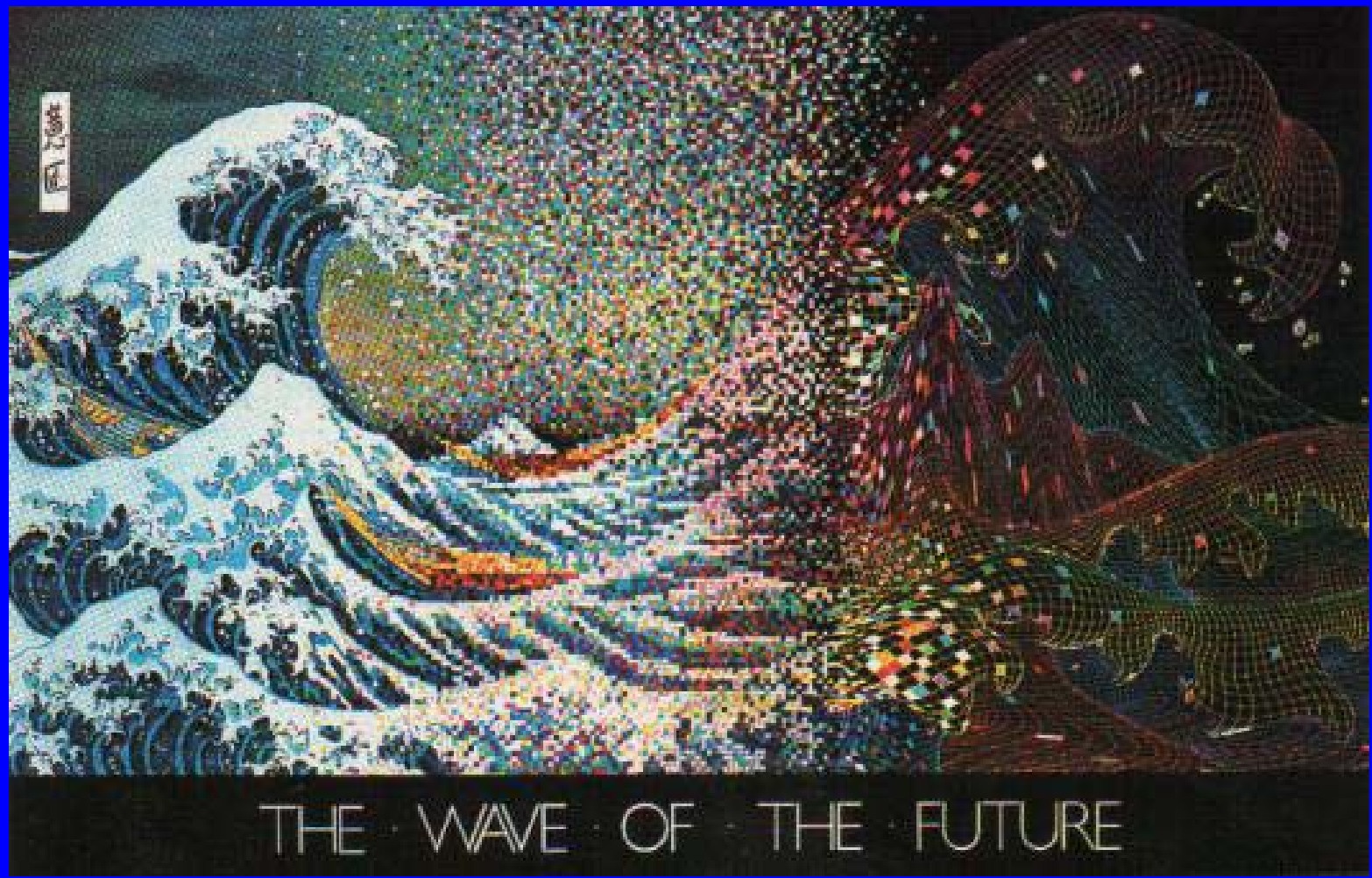
Vessel Optimization and Safety System *(VOSS)*



Ocean Systems Inc.

Oceanweather Inc.

"Some people are weather wise,
but most are otherwise"

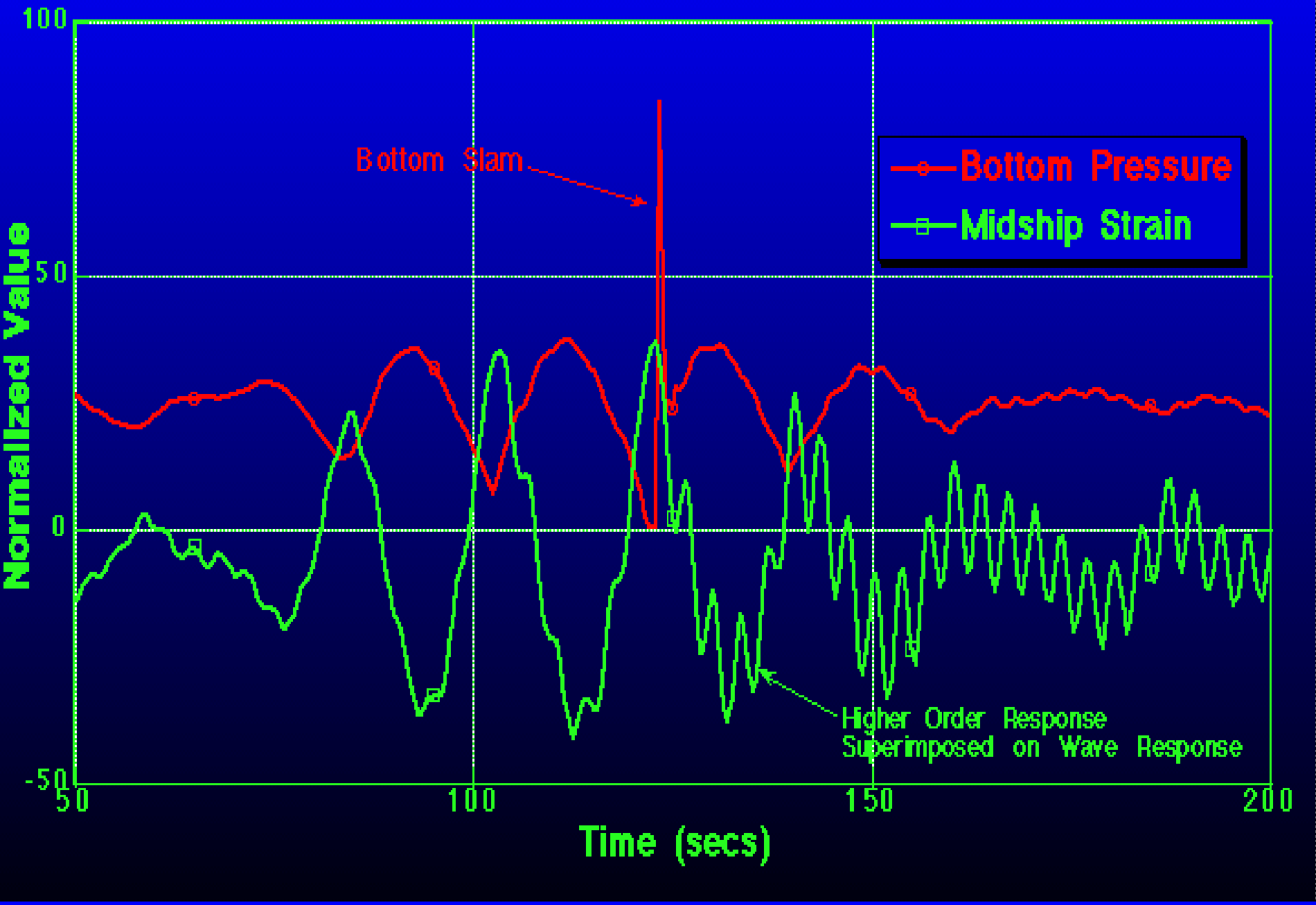
Benjamin Franklin

Sources of Heavy Weather Damage

- Weather routing not taking ship responses into account
- Operator not knowing the ship's design limits
- Ship too big too powerful to get the feel
- Improper loading for the expected wind and waves conditions
- Commercial pressure on the captain to take unwarranted risks

Too late to exercising “Prudent Seamanship”

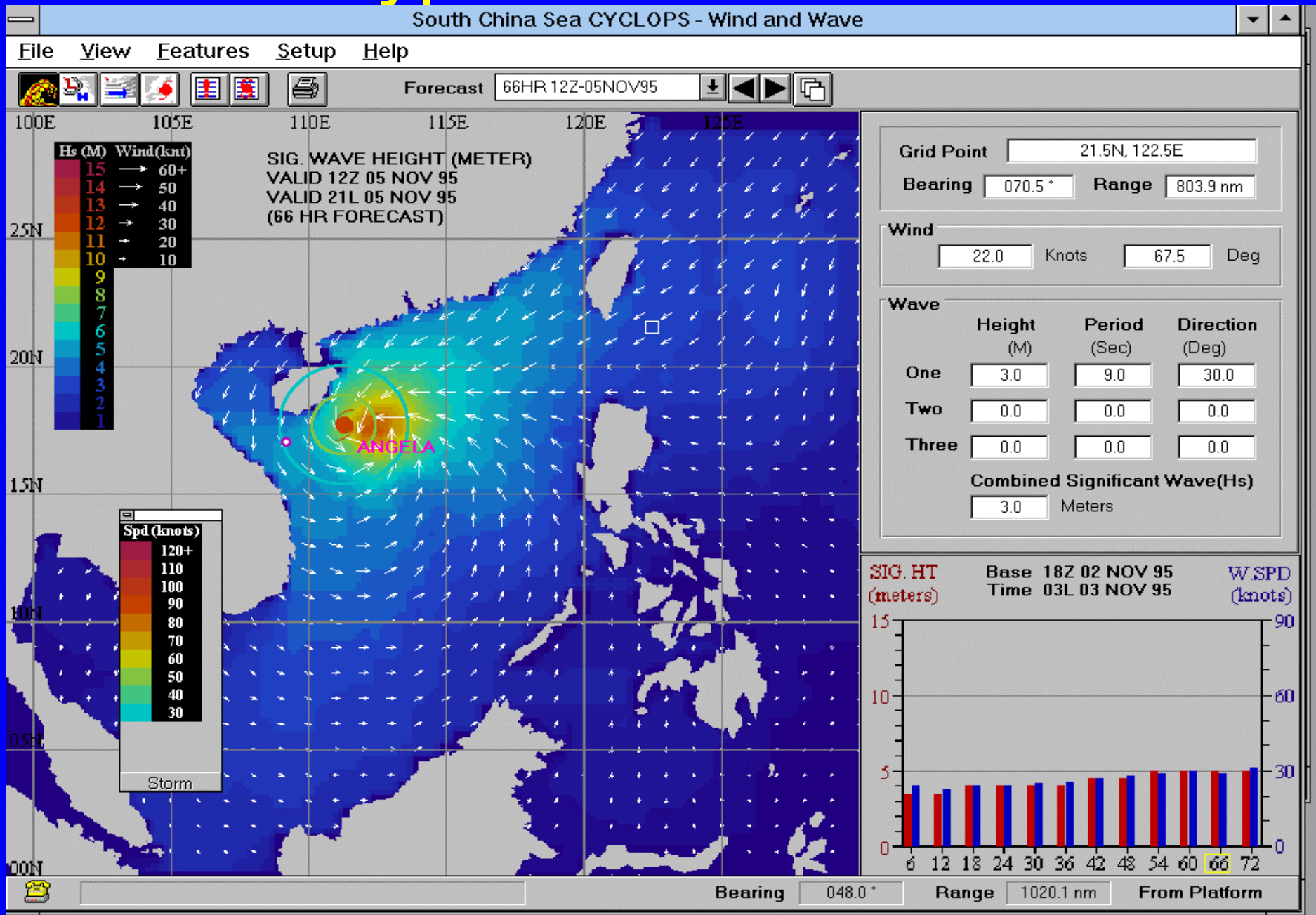
Bottom Slam


100
50
0
-50
Normalized Value
50
100
150
200
Time (secs)
Bottom Slam
Bottom Pressure
Midship Strain
Higher Order Response
Superimposed on Wave Response

Parametric Rolling

- Wide beam, large flare and
- Transom stern hull form
- Large stability variations as wave travel along the ship length due to water plan area changes
- Could happen in head or following seas
- Sudden, unexpected large roll motion with high lateral accelerations developed in minutes
- Resonance occurs when the wave encounter period or pitch period is half the natural roll period of the ship

Typhoon Forecast



Caribbean CYCLOPS - Strike Probability

File View Features Setup Help

Forecasts 60HR 18Z-11JUL96

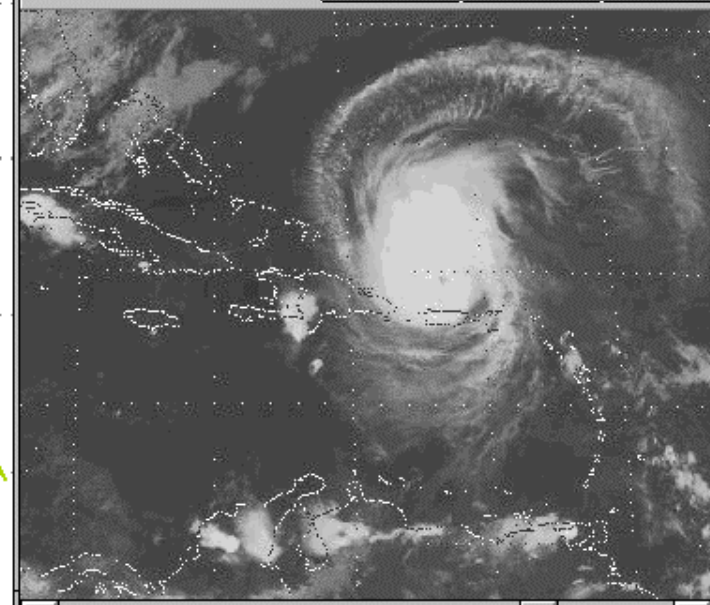
95W 90W 85W 80W 75W 70W 65W 60W 55W 50W 45W 40

