Wave Analysis Guidance for Tropical Cyclone Forecast Advisories

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Purpose

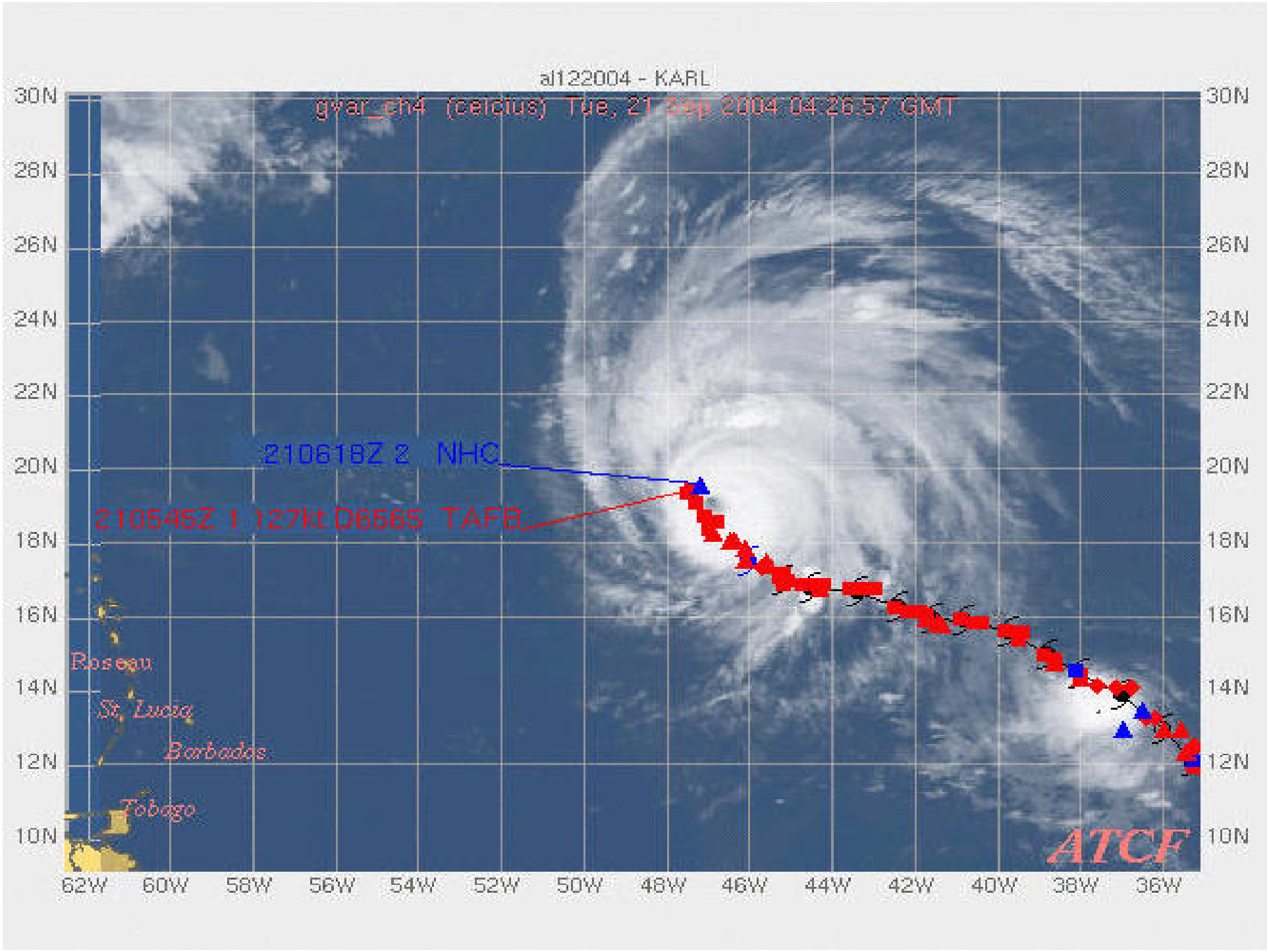
- Pilot study to integrate WW3 into ATCF
- Use latest tropical cyclone information from forecaster to create wind fields and drive the wave model.
- Produce a wave forecast (radii of 12-ft seas) which is consistent with the forecaster input

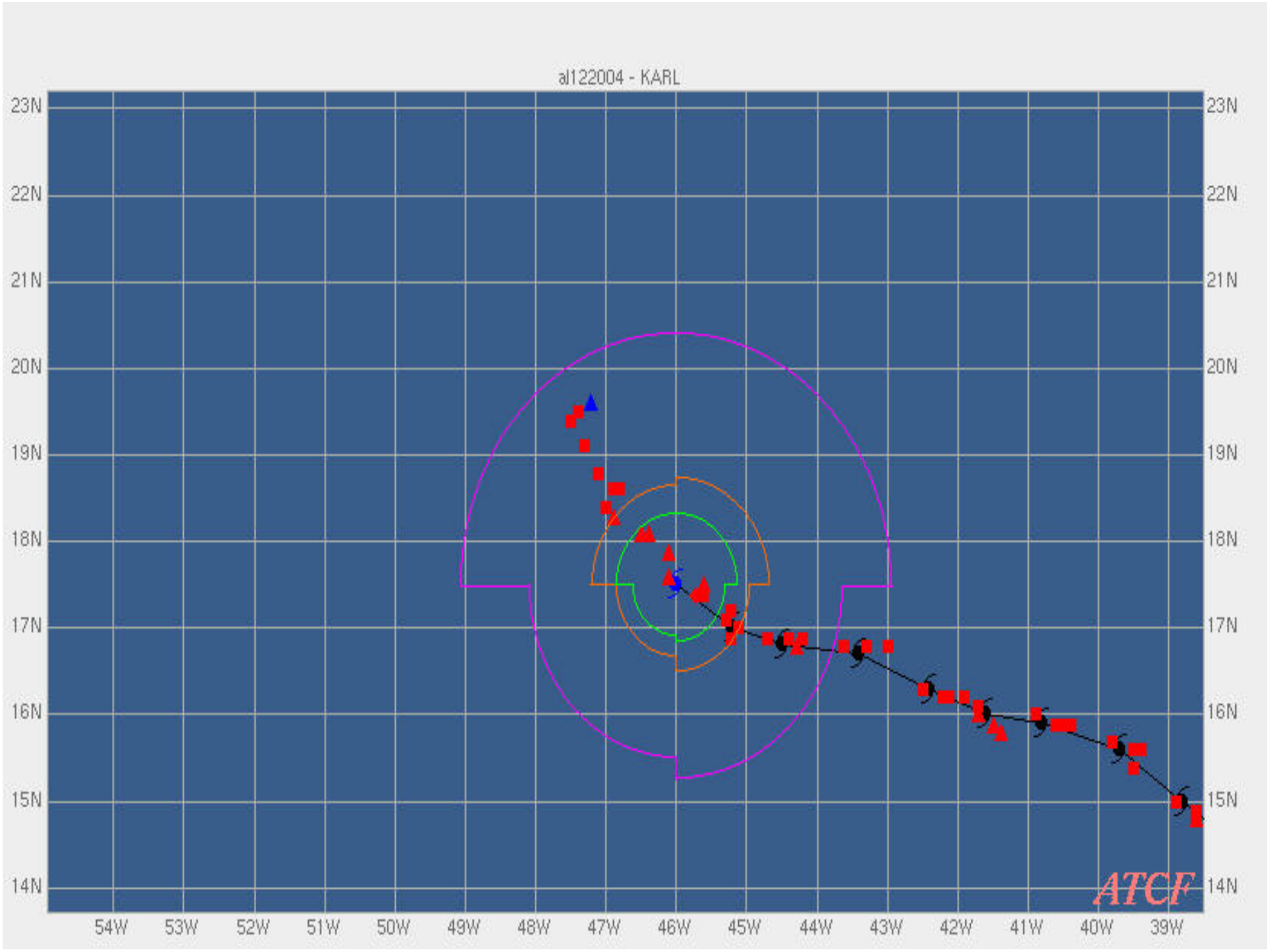
Automated Tropical Cyclone Forecast System (ATCF)

