

Marine Navigation Laboratory



Oceanography 101 Lab

MiraCosta College

Ray Rector: Instructor



Today's Lab Activities

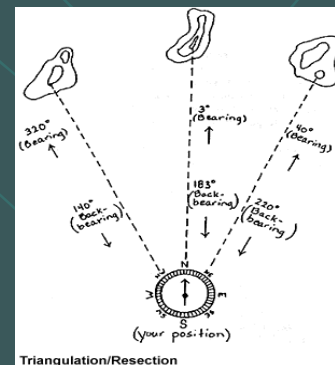
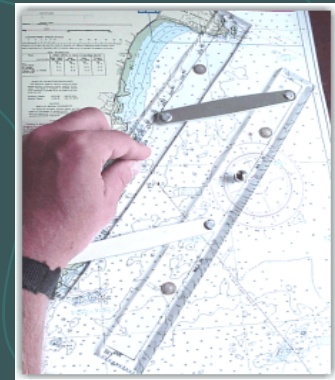
- 1) Discussion of Last Week's Seafloor Map Lab
- 2) Laboratory Lecture on Navigation at Sea
- 3) Plot a 4-Leg Ship Navigational Course
- 4) Determine Ship Position Using Several Methods
 - ✓ Course bearing Plotting using Dead Reckoning
 - ✓ Loran/GPS
 - ✓ Triangulation
- 5) Pre-lab Briefing of Next Week's Sediment Lab

Recommended Pre-Lab Web Activities

- 1) <http://en.wikipedia.org/wiki/Navigation>

Central Purpose of Today's Lab

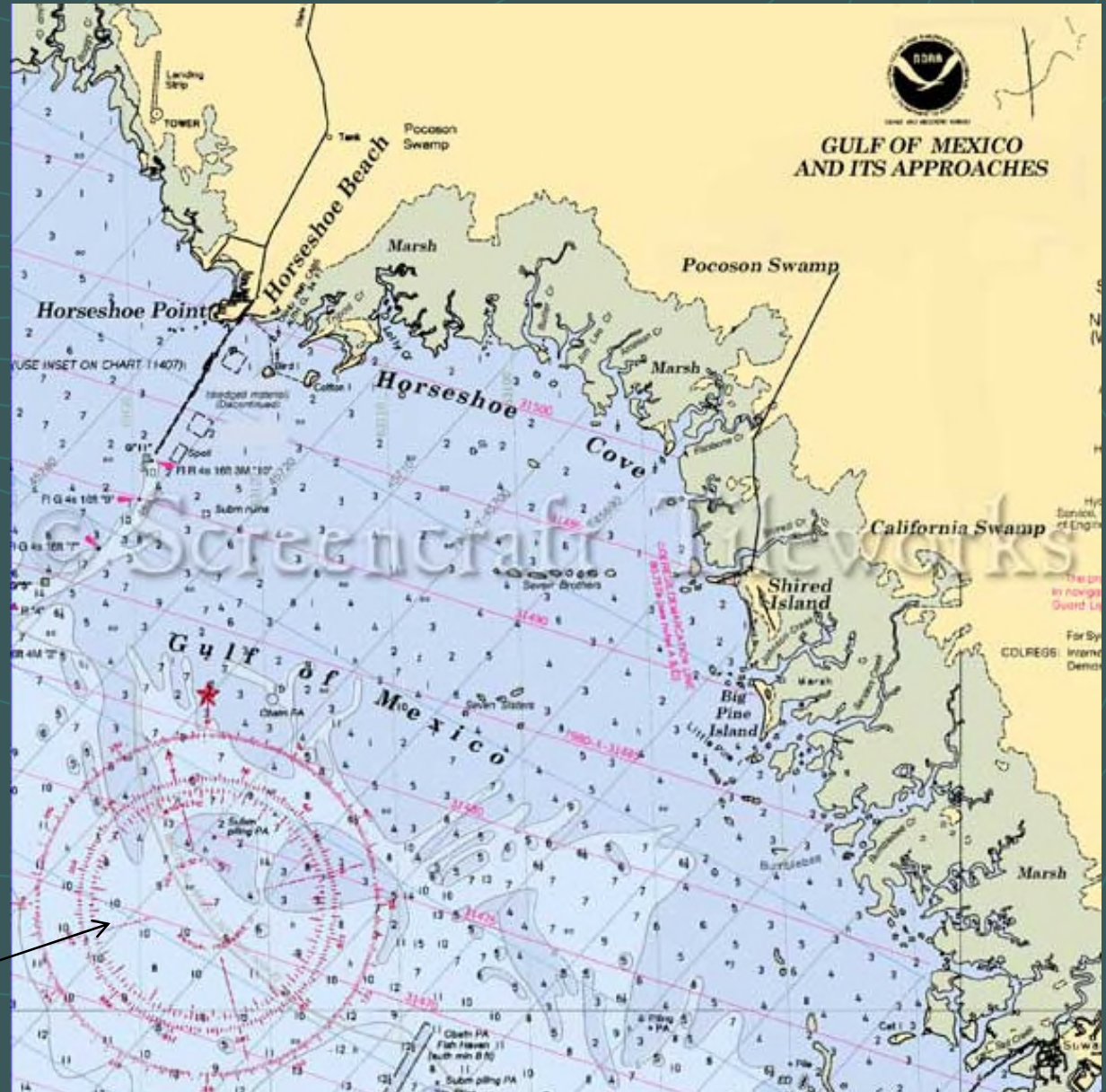
- 1) Become familiar with fundamentals of plotting multi-leg courses at sea using charts and compass
 - ✓ “Dead Reckoning” Navigation
- 2) Learn how to do the following on a navigational chart:
 - a) Plot waypoints and ship tracks
 - b) Measure distances and headings
 - c) Calculate travel times and drift distances
 - d) Make heading and travel time corrections for sea currents
 - e) Determine ship position on course track



