

Development and Implementation of NHC/JHT Products in ATCF

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Chris Lauer and Colin McAdie, Tim Marchok*

March 2006

Acknowledgements: NOAA USWRP JHT



NHC Forecast Process



Synoptic Hour

Enter Fix Obs, Update Best Track, Initialize Models

Synoptic +1 hour

Create Consensus, Create Official Forecast

Synoptic +2 hours

Conference Call, Create Advisories

Synoptic +3 hours

Issue advisories

A

T

C

F

TC Forecast Process

Enter Fix Observations

Update BT

Model Initialization

Create Consensus

Forecast Creation

Conference Call

Create Advisories

Issue Advisories



Seven Proposed Tasks

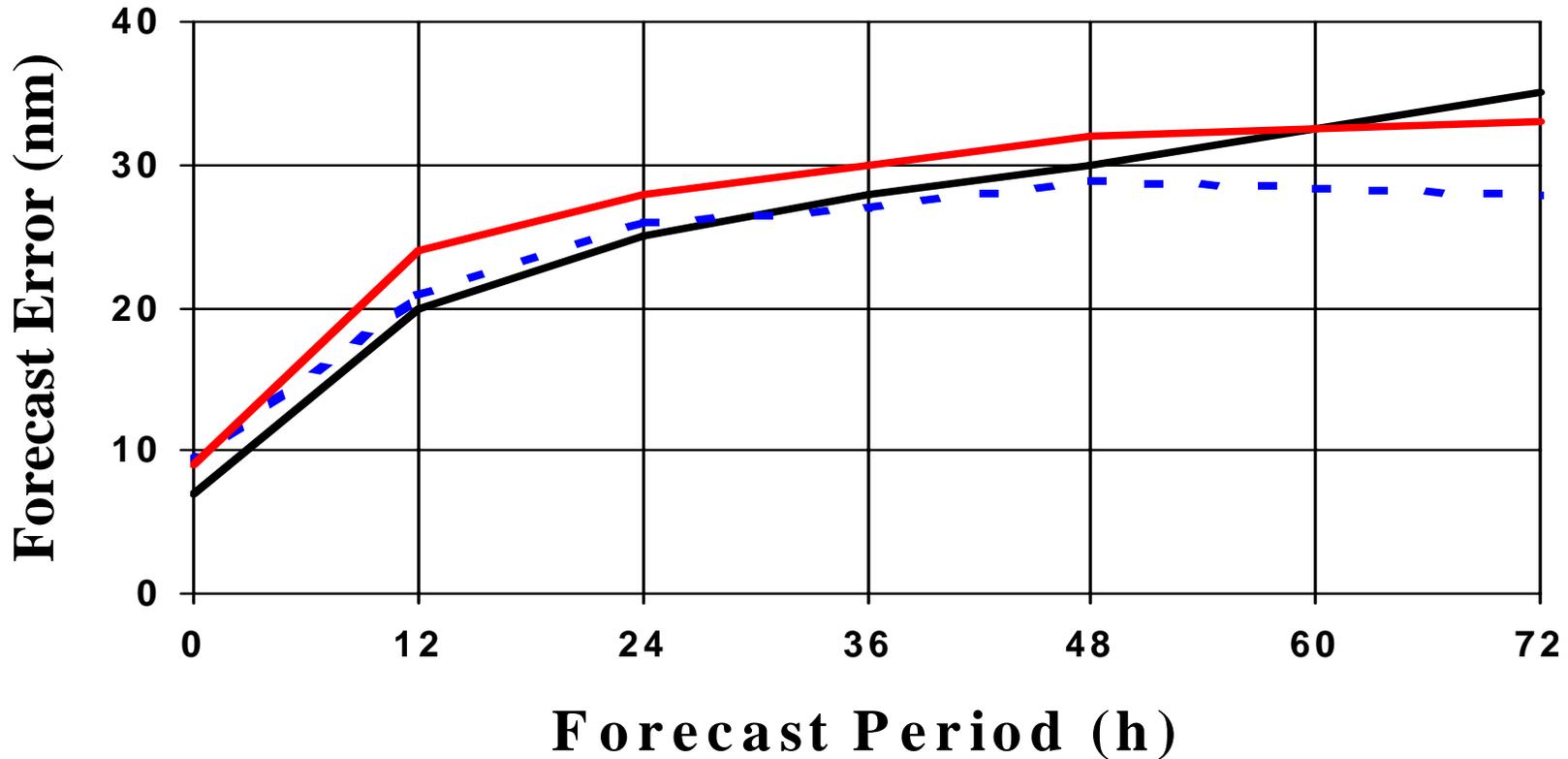
- Evaluate wind radii CLIPER algorithms (80%)
- Implement Monte Carlo wind probabilities in ATCF (90%)
- Implement GPCE track probabilities
 - Data retention (90%)
 - Display (90%)
 - Evaluation (10%)
- Streamline imagery overlays (90%)
- Improve objective best track capability (0%)
- Automate TC fix entry in NHC operations (90%)
- Modify ATCF user interface/code to improve efficiency (70%)

Wind Radii CLIPER Evaluation

- Two statistical models implemented on ATCF
 - DRCL: Atlantic, E. Pacific, W. Pacific
 - Assumes an idealized vortex, modified by storm motion and initial conditions
 - Developed by DeMaria (NOAA), Knaff (CIRA), ...
 - MRCL: Atlantic only
 - 60 separate equations (4 quadrants, 5 taus, 3 radii)
 - Developed by McAdie (NHC)

Avg 34 kt Radii Forecast Errors for 2004 Atlantic Season (06- 16)

896	872	822	765	707	632
899	887	836	771	709	633
899	864	816	761	669	628

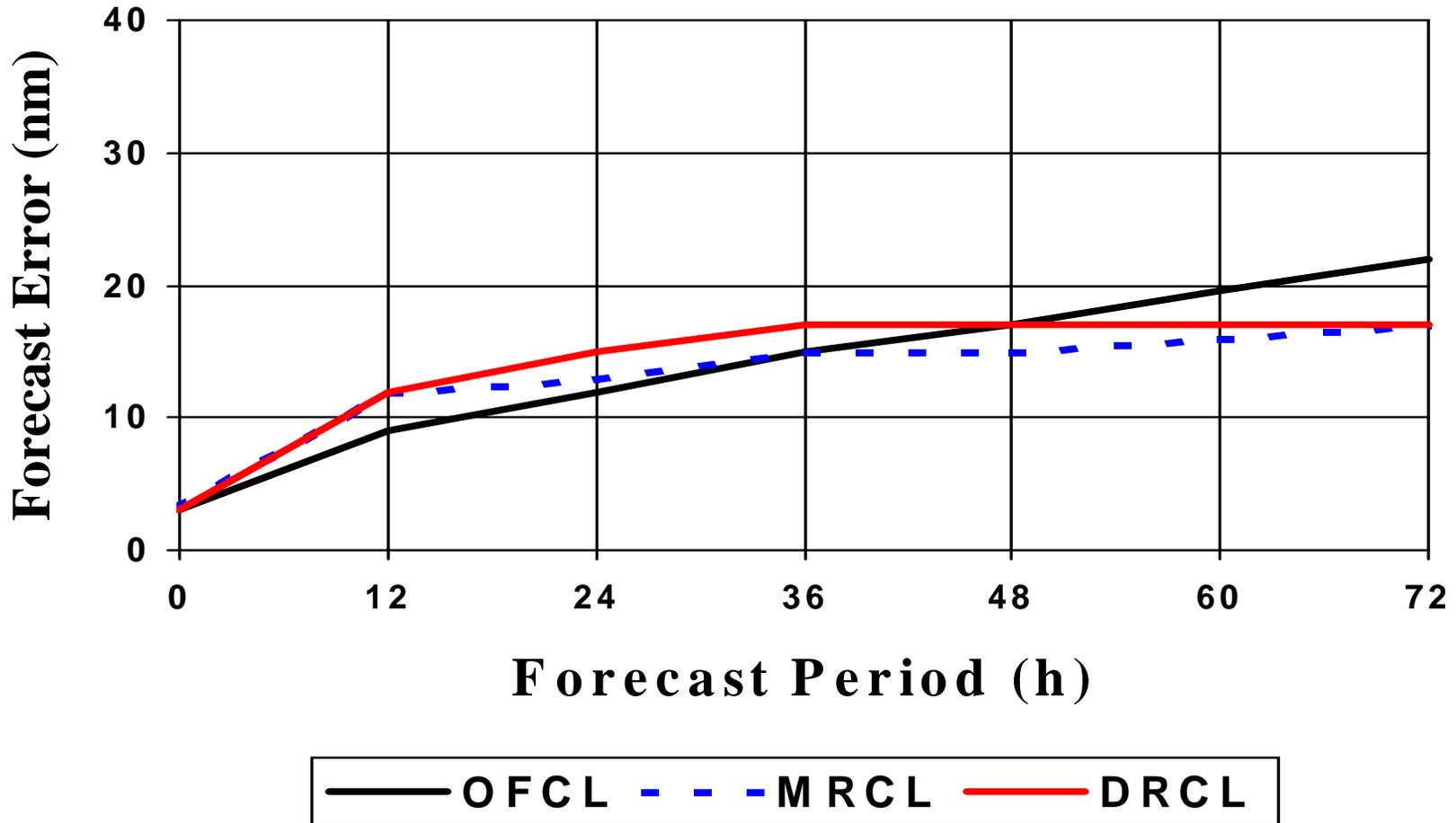


— OFCL - - - MRCL — DRCL

OFCL was skillful out to about 24 hours. Errors ~ 10% of average radii at 12h, ~ 30% of radii at 72.