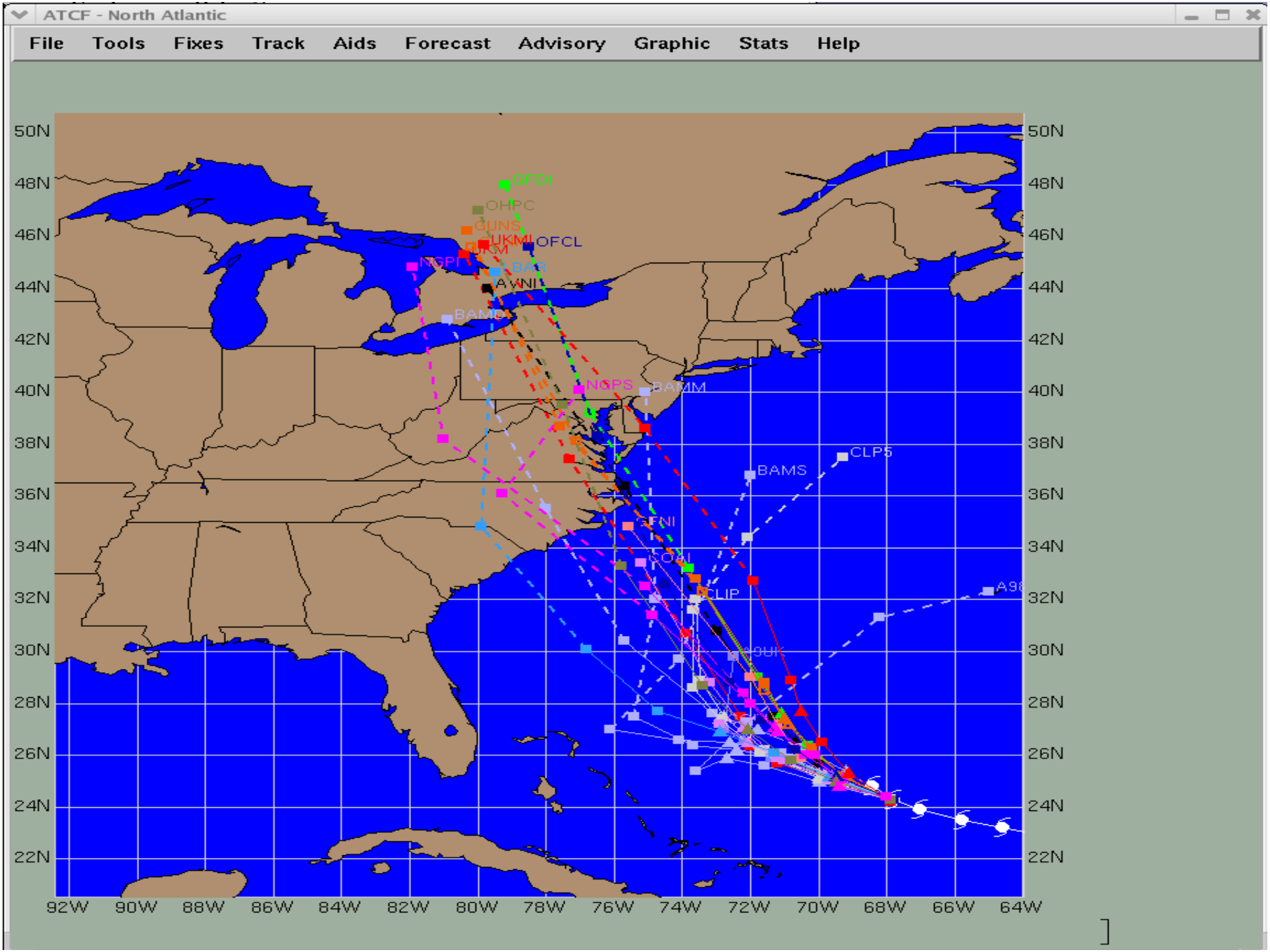
- Graphical TC nowcast and forecast tool
- Plotting raw fixes to analyze track positions
- Display track forecasts from NWP models
- Generated TC warning messages

