Overview of the Tropical Cyclone Guidance Project

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Road Map

- What is the Tropical Cyclone Guidance Project?
- Why is this project relevant?
- Current capabilities
- Desired future capabilities

What is the Tropical Cyclone Guidance Project (TCGP)?

TCGP is . . .

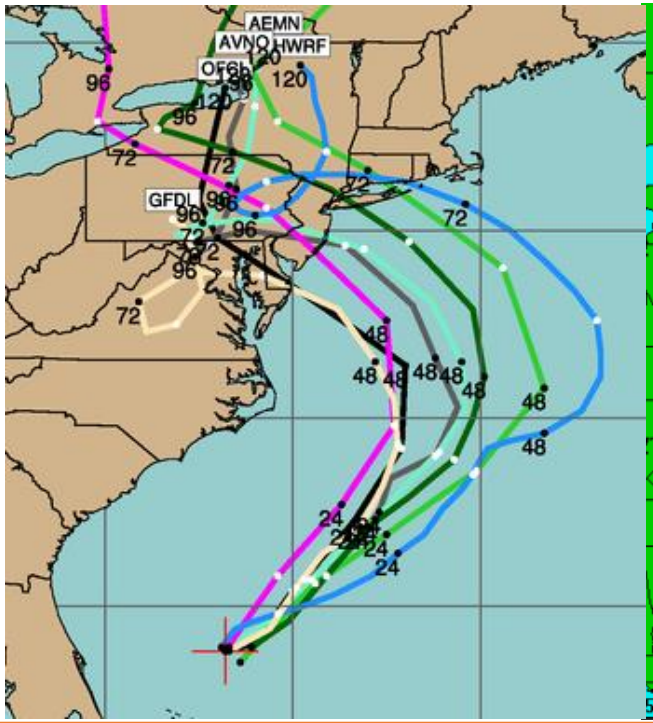
- a ***real-time platform*** for the visualization and dissemination of tropical cyclone forecast aids
- a ***testbed*** for displaying and comparing experimental forecast aids in real-time
- a ***portal*** to additional sources of information
- a provider of real-time observational information that goes beyond traditional metrics of track and intensity by adding ***structure information***
- an ***experiment*** in how hurricane communications can be improved and refined

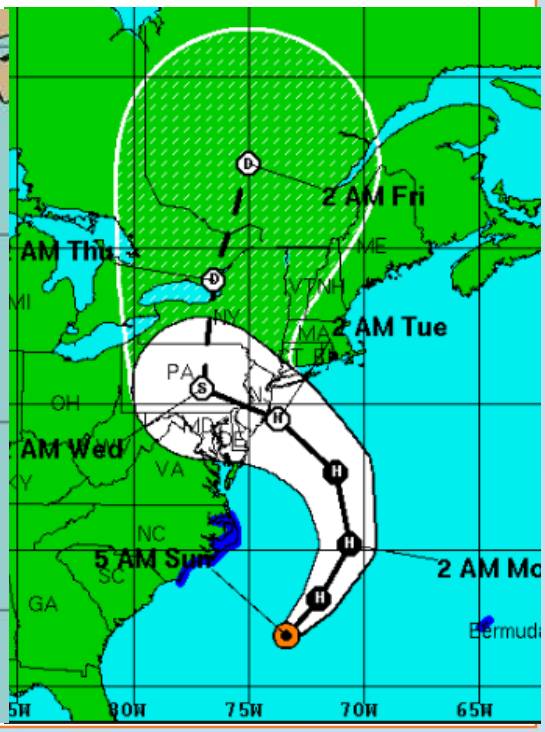
hurricanes.ral.ucar.edu

Why is TCGP relevant?

There is a societal need for clear and timely visualization and dissemination of tropical cyclone guidance

The official NHC forecast is based to a large degree on the consensus of a small group of “top-flight” models along with subjective forecaster intuition/weighting





Why is TCGP relevant?

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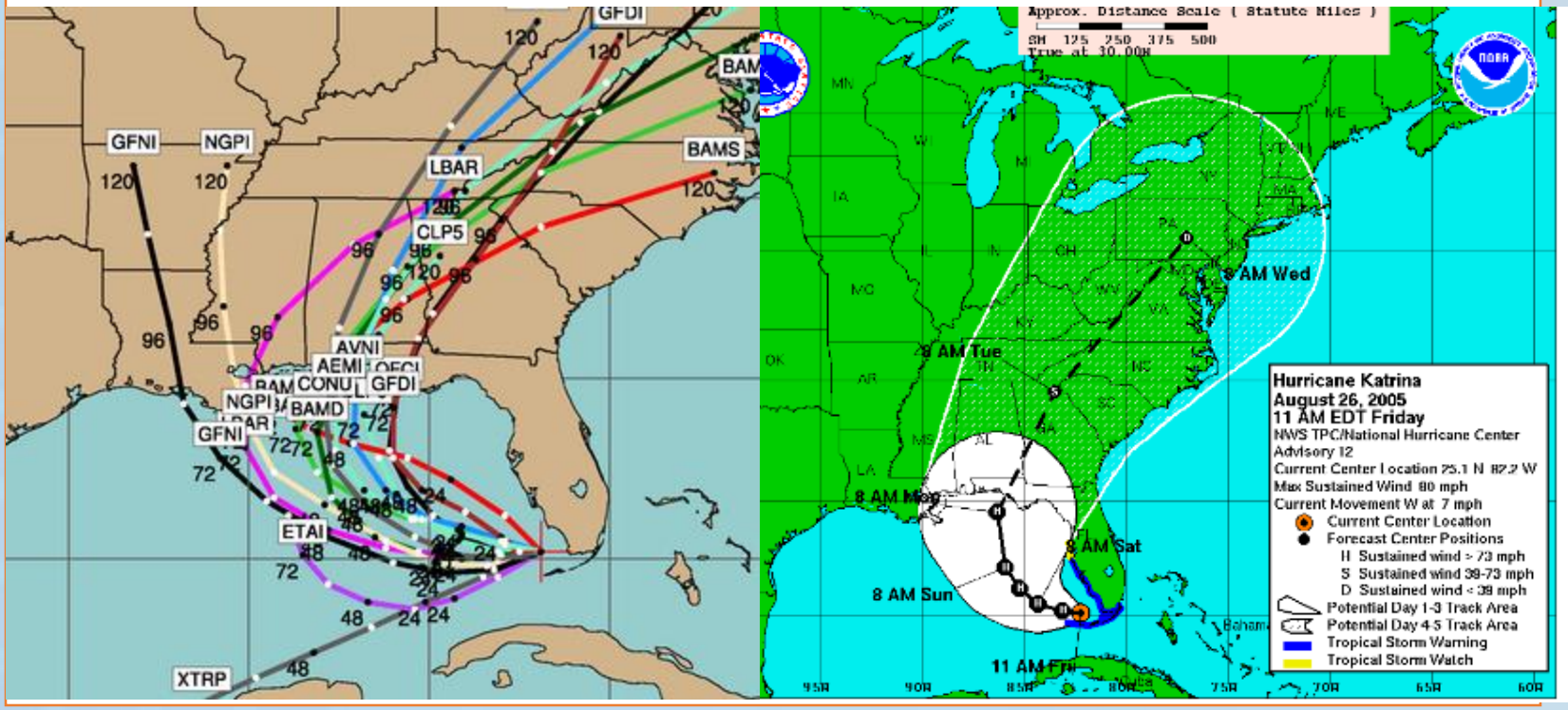
Changes in model scenarios often lead to revisions to the official forecast track in the next cycle