Plotting Ship Course with a Navigational Chart



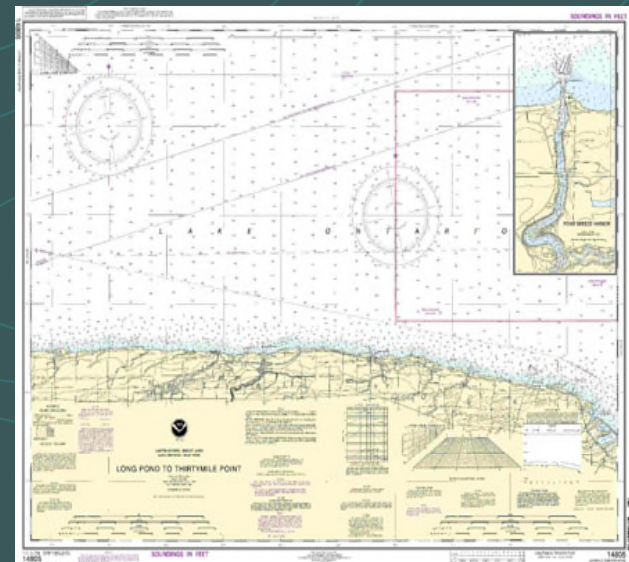
Nautical Charts are Used to Navigate



Compass
Rose

The Basics of a Nautical Chart

- 1) Similar to bathymetric map, but with less sea bottom detail
- 2) Specifically created for ship navigational purposes.
- 3) Water depth to sea bottom are symbolized by numeric depth values.
- 4) Nautical charts include navigational information, such as compass roses, bearings, tide and current data, nature of seabed, and hazardous obstacles.
- 5) Nautical symbols are colored purple



Fundamentals of Using a Navigational Chart

1) Map Scale

2) Map Distances

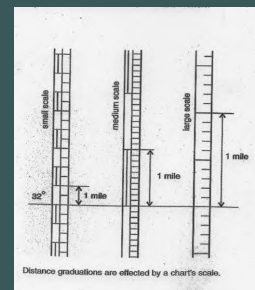
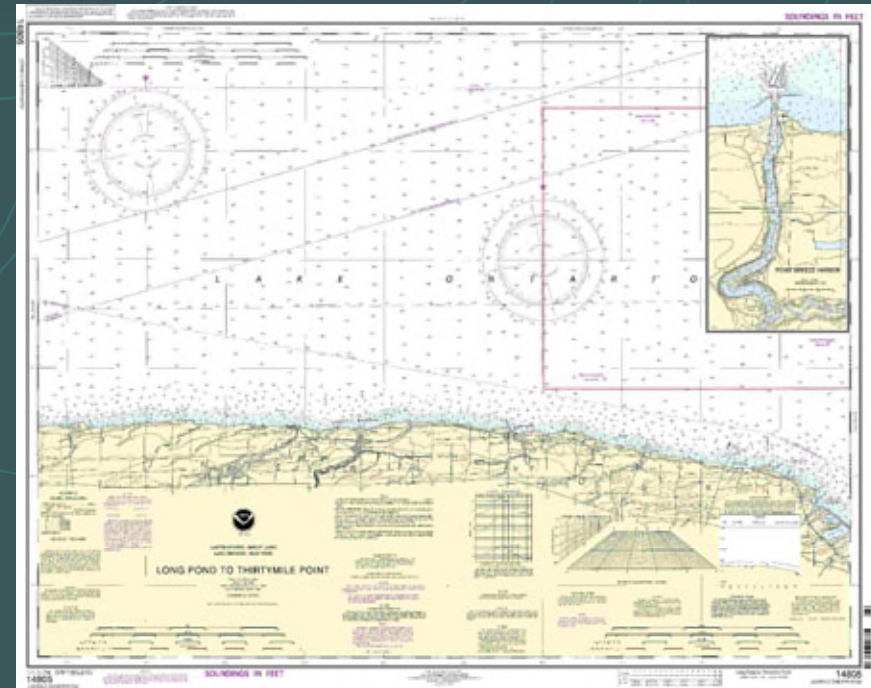
3) Lat/Long Coordinates

