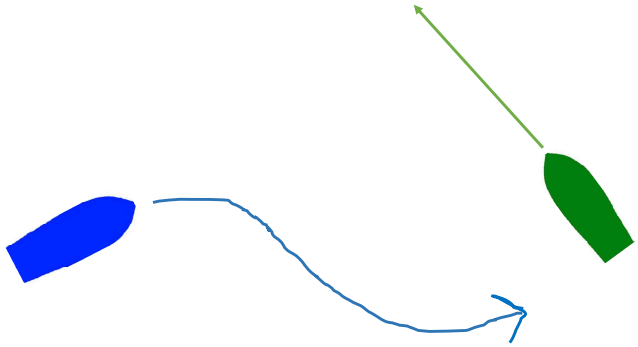
Week 8

1

IRPCS – Chapters 4 and 5

2

IRPCS Chapters 4 and 5

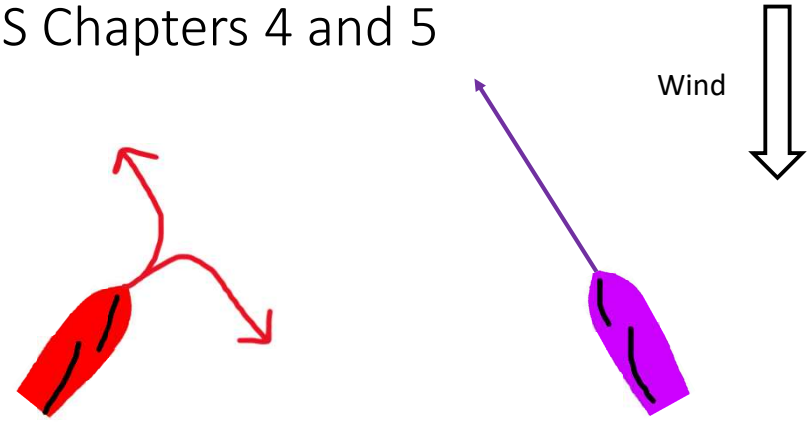


3

IRPCS Chapters 4 and 5

4

IRPCS Chapters 4 and 5



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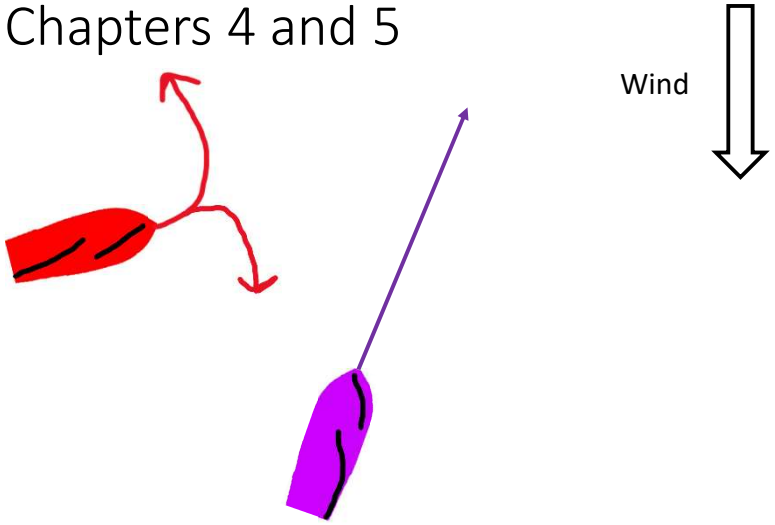
IRPCS Chapters 4 and 5



6

IRPCS Chapters 4 and 5

7

IRPCS Chapters 4 and 5

8

IRPCS Chapters 4 and 5

- What do the rules say about the conduct of vessels in restricted visibility?

Rule 19: Conduct of vessels in restricted visibility

(a) This Rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.

(b) Every vessel shall proceed at a safe speed adapted to the prevailing circumstances and conditions of restricted visibility. A power-driven vessel shall have her engines ready for immediate manoeuvre.

(c) Every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility when complying with the Rules of Section I of this Part.

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IRPCS Chapters 4 and 5

- What do the rules say about the conduct of vessels in restricted visibility?

