Navigation II Chartplotters and OpenCPN

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Aim of this session

Over the next 2 hours we hope to give you an overview of two important nautical navigation tools, the chartplotter and electronic chart plotting. At the end we hope you understand how the two fit together, and have developed basic competency with both.

Goals:
- Further expand the electronic representation of charts (continuation from last session)
- Understand what chartplotters do, wrt charts and boat data
- Be able to do all the common chartplotter tasks
- Understand why paper charts are still important
- Have a working understanding of OpenCPN
  - 'Tactical' and 'Strategic'
- Understand how to create routes in OpenCPN and transfer to the chart plotter

Of necessity there are a lot of topics we will not cover; there are plenty of sites on the web for further exploration.

Agenda

- **<u>Overview</u>**
  - Chartplotters: an integrated display of boat data and electronic charts. Good for in-the-moment. Not so good for planning.
  - Paper: never runs out of batteries or on the wrong screen; very quick and familiar big-picture representation.
  - OpenCPN: one example of laptop/tablet chart viewers/planners. Great for planning. Free app, free U.S. ENC charts. Not on iPad.

- **Onboard (primarily chartplotters here)**
  - Boat data devices and networks (NMEA 0182/3, NMEA 2000, some wireless)
  - Chartplotters: charts and data
  - The essential chart plotter operations (will be an exercise later)
  - Chartplotter / AIS wifi - share data with your iThings

- **Planning (primarily OpenCPN-like apps)**
  - OpenCPN basics
  - Routes, tides, currents, and notes
  - Exporting the route

- **Tactical and Strategic OpenCPN**
  - Close work / racing
  - Passage planning

Overview / Review

Nautical charts are representations of reality


Chart 13270
1:25,000
(@ 42°19'N)
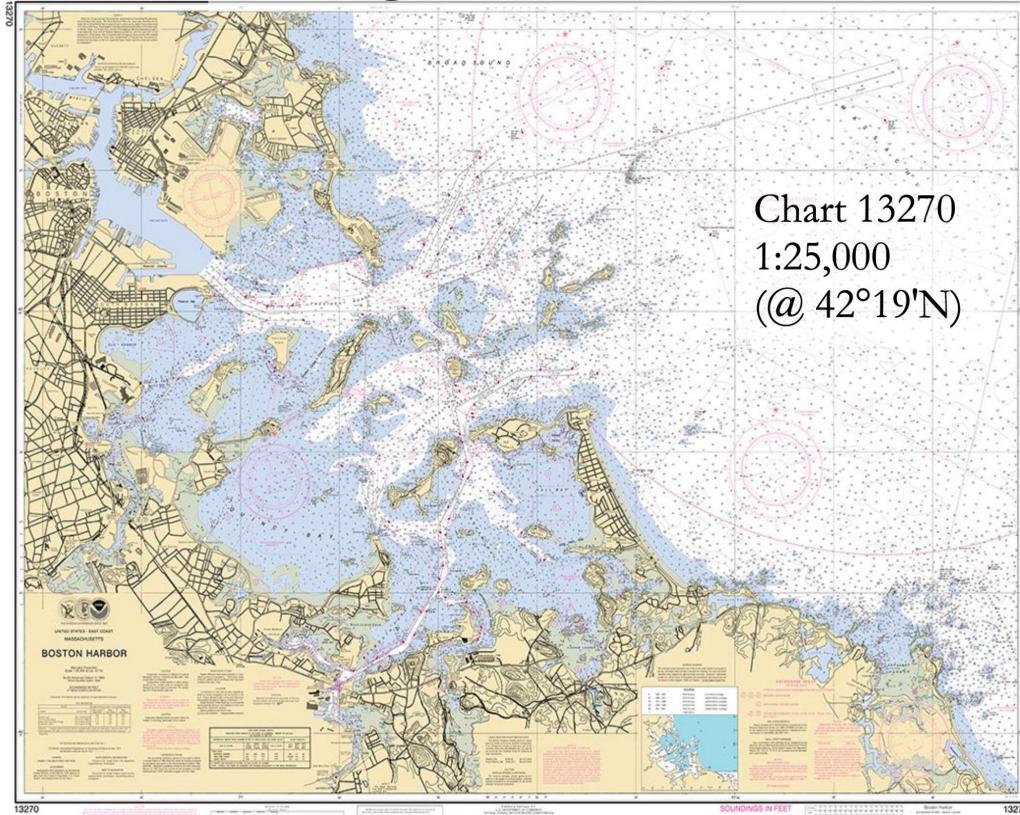
Paper chart -
always there