=> changes in model projections can give early indication of changes in the official forecast

26 Aug 1400 UTC

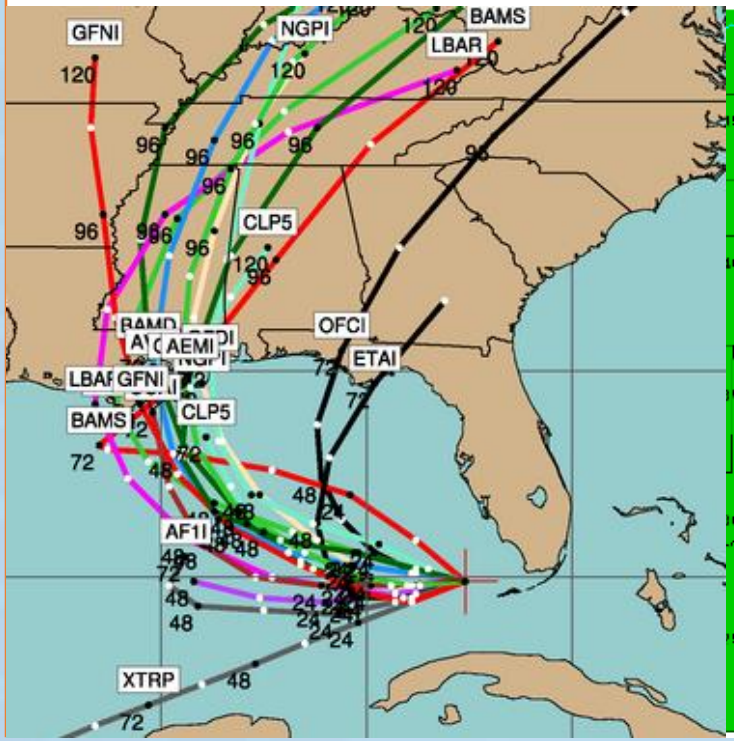
26 Aug 1500 UTC



Why is TCGP relevant?

- Large spread tends to indicate large uncertainty
- Small spread tends to indicate reduced uncertainty and higher confidence

26 Aug 2000 UTC



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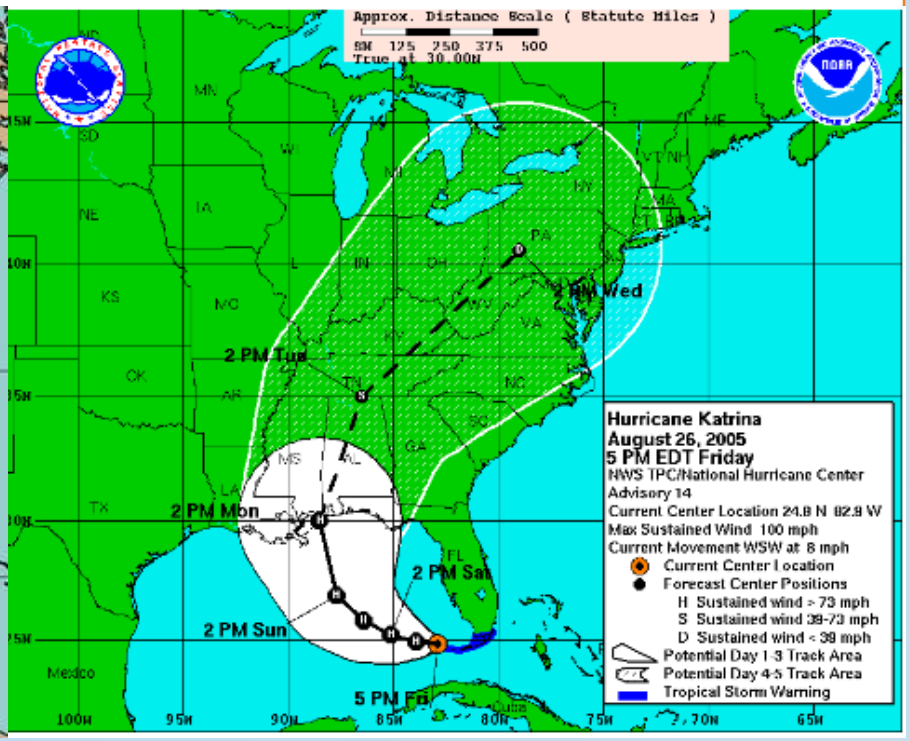
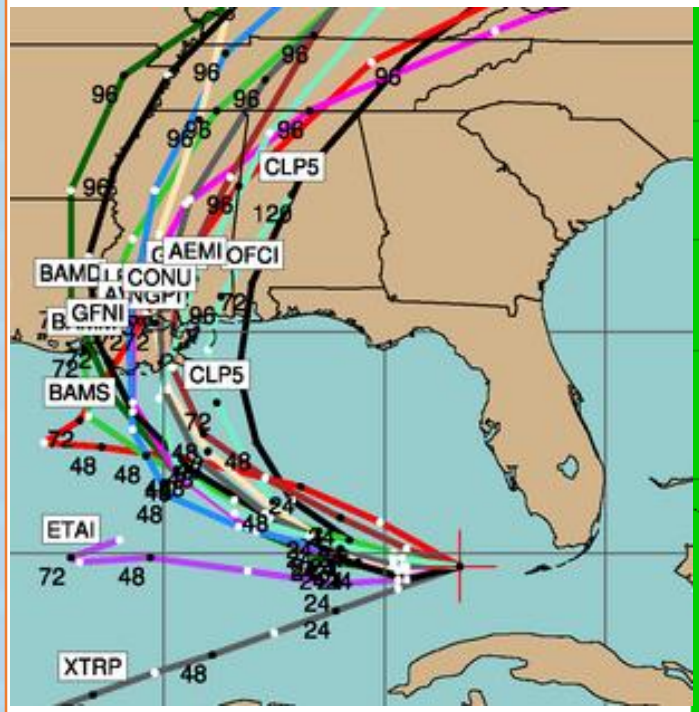


