

# *Applied Weather Technology*

## Ship Routing Services

Ship Efficiency  
1st International Conference  
Hamburg, October 8-9 2007



# Weather Routing – State of the Art

- shore-based routing (minimum time, minimum fuel consumption (ETA service))
- onboard voyage planning system BonVoyage
- delivering services through BonVoyage
- keys to improved quality
  - data quality
  - risk factors
  - optimization
  - severe motion alert
  - alarms



# Standard Ship Routing – Message Traffic

\*\*\*\*\*AWT 2007/05/29 18:52Z\*\*\*\*\*  
 TO: MASTER/MV \*\*\*\*\*  
 FM: AWT, 29 MAY, 07

THE FOLLOWING IS BASED ON ETD 30 MAY, 07 FROM BREMERHAVEN  
 TO HALIFAX AT CALM SEA SPEED 20 KNOTS.

IF YOUR DEPARTURE IS DELAYED BEYOND THE 30TH, PLEASE ADVISE  
 YOUR LATEST ET FROM BREMERHAVEN PILOTS

\*\*\*\*\*MASTER 2007/05/29 16:06Z\*\*\*\*\*  
 -----Original Message-----

1. WEATHER:  
 LAT/LONG/MB (H-HIGH, L-LOW, G-GALE, S-STORM)  
 FCST 30/12Z 31/12Z 01/12Z 02/12Z  
 1) L 59N14W999 61N27W002 60N39W003 56N49W007  
 2) G 52N16W992 53N14W999 55N12W006 WEAKEN  
 3) G 46N44W004 49N30W995 51N36W996 53N33W002  
 4) G 34N57W007 40N42W000 50N23W988 58N18W977

1. \*\*\*\*\* / \*\*\*\*\*
2. \*\*\*\*\*
3. Inmarsat B: \*\*\*\*\*
- Inmarsat C: \*\*\*\*\*
- E-mail: charterers.\*\*\*\*\*
4. Departure port: Bremerhaven
5. Destination: Halifax
6. Route intentions: Westward

THE INTERNATIONAL ICE PATROL ESTIMATES THE LIMIT OF ALL  
 KNOWN ICE BERGS TO EXTEND FROM THE NEWFOUNDLAND COAST NEAR 4639N  
 5305W TO 4415N 4845W TO 4415N 4800W TO 4630N 4500W TO 4845N  
 4500W TO 4845N 4530W TO 4915N 4815W TO 5000N 4830W TO 5300N  
 4930W TO 5500N 5130W TO 5800N 5600W THEN EASTWARD.  
 WESTERN ICEBERG LIMIT ESTIMATED FROM NEWFOUNDLAND COAST NEAR  
 4924N 5815W TO 4925N 6035W TO THE QUEBEC COAST NEAR 5035W.  
 2. ROUTE RECOMMENDATION: DIRECT PENTLAND FIRTH,  
 GC/57N035W DIRECT HALIFAX VIA ABBAM CAPE RACE, THEN DIRECT  
 NAVIGATION AND CLEARING ICE BERGS PERMIT

APPROXIMATE DISTANCE 2885 NM FROM BREMERHAVEN TO HALIFAX  
 5841N 00802W  
 BROB: 5125.7/148.1  
 SPEED: 20.1 KTS  
 HEADING: 270  
 WIND: SSE/5  
 SEA: 2M  
 SWELL: ENE/2.5M  
 DAILY DISTANCE: 663  
 NEXT PORT: HALIFAX  
 ETA: 050607 1900 UTC  
 PLS SEND ALL YR MESSAGES TO ONE OF MOST CONVENIENT:  
 AWT, USA: EASYLINK: 62981091 (CODE 230), OPS@APPLIEDWEATHER.COM  
 - AWT 24/HOUR PHONE LINE IN U.S. 408 725 7200

Brgds/Message no.1

\*\*\*\*\*MASTER 2007/05/30 12:38Z\*\*\*\*\*  
 -----Original Message-----

From: \*\*\*\*\*  
 [mailto:charterers.\*\*\*\*\*@appliedweather.com]  
 Sent: Wednesday, May 30, 2007 15:21Z  
 To: awt@appliedweather.com  
 Subject: COSP-SAILING PLAN

\*\*\*\*\*-COSP: 300200Z (LAT=53)  
 ROB: FO=5259, 6 M/T MDO=148, 1  
 SAILING PLAN: DIRECT PENTLAND  
 HALIFAX VIA  
 CAPE RACE WELL CLEAR SOUTH  
 VESSEL PROCEED WITH ADJUST  
 5TH JUNE 1600 HRS LOCAL TIME

RGDS/MASTER  
 \*\*\*\*\*MASTER 2007/05/31 12:45Z\*\*\*\*\*  
 ----- Original Message -----  
 From: "\*\*\*\*\*"  
 [mailto:charterers.\*\*\*\*\*@appliedweather.com]  
 Sent: Thursday, May 31, 2007 12:45Z  
 Subject: \*\*\*\*\* - MSG No1

\*\*\*\*\*AWT 2007/05/31 15:21Z\*\*\*\*\*  
 TO: MASTER/MV \*\*\*\*\*  
 FM: AWT, 31 MAY, 07 1521Z

1. WEATHER:  
 LAT/LONG/MB (H-HIGH, L-LOW, G-GALE, S-STORM)  
 FCST 01/12Z 02/12Z 03/12Z 04/12Z 05/12Z  
 1) H ----- 49N60W018 47N50W024 48N46W030  
 2) G 53N28W990 61N36W989 58N27W989 62N31W990 MERGE  
 3) G 55N62W005 50N53W000 52N42W983 57N31W989 63N29W998  
 4) L 38N99W004 44N94W004 42N92W003 46N84W996 53N73W993  
 5) L-G ----- 29N80W008 33N72W007 35N69W003 38N66W006