Overview / Review

Nautical charts are representations of reality
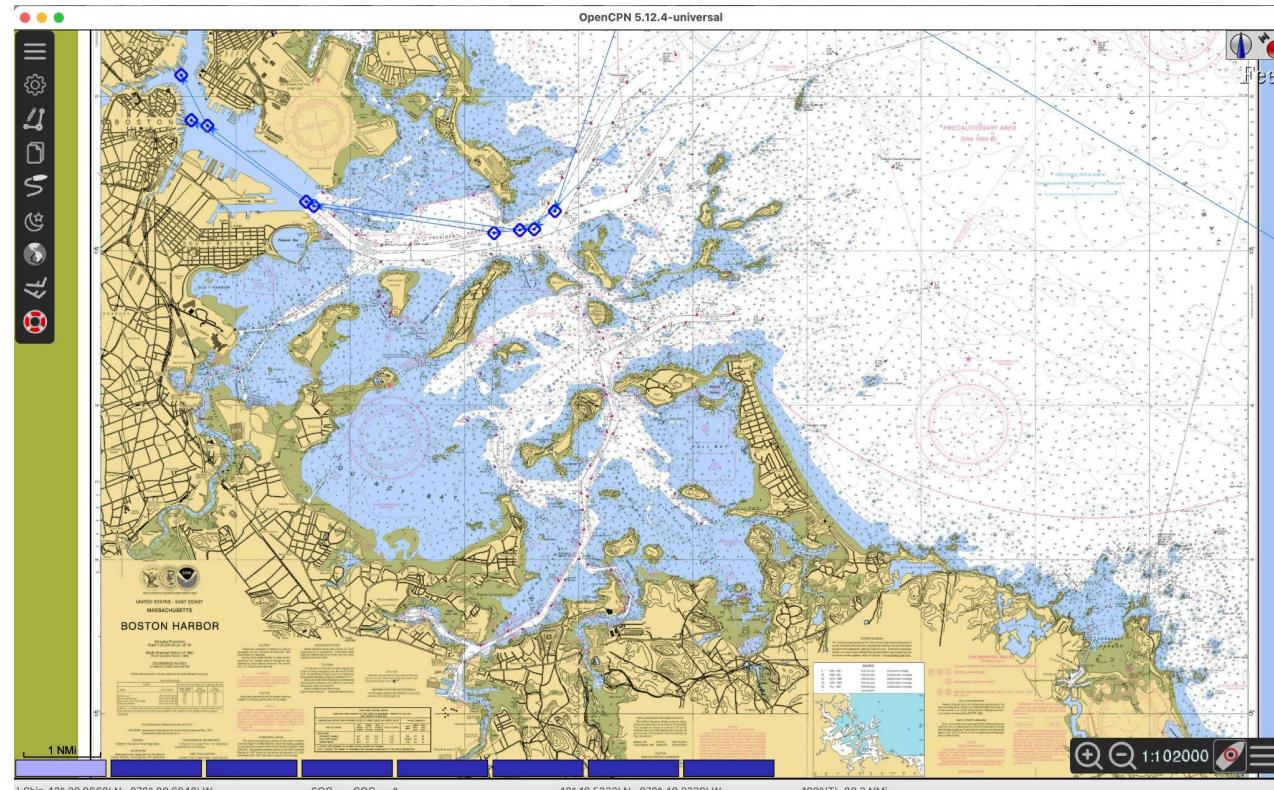
Raster ('RNC') chart on OpenCPN- paper chart and data (a couple of routes here)

Overview / Review

Nautical charts are representations of reality
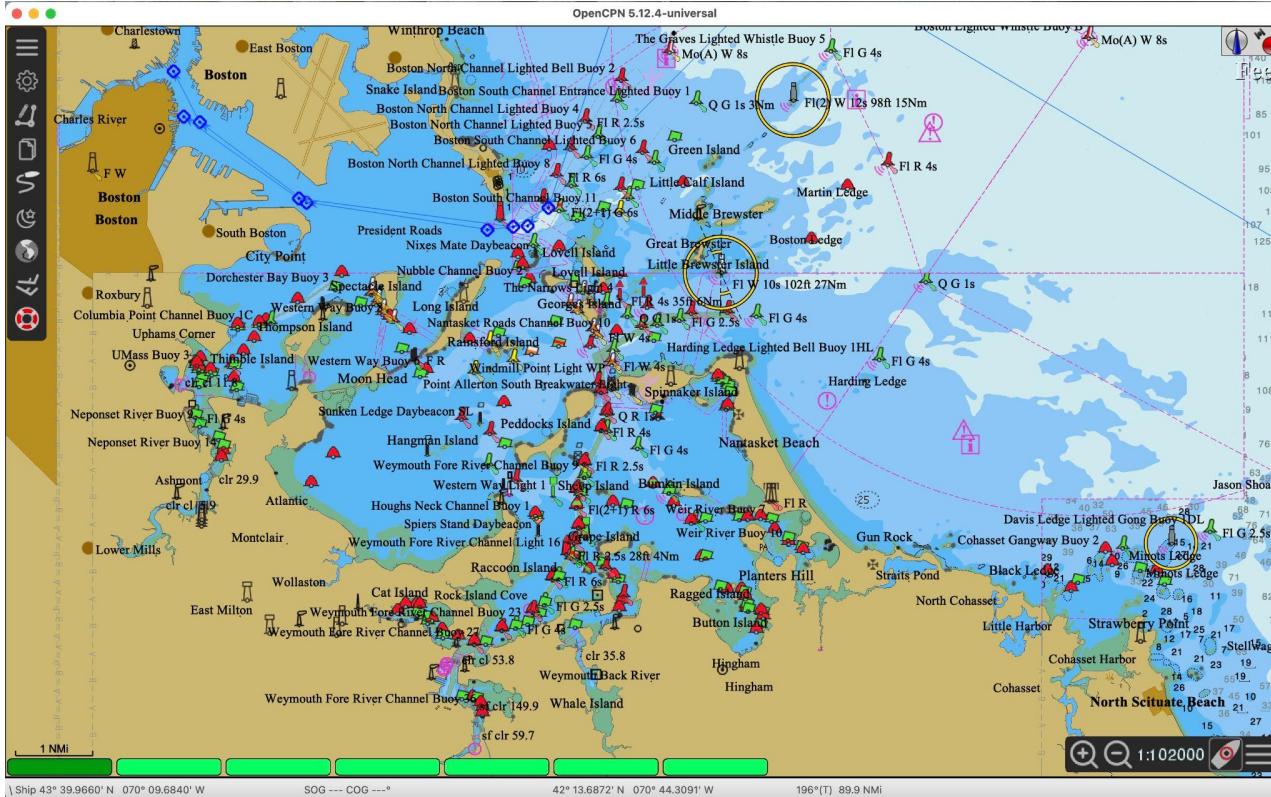
Vector chart ('ENC') on OpenCPN- chart and boat data (a couple of routes here)