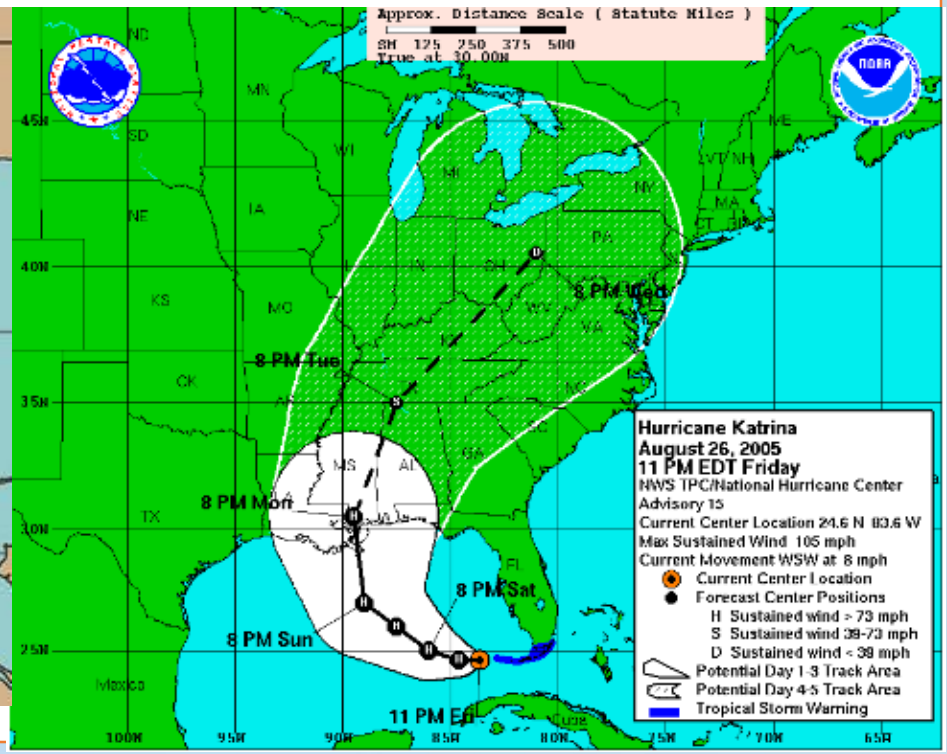
Why is TCGP relevant?

- Changes in model scenarios often lead to revisions to the official forecast track in the next cycle
- => changes in model projections can give early indication of changes in the official forecast

27 Aug 0200 UTC



27 Aug 0300 UTC



Why is TCGP relevant?

- **There is no such thing as the "general public"!**
- **Each user has a unique cost/value function for taking protective action:**
  - government agencies (e.g. NASA, DOD/Navy)
  - multinational corporation with widespread geographical operations (e.g. FedEx, shipping company)
  - energy operator in Gulf of Mexico (e.g. Chevron)
  - fisherman in Louisiana
  - emergency manager for a coastal county
  - weather-savvy small business proprietor
  - energy traders
  - coastal resident
- **Thus, it is impossible for one warning/communication system to adequately meet all user needs**

Why is TCGP relevant?

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The traditional warning system has focused on:

a) where the storm is going (e.g. “track”)
b) how strong the maximum winds will be (e.g. “intensity”)

Yet, hurricanes and tropical storms present a very wide spectrum of **structures** and **sizes**.

Experts as well as savvy users need additional information beside just track and intensity.

Impact-based warnings are not adequate to convey the threat to all users. *As the experience with Hurricane Sandy shows, sole reliance on impacts can confuse people.*

Why is TCGP relevant?

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- **Summary of usage**

	Total hits	Clicks	Plot Views	Total Bandwidth (GB)
2011	2,161,733	1,282,240	818,489	203.5
2012	4,645,476	1,936,818	1,270,322	302.3
2013	3,633,209	1,080,899	790,107	238.1

- **TCGP gets heavy web usage during storm events**
  - Peak day: Aug 14, 2013 – Tropical Storm Dorian
    - 13.2 GB of bandwidth
    - 91,467 clicks
  - In 2005 season, 3,000,000 hits in one month
  - ~35 GB of bandwidth in one day

Development Timeline

Pre-TCGP Era (2004 – 2010)

- **"Expert" resource** at Colorado State University in support of daily tropical weather briefings – very simple interface, little documentation

Phase I - released 14 Aug 2011

- Moved site from CSU to **NCAR**
- Brought new **storm-based interface** with overview map
- **4 types of plots:** early track, late track, GFS track, intensity
- **3 basins:** North Atlantic, Eastern Pacific, Central Pacific
- Updates on a **6 hour cycle**
- **Vortex Data Messages**

Phase II - late 2011

- Expanded site to cover **all global basins**
  - Northwest Pacific, North Indian Ocean, South Indian Ocean, Southwest Pacific
  - Added new portal features: links to CIRA satellite products, links to radar and buoy data, links to official warning information

Recent additional capabilities

Added more models and global ensembles

- Kerry Emanuel's CHIPS ensemble
- HWRF for all global basins
- GEFS/GEM/NAVGEM for global basins

Added links to operational information

- Buoys
- Surface observations (U.S. regions)
- Radars

Addition of links to research products

- ARCHER center-finding
- Satellite consensus estimates

Home | Welcome

WELCOME TO THE TROPICAL CYCLONE GUIDANCE PROJECT (TCGP)

Click here to go straight to the real-time guidance

The aims of this project are: (a) to foster increased development of forecast aids for global basins by engaging the wider community of operational centers, academic researchers, and commercial interests; and (b) to go beyond track and intensity both by encouraging the development of forecast aids for *structure change* and by providing structure data for use in track and intensity projection methods.

To accomplish these aims, the project is organized around four main objectives: (1) to provide a global repository of tropical cyclone forecast aids for track and intensity information, (2) to provide real-time plots of these data for active tropical cyclones, and (3) to visualize structure and intensity parameters from observations taken by reconnaissance aircraft, (4) to provide retrospective plots of these data for past tropical cyclones.

This site is organized by tabs underneath the banner image above. Please refer to the overview tab to learn more about the purpose and rationale of this project, as well as future plans and general information for users. Each main tab also has a page explaining more about that section. The guide to plots tab provides an in-depth explanation for each of the types of plots featured in the site, as well as information about the various tropical cyclone forecast aids that appear in the plots. Some additional tropical cyclone resources are provided on the links tab.

What's New - Updated 21 August 2012

The TCGP plotting system has been updated to use a newer, higher resolution map database. The previous map database did not include the island of Barbados as well as many other minor islands. The new map database also allows for state boundaries of Mexico, Brazil, Canada, and several other countries. The outlines of U.S. counties will now be displayed whenever the range of the map domain is smaller than 35 degrees.

For previous news, please click here.

Hurricane Rita

The banner image of this site features a NASA satellite image of Hurricane Rita, taken at 1920 UTC on 21 Sep 2005. Click on the image to see the original high resolution image.