Rule 19: Conduct of vessels in restricted visibility (cont'd)

(d) A vessel which detects by radar alone the presence of another vessel shall determine if a close-quarters situation is developing and/or risk of collision exists. If so, she shall take avoiding action in ample time, provided that when such action consists of an alteration of course, so far as possible the following shall be avoided:

(i) an alteration of course to port for a vessel forward of the beam, other than for a vessel being overtaken;

(ii) an alteration of course towards a vessel abeam or abaft the beam.

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IRPCS Chapters 4 and 5

- What do the rules say about the conduct of vessels in restricted visibility?

Rule 19: Conduct of vessels in restricted visibility (cont'd)

(e) Except where it has been determined that a risk of collision does not exist, every vessel which hears apparently forward of her beam the fog signal of another vessel, or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall reduce her speed to the minimum at which she can be kept on her course. She shall if necessary take all her way off and in any event navigate with extreme caution until danger of collision is over.

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Techniques for Visual Fixing Exercise - Debrief

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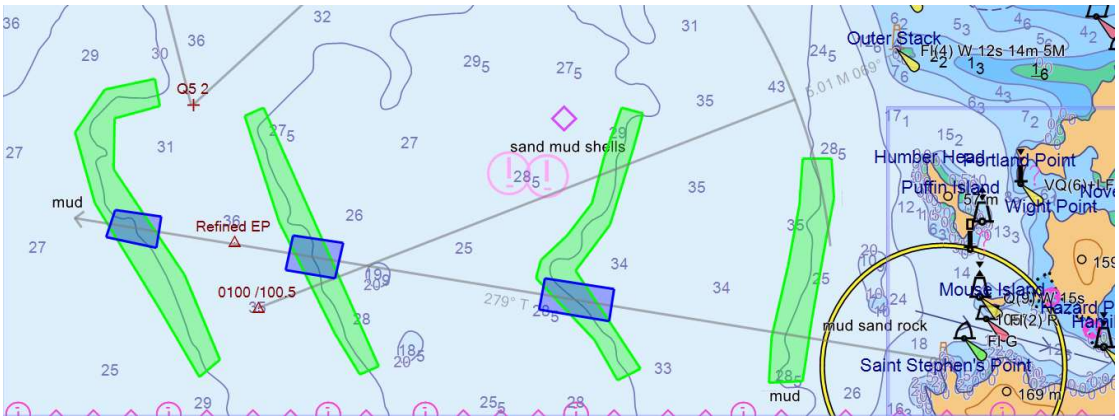
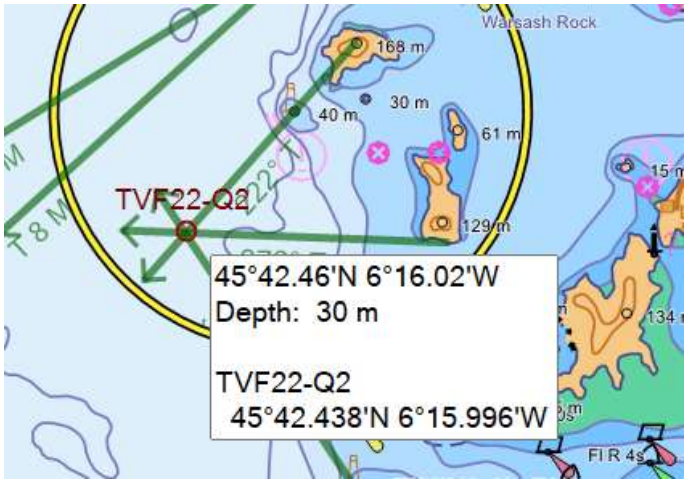
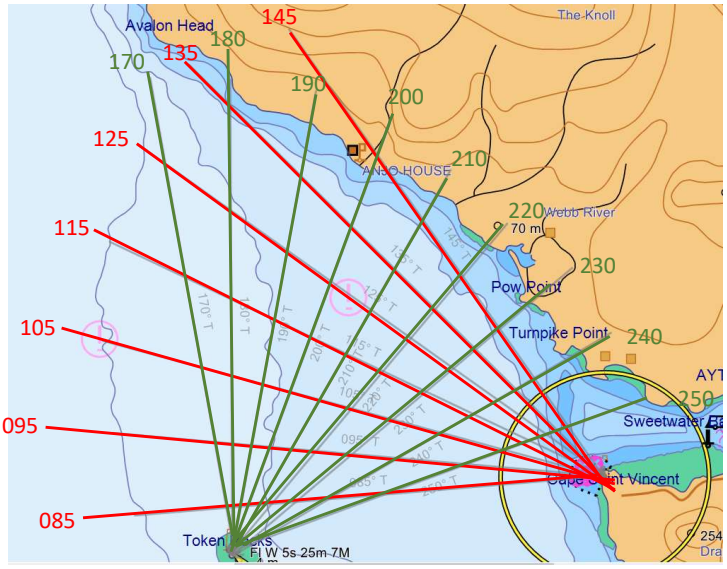
Question 1



