

RayTech

# RayTech Sail Racer Training



# Sail Racer

RayTech

- Sail Racer
  - Targeted toward the professional & high performance sailboat racer
  - Offers club sailors an edge over their competition
  - Sail Race Features:
    - DataTrak
    - Polars
    - Route Optimization
    - Pre Start display
    - Navigation Numbers



# Around the World, Alone...

RayTech



- Raymarine provides Around Alone with total tracking capabilities for all competitors.
  - Around Alone's race management system is based on RayTech Navigator technologies.
- Raymarine is sponsoring Brad Van Liew, and Tommy Hilfiger FREEDOM AMERICA.
  - Totally outfitted with Raymarine electronics including radar, chart plotter, GPS, autopilot, instruments, VHF, and RayTech Sail Racer.

# Sail Racer Modules

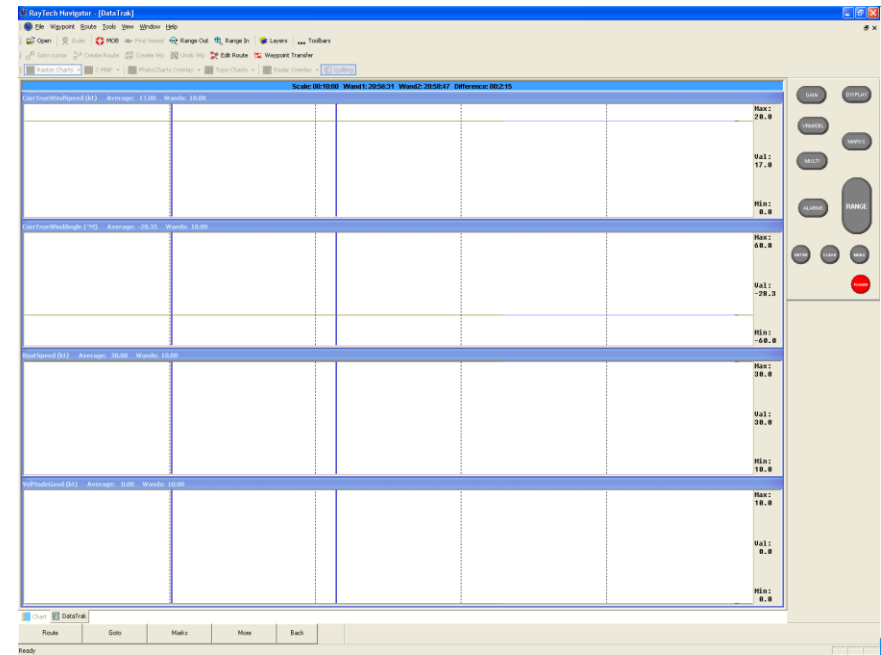


TOMMY HILFIGER *Freedom America*

# Data Track

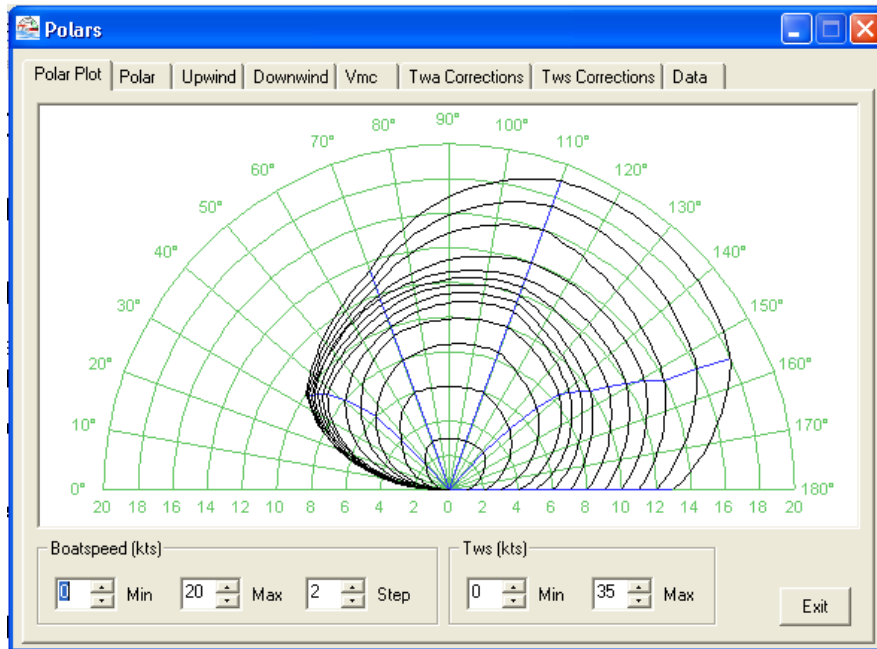
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- Allows any of the vessel's instrument channels to be monitored by the system and displayed as a time-based graph
- Any data that is received from the instruments can be graphed and viewed either on its own or simultaneously with other instrument data.



# Polars

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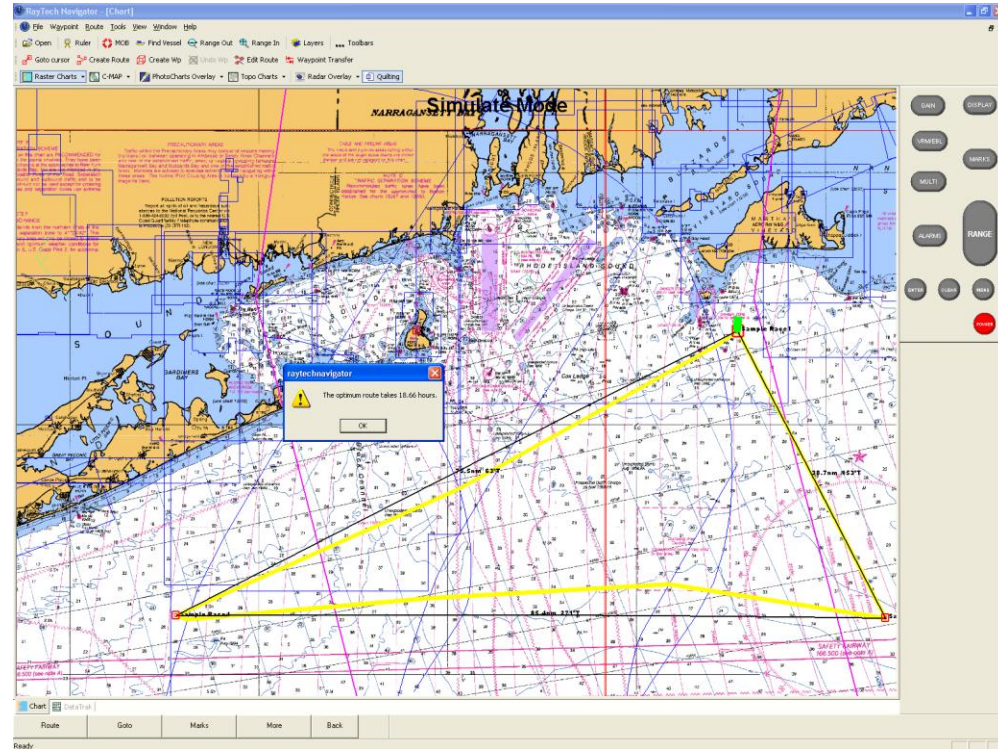
- Uses variables such as apparent / true / corrected wind angles, boat speed, heel / pitch to determine the heading to sail the boat in order achieve the best possible speed under varying wind conditions.
- Analysis results are displayed using several graphs that can be modified to suit individual needs.



# Route Optimization

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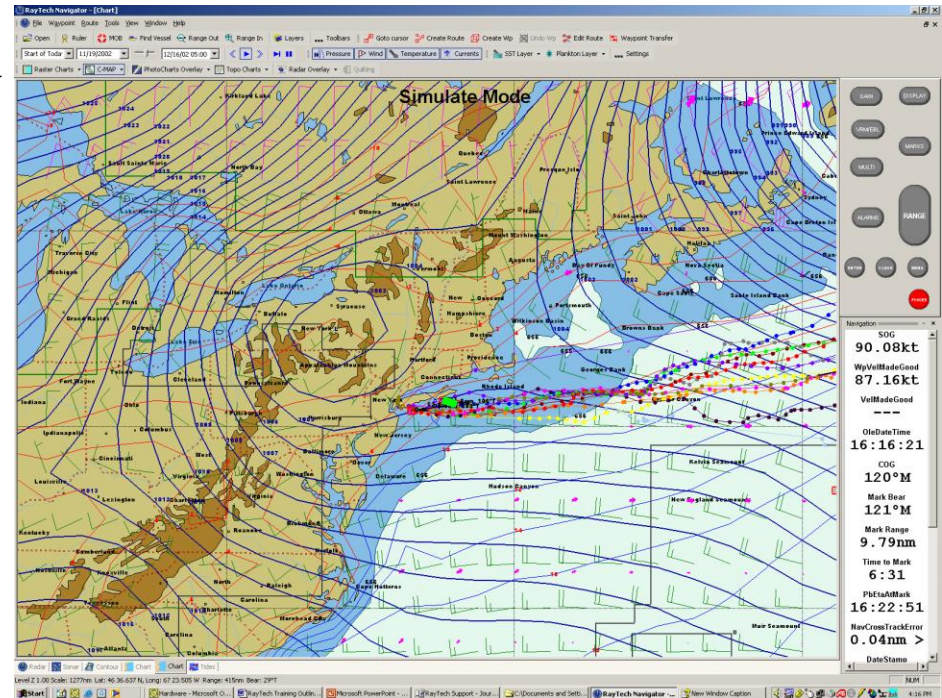
- Determines ideal route based upon:
  - ocean current
  - wind speed and direction
  - polar characteristics of vessel
- Plots route on the chart that you desire.



# Advanced Weather Routing

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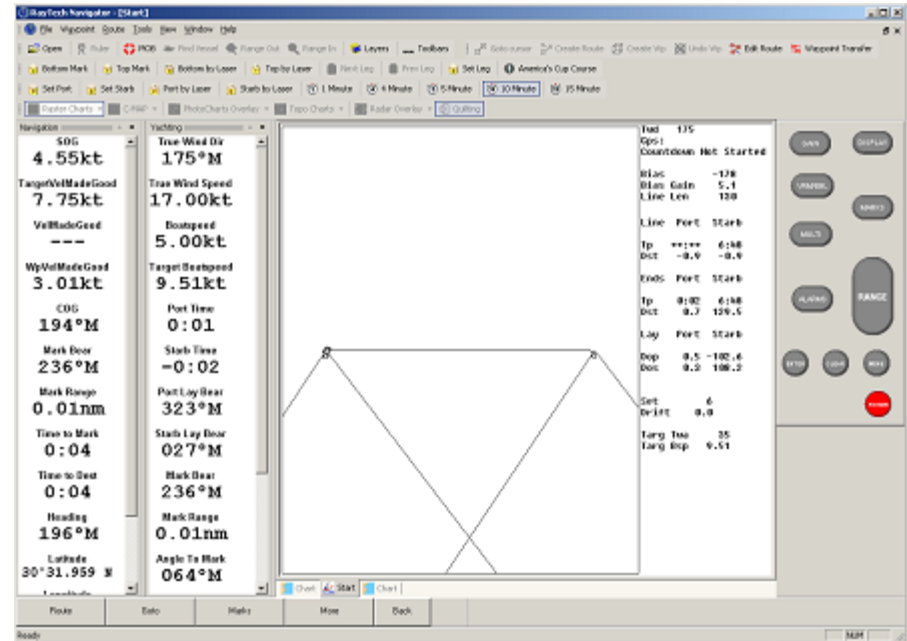
- Detailed 7-day animated weather files includes:
  - Surface pressure
  - Wind speed/direction
  - Surface temperature
- Text-based advisories:
  - North American coastal regions
  - Offshore forecasts & advisories.





# RayTech

- Provides graphical view starting area including:
  - 2 Start marks
  - Laylines
  - Vessel position relative to line
  - Track
  - Starting numbers
- Laser range finder support
- Tactical Data
  - Line bias in degrees
  - Distance gained in boat lengths by being either the port or starboard end of starting line



# Pre-Start (cont'd)

RayTech

- Time to the line
- Time to each end of the line on both tracks
- Accurate layline information:
  - Are we going to lay the Port end?
  - How many boat lengths are we below the starboard layline?

```
Twd 175
Gps:None
Countdown Not Started

Bias -178
Bias Gain 5.1
Line Len 130

Line Port Starb

Tp **:** **:**
Dst -0.1 -0.1

Ends Port Starb

Tp 0:01 9:02
Dst 0.3 129.3

Lay Port Starb

Dop 0.3 -102.1
Dos -0.2 107.1

Set 6
Drift 0.0

Targ Twa 36
Targ Bsp 6.76
```

# Navigation Numbers

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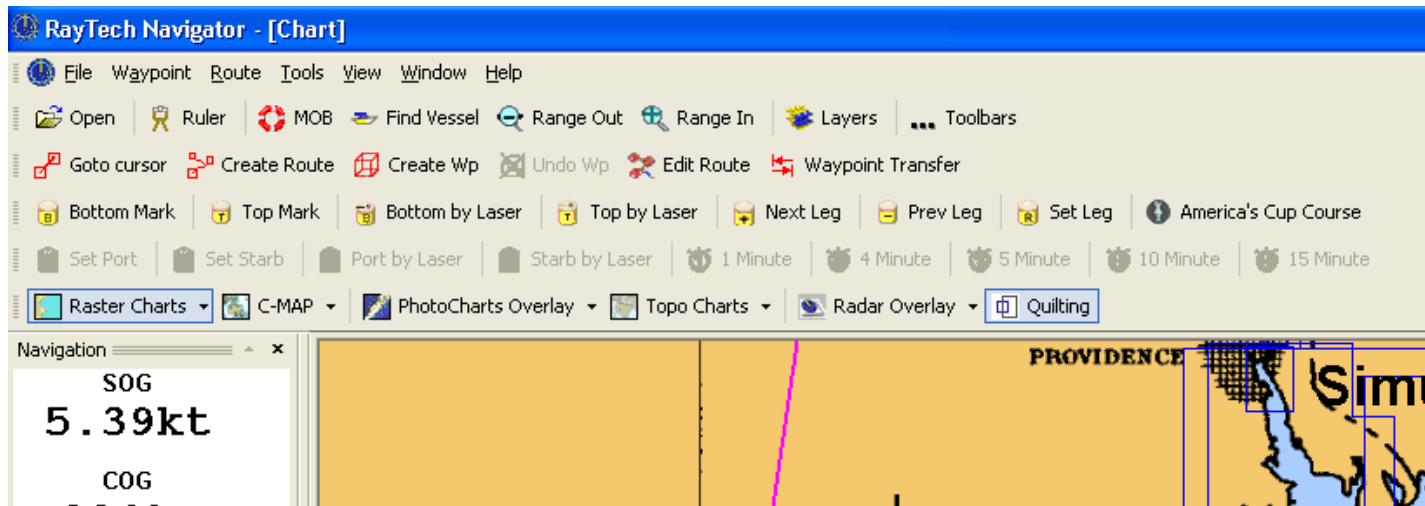
- Enables racer to quickly display detailed navigation and instrument numbers on the screen.
- Tabs for major categories:
  - Laylines
  - Mark
  - What If
  - Next Leg
  - Numbers
  - Wind
  - Laser
  - VMC

- Raymarine Yacht Racing Numbers				
File Options Help				
Laylines	Mark	What If	Next Leg	Numbers
Wind Laser Vmc				
Boatspeed		Twa		
Actual	90.00	99		
Target	-9999.00	-9999		
Port		Starb	Total	
Time	-0:03	-0:00	-0:03	
Dist	-10.4	-0.3	10.1	
Bear	74	272	253	
Tack Ang		OTack	Mark	Twa
20358		235	80	

# Yacht Racing Toolbar

RayTech

- Dedicated toolbar for use with racing environments



- Enables racer to set marks and courses quickly and accurately based upon laser- and Radar-guided input





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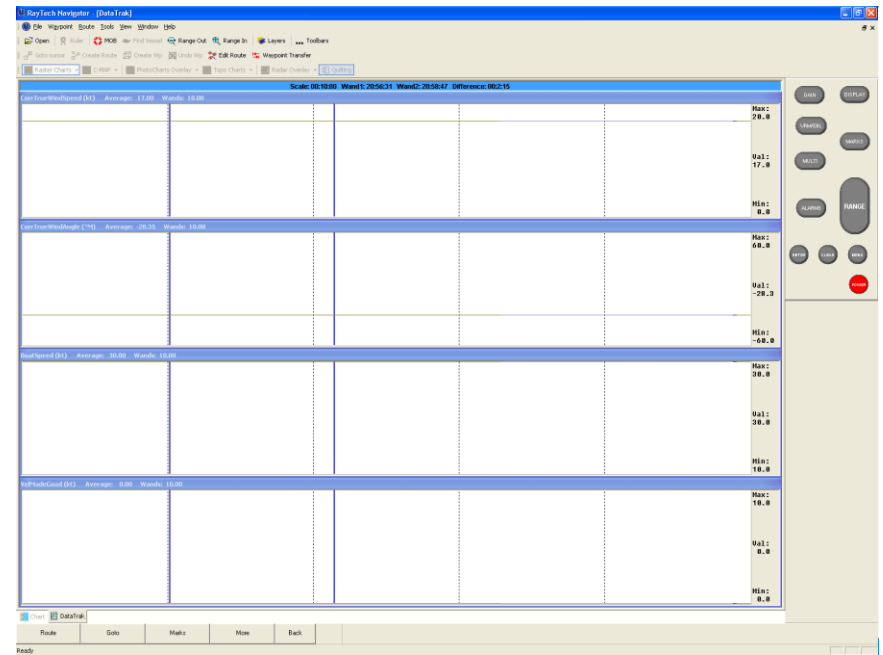
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# DataTrak

# DataTrak

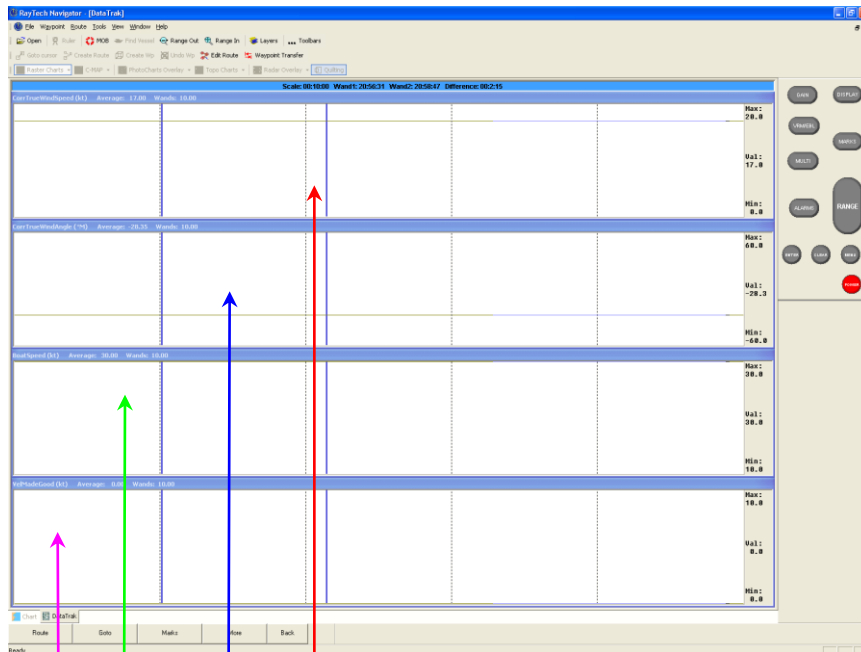
RayTech

- Allows any of the instrument channels monitored by the RayTech to be displayed as a time-based graph
- DataTrak is particularly useful for looking at:
  - Trends
  - Comparing instrument data
  - Averages
  - Real time data
- Performance data is manually extracted for use in your polars



# DataTrak (cont'd)

RayTech



- Multiple graphs permitted in each DataTrak window
- Use default DataTrak windows or create your own
- Graphs scroll from right to left (most recent data is on the right)

CorrTrueWindSpeed

CorrTrueWindAngle

BoatSpeed

VelMadeGood

# DataTrak Graphs

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- **AirTemp**  
Used to identify air temperature.
- **Awa Calibration**  
Apparent Wind Angle Calibration. Used to set the alignment of the masthead wand.
- **BoatSpdSOG**  
Contains two graphs. Boat speed and Speed over Ground.
- **Depth**  
Used to display the depth below the transducer.
- **HdgCOG**  
Contains two graphs. Heading and Course over Ground.
- **Polar Create**  
Used to identify good polar points.