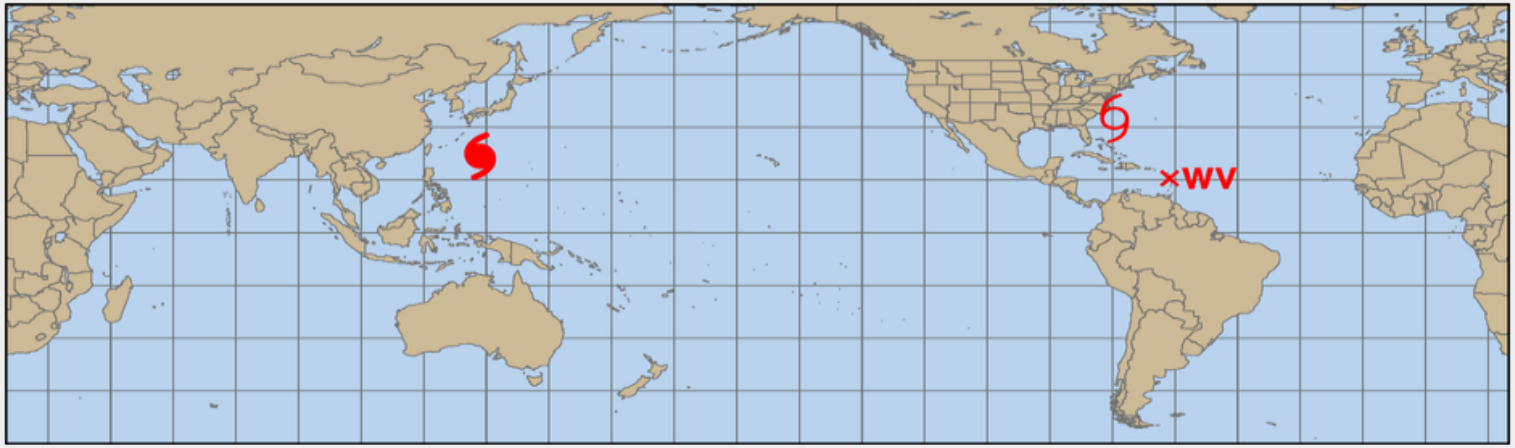
Real-Time Guidance | Current Active Storms

OVERVIEW OF CURRENT ACTIVE STORMS

The real-time guidance system generates an individual page for each active storm in the North Atlantic, Northeast Pacific, North Central Pacific, Northwest Pacific, North Indian Ocean, South Indian Ocean, and South Pacific basins (this page may not provide any information on storms in the Mediterranean or South Atlantic basin). Each individual storm page features the latest plots of model guidance and intensity forecast aids for that storm, as well as other diagnostic and observational information.

For more information and about the real-time guidance system and the documentation for each section of the individual storm pages, click here.

Storms active within the past 12 hours, valid for: 09 July 2018 0000 UTC **Last updated: 09 July 2018 0150 UTC**



Click on a storm on the map to go to the individual page for that storm.

NORTH INDIAN
No current storms

NORTHWEST PACIFIC
MARIA (WP10)

NORTH ATLANTIC
TROPICAL STORM CHRIS (AL03)
TROPICAL WAVE BERYL (AL02)

CENTRAL PACIFIC
No current storms

NORTHEAST PACIFIC
No current storms

SOUTHERN HEMISPHERE
No current storms

SOUTH ATLANTIC
No current storms

REAL-TIME GUIDANCE FOR MARIA (WP10)

This page provides plots and information for MARIA (WP10). The left side of this page provides TCGP-generated plots of numerical guidance and other TCGP-curated data. The right side of this page provides external links to additional information and products. **Most of the model guidance displayed in the plots come from modeling centers outside of NCAR, such as NOAA, other national numerical weather prediction centers, and universities.** Click here **for information about who contributes to TCGP.** Your use of this page is governed by the UCAR Terms of Service and this site's disclaimer. To obtain help for any item on this page, click on the question mark beside that item.

Information as of the most recent model cycle ?

At 0000 UTC, 09 July 2018, MARIA (WP10) was located in the Northwest Pacific basin at 21.8°N and 133.5°E. The current intensity was 135 kt and the center was moving at 15 kt at a bearing of 295 degrees. The minimum central pressure was 922 mb.

Plots of track guidance ?

Late cycle track guidance ? Archive

A plot of GFS ensemble track guidance has not yet been generated for this system.

Plots from Ensemble Prediction Systems (EPS) ?

Late EPS track guidance plotted by model ? Archive

Extra late EPS track guidance plotted by model ? Archive

Boxplot Visualizations for EPS Track ?

Late cycle curve boxplot for GEFS track guidance ? Archive

Plots of intensity guidance ?

Late cycle intensity guidance ? Archive

ATCF data files ?

awp102018.dat ? **track and intensity forecasts (a-deck)**

bwp102018.dat ? **history file (b-deck)**

Links to Official Warning Information

RSMC Tokyo - Japan Meteorological Agency

Additional Information

Products from the U.S. Joint Typhoon Warning Center

- JTWC Warning Graphic for MARIA
- JTWC Warning Text and Prognostic Discussion for MARIA

Links to External Satellite-based Products

NESDIS SAB Satellite Imagery for MARIA

- **Visible Imagery Loop** html5 flash
- **Enhanced Infrared Loop** html5 flash
- **Water Vapor Loop** html5 flash

CIRA TC Real-time Page for MARIA

- Enhanced Infrared Imagery Loop (4 km Mercator)
- Storm Relative Visible Imagery Loop (1 km Geostationary)
- AMSU Microwave 89GHz Imagery (4 km Mercator)
- Multiplatform Satellite Surface Winds Analysis (Operational)
- Multiplatform Satellite Surface Winds Analysis (Development)

UW-CIMSS TC Satellite Products for MARIA

- Satellite Consensus Intensity Estimates More info ?
- Advanced Dvorak Technique (ADT) ?
- ARCHER Center-finding Technique ?
- Morphed Integrated Microwave Imagery at CIMSS (MIMIC-TC) ?