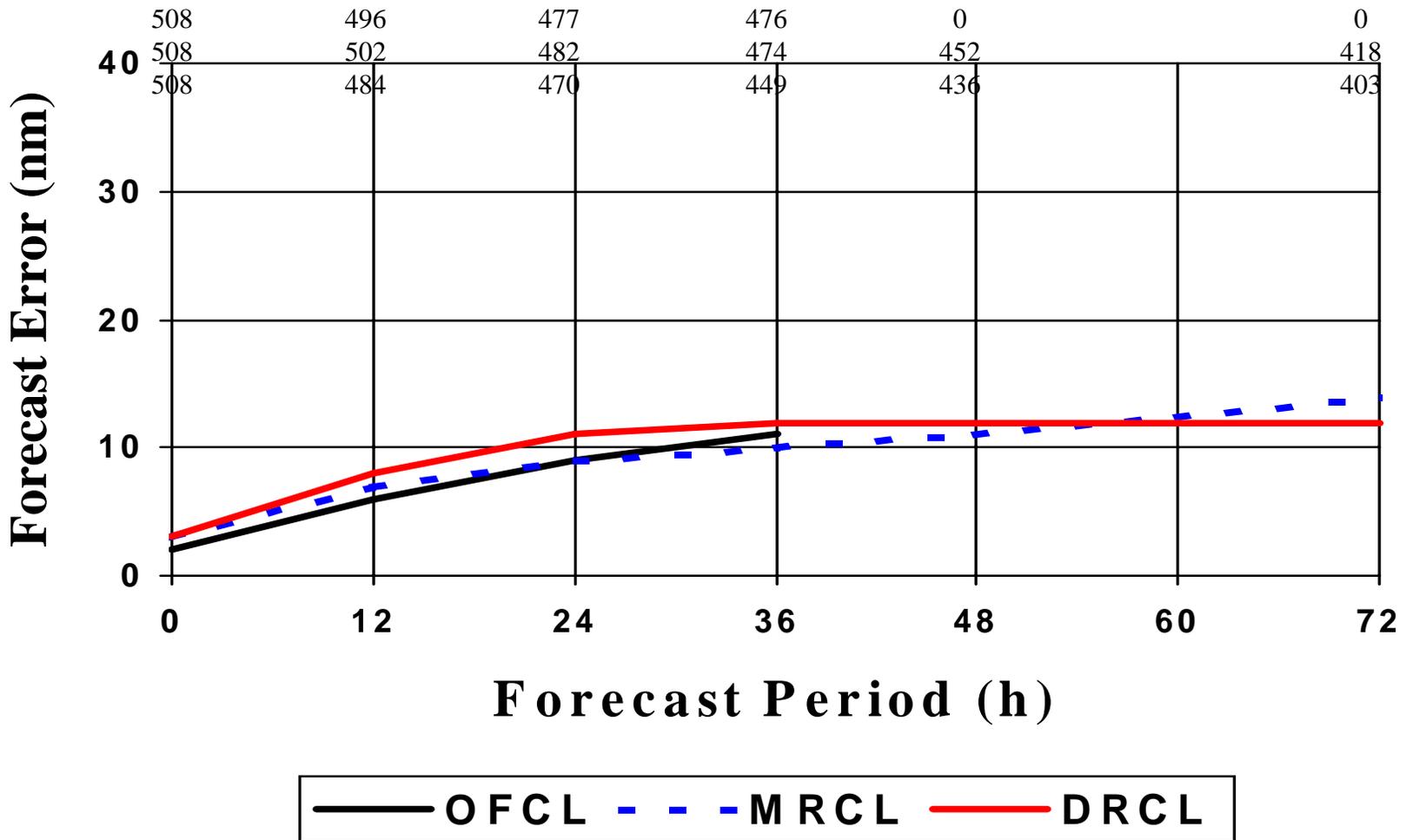
Avg 50 kt Radii Forecast Errors for 2004 Atlantic Season (06- 16)

671	647	620	585	567	507
664	665	630	596	575	507
664	646	603	576	554	502



OFCL was skillful out to about 24 hours. Errors ~ 15% of average radii at 12h, ~30% at 72.

Avg 64 kt Radii Forecast Errors for 2004 Atlantic Season (06- 16)



OFCL was skillful out to about 24 hours. Errors ~ 15% of average radii at 12h, ~ 25% at 72.

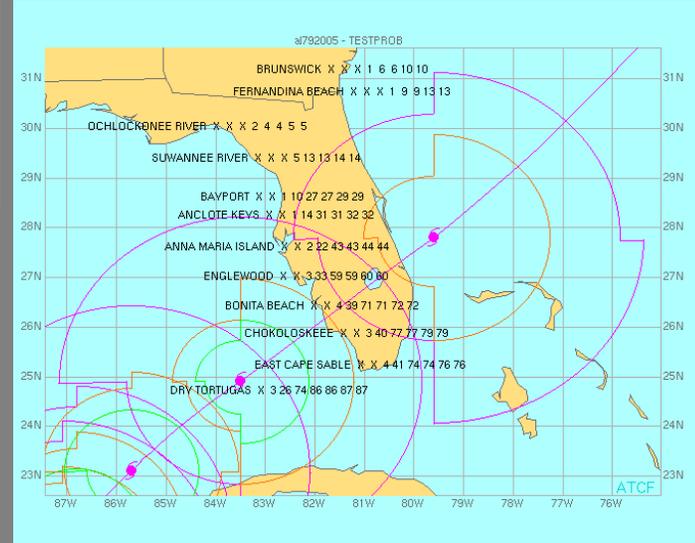
Wind Radii CLIPER Conclusions

- Both models adequate baselines
- Official forecast has skill to about 24 hrs
- Similar results for DRCL in EP and WP basins

Monte Carlo Wind Probabilities

ZCZC MIAPWSAT4 ALL
TTAA00 KNHC DDHHMM
HURRICANE TESTPROB WIND SPEED PROBABILITIES NUMBER 1
NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL AL792005
2100 UTC SAT OCT 22 2005

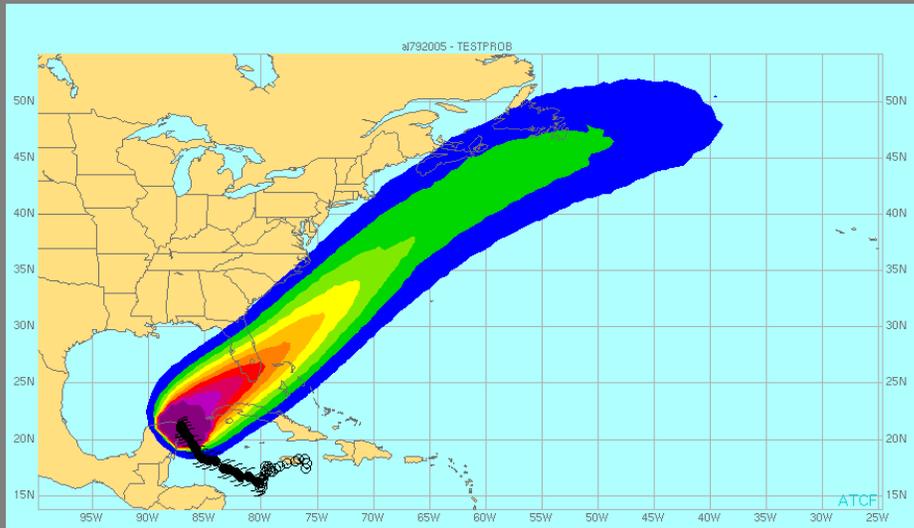
.....