# DataTrak Graphs (cont'd)

RayTech

- **SeaTemp**  
Contains two graphs. Sea temperature and Boat speed.
- **Standard**  
This is the standard template used by the system whenever creating a new DataTrak window. This should never be used opened or used by the user.
- **Target Compare**  
Used to compare your performance with your current targets.
- **Target Create**  
Used to identify good target points, when sailing upwind or downwind.
- **Targetsp**  
Contains three graphs. Corrected True Wind Speed, Target Boat speed and Boat speed.

# DataTrak Graphs (cont'd)

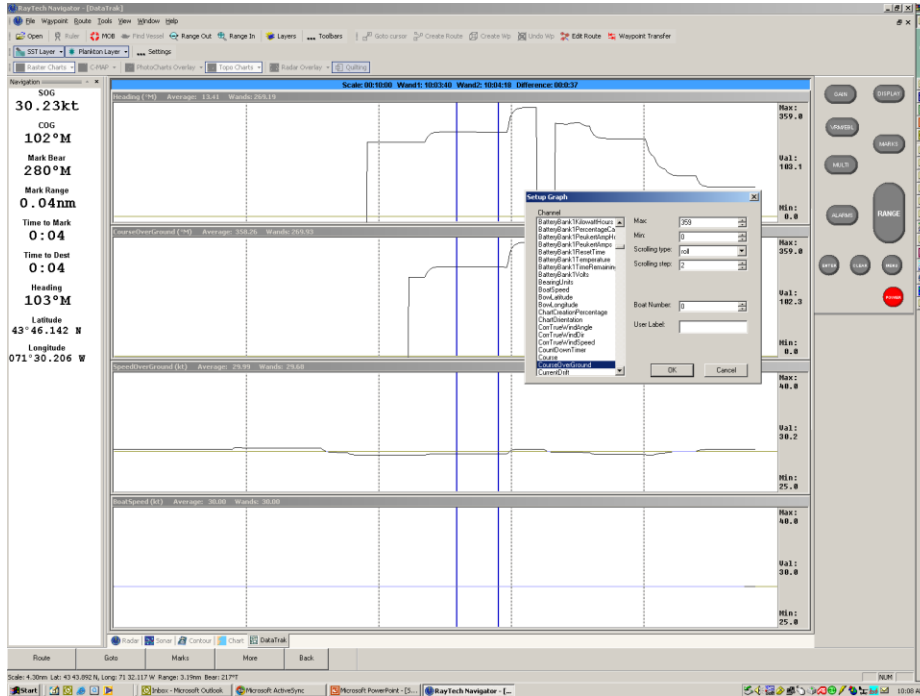
RayTech

- **Targetan**  
Contains three graphs. Apparent Wind Angle, Target True Wind Angle and Corrected True Wind Angle. Used to observe trends in Wind angle.
- **Tempdepth**  
Contains two graphs. Depth Below Transducer and Sea Temperature.
- **Tide**  
Used to establish tide set and drift.
- **True Wind**  
Contains two graphs. True Wind Direction and True Wind Speed. Used to observe trends in wind direction and speed.

# Using DataTrak

RayTech

- Right click to add graph or change timescale
- Double click the left mouse button key to bring up Setup Graph dialog
  - Select a channel
  - Select min/max values
  - Select scroll type
    - None
    - Expand Follow
    - Expand Symmetrical
    - Roll
  - Select scroll step
  - Select boat number
  - Enter label



# Using DataTrak (cont'd)

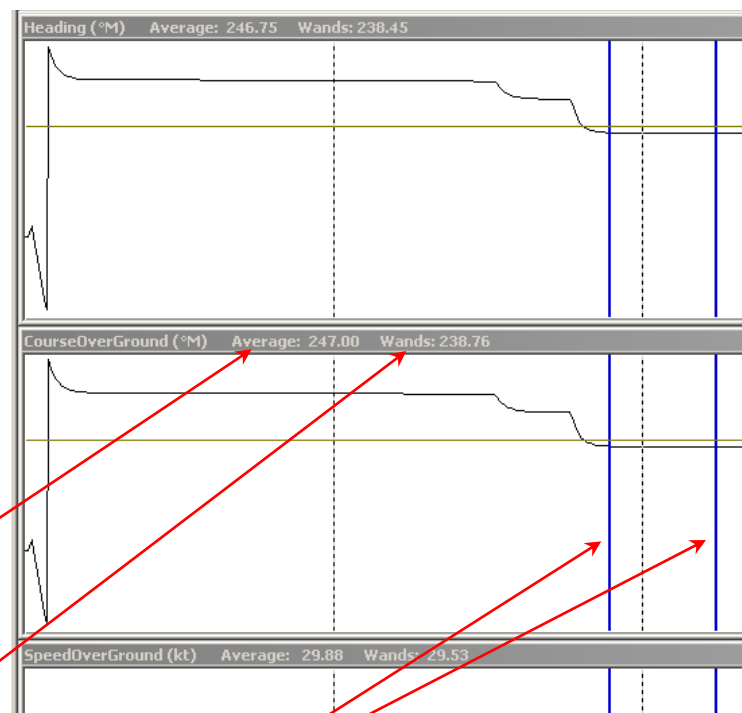
RayTech

- Left mouse button click to position wands to bound segment to be averaged
- Averages displayed adjacent to graph label

Average Over Time Interval

Average Within Wands

Wands







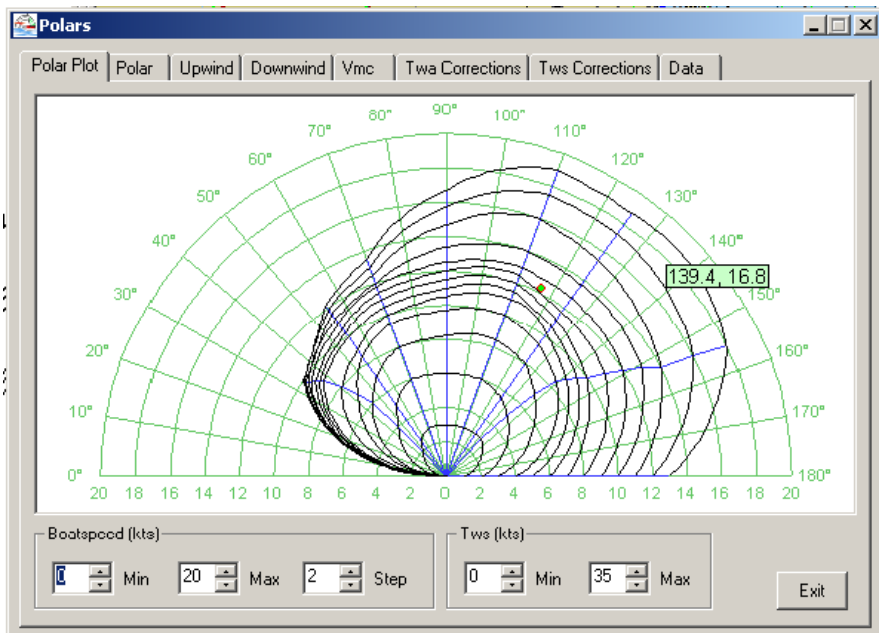
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# Polars

# Polar Plot Tab

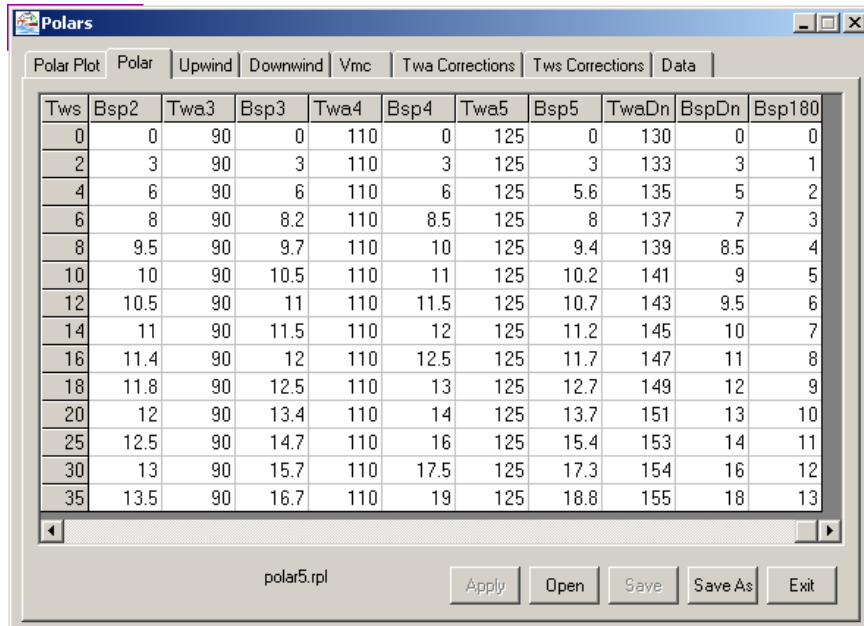
RayTech



- A polar plot presents a visual representation of boat speed in relation to True Wind Speed and True Wind Angle, and at times to a apparent wind angle
- Accuracy depends on volume and accuracy of boat- and weather-specific data entered
- Positioning cursor on plot will display wind angle/boat speed at that point

# Polar Tab

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The screenshot shows the 'Polar Tab' window with a menu bar (Polar Plot, Polar, Upwind, Downwind, Vmc, Twa Corrections, Tws Corrections, Data) and a data table. The table has columns: Tws, Bsp2, Twa3, Bsp3, Twa4, Bsp4, Twa5, Bsp5, TwaDn, BspDn, Bsp180. The data is as follows:

Tws	Bsp2	Twa3	Bsp3	Twa4	Bsp4	Twa5	Bsp5	TwaDn	BspDn	Bsp180
0	0	90	0	110	0	125	0	130	0	0
2	3	90	3	110	3	125	3	133	3	1
4	6	90	6	110	6	125	5.6	135	5	2
6	8	90	8.2	110	8.5	125	8	137	7	3
8	9.5	90	9.7	110	10	125	9.4	139	8.5	4
10	10	90	10.5	110	11	125	10.2	141	9	5
12	10.5	90	11	110	11.5	125	10.7	143	9.5	6
14	11	90	11.5	110	12	125	11.2	145	10	7
16	11.4	90	12	110	12.5	125	11.7	147	11	8
18	11.8	90	12.5	110	13	125	12.7	149	12	9
20	12	90	13.4	110	14	125	13.7	151	13	10
25	12.5	90	14.7	110	16	125	15.4	153	14	11
30	13	90	15.7	110	17.5	125	17.3	154	16	12
35	13.5	90	16.7	110	19	125	18.8	155	18	13

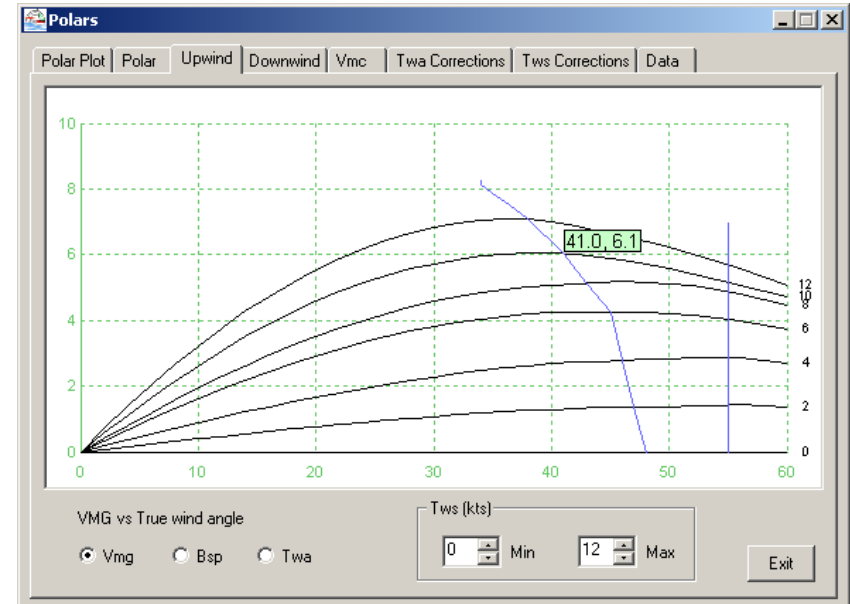
At the bottom, there is a status bar showing 'polar5.rpl' and buttons for 'Apply', 'Open', 'Save', 'Save As', and 'Exit'.

- Used to enter data for creating Polar, Upwind, Downwind, and Vmc graphs
- Reduced return on time investment when more than 6 radials are employed
- Polar files can be edited and manipulated with commonly available spreadsheet software. Strict adherence to format of the provided polar files must be observed by the user.

# Upwind Tab

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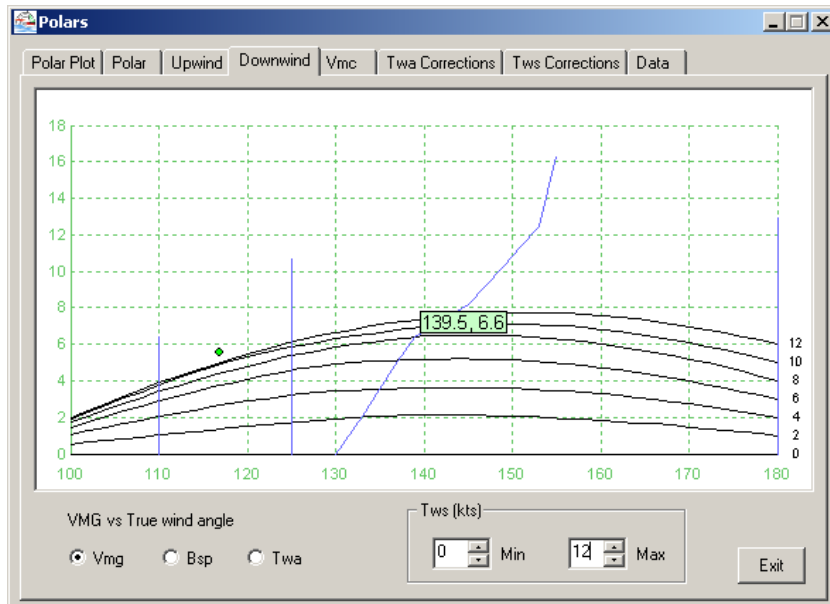
- Upwind plot calculates the best angle and boat speed when sailing upwind
- Displays
  - Vmg relative to Twa
  - Boat speed relative to Tws
  - Twa relative to Tws





# Downwind Tab

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- Downwind plot calculates the best angle and boat speed when sailing downwind
- Displays
  - Vmg relative to Twa
  - Boat speed relative to Twa
  - Twa relative to Tws

# Vmc Tab

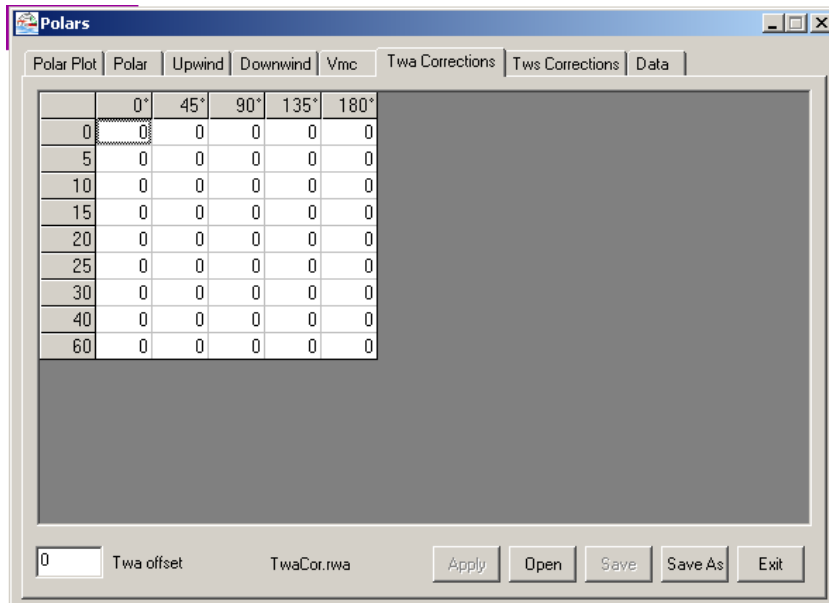
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- Upwind plot displays velocity made good toward a specific mark or target
- Vmc (w/respect to target) equals Vmg only when bearing to mark and wind direction are identical
- Used when a wind change is expected between present position and target
- Used primarily in long course racing



# Twa Corrections Tab

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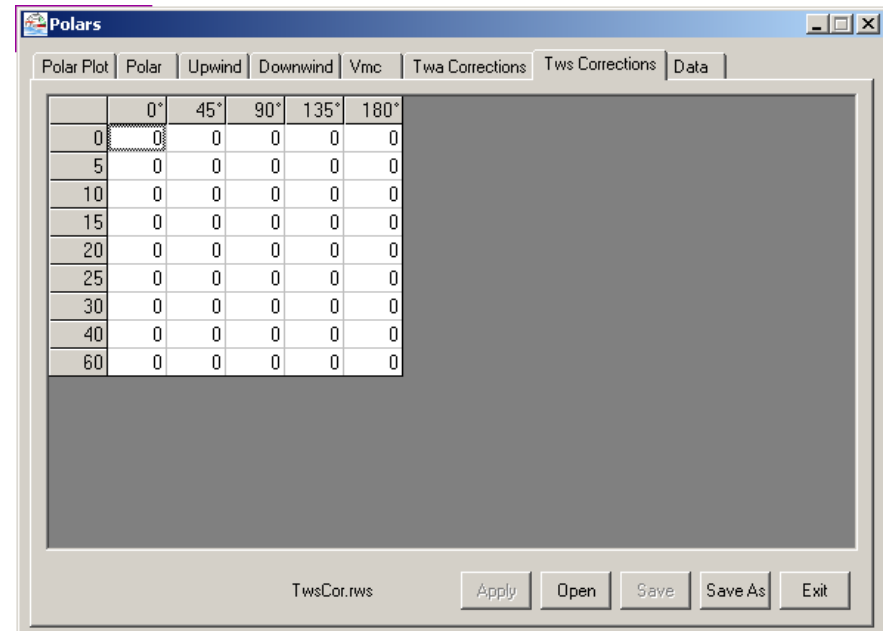


- Twa is derived from Awa and must be calibrated
- Awa is affected by
  - Mast top twisting
  - Airflow over sails & rigging
  - Wind Shear
- Calibration Process:
  - Perform 6 tacks/gybes each way
  - Halve the difference of the Twd before and after a tack
  - Add or subtract this value from the wind correction table for the corresponding wind strength

# Tws Corrections Tab

RayTech

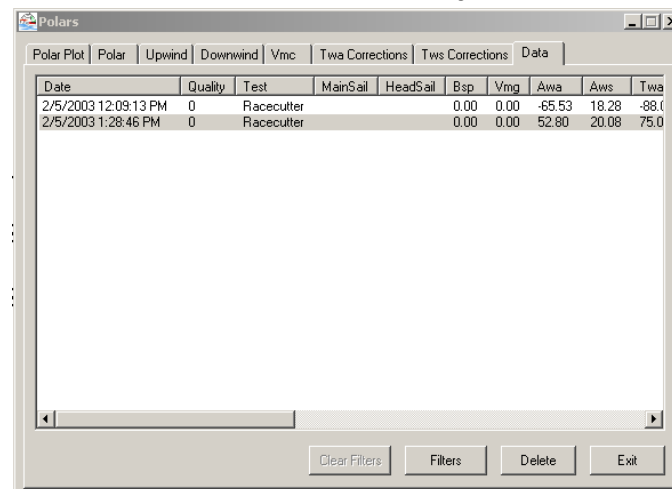
- Assumption: Tws upwind is correct value ...
- Tws downwind affected by:
  - Spinnaker
- Instruments must show same value for Tws upwind and downwind



# Data Tests Tab

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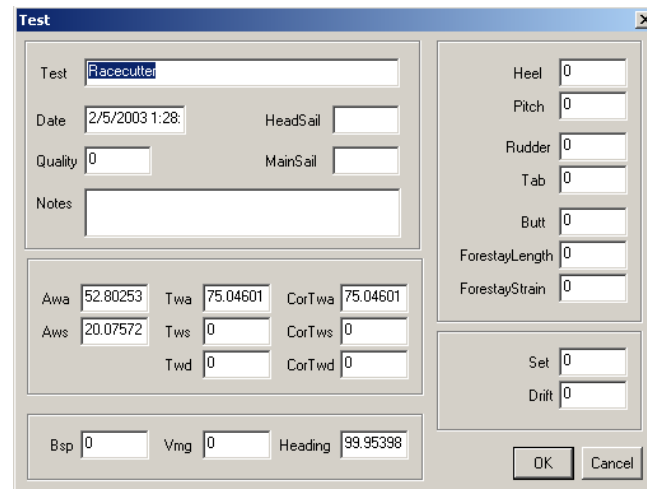
- Contains test data generated when Save To Database operation is performed in conjunction with a track plot
- Data can be qualified, filtered, then manually copied into the Polar tab and plotted



The screenshot shows the 'Polars' application window with the 'Data' tab selected. The window contains a table with the following data:

Date	Quality	Test	MainSail	HeadSail	Bsp	Vmg	Awa	Aws	Twa
2/5/2003 12:09:13 PM	0	Racecutter			0.00	0.00	-65.53	18.28	-88.0
2/5/2003 1:28:46 PM	0	Racecutter			0.00	0.00	52.80	20.08	75.0

At the bottom of the window are buttons for 'Clear Filters', 'Filters', 'Delete', and 'Exit'.

