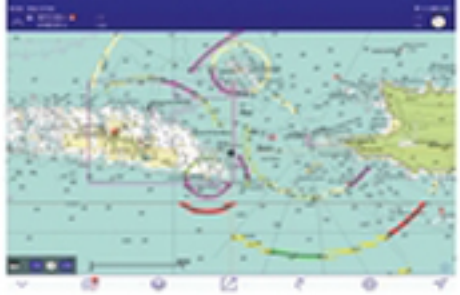
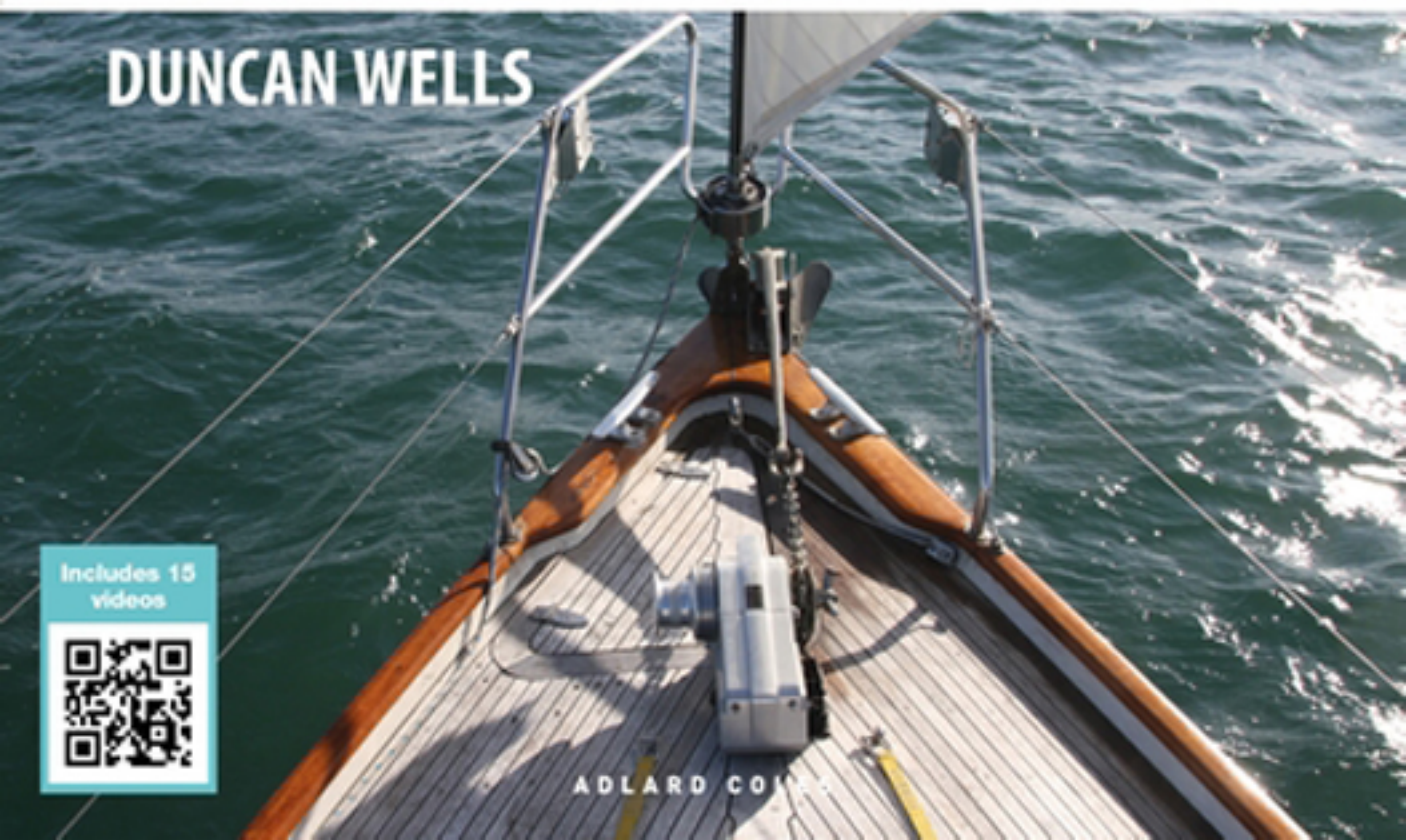




STRESS-FREE NAVIGATION

Electronic and Traditional

DUNCAN WELLS



STRESS-FREE NAVIGATION

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DUNCAN WELLS

LONDON • OXFORD • NEW YORK • NEW DELHI • SYDNEY

To the girls – Sally, Katie and Ellie

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and Sally – as always.