4) Compass Headings

- ✓ True Hearings
- ✓ Magnetic Hearings

4) Current Corrections

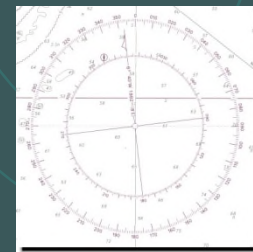
- ✓ Corrected Hearings



Map
Distance



Parallel
Rulers

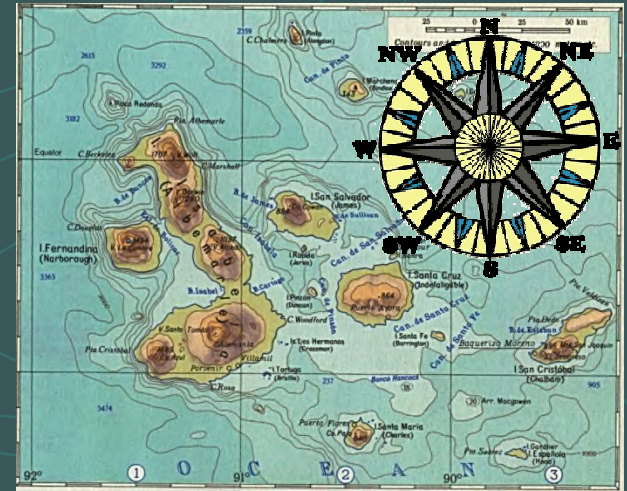


Compass
Rose

Geographic Orientation of Maps

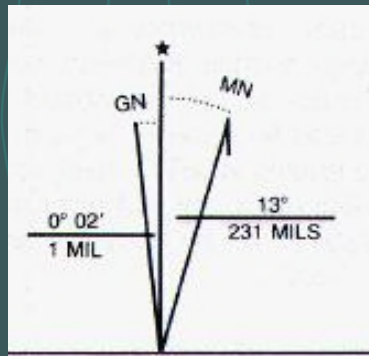
1) Compass direction of maps:

- True North points toward Top
- Due South points toward Bottom
- Due East points to the Right
- Due West points to the Left

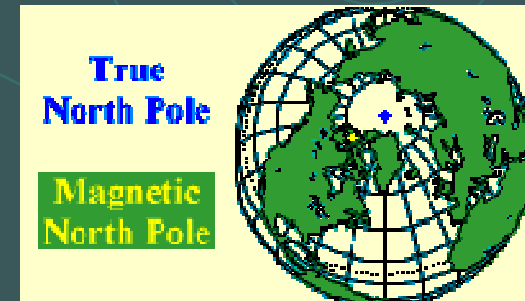


2) Note that a compass points to Magnetic North

- Magnetic declination information should be found in the map legend



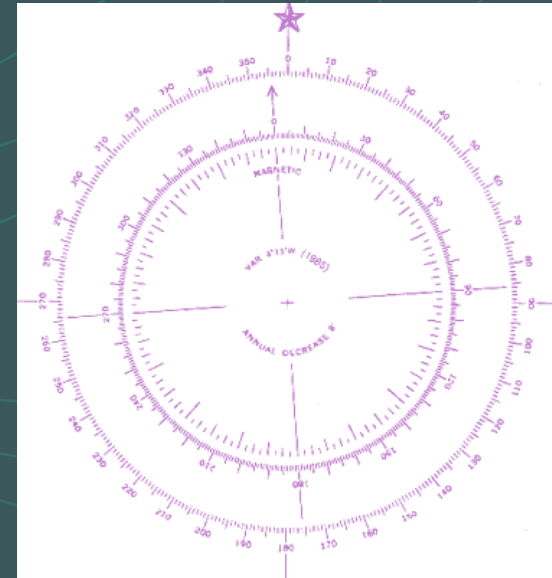
- ✓ ★ = true north
- ✓ MN = magnetic north
- ✓ GN = grid north



Navigational Chart Compass Rose

1) **Compass Rose is a map figure that displays cardinal direction**

- Outer ring is true geographic
- Inner ring is magnetic
- Directional offset between rings is the magnetic declination
- Ring values are in degrees
- The 360 degree direction bearing notation is called “Azimuth”