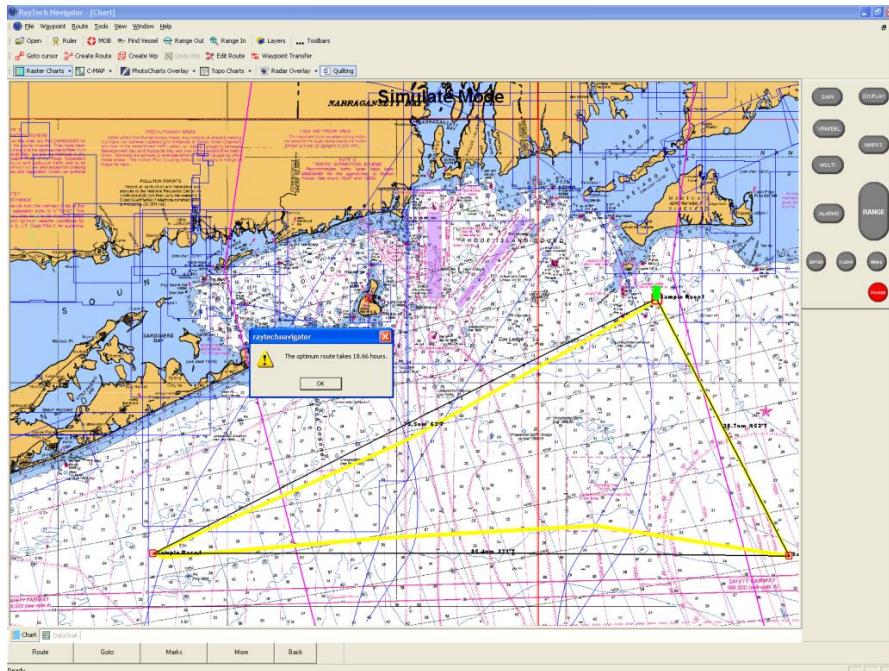


The screenshot shows the 'Test' dialog box with various input fields for test data. The 'Test' field is set to 'Racecutter'. The 'Date' field is set to '2/5/2003 1:28:'. The 'Quality' field is set to '0'. The 'Notes' field is empty. The 'HeadSail' and 'MainSail' fields are empty. The 'Awa' field is set to '52.80253', 'Twa' is set to '75.04601', and 'CorTwa' is set to '75.04601'. The 'Aws' field is set to '20.07572', 'Tws' is set to '0', and 'CorTws' is set to '0'. The 'Bsp' field is set to '0', 'Vmg' is set to '0', and 'Heading' is set to '99.95398'. The 'Heel' field is set to '0', 'Pitch' is set to '0', 'Rudder' is set to '0', 'Tab' is set to '0', 'Butt' is set to '0', 'ForestayLength' is set to '0', and 'ForestayStrain' is set to '0'. The 'Set' field is set to '0' and the 'Drift' field is set to '0'. The 'OK' and 'Cancel' buttons are at the bottom right.

# Route Optimization / Advanced Weather Routing

# Computing the Optimum Route

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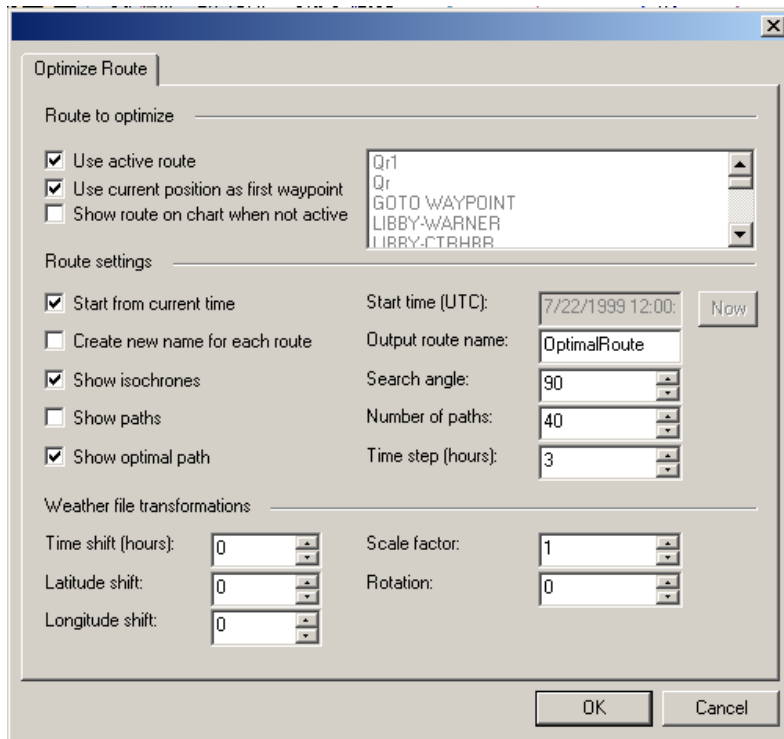


- Create a route or select an available route
- Download the latest weather file
- Select Tools-> Compute Optimum Route

# Optimum Route Dialog

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- Accessed via the Advanced button in Weather Layer dialog
- Route & 1<sup>st</sup> waypoint selection
- Route Settings
  - Start time, show toggles for isochrones, paths, and optimal path, name, search angle, number of paths, & time step
- Weather Transformations
  - Alters the forecasted weather used in route computation

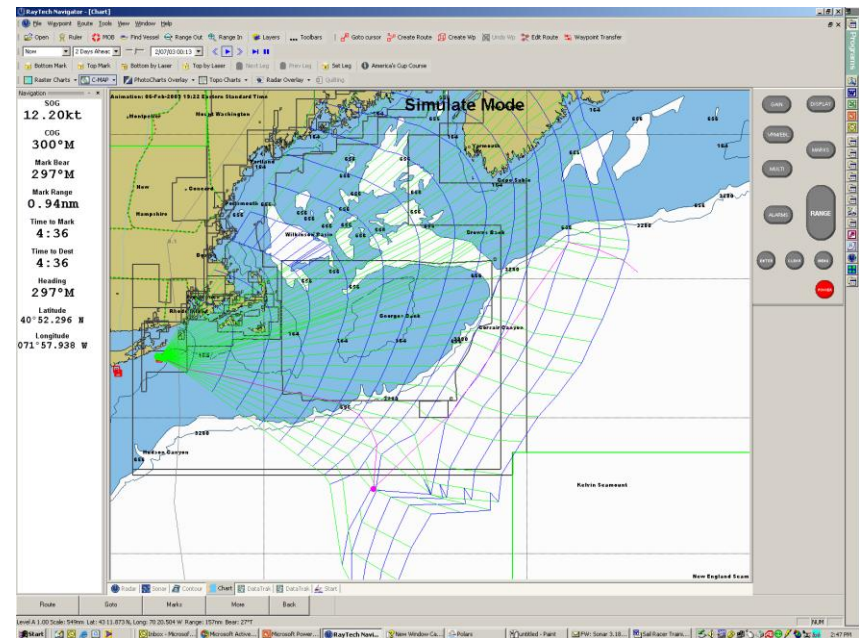




# Paths, Isochrones, and Animation

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- Select colors for paths and isochrones that will contrast with the chart
- Display the Animation Toolbar
- Isochrones show where the boat would be located when sailing different courses
- Paths used in the optimum route computation are shown
- Optimum route is shown and boat position can be animated



# Pre-Start

# RayTech

-

# Pre-Start Toolbar

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- Features:
  - Controls for starting line port & starboard marks when alongside or via laser sighting device
    - Controls will display an alert dialog.
    - Acknowledging the dialog will set the corresponding mark
    - Position is set when the control button (Set Port, Set Starb, etc.) is toggled.
  - Controls for synchronizing Pre-Start's countdown timer with the starting gun.
    - Controls will display an alert dialog.
    - Acknowledging the alert dialog will start the count down timer.
    - Timer is started when the acknowledging the alert dialog.

# Navigation Numbers

# Layline Numbers

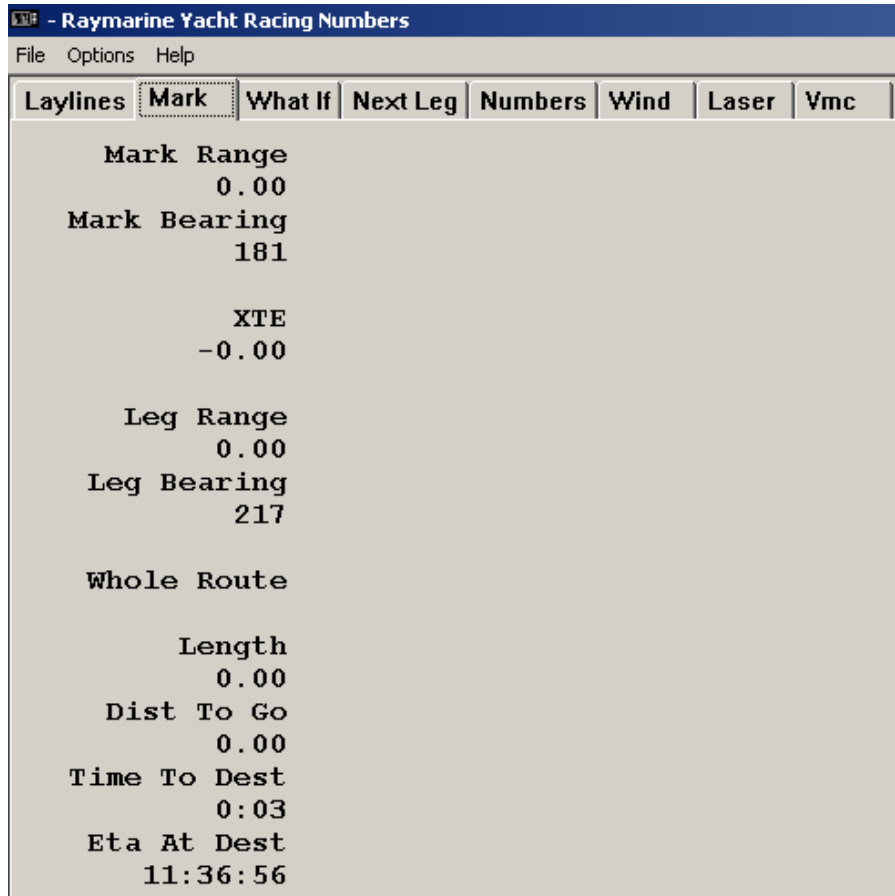
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- Boat Speed
  - Actual & Target
- True Wind Angle
  - Actual & Target
- Port Layline/Starboard Tack
  - Time, Distance, Bearing
- Total
  - Time, Distance, & Bearing to mark
- Tacking Angle
- Other Tack heading
- Mark True Wind Angle

Raymarine Yacht Racing Numbers						
File Options Help						
Laylines	Mark	What If	Next Leg	Numbers	Wind	Laser Vmc
Boatspeed		Twa				
Actual	3.00		57			
Target	9.51		35			
		Port	Starb	Total		
Time	0:00		-0:00	0:00		
Dist	0.0		-0.0	0.0		
Bear	205		134	325		
		Tack Ang	OTack	Mark	Twa	
		71	283		144	

# Mark Numbers

RayTech

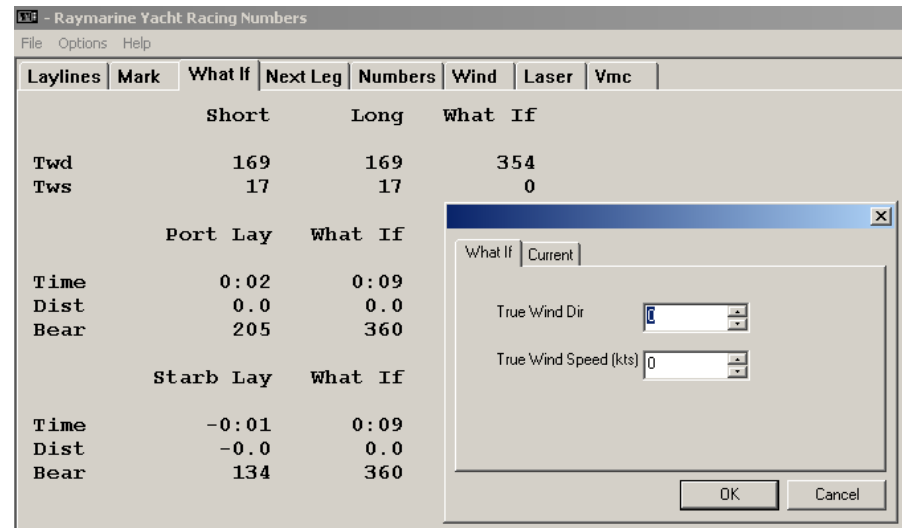


- Mark Range
- Mark Bearing
- Cross Track Error
- Leg Range
- Leg Bearing
- Whole Route:
  - Length
  - Distance to Go
  - Time To Destination
  - ETA At Destination

# What If Numbers

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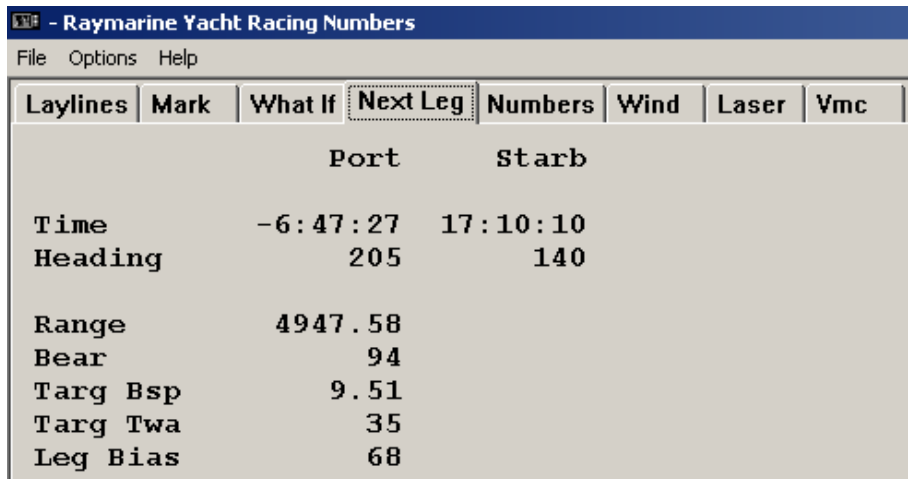
- Permits user to:
  - enter assumptions about what the wind will do
    - True Wind Direction
    - True Wind Speed
  - calculate alternate laylines
- 30 Second (Short) and 10 minute (long) averages for:
  - True Wind Direction
  - True Wind Speed
- Numbers updated using current position data
- Layline data from Laylines tab displayed for data comparison





# Next Leg Numbers

RayTech



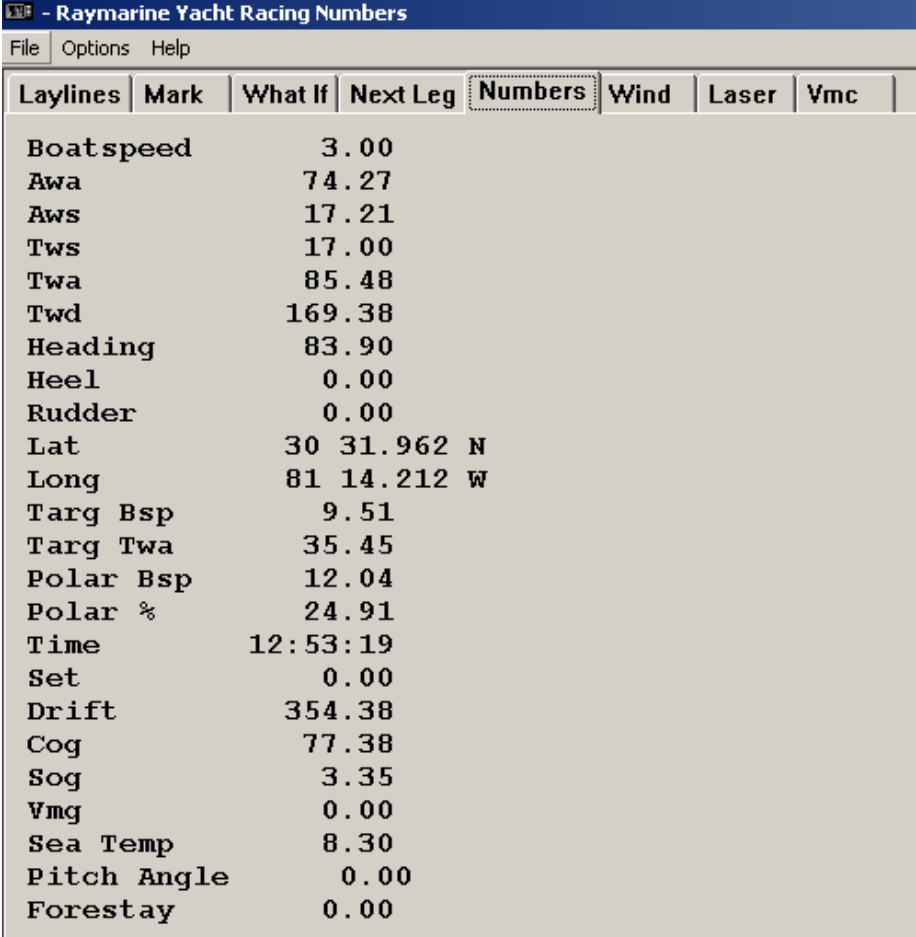
	Port	Starb
Time	-6:47:27	17:10:10
Heading	205	140
Range	4947.58	
Bear	94	
Targ Bsp	9.51	
Targ Twa	35	
Leg Bias	68	

- Time on Tack
  - Port & Starboard
- Tack Heading
- - Port & Starboard
- Leg Length
- Leg Bearing
- Target Boat Speed
- Target True Wind Angle
- Leg bias (True wind if heading directly at the mark)

# Instrument Numbers

RayTech

- Used to verify that GPS and instruments are functioning
- Information available:
  - Key Instrument Data
  - Internally Calculated Data

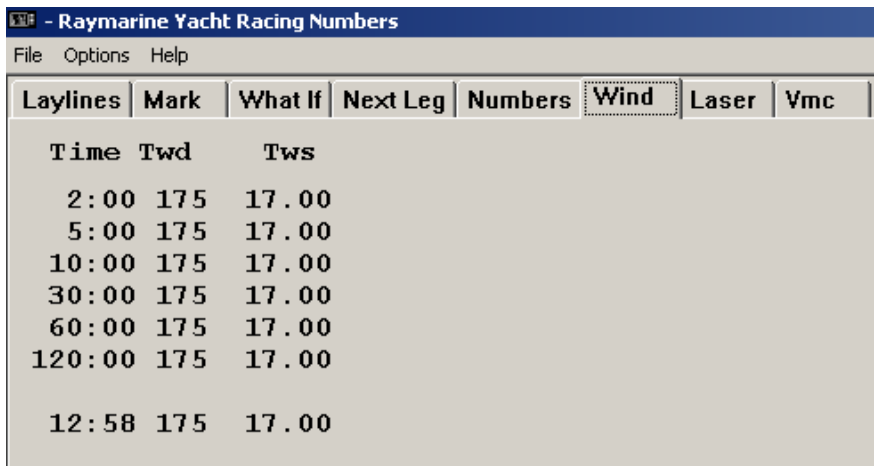


The screenshot shows the 'Raymarine Yacht Racing Numbers' software window. It has a menu bar with 'File', 'Options', and 'Help'. Below the menu bar is a tabbed interface with tabs for 'Laylines', 'Mark', 'What If', 'Next Leg', 'Numbers' (which is selected), 'Wind', 'Laser', and 'Vmc'. The main display area shows a list of instrument data with two columns: the instrument name and its value.