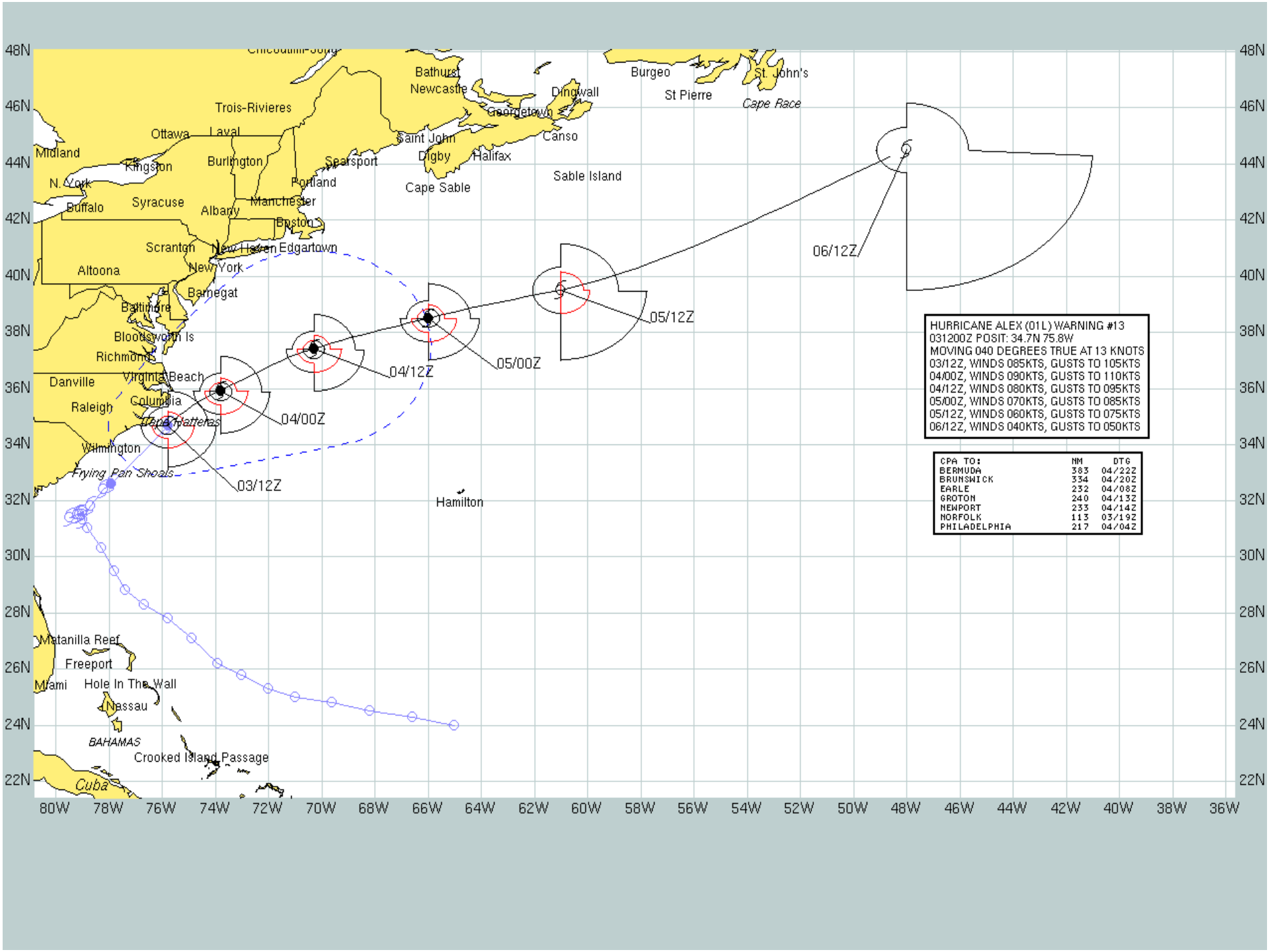
Radius of 12 ft seas

- Currently there are 2 parametric wave models used to forecast 12-ft seas radii.
  - 1) Wu et al. (2003)
  - 2) Steve Lyons (Weather Channel)

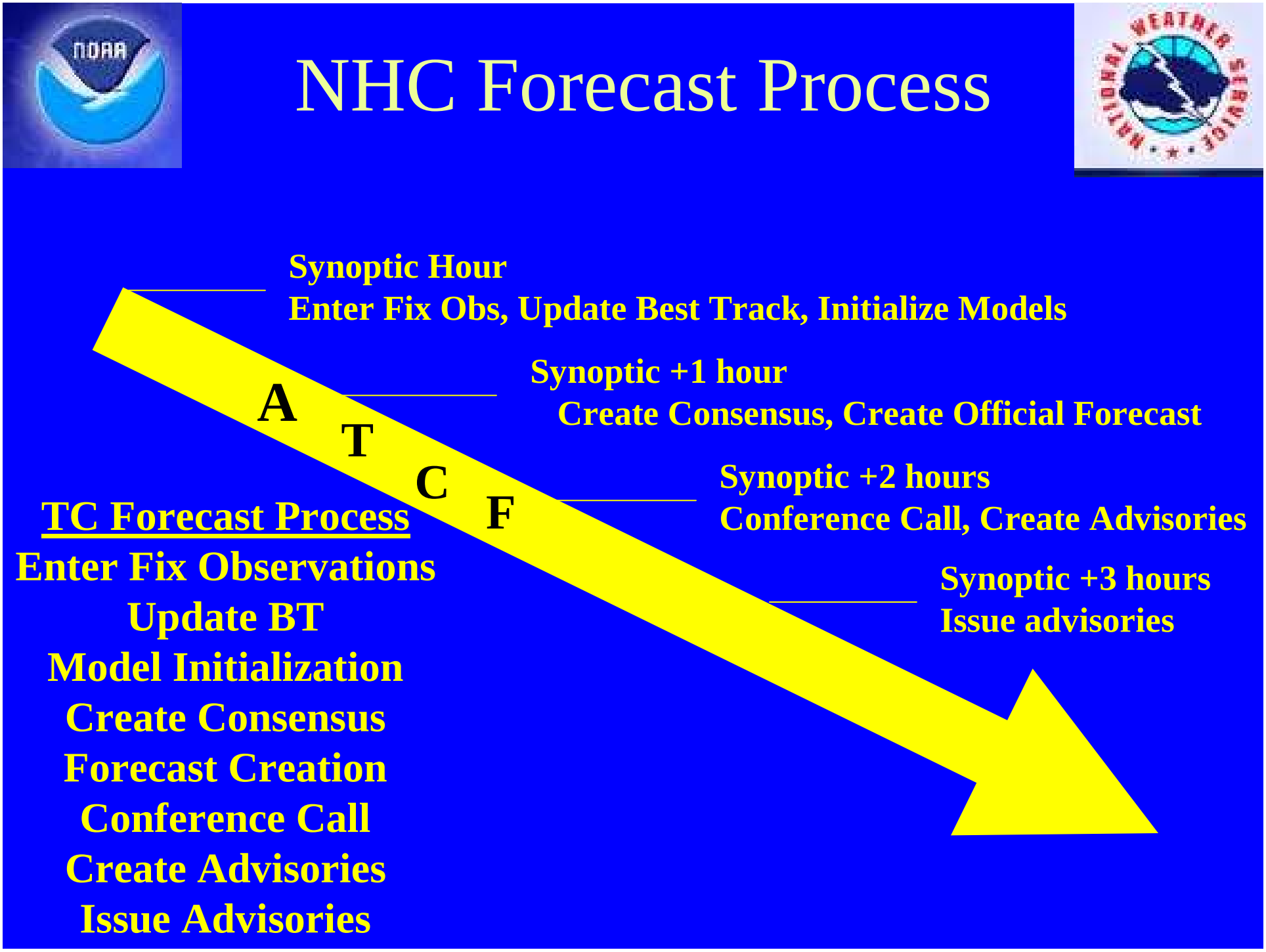

al122004 - KARL
gvar_ch4 (celcius) Tue, 21 Sep 2004 04:26:57 GMT
210618Z 2 NHC
210545Z 1 127kt D6565 TAFB
Roseau
St. Lucia
Barbados
Tobago
ATCF
30N
28N
26N
24N
22N
20N
18N
16N
14N
12N
10N
62W
60W
58W
56W
54W
52W
50W
48W
46W
44W
42W
40W
38W
36W


al122004 - KARL
23N
22N
21N
20N
19N
18N
17N
16N
15N
14N
54W
53W
52W
51W
50W
49W
48W
47W
46W
45W
44W
43W
42W
41W
40W
39W
ATCF