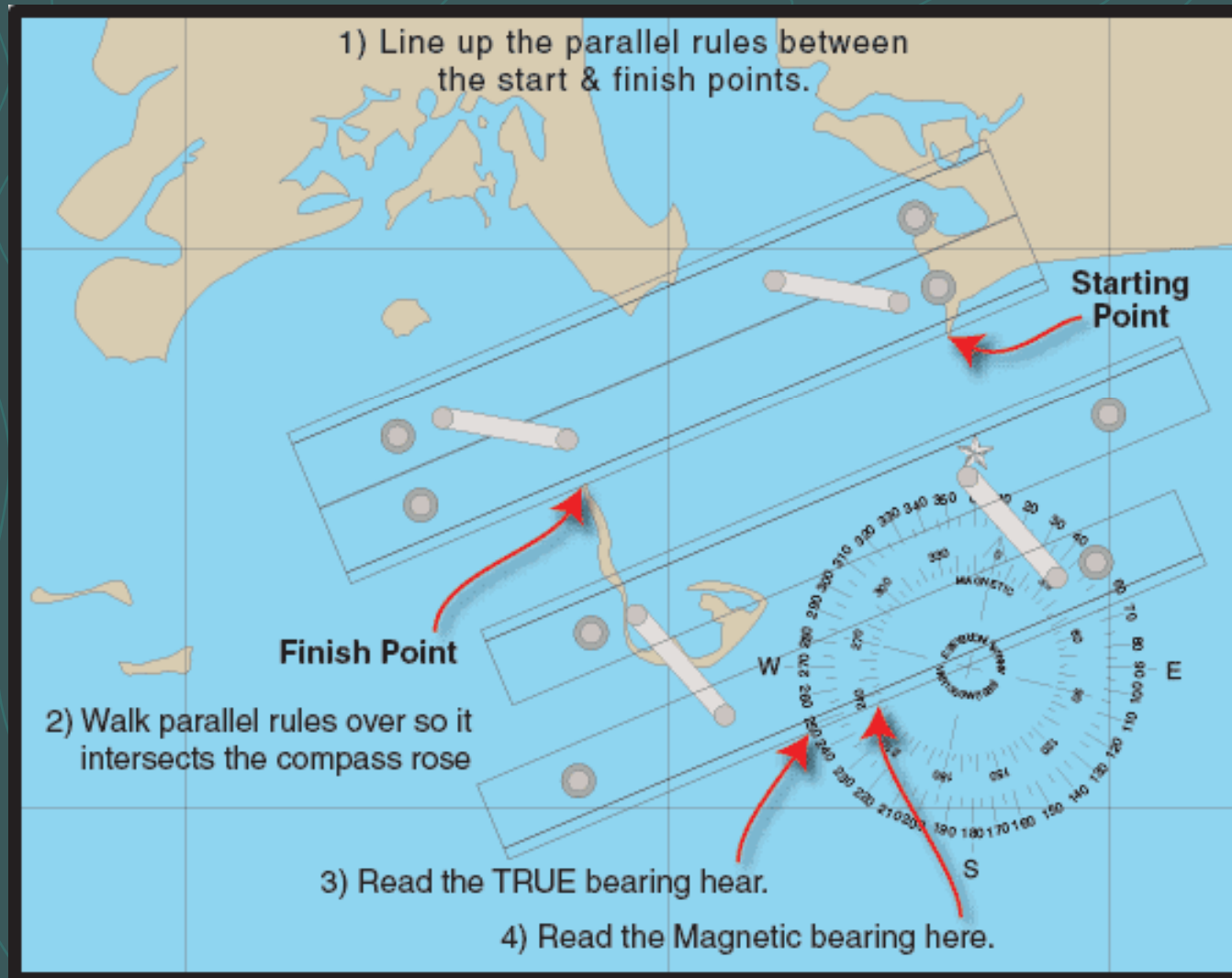


2) **The Compass Rose is used to determine ship location, landmark headings and course headings**

Course Plotting Terminology

Origin/Destination	The starting point and desired finishing point of a passage.
Intended Track	The true or shortest direction between origin and destination.
Track	The path the vessel actually travels over the ground. Loosely called COG.
Course	The compass direction in which the vessel is to be steered.
Sw	Speed of the vessel through the water. A known constant.
Sb	Speed of the vessel over the bottom. (SOG).
Set	The direction in which ocean and tidal currents move, causing offset from the intended track.
Leeway	The effect on the intended track of a vessel due to wind/waves.
Drift	The distance offset from the intended track due to the combined effect of set and leeway.
Rate	The speed of the drift in knots.
Dead Reckoned Position	A vessel position obtained by dead reckoning, based on the direction of the intended track, and the speed of the vessel through the water, Sw.
Estimated Position	A vessel position by dead reckoning, with a correction for drift.
Actual Position	A vessel position determined by a bearing fix, or by GPS.
Waypoint	A destination on a chart defined accurately by L. & L. coordinates.

Plotting Ship Course Heading with a Navigational Chart



Determining Course Heading

Four Basic Steps

Step 1: Locate your present position

Step 2: Locate the position you want to establish a heading to

Step 3: Use a properly positioned parallel rulers to determine the compass heading from your location to the other position

Step 4: Measure the heading as either a *true heading* (off outside ring) or a *compass bearing* (off inside ring)



Outer ring for True Heading / Inner ring for Magnetic Heading

Navigational Tasks for a Voyage

Task 1: Plot the legs of your voyage

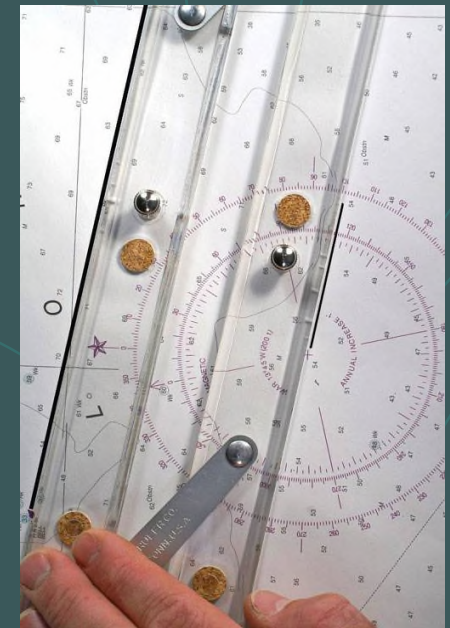
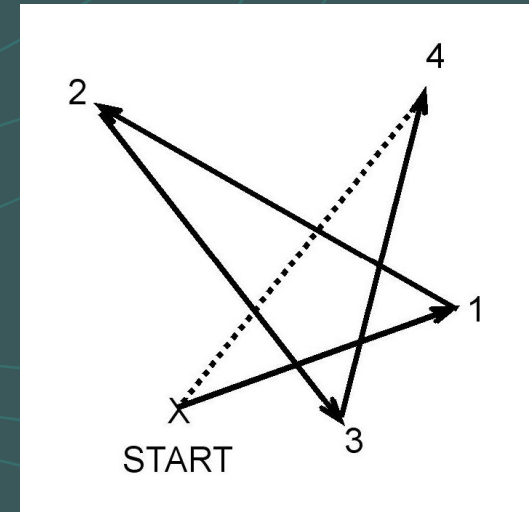
- Origin and Destination points
- Track lines between points