Boatspeed	3.00
Awa	74.27
Aws	17.21
Tws	17.00
Twa	85.48
Twd	169.38
Heading	83.90
Heel	0.00
Rudder	0.00
Lat	30 31.962 N
Long	81 14.212 W
Targ Bsp	9.51
Targ Twa	35.45
Polar Bsp	12.04
Polar %	24.91
Time	12:53:19
Set	0.00
Drift	354.38
Cog	77.38
Sog	3.35
Vmg	0.00
Sea Temp	8.30
Pitch Angle	0.00
Forestay	0.00

# Wind Numbers

RayTech



The screenshot shows the 'Raymarine Yacht Racing Numbers' application window. The 'Wind' tab is selected, displaying a table of wind data. The table has three columns: 'Time', 'Twd' (True Wind Direction), and 'Tws' (True Wind Speed). The data shows a constant wind direction of 175 and a constant wind speed of 17.00 across all time intervals from 2:00 to 12:58.

Time	Twd	Tws
2:00	175	17.00
5:00	175	17.00
10:00	175	17.00
30:00	175	17.00
60:00	175	17.00
120:00	175	17.00
12:58	175	17.00

- View wind averages over different periods
- Used to examine wind trending & shifts
- Samples:
  - True Wind Direction
  - True Wind Speed
  - 2 ,5 ,10 ,30 ,60 , & 120 minute samples
- Overall 5 minute average True Wind Speed and True Wind Direction

# RayTech

- [illegible]

# VMC Numbers

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- Strictly for use in large course yachting
- Shows relative Velocity Made Good on Course
- Compares current performance with straight line performance to mark
- Predicts optimal angle to sail for best speed of advance toward mark


Raymarine Yacht Racing Numbers						
File Options Help						
Laylines	Mark	What If	Next Leg	Numbers	Wind	Laser Vmc
		Twa	Bsp	Vmc	Delta	Hdg
Actual		-24	3.00	2.77		194
Polar		20	4.43	4.43	-1.66	167
Opt Vmc		38	6.95	5.69	-2.92	207

# Entering Baseline Polar Data

# Baseline Polars

RayTech

- Baseline polar data provides a starting point to develop custom polars
- Polars sources:
  - Yacht Designer
  - USSA
  - Velocity
  - Sailing Clubs



Hooligani b'Parke W50  
for Mile. C. Plaisant

27 Feb 1997  
A Performance Prediction by Velocity, 6514 41st Avenue, University Park, MD 20782, (301) 827-6254

PERFORMANCE Pg 1

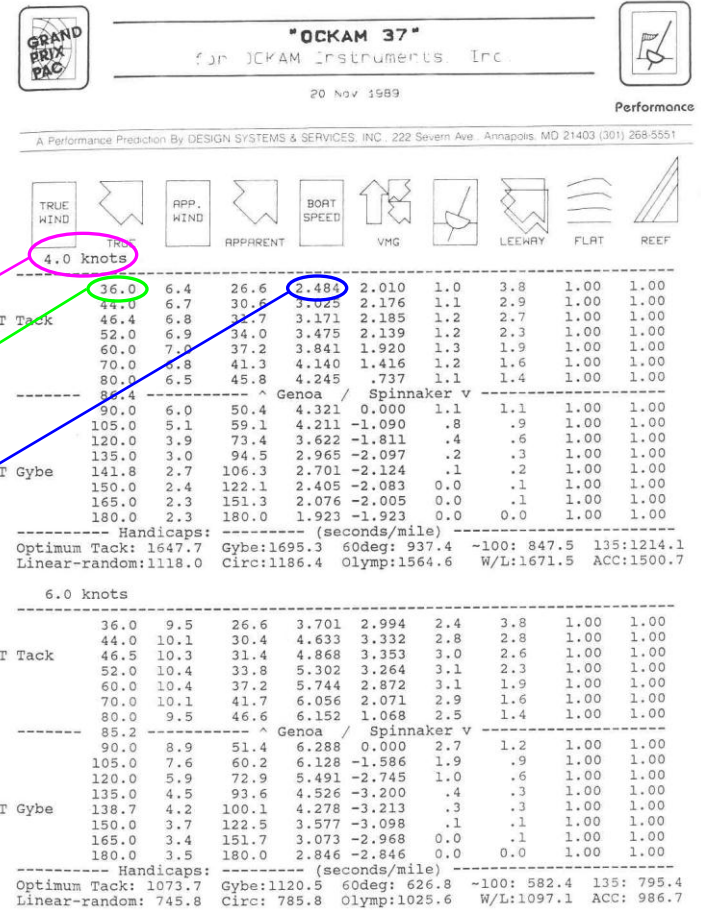
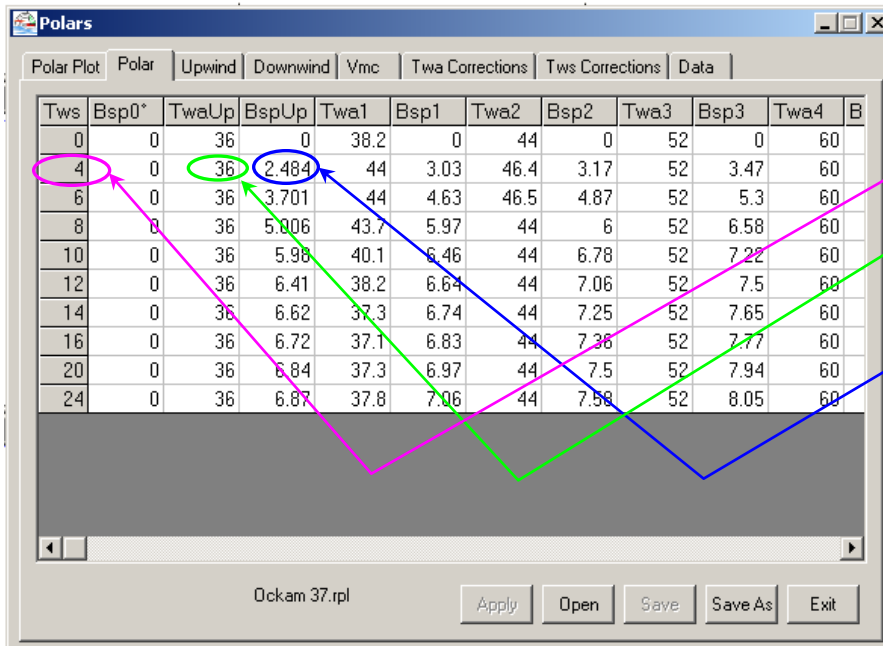
	TWA	AWS	AWA	VB	VMG	HL	LWY	FLT	RF
	kts			kts	kts			1/2->1	hgt
----- 2.0 knots True Wind Speed -----									
	36.0	3.9	18.8	1.881	1.522	.7	3.24	1.00	1.00
	44.0	4.2	21.7	2.276	1.637	.8	2.63	1.00	1.00
OPT Tack	46.1	4.2	22.4	2.366	1.642	.8	2.51	1.00	1.00
	52.0	4.3	24.2	2.602	1.602	.9	2.23	1.00	1.00
	60.0	4.4	26.6	2.858	1.429	1.0	1.93	1.00	1.00
----- 56.3 ----- Genoa / Spinnaker v -----									
	70.0	4.5	29.2	3.179	1.087	1.5	2.07	1.00	1.00
	80.0	4.3	31.9	3.369	.585	1.5	1.84	1.00	1.00
	90.0	4.1	34.8	3.448	0.000	1.4	1.63	1.00	1.00
	105.0	3.5	40.0	3.353	-.868	1.0	1.30	1.00	1.00
OPT Gybe	120.0	2.7	48.1	3.000	-1.500	.6	.95	1.00	1.00
	135.0	1.8	64.0	2.424	-1.714	.3	.62	1.00	1.00
	135.0	1.8	64.1	2.424	-1.714	.2	.57	1.00	1.00
	150.0	1.1	98.8	1.785	-1.546	.1	.24	1.00	1.00
	165.0	1.0	143.0	1.387	-1.339	0.0	.07	1.00	1.00
	180.0	1.0	180.0	1.236	-1.236	0.0	.03	1.00	1.00
----- Handicaps: ----- (seconds/mile) -----									
	Optimum Tack:	2192.6		Gybe:	2100.2	60deg:	1259.4	-100:	1063.6
	Linear-random:	1418.6		Circ:	1502.2	Olymp:	1990.7	W/L:	2146.4
	BELL Versions:	1510.3			:1565.8		:2119.8	AC92:	1922.6
								GPH:	413.0
----- 4.0 knots True Wind Speed -----									
	36.0	7.7	19.0	3.616	2.925	2.8	3.40	1.00	1.00
	44.0	8.2	22.0	4.399	3.164	3.4	2.73	1.00	1.00
OPT Tack	47.7	8.4	23.2	4.741	3.188	3.6	2.49	1.00	1.00
	52.0	8.6	24.4	5.105	3.143	3.9	2.27	1.00	1.00
	60.0	8.8	26.6	5.684	2.842	4.2	1.94	1.00	1.00
----- 56.5 ----- Genoa / Spinnaker v -----									
	70.0	8.9	29.0	6.370	2.175	7.4	2.05	1.00	1.00
	80.0	8.7	31.6	6.759	1.174	7.5	1.82	1.00	1.00
	90.0	8.2	34.5	6.919	0.000	6.8	1.61	1.00	1.00
	105.0	7.0	39.7	6.754	-1.748	4.7	1.29	1.00	1.00
OPT Gybe	120.0	5.4	48.0	6.012	-3.006	2.5	.95	1.00	1.00
	131.4	3.9	60.2	5.050	-3.338	1.2	.66	1.00	1.00
	135.0	3.5	66.2	4.697	-3.321	.9	.57	1.00	1.00
	150.0	2.3	101.1	3.472	-3.007	.2	.25	1.00	1.00
	165.0	1.9	143.8	2.727	-2.634	0.0	.08	1.00	1.00
	180.0	2.0	180.0	2.439	-2.439	0.0	.03	1.00	1.00
----- Handicaps: ----- (seconds/mile) -----									
	Optimum Tack:	1129.2		Gybe:	1078.5	60deg:	633.4	-100:	528.7
	Linear-random:	727.3		Circ:	782.5	Olymp:	1025.1	W/L:	1103.9
	BELL Versions:	794.5			: 827.1		:1134.5	AC92:	987.3
								GPH:	413.0

Velocity

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# Enter Baseline Polar Data

RayTech



DESIGN SYSTEMS

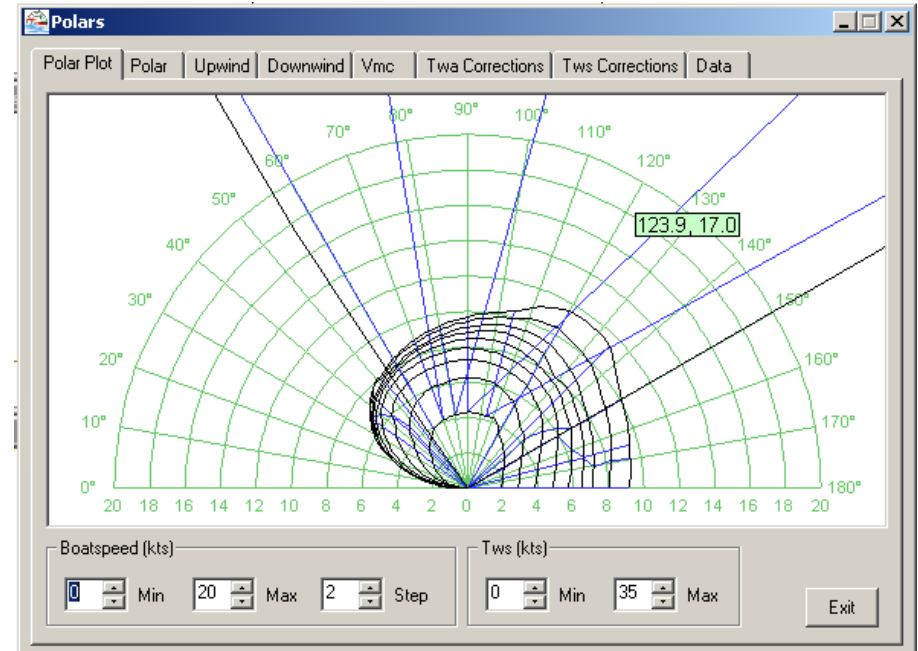
Raymarine  
ON BOARD



# Polar Data Entry Tips

RayTech

- Polars Data can be entered via RayTech or spreadsheet application (i.e. MS Excel)
- Users will want to consider the practical limit to radials ... most users will want no more than six.



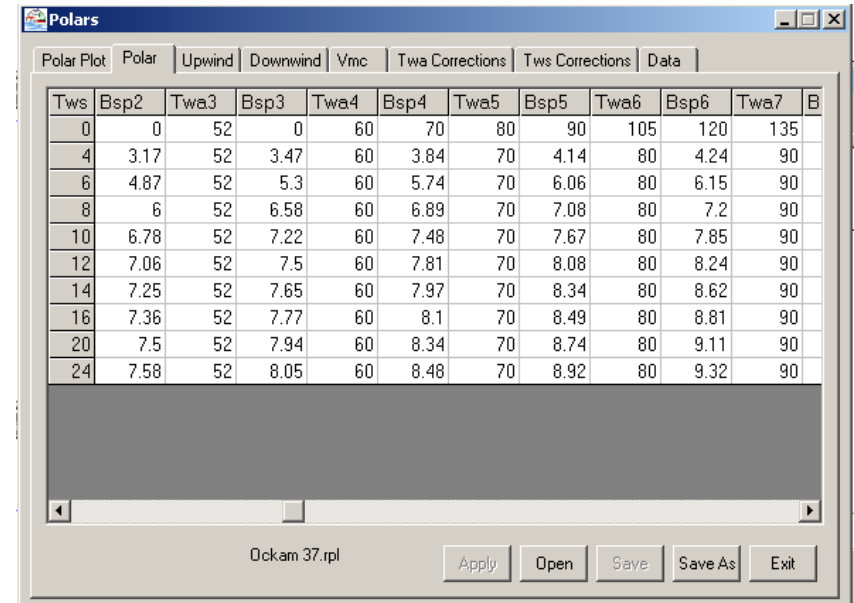
# Customizing Polars

## Upwind/Downwind Polars

# Upwind/Downwind Data Collection

RayTech

- Important to short course sailors
- When collecting data, ensure the following:
  - Collect data under conditions that provide steady wind
  - Collect data under conditions lacking wind sheer or gradient
  - Sail the boat in a consistent manner



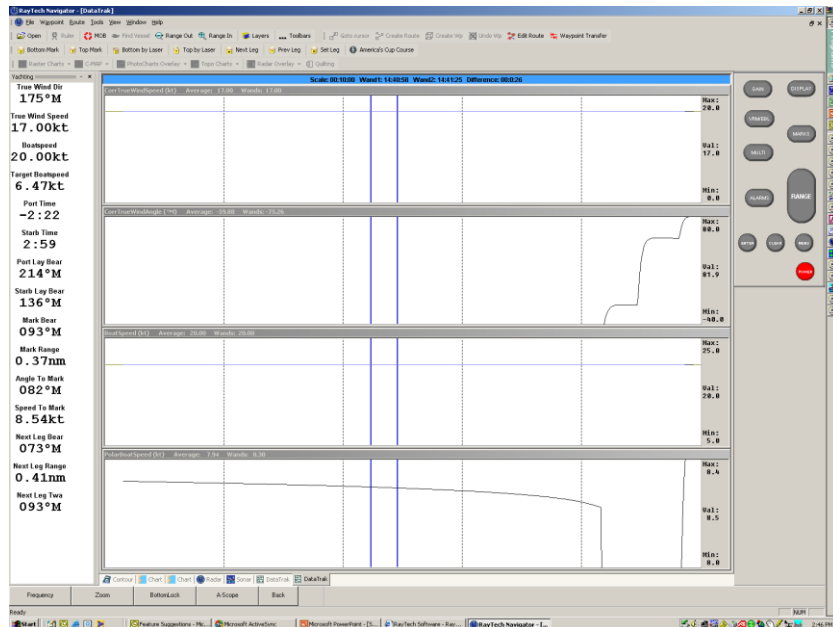
The screenshot shows the 'Polars' software window with the 'Data' tab selected. The table displays various sailing performance metrics for different wind speeds (Tws) and boat speeds (Bsp). The data is organized into columns for Tws, Bsp2, Twa3, Bsp3, Twa4, Bsp4, Twa5, Bsp5, Twa6, Bsp6, Twa7, and B. The values represent time in seconds.