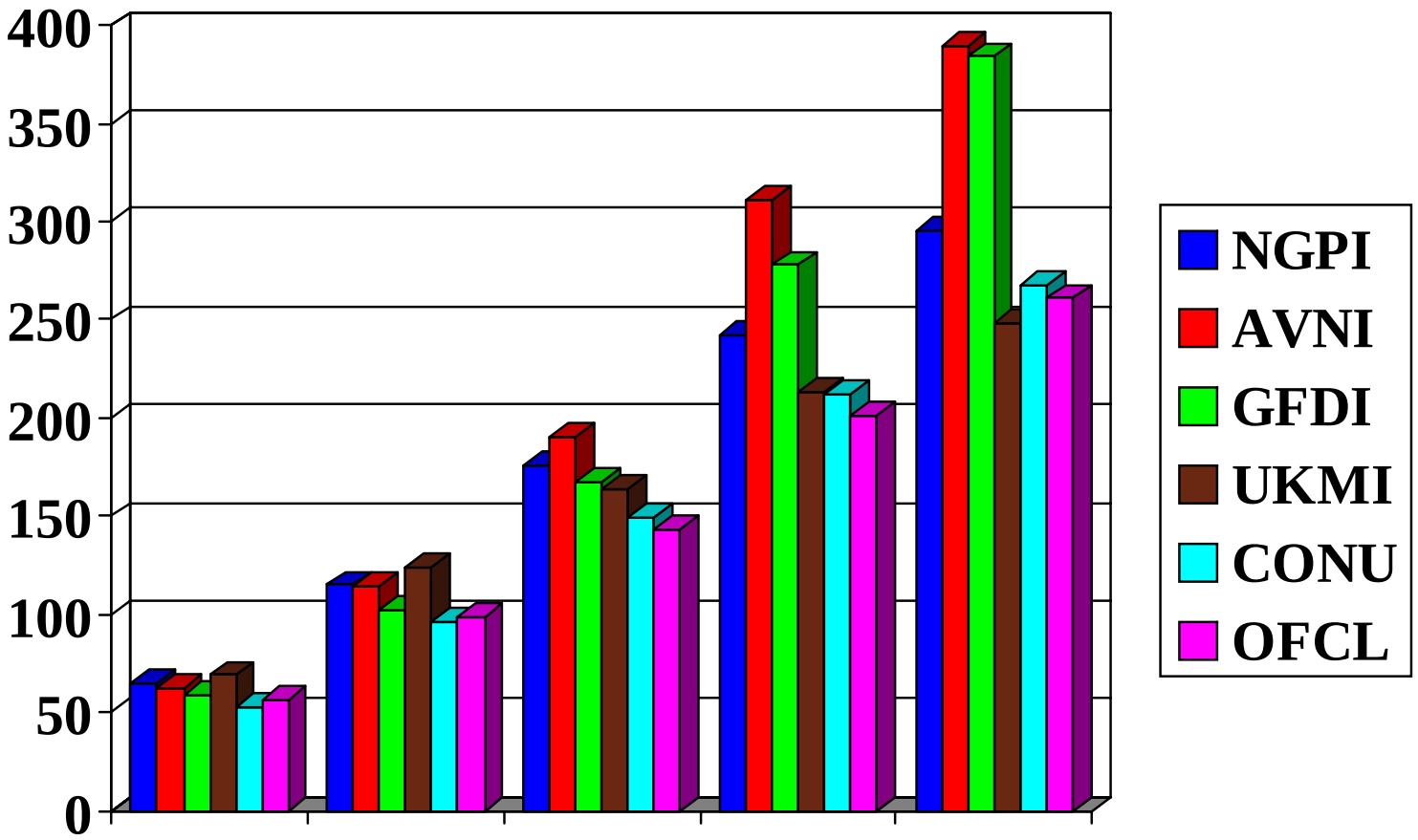

ATCF - North Atlantic
File
Tools
Fixes
Track
Aids
Forecast
Advisory
Graphic
Stats
Help
GFDI
OHPC
GUNS
UKMI
OFCL
NGPI
BAS
AWNI
BAMD
NGPS
BAMM
CLP5
BAMS
LIP
50N
48N
46N
44N
42N
40N
38N
36N
34N
32N
30N
28N
26N
24N
22N
92W
90W
88W
86W
84W
82W
80W
78W
76W
74W
72W
70W
68W
66W
64W


HURRICANE ALEX (01L) WARNING #13
031200Z POSIT: 34.7N 75.8W
MOVING 040 DEGREES TRUE AT 13 KNOTS
03/12Z, WINDS 085KTS, GUSTS TO 105KTS
04/00Z, WINDS 090KTS, GUSTS TO 110KTS
04/12Z, WINDS 080KTS, GUSTS TO 095KTS
05/00Z, WINDS 070KTS, GUSTS TO 085KTS
05/12Z, WINDS 060KTS, GUSTS TO 075KTS
06/12Z, WINDS 040KTS, GUSTS TO 050KTS
CPA TO: NM DTG
BERMUDA 383 04/22Z
BRUNSWICK 334 04/20Z
EARLE 232 04/08Z
GROTON 240 04/13Z
NEWPORT 233 04/14Z
NORFOLK 113 03/19Z
PHILADELPHIA 217 04/04Z
03/12Z
04/00Z
04/12Z
05/00Z
05/12Z
06/12Z
Bathurst
Newcastle
Dingwall
Burgeo
St. John's
St Pierre
Cape Race
Georgetown
Canso
Trois-Rivieres
Ottawa
Laval
Midland
Kingston
Burlington
Saint John
Digby
Halifax
Spearsport
Sable Island
N. York
Portland
Cape Sable
Buffalo
Syracuse
Albany
Manchester
Boston
Scranton
New Haven
Edgartown
Altoona
New York
Barnegat
Baltimore
Bloodsworth Is
Richmond
Danville
Virginia Beach
Raleigh
Columbia
Cape Hatteras
Wilmington
Frying Pan Shoals
Hamilton
Matanilla Reef
Freeport
Miami
Hole In The Wall
Nassau
BAHAMAS
Crooked Island Passage
Cuba
48N
46N
44N
42N
40N
38N
36N
34N
32N
30N
28N
26N
24N
22N
80W
78W
76W
74W
72W
70W
68W
66W
64W
62W
60W
58W
56W
54W
52W
50W
48W
46W
44W
42W
40W
38W
36W