Overview / Review

Nautical charts are representations of reality
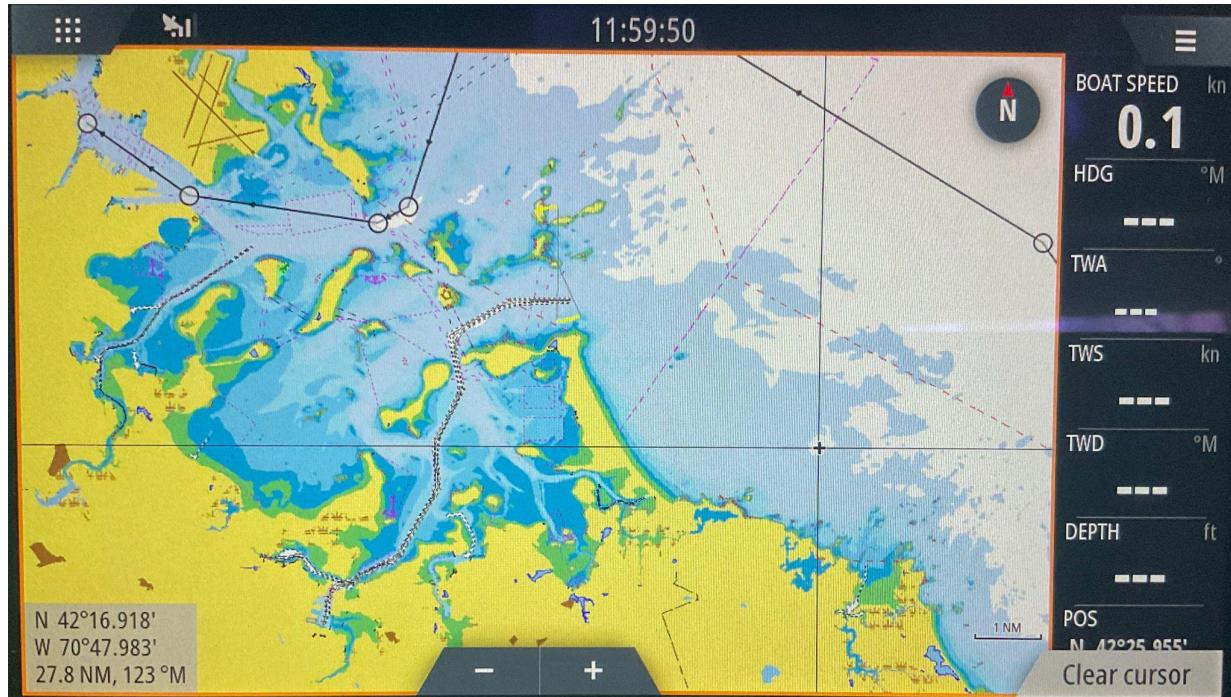
Vector chart (C-MAP) on the chartplotter- chart and boat data (instrument data and one route here)

Overview / Review

You should know about and have both paper and electronic charts.

Paper charts because:
- Instant high-resolution north-up big-picture vision
- No power/data glitches

Electronic charts because:
- That is what you will find on boats
- Accurate GPS position (usually, but…)
- Overlays (AIS, radar, etc.)
- Routes
- Integrate with other boat data

Overview / Review

In this session we will be focusing on the B&G Zeus 3s and OpenCPN as exemplars of chartplotters and planning tools

Chartplotters are:
- On the boat and wired to boat instruments
- Smaller
- Infrequently updated
- Used primarily for 'here, now' decisions

Planning tools are:
- On laptops and iThings
- Much easier to use for planning
- Easy to update charts etc.
- Can integrate with boat data via WiFi

Questions?

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Boat Devices and Data Networks

Many types of boat devices:

depth, water speed, wind speed, GPS, lighting, radar, Nav computers, displays

Two principle types of boat networks:

NMEA 0182/0183 (serial): separate wires and inputs/outputs for everything. Used to be the only type of network. Open.

NMEA 2000 (devices can share the same backbone like Ethernet): Simpler to wire, but some devices are still natively 0183 (e.g. wind instruments) and require a converter. Closed.