▲ *The start of today's navigation: John Harrison's 'sea watch' (H4), completed in 1795 and accurate enough to allow us to measure longitude.*

Preface

This book came about because a student of mine said to me that occasional sailors wanted a book that would show them how to get a charter boat from the marina out to sea. A book that started on board with the electronic chart plotter.

And that is exactly what I show you in Chapter 2, 'On board'.

The simple fact about this clever technology is that the more we have, the more we need to know what it is doing and what it all means. For that we need to return to the basics – a paper chart, a magnetic compass, a plotter, a set of dividers and an almanac.

After all, if anything should happen to our electronic devices we will need to refer to our paper chart back-up.

But what our electronics can do for us is amazing. We can do it all manually, of course, but the electronics do the sums in a flash and they give us incredible detail and accuracy. Well, they will do if the data they are being fed is sound.

Don Cockrill MBE, Port of London pilot and one-time chairman of the UK Maritime Pilots' Association, told me: 'Today we know our position to within less than a metre on the Earth's surface. We are following the red course line on the digital chart. And yet we don't really know where we are. Not until we look out the window and we see the buoy that's marked on the screen in front of us. Then we know where we are.' And that is so true. The digital is fine, but we need to back it up with the fact.

Navigation is a fascinating subject and it is so broad, covering everything from oceanography to geometry, metereology, the universe, psychology, people management – the list is endless.

With this book you would easily be able to pass a Yachtmaster standard examination anywhere in the world. It is also for newcomers to sailing who may be setting out on a Day Skipper level course. Check what your course requires you to know and pick what you need from the book.

The key is the integration of the electronics, the chart plotters, radar and AIS and an explanation of what they are telling us.

Navigation is not a complicated subject, but it can be involved. I have done my best to distil the information and present it to the reader in a manner that allows for stress-free absorption.

I have tried to keep the thing as international as possible. Of course, many examples will come from home waters, the Solent for example, but we also look at East Coast America, Australia, the Baltic and France, to include our friends in other countries.

I will always start my passage planning by looking at a small-scale paper chart of the area I will be sailing but will then monitor my route on a chart plotter. Indeed, I will allow the chart plotter to take the lead role, but when offshore I will always plot my position every hour on a paper chart along with the log reading and the time. I will then fill out the log hourly with my speed over ground, course over ground, heading, wind direction, wind strength and pressure.

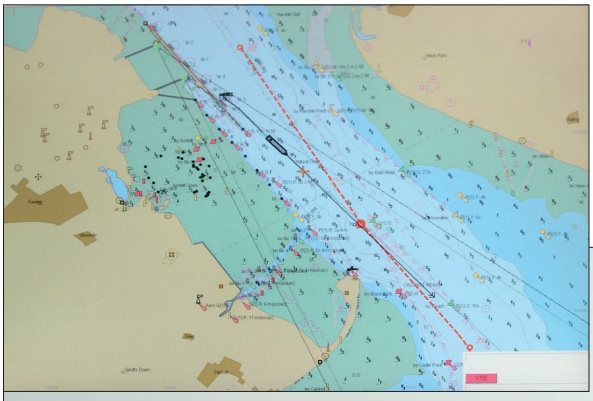
One other thing to mention about electronics and sailing a boat is that every member of crew needs to know how they work. I mean really know how they work. We have the ability to show different data on the screen – the chart, our position, heading, course over ground, overlaid with AIS (Automatic Identification System) or radar, wind data, lay line information, fish finder information, the seabed. To have the helmsman navigating in shallow water in fresh winds and calling for someone to set the repeater screen by the helm to show depth of water

and no one being able to do this is a dangerous situation. The helmsman at this point is literally sailing blind. If I am sailing near the coast, whatever information I have on screen I will always include depth of water, or have an independent stand-alone echo sounder depth indicator.