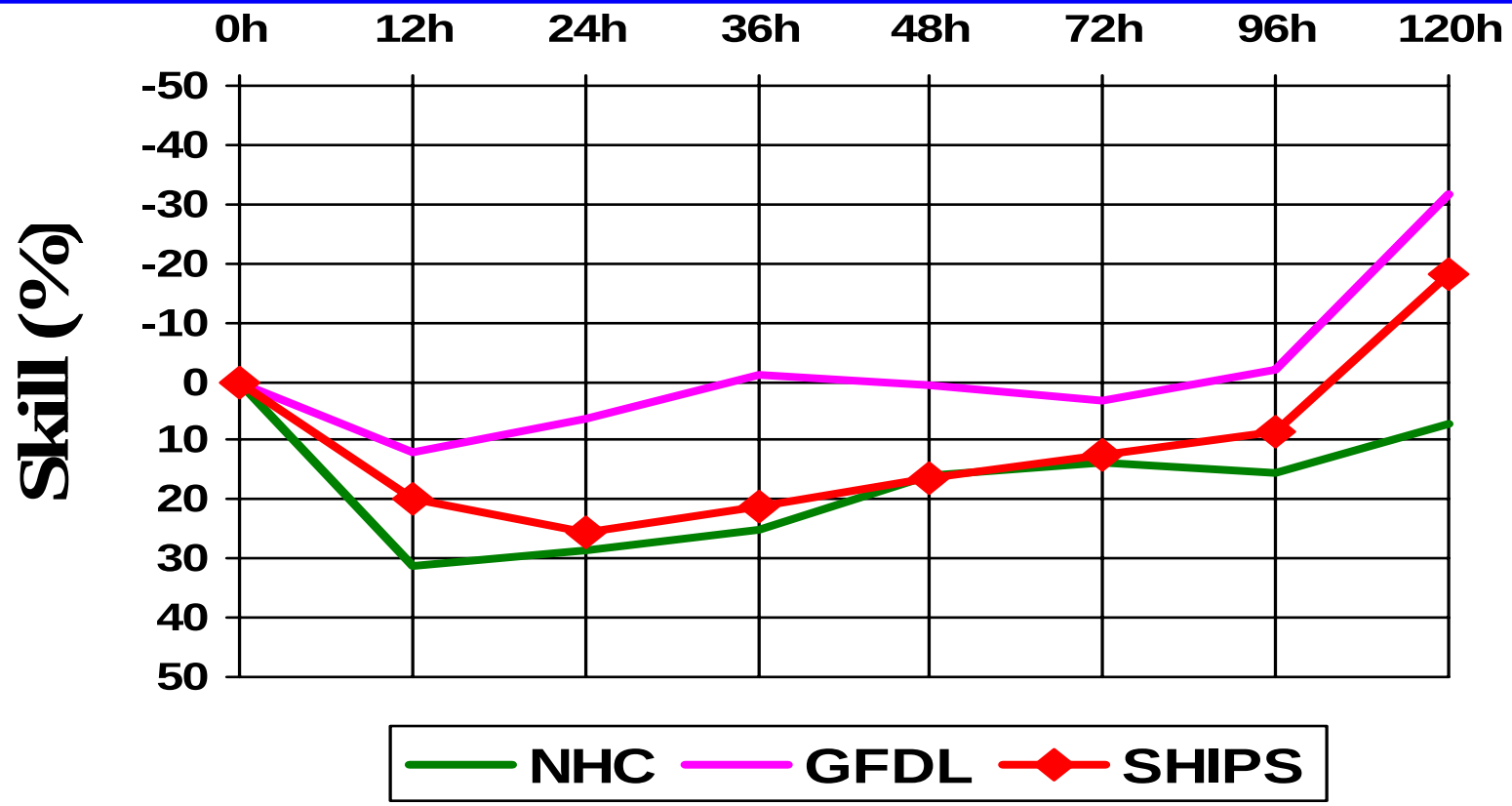
NHC Forecast Process



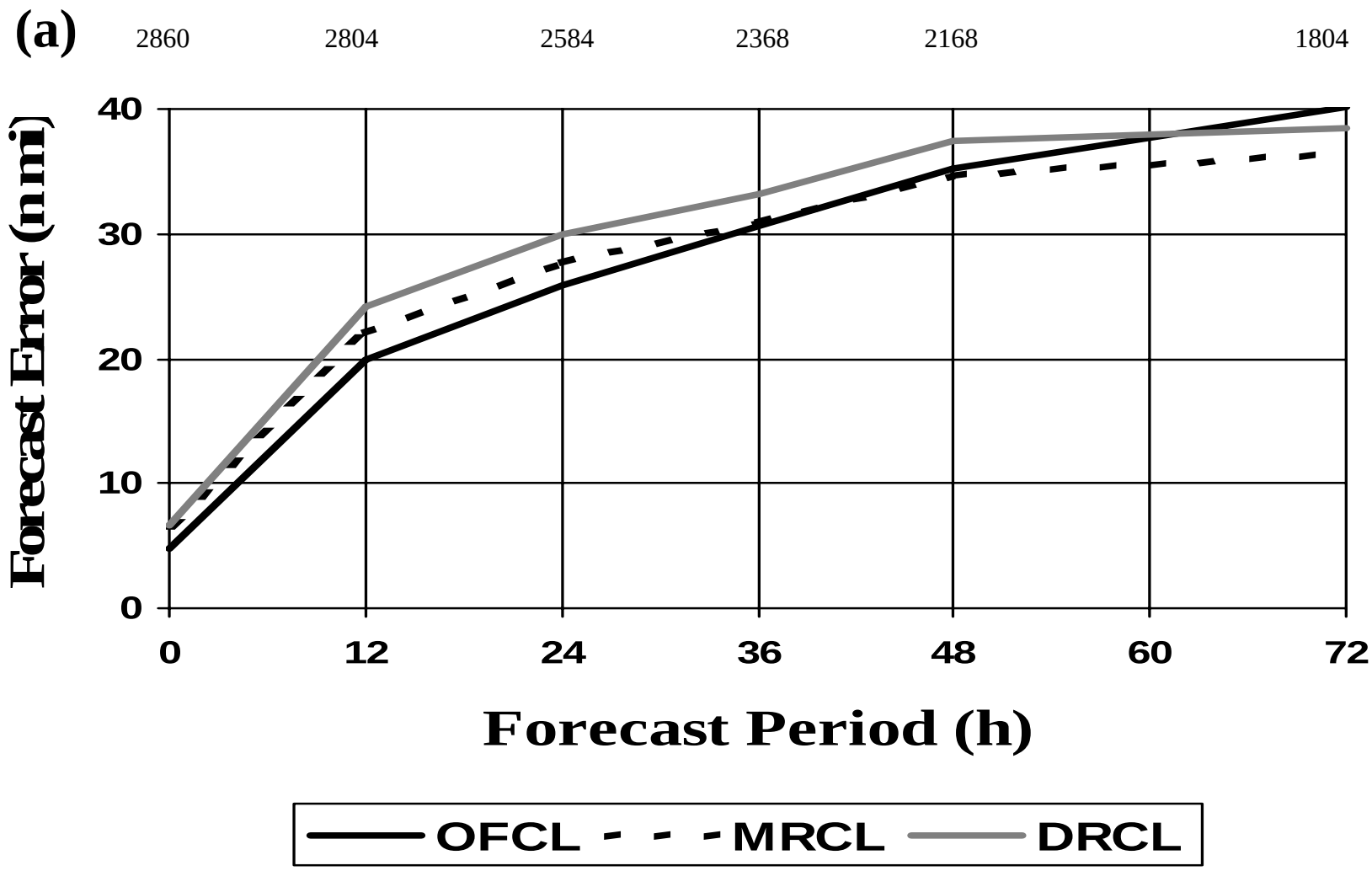
2005 Atlantic (to 8 December)
Homogeneous TC Forecast Error (nm)



Intensity Skill in Atlantic (01-18, 2005)



The NHC forecasters outperform intensity guidance at all forecast hours . SHIPS is the best overall guidance available to the forecasters and GFDL is the leading NWP intensity forecast model. Skill is measured as % improvement over the no-skill baseline (a 5-day intensity CLIPER).