FCST	WIND (D/BF/SEA)	SWELL (D/HT/PD)
01/12Z	ESE/6/3.0M	NNE/2.0M/12S
02/00Z	SSW/5/2.0M	NNE/1.5M/12S
02/12Z	W/6/2.5M	W/2.0M/8S
03/00Z	WSW/5/2.0M	NNW/1.5M/10S
03/12Z	W/6/2.5M	S/1.5M/6S
04/00Z	NW/4/1.0M	SW/2.5M/10S
04/12Z	ENE/5/1.5M	SSW/1.0M/8S
05/00Z	E/5/2.0M	NNE/1.0M/11S
05/12Z	ESE/5/2.0M	SSE/1.5M/8S

THE INTERNATIONAL ICE PATROL ESTIMATES THE LIMIT OF ALL  
 KNOWN ICE TO EXTEND FROM THE NEWFOUNDLAND COAST NEAR 4639N  
 5305W TO 4415N 4845W TO 4415N 4800W TO 4630N 4500W TO 4845N  
 4515W TO 5000N 4830W TO 5300N 4930W TO 5800N 5600W THEN  
 EASTWARD.

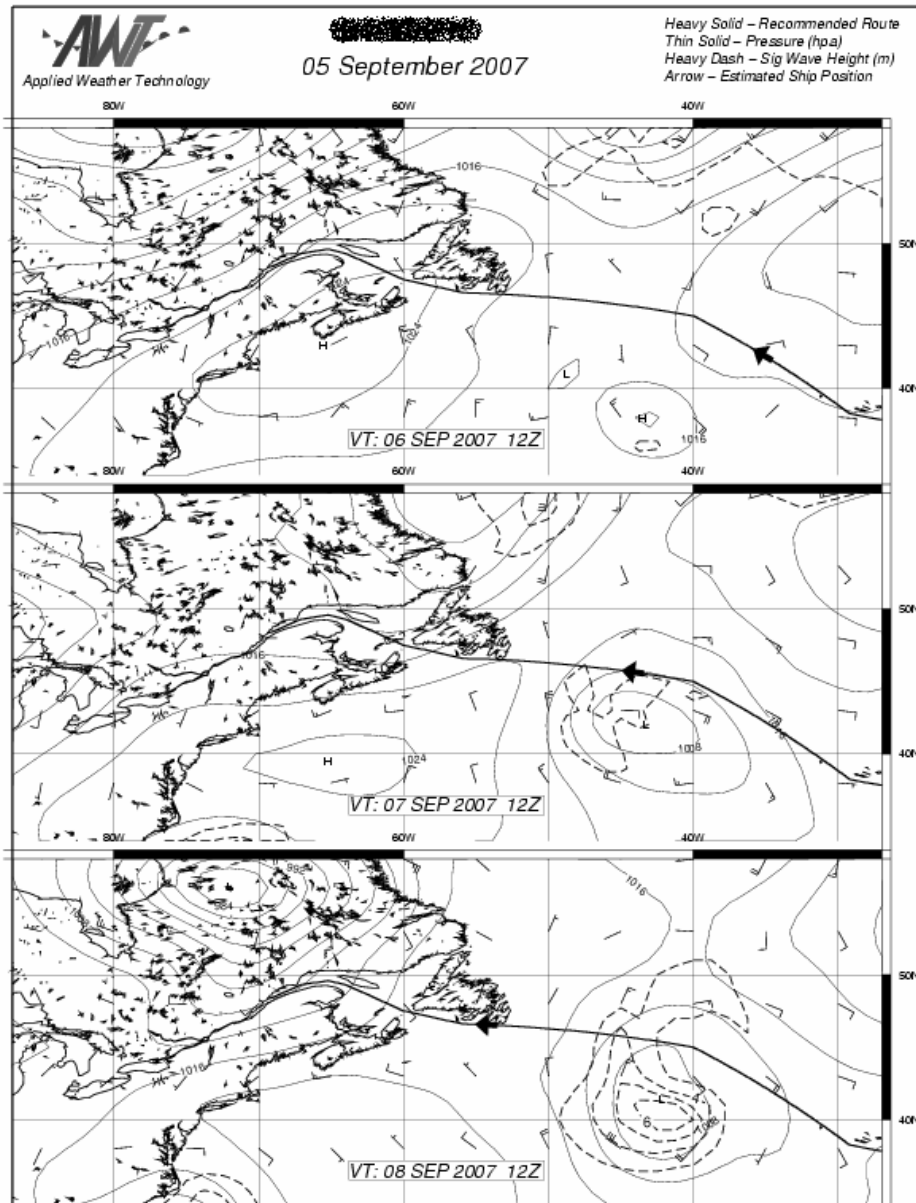
2. NOW RECOMMEND: AS SAFE NAVIGATION PERMITS, RL/45N40W,  
 RL/4400N4730W, THEN DIRECT HALIFAX PASSING NORTH OF SABLE  
 ISLAND.

COMMENTS: REVISED ROUTE SUGGESTED TO PASS WELL EAST/SOUTH  
 OF GALE(3) LISTED ABOVE (MAY BE NEAR STORM INTENSITY MAY  
 3RD-4TH) AND THE EXTENSIVE ICEBERG AREA.