Task 2: Plot the compass bearing for each leg of the voyage

Task 3: Measure the distance for each leg of the voyage

Task 4: Calculate the travel time based on leg distance and ship speed

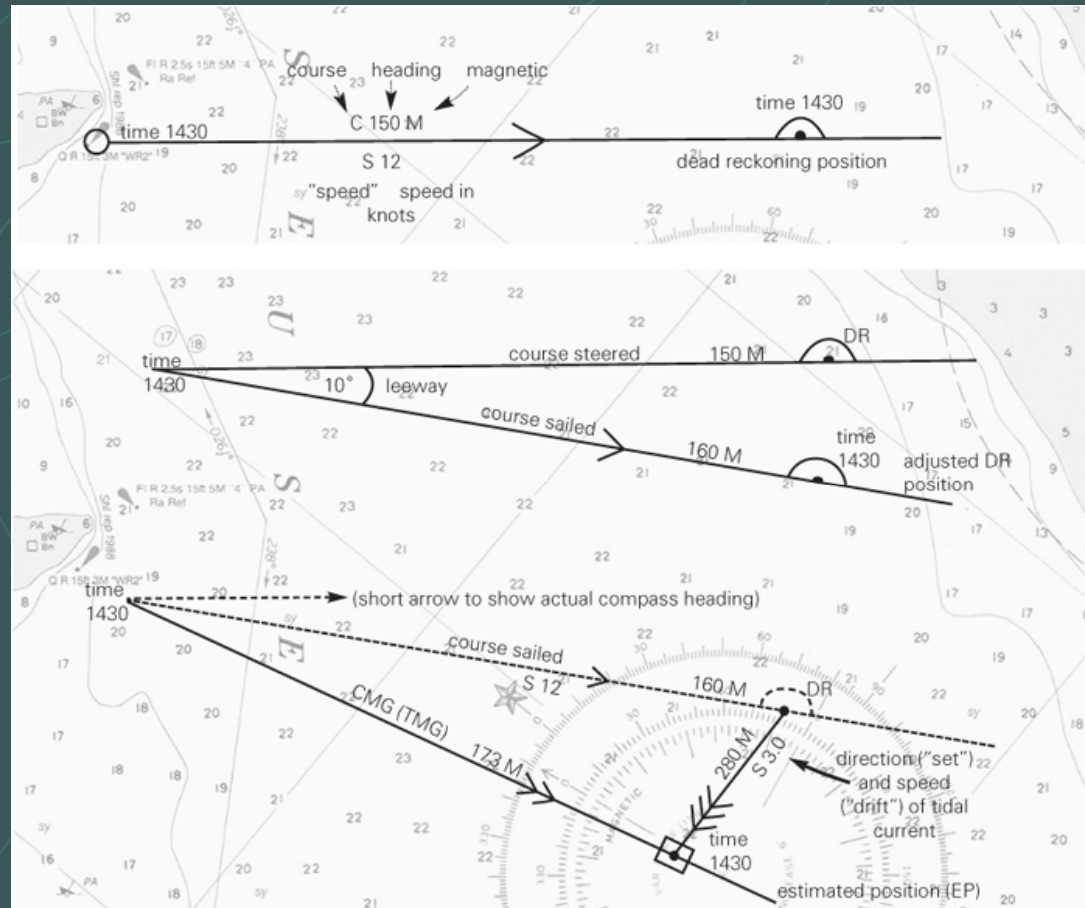
Task 5: Make bearing corrections for any leg that has a current running



Determining Corrected Bearing or Heading

Three Basic Steps

- 1) Plot leg of course to be navigated.
- 2) Plot current direction for the plotted leg of course.
- 3) Calculate the corrected course bearing needed to compensate for current drift.



You need to determine a Corrected Bearing if ship track crosses significant ocean currents or winds

Nautical Chart for Today's 4-Leg Course

San Diego to Santa Rosa Island



Real Bad Luck on Leg 4!!!!

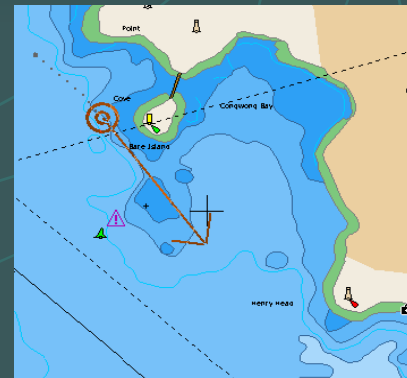


Oh Hell... Hey - Where is the ice chest with the beer and fish????