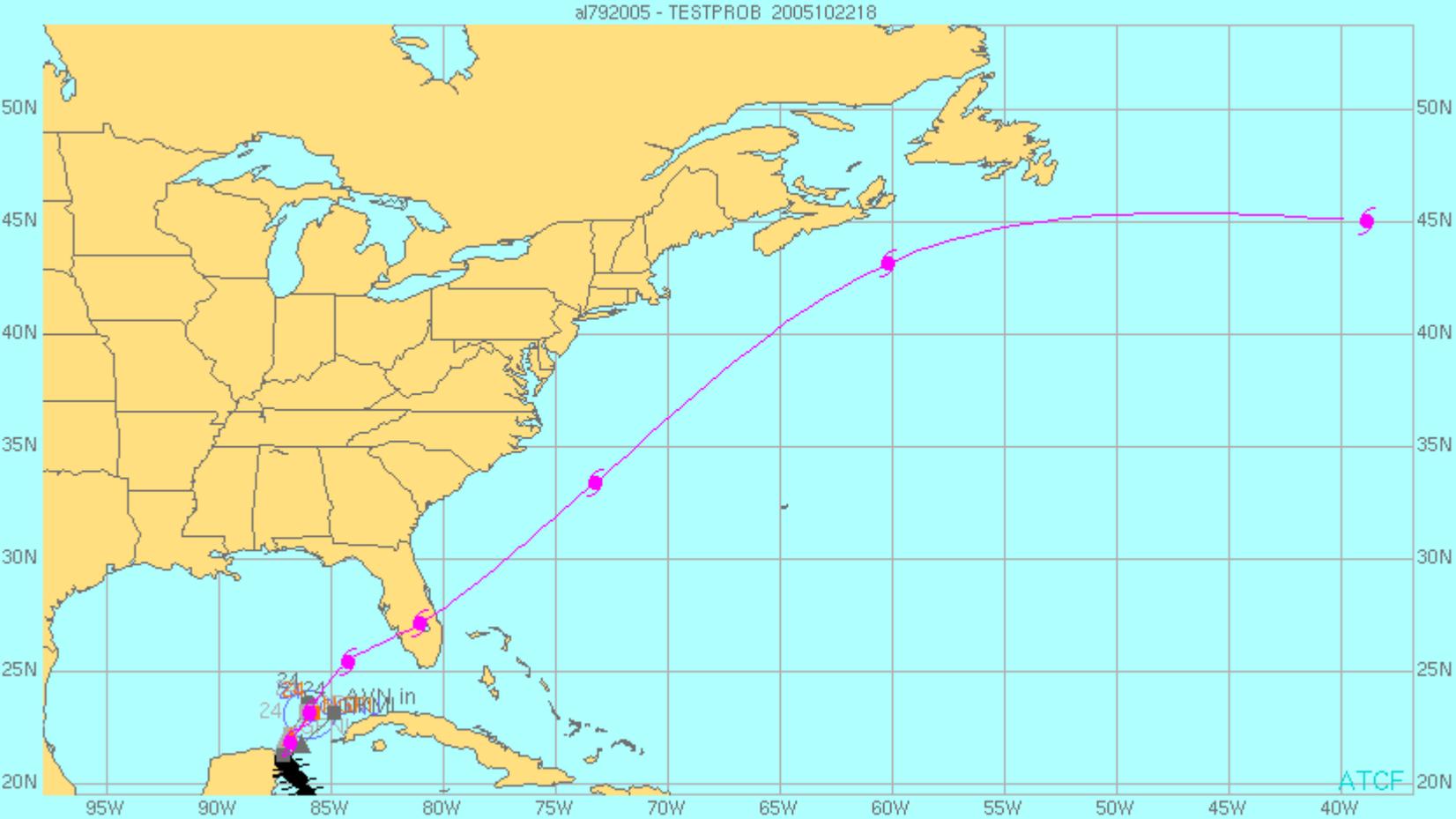
Messages

Breakpoints

Grids



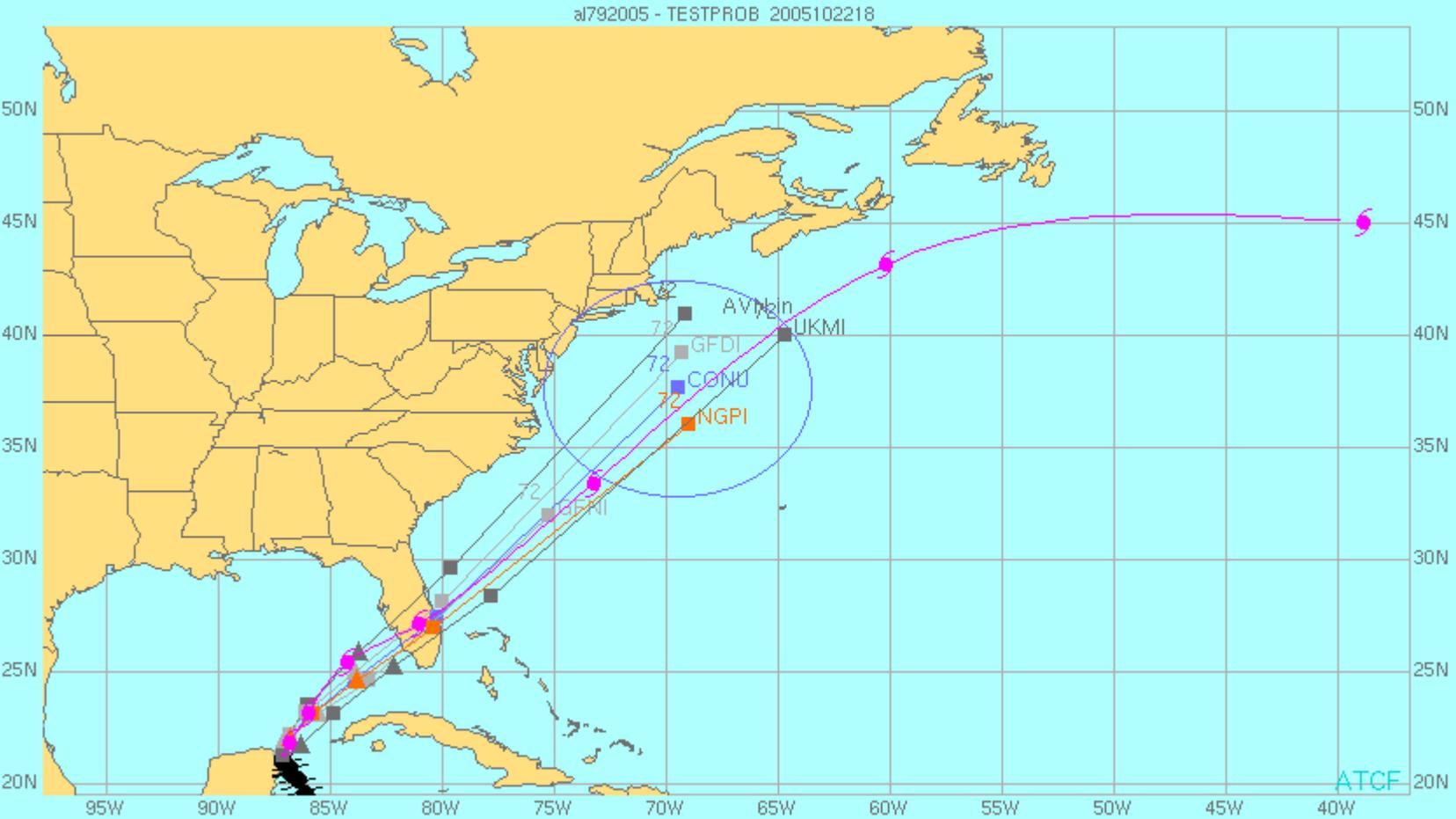
Goerss Prediction Consensus Error (GPCE) (24 hour forecast)



Goerss Probability Consensus Error (GPCE) computation, display, retention of the error radii complete.

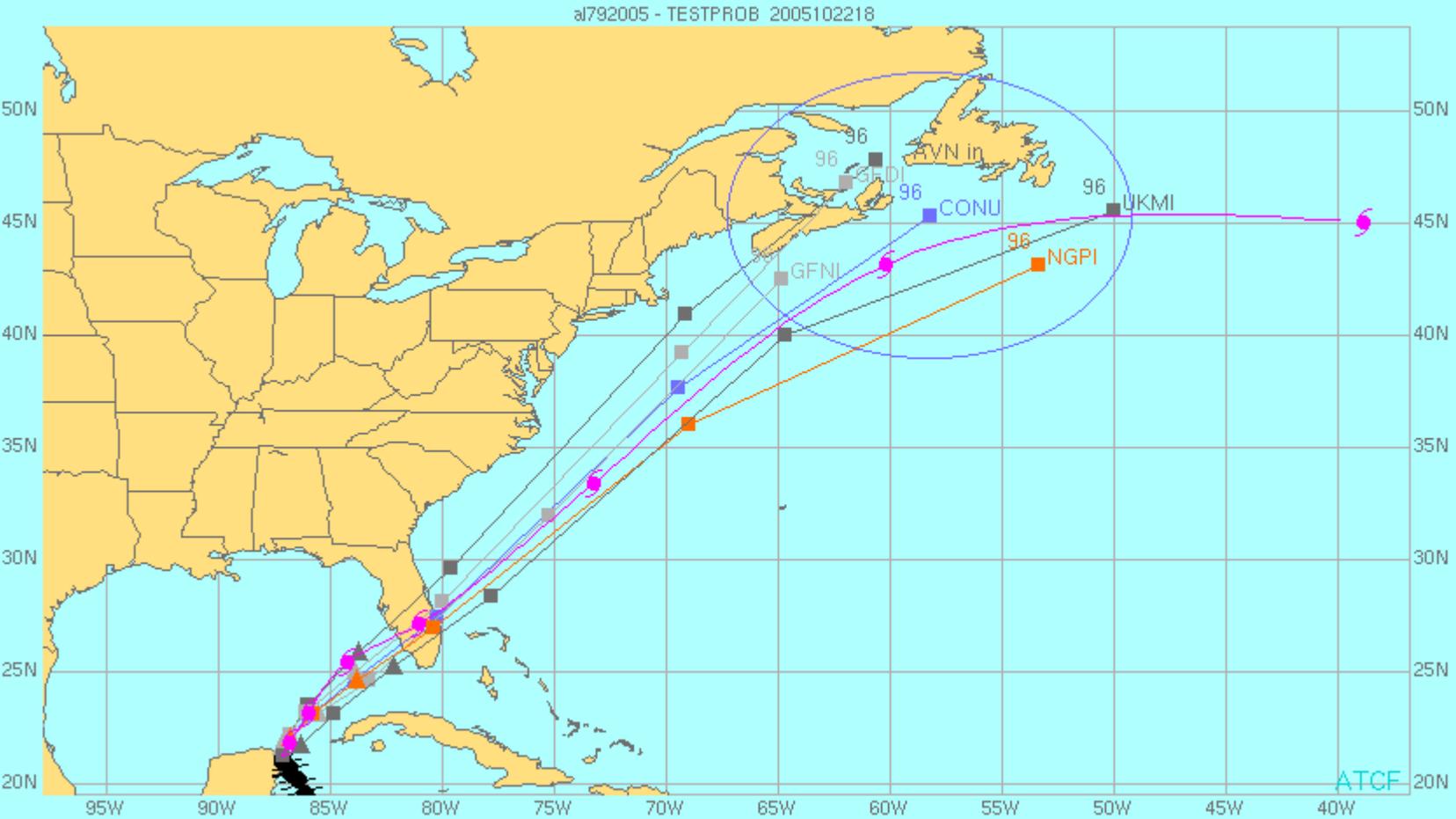
Goerss Prediction Consensus Error (GPCE)

(72 hour forecast)

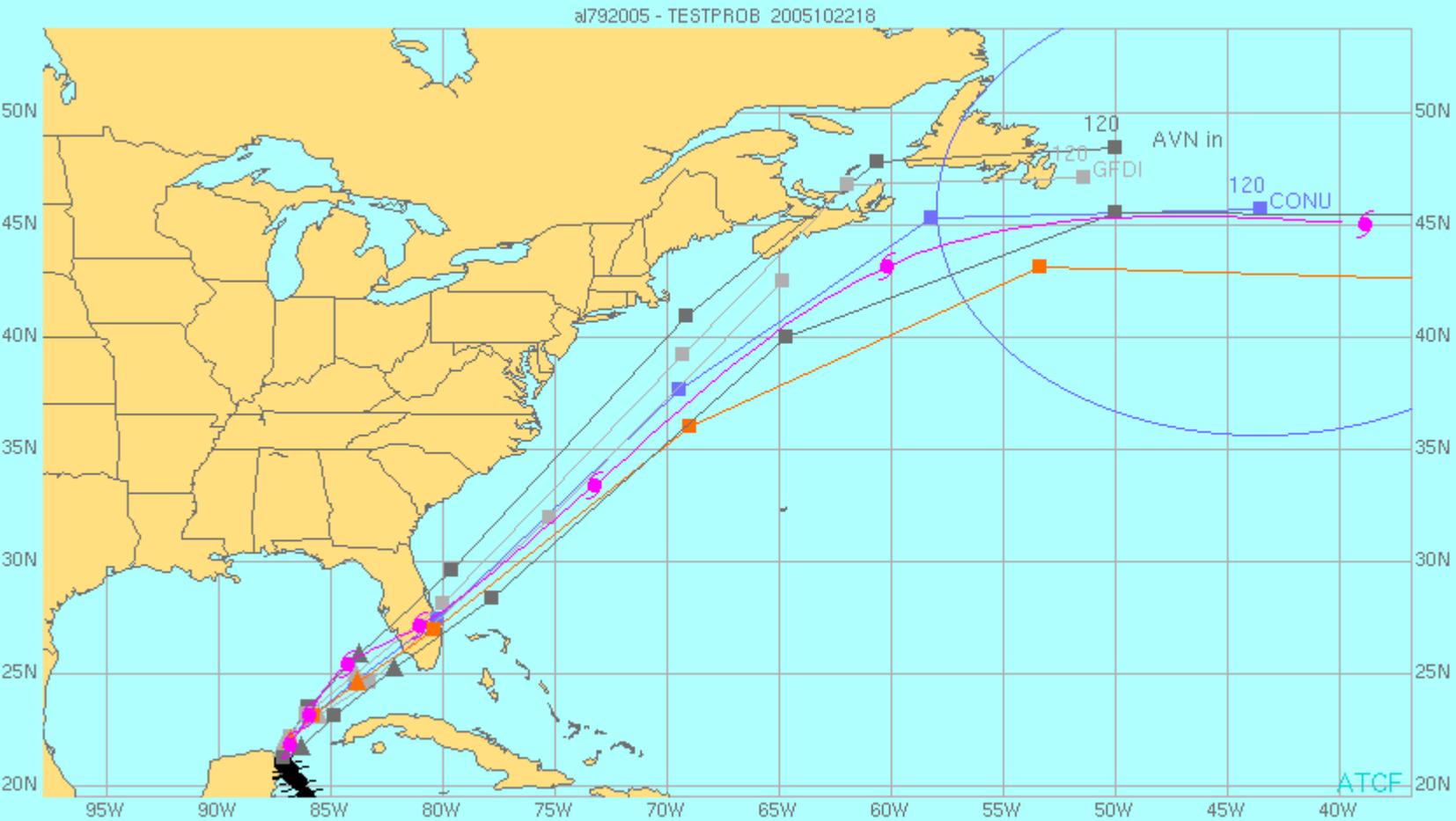


Goerss Prediction Consensus Error (GPCE)