PLEASE ADVISE INTENTIONS  
 Brgds/Message no.2



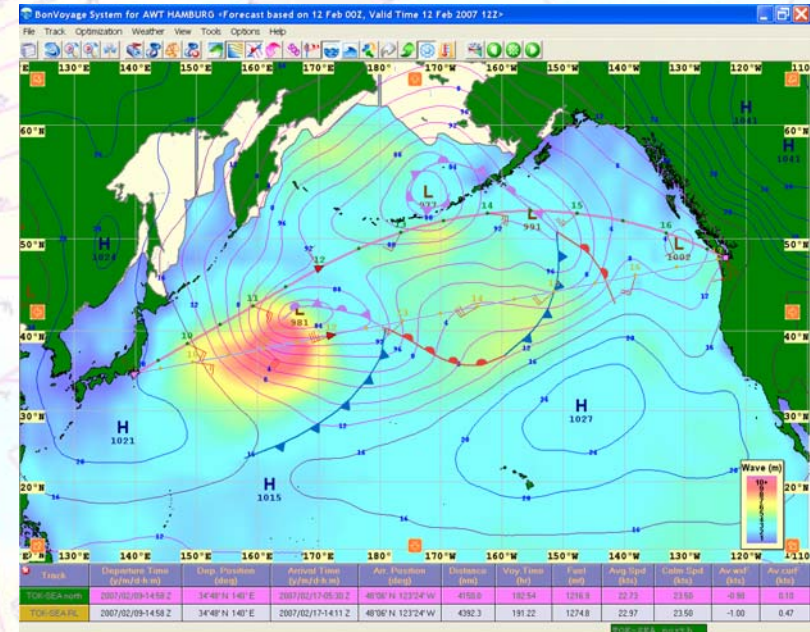
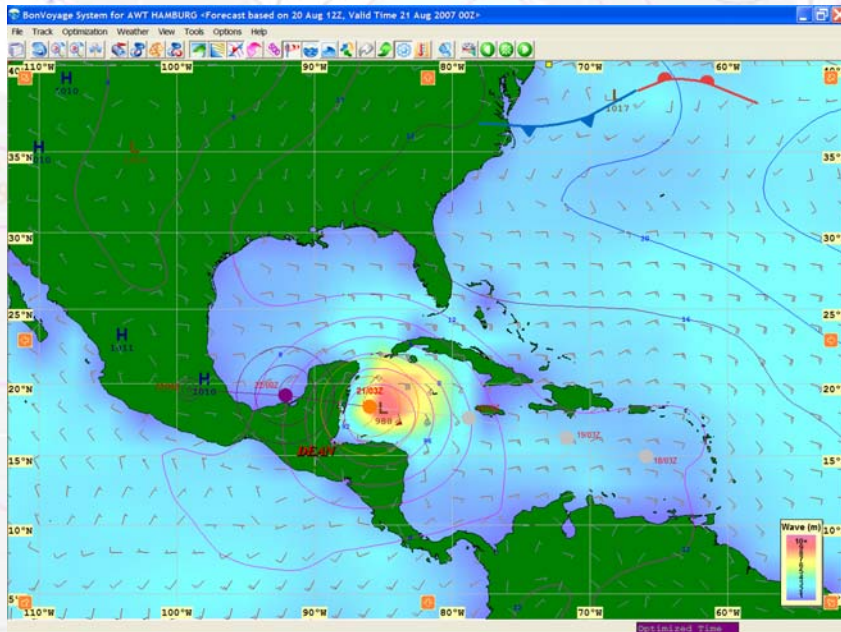
# 3-Panel Track/Weather Chart



- better understanding of given recommendation
- Weather data (windbarbs, pressure contours, significant wave height)
- Voyage track and dead-reckoned position



# Onboard Solution



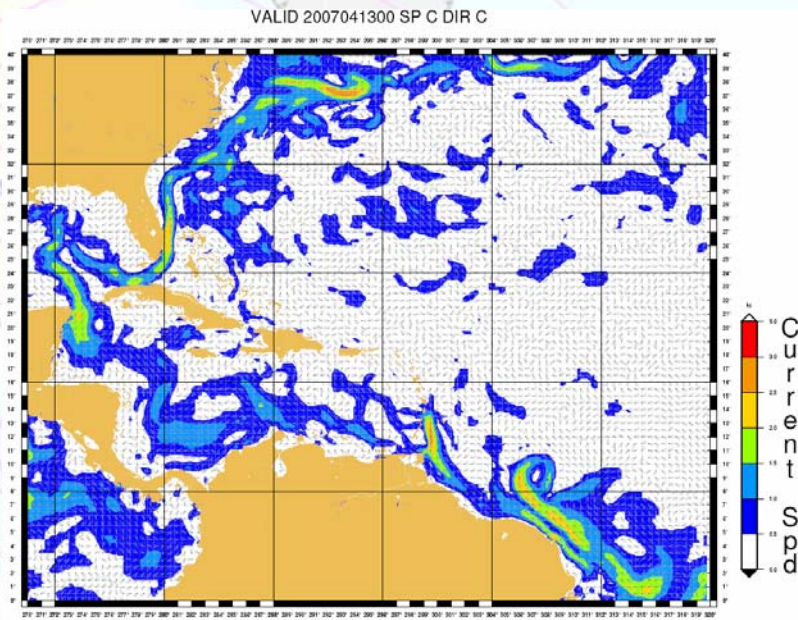
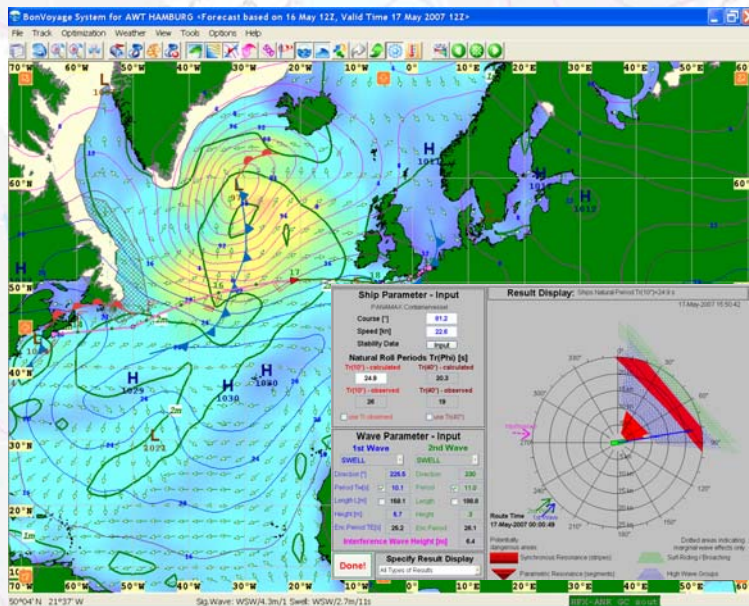
## BON VOYAGE SYSTEM