35N 30N 25N 20N 15N 10N 5N

BERTHA

Satellite Images

96070902 Back Forward Loop

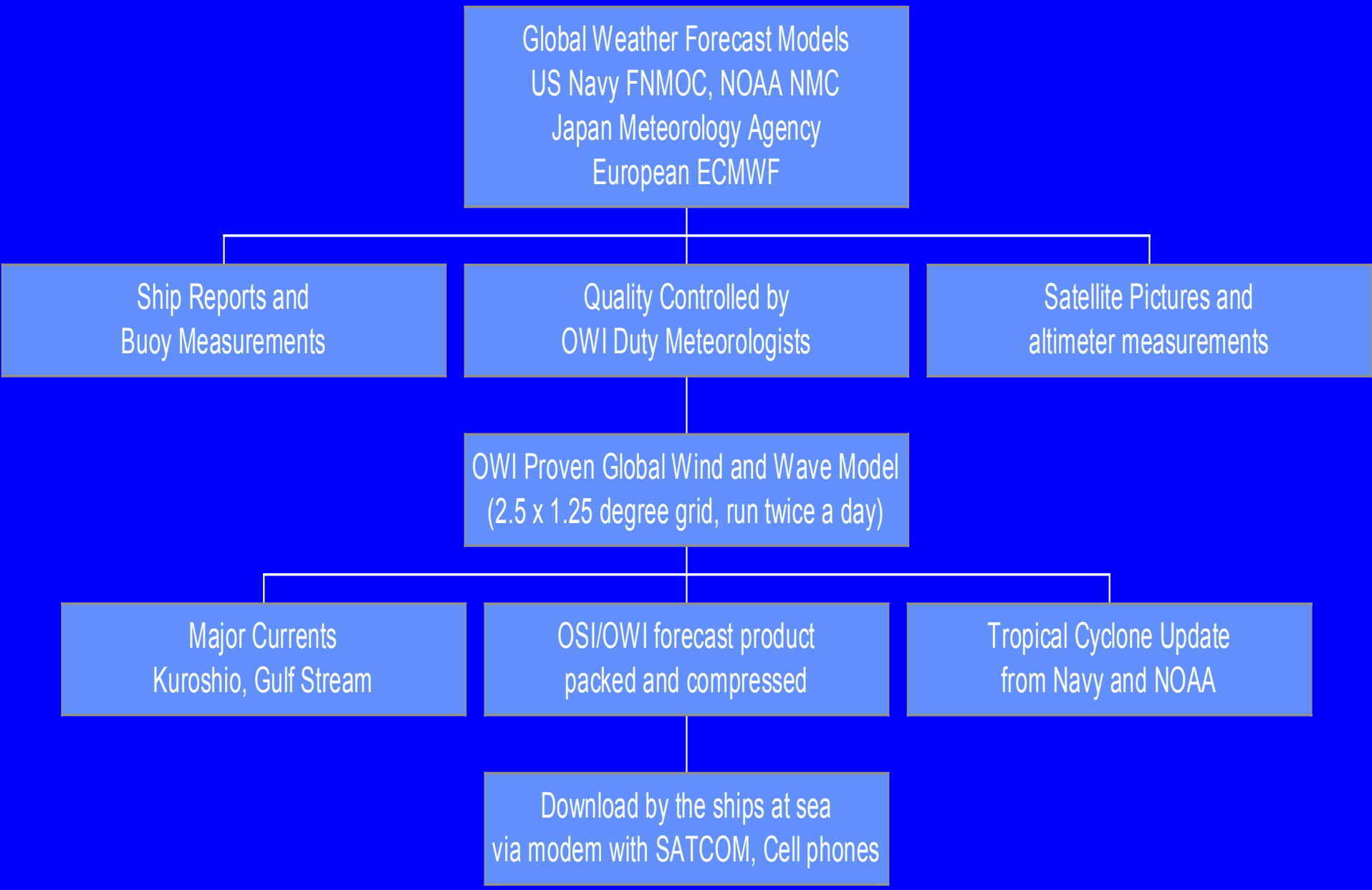


Strike %
100
90
80
70
60
50
40
30
20
10

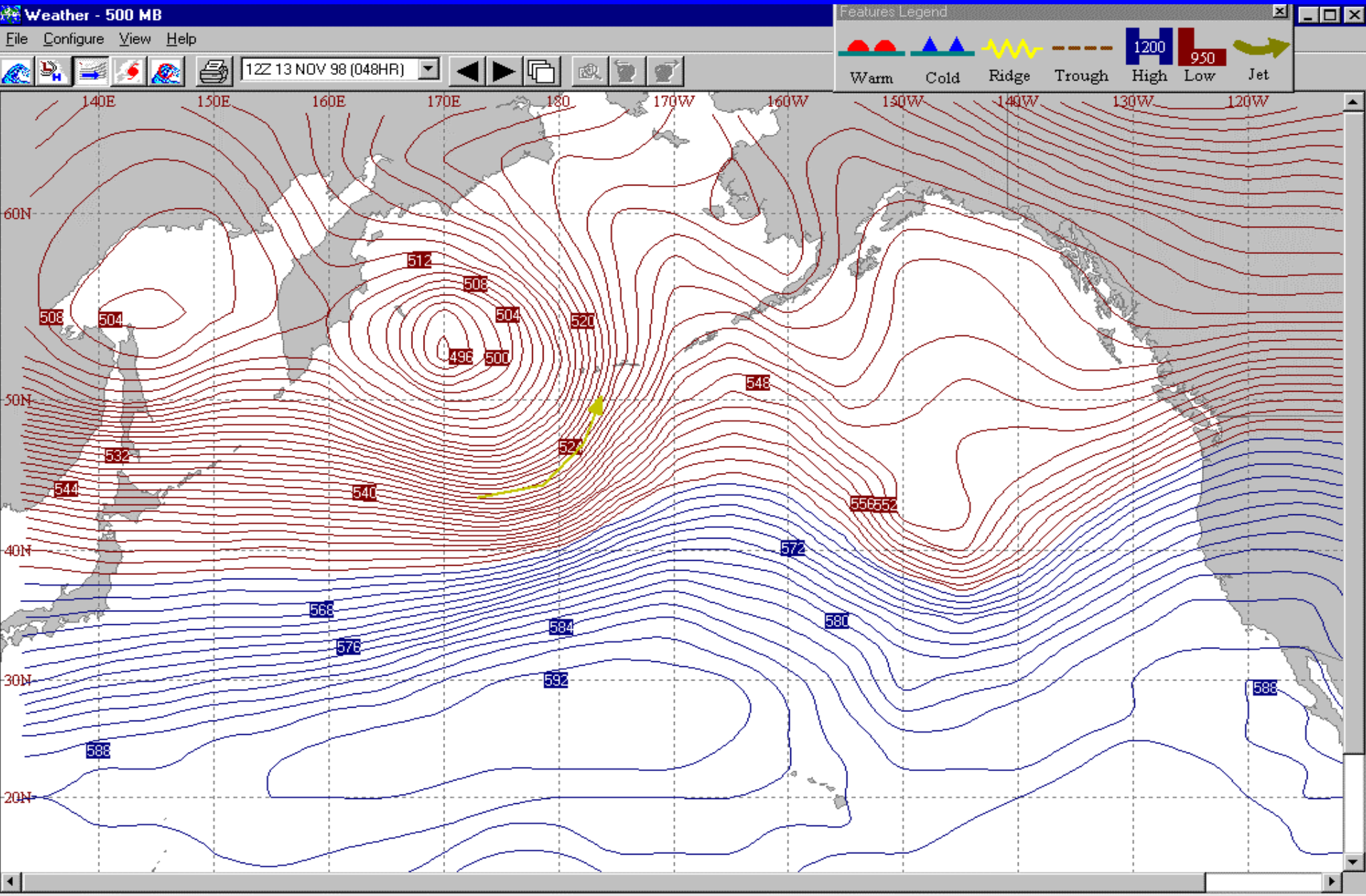
PROBABILITY THAT THE CENTER OF THE TROPICAL SYSTEM
WILL PASS WITHIN 65 NAUTICAL MILES DURING THE
60 HOURS ENDING AT 15L-11JUL96