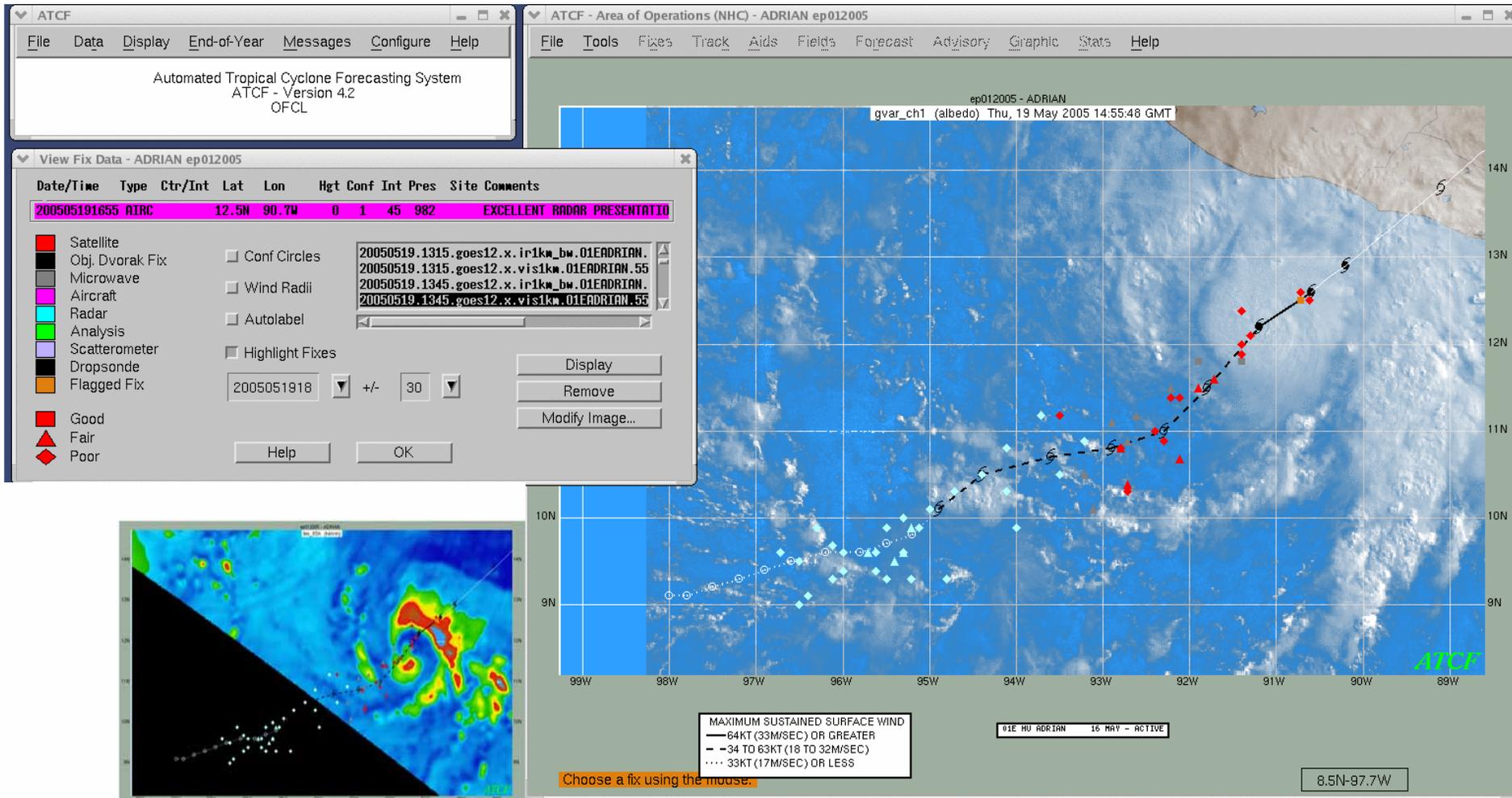
(96 hour forecast)



Goerss Prediction Consensus Error (GPCE) (120 hour forecast)



Streamline Satellite Imagery Overlay, Add Products



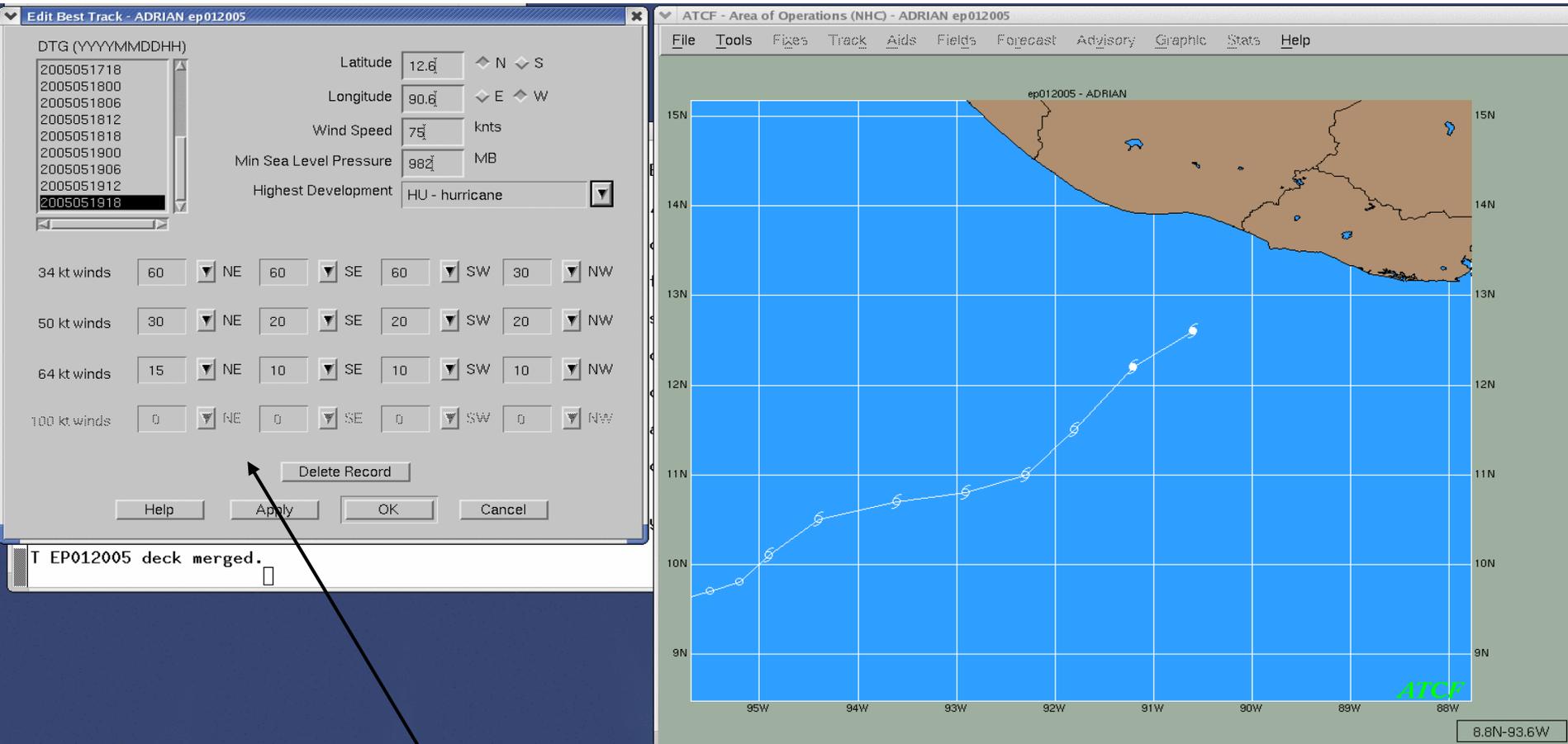
Imagery from NRL TC Page can be retrieved and displayed. RH 4 and NHC firewall issues now fixed. New products can be added on request.

User Interface/Forecaster Efficiency

- ~ 35 NHC requirements addressed
- Varying degrees of difficulty
- ATCF Requirements Lists (2005/2006)
 - GUI changes
 - Message changes
 - New capabilities

Track Function Improvements / Enhancements

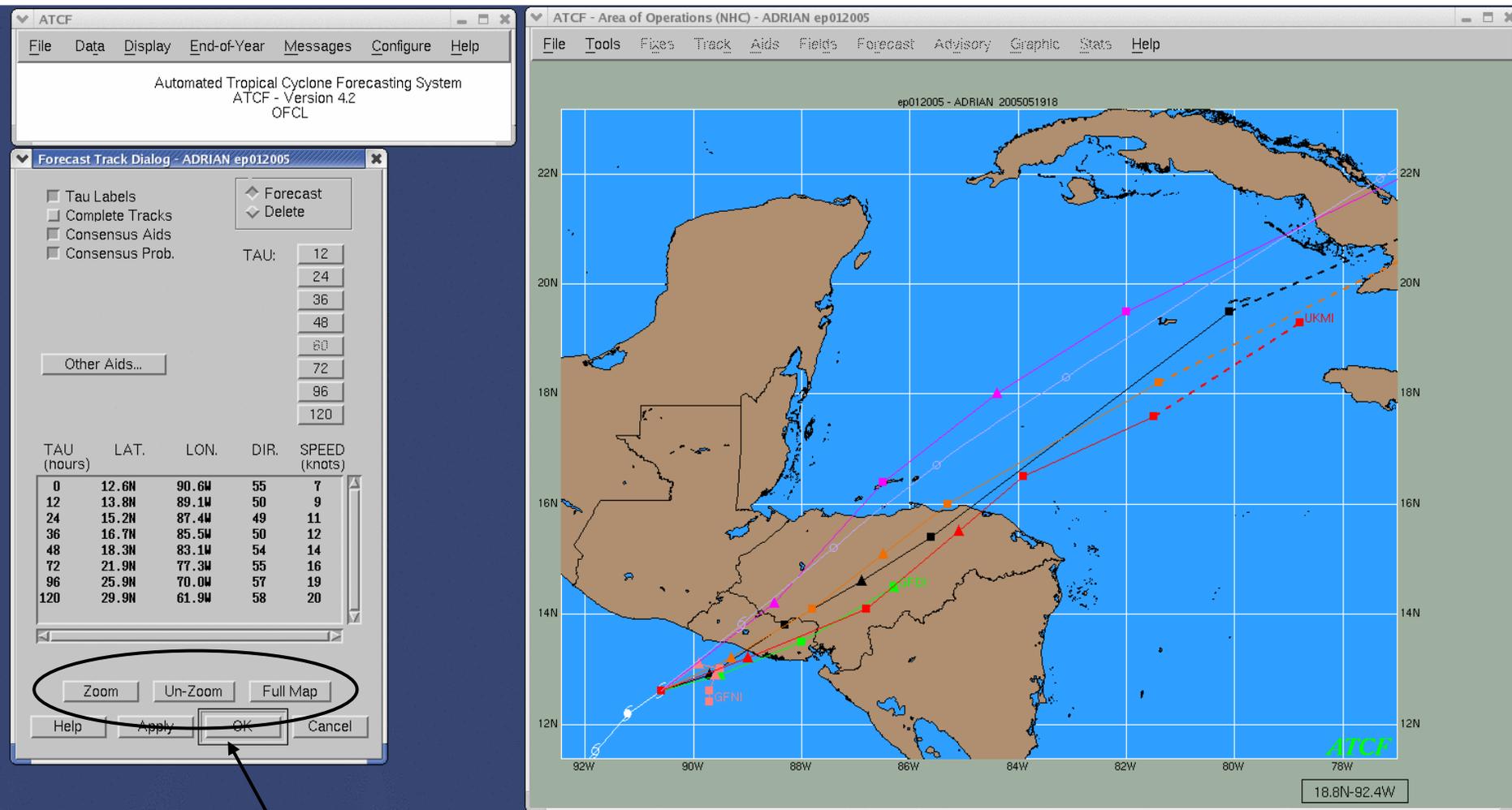
Positive Impact: improved editing (all Centers)...