Question 2



Question 3



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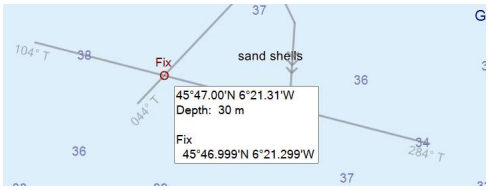
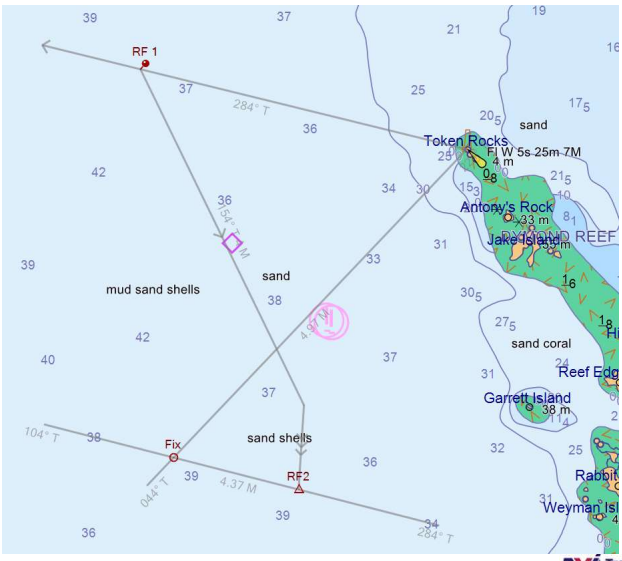
Question 4

C	D	M	V	T
155	(+) 5E	160	(-) 6W	154
		110	(-) 6W	104
		050	(-) 6W	044





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Question 5

Part a)

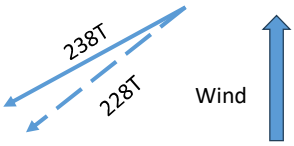
C	D	M	V	T
235	1W	234	6W	228

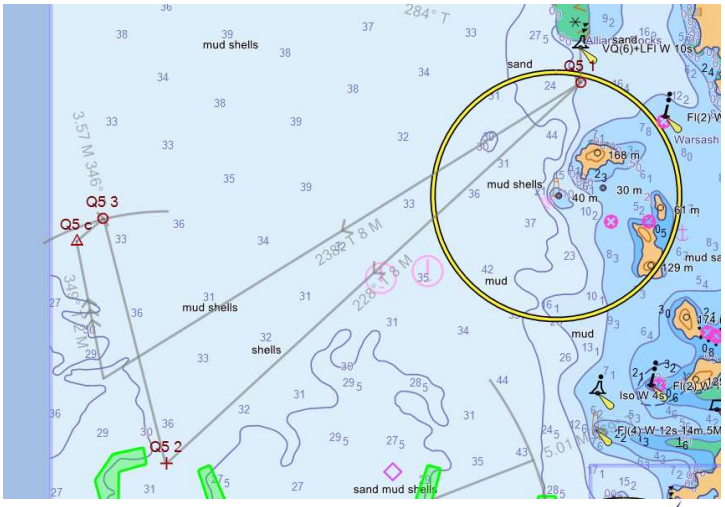
Part c)

Heading 228T

L'way + 010

Water Track 238T





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Global Navigation Satellite Systems

(GNSS)

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The Hardware

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What is GNSS?

- They are satellite-based radio-navigation systems.
- Two major systems in use:
  - GPS – American
  - GLONASS – Russian
- Both operate in the same way and modern receivers can (and do) make use of both
- They permit land, sea and airborne users to determine their three-dimensional position, velocity and time 24 hours a day, in all weather, anywhere in the world.