Onboard weather display and route optimisation software

- Data requests and forecasts provided through e-mail
- Weather parameter: Surface pressure, 500 mb heights, surface winds, sig. wave, swell, tropical storms, ice, current, sea surface temperature
- Route input & comparison
- Route optimisation with weather constraints and nogo areas
- Voyage simulation



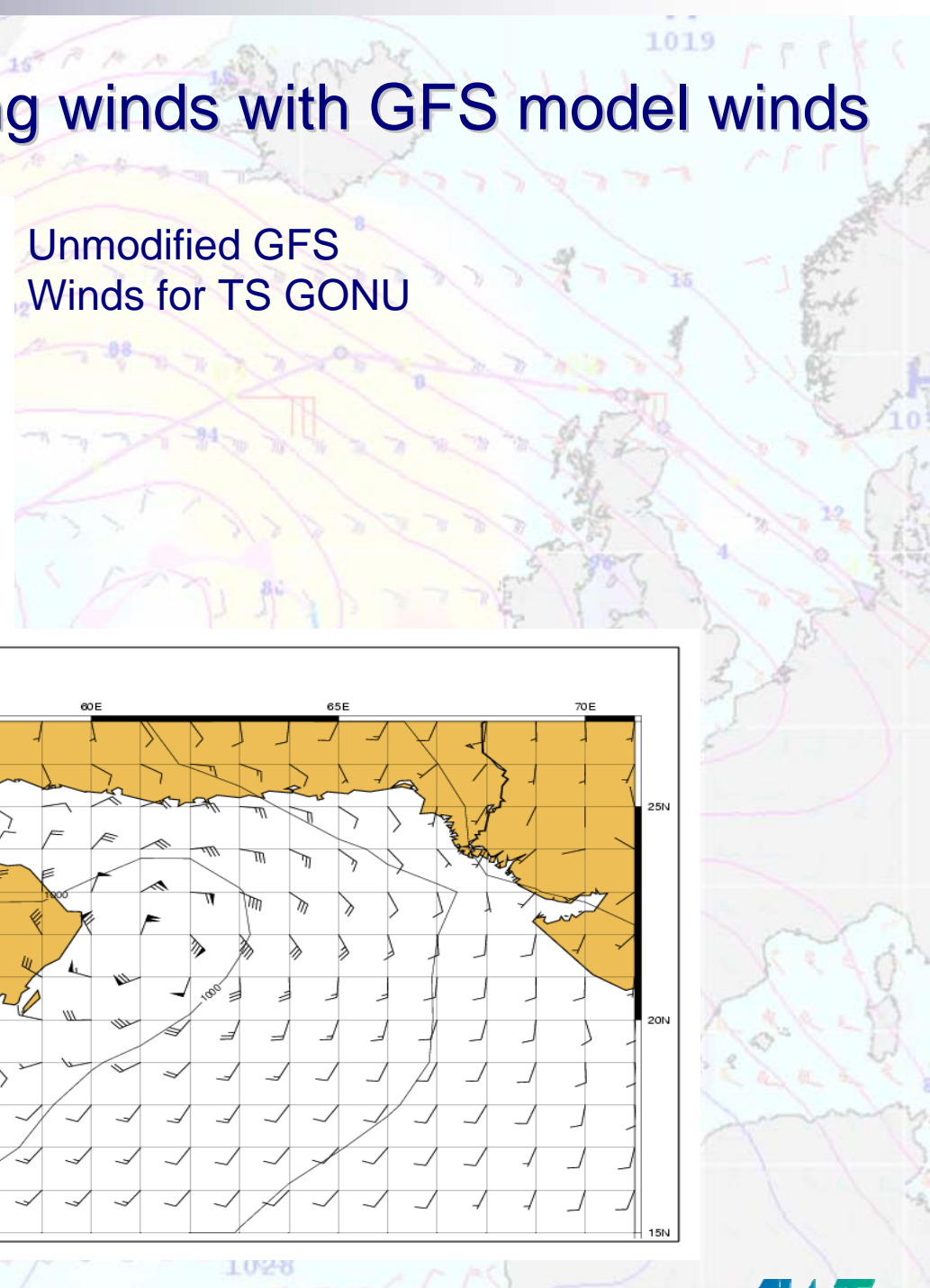
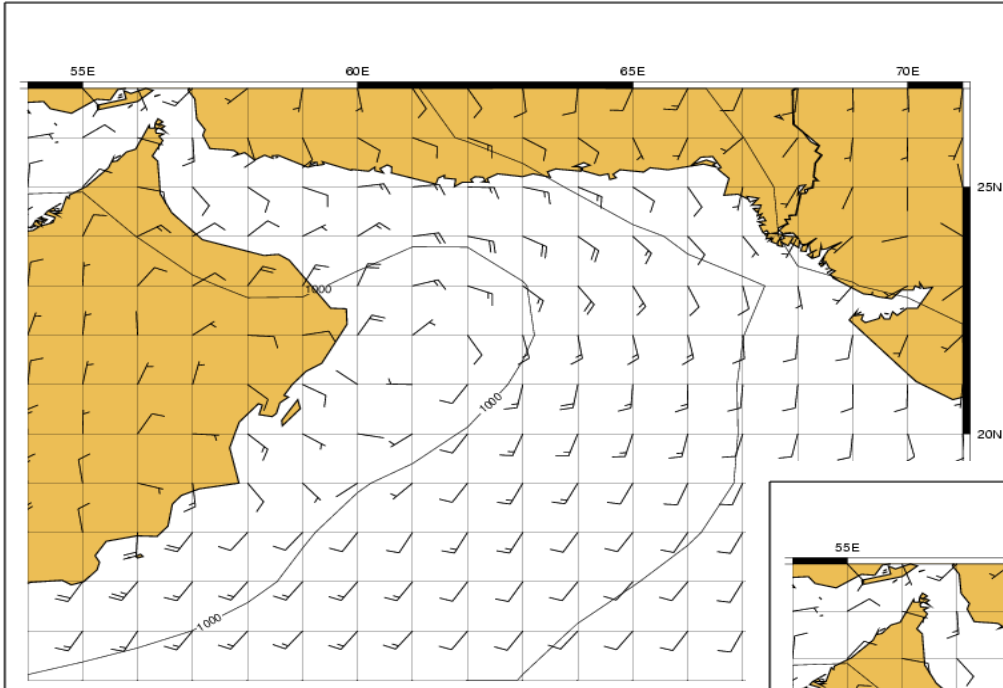
# Recent AWT Developments