Best Track editing dialog has been improved by adding wind radii.
NHC now best tracks wind radii at the end of the season.

Forecast Function Improvements / Enhancements

Positive Impact: time saving (all Centers)...



Capability added to allow for zoom/unzoom/full-map snap to while keeping forecast track dialog open.

Note – last year you had to quit the dialog, re-zoom and then re-enter the dialog to continue the forecast track preparation

Forecast Function Improvements / Enhancements

Positive Impact: time saving and flexibility (all Centers)...

The screenshot displays the ATCF software interface with several windows open. The main window shows a map of the Atlantic Ocean with forecast tracks. Two dialog boxes are overlaid on the map:

- Forecast Track Dialog - ADRIAN ep012005:** This dialog has a 'Forecast' section with 'Tau Labels' checked. Below it is a 'TAU' list with values from 12 to 120. A table at the bottom shows forecast data for various TAU values.
- Objective Aids - ADRIAN ep012005:** This dialog allows selecting a profile (CONU ensemble) and DTG(s) (2005051918). It lists various objective aids like GFDL, UKMET, and NOGAPS models. A 'Clear Aids' button is circled in red.

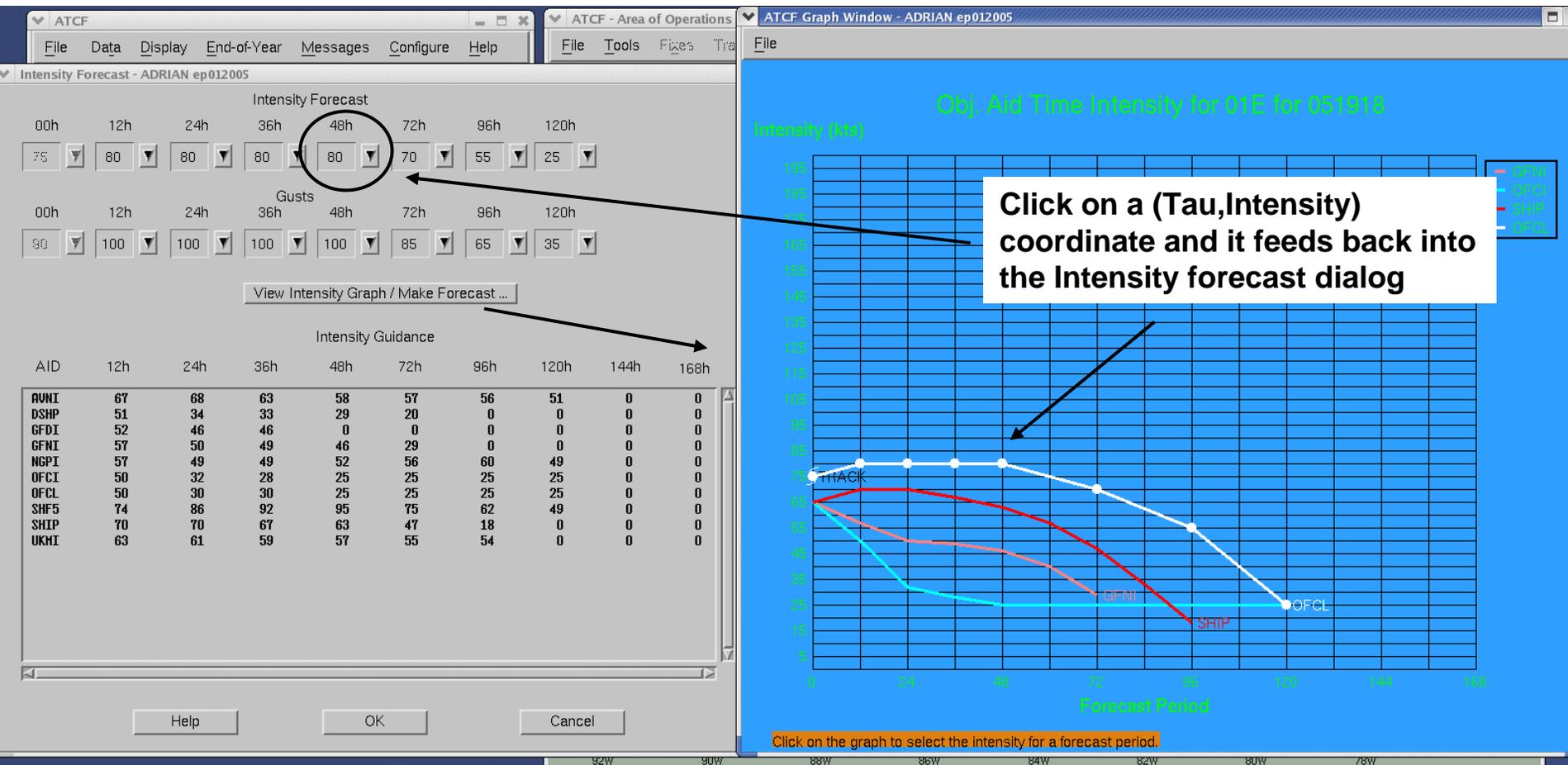
TAU (hours)	LAT.	LON.	DIR.	SPEED (knots)
0	12.6N	90.6W	55	7
12	13.8N	89.1W	50	9
24	15.2N	87.4W	49	11
36	16.7N	85.5W	50	12
48	18.3N	83.1W	54	14
72	21.9N	77.3W	55	16
96	25.9N	70.0W	57	19
120	29.9N	61.9W	58	20

Forecast dialog button allows call up of objective aids while preparing the forecast track. Clear Aids button of course clears the currently displayed guidance and quick re-selection of other objective aids is now available.

Note – Allows user to quickly alter the displayed objective aids. The procedure to accomplish this last took a bit a cycling through menu options to accomplish this task.

Forecast Function Improvements / Enhancements

Positive Impact: flexibility (all Centers)...



Open up view Intensity Graph and the user can click on a Tau/Intensity which will link to the Intensity Forecast Tau and make the change there.

Forecast Function Improvements / Enhancements

Positive Impact: enhanced display and flexibility (all Centers)...

The screenshot displays the ATCF software interface. The main window shows a map of the Caribbean region with forecast tracks and wind radii. Two dialog boxes are open:

- Forecast Wind Radii Display Options - ADRIAN ep012005**: This dialog allows users to select which wind radii to display. It includes a TAU list (0, 12, 24, 36, 48) and checkboxes for 34, 50, 64, and 100 knot radii. Buttons for "All 34 kt", "All 50 kt", "All 64 kt", "All 100 kt", "Display All", and "Clear All" are present.
- Forecast Wind Radii Dialog - ADRIAN ep012005**: This dialog provides detailed settings for wind radii. It shows Max Wind (50 kts), Direction (50), and Speed (8 kts). It includes a TAU list (0, 12, 24, 36, 48, 60, 72, 84, 96, 100) and a grid for selecting radii for 34, 50, and 64 kt winds at NE, SE, SW, and NW directions. An "Options..." button is circled, with an arrow pointing to the "Forecast Wind Radii Display Options" dialog.

Below the dialog boxes, a table titled "Wind Radii Guidance for TAU 12" is shown:

Tech	TAU (hr)	V-Max (knots)	34 knot radii (nm)			50 knot radii (nm)			64 knot radii (nm)		
DRCL	12	50	47	51	47	24	0	16	0	0	
NGPS	12	39	0	151	104	0					

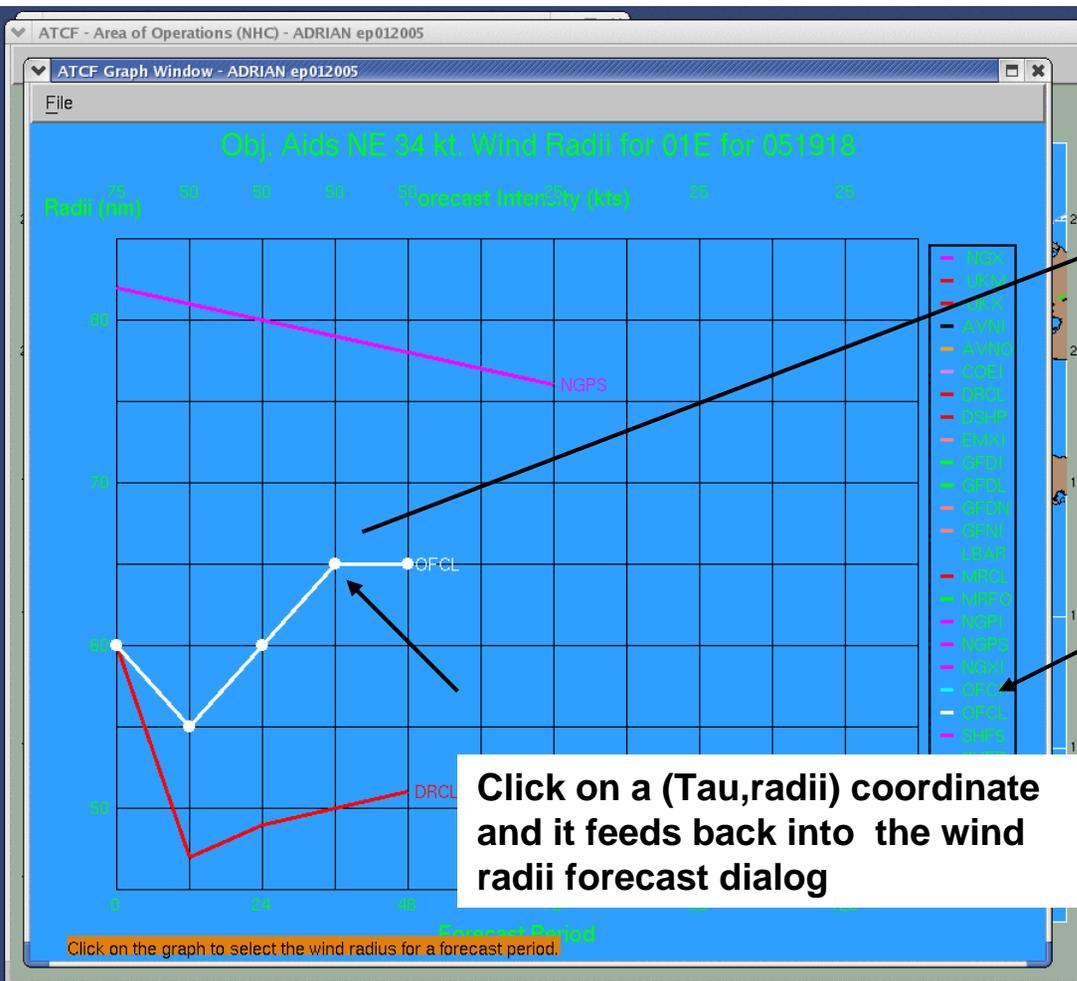
Below that, a table titled "Current Forecast" is shown:

TAU (hr)	V-Max (knots)	34 knot radii (nm)			50 knot radii (nm)			64 knot radii (nm)				
0	75	60	60	60	30	30	20	20	15	10	10	10
12	50	60	60	60	30	30	20	20				
24	50	60	60	60	30	30	20	20				
36	50	60	60	60	30	30	20	20				
48	50	60	60	60	30	30	20	20				
72	25											
96	25											

Option button in Forecast wind radii dialog calls an additional dialog display to allow user selection of wind radii at select Taus or select radii values.