Observations near MARIA

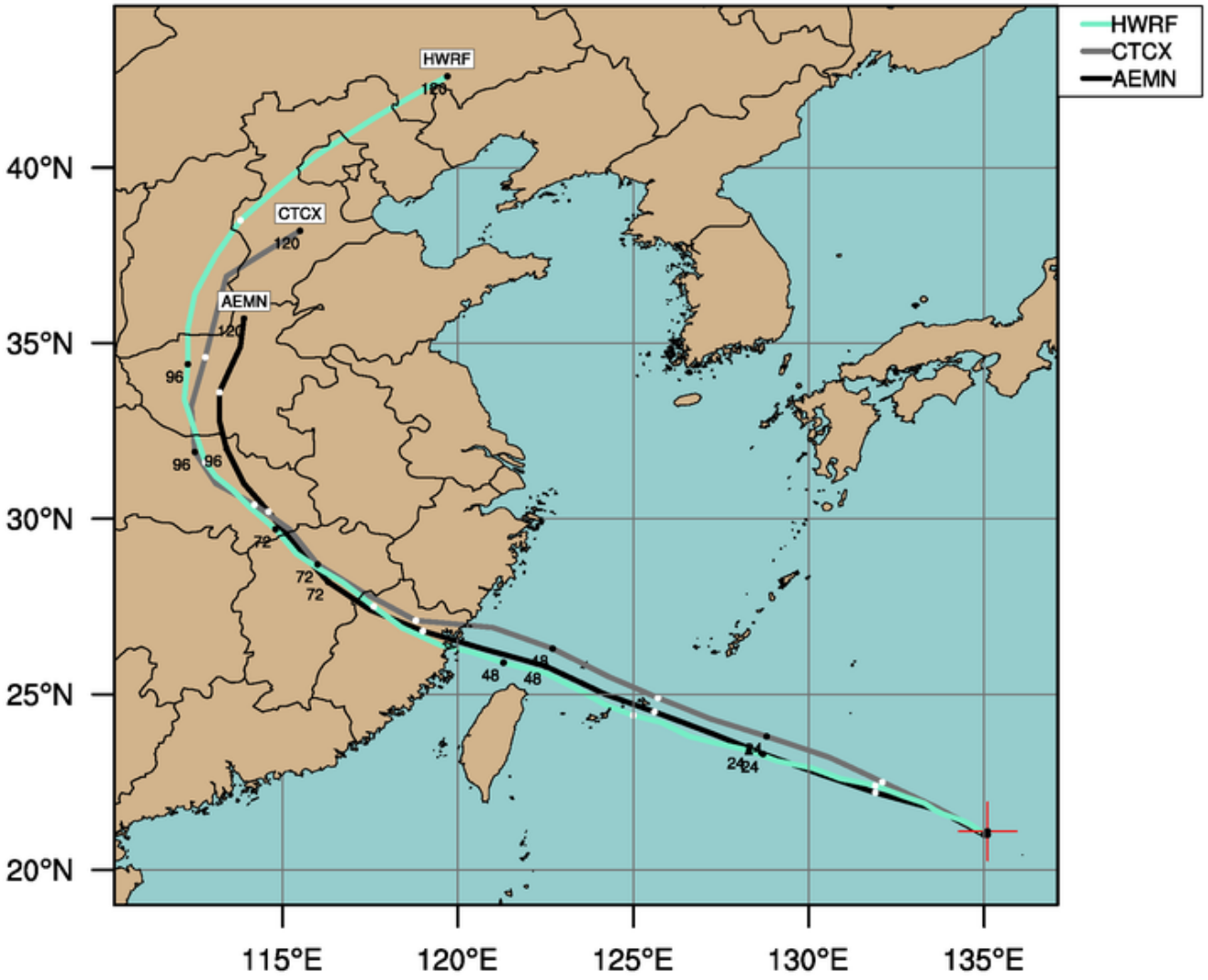
- NDBC Ship and Buoy Obs within 300 km
- Mesonet Observations from NWS WRH Hazard Viewer

MARIA (WP10)

Late-cycle track guidance initialized at 1800 UTC, 08 July 2018

NCAR

Current Intensity: 140 kt Current Basin: Northwest Pacific



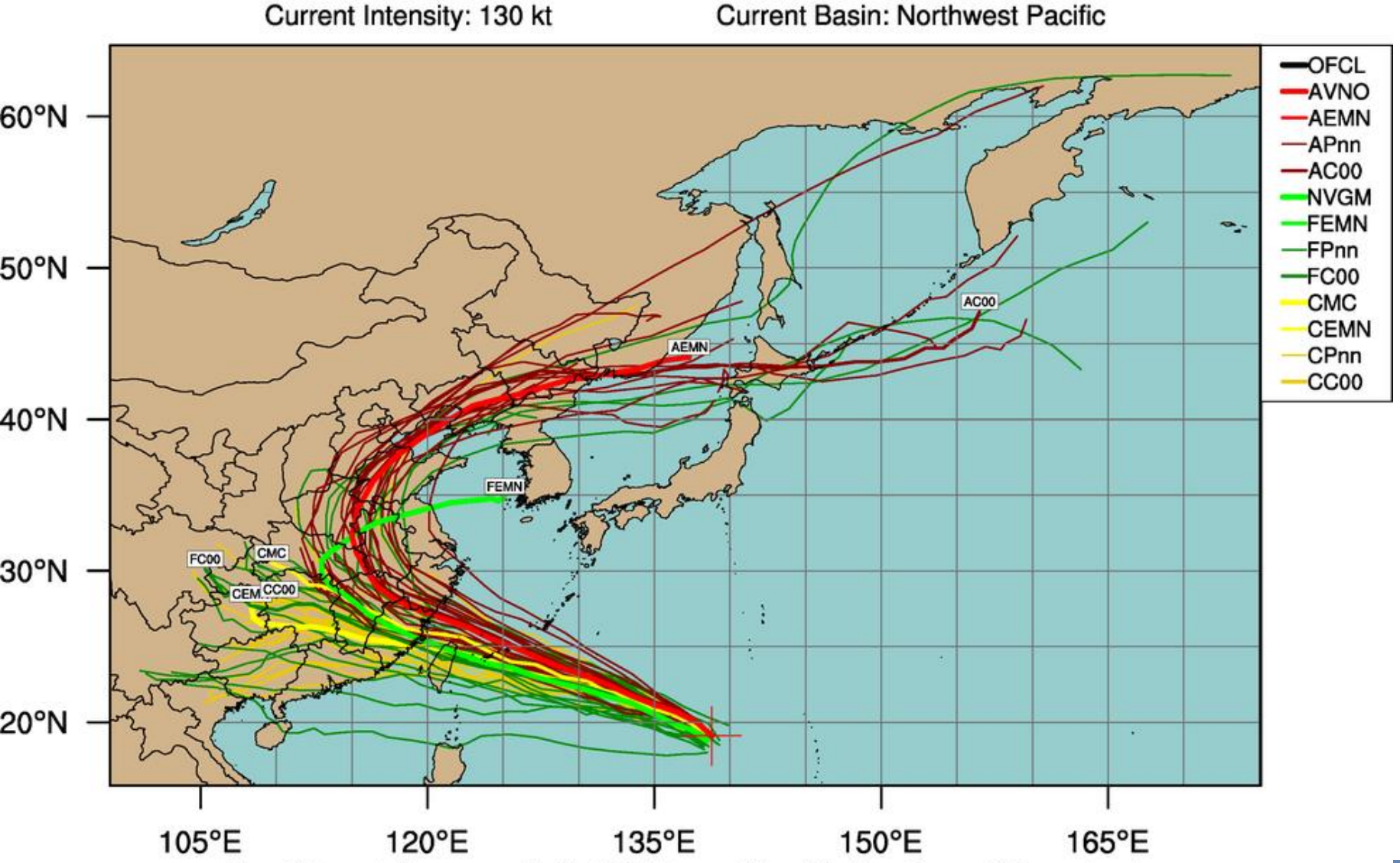
Plot generated at 0149 UTC 09 July 2018

NCAR

MARIA (WP10)