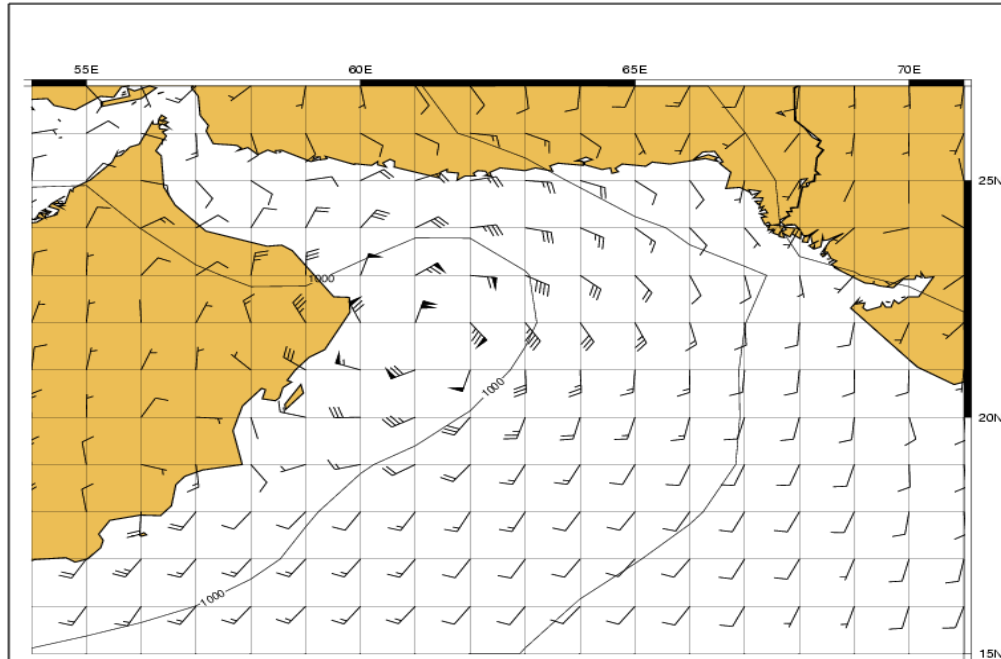
- AWT proprietary forecast out to 16 days
- Merging tropical cyclone warning winds with GFS model winds
- AWT WWIII Wave Model
  - Run twice daily 00 and 12 -> T+384
  - Unique AWT spectral energy decomposition sea, Swell + Primary, Secondary etc (up to 5)
  - Unique AWT blocking (suppress energy passing through land)
- Global NCOM current data [JunGulfStream0.gif](#)
- Routing and Avoidance of Heavy Motions
  - severe motions alert through Avoidance of Roll Resonance or Wave Impact (ARROW) program

# Merge tropical cyclone warning winds with GFS model winds

Unmodified GFS Winds for TS GONU



Warning winds merged with GFS winds



# Optimization

## Objective functions

- Voyage time  $\rightarrow$  min. (least time track)
- Fuel consumption  $\rightarrow$  min. (least fuel track for required arrival time)