Pointer Position: 31.84N, 63.7W Bearing 051.1 ° Range 844.9 nm From Platform

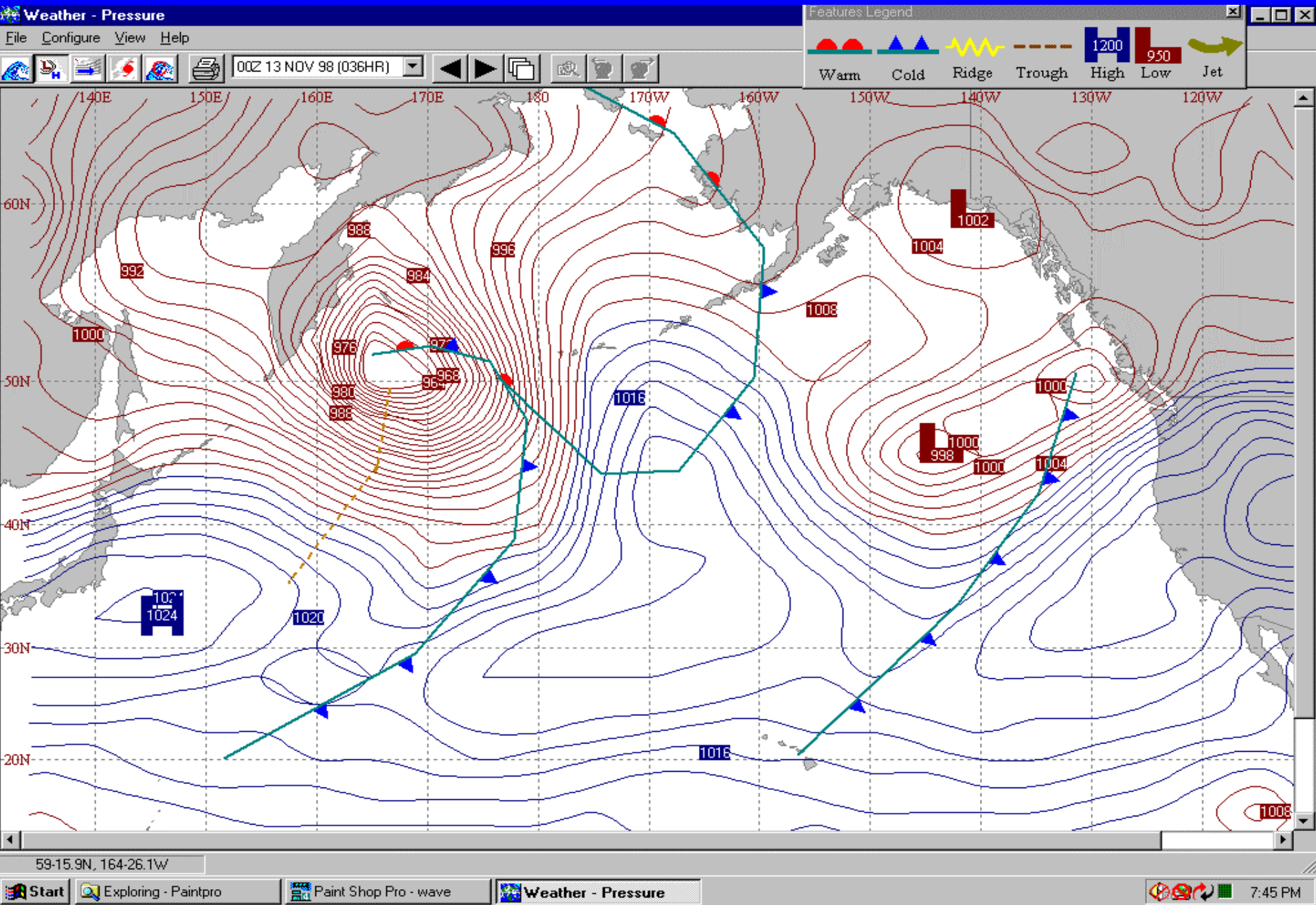
The OWI/OSI Weather forecast process



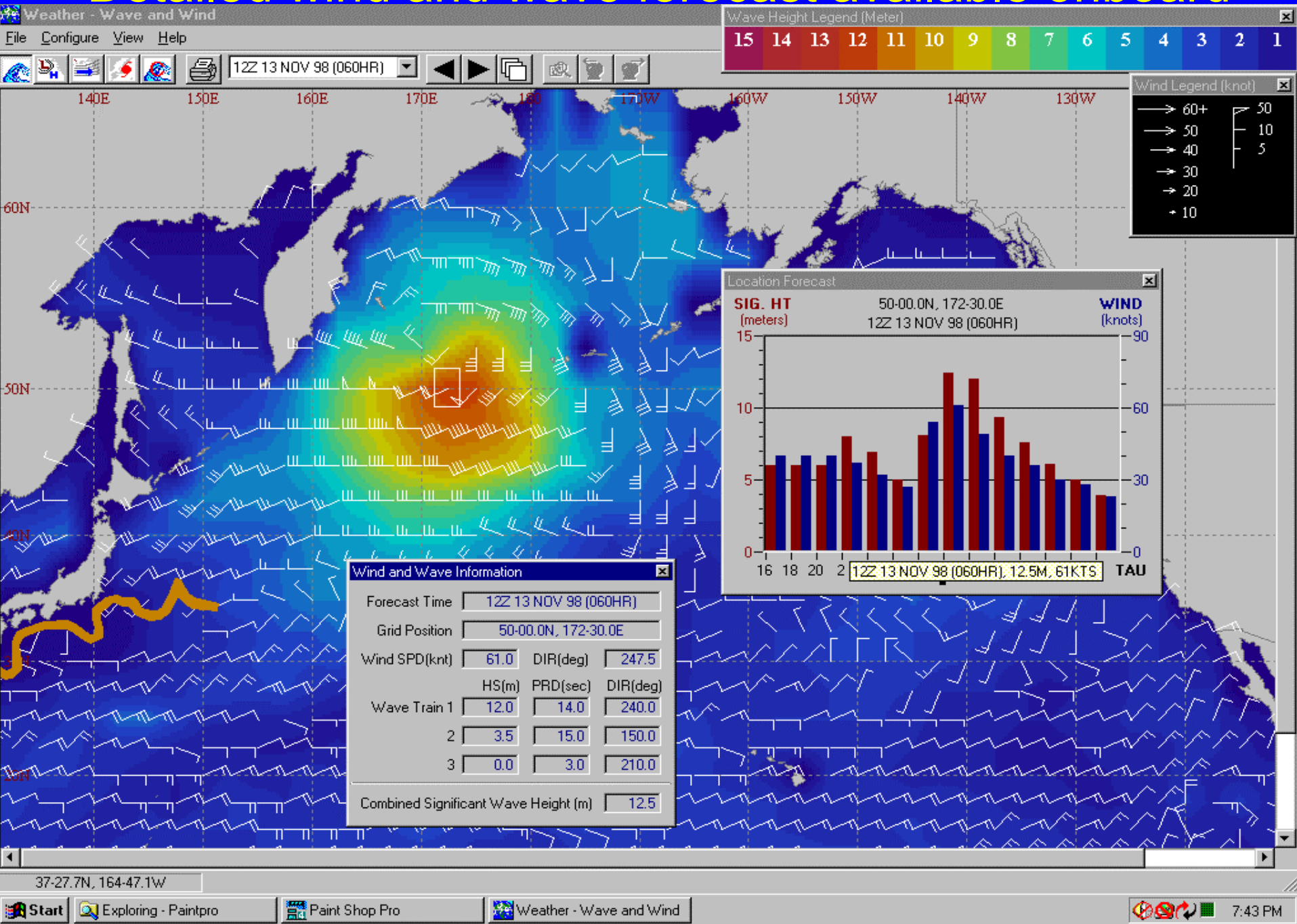
500MB Upper Air Charts



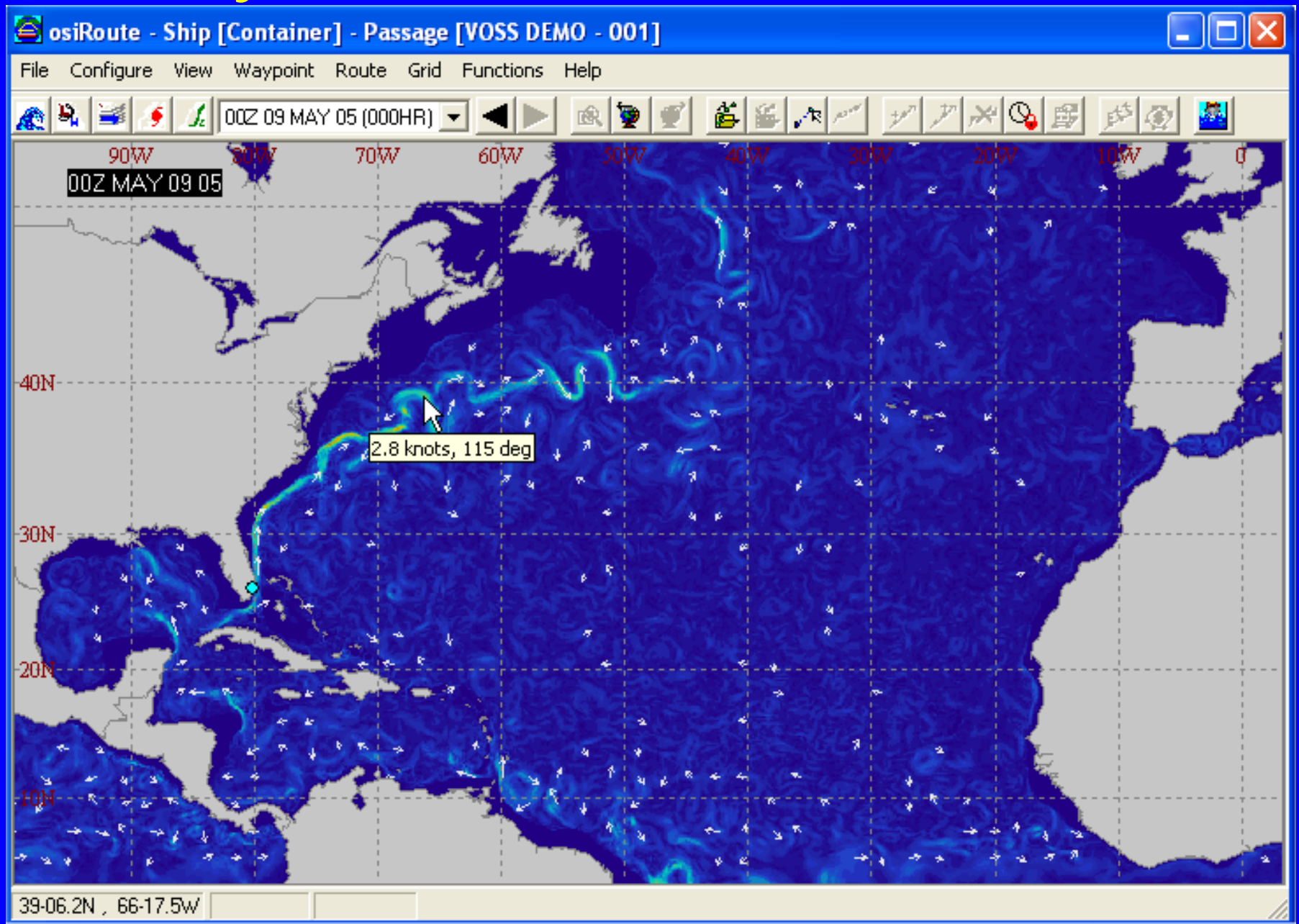
Surface Pressure Charts



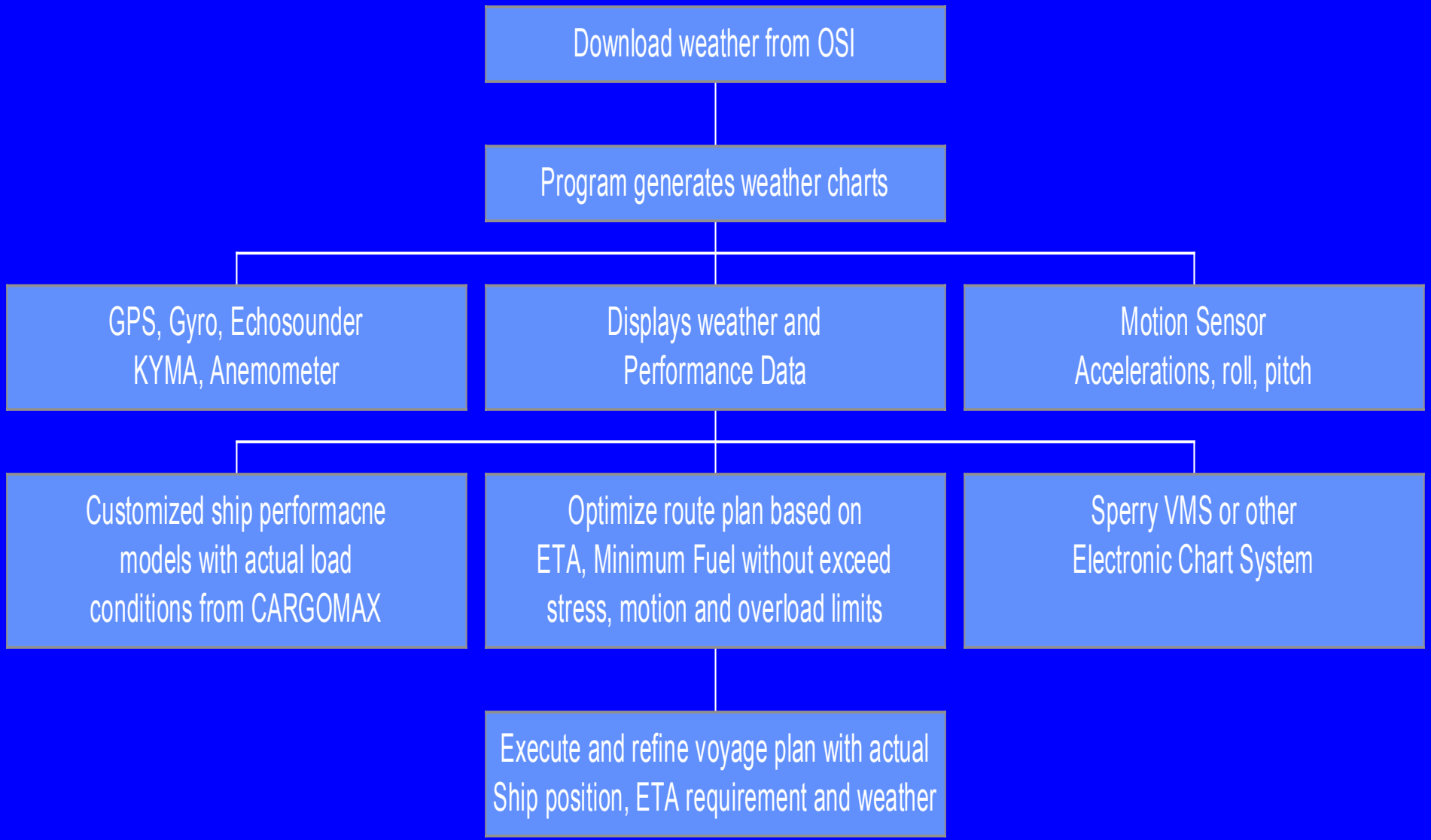
Detailed wind and wave forecast available onboard