EPS track guidance initialized at 0000 UTC, 08 July 2018

AR

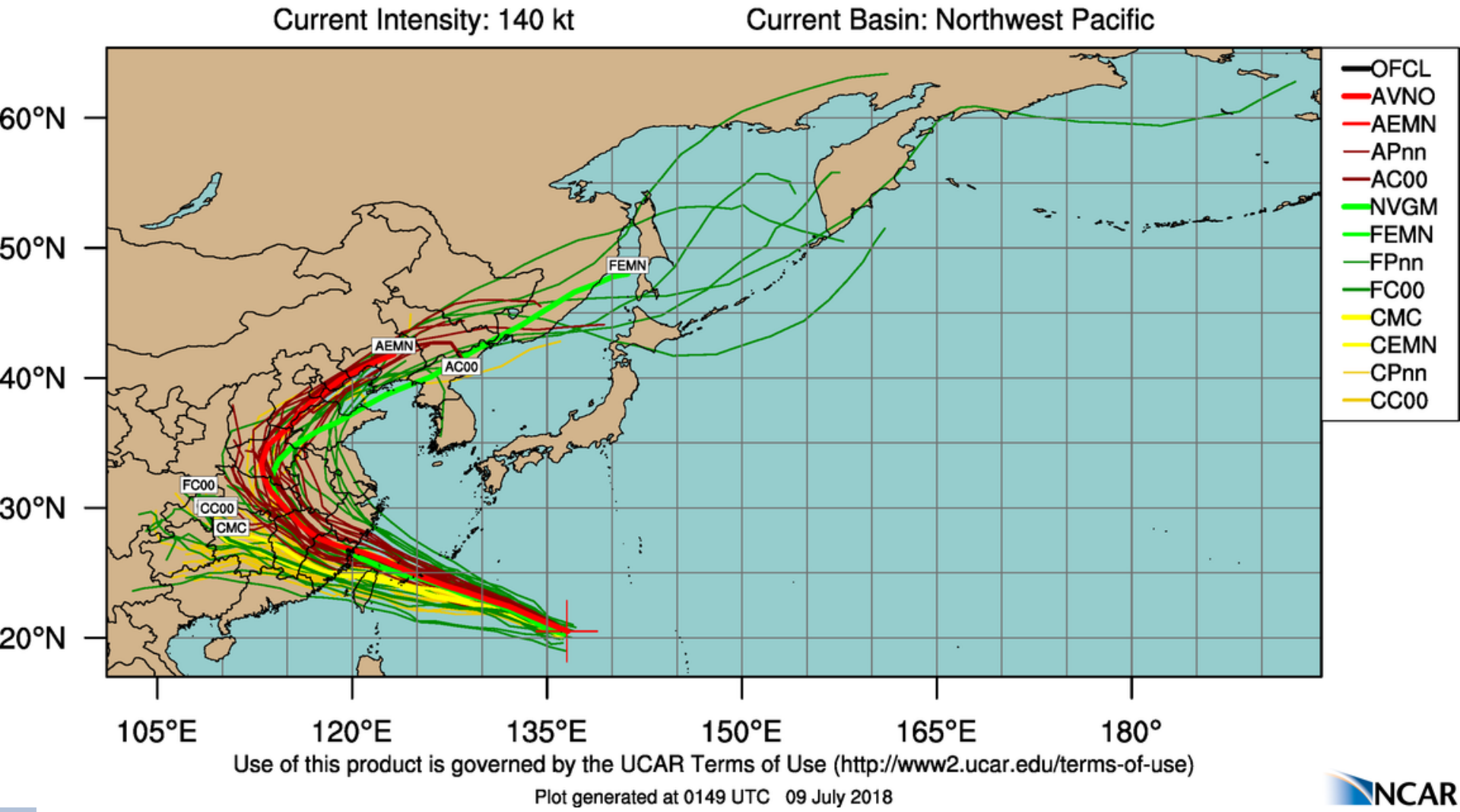


Plot generated at 0920 UTC 08 July 2018

NCAR

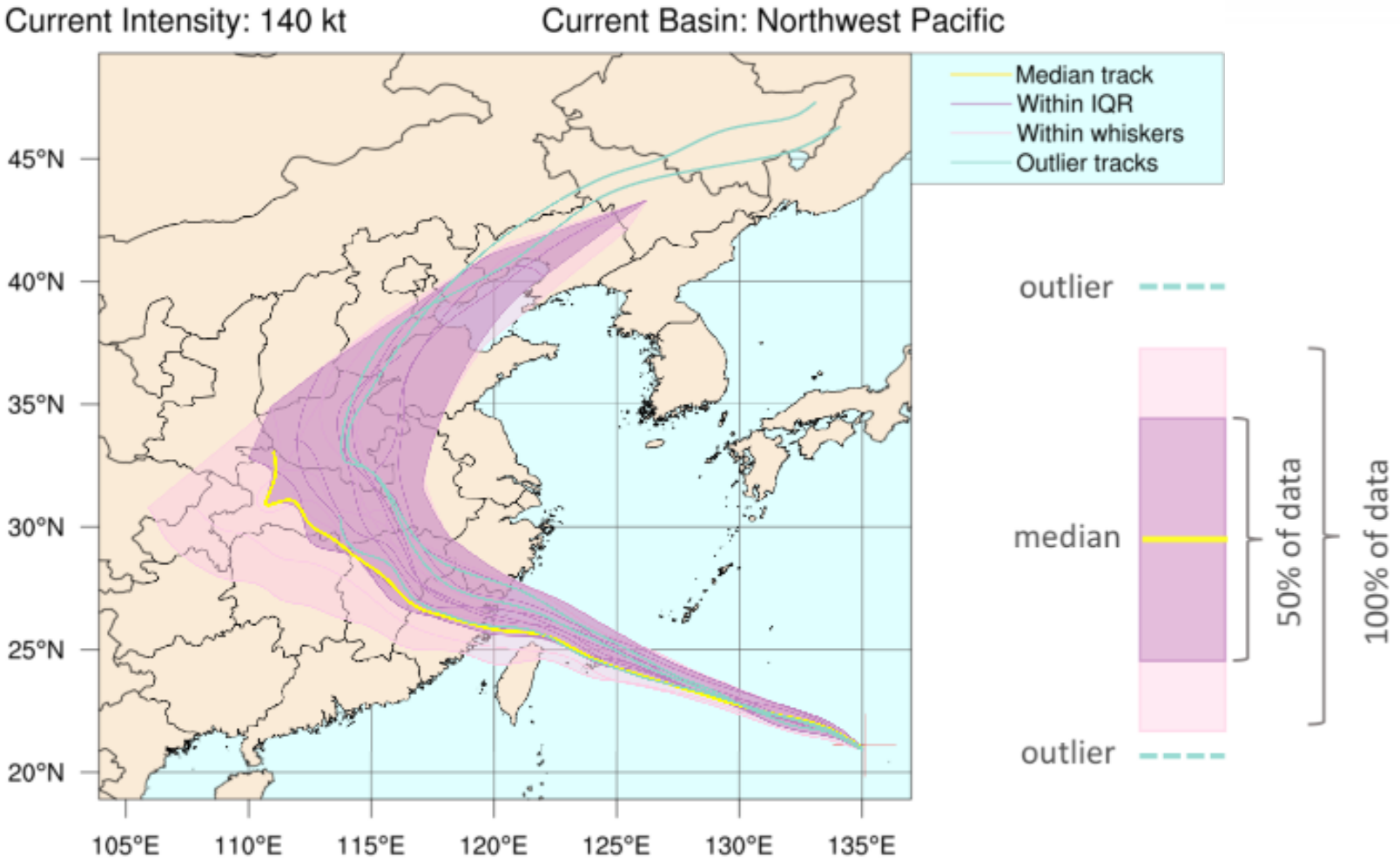
MARIA (WP10)

EPS track guidance initialized at 1200 UTC, 08 July 2018



MARIA (WP10)