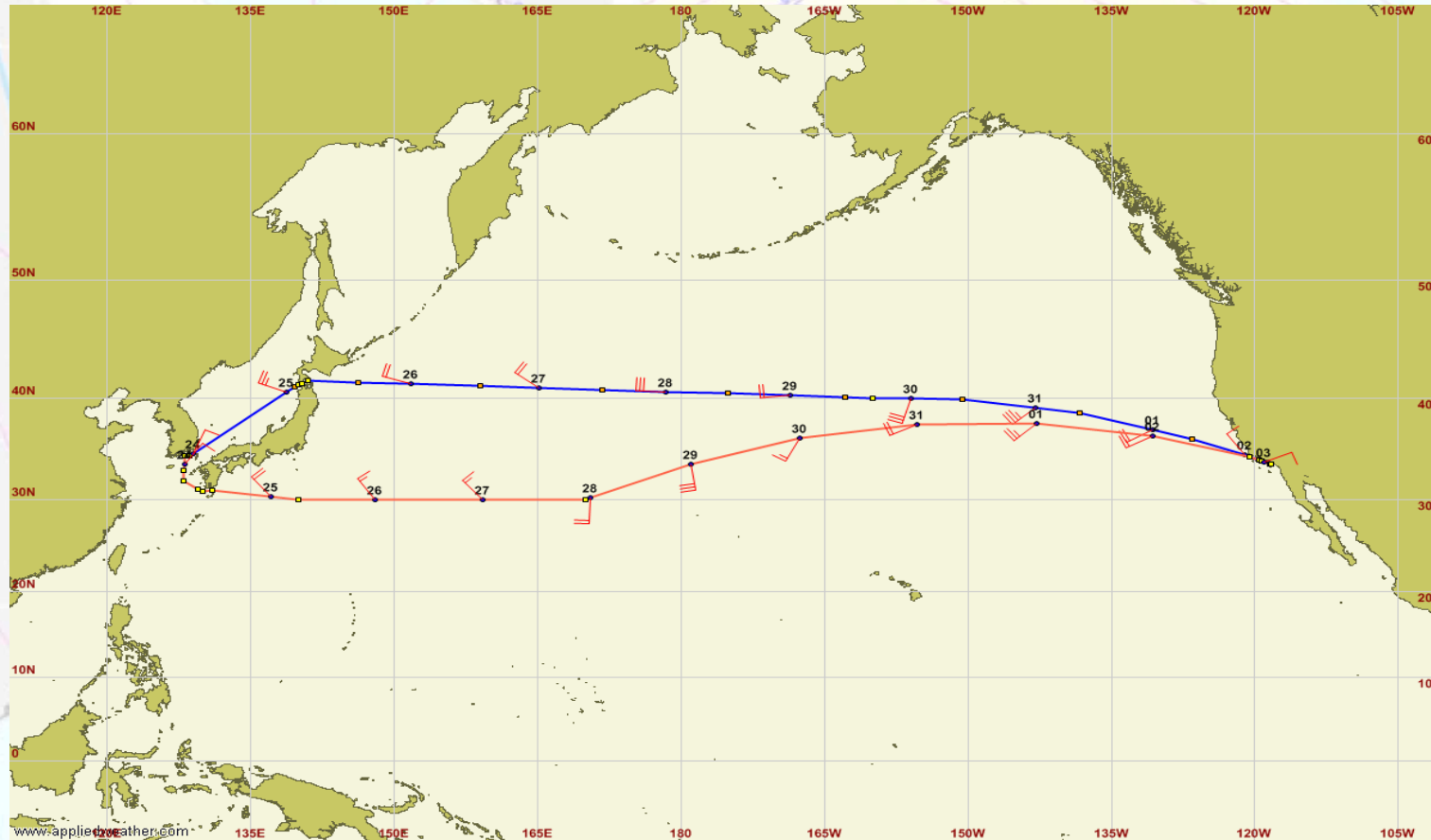
## Constraints

- Weather induced constraints
- NoGo areas



# Busan - Long Beach

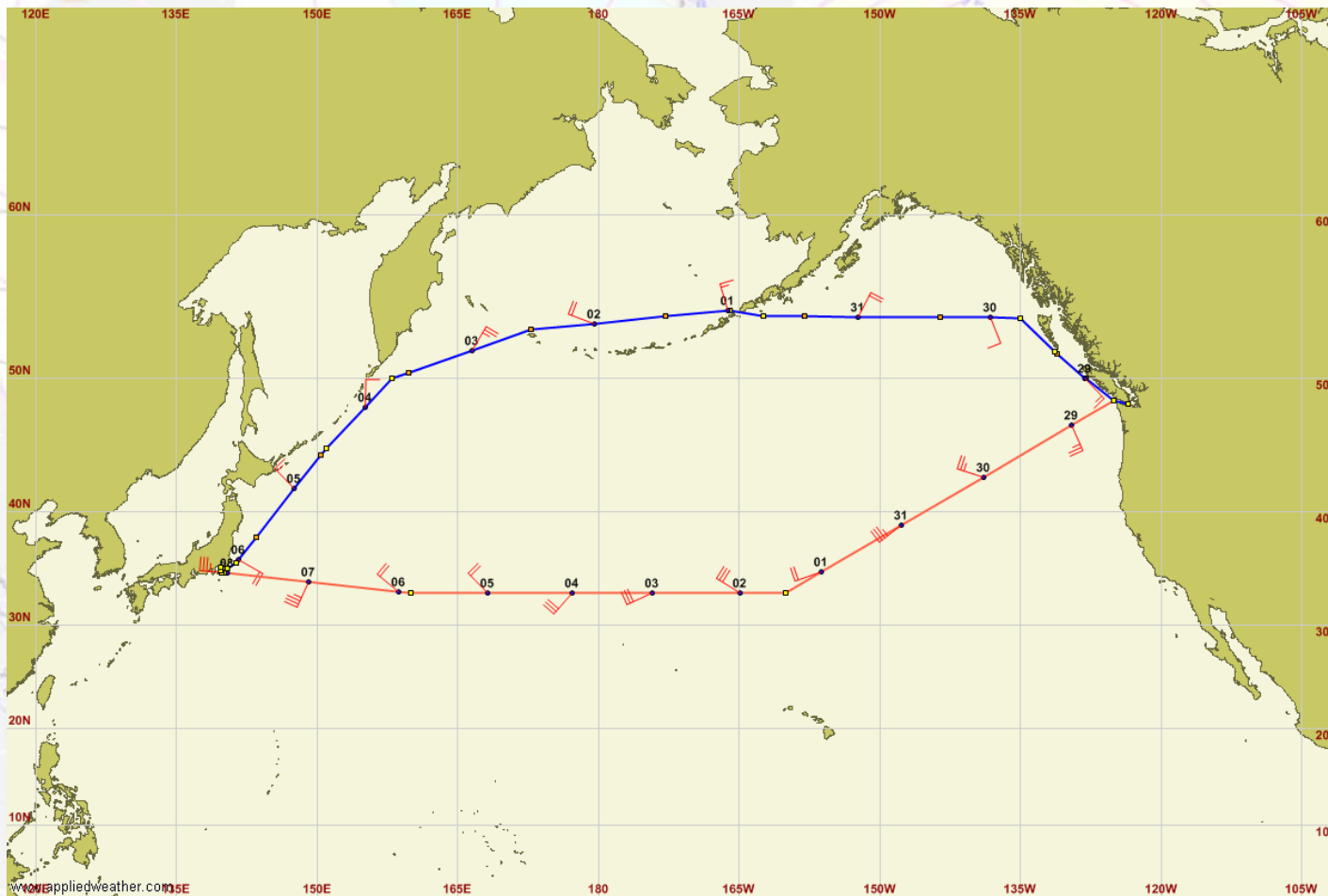
(ship routing for efficiency)