Forecast Function Improvements / Enhancements

Positive Impact: flexibility (all Centers)...



Click on a (Tau,radII) coordinate and it feeds back into the wind radii forecast dialog

Forecast Wind Radii Dialog - ADRIAN ep012005

Max Wind: 50 kts TAU 48 TAU: 0

Direction: 55

Speed: 14 kts

	NE (nm)	SE (nm)	SW (nm)	NW (nm)
34 kt winds:	65	60	60	30
50 kt winds:	30	20	20	20
64 kt winds:	0	0	0	0

Use TAU 0 values Delete Radii Options...

Graph/Make-Forecast 34 kt radii: **NE...** SE... SW... NW...

Wind Radii Guidance for TAU 48

Tech	TAU (hr)	V-Max (knots)	34 knot radii (nm)	50 knot radii (nm)	64 knot radii (nm)
DRCL	48	50	51 72 56 35	0 28 0 0	

Current Forecast

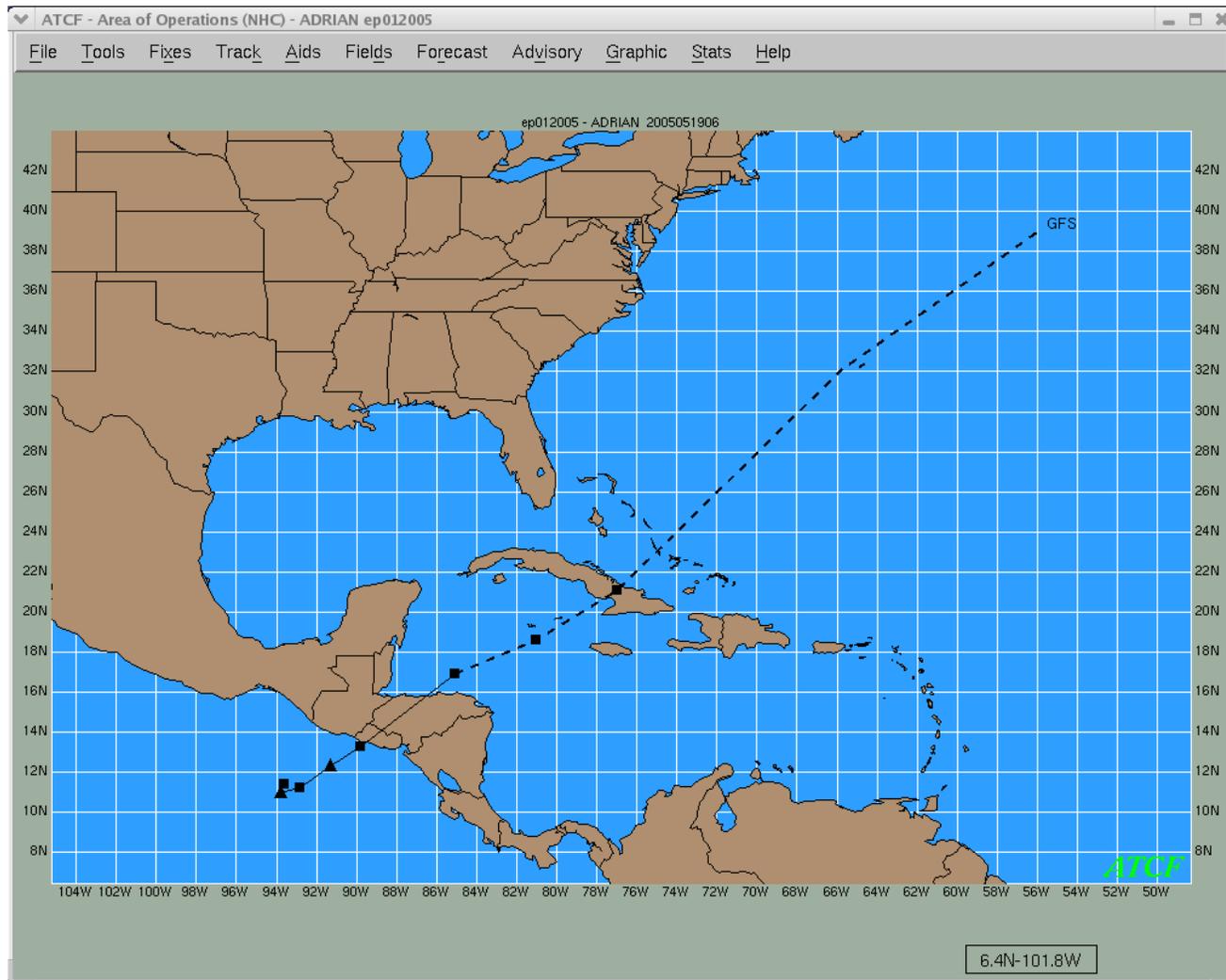
TAU (hr)	V-Max (knots)	34 knot radii (nm)	50 knot radii (nm)	64 knot radii (nm)
0	75	60 60 60 30	30 20 20 20	15 10 10 10
12	50	55 60 60 30	30 20 20 20	
24	50	60 60 60 30	30 20 20 20	
36	50	65 60 60 30	30 20 20 20	
48	50	65 60 60 30	30 20 20 20	
72	25			
96	25			

Help Apply OK Cancel

Open up the view Graph (radii quadrant) and the user can click on a Tau/radii value which will link to the Wind radii Forecast Tau and make the change there.

Forecast Function Improvements / Enhancements

Positive Impact: flexibility (all Centers)...



Display of objective aids out to **10** days. Internal objective aids merge routine allows forecast hours out to **10** days.

Advisory Improvements / Enhancements

Positive Impact: additional information and time savings (NOAA/NWS only)...

The screenshot displays the ATCF software interface. The main window shows a map of the Caribbean region with a storm track indicated by a line of symbols. Two dialog boxes are overlaid on the map:

- Advisory Composition Dialog - ADRIAN ep012005**: This dialog contains various fields for configuring an advisory. The "Geography Reference" field is circled in red and contains two entries: "13.7N 89.2W SAN SALVADOR EL SALVADOR" and "16.2N 95.2W SALINA CRUZ MEXICO". Other fields include "Special Advisory", "Time of advisory", "Forecaster Initials", "Advisory number", "AWIPS bin number", "Time Zone", "Daylight Time", "Subtropical", "Surface Pressure", "Center Accuracy", "Eye Diameter", "Public advisory frequency", and "Last Advisory".
- Advisory - Storm State - ADRIAN ep012005**: This dialog shows the storm state for different TAU values. The "Storm state" section has radio buttons for "Normal", "Inland", "Dissipating", "Extratropical", and "Remnant Low". The "Dissipating" option is selected. The "TAU" list on the left shows values from 12 to 120, with 120 selected. The "tau" list on the right shows the corresponding storm state for each TAU value.

tau	Storm State
12	Normal
24	Normal
36	Inland
48	Inland
72	Normal
96	Dissipating
120	Dissipating

In the advisory composition dialog, there are now two geography references.

Advisory Improvements / Enhancements

The image displays two overlapping dialog boxes from the ATCF software interface, set against a map of the Caribbean and Central America. The background map shows a storm track with various advisory symbols (triangles and diamonds) and a red diamond indicating the current advisory location. The ATCF logo is visible in the bottom right corner of the map.

Advisory Composition Dialog - ADRIAN ep012005

Tropical Cyclone ep012005 on 2005051918

Special Advisory Time of advisory: 0000 HHMM

Forecaster Initials: []

Advisory number: [] AWIPS bin number: 1

Time Zone: Atlantic Eastern Central Daylight Time

Subtropical Surface Pressure: 850 mb

Center Accuracy: 0 nm Eye Diameter: 0 nm

Forecast type...

Geography Reference: 13.7N 89.2W SAN SALVADOR EL SALVADOR

Geography Reference: 16.2N 95.2W SALINA CRUZ MEXICO

Public advisory frequency: 6 hourly 3 hourly 2 hourly

Last Advisory

Buttons: Advisory Data..., Edit Warning..., Help, OK, Cancel

Advisory - Storm State - ADRIAN ep012005

TAU: 12, 24, 36, 48, 72, 96, 120

Storm state:

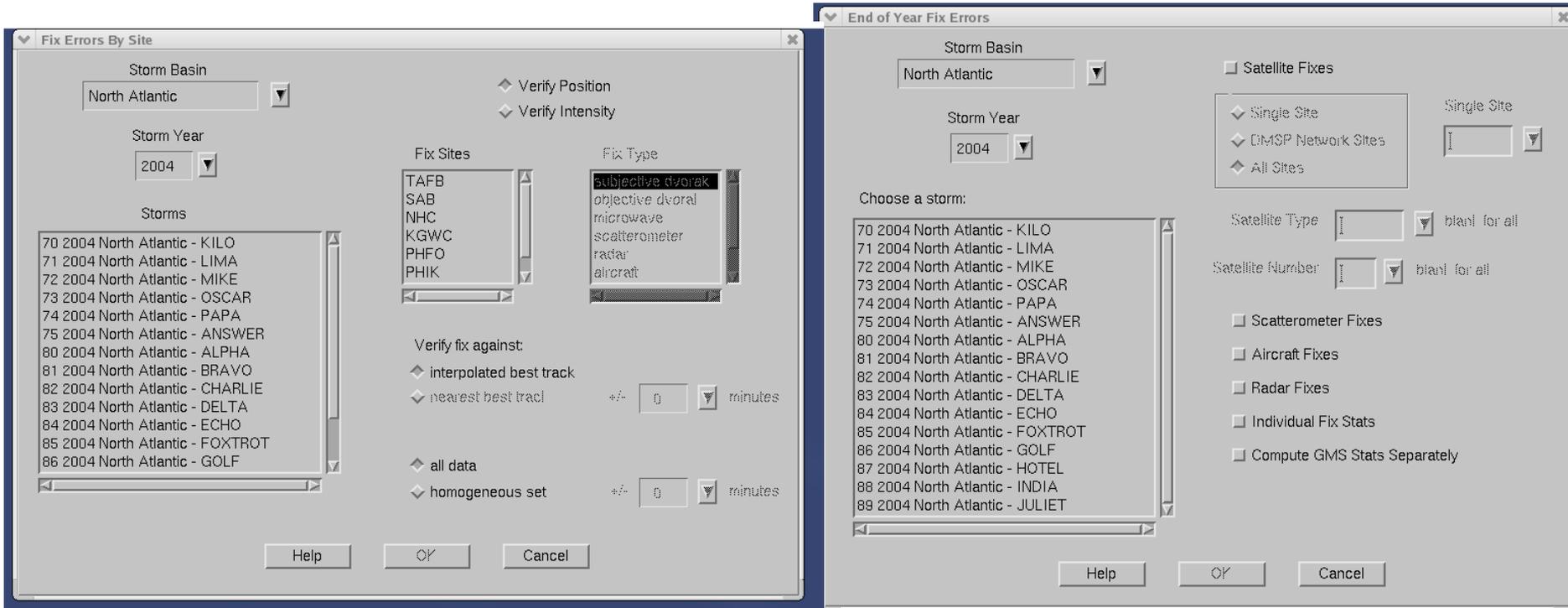
- Normal
- Inland
- Dissipating
- Extratropical
- Remnant Low

tau 12	Normal
tau 24	Normal
tau 36	Inland
tau 48	Inland
tau 72	Normal
tau 96	Dissipating
tau 120	Dissipating

