on repeat voyages.

Named Winds — Worldwide

Ref., No.,	Named Wind (Local Name)	Prevailing Direction	Location & General Remarks
1.	Mistral	NW	Gulf of Lyons
2.	Gregale	NE Gale	Malta region
3.	Sirocco	SE	Mediterranean
4.	Levanter	E	Hot — Gibralter area
5.	Shamal	NW	Arabian Gulf
6.	Haboob	varies	Red Sea associated with 'Dust Storms'
7.	Southerly Buster	SW	Australian South East coast.
8.	Roaring Forties	W	Gale force winds of the South Atlantic.
9.	Harmattan	W	Dry wind from the African desert, laden with sand.
10.	Pamperos	SW	South America.
11.	Chinook	varies	A warm dry wind of North America, experienced down off mountain ranges.
12.	Trades	NE & SE	Atlantic & Pacific & Indian Oceans.
13.	Bora	NE	Adriatic
14.	Brickfielder	N	Hot wind on the Australian coast.
15.	Khamsin	N	Gulf of Aden.
16.	Williwaws	Squalls	Straits of Magellan
17.	Vendevale	SW	West Mediterranean
18.	Etesian	N	Aegean Sea.
19.	Khamsin	S	Egypt.
20.	Simood	S	Arabia.
21.	Kaus	SE	Arabian Gulf.
22.	Elephanta	S/SE	Malabar Coast
23.	Norther	N	Panama/Gulf of Mexico.
24.	Föhn	S	Alps

THE WORLD

NORTHERN WINTER

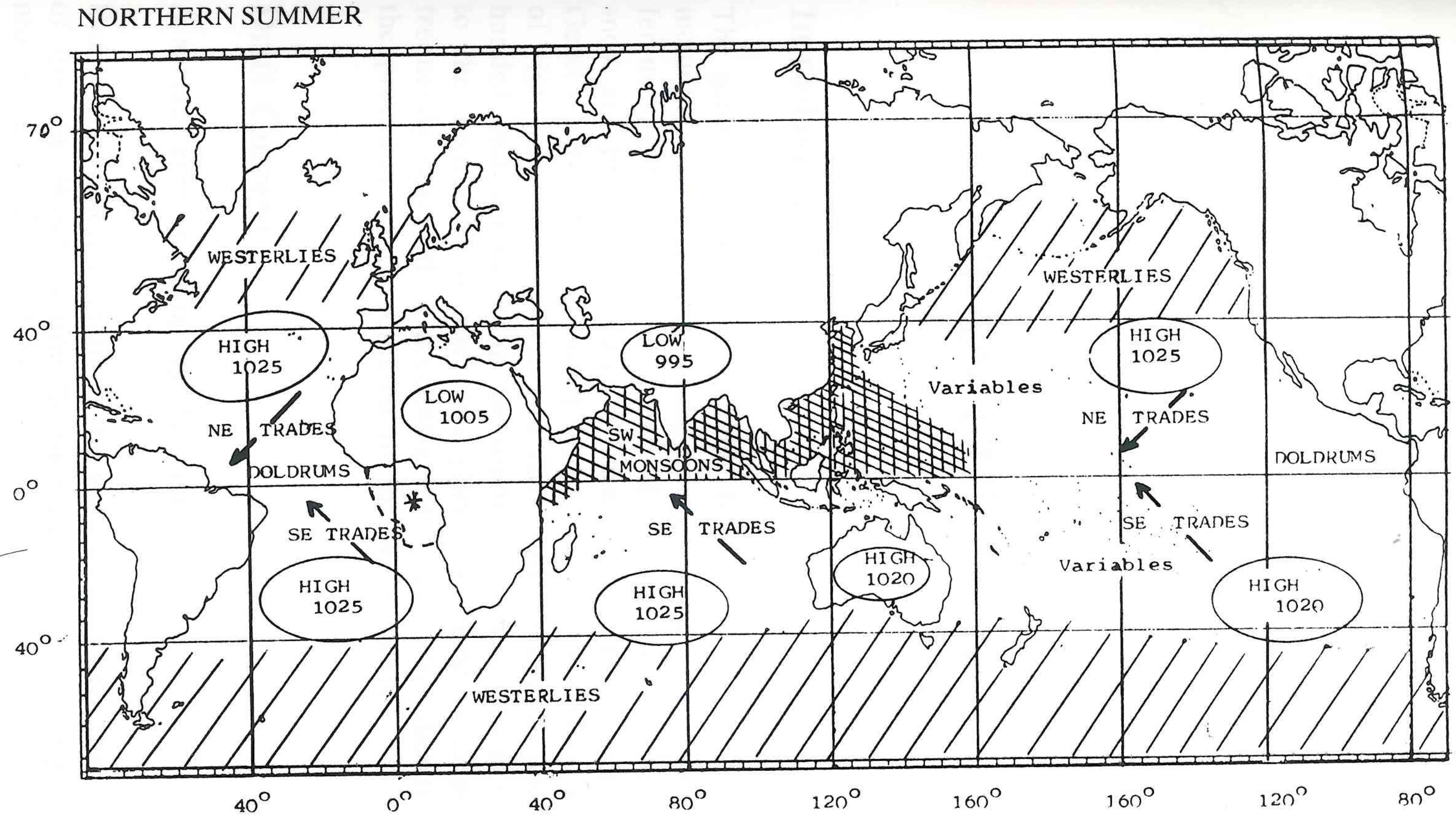


* NE Winds

Pressure centres and prevailing winds (December to April)

THE WORLD

NORTHERN SUMMER



* SW Winds

Pressure centres and prevailing winds (June to October)

Chapter Six

OCEAN CURRENTS

Introduction

The generation of ocean currents is caused by several factors including: the prevailing winds, heavy rainfall, temperature differences, density differences, excessive evaporation, melting ice/snow and probably pressure differences changing surface levels. General circulation of water about the earths surface is one of right-handed (clockwise) in the northern oceans and left-handed (anti-clockwise) in the southern oceans. This is similar to the circulation of the atmosphere and hence currents are frequently observed to accelerate with the general direction of the prevailing winds common to that of currents.

Drift Current

A surface current set up by the wind.

Due to the trailing friction of the wind passing over the surface of the sea. Wind continually blowing in one direction for a prolonged period develops a thick layer of surface water.