The recommended route by AWT was shortened about 490 nm and about 20 hours of sailing time was saved.



# Seattle – Yokohama (ship routing for reliability)



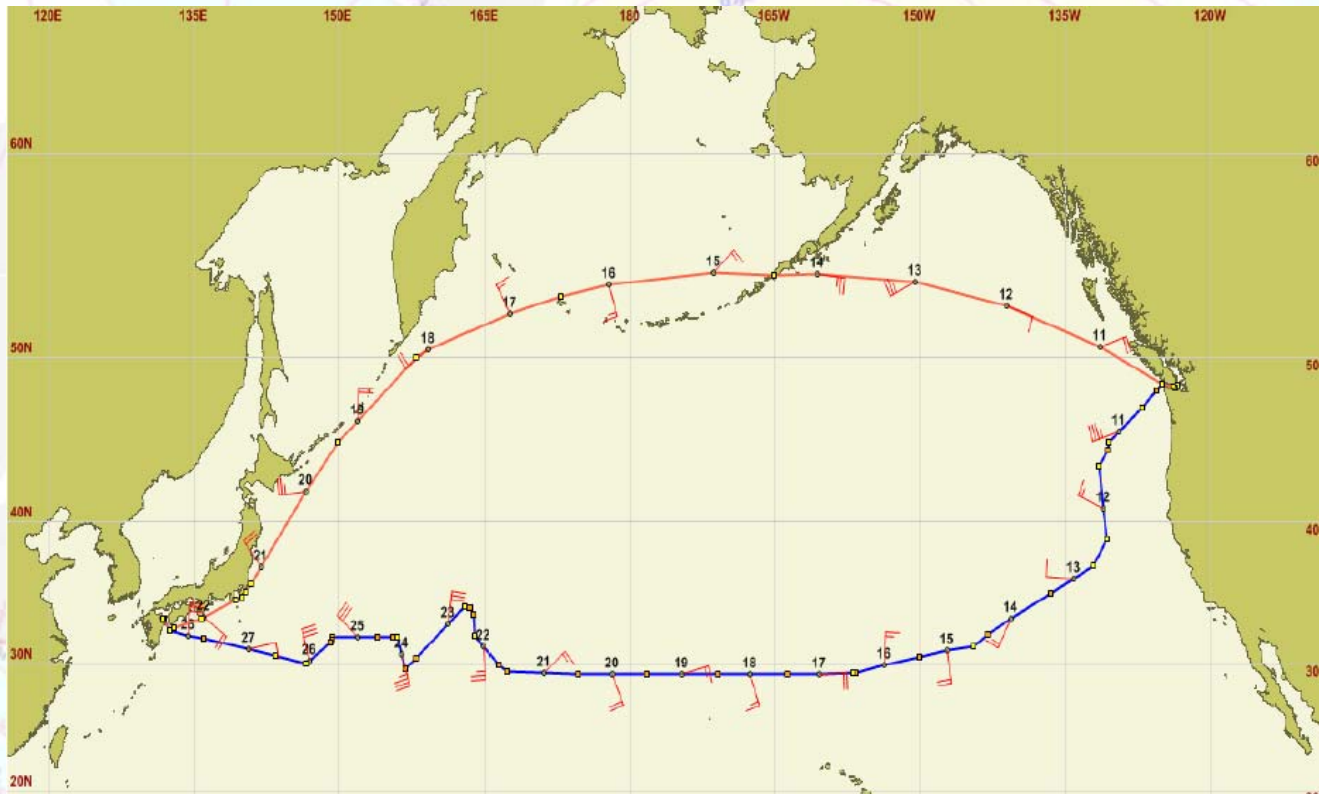
Along the actual route, the vessel was sailed at an economical speed, with further reduction during the last 17 hours of the voyage. It is estimated that the vessel consumed 92mt/day at 20.5 knots for the first 8.1 days of the voyage, then reduced speed further. Total consumption for the voyage was 787 mt.

At max calm speed of 21.5 knots, it is calculated the ship would consume about 105 mt/day. It is calculated that the voyage would have taken 254 hours. At 105 mt/day, the ship would have consumed 1111mt of fuel oil.