Tws	Bsp2	Twa3	Bsp3	Twa4	Bsp4	Twa5	Bsp5	Twa6	Bsp6	Twa7	B
0	0	52	0	60	70	80	90	105	120	135	
4	3.17	52	3.47	60	3.84	70	4.14	80	4.24	90	
6	4.87	52	5.3	60	5.74	70	6.06	80	6.15	90	
8	6	52	6.58	60	6.89	70	7.08	80	7.2	90	
10	6.78	52	7.22	60	7.48	70	7.67	80	7.85	90	
12	7.06	52	7.5	60	7.81	70	8.08	80	8.24	90	
14	7.25	52	7.65	60	7.97	70	8.34	80	8.62	90	
16	7.36	52	7.77	60	8.1	70	8.49	80	8.81	90	
20	7.5	52	7.94	60	8.34	70	8.74	80	9.11	90	
24	7.58	52	8.05	60	8.48	70	8.92	80	9.32	90	

# Method #1 – Live Data Tracking

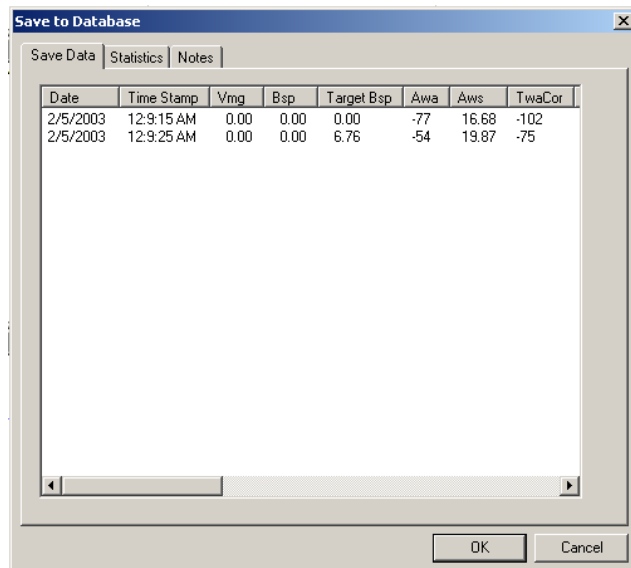
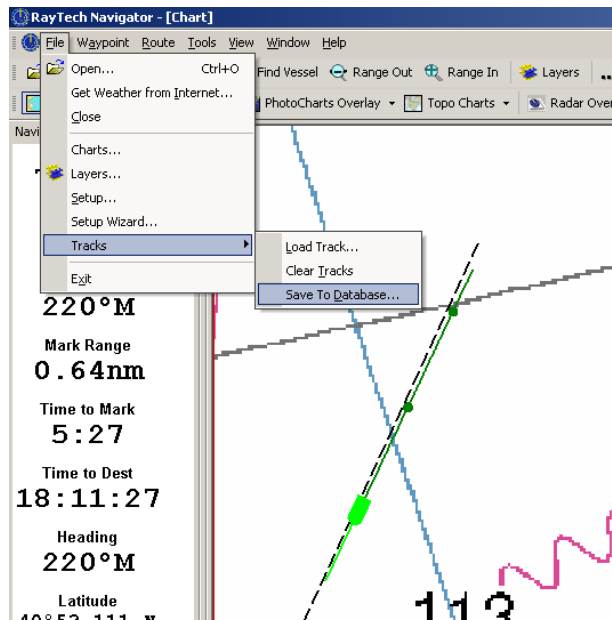
RayTech

- For large vessels
- Repeat as many times as necessary:
  - Identify a section of the DataTrack VMG graph showing good speed and stable data
  - Set the DataTrak wands to bound the sample section and obtain the desired averages
  - Update polar table using the averages calculated in the user specified time interval



# Method #2 – Historical

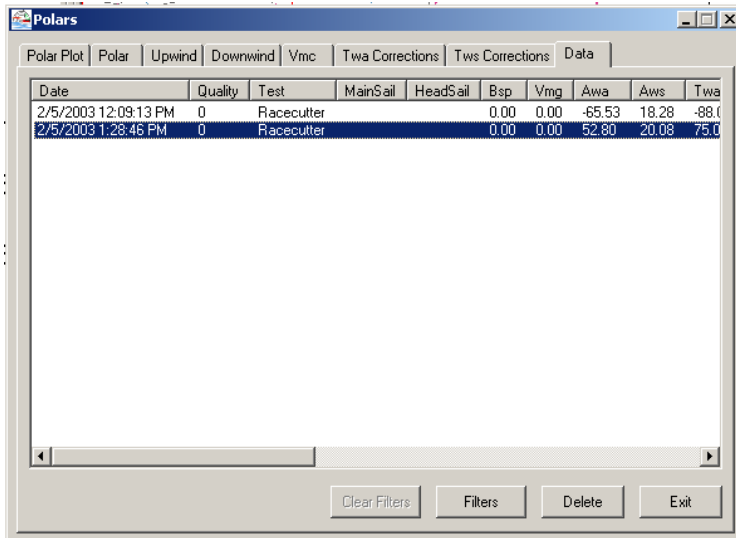
RayTech



- For smaller vessels
- Use track coloring to aid in identifying track segments
- Repeat as many times as necessary:
  - Perform left mouse clicks on the track behind the boat to bound the sample track segment
  - Select File->Tracks->Save to Database
  - In the Save to Database dialog:
    - Examine Min, Max, and Average values on the Statistics tab (deviation < 5°)
    - Select OK button
  - Update Polar table with desired data

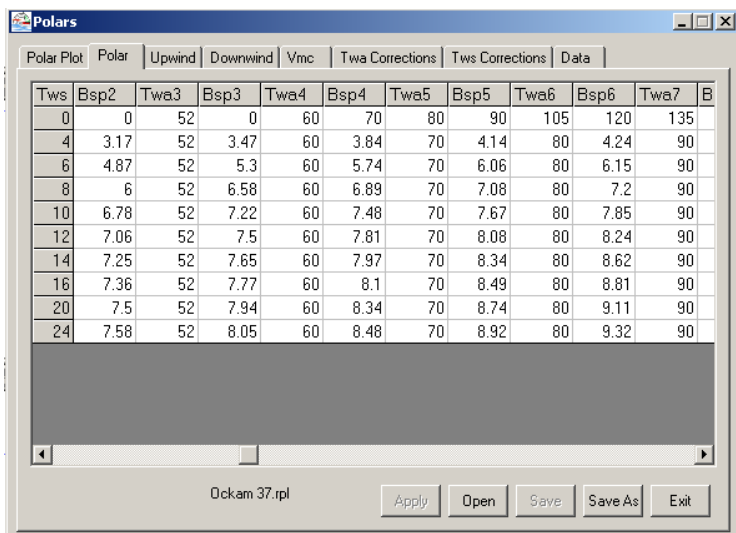
# Enter Upwind/Downwind Data

RayTech



Date	Quality	Test	MainSail	HeadSail	Bsp	Vmg	Awa	Aws	Twa
2/5/2003 12:09:13 PM	0	Racecutter			0.00	0.00	-65.53	18.28	-88.0
2/5/2003 1:28:46 PM	0	Racecutter			0.00	0.00	52.80	20.08	75.0

- Polars Data tab displays data saved to database
- Copy the Twa value from the Polars Data tab into the corresponding field in the Polar table
- Copy the Bsp from the Polars Data data into the corresponding field in the Polar table.



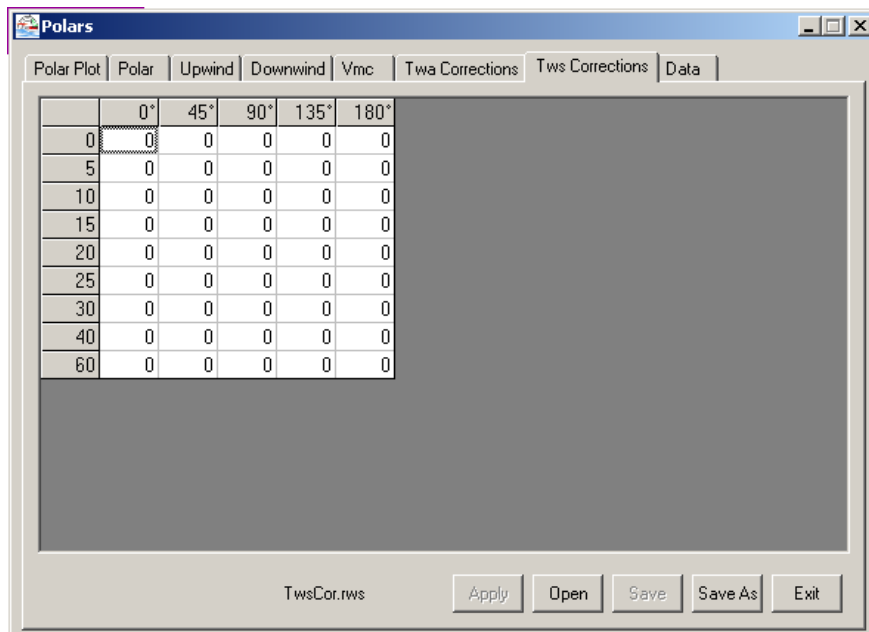
Tws	Bsp2	Twa3	Bsp3	Twa4	Bsp4	Twa5	Bsp5	Twa6	Bsp6	Twa7	B
0	0	52	0	60	70	80	90	105	120	135	
4	3.17	52	3.47	60	3.84	70	4.14	80	4.24	90	
6	4.87	52	5.3	60	5.74	70	6.06	80	6.15	90	
8	6	52	6.58	60	6.89	70	7.08	80	7.2	90	
10	6.78	52	7.22	60	7.48	70	7.67	80	7.85	90	
12	7.06	52	7.5	60	7.81	70	8.08	80	8.24	90	
14	7.25	52	7.65	60	7.97	70	8.34	80	8.62	90	
16	7.36	52	7.77	60	8.1	70	8.49	80	8.81	90	
20	7.5	52	7.94	60	8.34	70	8.74	80	9.11	90	
24	7.58	52	8.05	60	8.48	70	8.92	80	9.32	90	

# Customizing Polars Apparent Wind Angle (Awa) Calibration

# Awa Calibration

RayTech

- Corrects misalignment of mast head wand relative to the boat's centerline (varies day to day)
- Recommended Calibration Process:
  - Choose a day with no wind shear, minimal gradient, and steady wind
  - Sail upwind at optimum close-hauled angle
  - Perform 4-6 tacks upwind
  - Compare average Awa tack-to-tack using DataTrak – use half the difference between the wind angle on each tack
  - Enter the Awa offset into the Mast Head Unit Offset parameter within the instrument

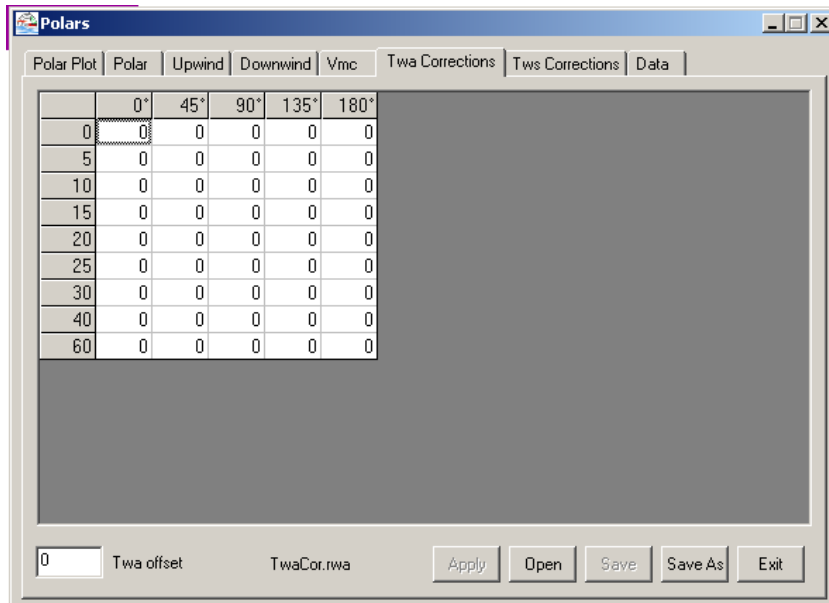




# True Wind Angle (Twa) Correction

# Twa Correction

RayTech



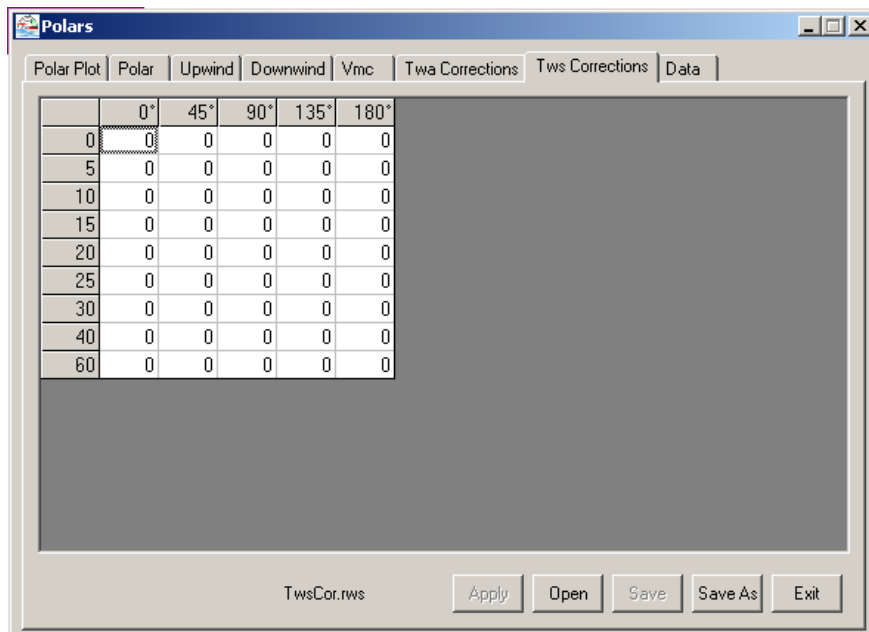
- Correction Process:
  - Perform 6 tacks/gybes each way
  - Halve the difference of the Twd before and after a tack
  - Add or subtract this value from the wind correction table for the corresponding wind strength

# True Wind Speed (Tws) Correction

# Tws Correction

RayTech

- Correction Process:
  - Measure wind speed upwind
  - Calculate the average using the wand method
  - Spinnaker up and boat stable downwind
  - Calculate the average using the wand method
  - The difference between the upwind and downwind averages should be subtracted from the corresponding entry in the 180° column of the Tws Corrections table.



# Appendix

RayTech

## Tactical Numbers



# How to Win a Race?

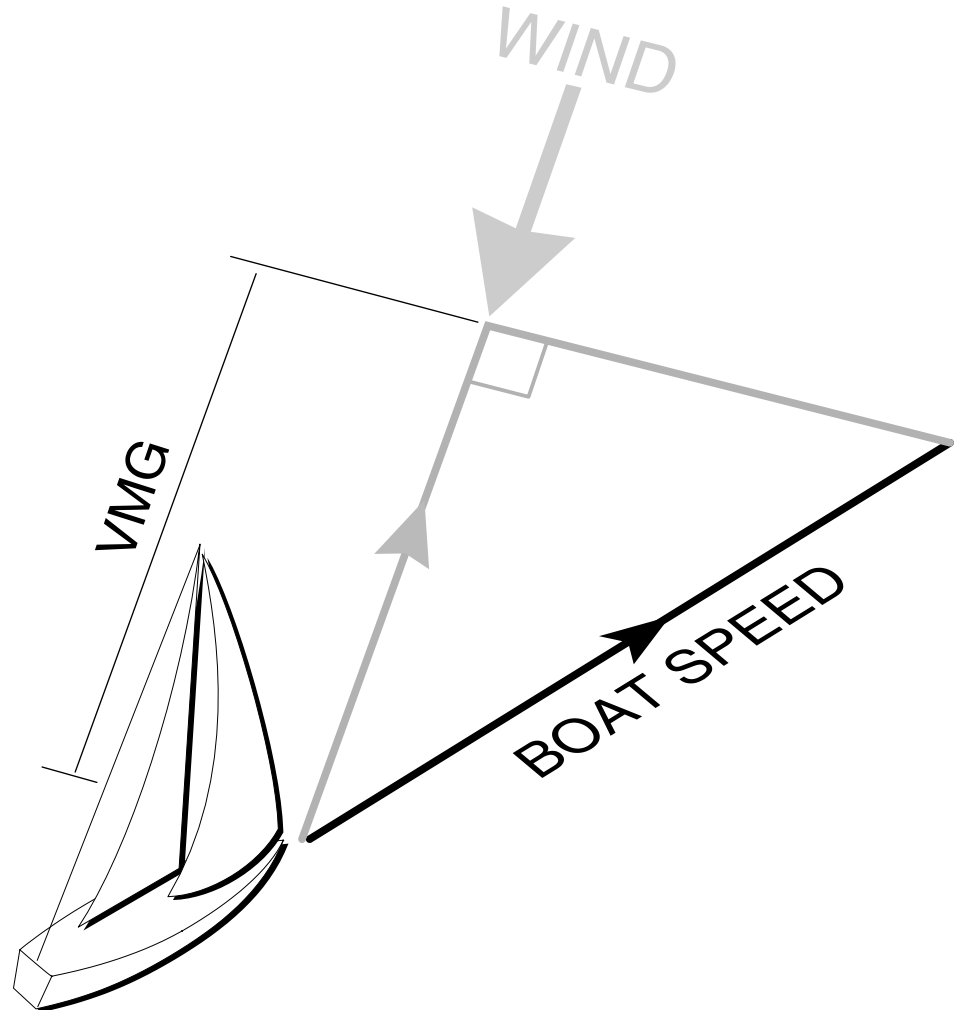
RayTech

- Maximize your Sailing Performance
- Have the best Sailing TACTICS
- You can work as hard as you like to get the best speed out of your boat, but if you're not sailing in the best direction, your efforts are wasted
- Maximize VMG
- Use wind shifts to your advantage

# What is VMG?

RayTech

- VMG = Velocity made good
- Component of Boat Speed parallel to the wind
- Measures progress made upwind / downwind
- Simple for instrument systems to calculate from Speed data and Wind data