And another thing: the motion of a boat tends to dull the senses, allowing us to become confused easily, so really knowing how to navigate round the screens of the chart plotter is essential for all on board.

Navigation at its essence is a matter of conning the boat safely and with due regard for your crew from one place to another.

There are videos throughout the book, which you can view by scanning the QR code on your smartphone. You can also watch these videos online at www.westviewsailing/stress-free-navigation-videos. For those following the RYA syllabus there are also the Westview Sailing tutorials videos, which can be accessed via www.westviewsailing.co.uk



◀ *Following the red line.*

▼ *The view out of the window.*

1 Introduction and philosophy

The fundamental difference between navigating on land and navigating at sea is that at sea you are navigating your way around a moving body of water. When you stop your car you can be reasonably sure that with the hand brake on, it will not move from this position. Not so with a boat. You may well have stopped the boat in the water, but it will be moving with the wind and the tide, over the ground, the seabed below. And this could be moving the boat into danger.

The other thing to consider is that on land the sea represents a danger. You can drown while swimming or get cut off by the tide. The sea can smash the shore and do damage. But when you are at sea you have to adjust your mindset. It is the land that is the danger. Hitting land when in a boat never ends well for the boat, or its crew. So when you are out there you want to steer well clear of land and ensure that at all times you have sufficient water underneath to be able to float.

Obviously you have to make port – and a copy of *Stress-free Sailing* or *Stress-free Motorboating* will make casting off and coming alongside a breeze – but if you can get into your mind that in a boat the sea is safe, the land is not, you will be well armed.

I am going to approach every element of navigation from the digital, first. I will look at the latest technology, designed to make our lives easier out there on the water. And then I will relate what's on screen to the analogue, the paper chart, so you understand what the screens are telling you.

Of course, there is always the possibility, however unlikely and however many electronic back-ups you may have, that everything will go dead. That is when you will need to fall back on your self-sufficient navigation skills. And these I will show you, so that you can find your position accurately enough and reasonably quickly, without any electronic aids.

In this book I have mentioned a number of chart plotters. This is not an exhaustive list as this is not

My trusty steed – Dorothy Lee.

supposed to be a product review or comparison. I have just included examples where I have had access to the plotters. I am simply using this as an introduction to show you what the electronics can do and what it all means. And whatever products come along in the future, you will still need to know what they are telling you and what you need to do if for some reason they stop working all of a sudden.

Remember that putting to sea in any vessel, especially a small boat, is not without risk. I do not subscribe to the 'It's not my fault' culture that seems to pervade society these days, so let me make it quite clear that whether we are dealing with electronic or paper charts or pilot books, we do so at our own risk, we do so knowing that we need to cross reference information and that nothing will be 100% accurate or foolproof.

Don't follow any electronic aid blindly, look out of the window, look for the road signs.

You might wonder why astro navigation and the sextant are not mentioned in this book? Navigating by the stars is just the most wonderful, purest pure way to navigate and it is not hard despite the way some people present it. The satisfaction of fixing your position to within a couple of miles out on an ocean cannot be measured. But unfortunately there simply is not the space to include it here.

2 On board

You've just stepped on board. The kettle's on and tea will be along in a moment, so you switch on the chart plotter.

You will be faced with a warning.

Some say: 'All information is presented for reference only. You assume total responsibility and risk associated with using this device.'

Others may say: 'Not to be used for navigation', which I think is taking things a bit far, given that this is exactly what we will be using it for.

You then generally need to click the OK button to access the program.

I promised in the Preface that I would get you from your mooring out to sea the minute you stepped on the boat. You will have to get the boat from the dock to the fairway, but from here Navionics Dock to Dock, or Expedition or Adrena, or PC Plotter, or Savvy Navvy, or other apps that will no doubt come along, can do the rest.