Buttons: Help, OK, Cancel

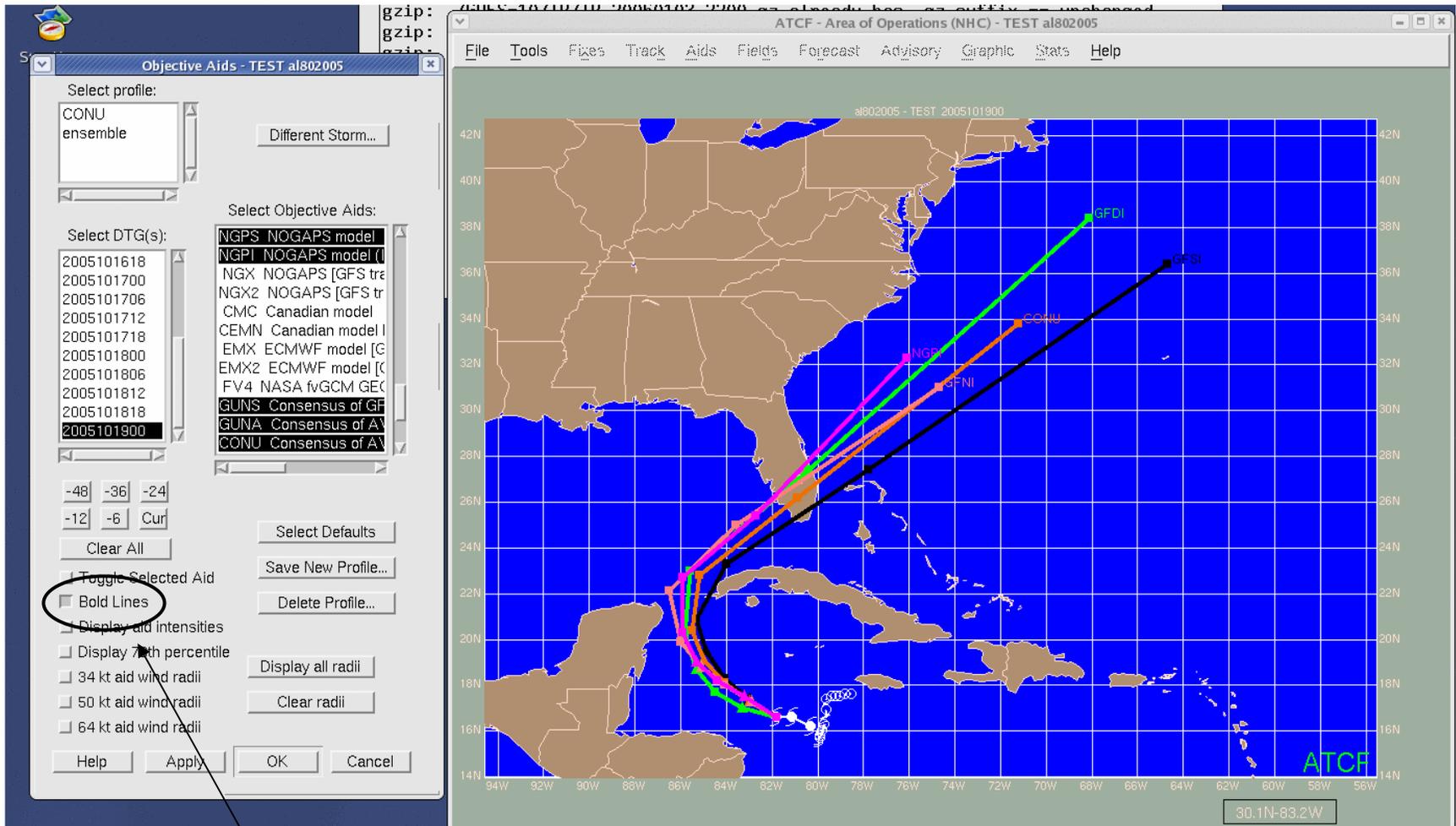
In advisory composition, capability to selection of the forecast type (normal, inland, ...) as a function of Tau.

Enhancement for Statistics



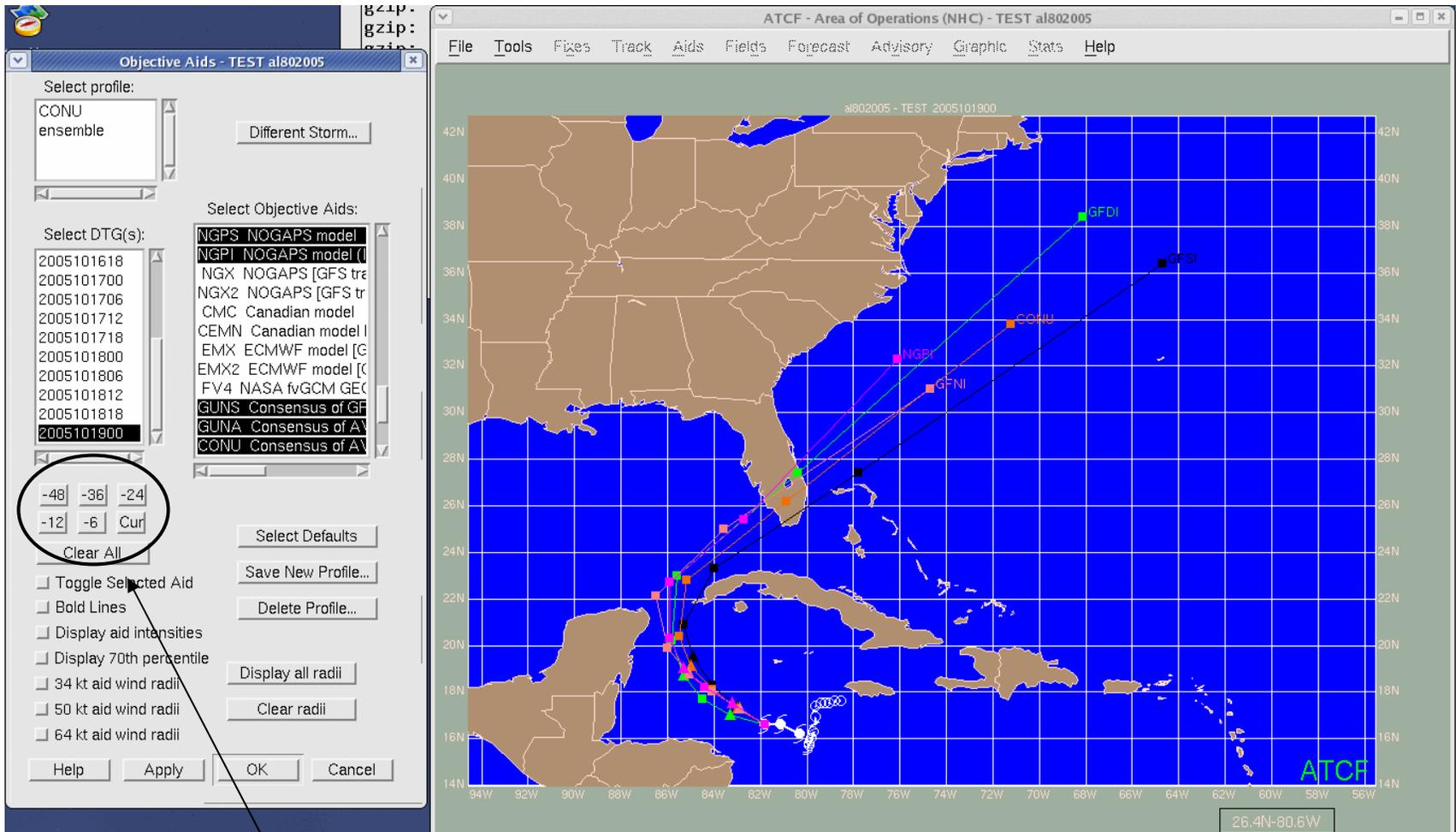
Dialogs added for NHC homogeneous fix statistics.