# What's wrong with VMG?

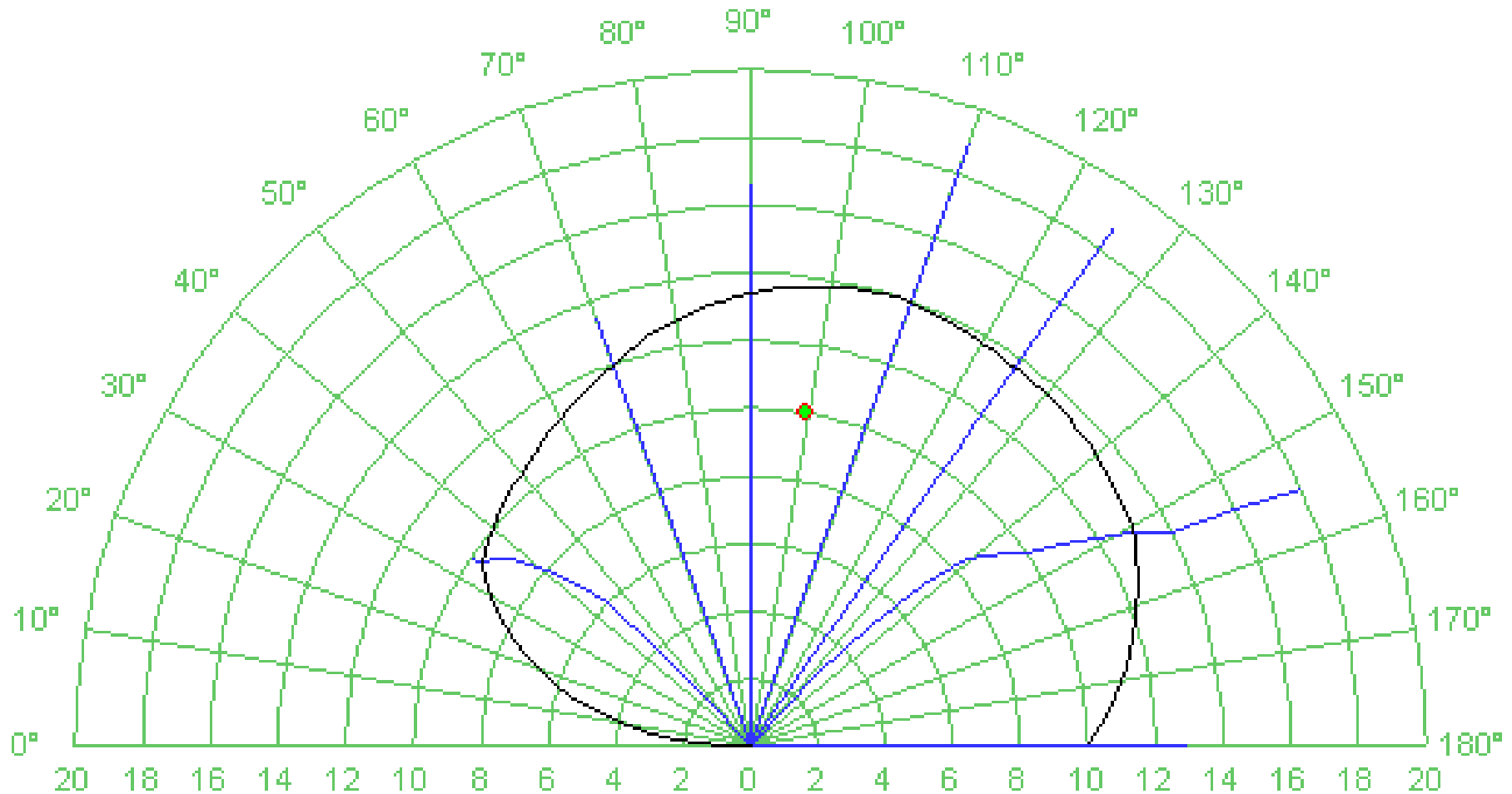
RayTech

- If your instruments tell you that VMG is 4.5 knots, you do not know whether you can increase it or not
- If you think that it can be increased, which direction to you turn to increase it ?
- VMG is misleading because of the boats momentum (pinching)



# Polars

RayTech



Note: The full polar will be symmetrical

# Polars (cont'd)

RayTech

- With data from the instruments, it is possible to work out True Wind Speed, and True Wind Angle
- Knowing your Wind Speed and Angle enables you to work out what speed the Polar thinks you should achieve (Polar Speed)
- You can compare Polar Speed with your current speed

# Polar Speed

---

RayTech

- RayTech, B&G, Ockam etc, can give you various polar speed info:
  - Polar Speed
  - Polar Speed Delta (diff from Boat Speed)
  - Polar Speed Percentage (% BS/PS)

# Polars

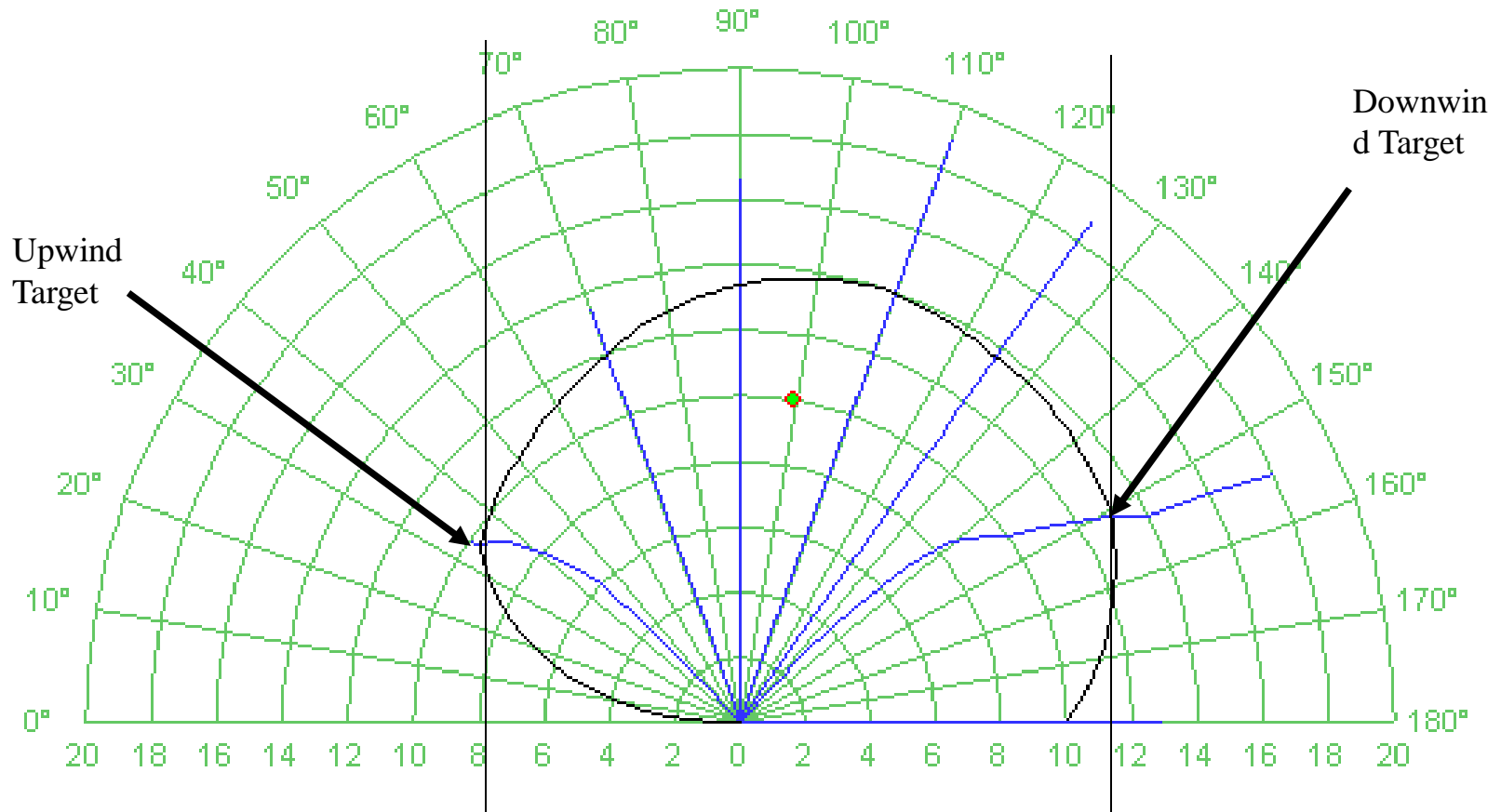
---

RayTech

- Polar Speed specifies what the boat should be capable of achieving at your current wind angle
- You can maximize the performance of the boat, but you are not steering the best course
- A good skipper/crew will be maximizing the boat speed at that wind angle anyway
- To sail the best course you need to use TARGETS

# Targets

RayTech



- It's easy to see on the Polar plot, the wind angles that give you the best VMG (wind)

# Targets (cont'd)

---

RayTech

- When you know the True wind speed, there is one Wind Angle upwind and one Wind Angle downwind when VMG is maximized
- These angles are called Target Wind Angles, and tactical software can tell you where they are:
  - Target Wind Angle
  - Target Wind Angle Delta

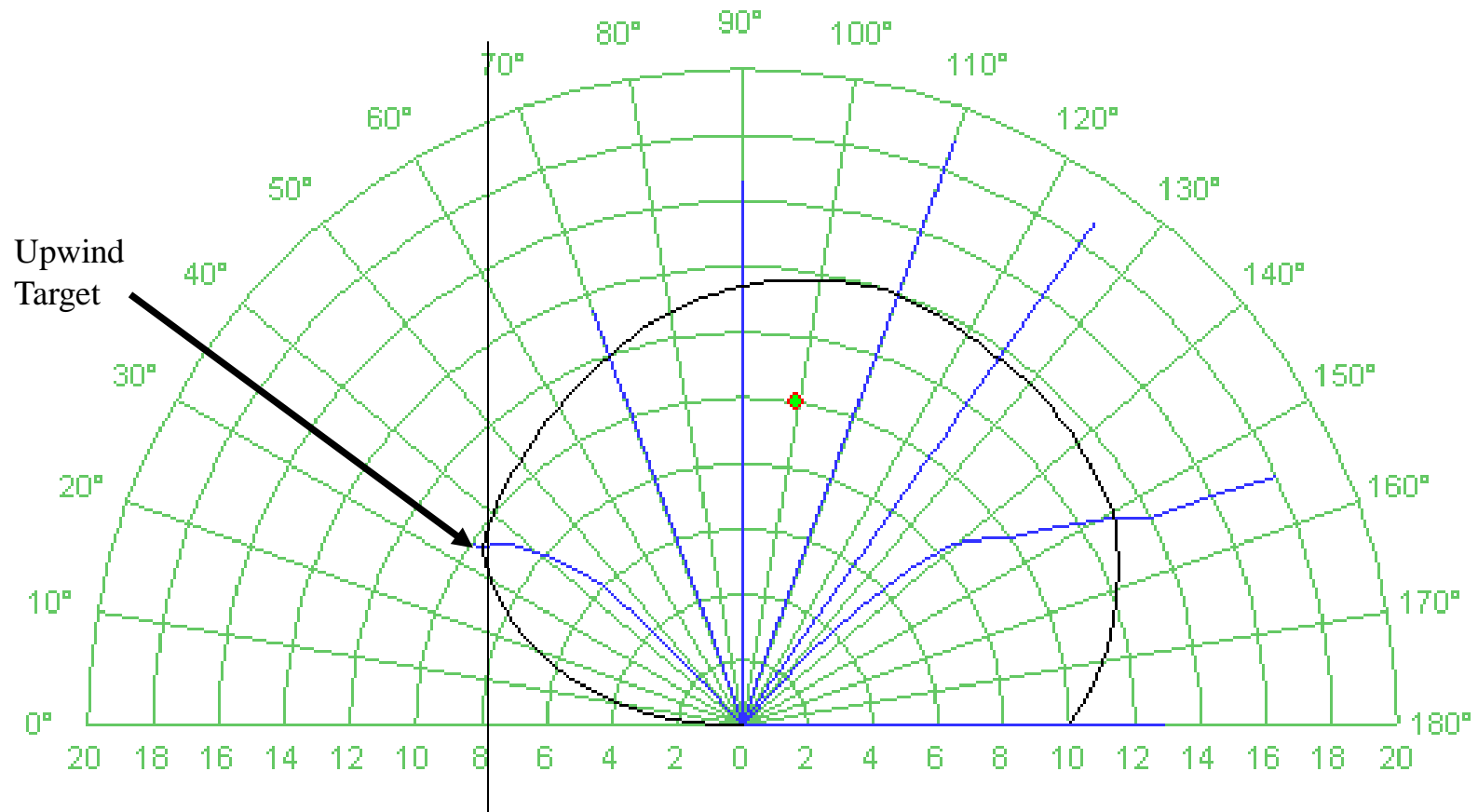
# Target Wind Angles

RayTech

- Steering to Target Wind Angle makes it extremely simple to sail the best course to maximize VMG
- Target Wind Angle is immune to momentum errors, as your current boat speed is not used to find the Target Wind Angle
- As the wind changes (in speed) Target Wind Angle will change instantly, so that you are always at the point of sail that should give maximum VMG

# Target Boat Speed

RayTech

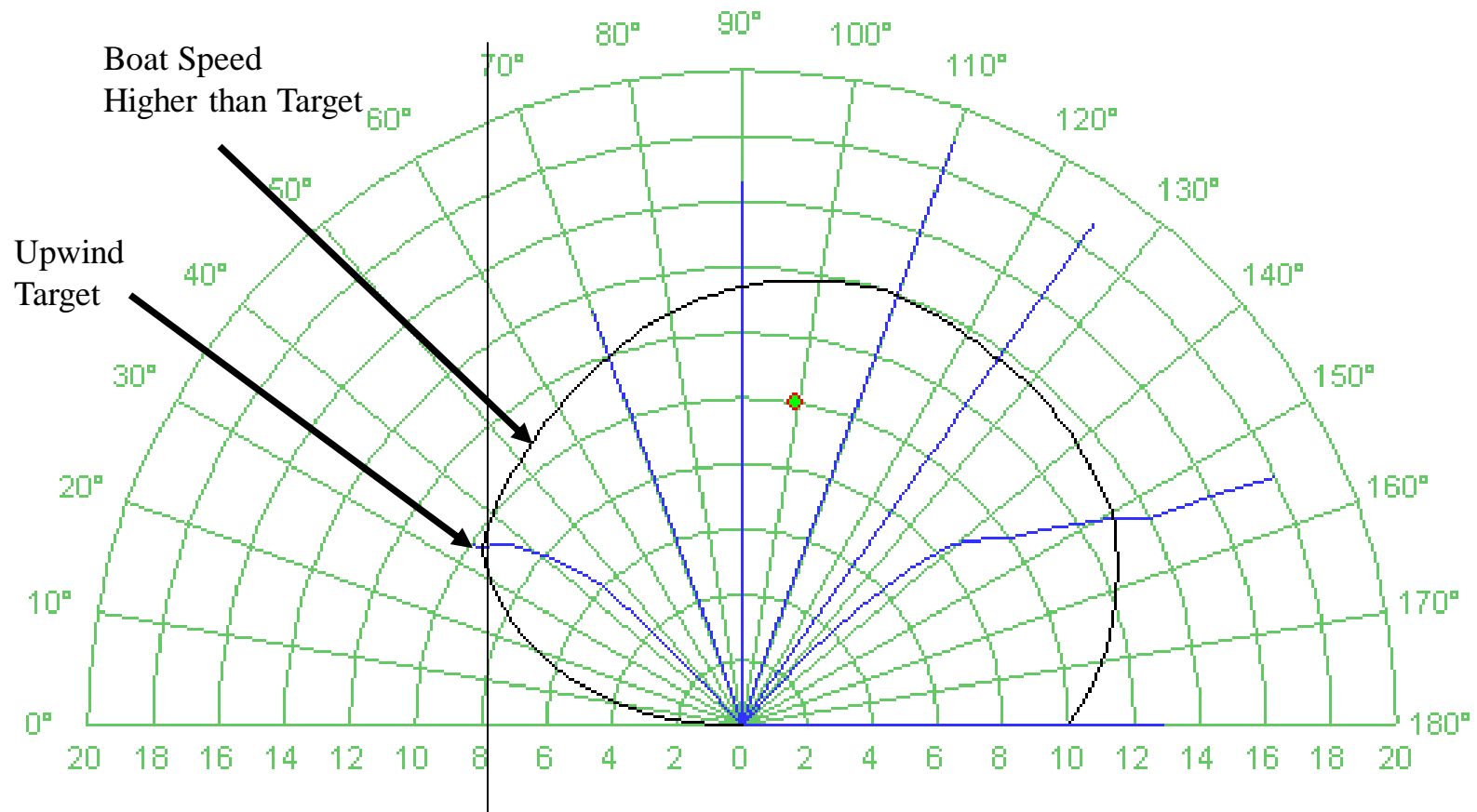


- You can also find the Boat Speed that you should have with maximum VMG



# Target Boat Speed (cont'd)

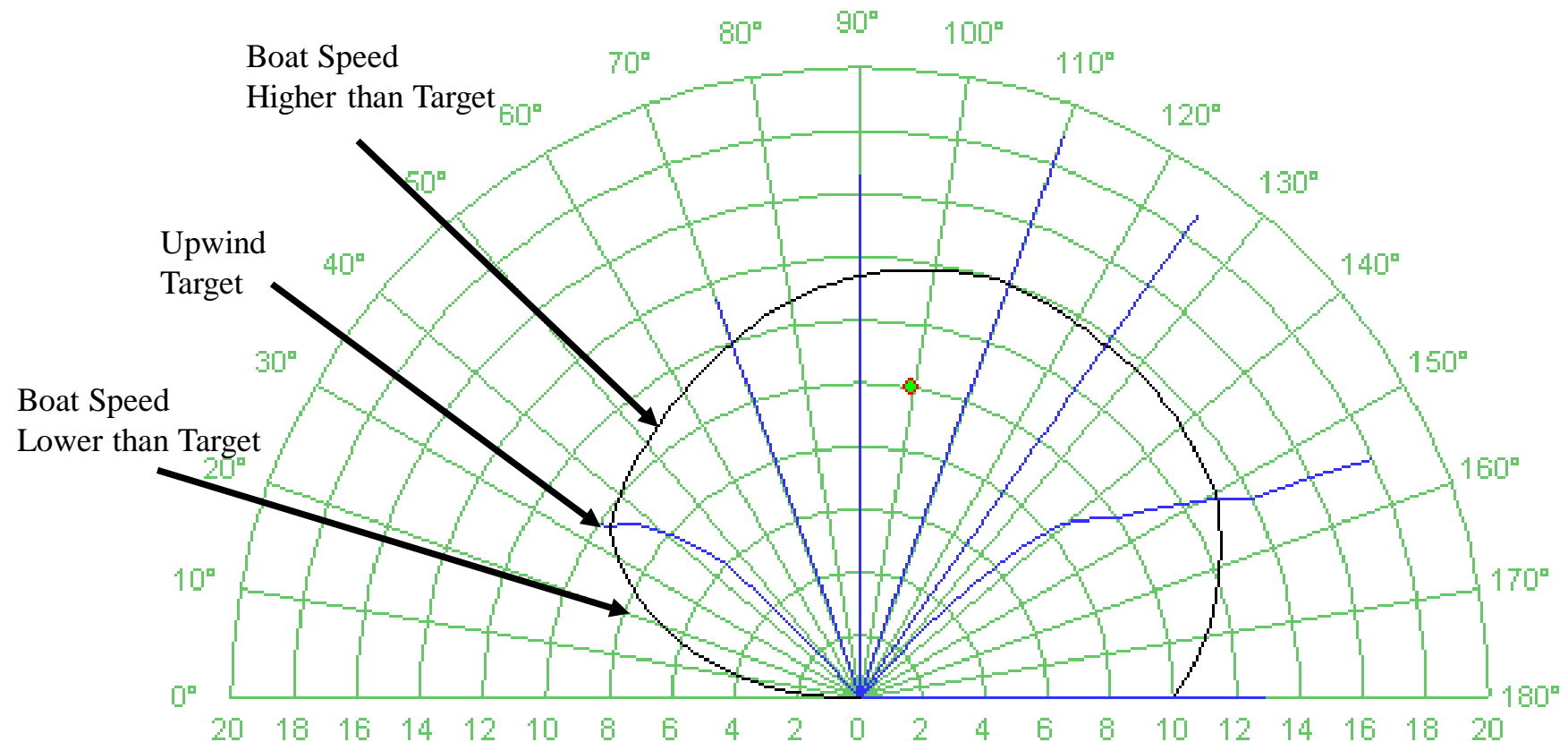
RayTech



- Notice that wind angles downwind from the Target give greater boat speed

# Target Boat Speed (cont'd)

RayTech



- And wind angles upwind from the Target give lower boat speed

# Target Boat Speed (cont'd)

RayTech

- When you know the True wind speed, there is one Boat Speed upwind when VMG is maximized
- This is called Target Boat Speed
- You can compare your current Boat Speed with your Target Boat Speed
- $\text{Boat Speed} > \text{Target Boat Speed}$  : Sailing too far down wind - turn to wind (bear up)
- $\text{Boat Speed} < \text{Target Boat Speed}$  : Sailing too far up wind - turn down wind (bear away)