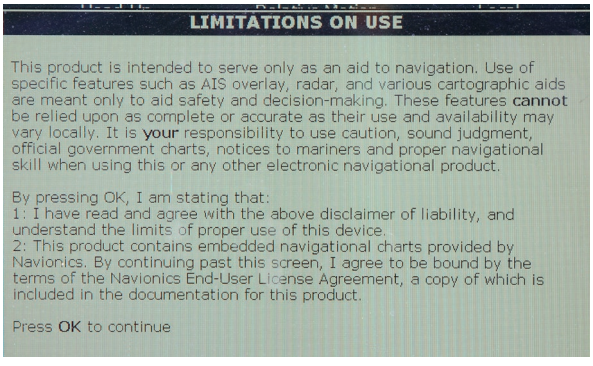
From the home page, click on Chart and this is what you will see.

A chart with your boat – the blue triangle here – at the centre. You're not moving. You know that for a fact as you are tied to the dock.

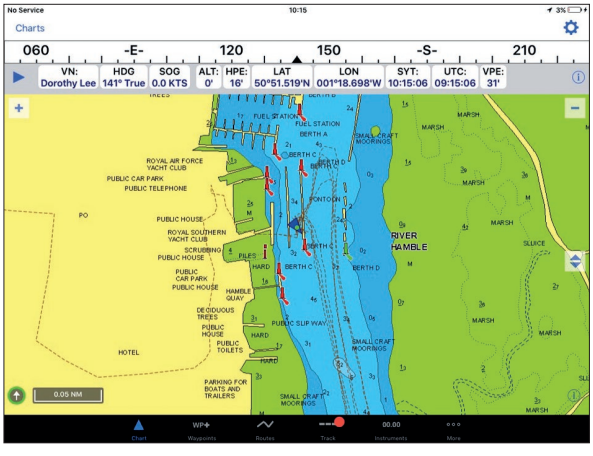
The chart plotter confirms this by showing your Speed Over the Ground (SOG) as 0.0 knots. You can see the way the GPS thinks the boat is lying, which is your heading, from the aspect of the boat (the triangle) on the screen. It also gives you this as a compass heading at the top of the screen. It thinks your bow is pointing at 141° true.

The minute you start moving, your SOG will be displayed on screen, along with your Course Over the Ground (COG) and a line projecting forward from the bow of your boat. This line is your heading. 'Heading' shows the direction in which the boat

▲ *Chart plotter on.*



▲ *Warning.*



▲ *Tied to the dock, according to the plotter.*

is facing and is different from COG in that if you were going sideways your COG would show your sideways movement but your heading would show a line at right angles to this, indicating the direction in which your bow was pointing.

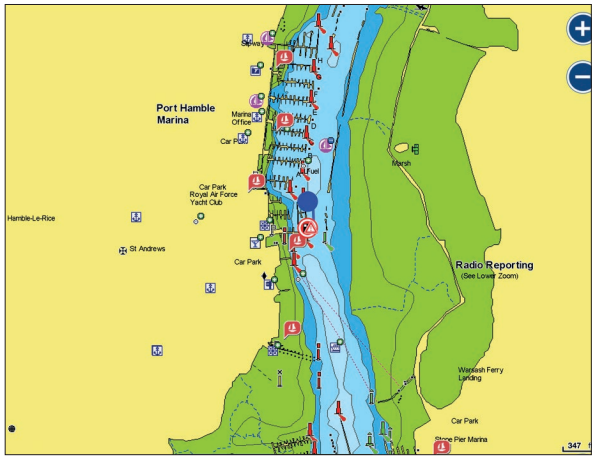
The latitude and longitude of your position is displayed at the top of the screen, along with your heading, the direction in which you are pointing and the time, which in the UK is UT.

Latitude and longitude are how we define our position on the surface of the Earth.