Therefore, 325 mt ifo were saved along the recommended route, along with an arrival 43 hours earlier.



# We can do a lot...but if Master is not following the given recommendation...



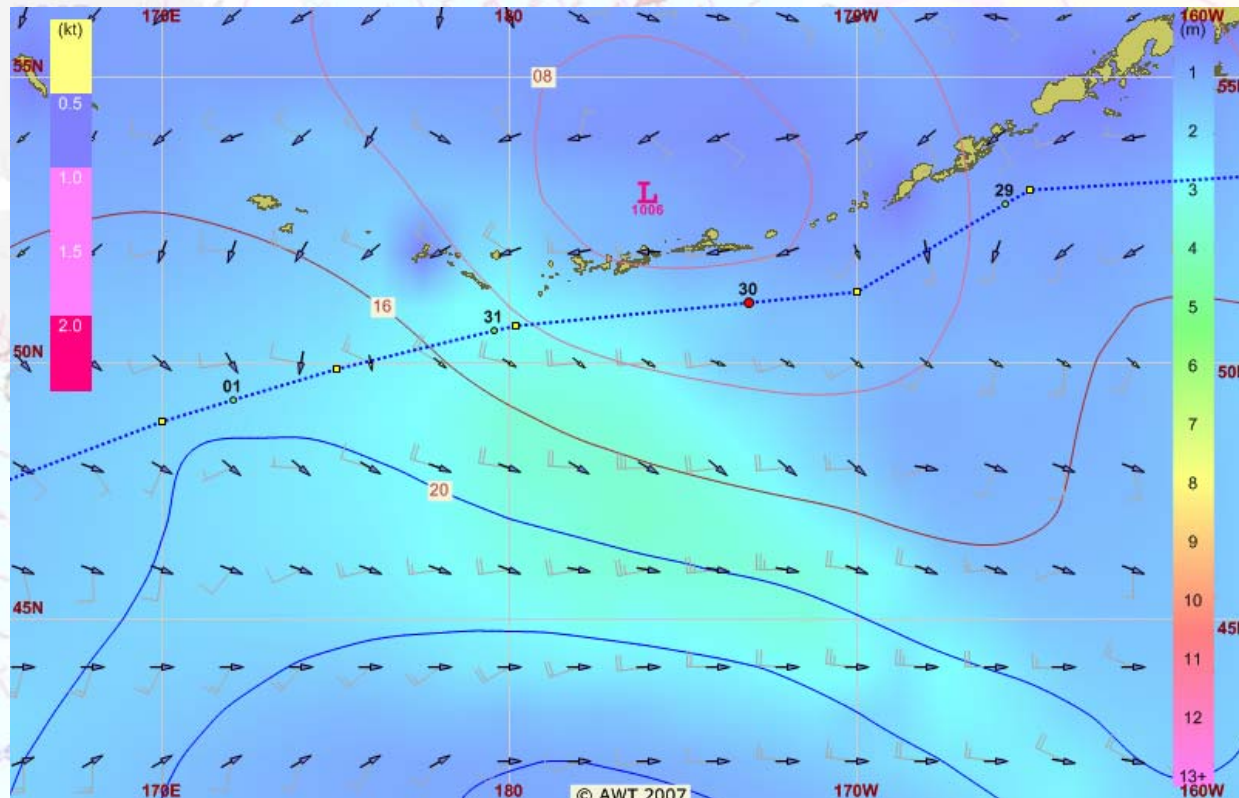
### Route Comparison

	ACTUAL ROUTE	RECOMMENDED ROUTE
DISTANCE	6410 NM	4630 NM
TIME ENROUTE	444.6 HRS	302.9 HRS
AVERAGE SPEED	14.4 KTS	15.3 KTS
CURRENT FACTOR	-0.1 KTS	0.1 KTS
WEATHER FACTOR	-2.1 KTS	-1.4 KTS
PERFORMANCE SPEED	16.6 KTS	16.6 KTS



# ... no charts on board

- MASTER ADVISED ON DEPARTURE STEWART ISLAND THAT HE HAS NO CHARTS FOR UNIMAK PASS OR ATTU ISLAND. HE GAVE INTENDED WAYPOINTS SOUTH OF THE ALEUTIANS.
- HIS INTENDED ADDS ONLY APPROX 35NM. HOWEVER, WE CALCULATE APPROX 10 HOUR LATER ARRIVAL DUE TO WEATHER CONDITIONS.



# Issues in Ship Routing

- The Polar Route – Could save lots of fuel, but not really a function of weather routing
- Load Line Limits / Institute Warranty Limit – Silly & antiquated policy which expose ships to very heavy weather and can cost huge amounts of fuel.
  - Insurers should have details on where the greatest amount of damage occurs.
- Piracy - IMO guidelines indicate to pass 100 nm north and east of Socotra, which exposes them to the heaviest monsoon conditions.
  - 3,450-TEU container vessel **M/V Ital Florida** built 2007, **lost at least three containers in severe seas** between June 16 and 19 in the Arabian Sea. The vessel faced waves of 7-10m in height. **The ship's deck also suffered storm damage.** She arrived in port on June 22 with a substantial port of its containers shifted to starboard and damaged.
  - Panamanian chemical transporter **M/V Fairchem Steed / Alexander C** **sank in strong weather** in the Arabian Sea between Socotra Island and the south coast of Yemen after being battered by high winds and waves.



# 5 Year Growth

- **2002**      **75-80 routes per month**
- **2007**      **approx. 2000 routes per month**
  - 650-700 outgoing messages per day
  - close to 1500 incoming messages per day





# SHIP EFFICIENCY

by STG