Three Methods of Determining Ship Position

1. Dead Reckoning

- Using Plotted Course Travel Time and Ship Speed Information



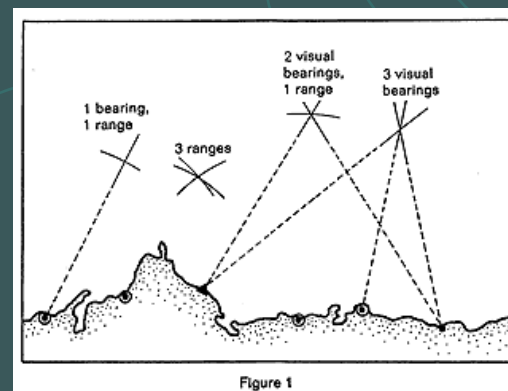
2. Loran/GPS Coordinates

- Wireless Ship to Signal Station Electronic Triangulation Methods
- Satellite-based electronic signal point location fixing



3. Manual Triangulation

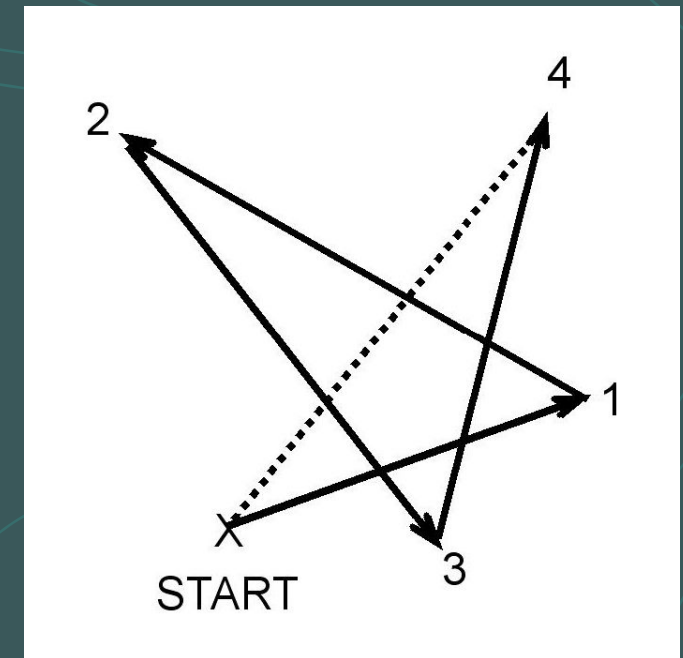
- Line of Sight Triangulation
- Bearings to Landmarks



Navigating by Dead Reckoning

1) Dead (or “ded”) Reckoning is the technique of using ship speed and travel time to “deduce” (hence the term “ded” reckoning) your position based on traveling from a known position to a plotted destination.

2) You plot a course, and then at regular intervals, you determine your position along that course line using dead reckoning technique.



Using DED Reckoning to Fix Ship Position

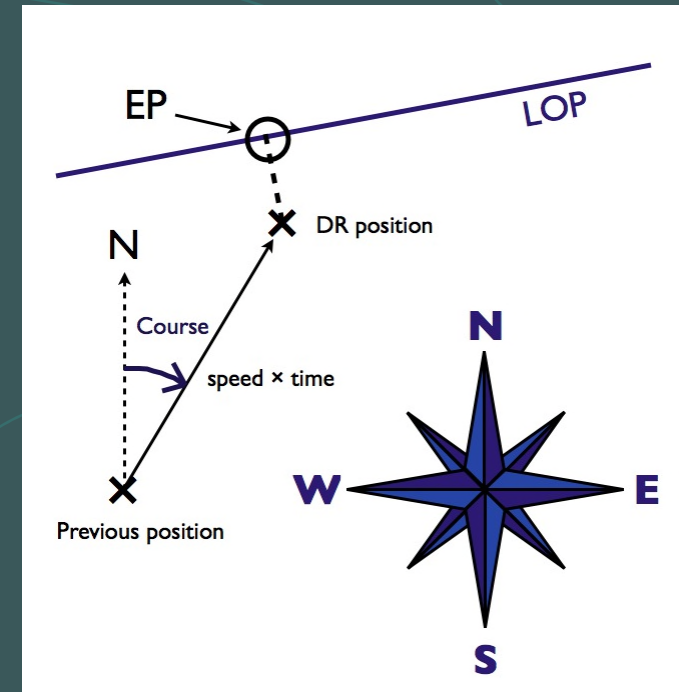
Step 1: Determine the distance and ship speed between waypoints

Step 2: Use graphic vector calculation on chart to determine the corrected bearing if current present

Step 3: Determine present ship position along plotted track by using ship speed multiplied by elapsed travel time to find distance traveled along the ship track