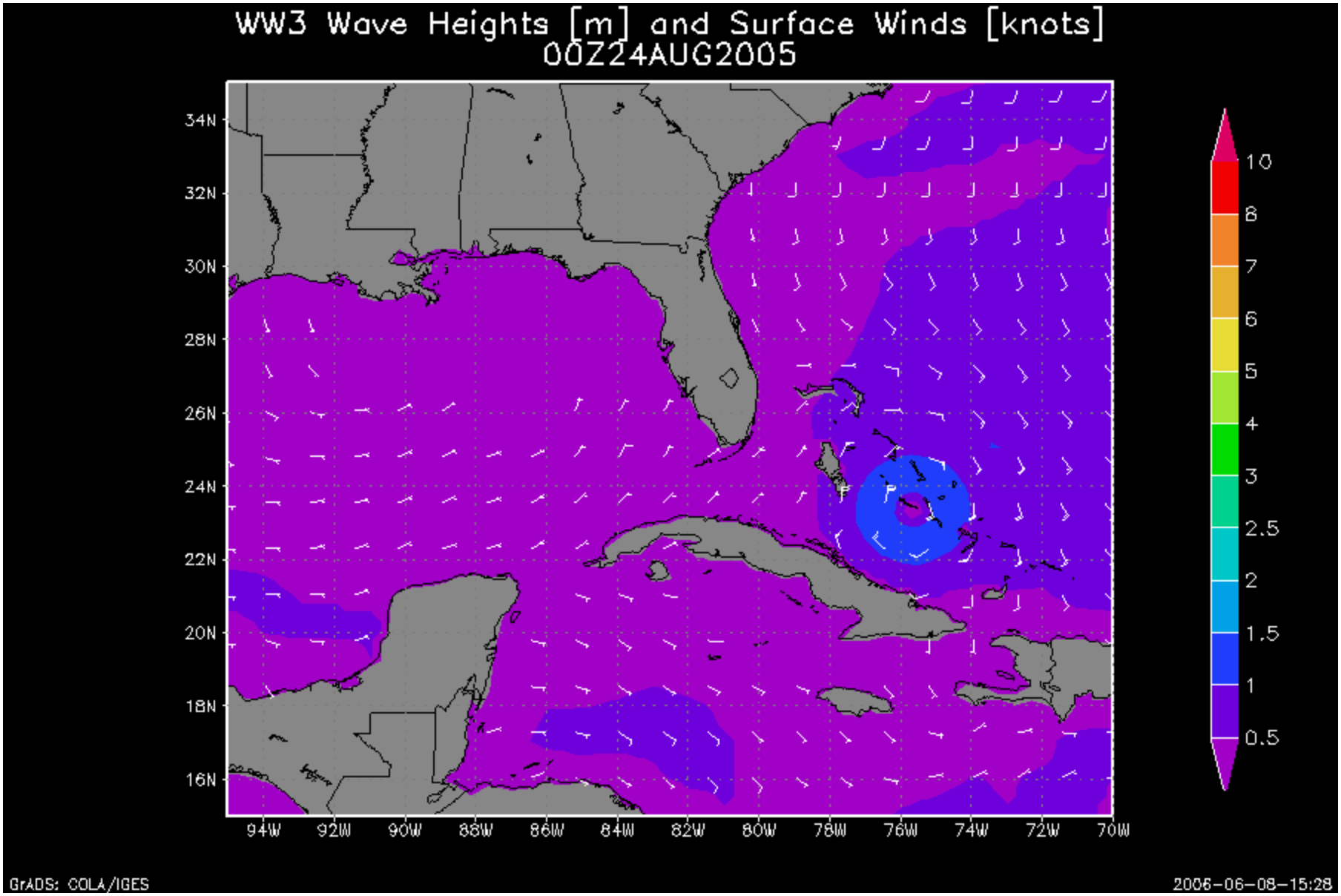

(a)
2860
2804
2584
2368
2168
1804
Forecast Error (nmi)
40
30
20
10
0
0
12
24
36
48
60
72
Forecast Period (h)
OFCL
MRCL
DRCL