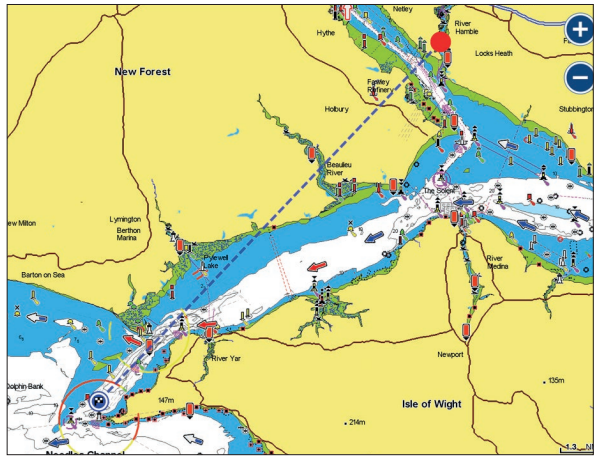
Let's go somewhere (the example shown uses Navionics Dock to Dock).

Follow the given route and you will get from the fairway out to sea in the English Channel by the Needles.

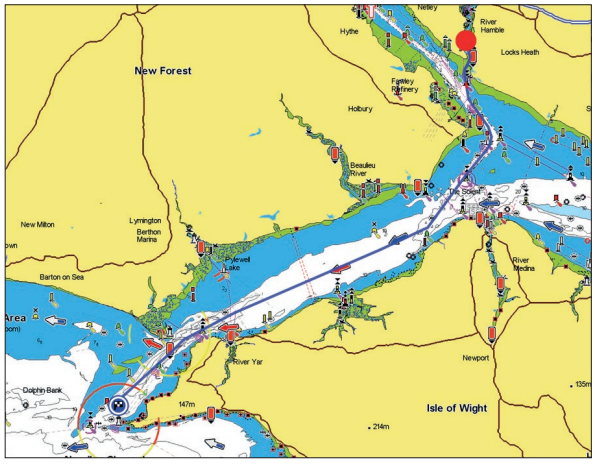
There, I have delivered on my promise.



▲ 1. *Touch your boat on screen and a circle appears.*



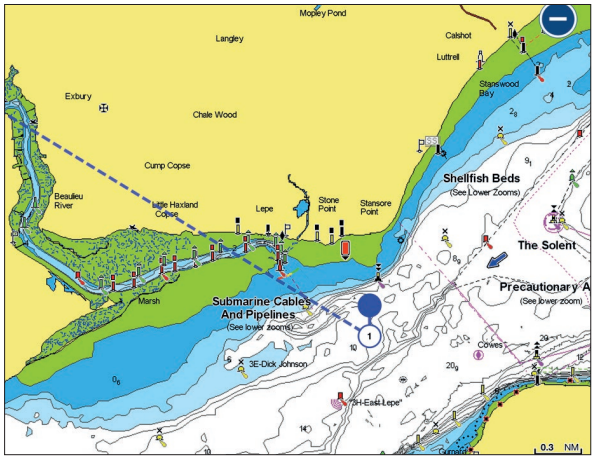
▲ 2. *Touch where you want to go to. Another circle appears and it draws a dotted line from here to your boat. Yikes! That's across land.*



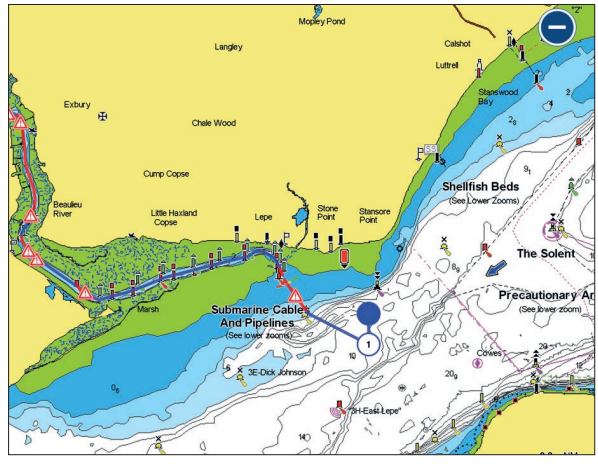
▲ 3. *It thinks about it for a moment and works out that you need a depth of water to float in and a safety margin, so it routes you down the river and to your desired location safely via the preferred channels.*