# Target Boat Speed (cont'd)

RayTech

- Tactical software can tell you the Target Boat Speed
  - Target Boat Speed
  - Target Boat Speed Delta (diff from Boat Speed)
  - Target Boat Speed Percentage ( $\%BS/TBS$ )

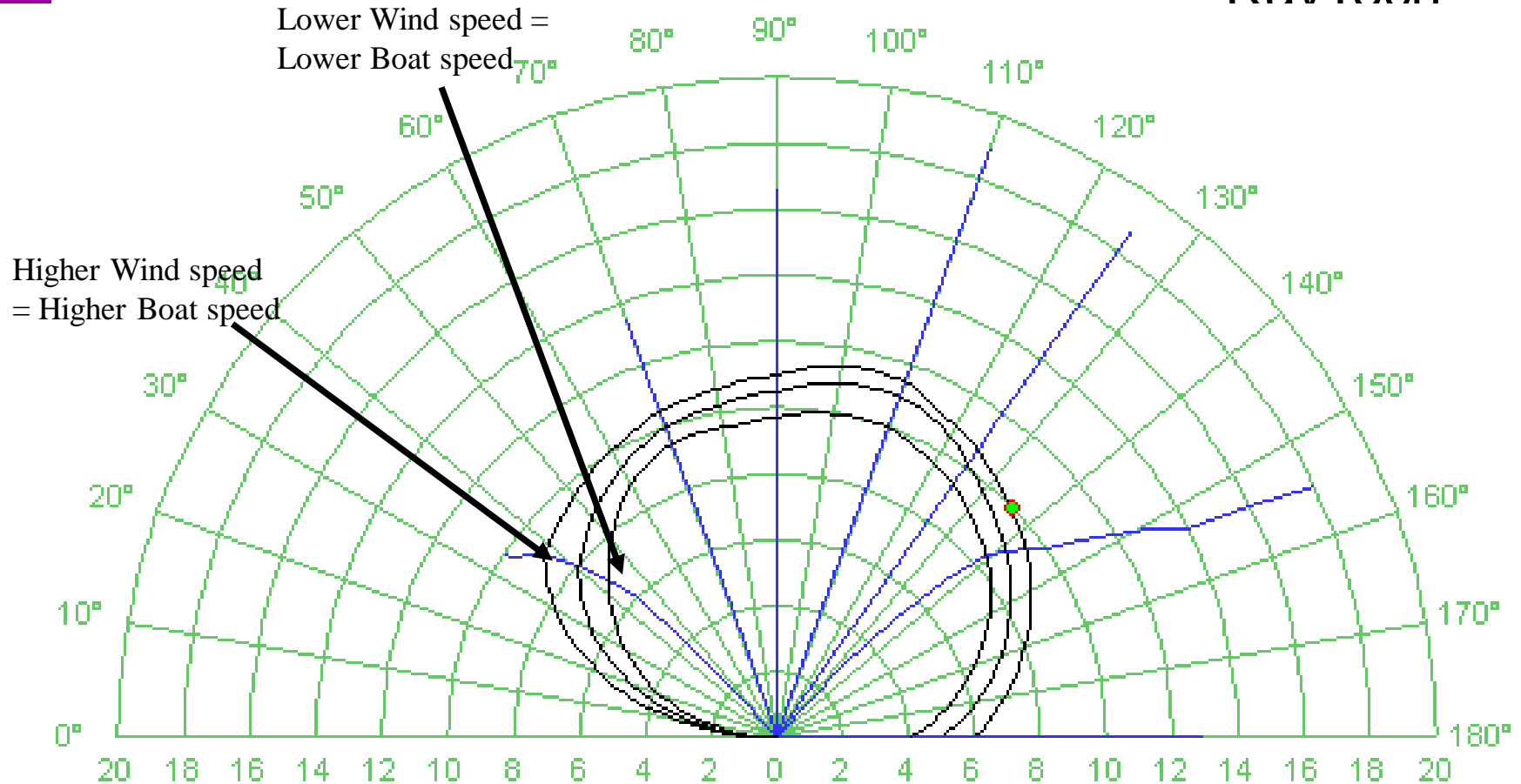
# Why use Target Boat Speed?

RayTech

- It does seem that using Target Boat Speed is more complicated than using Target Wind Angles, and achieves the same thing
- Using Target Boat Speed gives you a tactical advantage during wind shifts

# What happens in Wind Shifts?

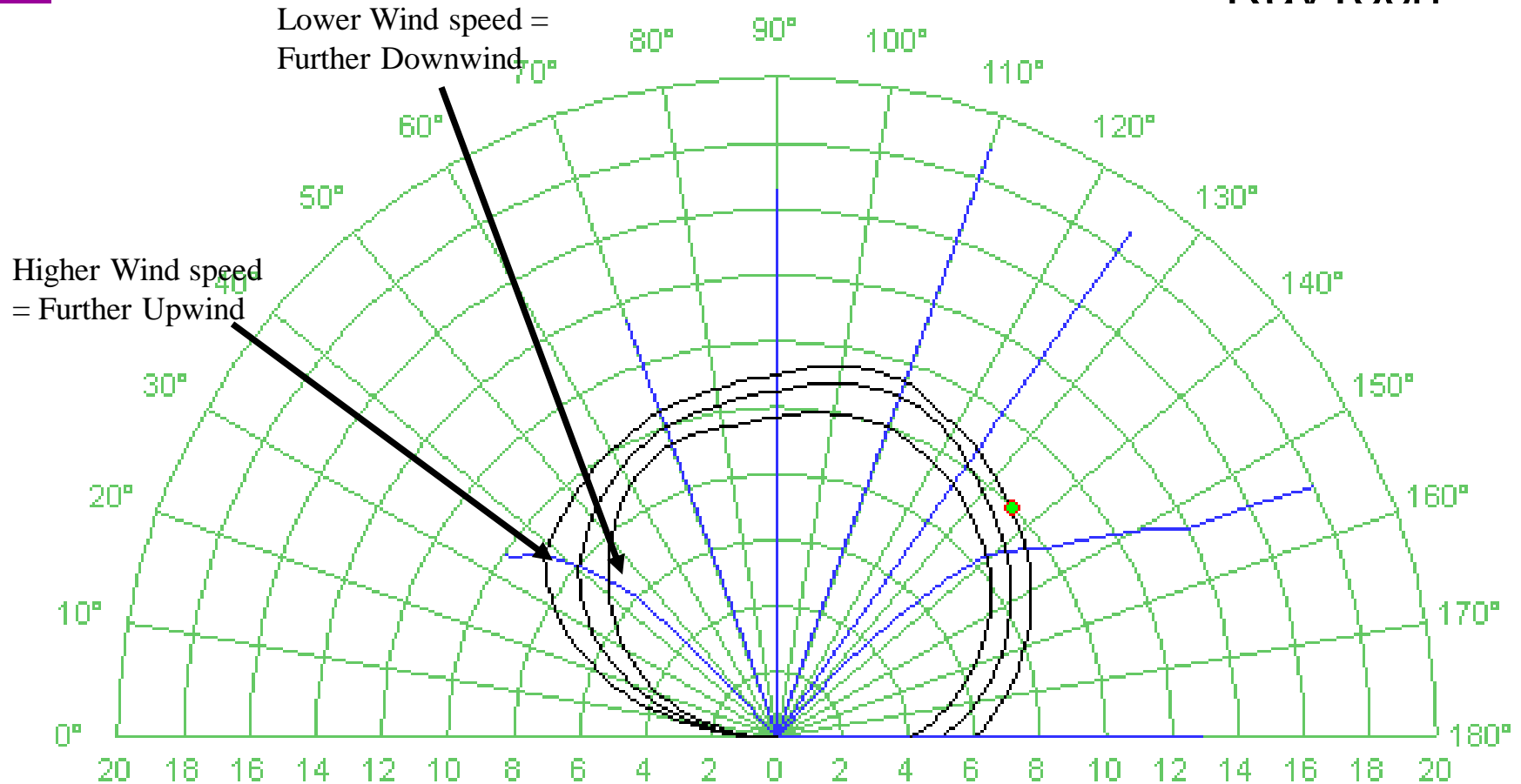
RavTech



- Target Boat Speed increases and decreases as wind speed increases and decreases

# What happens in Wind Shifts?

RavTech



- As wind increases you steer closer to wind and as wind decreases you steer further from wind

# Wind Speed Decreasing

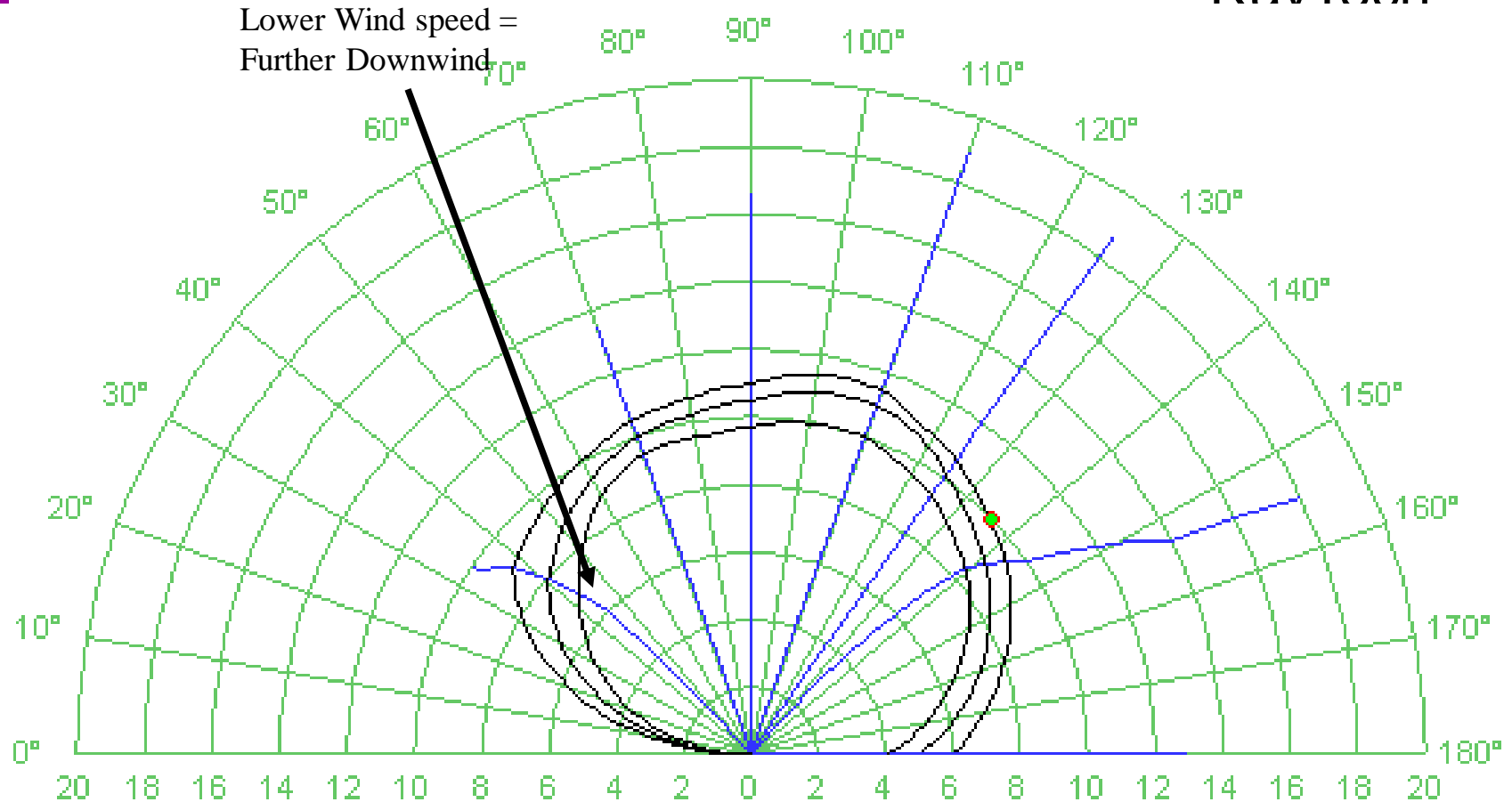
RayTech

- Imagine that you are steering to Target Wind Angle
- True wind speed then decreases
- Target Wind Angle will increase, telling you to steer away from the wind
- You do what your told and your speed gradually decreases to the new lower Boat Speed



# Wind Speed Decreasing (cont'd)

RavTech



- As wind speed decreases you steer further from the wind

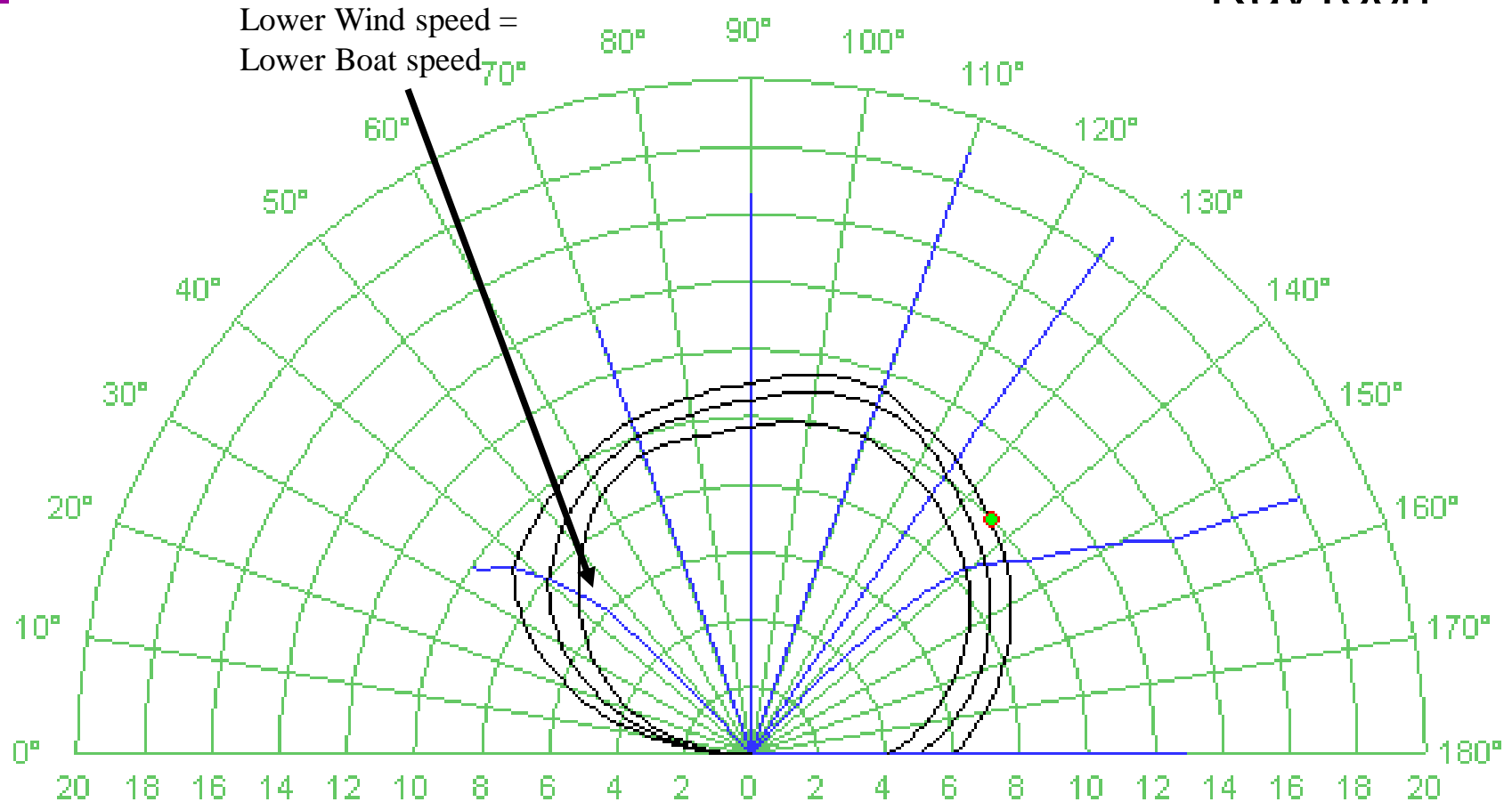
# Wind Speed Decreasing (cont'd)

RayTech

- Now imagine steering to Target Boat Speed
- True wind speed decreases
- Target Boat Speed will decrease, telling you to steer towards the wind, to reduce your boat speed
- You do what your told, but your boat speed will continue to fall and if you follow Target Boat Speed, you will eventually end up steering further away from the wind than you were before the Wind Speed dropped

# Wind Speed Decreasing (cont'd)

RavTech



- Target Boat Speed decreases as wind speed decreases

# Wind Speed Decreasing (cont'd)

RayTech

- So what's happened ?
- We've ended up on the same wind angle using both methods
- Using Target Boat Speed we briefly pointed too far upwind
- This actually made best use of the boats momentum to give us a slightly higher VMG, before the boat slowed down
- The overall average VMG was higher when following Target Boat Speed

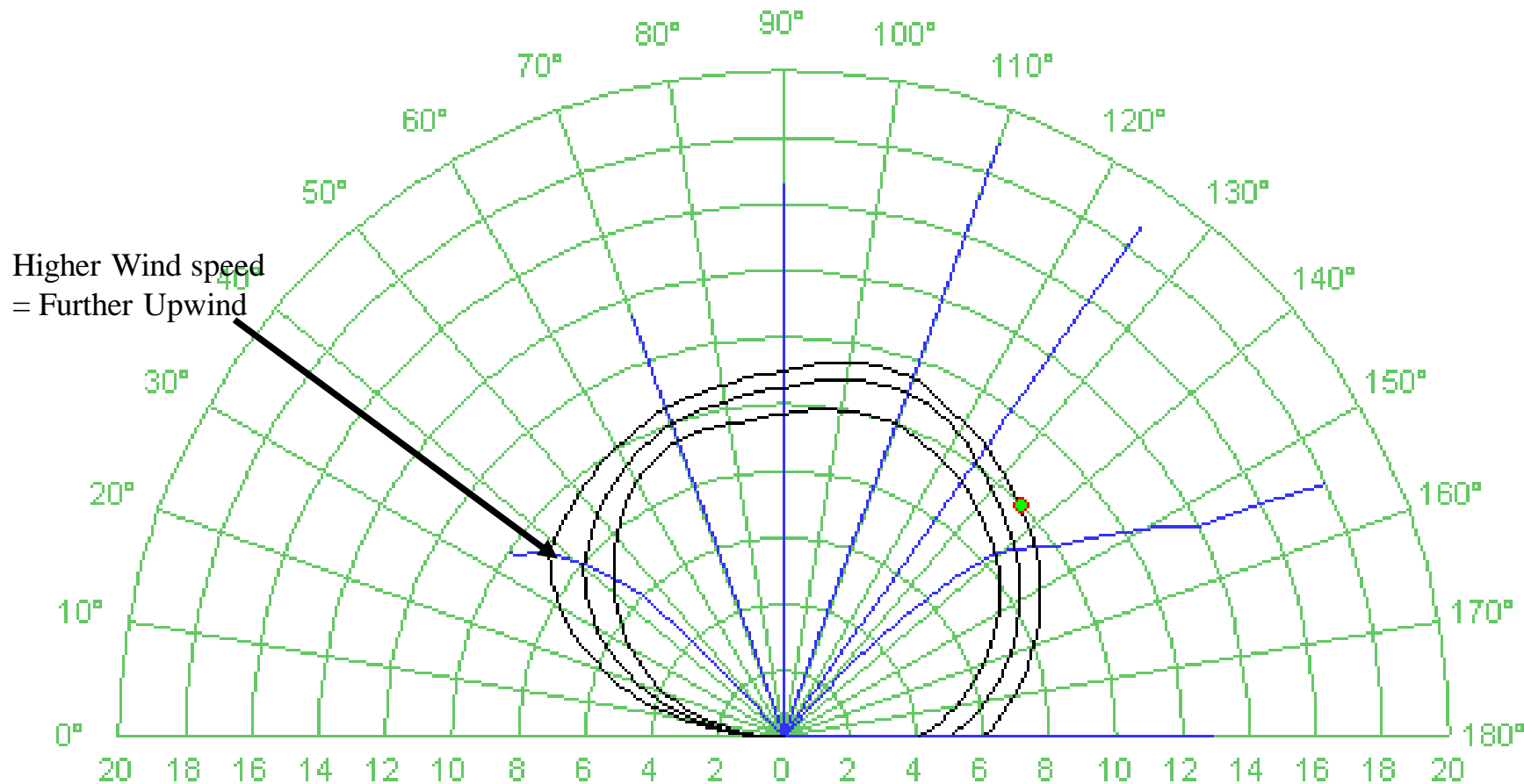
# Wind Speed Increasing

RayTech

- Imagine that you are steering to Target Wind Angle
- True wind speed then increases
- Target Wind Angle will decrease, telling you to steer towards the wind
- You do what your told and your speed gradually increases to the new higher Boat Speed