Distance Traveled along Track =

Ship Speed x Elapsed Travel Time

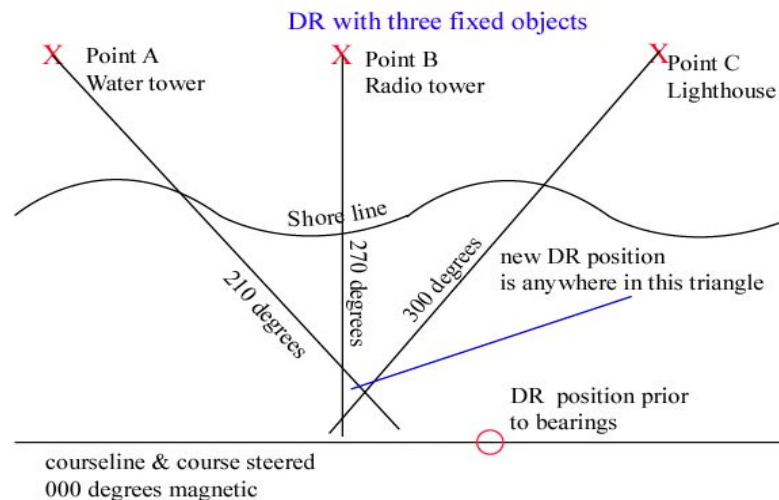
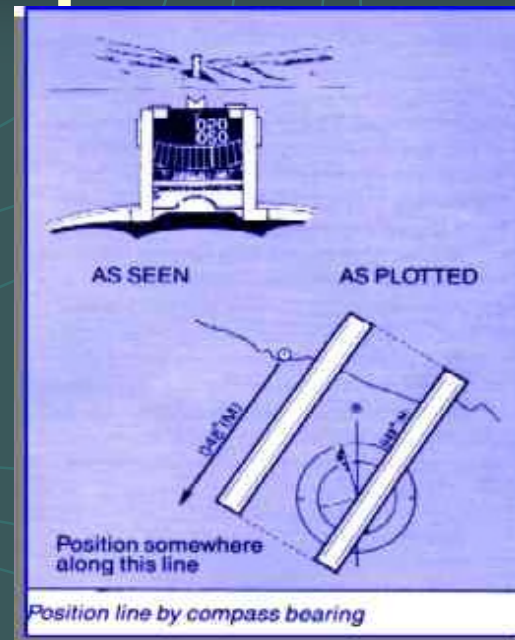


Using Triangulation to Fix Ship Position

Step 1: Determine the bearings to at least two visible landmarks from your ship's position using a compass.

Step 2: Plot each landmark bearing on the chart, using parallel rules and the compass rose. When the parallel rules are on the landmark, draw your line.

Step 3: Mark the location where the plotted bearing lines intersect – that is your ship's triangulated position



Navigating by LORAN

1) LORAN (LONg RANGE Navigation) is an electronic navigation technology using an array of land-based low frequency radio transmitters to determine the location and speed of the receiver.

2) LORAN suffers from electronic effects of weather and the ionospheric effects of sunrise and sunset.



Navigating by GPS

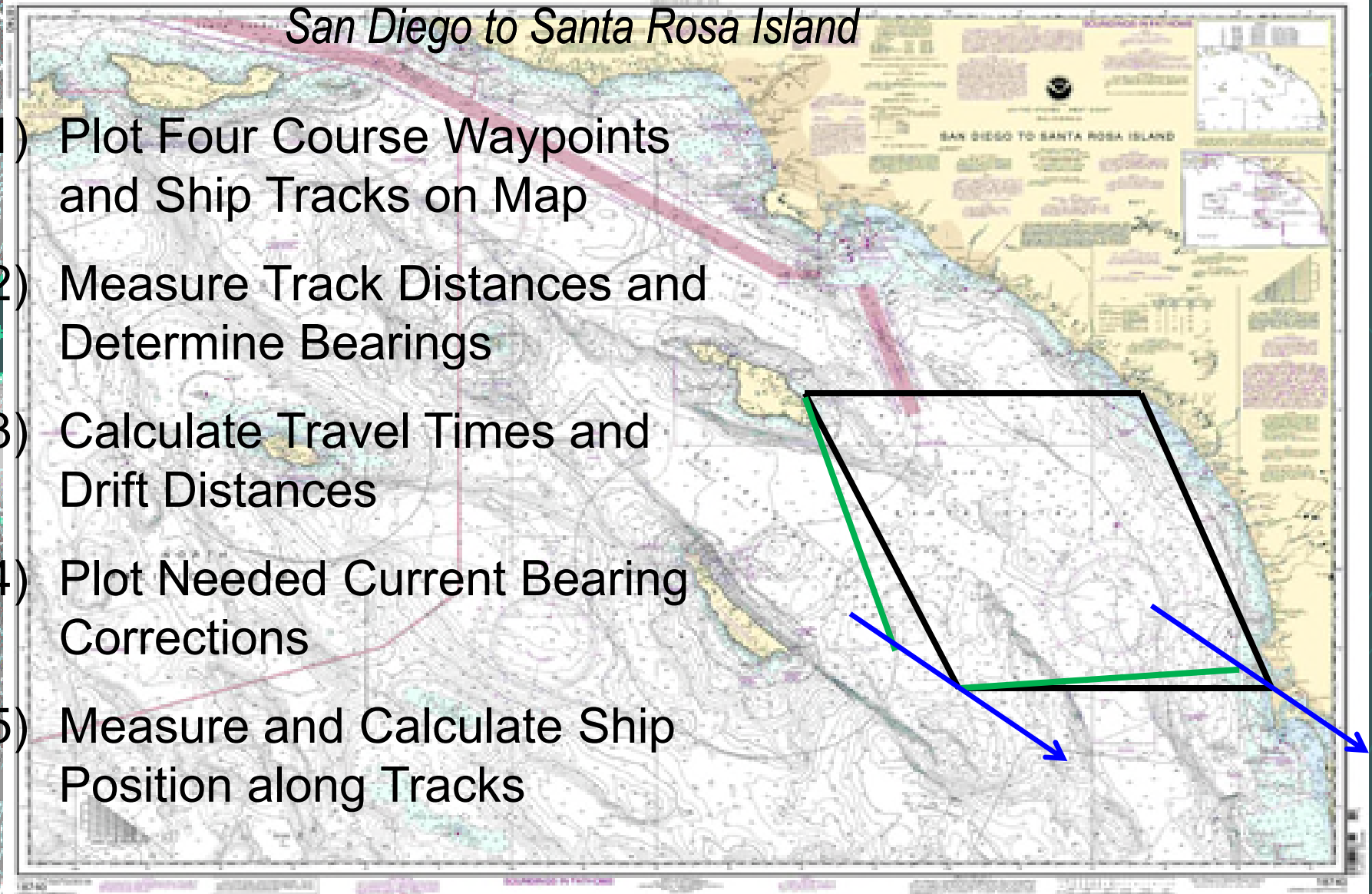
- 1) GPS (Global Positioning System) is an electronic navigation technology using an array of satellite-based high frequency radio transmitters to determine the location and speed of the receiver.
- 2) GPS is very accurate and is fairly reliable for marine navigation
- 3) GPS occasionally suffers from limited access to a sufficient number of overhead satellites.