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What is GPS?

- GPS is a satellite-based radio-navigation system developed and operated by the U.S. Department of Defence.
- It permits land, sea and airborne users to determine their three-dimensional position, velocity and time 24 hours a day, in all weather, anywhere in the world.
- It reached full operational capacity on July 17, 1995.

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The System Hardware (GPS).

This consists of three segments, space, control and user.

- Space:
  - 31 satellites in circular orbits.
  - at least 6 satellites always visible to users anywhere in the world.
  - satellites broadcast position and time data to users.
- Control
  - consists of a master control station, five monitor stations and three ground antennas located throughout the world.
  - these are used to monitor the satellite orbits, modified information about these is then broadcast to the satellites.
- User
  - consists of receivers, processors and antennas, which detect and process the information from the satellites to determine the user's position.

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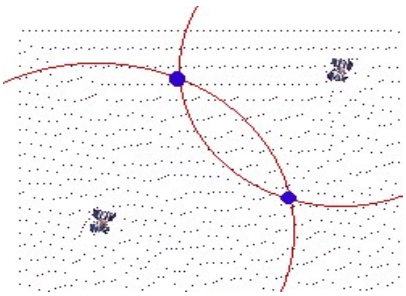
How it works.

- GPS receivers calculate the range from the receiver to the satellite. To do this they need to know the time taken by the signal to transit from the satellite to the receiver and the speed at which the signal travels.
- Once the range is known, the receiver knows that it lies on the surface of a sphere with this radius from the satellite.



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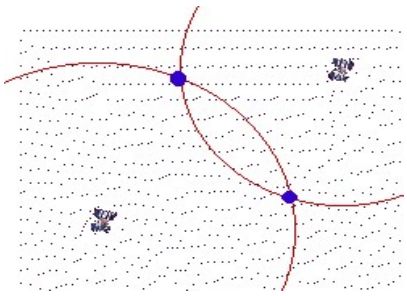
How it works.

- Information from two satellites gives two spheres which intersect to form a circle.
- Three satellites reduce this to two points. One of these will be far out in space and can thus be disregarded.
- A fourth satellite is needed to refine this information and give the accuracy which GPS is capable of.



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Sources of GPS error

- Atmospheric Errors +/- 5m
- HDOP +/- 5m
- Ephemeris error +/- 2m
- Satellite Clock error +/- 2m
- Receiver error +/- 1m

BUT

- Positional errors due to differences in the DATUM used to produce the chart and that used by the GPS receiver can result in larger errors occurring.

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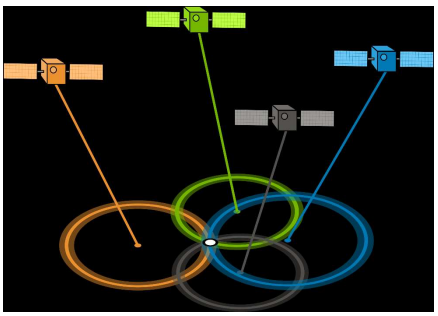
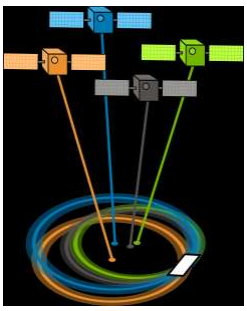
HDOP
Horizontal Dilution of Precision



Wide satellite spacing – small area of cut



Small satellite spacing – large area of cut

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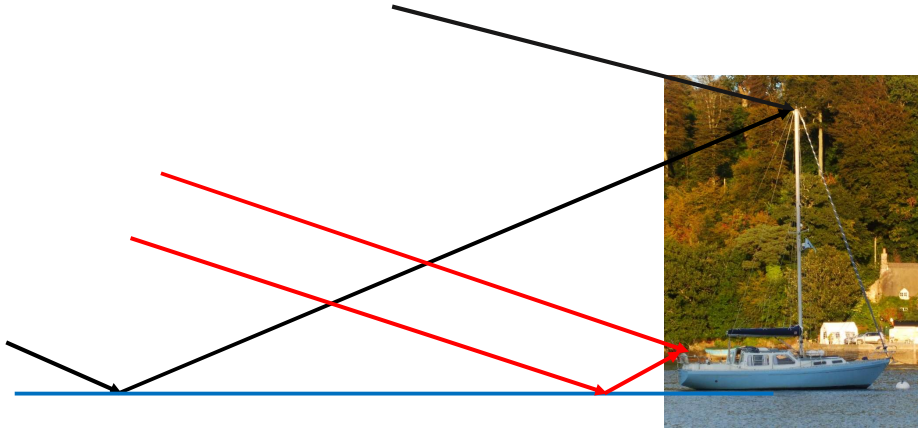
HDOP Scale