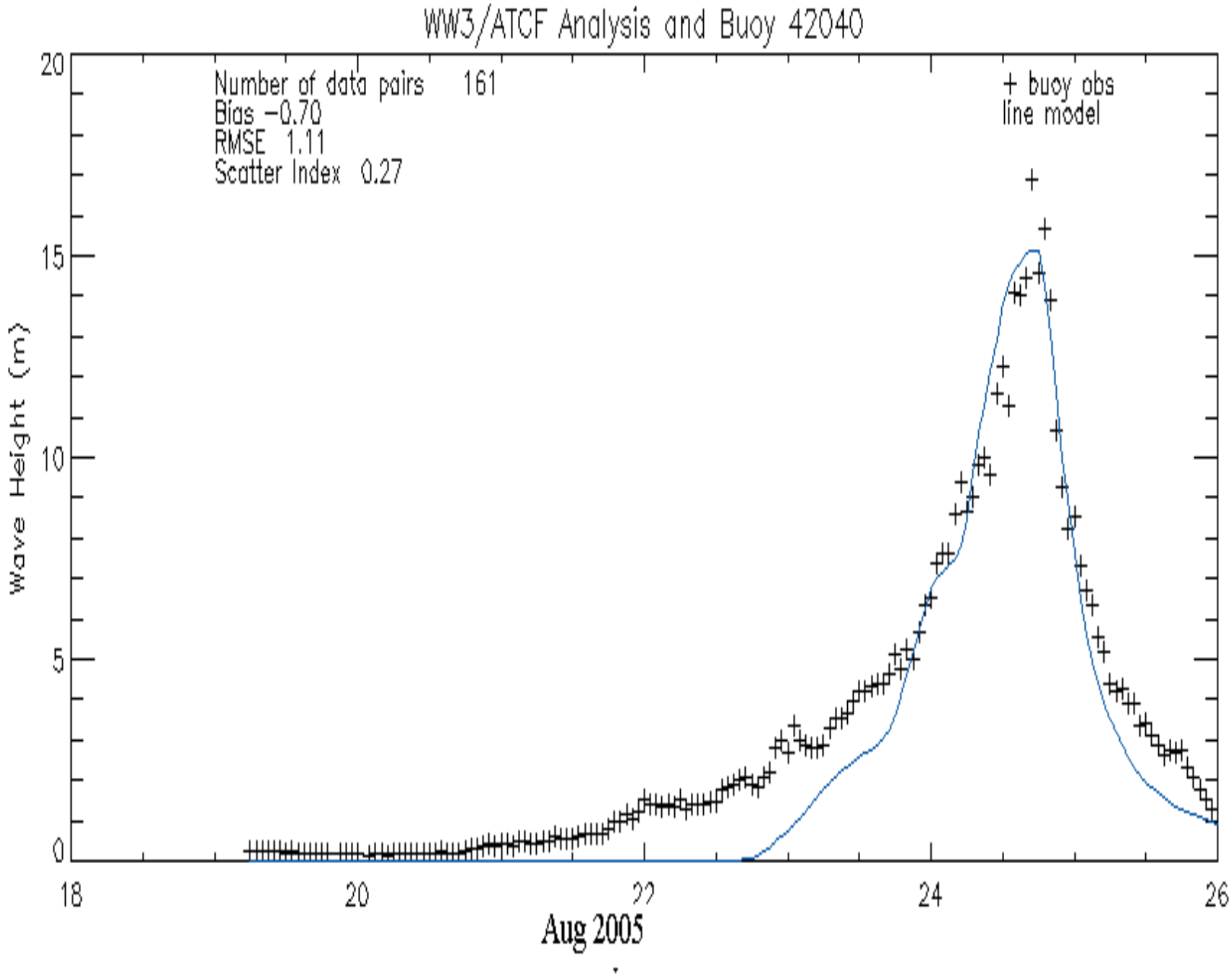
WW3 implementation

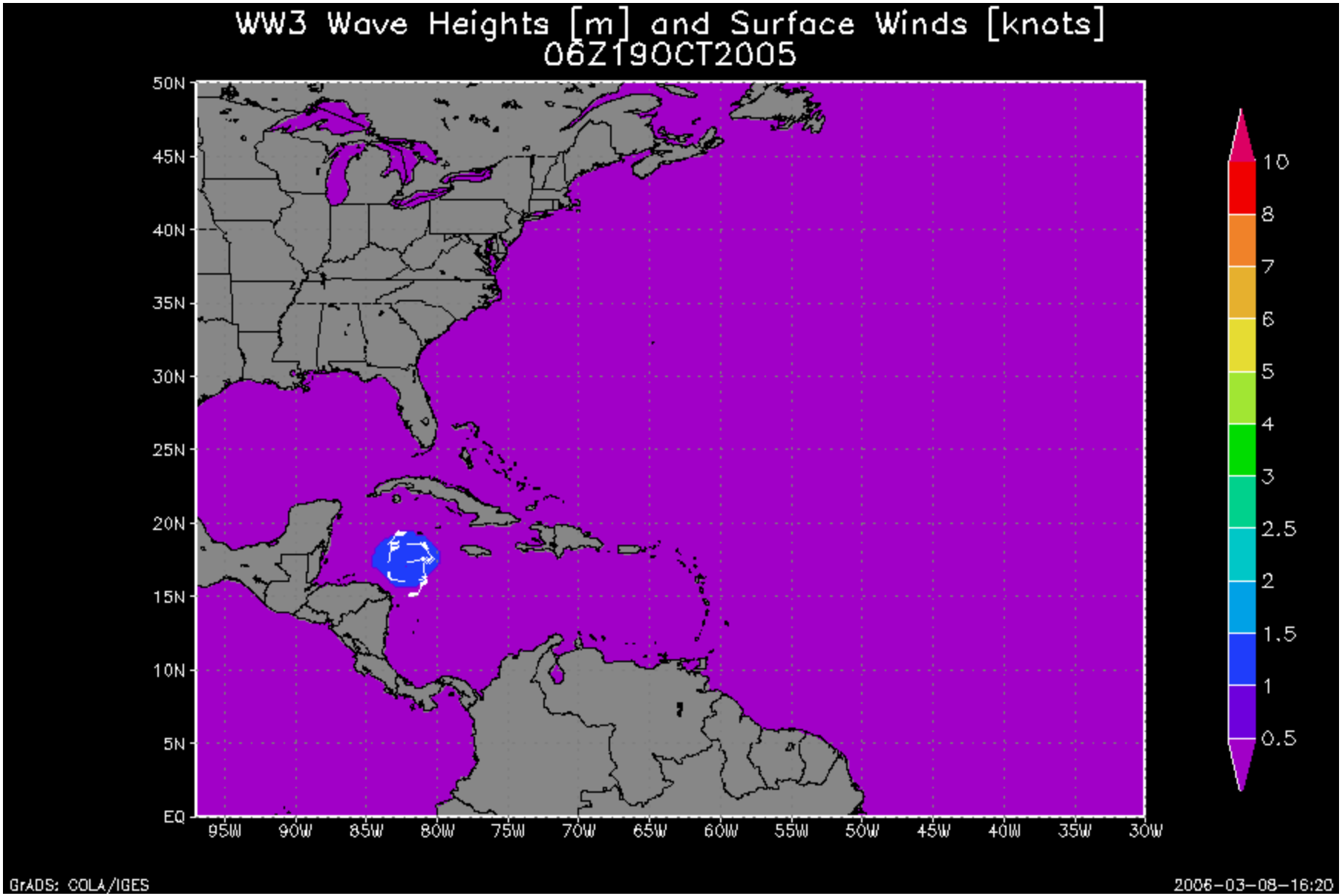
- Used the NOAA/NCEP North Atlantic Hurricane implementation
- 0.25x0.25 deg
- 1 hour wind time step
- Standard 24 directions by 25 frequencies spectral resolution
- 6 hour update cycle