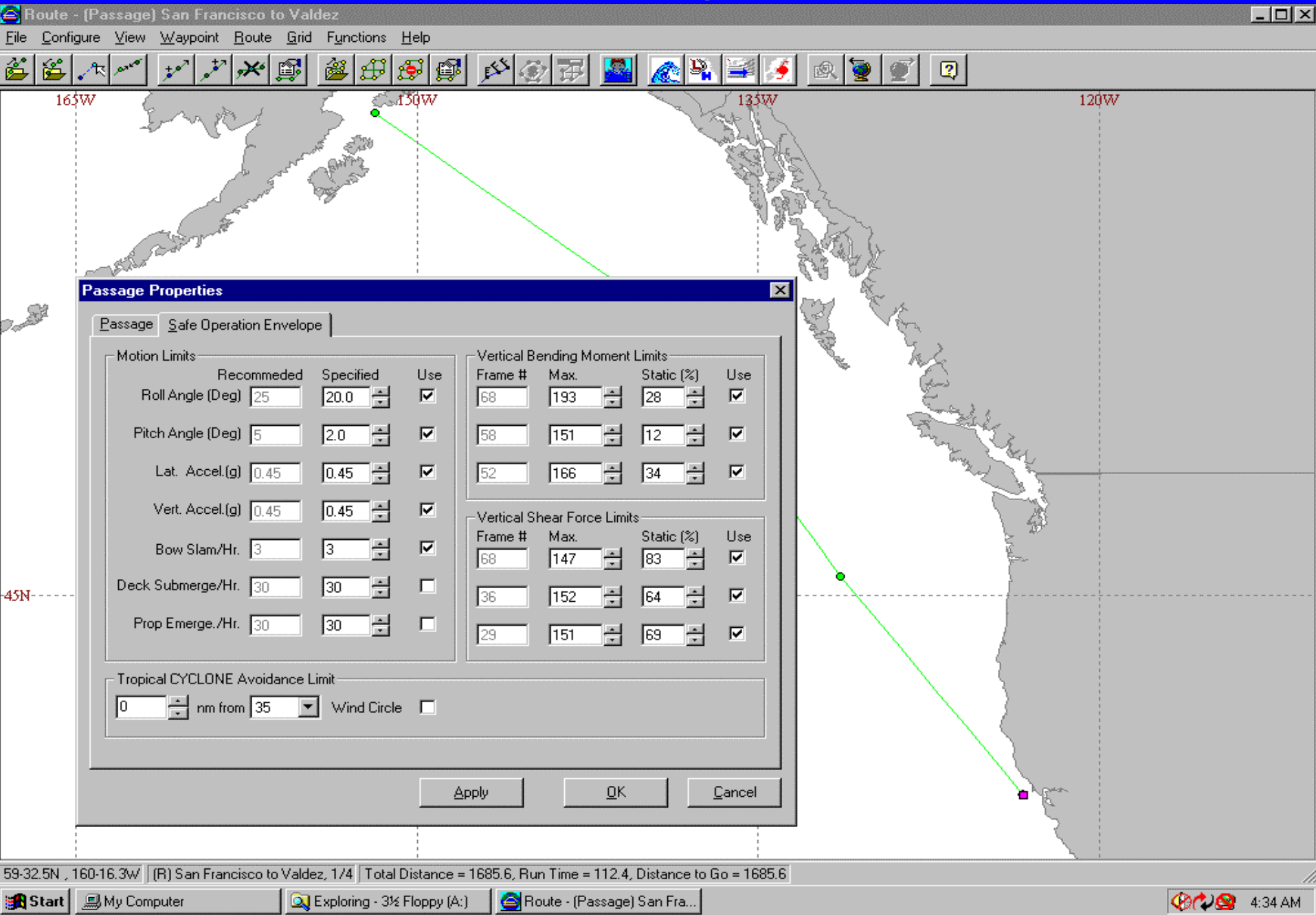
Daily Global Current Nowcast



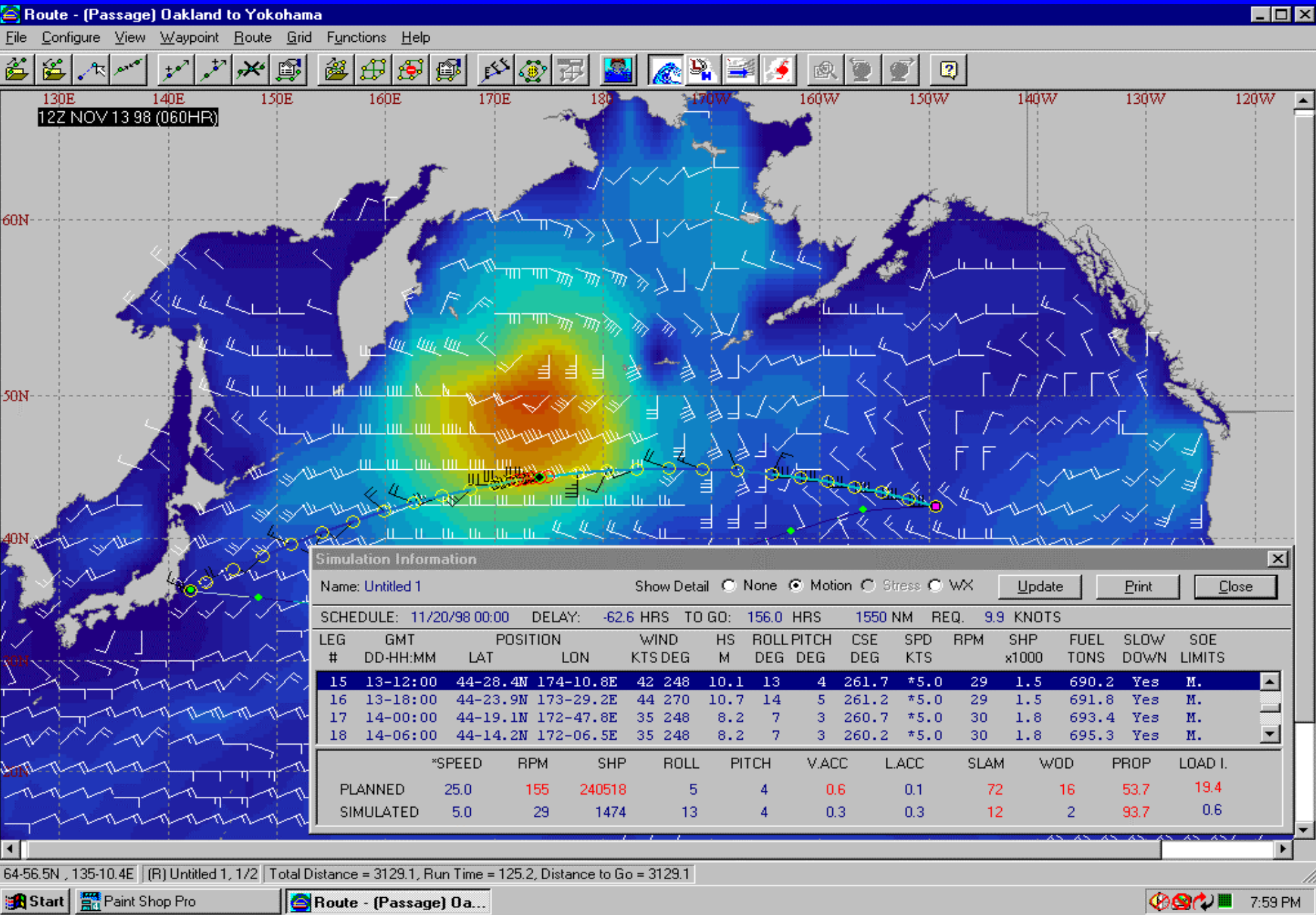
Shipboard voyage planning process



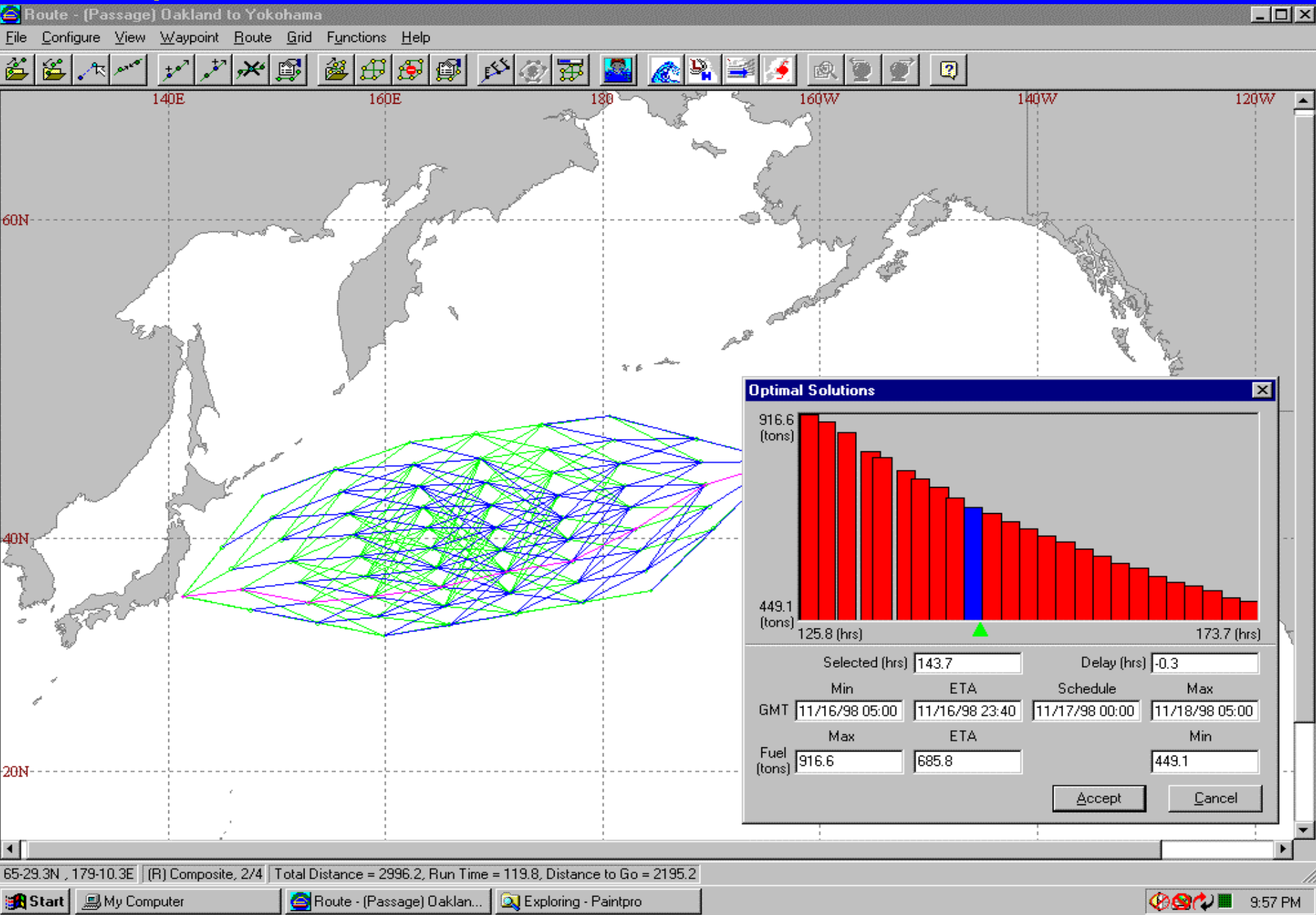
Safe Operating Envelope



Route Simulation in forecast wind and waves



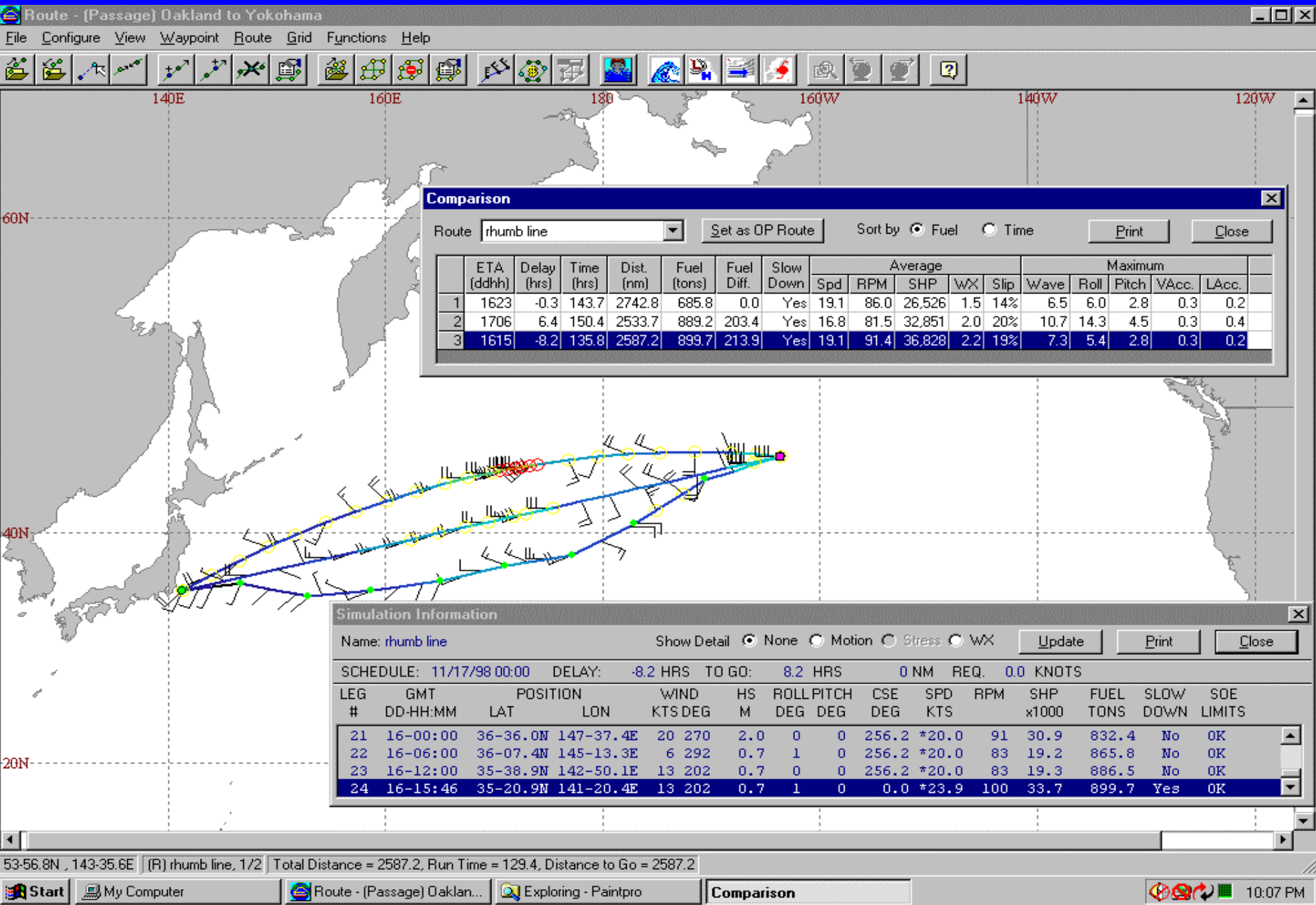
Optimization to arrive on time with minimum fuel