Mashee Boat Devices and Data Networks
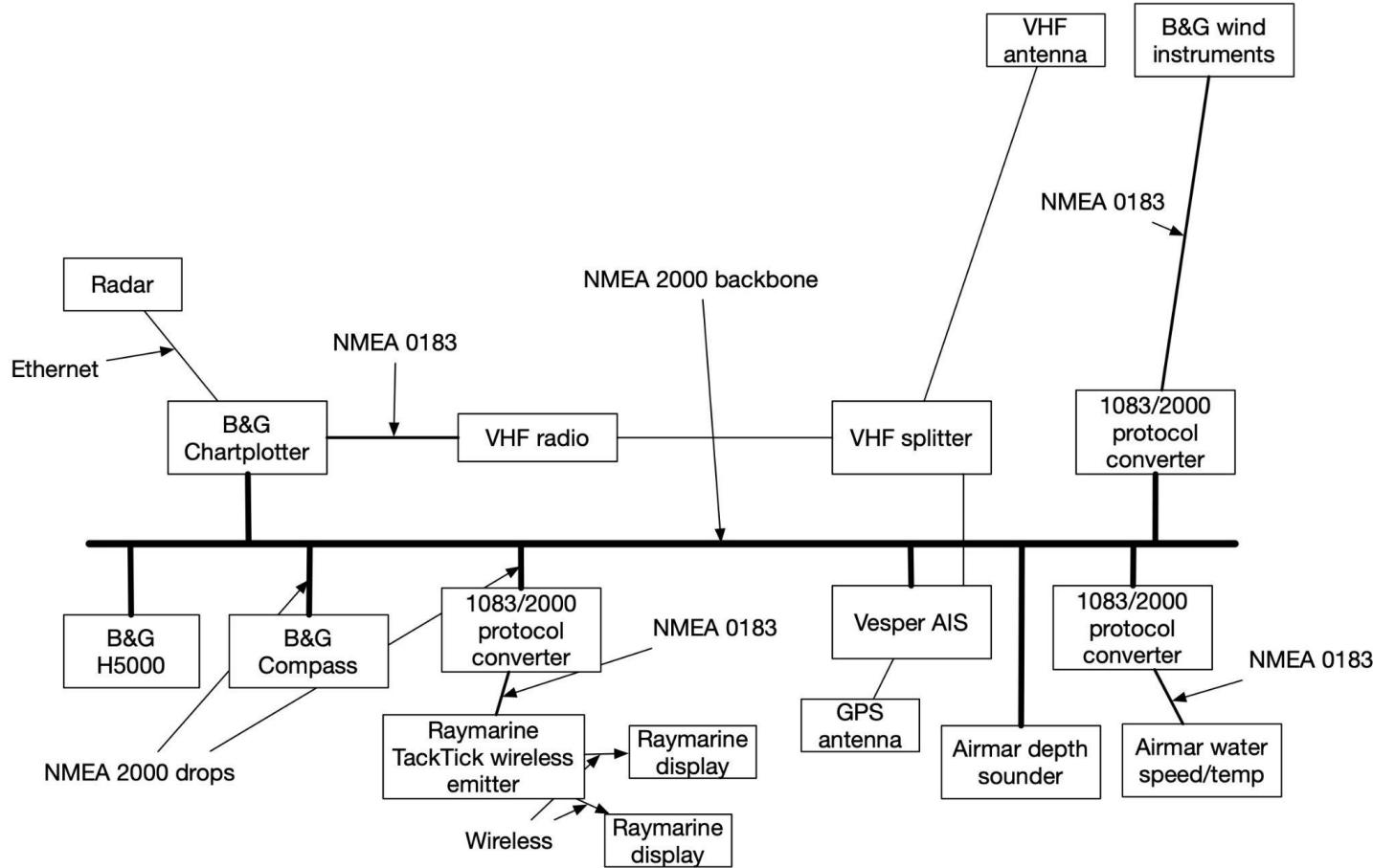
The Chartplotter

Sources of data:
- GPS (internal)
- Stored charts (C-MAP in the B&G)
- Data from NMEA 2000 bus (GPS, AIS, speeds, depth, etc.)
- Files loaded via SD card or Wifi

You can select which devices provide data - GPS, for example.

Your interface:
- Touchscreen
- Buttons/knobs
- Wifi hotspot (connect your iThings to receive boat data and mirror screen)

Core Chartplotter Operations

- Crew overboard marker
- Night mode
- Brightness
- Removing pan
- Knowing when to use paper
- IDing AIS target

- Finding light data
- Navigating to a location
- North/heading/course up
- Second data bar

Getting WiFi Boat Data

Both the chartplotter and the AIS provide hotspots through which your iThings can connect to get boat data

Chartplotter:
   SSID: Zeus3S aaa2 pw: S4XGZxx9
   Data type: NMEA 0183 IP: 192.168.76.1 port: 10110

AIS:
   SSID: VesperXB-YF87444 pw: WatchMate
   Data type: NMEA 0183 IP: 192.168.15.1 port: 39150

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OpenCPN Basics

- Getting / Updating charts
- Night mode
- Brightness
- Hiding depths
- Knowing when to use paper
- IDing AIS target

- Finding light data
- Navigating to a location
- Creating a waypoint
- Creating a route
- North/heading/course up
- Loading weather files (GRIBS)

Practical OpenCPN: Route Planning

Apps like OpenCPN provide a lot of affordances for proper route planning:

- You have all the charts
- Trivial to zoom in and out to walk the route looking for hazards
- Easy to create waypoints and routes
- Easy access to tides and currents
- Can optimize using weather and current data
- Can export route to put on chartplotter

Practical OpenCPN: Route Planning

Example: planning a route from Boston to Provincetown

Practical OpenCPN: Route Planning

Example: planning a route through Woods Hole

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Tactical OpenCPN

Before trip:

    Study wind prediction (windy?)

      Over trip route

       Maybe: download GRIBS into OpenCPN for wind (waves?)

Chartplotter Pluses

It is there

Fine for entering some marks and a course

Nice Displays for helmsperson (freeway)

Can monitor all boat instruments

    Location, depth, COG, AIS traffic

    Wind

Can overlay Radar

OpenCPN advantages

Chartplotter location is difficult and not practical place to work when things are hectic (races…)

Computer / OpenCPN
   Below decks: is more practical place to work

User interface, with mouse, is much nicer for close interaction

OpenCPN on laptop can connect to boat NMEA 0183 network via WIFI from chartplotter
   See all instruments
   See AIS traffic

OpenCPN in Races

Racing navigator responsibilities
   Before race
      Get sailing instructions / notice of race
         Refer to GBSA??? Mark list
            Easiest to locate marks on raster charts instead of vector chart
         Check for restricted areas near course
      '   Scope out potential race courses'
         Study wind prediciton over time of race (<15kts vs >15kts)
         Get VHF channel, muster location, check in time

Right Before Race

Right before race

    Get course from committee boat or VHF

     Enter waypoints and course into chartplotter ?   can be hassle

     Enter waypoints and course into laptop and IPAD

    Get initial bearing to first mark

     May be announced by committee boat, this gives navigators more time to enter courses

During Race

Drop a waypoint at the start if it is the same as the finish
   Make sure we don't run aground
      Watch depth, a lot
   Keep track of where we are on course
      Navigate around islands
         Don't go too close to shallow areas
    Keep track of traffic on AIS and visual
   Answer questions about navigation
      What is next heading going to be (spinnaker up down)
      How many miles or minutes to the mark
      How close to that island shore can we go?