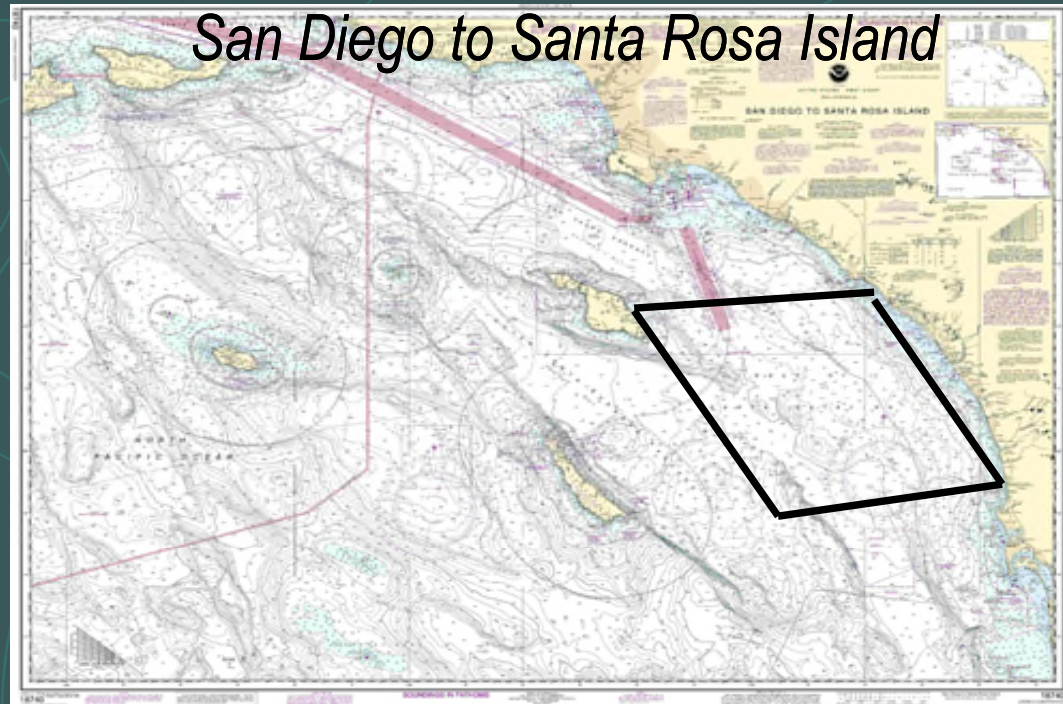
Nautical Chart for Today's 4-Leg Course

San Diego to Santa Rosa Island

- 1) Plot Four Course Waypoints and Ship Tracks on Map
- 2) Measure Track Distances and Determine Bearings
- 3) Calculate Travel Times and Drift Distances
- 4) Plot Needed Current Bearing Corrections
- 5) Measure and Calculate Ship Position along Tracks



Nautical Chart for Today's 4-Leg Course



- 1) Plot Four Course Waypoints and Ship Tracks on Map
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Next Week's Lab – Seafloor Sediments

Preparation

- 1) Study Textbook on Marine Sediments – Chapter 4
- 2) Study lecture textbook on marine sediments.
- 3) Do Sediment Lab Pre-lab activity – due at start of lab