GFS ensemble curve boxplot initialized at 1800 UTC, 08 July 2018



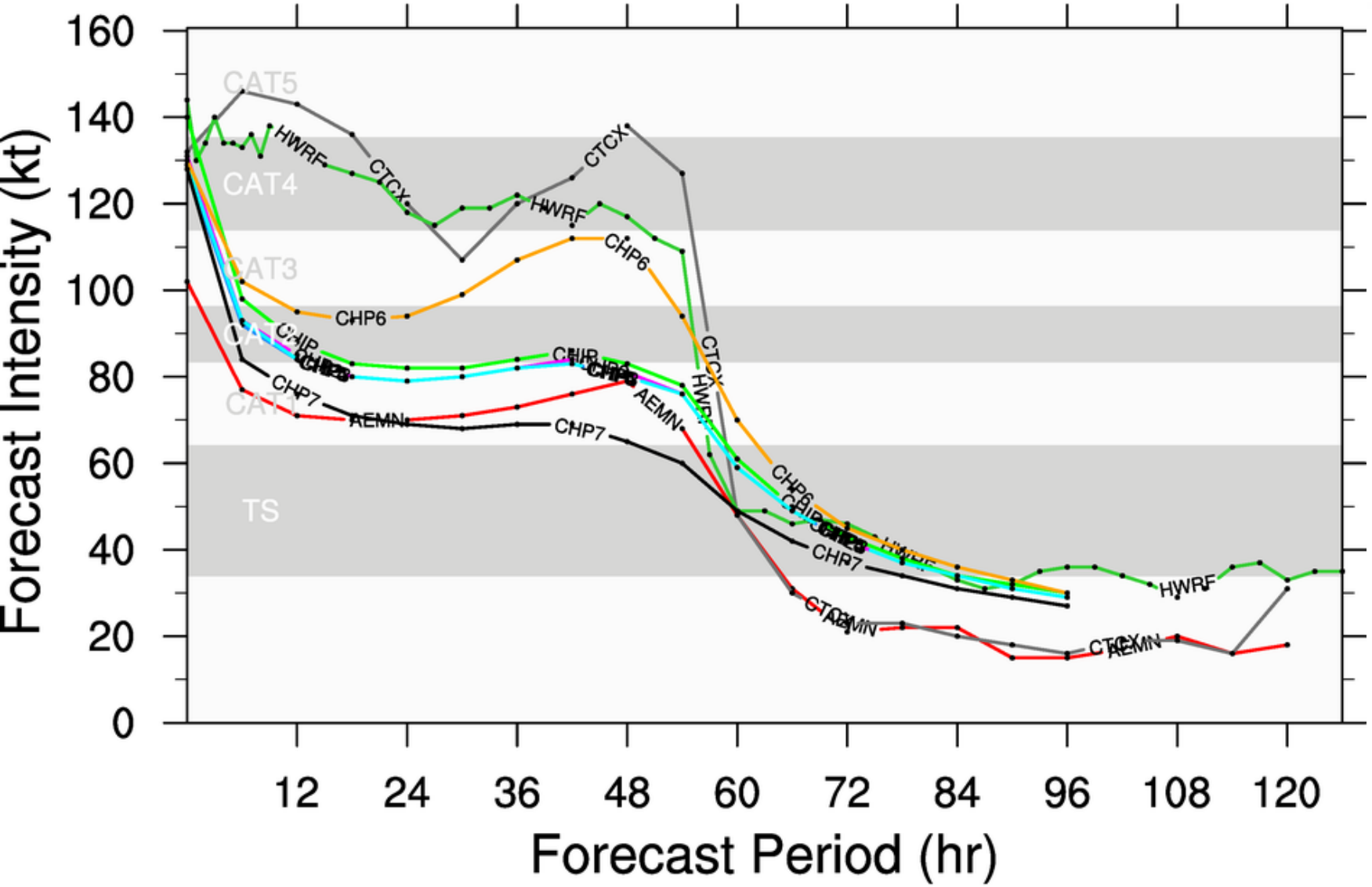
This plot is an experimental boxplot visualization

Plot generated at 0149 UTC 09 July 2018

MARIA (WP10)