DOP Value	Rating	Description
< 1	Ideal	Highest possible confidence level to be used for applications demanding the highest possible precision at all times.
1-2	Excellent	At this confidence level, positional measurements are considered accurate enough to meet all but the most sensitive applications.
2-5	Good	Represents a level that marks the minimum appropriate for making business decisions. Positional measurements could be used to make reliable in-route navigation suggestions to the user.
5-10	Moderate	Positional measurements could be used for calculations, but the fix quality could still be improved. A more open view of the sky is recommended.
10-20	Fair	Represents a low confidence level. Positional measurements should be discarded or used only to indicate a very rough estimate of the current location.
>20	Poor	At this level, measurements are inaccurate by as much as 300 meters with a 6-meter accurate device (50 DOP × 6 meters) and should be discarded.

Possible problems with GPS

- Power failure
- Transmissions from mobile phones
- Interruption of, or changes to, the satellite system
- Aerial failure or poor installation
  - Signal bounce

Signal Bounce – different path lengths



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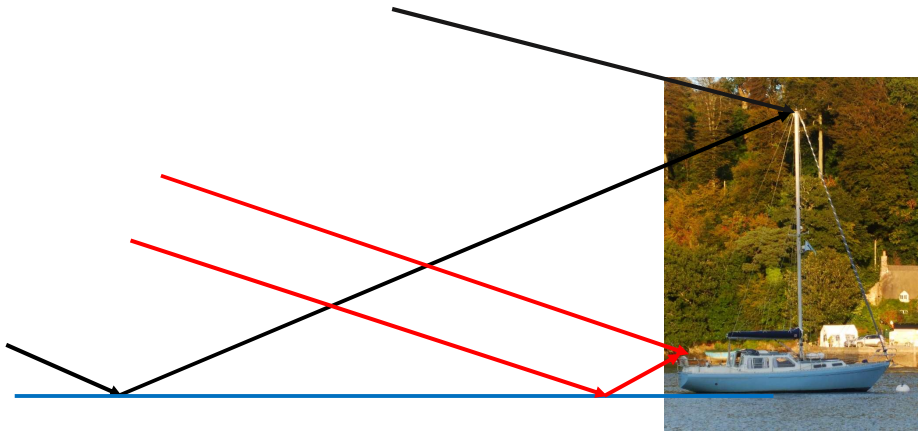
Signal Bounce – different path lengths



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Information from the GPS receiver

- Lat / Long and Elevation
- COG and SOG
- Distance and bearing to waypoint
- ETA at waypoint
- Cross-track error
- Velocity Made Good (VMG)

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Limitations of GPS

- Information from a single source.
- Back up with information from another source.
- Not a good pilotage tool.
- Retrospective if the position has to be plotted from a text-based system.
- No indication of “limits” if using a Chart Plotter.

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Plotting Techniques with GPS

- Sailing / displacement power boat techniques:
  - Latitude and Longitude
  - Bearing and distance to a Waypoint
    - Use of centre point of compass rose (Course Notes p48)
- Planing power boat techniques:
  - Distance to W.P. and X.T.E.
  - Web with distance and bearing to waypoint.