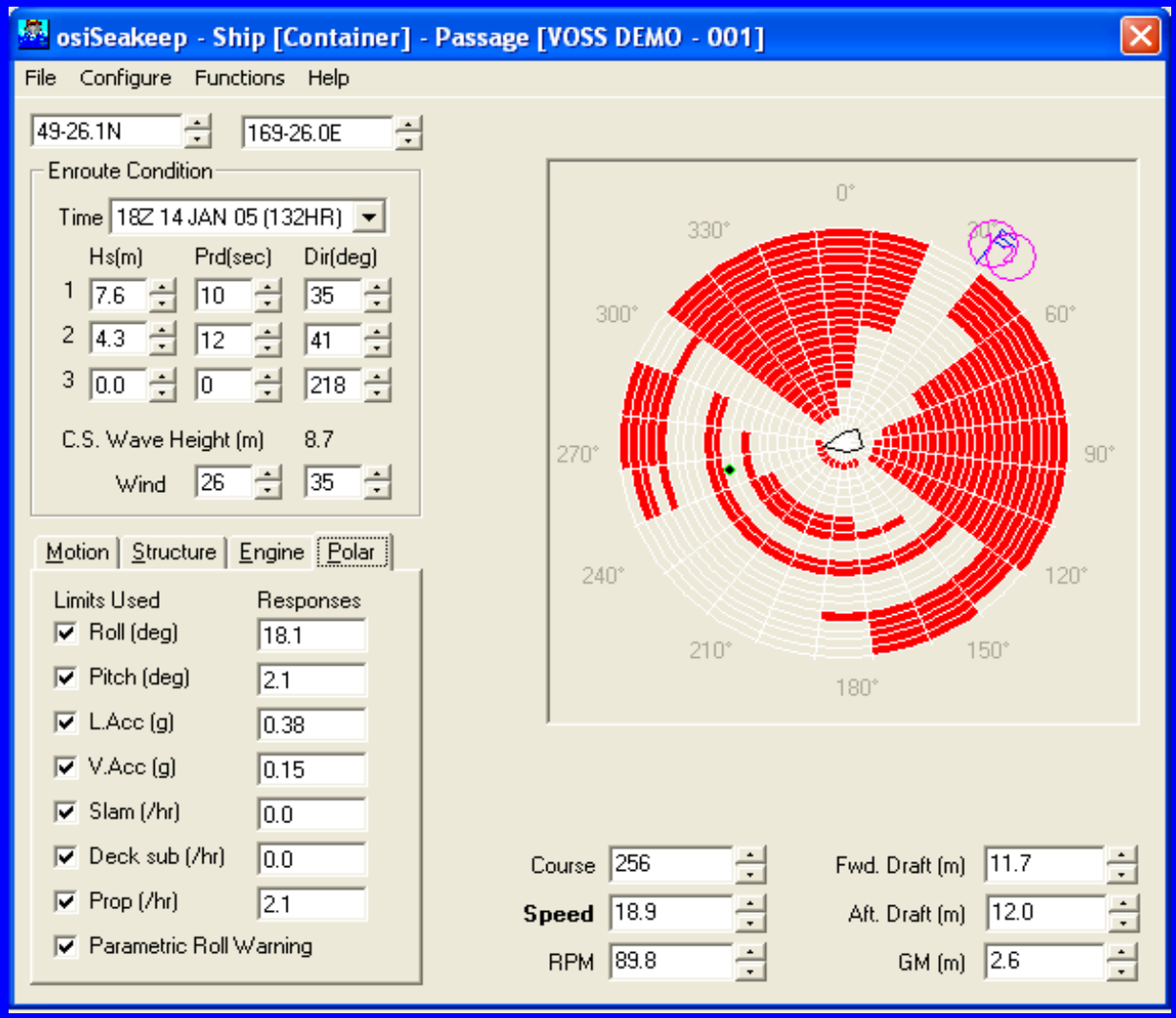
Unique Optimization Algorithm

- True optimization on fuel consumption based on ship performance in forecast wind, wave and current conditions
- User specified Safe Operating Limits in terms of ship motion, engine overload and storm/seastate avoidance to minimize heavy weather damage
- Show fuel differences for arriving early or late from schedule
- Optimize on set route or thousands of possible routes within specified route envelop

Route Comparisons



Predicts and monitors ship motion



- Based on Ship Motion Theory
- Predicts motions for different speeds, heading and wind and wave conditions
- Provide guidance to many “What if” questions

Monitoring/Detection of Parametric/Synchronous Motions

- Alarms when max motion or Parametric roll are detected
- Uses latest theory and model test data
- Advices speed and heading changes
- Low cost sensor box measures roll, pitch and accelerations in XYZ
- USB interface, no external power required

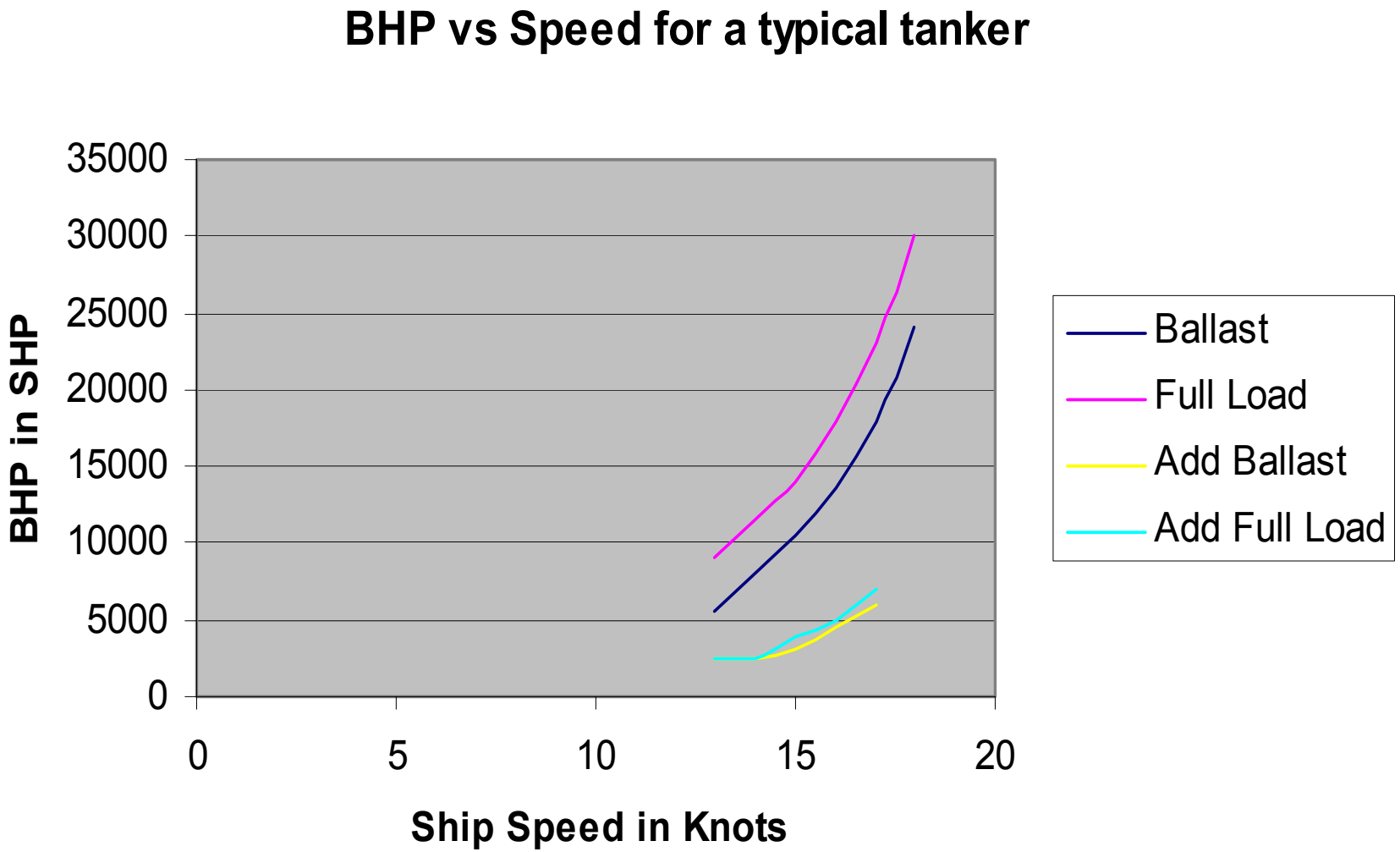
Sources of Fuel Waste

- Bad weather routing
- Improper speed management

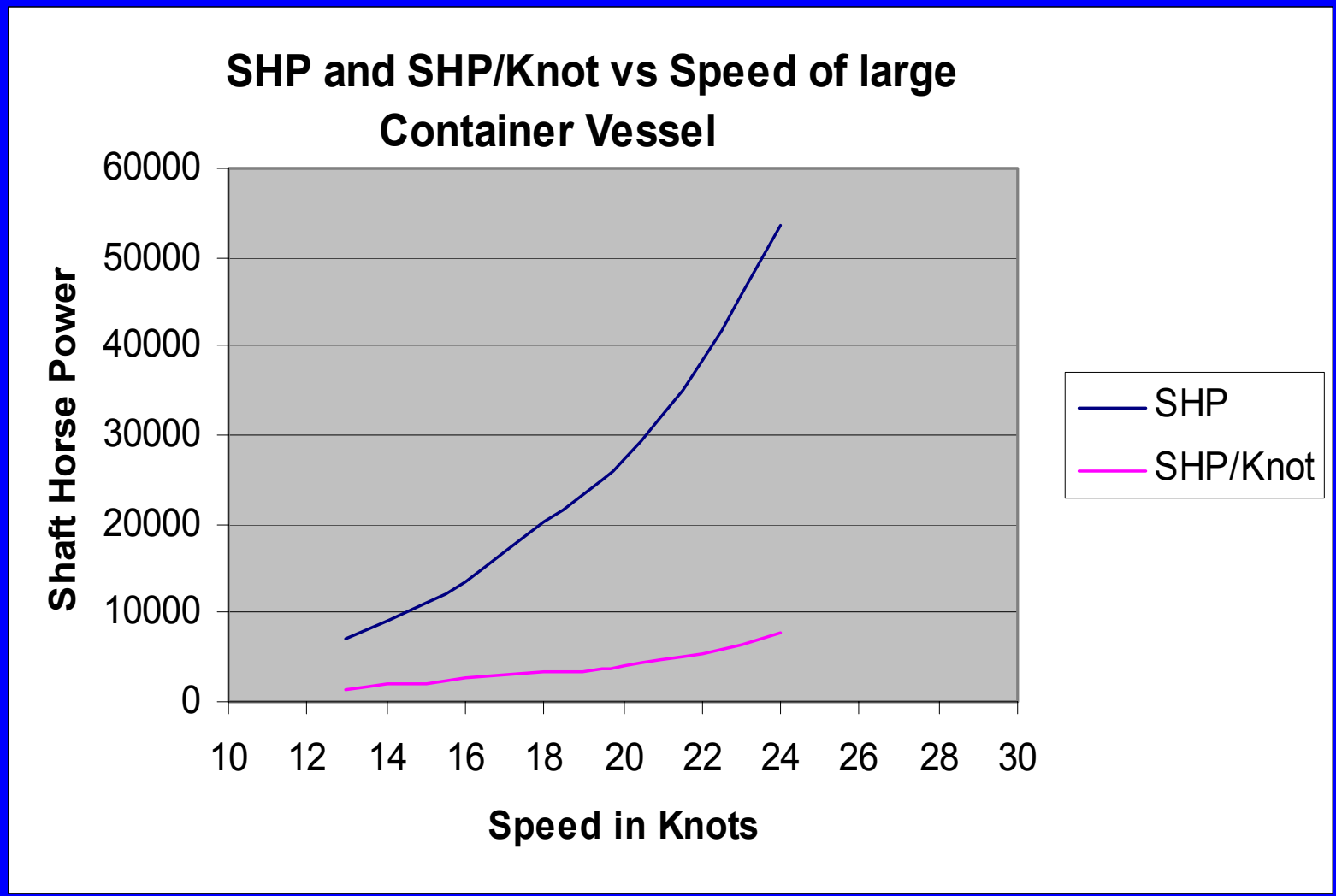
  e.g. Tried to increase speed in head seas;

  Too high speed in the beginning of a voyage to make sure on-time arrival
- Engine not properly tuned
- Propeller/hull fouling
- Improper trim and GM

Required SHP to increase extra knot doubled (2X) from 13-16 knots



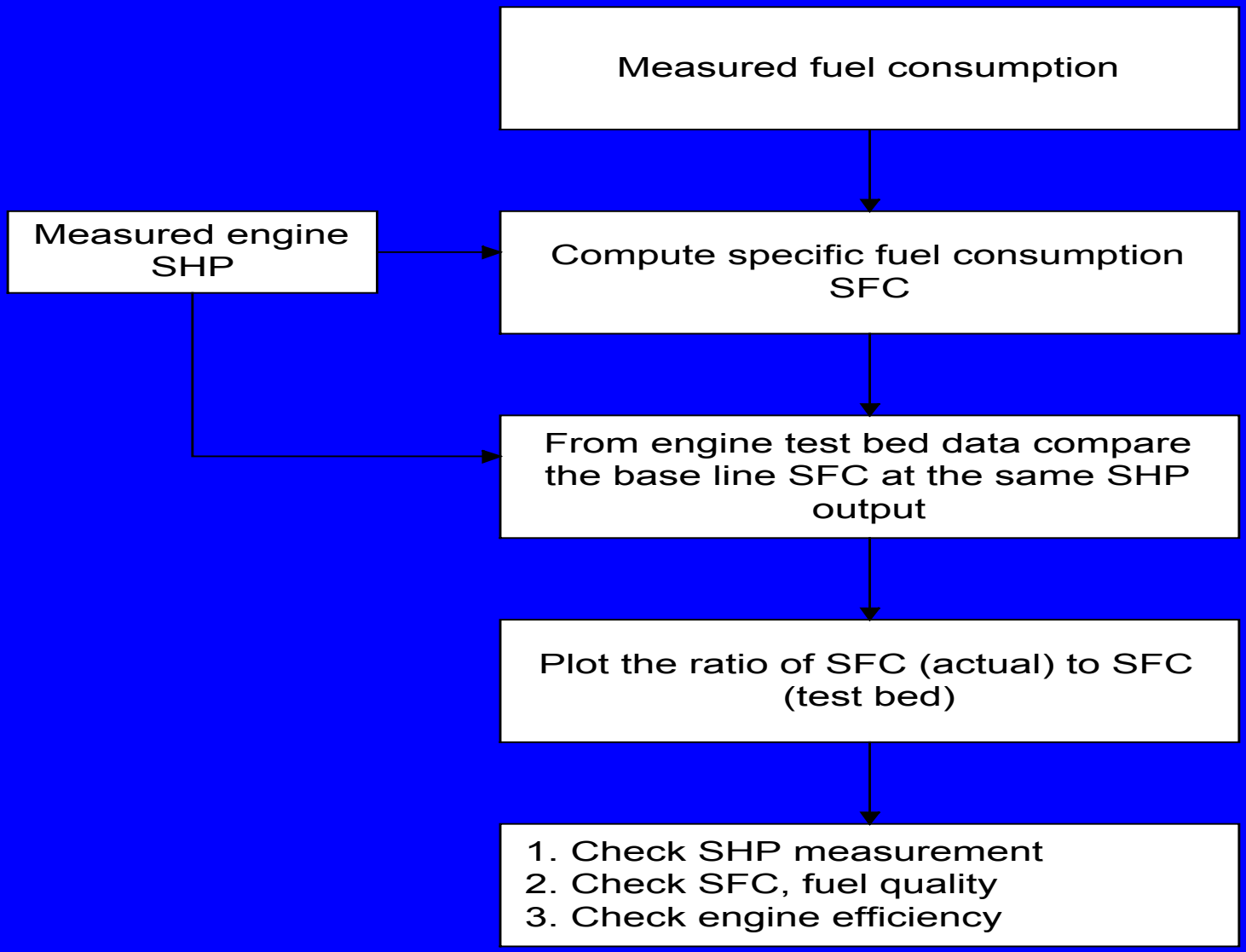
Required SHP to increase extra knot is 4X at 23 knots compared to 13