▲ 4. *Zoom in to see that you need to start from the fairway beside your berth.*

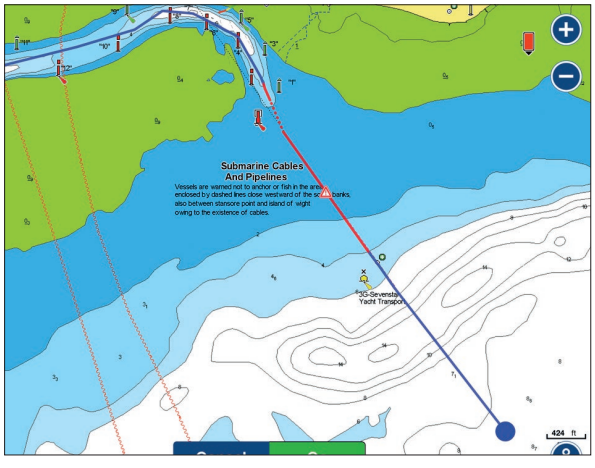
These programs will also warn you about dangers on the way.



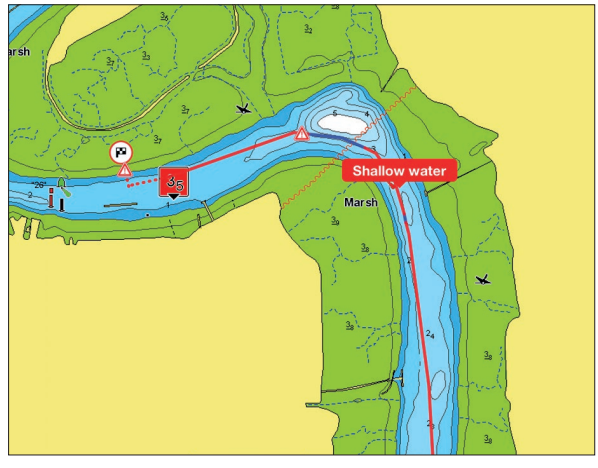
▲ 1. *In the Solent, heading for Buckler's Hard up the Beaulieu River.*



▲ 2. *That's better – going by river rather than overland.*

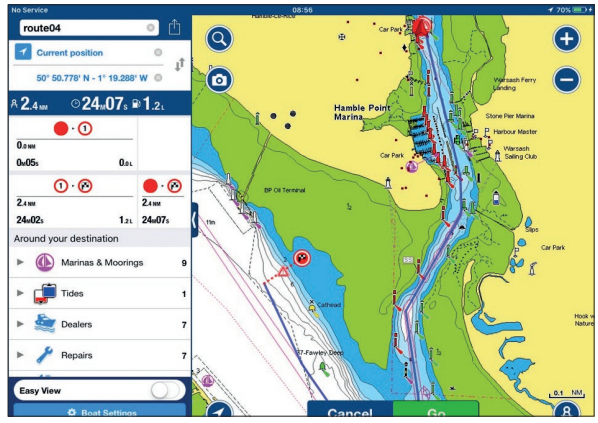


▲ 3. *Dock to Dock warns us of dangers.*



▲ 4. *And it is not too keen on our destination. We will do our best not to run aground.*

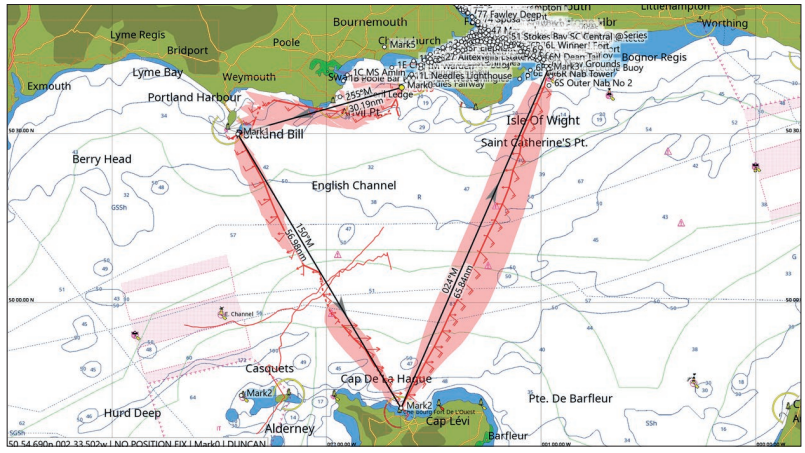
Once the program has given you the route, you should interrogate it and zoom in to see what dangers or obstacles you might meet. You then follow the route, looking out for the navigational marks on the way.