Calling Tacks and Jibes

Want to minimize # of tacks and jibes
Example: want to tack or jibe to 'just make' a mark

Need to know the current 'Laylines'
        What is a layline
Can be predicted by Chartplotter or OpenCPN plugin
Problems:
        need estimates of true wind: tricky to predict from
                        measured apparent wind, heading, speed of boat
        Need to model of boat performance (tack angles…)
        Result is often noticeably 'off'

Alternative: use recent info

Study recent GPS track for achieved lay lines

   Measure headings

Strike a line from mark on reciprocal course

Call 'Tack' when the boat crosses the line

Similar for Jibing

OpenCPN Race Review

Hereschoff Regatta Saturday Race 1

2025 Herreshoff Classic Yacht Regatta
Scratch Sheet

Boat Name	Name	Sail #	Year	LOA	Feet	SPM	Division	S/NS
Class 1								
Courageous	Oakcliff Sailing	US 26	1974	68	58.71	-24	Modern Classic	S
Weatherly	Steve Eddleston	US 17	1958	68	48.21	5	Classic	S
Nefertiti	Sea Scouts	US 19	1962	68	46.07	12	Classic	S
Onawa	Mark Watson	US 6	1928	69	43.09	23	Vintage	S
Gleam	Andy Tyska	US 11	1937	69	42.75	24	Vintage	S
Black Watch	Joe Robillard	71	1938	68	39.4	38	Vintage	S
Class 2								
Jax	Øivind Lorentzen	2022	2023	49	65.2	-38	Contemporary	S
Cavallino	Bill Kahane	USA 2	2010	37	43.7	21	Spirit of Tradition	S
Dorade	Matt Brooks	16	1930	53	31.33	80	Vintage	S
Mashnee	Adam Traina	A7	1902	46	30.16	87	Vintage	S
Neith	Van Brown	US 123	1907	53	27.58	105	Vintage	NS
Nor'easter	Shelia Graves	Q10	1956	50	24.27	132	Vintage	NS
Weatherly	Clifton Leonhart	NONE	1972	53	23.46	140	Modern Classic	NS
Narwhal	Steve Frary	73	1999	64	23.08	144	Modern Classic	NS
Lively Lady	Will Hubbard	2600	1969	36	19.64	181	Modern Classic	NS
Class 3								
Gamecock	Peter McClennen	R40	1925	40	21.6	159	Vintage	S
Procyon	Bruce Bradley	58	1929	44	20.57	170	Vintage	NS
Mariner	Stephen Antaya	161	1950	54	20.43	172	Classic	NS
Skye	Steve Lindo	393	1956	40	19.04	203	Classic	NS

Marks
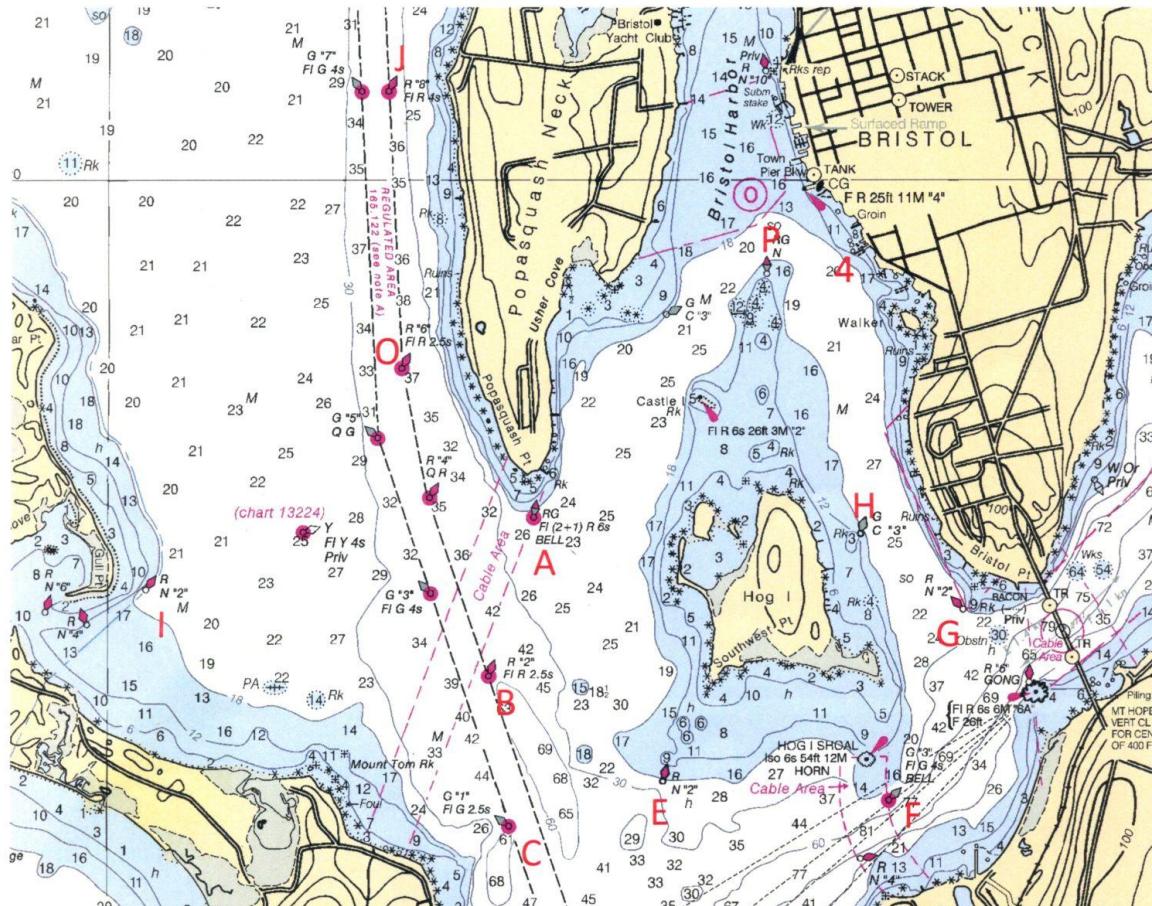
From Skipper's Meeting

Class 2   1st warning (second) 12:

Course: #1
→ Signal boat — orange

Start: 1 D (P)

2 A (SB)

3 J (P)

finish: 100 yards SB finish boat = blue flag ▽ orange pin / yellow pin

Course #2

Start: RC — orange

1   D   (P). [RG]

2   F.   (P) [G]

OpenCPN Demo

Strategic OpenCPN: trip to Bermuda

1/16/24

Get current GRIB predictions from saildocs.com

Email these messages to: querey@saildocs.com

Separate emails, no subject line, nothing else,   is fragile

gfs:32N,43N,64W,72W|0.5,0.5|0,3..240|WIND,WAVES

rtofs:32N,43N,64W,72W|0.5,0.5|0,3..240|CURRENT

These specified which product, latitude - longitude range, .5 degree grid, 240 hours

Receive grib files by email

Download them

Start up *openCPN* grib feature

Load *both* files at the same time

OpenCPN 5.8.2-0

Fathoms

Select a GRIB file

sw > Dropbox > Sailing > Gribs

Search Gribs

Organize ▾   New folder

Quick access
Desktop
Downloads
Documents
Pictures
Dropbox
Baltic-38
boats
Gribs
recordings

Dropbox
.dropbox.cache
1Password
2020 Uncertainty
a
Agendas
Airsoft

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File name: "gfs20250116211802087.grb" "rtofs20250116211902088.grb"   Grib files (*.grb;*.bz2;*.gz;*.grib)

Open   Cancel

File: rtofs20250116211902088.grb (Thu 16-Jan-2025 00:00 UTC)

Thu 16-Jan-2025 21:00 UTC   Now   123

Data at cursor position
Current   N/A   N/A

File: rto

\ Ship 42° 20.9760' N 071° 01.1760' W   SOG --- COG ---°   32° 47.8369' N 075° 58.4566' W   216°(M) 619 NMi

1: 8.6 MM

Browse gribs

OpenCPN 5.8.2-0

Fathoms

80° W   75° W   70° W   65° W   60° W   55° W

JustMeetup

File: rtof

File: rtofs20250116211902088.grb (Thu 16-Jan-2025 00:00 UTC)