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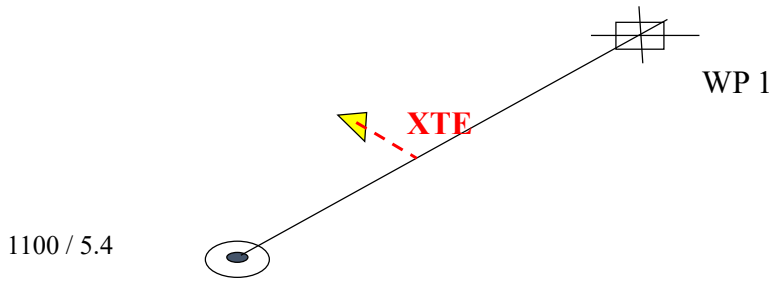
Cross Track Error (XTE)



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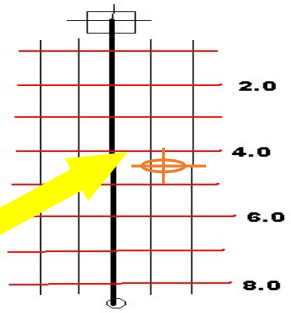
Distance to Waypoint and Cross Track Error

Grid drawn on chart from starting position to way point.

Position is plotted by distance to run and CTE.



E.g. DST = 4.5'

CTE = 0.75'to st'b'd.

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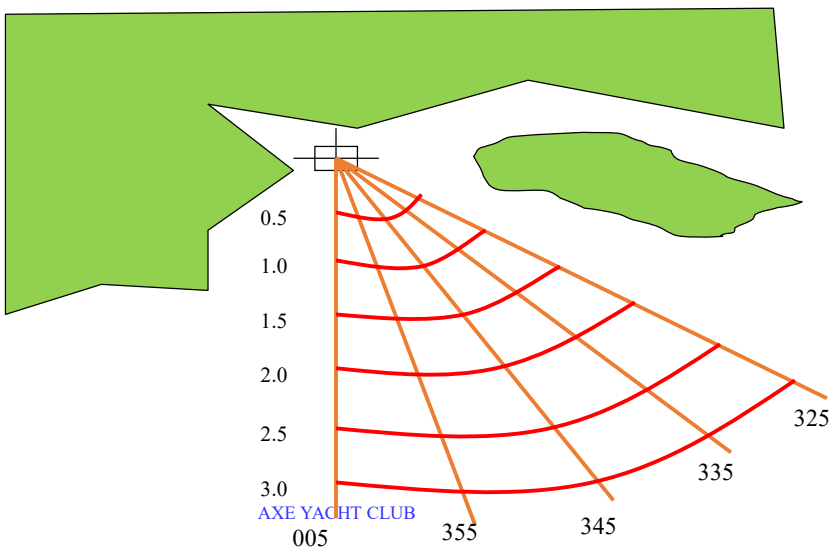
Navigation Web



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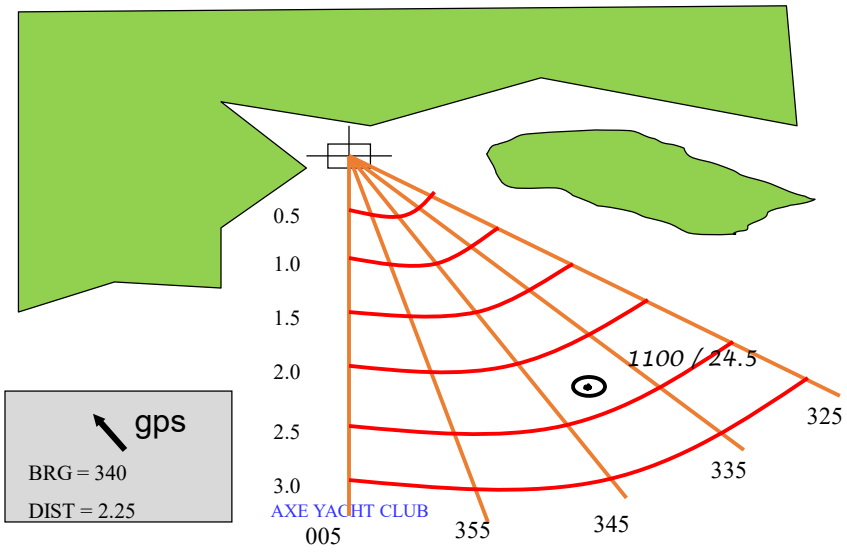
Navigation Web 2