Here it has decided that my destination waypoint is too shallow.

Parameters

The program is working to parameters that have been set either automatically or manually – the digital chart, a minimum depth requirement. It can access weather information, tidal height and tidal stream information and in some of the more sophisticated programs you can input optimum sailing angles for each sail and maximum wind speeds for the sails. Then when you set a route it will not only tell you which tack you will be on but also which sails you should set and fuel consumption if there is no wind. You can also limit the wave height you want to experience and the wind speed, in which case the program will tell you that setting off next Tuesday at three in the afternoon will be the ideal start time for the passage, as opposed to right now.

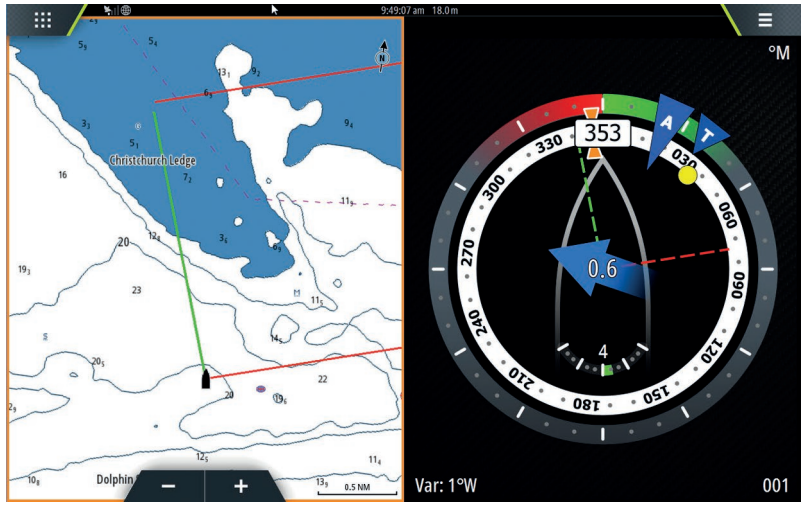


A passage from the Needles via Portland Bill to Cherbourg and the NAB tower, showing the direct route and then what we will actually be sailing according to the wind. The program has also allowed for the tide.