Engine Efficiency and Weather Factor

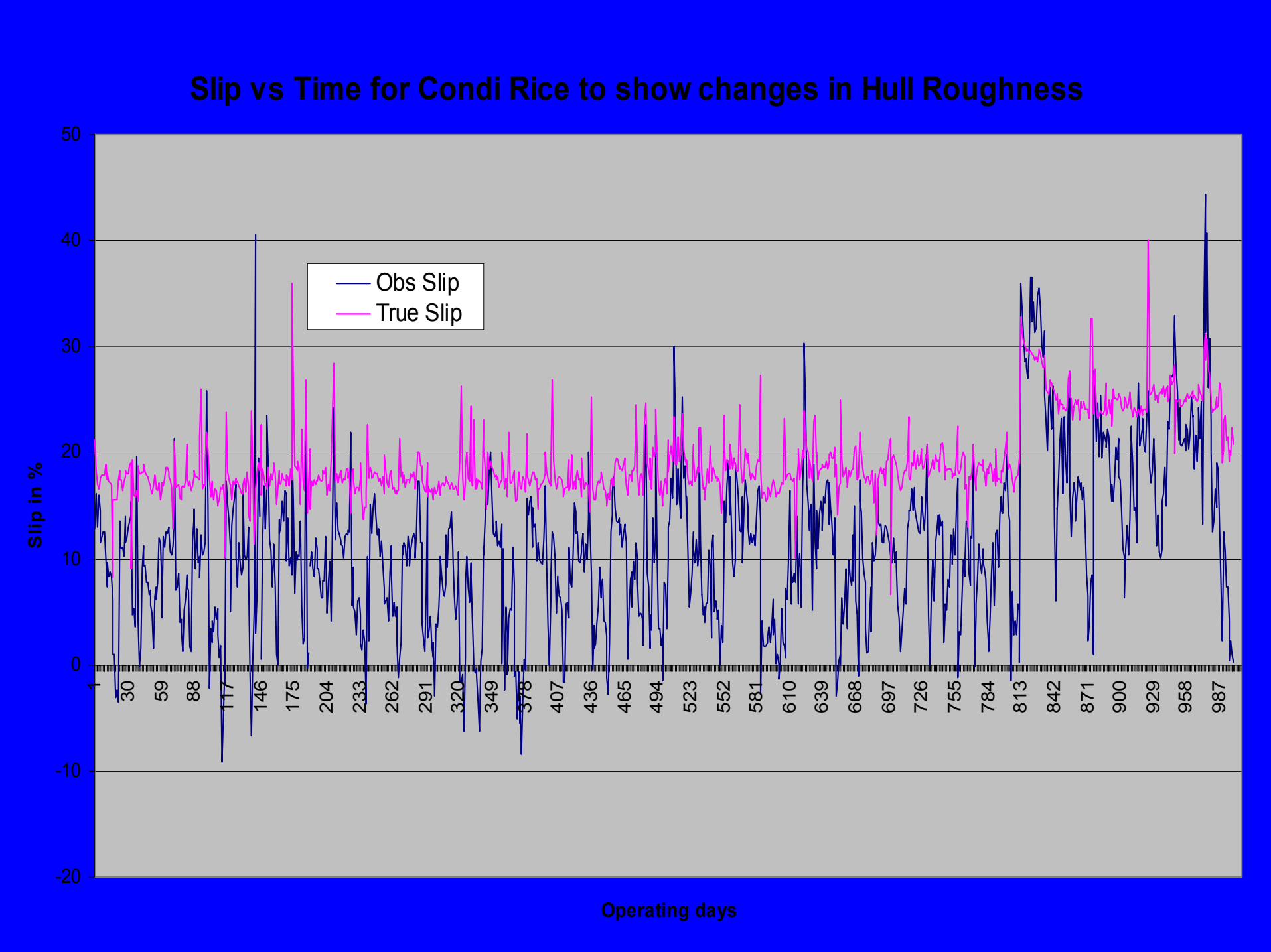
- Plot SFC ratio = SFC actual / SFC ideal over time to see trends
- If the engine is properly tuned and fuel quality is good, the SFC should be very close to the engine test-bed condition at the same power output
- Plot WX = SHP actual / SHP calm weather
- Check trends and compare to base line

Engine Efficiency and Fuel Quality Monitoring

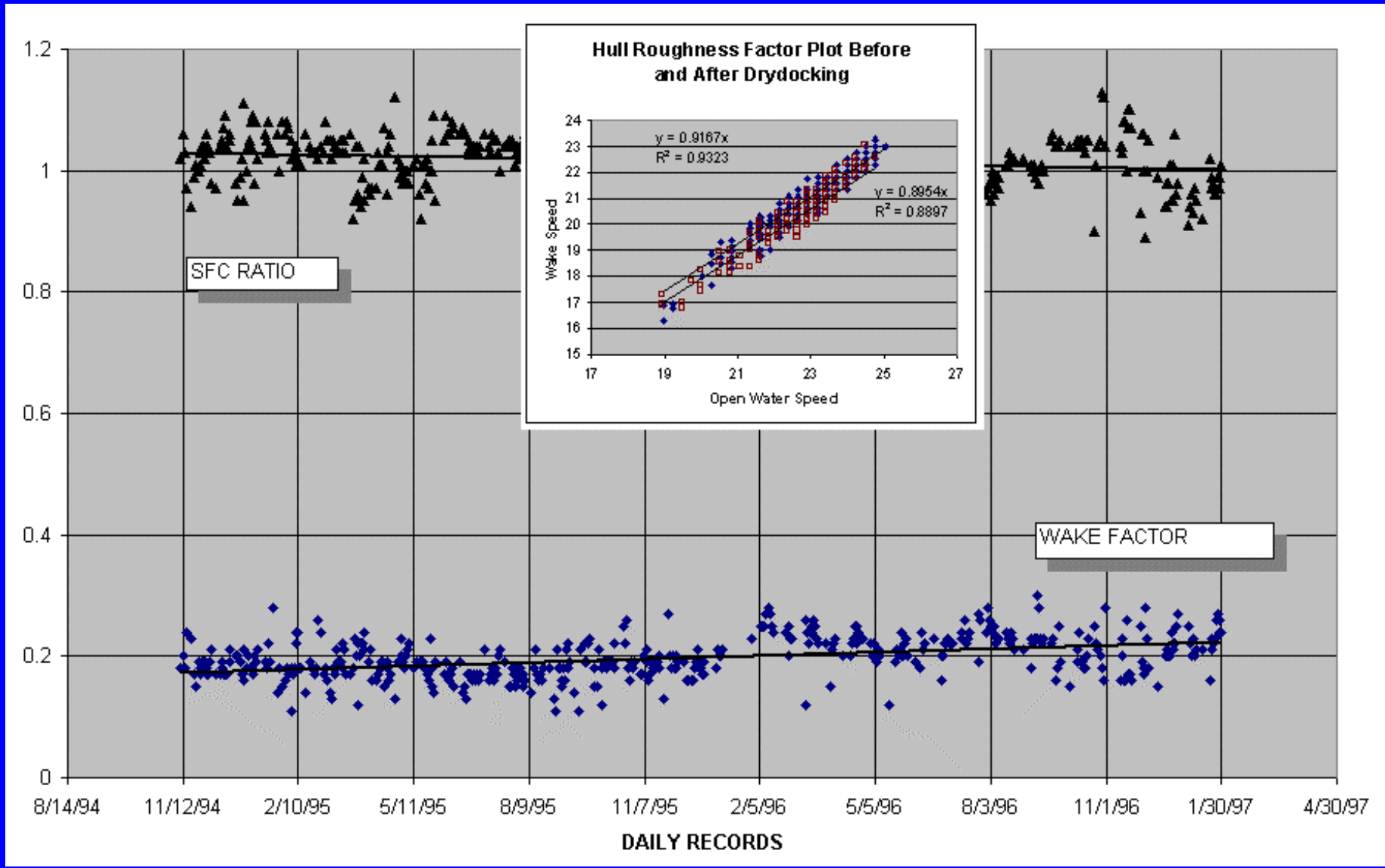


Hull/Propeller Roughness

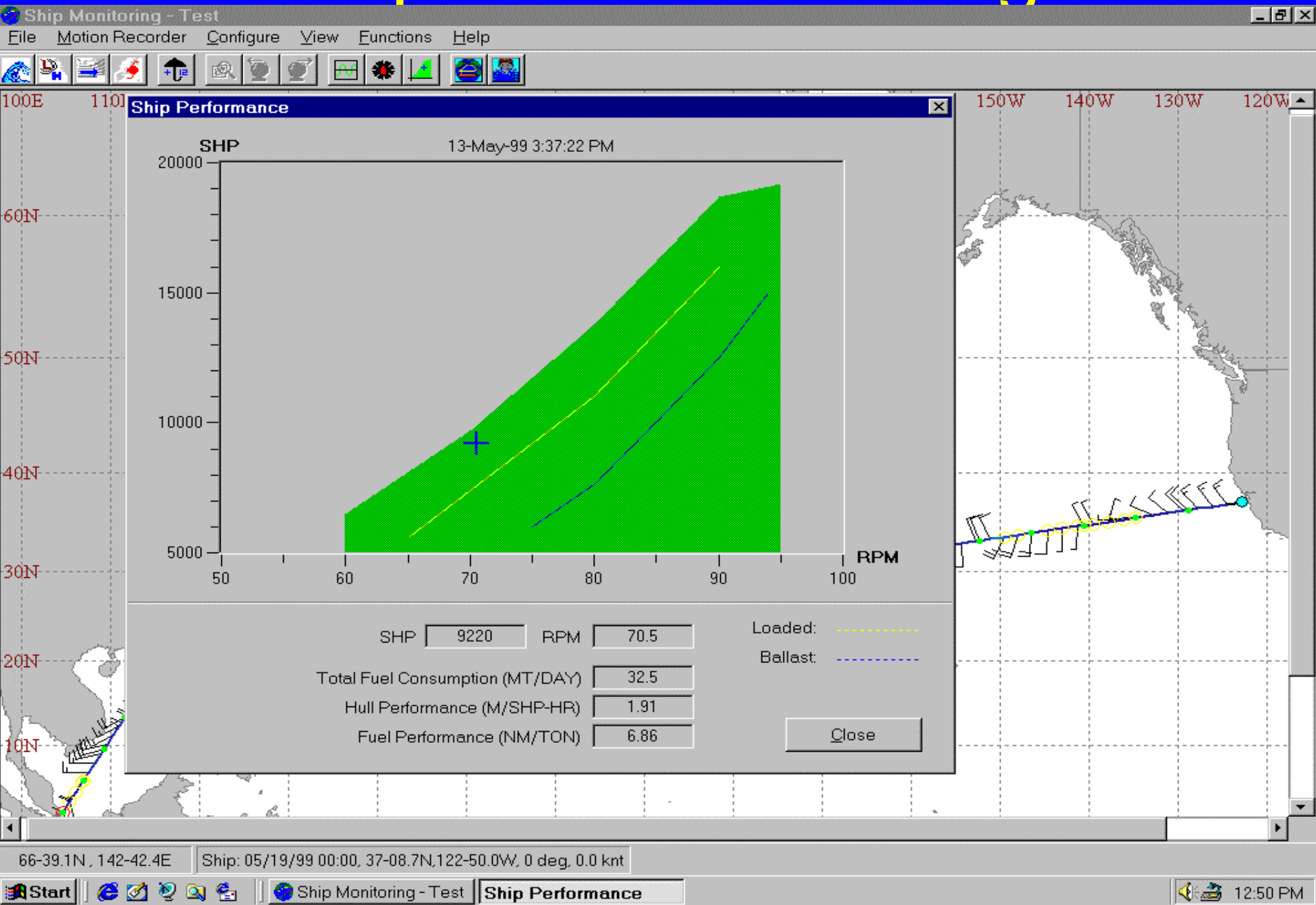
- True slip increases when hull/propeller roughness increase
- Observed slip not a good measure
- Need to account for the effect of weather and draft changes to reduce scatter
- Other indicators (EngineTemperature, Torque limits in calm weather etc.)
- Thrust meter needed to separate hull/prop
- Post Voyage analysis to create database