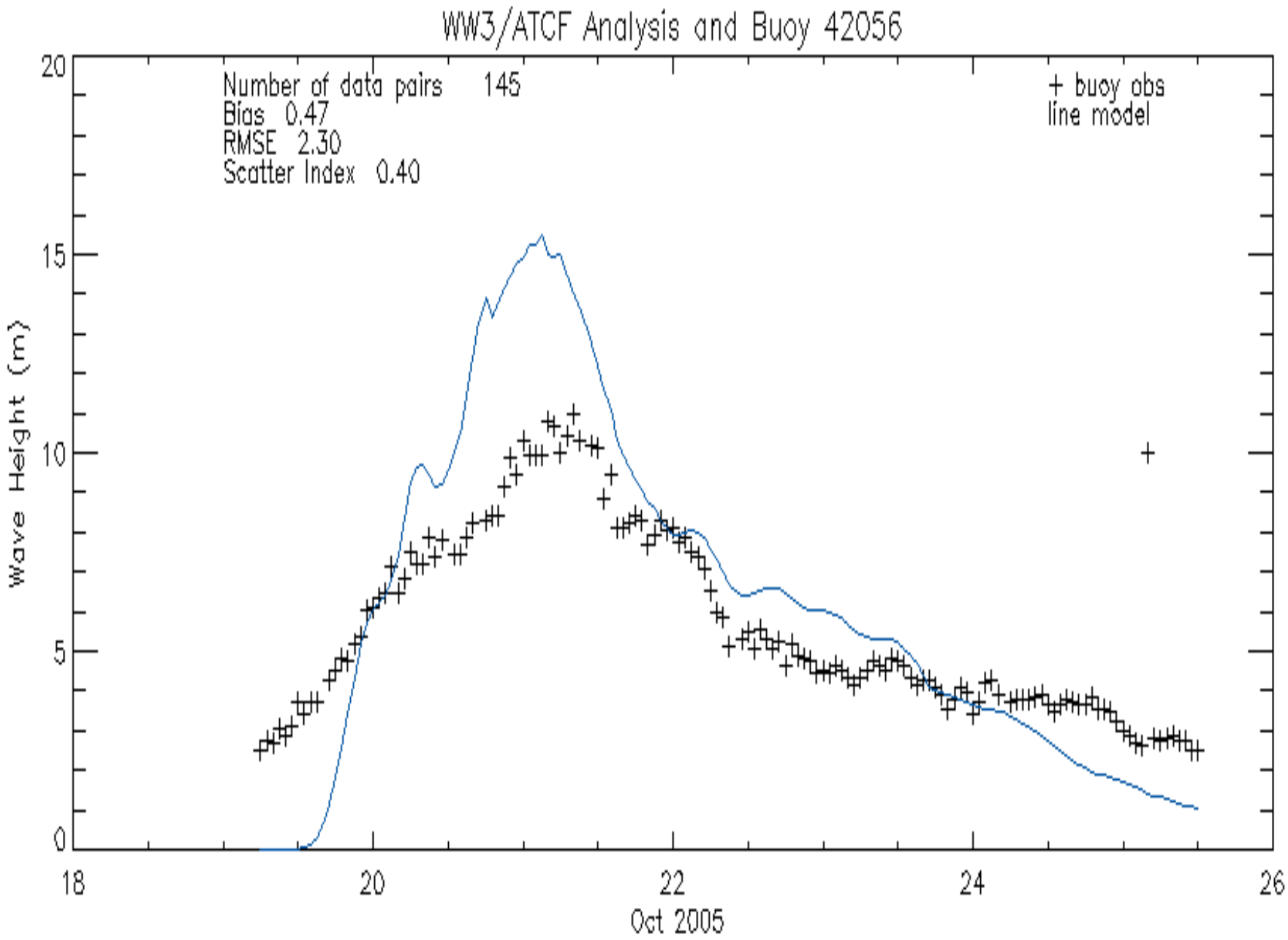
Wind field creation

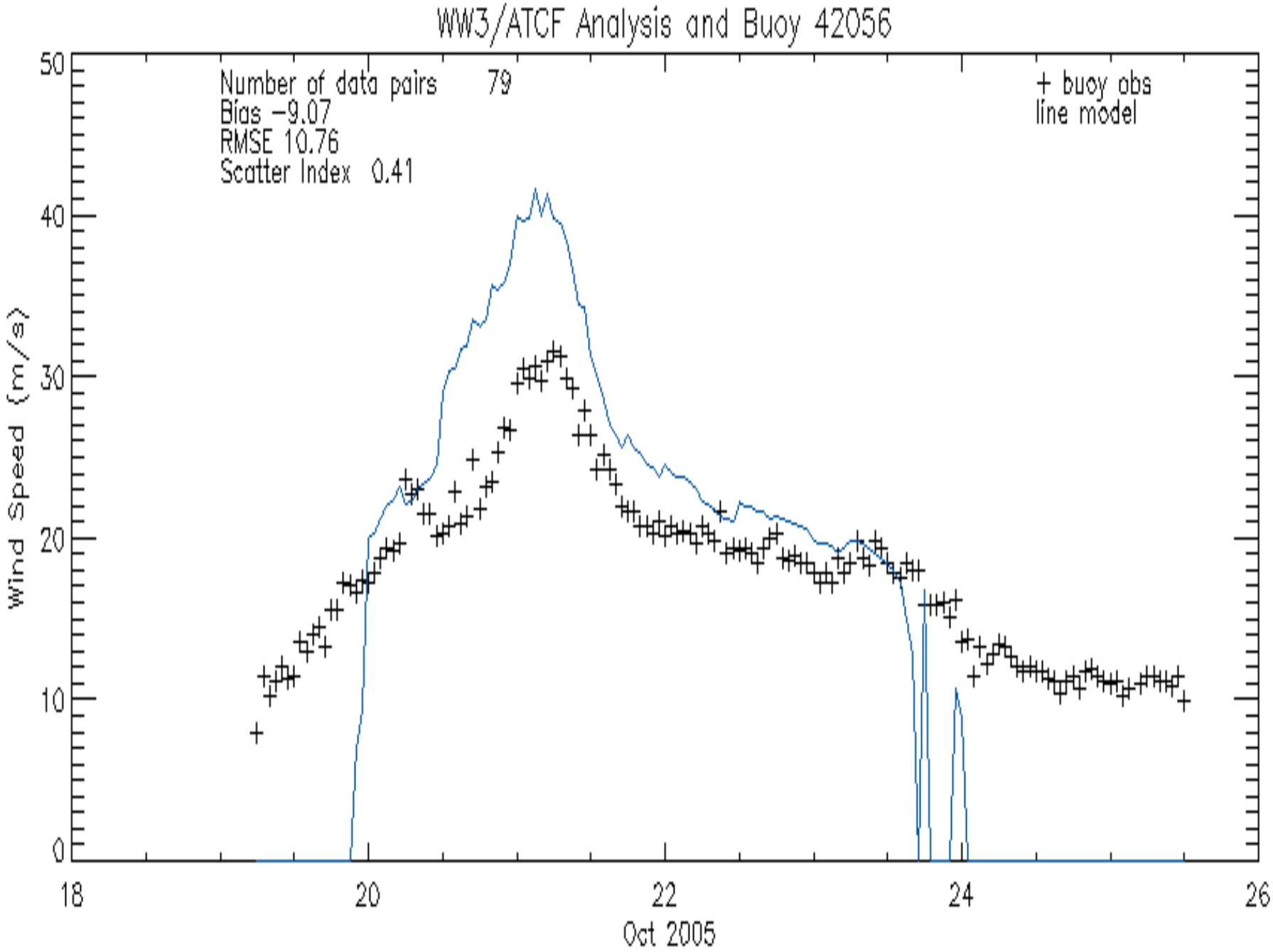
- Interpolated the winds from the 34, 50 and 64-kt wind radii, the radius of maximum winds and the outermost closed isobar (15kt) to a regular grid
- Used the Dalaunay tessellation method
- Capped the drag coefficient
- Blend into background wind fields (NOGAPS)


WW3 Wave Heights [m] and Surface Winds [knots]
00Z24AUG2005
34N
32N
30N
28N
26N
24N
22N
20N
18N
16N
94W
92W
90W
88W
86W
84W
82W
80W
78W
76W
74W
72W
70W
10
8
7
6
5
4
3
2.5
2
1.5
1
0.5
GrADS: COLA/IGES
2006-06-08-15:28


WW3/ATCF Analysis and Buoy 42040
Number of data pairs 161
Bias -0.70
RMSE 1.11
Scatter Index 0.27
+ buoy obs
line model
Wave Height (m)
0
5
10
15
20
18
20
22
24
26
Aug 2005


WW3 Wave Heights [m] and Surface Winds [knots]
06Z19OCT2005
50N
45N
40N
35N
30N
25N
20N
15N
10N
5N
EQ
95W
90W
85W
80W
75W
70W
65W
60W
55W
50W
45W
40W
35W
30W
10
8
7
6
5
4
3
2.5
2
1.5
1
0.5
GrADS: COLA/IGES
2006-03-08-16:20


WW3/ATCF Analysis and Buoy 42056
Number of data pairs 145
Bias 0.47
RMSE 2.30
Scatter Index 0.40
+ buoy obs
line model
Wave Height (m)
0
5
10
15
20
18
20
22
24
26
Oct 2005


WW3/ATCF Analysis and Buoy 42056
Number of data pairs 79
Bias -9.07
RMSE 10.76
Scatter Index 0.41
+ buoy obs
line model
Wind Speed (m/s)
0
10
20
30
40
50
18
20
22
24
26
Oct 2005

Plans

- Further validation vs buoy and altimetry data
- Fully integrate into ATCF
- Develop graphics
- Look at ways to enhance the TC wind fields to be more realistic