Mon 20-Jan-2025 09:00 UTC

Now

123

Data at cursor position

☑ Wind N/A N/A ☑ Waves N/A ☐ Current N/A N/A

| Ship 42° 20.9760' N 071° 01.1760' W

SOG --- COG ---°

38° 17.0339' N 073° 35.4614' W

219°(M) 271 NMi

1: 8.7 MM
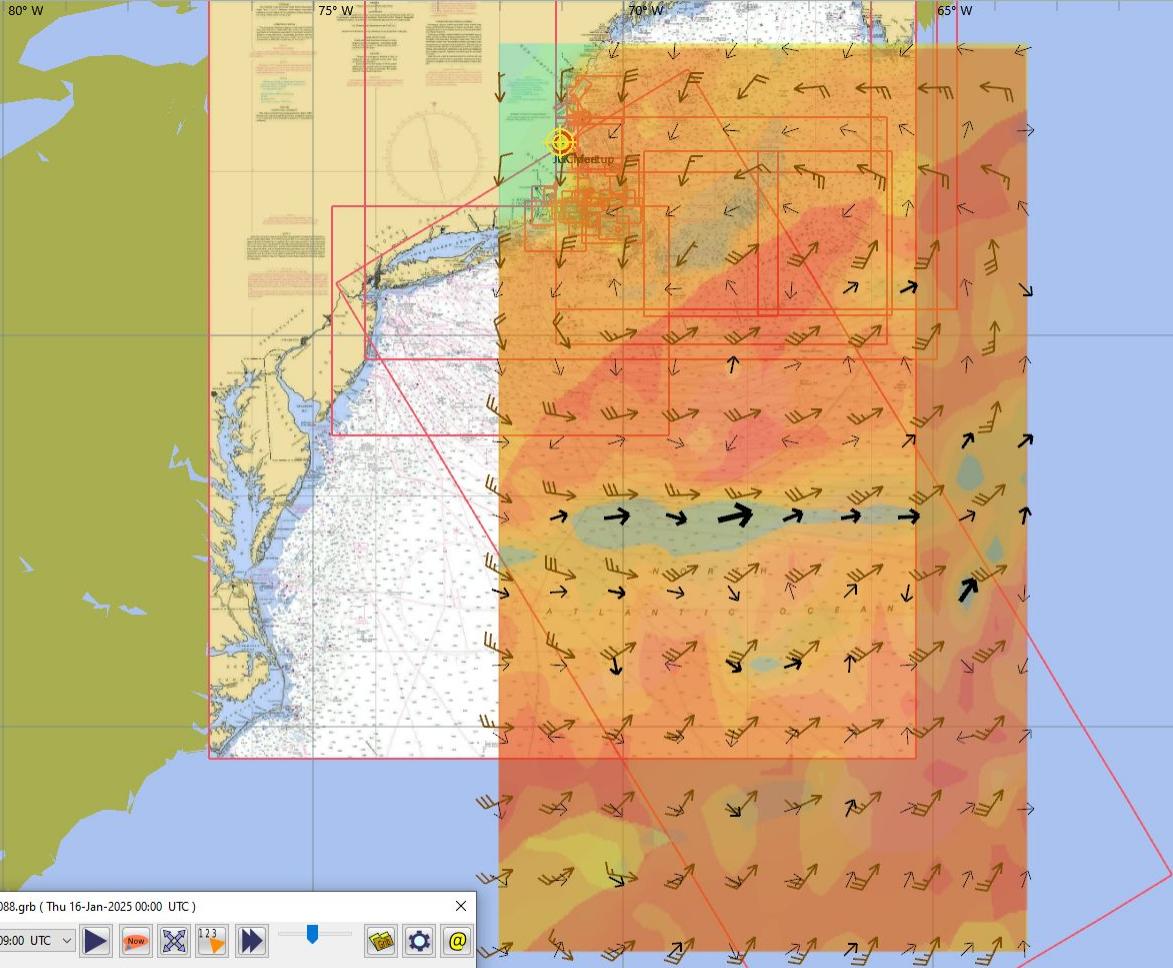
Configure and run planner
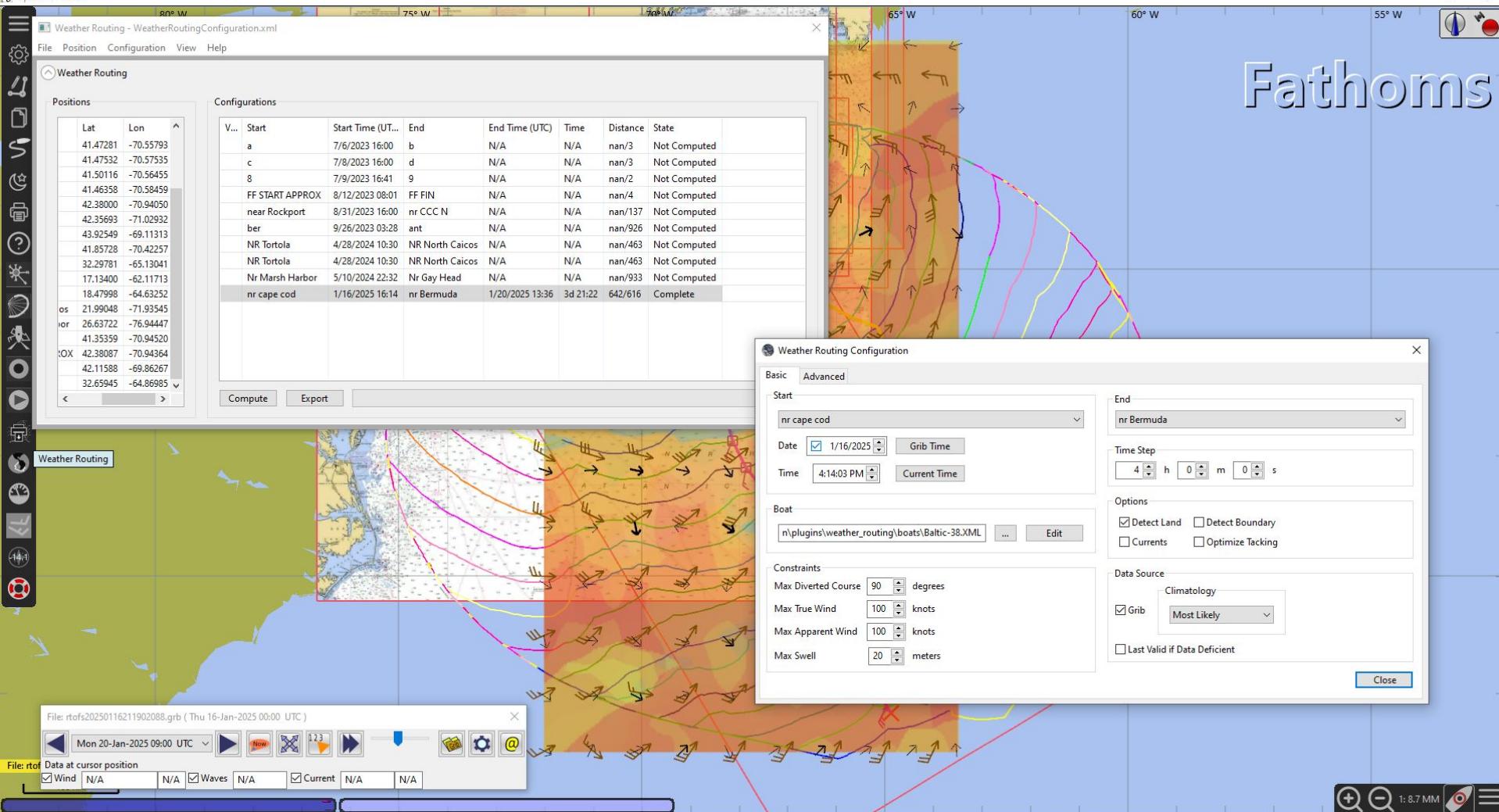
Browse plan
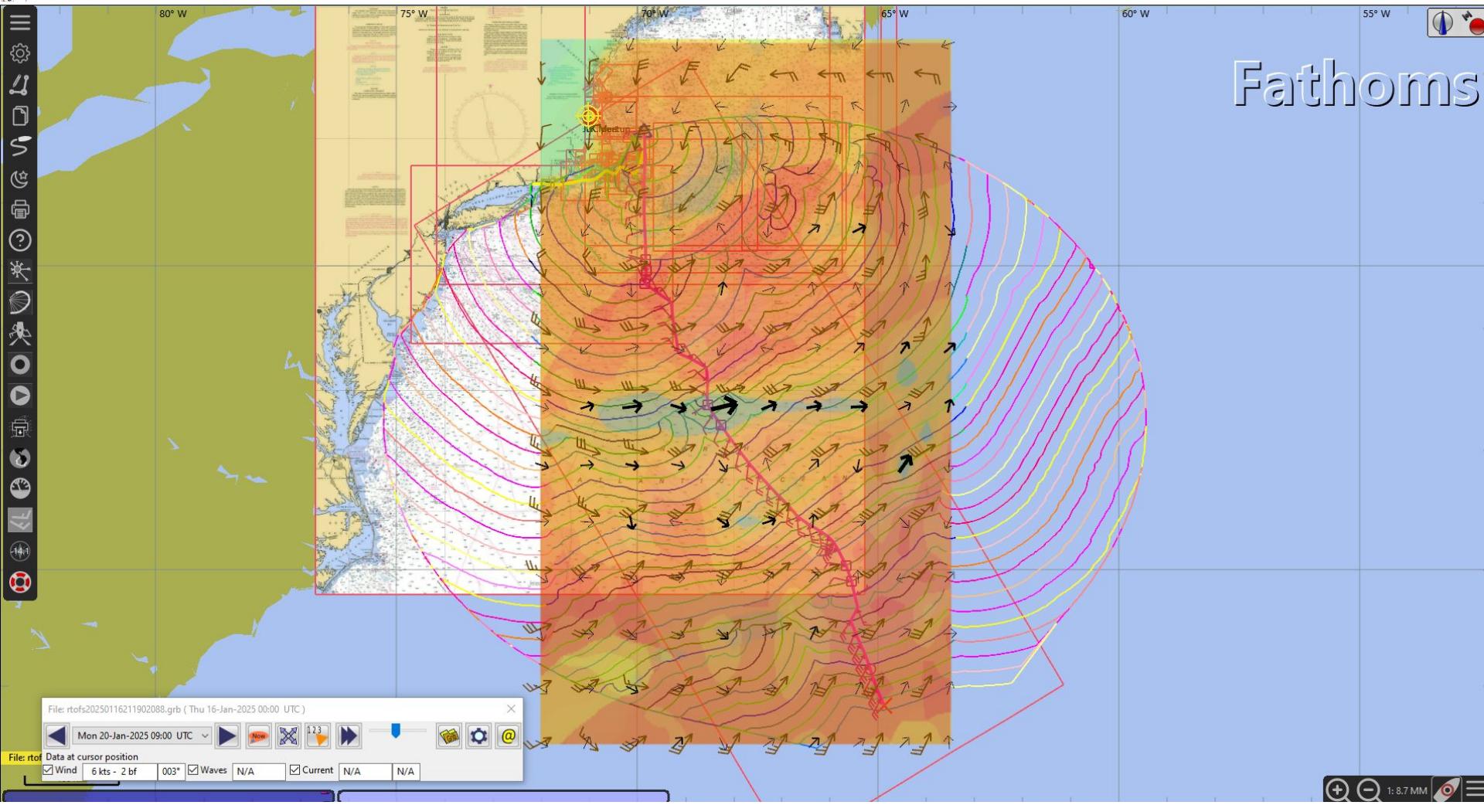
View report