Slip vs Time for Condi Rice to show changes in Hull Roughness
Obs Slip
True Slip
Slip in %
Operating days
50
40
30
20
10
0
-10
-20
1
30
59
88
117
146
175
204
233
262
291
320
349
378
407
436
465
494
523
552
581
610
639
668
697
726
755
784
813
842
871
900
929
958
987

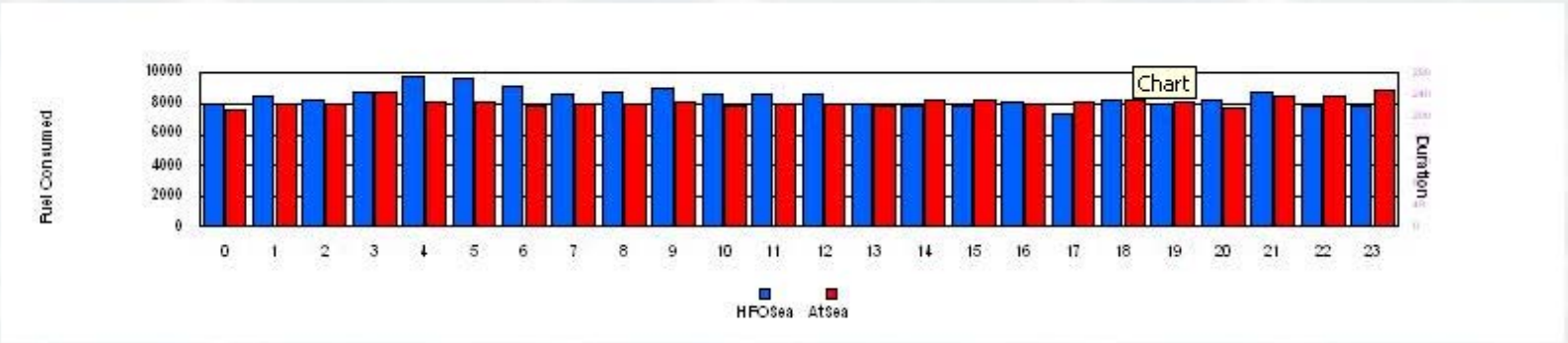
Performance Evaluation



Shipboard Monitoring



Comparison of Fuel and Transit time for the same passage



Multiple Passage Report

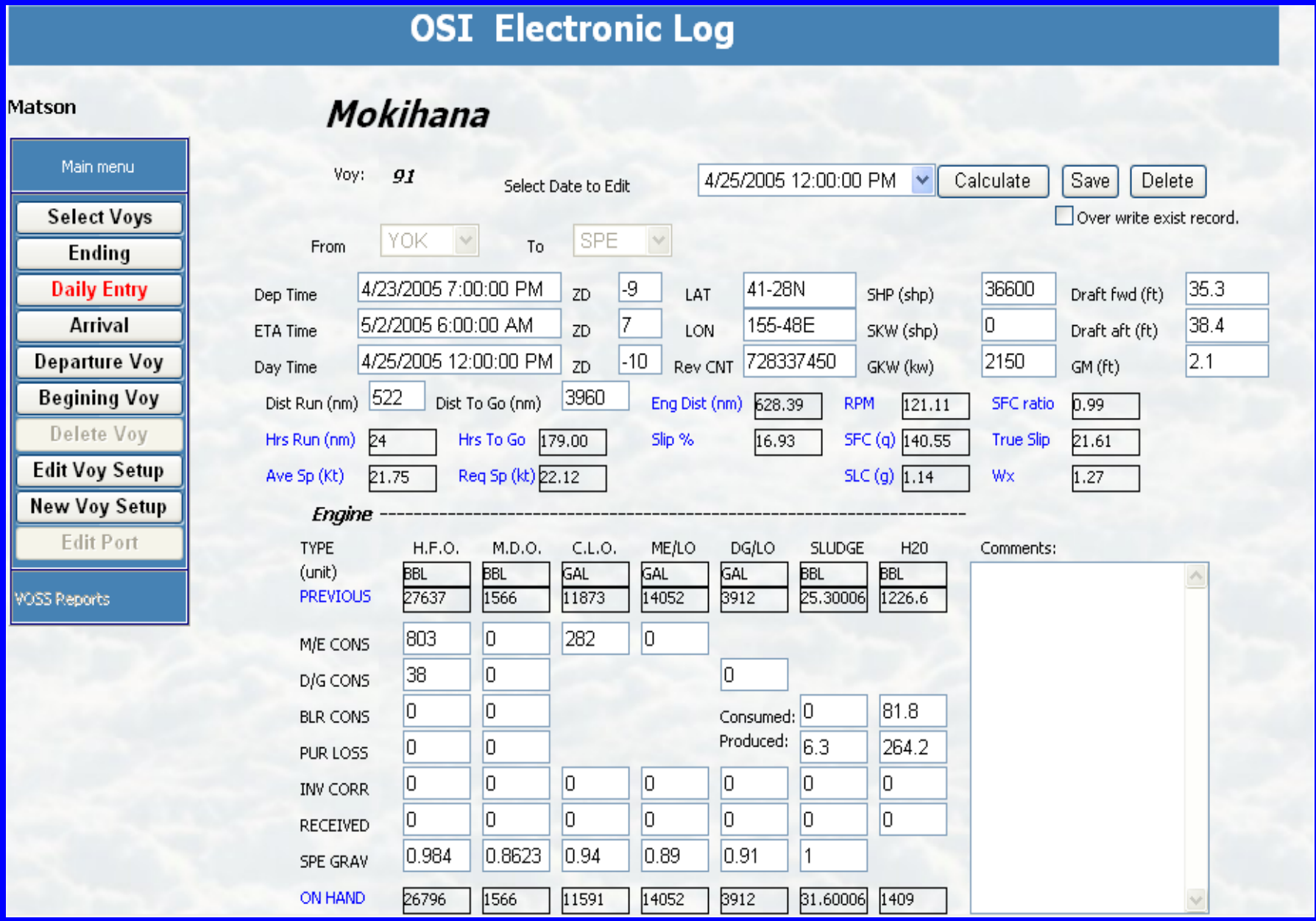
Dep Port: OAK

Arr Port: GUM

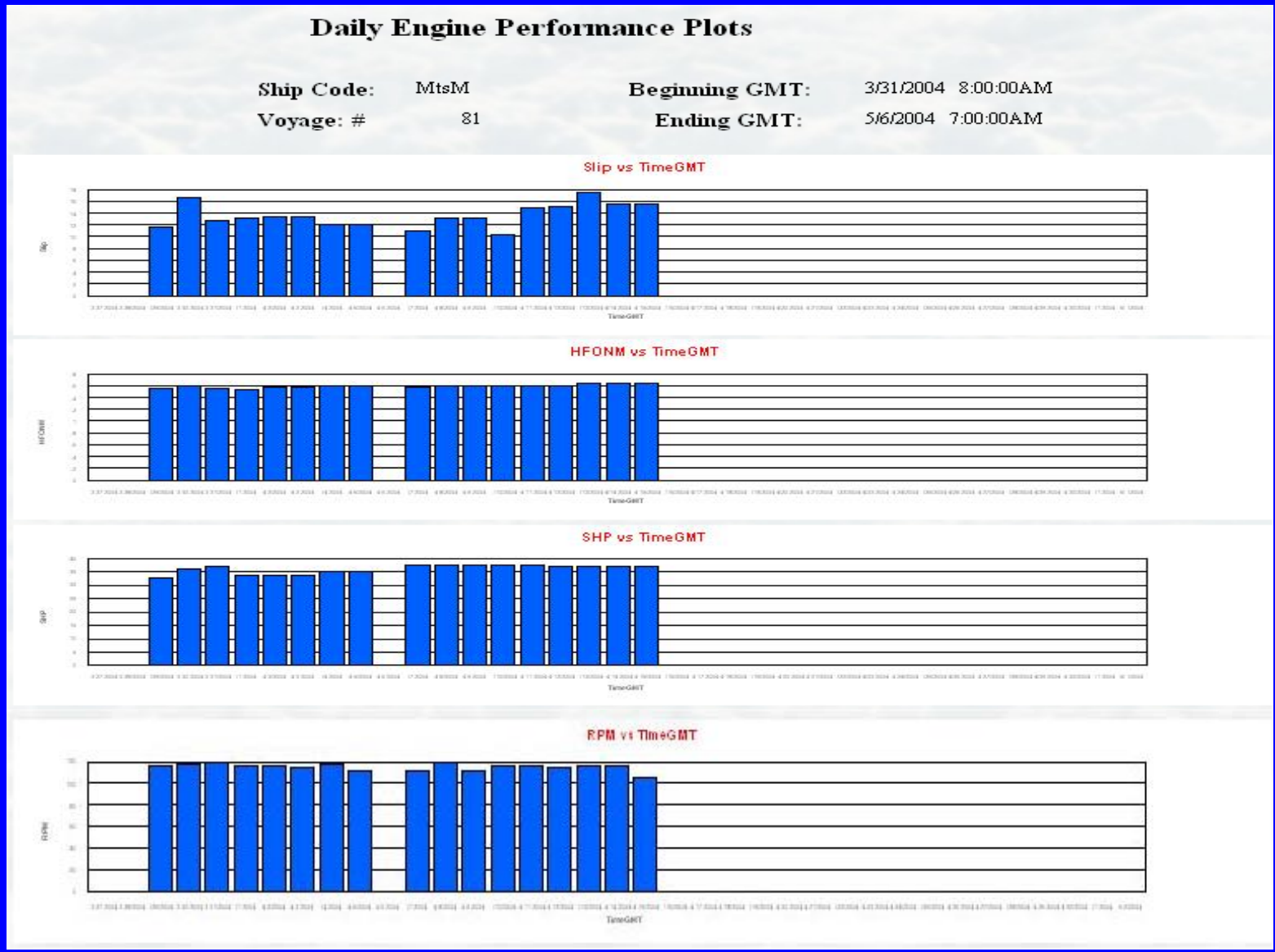
Report generate at : 9/28/2005 3:13:04PM

In Port hrs	At Sea hrs	Fwd Draft ft	Aft Draft ft	Ave Spd kn	Performance True Slip	Wx	SFC Ratio	Eng Miles NM	Obs Miles NM	In Port HFO total BBL	In Port MDO total BBL	In Port CLO total BBL	At Sea HFO total BBL	At Sea MDO total BBL	At Sea CLO total BBL	SFC g/SHP-hr	HFO/ NM BBL	Obs Slip %	RPM	Engine Power SHP
Rec: 0	**Ship Code:** MtsMHI				**Voy # :** 44			**Dep. Time:** 7/15/2000 4:12:00AM					**Arr. Time:** 7/24/2000 3:00:00AM							
41.2	214.8	26.3	32.6	23.5		1.1	1.0	5,545.7	5,040.8	280.0	35.0	0.4	7,967.0	15.0	53.4	162.6	1.6	9.1	119.4	34,641.5
Rec: 1	**Ship Code:** MtsMHI				**Voy # :** 46			**Dep. Time:** 9/23/2000 1:00:00PM					**Arr. Time:** 10/2/2000 8:24:00PM							
41.2	223.4	30.0	34.3	22.8		1.3	1.0	5,845.9	5,102.0	212.0	17.0	0.4	8,562.0	282.0	48.0	153.9	1.7	12.7	121.0	37,809.6
Rec: 2	**Ship Code:** MtsMHI				**Voy # :** 48			**Dep. Time:** 12/1/2000 6:12:00PM					**Arr. Time:** 12/11/2000 3:00:00AM							
27.4	224.8	30.4	29.4	22.7		1.2	1.0	5,774.2	5,104.8	146.0	56.0	0.4	8,279.0	330.0	53.9	156.3	1.6	11.6	118.8	35,787.2
Rec: 3	**Ship Code:** MtsMHI				**Voy # :** 49			**Dep. Time:** 1/6/2001 2:30:00PM					**Arr. Time:** 1/16/2001 8:48:00PM							
29.6	246.3	28.0	30.8	22.0		1.3	1.0	6,131.0	5,410.1	170.0	34.0	0.4	8,722.0	58.0	56.9	159.4	1.6	11.8	115.1	33,725.2
Rec: 4	**Ship Code:** MtsMHI				**Voy # :** 50			**Dep. Time:** 2/9/2001 6:42:00PM					**Arr. Time:** 2/19/2001 6:18:00AM							