Enhancement for Objective Aids



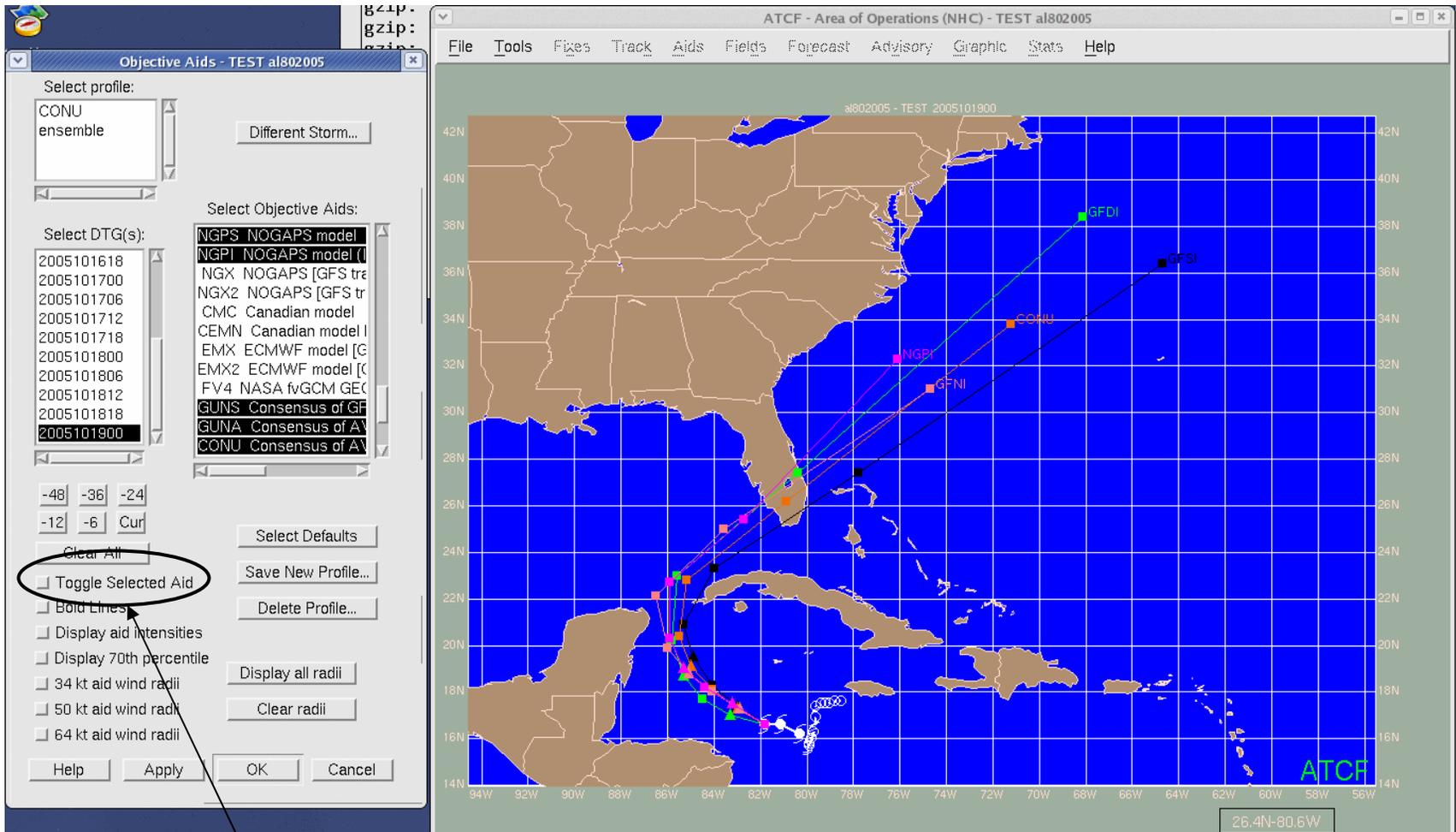
Toggle on/off thick lines.

Enhancement for Objective Aids



Toggle current selected guidance to Current, -06, -12, -24, -36 or -48h

Enhancement for Objective Aids



Toggle on/off currently selected aid(s).

Enhancement for Forecast Wind Radii

Forecast Wind Radii Dialog - TEST al802005

TAU: 36 TAU: 0

NE (nm) SE (nm) SW (nm) NW (nm)

34 kt: circle quad 150 150 150 150

50 kt: circle quad 80 80 80 80

64 kt: circle quad 25 25 25 25

Use previous TAU Delete Radii

Use TAU 0 - all TAUs Options...

Use DRCL - current TAU

Use DRCL - all TAUs

Graph/Make-Forecast 34 kt radii: NE... SE... SW... NW...

Max Wind: 120 kts
Dir: 323
Spd: 6 kts

Wind Radii Guidance for TAU 36

Tech	TAU (hr)	V-Max (knots)	34 knot radii (nm)				50 knot radii (nm)				64 knot radii (nm)			
AN01	36	60	198	178	192	178	129	130	110	0				
AN02	36	50	168	159	162	129								
AN03	36	58	175	165	155	143	110	99	128	84				
AN04	36	65	246	224	135	156	133	142	116	127	81	0	0	0
AN05	36	54	182	142	133	160	120	65	90	0				
AP01	36	50	166	189	136	137	83	0	93	0				
AP02	36	63	235	233	152	168	123	116	103	112				

Current Forecast

TAU (hr)	V-Max (knots)	34 knot radii (nm)				50 knot radii (nm)				64 knot radii (nm)				
0	130	135	90	90	135	60	30	30	60	15	15	15	15	
12	105	150	150	150	150	65	65	65	65	20	20	20	20	
24	115	160	125	115	160	70	50	50	70	25	25	25	25	
36	120	150	150	150	150	80	80	80	80	25	25	25	25	
48	125	165	155	140	165	85	85	50	85					
72	115	165	155	140	165	85	65	50	85					
96	100													
120	70													

Help Apply OK Cancel

ATCF - Area of Operations (NHC) - TEST al802005

File Tools Fixes Track Aids Fields Forecast Advisory Graphic Stats Help

20.4N-84.8W

Circle option for wind radii

Enhancement for Forecast Wind Radii

Forecast Wind Radii Dialog - TEST al802005

TAU 36 TAU: 0

NE (nm) SE (nm) SW (nm) NW (nm)

34 kt: circle quad 150 150 150 150 TAU: 12

50 kt: circle quad 80 80 80 80 TAU: 24

64 kt: circle quad 25 25 25 25 TAU: 36

Use previous TAU Delete Radii

Use TAU of all TAUs Options...

Use DRCL - current TAU

Use DRCL - all TAUs

Graph/Make-Forecast 34 kt radii: NE... SE... SW... NW... Max Wind: 120 kts

Dir: 323 Spd: 6 kts

Wind Radii Guidance for TAU 36

Tech	TAU (hr)	V-Max (knots)	34 knot radii (nm)				50 knot radii (nm)				64 knot radii (nm)			
AN01	36	60	198	178	192	178	129	130	110	0				
AN02	36	50	168	159	162	129								
AN03	36	58	175	165	155	143	110	99	128	84				
AN04	36	65	246	224	135	156	133	142	116	127	81	0	0	0
AN05	36	54	182	142	133	160	120	65	90	0				
AP01	36	50	166	189	136	137	83	0	93	0				
AP02	36	63	235	233	152	168	123	116	103	112				

Current Forecast

TAU (hr)	V-Max (knots)	34 knot radii (nm)				50 knot radii (nm)				64 knot radii (nm)			
0	130	135	90	90	135	60	30	30	60	15	15	15	15
12	105	150	150	150	150	65	65	65	65	20	20	20	20
24	115	160	125	115	160	70	50	50	70	25	25	25	25
36	120	150	150	150	150	80	80	80	80	25	25	25	25
48	125	165	155	140	165	85	65	50	85				
72	115	165	155	140	165	85	65	50	85				
96	100												
120	70												

Help Apply OK Cancel

ATCF - Area of Operations (NHC) - TEST al802005

File Tools Files Track Aids Fields Forecast Advisory Graphic Stats Help

20.4N-84.8W

Use previous wind radii values button.

Enhancement for Forecast Wind Radii

Forecast Wind Radii Dialog - TEST al802005

TAU 36 TAU: 0

NE (nm) SE (nm) SW (nm) NW (nm)

34 kt: circle quad 150 150 150 150

50 kt: circle quad 80 80 80 80

64 kt: circle quad 25 25 25 25

Graph/Make-Forecast 34 kt radii:

Max Wind: 120 kts
Dir: 323
Spd: 6 kts

Wind Radii Guidance for TAU 36

Tech	TAU (hr)	V-Max (knots)	34 knot radii (nm)				50 knot radii (nm)				64 knot radii (nm)			
AN01	36	60	198	178	192	178	129	130	110	0				
AN02	36	50	168	158	162	129								
AN03	36	58	175	165	155	143	110	99	128	84				
AN04	36	65	246	224	135	156	133	142	116	127	81	0	0	0
AN05	36	54	182	142	133	160	120	65	90	0				
AP01	36	50	166	189	136	137	83	0	93	0				
AP02	36	63	235	233	152	168	123	116	103	112				

Current Forecast

TAU (hr)	V-Max (knots)	34 knot radii (nm)				50 knot radii (nm)				64 knot radii (nm)			
0	130	135	90	90	135	60	30	30	60	15	15	15	15
12	105	150	150	150	150	65	65	65	65	20	20	20	20
24	115	160	125	115	160	70	50	50	70	25	25	25	25
36	120	150	150	150	150	80	80	80	80	25	25	25	25
48	125	165	155	140	165	85	65	50	85				
72	115	165	155	140	165	85	65	50	85				
96	100												
120	70												

ATCF - Area of Operations (NHC) - TEST al802005

File Tools Fixes Track Aids Fields Forecast Advisory Graphic Stats Help

20.4N-84.8W

Populate all Taus with Tau 0 wind radii

Enhancement for Forecast Wind Radii

Forecast Wind Radii Dialog - TEST al802005

TAU: 36 TAU: 0

NE (nm) SE (nm) SW (nm) NW (nm)

34 kt: circle quad 150 150 150 150

50 kt: circle quad 80 80 80 80

64 kt: circle quad 25 25 25 25

Buttons: Use previous TAU, **Delete Radii**, Options..., Use TAU 0 - all TAUs, Use DRCL - current TAU, Use DRCL - all TAUs

Graph/Make-Forecast 34 kt radii: NE... SE... SW... NW...

Max Wind: 120 kts
Dir: 323
Spd: 6 kts

Wind Radii Guidance for TAU 36

Tech	TAU (hr)	V-Max (knots)	34 knot radii (nm)				50 knot radii (nm)				64 knot radii (nm)			
AN01	36	60	198	178	192	178	129	130	110	0				
AN02	36	50	168	159	162	129								
AN03	36	58	175	165	155	143	110	99	128	84				
AN04	36	65	246	224	135	156	133	142	116	127	81	0	0	0
AN05	36	54	182	142	133	160	120	65	90	0				
AP01	36	50	166	189	136	137	83	0	93	0				
AP02	36	63	235	233	152	168	123	116	103	112				

Current Forecast

TAU (hr)	V-Max (knots)	34 knot radii (nm)				50 knot radii (nm)				64 knot radii (nm)			
0	130	135	90	90	135	60	30	30	60	15	15	15	15
12	105	150	150	150	150	65	65	65	65	20	20	20	20
24	115	160	125	115	160	70	50	50	70	25	25	25	25
36	120	150	150	150	150	80	80	80	80	25	25	25	25
48	125	165	155	140	165	85	65	50	85				
72	115	165	155	140	165	85	65	50	85				
96	100												
120	70												

Buttons: Help, Apply, OK, Cancel

ATCF - Area of Operations (NHC) - TEST al802005

Map showing forecast wind radii for TAU 36. The map displays the Caribbean region with various wind radii circles and lines. A red circle is highlighted around the 'Delete Radii' button in the dialog box.

Delete current Tau wind radii (i.e. zero out all values)

Conclusions

- Wind radii CLIPER algorithms evaluated (80%)
- Monte Carlo wind probabilities in ATCF (90%)
- GPCE track probabilities
 - Data retention (90%)
 - Display (90%)
 - Evaluation (10%)
- Imagery overlay capability (90%)
- Objective best track capability (0%)
- Automate TC fix entry in NHC operations (90%)
- Modify ATCF user interface/code to improve efficiency (70%)