# Wind Speed Increasing (cont'd)

RavTech



- As wind speed increases you steer closer to the wind

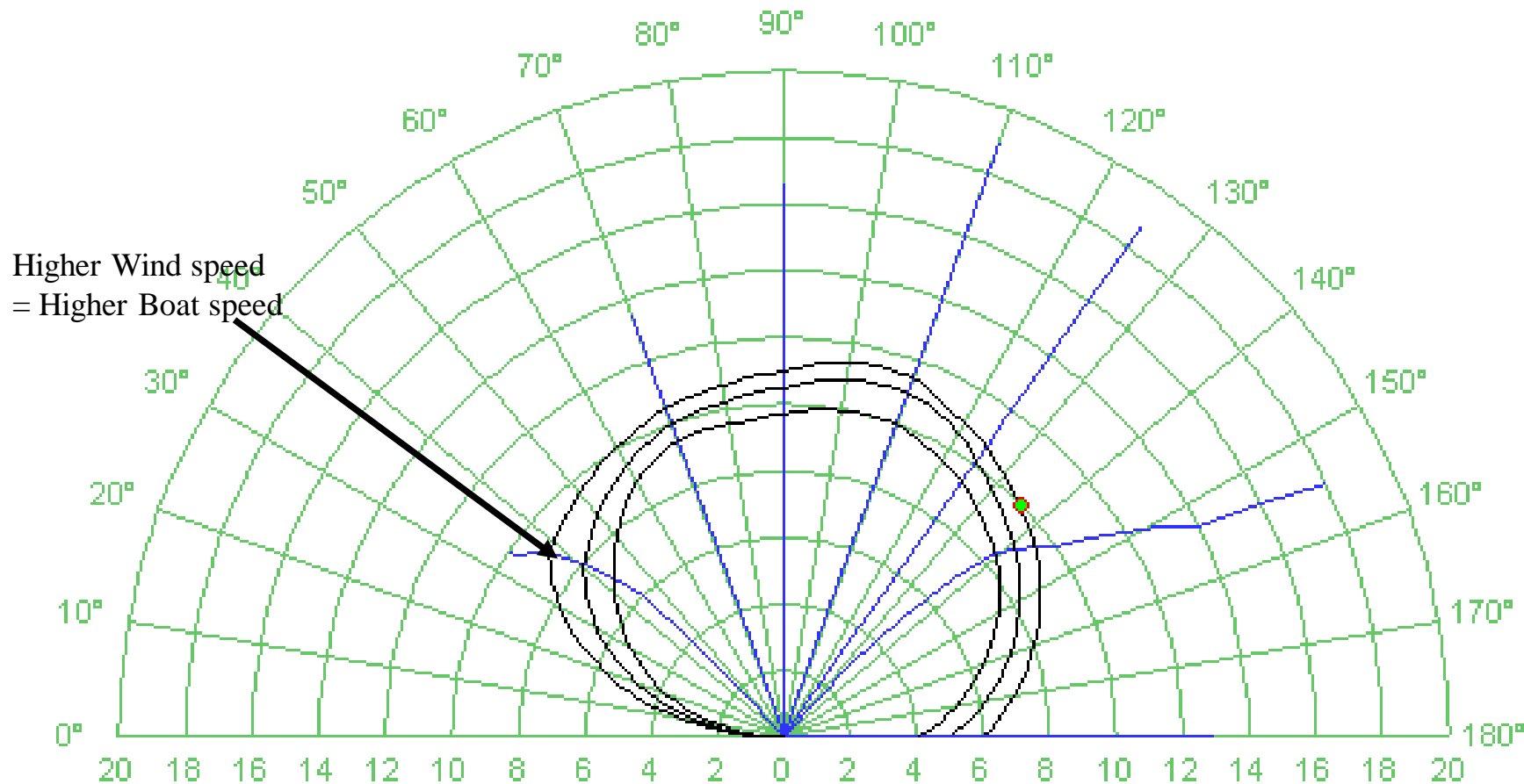
# Wind Speed Increasing (cont'd)

RayTech

- Now imagine steering to Target Boat Speed
- True wind speed increases
- Target Boat Speed will increase, telling you to steer away from the wind, to increase your boat speed
- You do what your told, but your boat speed will continue to rise and if you follow Target Boat Speed, you will eventually end up steering further towards the wind than you were before the Wind Speed dropped

# Wind Speed Increasing (cont'd)

RavTech



- Target Boat Speed increases as wind speed



# Wind Speed Increasing (cont'd)

RayTech

- So what happened ?
- We've ended up on the same wind angle using both methods
- Using Target Boat Speed we briefly pointed too far downwind
- This actually makes the boat accelerate quicker to the new VMG
- The overall average VMG was higher when following Target Boat Speed

# Using Targets

---

RayTech

- The advantages of using Target Boat Speed are greatest when sailing upwind
- Downwind it is best to use Target Wind Angle
- The differences in overall VMG are very small
- Any slight advantage is worth taking as it may give you the edge over the competition
- Professional racers now use Targets extensively

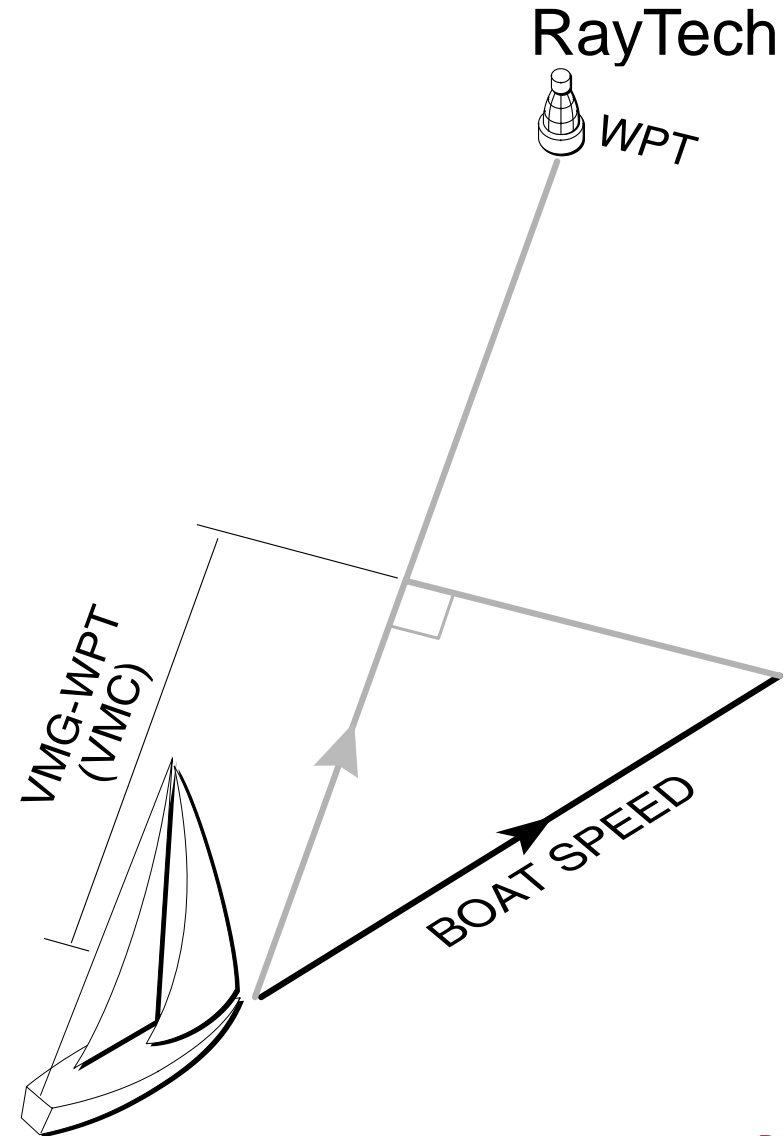
# What about legs that aren't parallel to the wind?

RayTech

- Tactical software such as RayTech not only calculates Targets for upwind and downwind, but can also calculate Targets for a leg in any direction
- The principle is exactly the same, only we are now maximizing VMC (VMG-WPT) rather than VMG (WIND)

# What is VMC?

- VMC = Velocity made good on course
- Also known as VMG-WPT
- Measures progress made towards waypoint



# What about Tide?

---

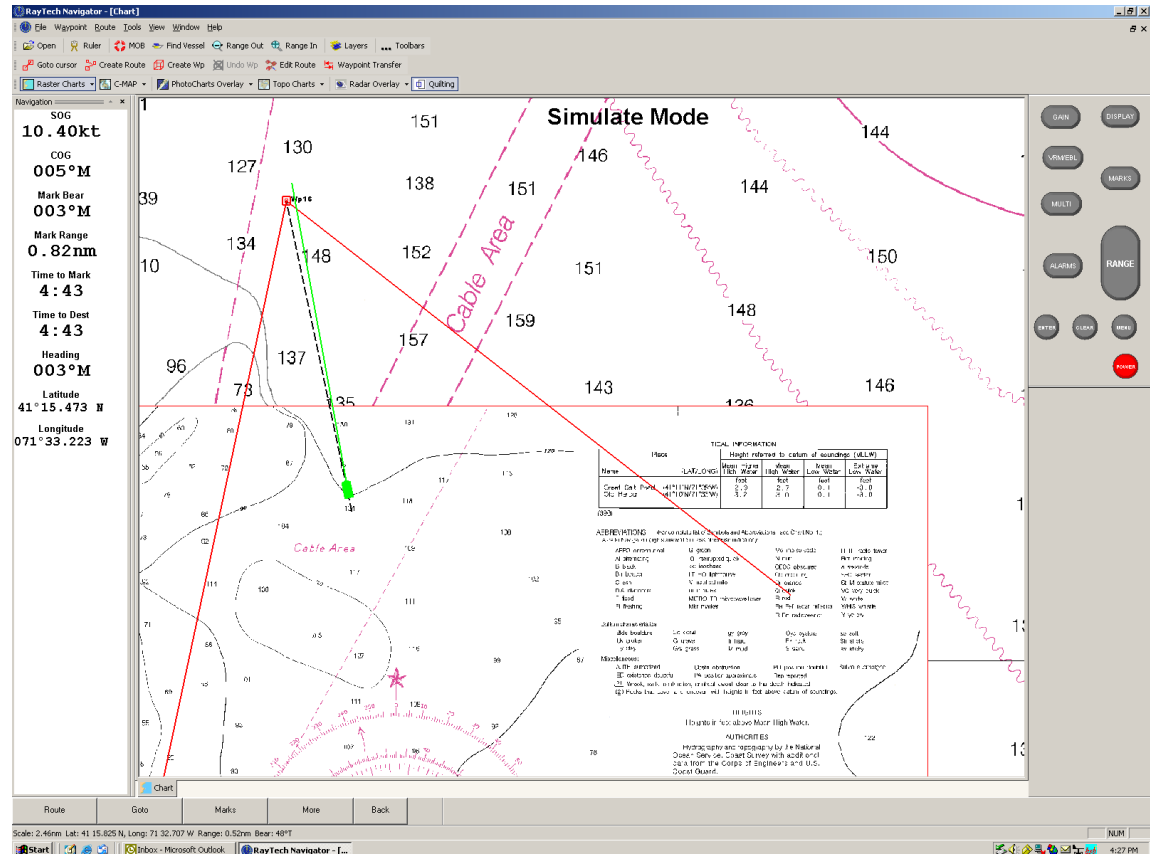
RayTech

- Tactical software such as RayTech can compensate for tide, which will shift the Targets about

# Laylines

RayTech

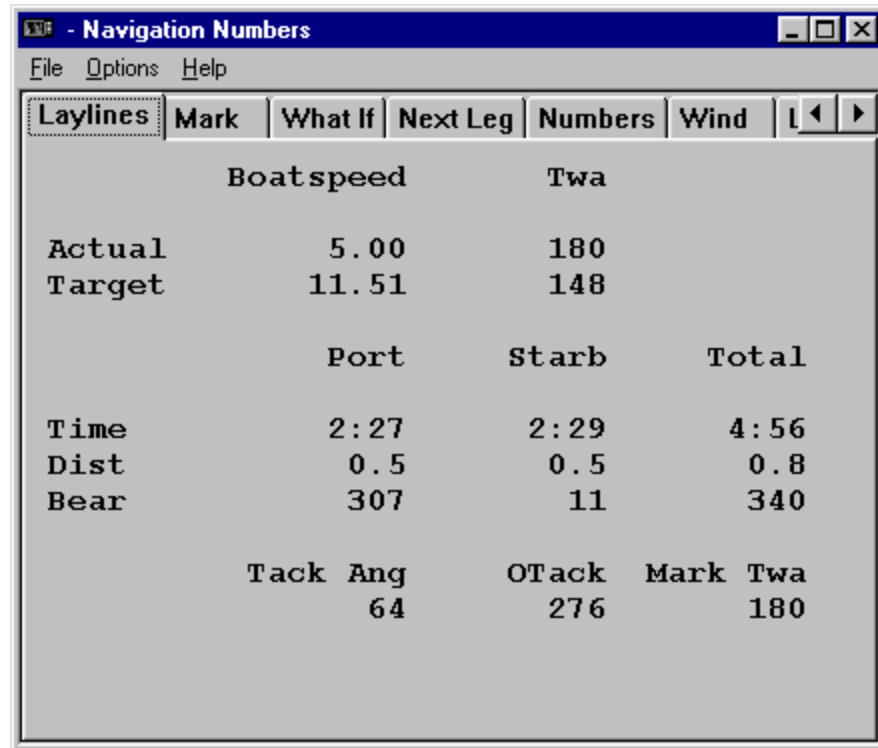
- Laylines are your targets
- If you sail parallel to laylines, you will be maximizing VMG
- Tack when you reach a layline



# Layline Data

RayTech

- Gives you distances and times to each layline
- Total distance and time to the mark



The screenshot shows a software window titled "Navigation Numbers" with a menu bar (File, Options, Help) and a tabbed interface. The "Laylines" tab is active, displaying a table of navigation data. The table is organized into several sections: a top section with "Boatspeed" and "Twa" values for "Actual" and "Target"; a middle section with "Port", "Starb", and "Total" values for "Time", "Dist", and "Bear"; and a bottom section with "Tack", "Ang", "OTack", "Mark", and "Twa" values.

	Boatspeed	Twa
Actual	5.00	180
Target	11.51	148

	Port	Starb	Total
Time	2:27	2:29	4:56
Dist	0.5	0.5	0.8
Bear	307	11	340

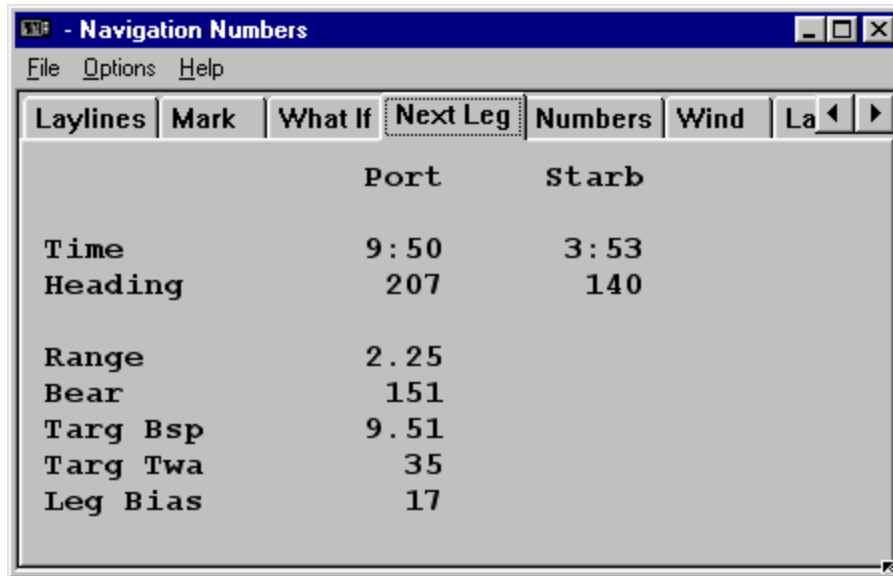
  

Tack	Ang	OTack	Mark	Twa
	64	276		180

# Data for the Next Leg

RayTech

- Tells you everything you need for the next leg



The screenshot shows a software window titled "Navigation Numbers" with a menu bar (File, Options, Help) and a tabbed interface. The "Next Leg" tab is selected. The window displays a table of navigation data with two columns: "Port" and "Starb".

	Port	Starb
Time	9:50	3:53
Heading	207	140
Range	2.25	
Bear	151	
Targ Bsp	9.51	
Targ Twa	35	
Leg Bias	17	



# Predicting Performance

RayTech

- And can even tell you what will happen if the wind/tide changes

What If | Current

True Wind Dir: 172

True Wind Speed: 17

OK Cancel Apply

	Short	Long	What If
Twd	172	357	357
Tws	17	0	0

	Port Lay	What If
Time	29:12	29:12
Dist	5.6	5.6
Bear	320	320

	Starb Lay	What If
Time	-2:13:53	-2:13:53
Dist	-25.7	-25.7
Bear	24	24

# Custom SeaTalk Channels

RayTech

- And all these values can be displayed on the ST80 Maxiview and ST290 Graphic

Custom	Display Text	Channel	Decimal Places	Leading Zeros	Units
Custom 1	Target Speed	BoatSpeed	3	<input type="checkbox"/>	No Conversion
Custom 2	Optimum VMC	NavOptimaVmc	1	<input type="checkbox"/>	No Conversion
Custom 3	TARGET SPEED	NavOptimaVmcDelta	2	<input type="checkbox"/>	Kilometers
Custom 4	TIME TO TACK	NowcastBearRockGustSpeed	0	<input type="checkbox"/>	No Conversion
Custom 5	Targ Wind Delta	NoChannel	1	<input type="checkbox"/>	No Conversion
Custom 6	Corr TWind Dir	NoChannel	0	<input type="checkbox"/>	No Conversion
Custom 7	Corr TWind Spd	NoChannel	0	<input checked="" type="checkbox"/>	No Conversion
Custom 8	Polar Speed	NoChannel	0	<input type="checkbox"/>	No Conversion
Custom 9	Polar Delta	NoChannel	0	<input checked="" type="checkbox"/>	Degrees Magnetic
Custom 10	Polar Speed %	NoChannel	1	<input type="checkbox"/>	No Conversion
Custom 11	Custom11	NoChannel	0	<input type="checkbox"/>	No Conversion
Custom 12	Custom12	NoChannel	0	<input type="checkbox"/>	No Conversion

OK Cancel Apply Help