Current Configuration

Boat Filename Baltic-38
Route from nr cape cod to nr Bermuda
Leaving 1/16/2025 4:14:03 PM
Arriving 1/20/2025 3:33:25 PM
Duration 95:19:22

Distance sailed: 663.26 NMi : 47.17 NMi or 7.66% longer than great circle route
Average Speed Over Water (SOW): 6.94 knots
Average Speed Over Ground (SOG): 6.94 knots
Average Wind: 17.99 knots
Maximum Wind: 37.85 knots
Average Swell: 2.24 meters
Upwind: 66.67%
Port/Starboard: 12/88
Number of tacks: 1
Sailing comfort: Difficult

Routes

nr cape cod to nr Bermuda (1 configurations)
Fastest configuration 1/16/2025 4:14:03 PM avg speed: 6.94 knots
Best Times (mostly downwind): none
Best Sailing Comfort: Difficult on 1/16/2025 4:14:03 PM
Cyclones: none
Start times for cyclone safe routes: 1/16/2025

Questions?

Chartplotter Finger Exercises:

- Drop a COB marker, and then delete it
- Put the chartplotter in Night Mode
- Brightness
- Removing pan
- Choose a location, and then create a route to that location
- Switch between north, heading, and course up
- Find the light data for the green "3" mark in Lower Middle

Plotting Exercises:

In President Roads, Deer Island Light is behind you to port, about 8 o'clock, and a yellow buoy is just slightly to starboard behind you. Directly ahead, a yellow buoy and red buoy are in line with each other.

      Where are you?

      How will you figure this out?

Use all available resources.

You have 3 minutes to do this.

Plotting Exercises:

On a clear night you are sailing back to Waterboat Marina, and are at the G "3" mark SE of Boston light. You want to navigate through the Narrows, and then through Lower Middle, to get to Waterboat.

     a. What is your navigation strategy?

     b. What do you first tell the helm to steer?

Use all available resources.

You have 7 minutes to do this.

Practical OpenCPN: Route Planning

Exercise: Plan a route from Dions Yacht Yard on Salem (42° 30.5874' N, 070° 53.1591' W) to Waterboat marina (42° 21.6913' N, 071° 02.7871' W) for Friday 17 April 2026. Note that you have to leave Dions when there's at least 4 feet of tide, and Dions is open (8 AM - 4:30 PM).

What is the earliest and latest time you can leave?

What is your route? Export it so you can load it on the B&G.

Practical OpenCPN: Route Planning

Exercise: plan a route from Plymouth to Onset, arriving at Onset in time for lunch on Thursday, June 4th, 2026.

Hint: It's best to enter the Cape Cod Canal just as the current is starting to head in your direction.

Practical OpenCPN: Route Planning

Exercise: plan a route from Weymouth to the RW "BG" mark

Fair Winds and Following Seas!