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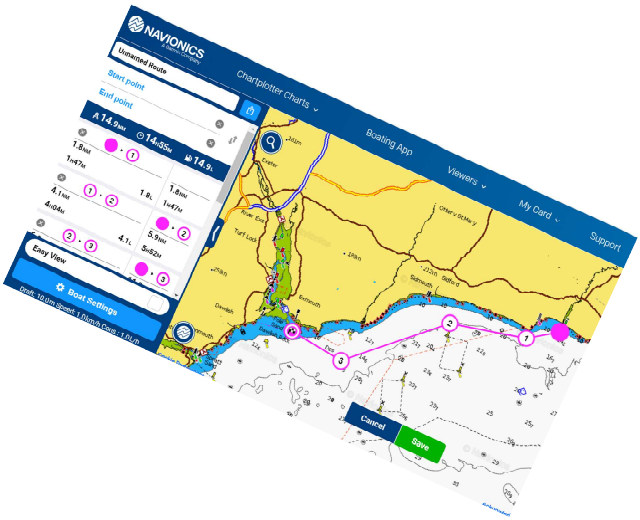
Routes on the Chartplotter

A suggested process.



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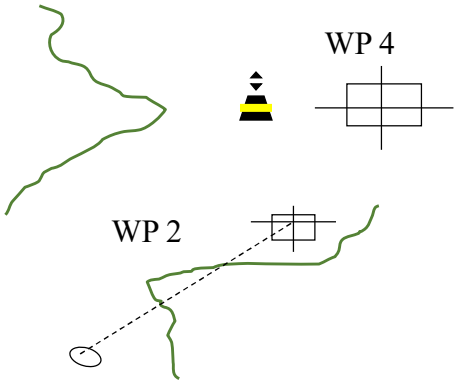
Waypoint Navigation 1

- Take waypoints from a large scale chart or the almanac
- Position the waypoint on the **safe side** of buoys etc.
- Position the waypoint so that you can confirm your arrival by means other than GPS.
- Check the track from the start position to the waypoint to ensure that the track does not cross hazards.



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Waypoint Navigation 2

- Note the waypoint in the log and on the chart.
- Plot position regularly - check for agreement with the E.P..
- Calculate the C.T.S. instead of following the bearing given by the GPS, or trying to balance out cross track error. If there is a significant cross tide you:
  - will sail a longer route,
  - could put the boat in danger.

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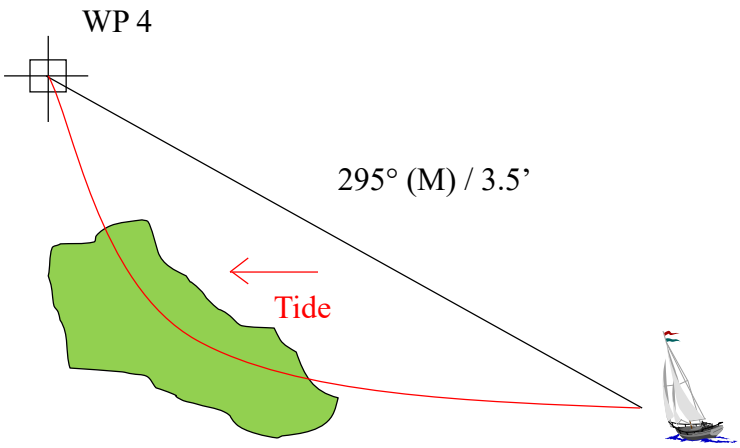
Bearing and Distance



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Routes - An outline of the process

1. Use the pilot book / almanac to obtain passage information. (We will cover passage planning later in the course.)
2. Zoom out until you can see both starting and finishing points.
3. Put in waypoints for an initial route on the zoomed out chart.
4. Go back to starting point and zoom in to show detail and adjust position of this if necessary.
5. Follow along the route, checking for hazards, add, delete or move waypoints as necessary. As part of this process check that arrival at the waypoint can be confirmed by non-gps method.

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An outline of the process

1. Use the pilot book / almanac to obtain passage information. (We will cover passage planning later in the course.)
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Electronic Charts and Chart Plotters

- Charts – Raster or Vector
- Official Charts meeting international standards- RNC or ENC
- Other Charts - EC

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Chart Plotter – Primary Navigational Aid?

Things to take into account -

Chart

- How reliable is it? RNC, ENC or EC?
- Is it up-to-date?

GNSS Fix

- Can you verify the quality of the fix? (HDoP, number of satellites)
- Can you confirm it by independent means?