GMT Summer Time	Twd°M	Tws	Twa	Targ	Bsp	Set°M	Drift	Sail	Brg°M	Dist nm	Mo...	MSLP	Latitude
10-May-18 14:20	260	13.5	48	042	6.7	099	0.3	J2	209	1.85	Sail	1018.21	50 38.070
10-May-18 14:38	253	14.0	43	042	6.4	095	0.4	J2	207	1.77	Sail	1018.37	50 36.440
10-May-18 14:56	248	14.5	(33°)	042	6.3	087	0.5	J2	211	1.75	Sail	1018.52	50 34.852
10-May-18 15:17	245	14.8	(-20°)	042	6.4	082	0.7	J2	265	4.08	Sail	1018.67	50 33.337
10-May-18 16:13	238	15.5	(-40°)	041	6.4	072	0.9	J2	282	4.77	Sail	1018.92	50 32.908
10-May-18 17:04	233	15.9	-41	041	6.4	071	1.0	J2	278	3.57	Sail	1019.08	50 33.835
10-May-18 17:42	233	14.6	-46	042	6.6	078	0.8	J2	282	3.86	Sail	1019.22	50 34.274
10-May-18 18:20	235	13.6	-46	042	6.5	070	0.4	J2	282	4.11	Sail	1019.34	50 34.992
10-May-18 18:59	236	14.0	(-8°)	042	6.3	354	0.2	J2	246	2.70	Sail	1019.44	50 35.806
10-May-18 19:32	238	14.5	(38°)	042	6.3	264	0.5	J2	204	2.40	Sail	1019.55	50 34.658
10-May-18 19:55	238	14.8	42	042	6.4	241	0.5	J2	200	1.97	Sail	1019.67	50 32.457
10-May-18 20:13	239	14.8	(-19°)	042	6.4	230	0.5	J2	255	2.52	Sail	1019.75	50 30.593
10-May-18 20:39	240	15.6	97	160	8.0	231	1.4	J2	153	3.22	Sail	1019.81	50 29.901
10-May-18 21:03	243	14.3	97	160	7.9	246	0.9	A0	153	3.22	Sail	1019.92	50 27.055
10-May-18 21:28	242	12.3	93	161	7.5	259	0.5	A0	153	3.22	Sail	1019.90	50 24.217
10-May-18 21:55	240	11.1	88	042	7.2	262	0.8	A0	158	3.32	Sail	1019.87	50 21.387
10-May-18 22:25	237	10.0	86	042	7.0	266	1.2	J1	160	3.38	Sail	1019.80	50 18.327
10-May-18 22:56	229	8.9	85	044	6.8	264	1.3	J1	153	3.27	Sail	1019.72	50 15.181
10-May-18 23:29	219	7.9	77	045	6.3	266	1.3	J1	153	3.27	Sail	1019.62	50 12.288
11-May-18 00:04	200	7.4	64	045	5.8	247	1.5	J1	152	3.27	Sail	1019.52	50 09.412
11-May-18 00:44	180	6.5	76	044	5.3	240	1.4	J1	115	3.07	Sail	1019.38	50 06.554
11-May-18 01:30	162	6.3	(12°)	044	4.2	274	1.2	J1	169	4.05	Sail	1018.99	50 05.322
11-May-18 02:22	131	12.5	(-42°)	042	6.1	090	1.3	J2	159	3.53	Sail	1018.35	50 01.357
11-May-18 02:57	130	11.9	(-19°)	042	6.0	089	0.9	J2	139	3.05	Sail	1017.93	49 58.090

And here is the detail, including which sail to use. Port tack is in red and starboard tack is in green.

There are programs that work out the line you need to lay (lay line) to make the next mark. This is not just useful for racers, cruisers can use it too. For 'Lay line', the cruiser will be thinking 'Headland'. When do I need to tack to make the headland?



▶ *This is B&G's SailSteer program showing us when to tack to make the next mark.*

HOW THE CHART PLOTTER KNOWS WHERE IT IS

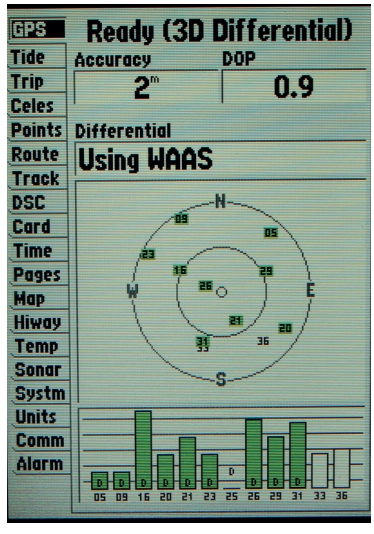
What is the chart plotter doing while it's warming up? Well, it is obviously not warming up. It doesn't need to warm up but it does need to think about things.

At the heart of a chart plotter is a Global Positioning System (GPS) and the first thing it needs to do is to find out where it is.

The many channels of the GPS receiver search the sky for satellite signals. Satellites transmit the exact time they send a signal. The GPS receiver knows the time the signal was received. By subtracting this from the time it was sent, the GPS receiver can tell how far away from the satellite it is. The GPS receiver also knows the exact position of each satellite in the sky when they sent their time signal and with the information from three satellites it can establish its position on Earth two-dimensionally. It requires a fourth satellite to get a 3D position, allowing for height.

The system the GPS uses to find its position is known as trilateration.

Modern GPS receivers are able to receive signals from the two existing worldwide satellite systems, the American Navstar and the Russian GLONAS. The Chinese have a system called BEIDOU, which I am sure will be accessible once they provide global coverage, due by 2020. And of course Europe has Galileo which is expected to be fully operational by 2020.



▲ *Green bars represent satellite signals received and strength.*