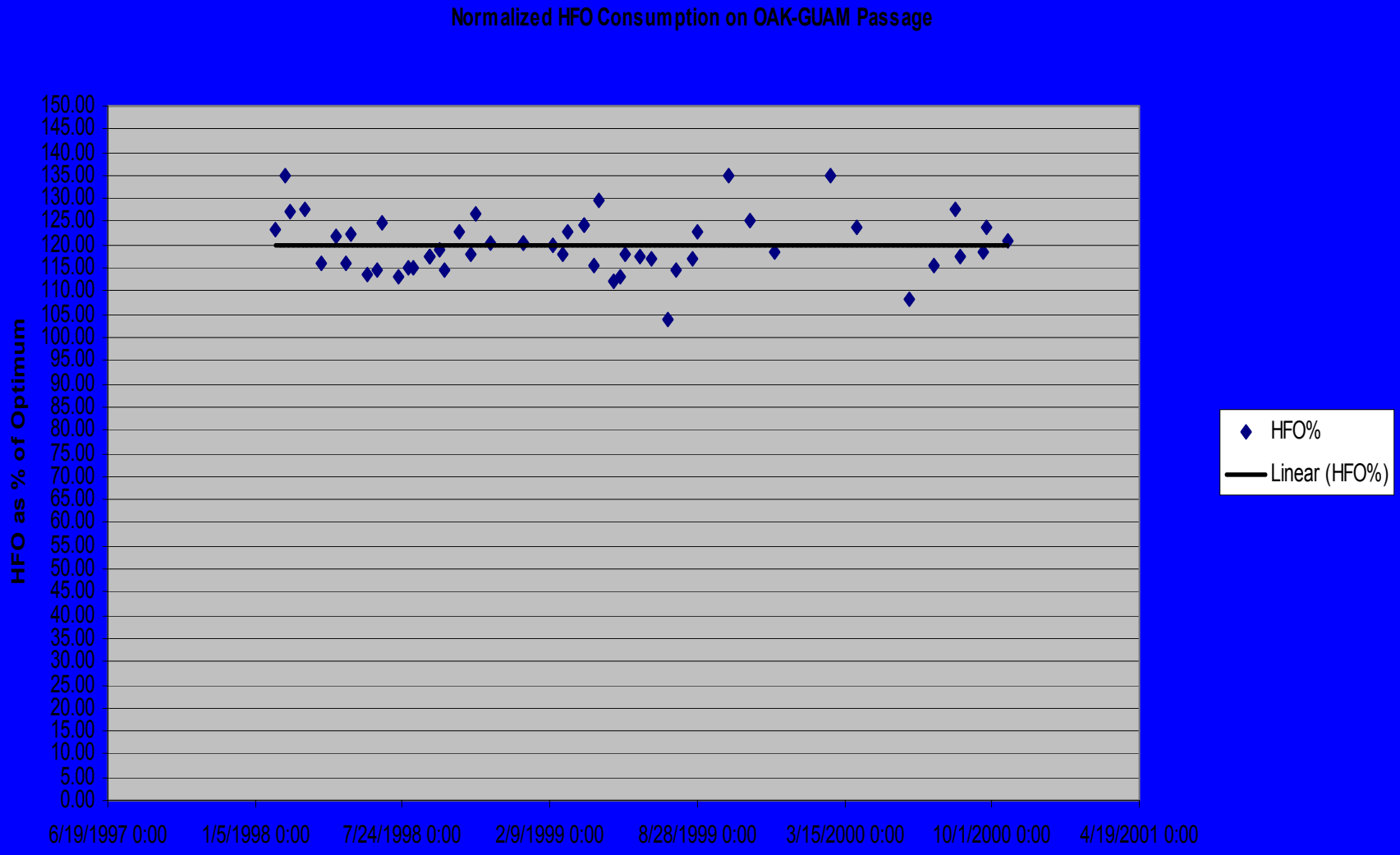
Capture performance data using Electronic Log



Evaluating Daily Performance



Fuel Consumption normalized by drafts and environmental conditions



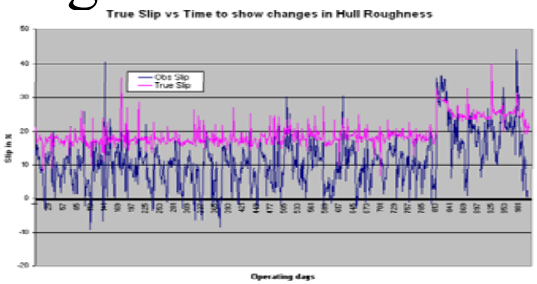
Use of Statistical Quality Control Techniques

- Originally developed for manufacturing QC/QA by Dr. Edwards Deming
- Establish historical level with random variation (Upper bound and lower bound)
- Sporadic departure from historical level can be explained
- Establish optimum level after the fact using hindcast data, i.e. post voyage optimization
- % approaching optimum demonstrates the effectiveness of operation policy changes

Operation Support Information via Web Services

- ✓ Hosting of secured voyage database for shipping companies
- ✓ Post Voyage analysis using VOSS weather, current and ship model

- ✓ Performance analysis on hull, propeller roughness
- ✓ Wave, Fatigue cycle counting
- ✓ Generate custom reports on energy
- ✓ conservation improvements



Performance Report

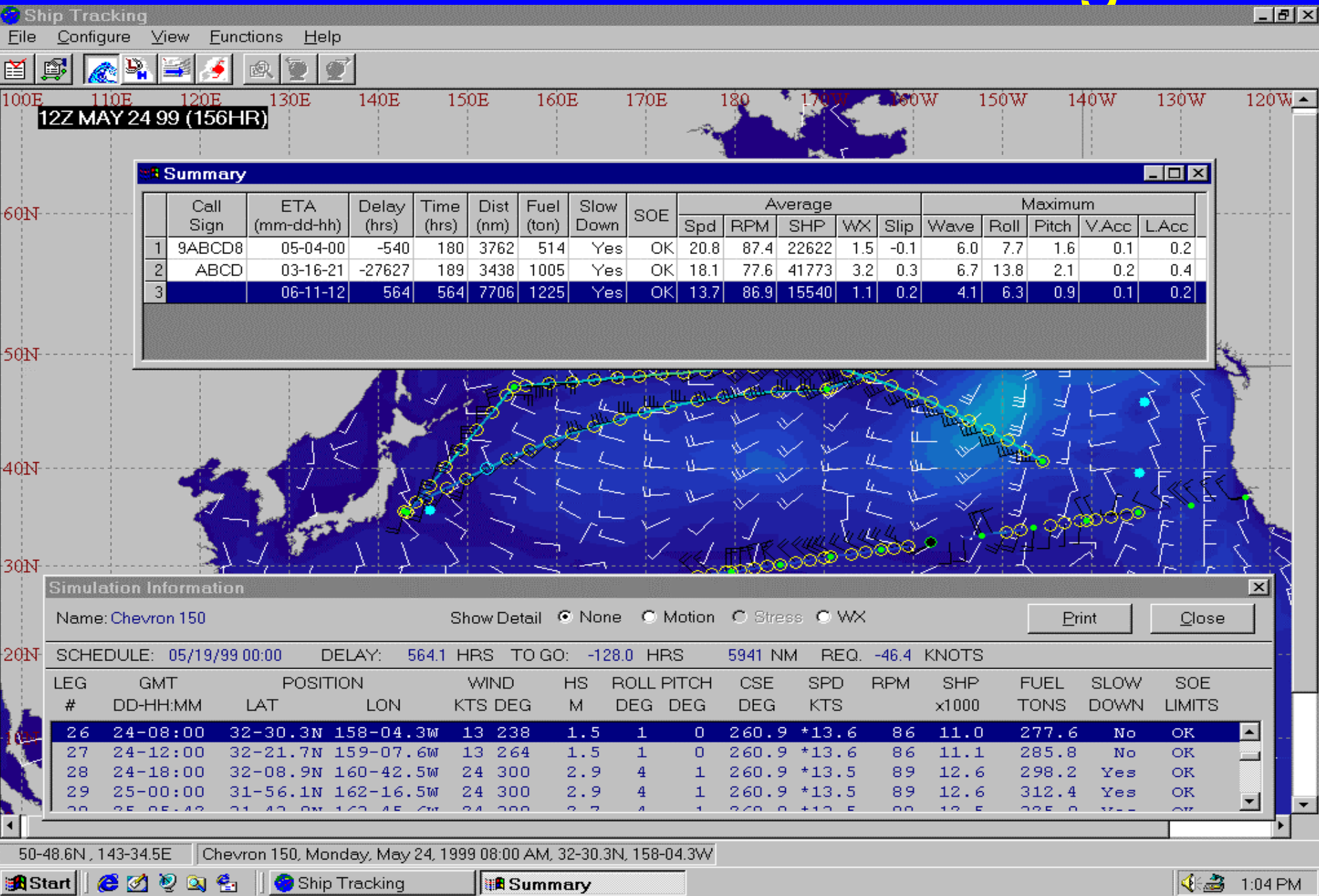
Departure: *C09* **Class:** *HON* **Beginning:** *2/15/1996*
Arrival: *GUM* **Ending:** *3/13/1996* Friday, March 04, 2005 12:45:51 AM

Code	Voy #	Service	Departure GMT	Arrival GMT	In Port hrs	At Sea hrs	Fwd Draft ft	Aft Draft ft	Ave Spd kn	Performance Trns Ship	Wx Eng Ratio		Eng Miles NM	Obs Miles NM	In Port HFO	In Port MDO total	In Port CLO	At Sea HFO	At Sea MDO total	At Sea CLO	SFC g/KHP-hr	HFO/ NM BB	Obs Slip	RPM	Engine Power SHP
															BBL/hr				BBL/hr						
MHI	1	PIX	2/15/1996 2:54:00	2/21/1996 9:30:00	37.9	150.	28.4	29.0	22.0	17.3	1.0	0.9	3563	3315	147	27	12	5194	7	1427	155.	1.58	4.5	109	31414
															3.9	0.7	0.3	34.5	0.0	9.5					
MNA	1	PIX	2/22/1996 3:12:00	2/28/1996 7:00:00	33.7	147.	27.4	30.3	22.4	17.2	1.0	1.2	3590	3315	140	0	40	4805	40	1140	179.	1.45	7.4	112	24595
															4.2	0.0	1.8	12.5	0.4	7.2					
MKA	1	PIX	3/7/1996 5:42:00	3/13/1996 4:30:00	38.5	142.	30.8	31.5	23.3	14.0	0.9	1.1	3458	3323	110	0	1	5490	0	1393	177.	1.45	9.1	119	27504
															2.9	0.0	0.0	38.4	0.0	9.8					
				Average	36.7	147.	28.9	30.3	22.6	16.2	1.0	1.0	3603.	3317.	139	9	24	5163	22	1320	170.	1.56	7.73	113.	28572
															3.8	0.2	0.7	35.1	0.2	9.0					

- ✓ Track ships and anticipate delay due to weather
- ✓ Emergency response

osi

Shore-side Fleet Tracking



	Call Sign	ETA (mm-dd-hh)	Delay (hrs)	Time (hrs)	Dist (nm)	Fuel (ton)	Slow Down	SOE	Average					Maximum				
									Spd	RPM	SHP	WX	Slip	Wave	Roll	Pitch	V.Acc	L.Acc
1	9ABCD8	05-04-00	-540	180	3762	514	Yes	OK	20.8	87.4	22622	1.5	-0.1	6.0	7.7	1.6	0.1	0.2
2	ABCD	03-16-21	-27627	189	3438	1005	Yes	OK	18.1	77.6	41773	3.2	0.3	6.7	13.8	2.1	0.2	0.4
3		06-11-12	564	564	7706	1225	Yes	OK	13.7	86.9	15540	1.1	0.2	4.1	6.3	0.9	0.1	0.2

LEG #	GMT DD-HH:MM	POSITION LAT	LON	WIND KTS	DEG	HS M	ROLL DEG	PITCH DEG	CSE DEG	SPD KTS	RPM	SHP x1000	FUEL TONS	SLOW DOWN	SOE LIMITS
26	24-08:00	32-30.3N	158-04.3W	13	238	1.5	1	0	260.9	*13.6	86	11.0	277.6	No	OK
27	24-12:00	32-21.7N	159-07.6W	13	264	1.5	1	0	260.9	*13.6	86	11.1	285.8	No	OK
28	24-18:00	32-08.9N	160-42.5W	24	300	2.9	4	1	260.9	*13.5	89	12.6	298.2	Yes	OK
29	25-00:00	31-56.1N	162-16.5W	24	300	2.9	4	1	260.9	*13.5	89	12.6	312.4	Yes	OK

Examples of Operation Support Information

- Provide detailed long range wind and wave forecast to assist Captain in planning optimum passages.
- Provide expert advice on motion/stress responses in heavy weather to minimize risk of damage.
- Monitor motion and engine performance and alert the operator of impending danger as well as avoid Engine overload.
- Analysis of voyage record to improve performance
- Training and accident prevention

Benefits of OSI Technology Solution

- Complete model ship motion and structure responses; engine and power characteristics.
- Optimum ship routing to increase schedule reliability, minimize damage and fuel cost.
- Voyage Data Recorder to capture pertinent operation data for incident investigation and training.
- Real-time display to alert operator of abnormal conditions and damaging events.
- Post voyage analysis to evaluate/monitor performance of hull, engine and propeller.

Here is what a client found after using OSI

- Actual number of hours delayed due to heavy weather decreased by 80%
- Number of Structural damage claims due to heavy weather decreased by 73%, cost by 29%
- Cargo damage claims due to heavy weather decreased by 87%
- Eliminated 23% variability in fuel consumed on each crossing.

Partial list of clients

- The US Navy, Coast Guard
- Maersk Sea-Land, US Ship Management
- American Ship Management, APL
- Matson Navigation
- Chevron Shipping, SeaRiver Maritime
- CSX Lines
- Royal Caribbean Cruise Lines

Contact: Ocean Systems Inc.
2701 Monarch Street #210
Alameda, CA 94501
U.S.A.

Tel: 1 (510) 337-0812
Fax: 1 (510) 337-0120
E-mail: osi@ocean-systems.com
Web: www.ocean-systems.com

Company Profiles

- OSI and OWI were founded 16 and 22 years ago.
- Staffed with professional meteorologists, scientists. Oceanographers, naval architects, computer programmers and a ship captain.
- Major clients include Army, Navy, international oil companies, shipping lines and engineering firms.
- Joint Venture established 10 years ago. Over 100 ships currently using the routing system. 5 oil companies using the South China Sea Typhoon Forecast System since 95.
- VOSS has developed over the last 15 years with help of shipboard captains and engineers under several government sponsored programs. A version is used by the US Navy OTSR Centers.