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Automatic Identification System

AIS

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Automatic identification systems (AIS) transponders are designed to be capable of providing position, identification and other information about the ship to other ships and to coastal authorities automatically.

SOLAS regulation V/19 - *Carriage requirements for shipborne navigational systems and equipment*

The regulation requires AIS to be fitted aboard all ships of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and upwards not engaged on international voyages and all passenger ships irrespective of size. The requirement became effective for all ships by 31 December 2004.

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AIS Types

1.Class A: Mandated for all vessels 300 GT and above engaged on international voyages as well as all passenger ships

2.Class B: Provides limited functionality and is intended for non-SOLAS vessels. Primarily used for vessels such as pleasure crafts

AIS operates principally on two dedicated frequencies or VHF channels:

•AIS 1: Works on 161.975 MHz- Channel 87B (Simplex, for the ship to ship)
•AIS 2: 162.025 MHz- Channel 88B (Duplex for the ship to shore)

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DATA transmitted:

1. Static Information (Every 6 minutes and on request):
- MMSI number
- IMO number
- Name and Call Sign
- Length and Beam
- Type of ship
- Location of position fixing antenna

2. Dynamic Information (Depends on speed and course alteration)
- Ship's position with accuracy indication
- Position timestamp (in UTC)
- Course Over Ground (COG)

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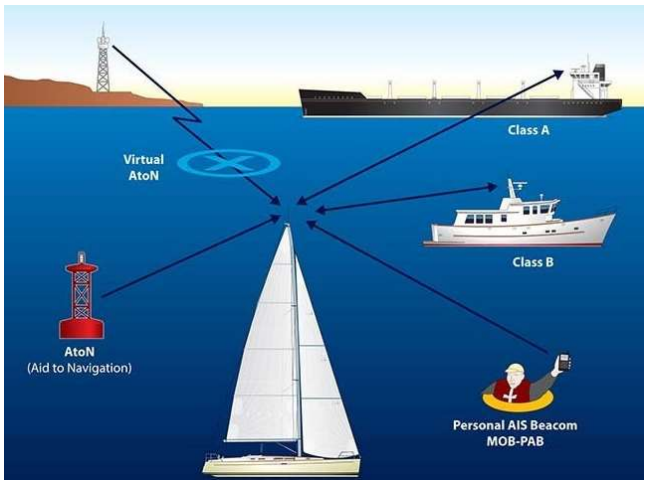
AIS Links



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MOB GPS v AIS

GPS

- Triggered from onboard vessel.
- Sets a waypoint at the position of the vessel when the alarm is triggered.
- Does not allow for tide / current or windage.
- Only visible onboard one vessel.

AIS

- Normally attached to the MOB and triggered by them.
- Transmits actual position of the person in the water.
- Position updated as the casualty drifts with tide / current or windage.
- Visible to all vessels in AIS range.

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MOB GPS v AIS

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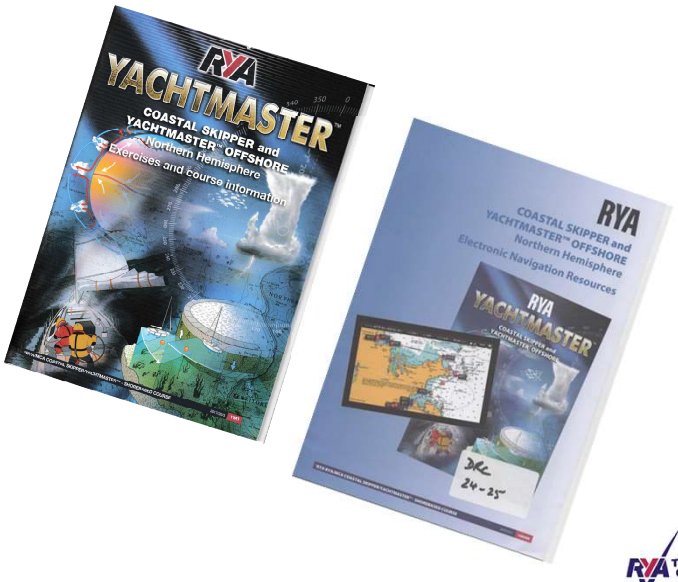
Homework

Exercise:

Electronic Aids to Navigation pp 14 – 16

For return next week.



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