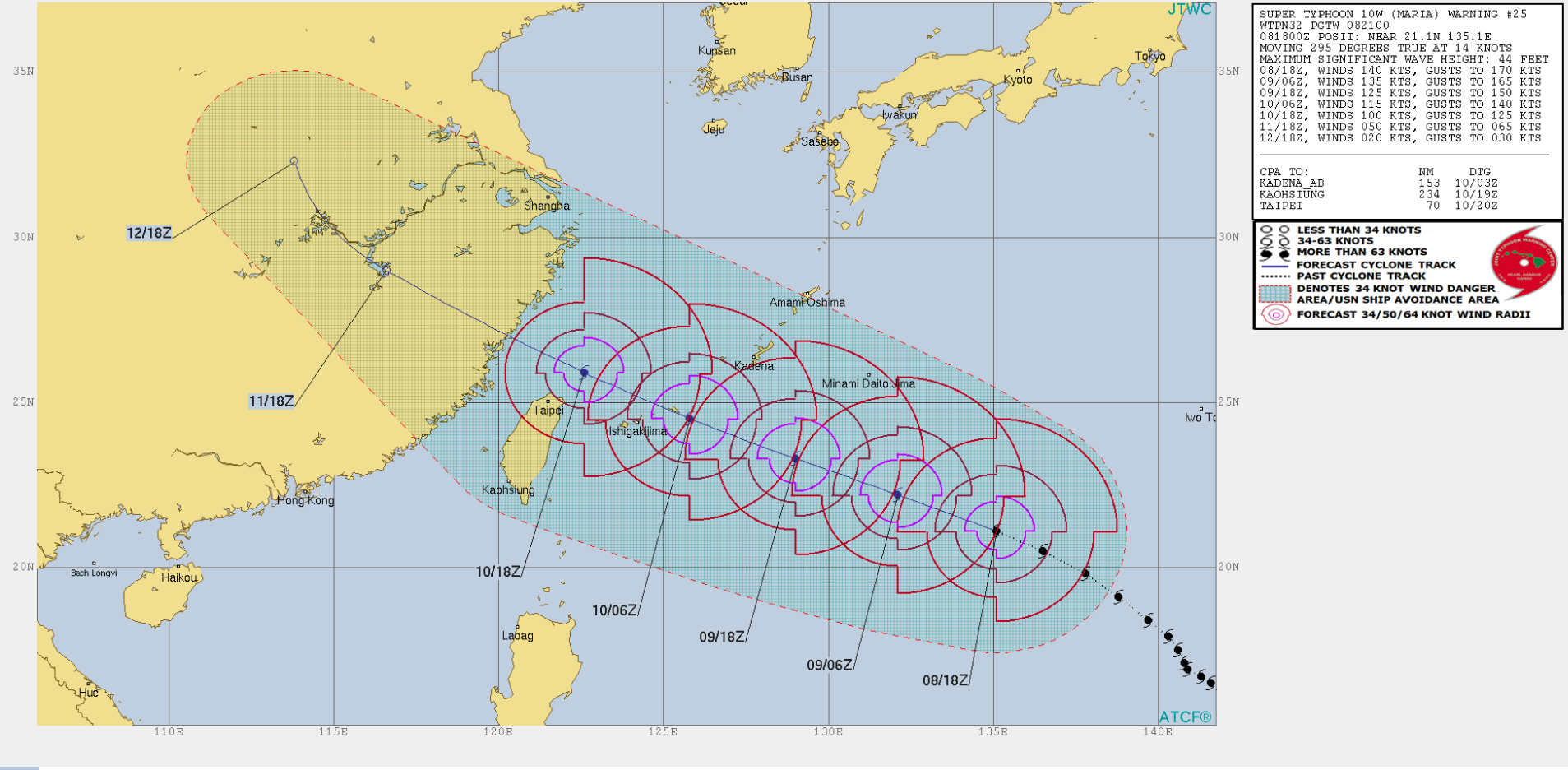
Late-cycle intensity guidance

initialized at 1800 UTC, 08 July 2018



Plot generated at 0149 UTC 09 July 2018

NCAR


JTWC
SUPER TYPHOON 10W (MARIA) WARNING #25
WTPN32 PGTW 082100
081800Z POSIT: NEAR 21.1N 135.1E
MOVING 295 DEGREES TRUE AT 14 KNOTS
MAXIMUM SIGNIFICANT WAVE HEIGHT: 44 FEET
08/18Z, WINDS 140 KTS, GUSTS TO 170 KTS
09/06Z, WINDS 135 KTS, GUSTS TO 165 KTS
09/18Z, WINDS 125 KTS, GUSTS TO 150 KTS
10/06Z, WINDS 115 KTS, GUSTS TO 140 KTS
10/18Z, WINDS 100 KTS, GUSTS TO 125 KTS
11/18Z, WINDS 050 KTS, GUSTS TO 065 KTS
12/18Z, WINDS 020 KTS, GUSTS TO 030 KTS
CPA TO: NM DTG
KADENA_AB 153 10/03Z
KAOHSIUNG 234 10/19Z
TAIPEI 70 10/20Z
LESS THAN 34 KNOTS
34-63 KNOTS
MORE THAN 63 KNOTS
FORECAST CYCLONE TRACK
PAST CYCLONE TRACK
DENOTES 34 KNOT WIND DANGER AREA/USN SHIP AVOIDANCE AREA
FORECAST 34/50/64 KNOT WIND RADII
12/18Z
11/18Z
10/18Z
10/06Z
09/18Z
09/06Z
08/18Z
Kunsan
Busan
Jeju
Sasebo
Iwakuni
Kyoto
Tokyo
Shanghai
Amami Oshima
Kadena
Minami Daito Jima
Taipei
Ishigakijima
Kaohsiung
Hong Kong
Bach Longvi
Haikou
Laoag
Hue
35N
30N
25N
20N
110E
115E
120E
125E
130E
135E
140E
ATCF®

NCAR

Along with visual plots, TCGP provides the underlying raw data in Automated Tropical Cyclone Forecast (ATCF) format:

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```

Vortex Data Messages – a “nutrition label” for hurricanes

```
000
URNT12 KNHC 250433
VORTEX DATA MESSAGE   AL182012
A. 25/04:14:20Z
B. 19 deg 34 min N
   076 deg 06 min W
C. 700 mb 2713 m
D. 91 kt
E. 083 deg 15 nm
F. 169 deg 117 kt
G. 082 deg 17 nm
H. EXTRAP 957 mb
I. 10 C / 3046 m
J. 16 C / 3042 m
K. 10 C / NA
L. CLOSED WALL
M. C24
N. 12345 / 07
O. 0.02 / 3 nm
P. AF302 0518A SANDY                OB 17
MAX FL WIND 117 KT E QUAD 04:09:00Z
SLP EXTRAP FROM 700 MB
MAX FL TEMP 18 C 064 / 10 NM FROM FL CNTR
;
```

TCGP provides extensive documentation throughout the site

- *Latitude and longitude of the storm center that was provided to the forecast aids for this model cycle.* Given in decimal form to the nearest tenth of a degree. Keep in mind that the storm position may have much more uncertainty than what is implied by the precision of a tenth of a degree.
- *Intensity of the storm that was provided to the forecast aids for this model cycle.* Normally this is the best operational estimate of the storm's 1-minute average maximum sustained surface windspeed (in knots). Since the various forecast aids are initialized on a cycle that falls in between the official storm advisories from some warning centers, this value will sometimes be an estimate that does not correspond to earlier or later advisories. Generally, this intensity value is quite important for the resulting output of the forecast aids.
- *Translation speed of the storm center* (in knots) *and direction of motion* (in degrees, 0º corresponds to North). Together, these quantities define the storm motion vector that was provided to the forecast aids for this model cycle. This can also have an important effect on the projections of various forecast aids, particularly for models which bogus the initial storm vortex.
- *Minimum central pressure of the storm* (in millibars) *that was provided to the forecast aids for this model cycle.* Like intensity, this value is generally an estimate specific to the forecast cycle and may not match the values given in warning advisories before or after this time.

About track guidance plots

This section of the individual storm page provides links to three types of track guidance. The first two types of plots include groups of forecast aids which have been selected based on which forecast cycle they fall under (early vs. late). The third type of plot shows just the guidance from the GFS ensemble. The contents of each plot type are described in more detail in the guide to early cycle track plots, guide to late cycle track plots, and guide to GFS ensemble track plots. Use these links to find out more about the forecast aids that are plotted therein.

In general, the individual storm page will provide a link to the most recent of each plot type. If the storm has dissipated, or for some reason updated guidance is not available, the link will point to the most recent plot available (even if the storm dissipated a long time ago). The archive link provides links to all the track guidance plots of this type for the storm.

See the sidebar to the right for more information about the schedule in which these plots are updated and how to access real-time plots for past storms.

Exactly when does the real-time guidance system do its updating?

The real-time system updates 4 times a day: at 01, 07, 13, and 19 UTC. The system starts running around 40 minutes past the hour by starting to collect some preliminary data. At 46 minutes the hour, it starts gathering the a-decks of forecast aids and model guidance. At 50 minutes past, the system begins making the new guidance plots. Depending on how many plots there are to create, this may take a minute or two. After the plot are finished, all content is linked to the individual storm pages and the overview map is updated. Generally, content is available by 51 or 52 minutes past the hour.

Is there an archive? Where can I find past plots of real-time guidance?

At the current time, there is not an easy way to access past plots of the real-time guidance. The real-time content doesn't go away - it continues to live in the location in which it was placed, so all past content can be accessed from the original URLs. To find a particular recent storm, feel free to browse around in the basin directories, select the year, and then the storm. Iin the near future we plan to implement an archive page to facilitate easier access to past storms.

TCGP is building a model "encyclopedia" to document the various forecast models

NCAR

Home | Overview | Real-Time Guidance | Global Repository | Structure Data | Guide to Plots | Links

About the global repository | Data Contributors | Global Techlist | Model Documentation

Global Repository | Documentation For The Hurricane Weather Research And Forecasting (HWRF) Model

DOCUMENTATION FOR THE HURRICANE WEATHER RESEARCH AND FORECASTING (HWRF) MODEL

Summary

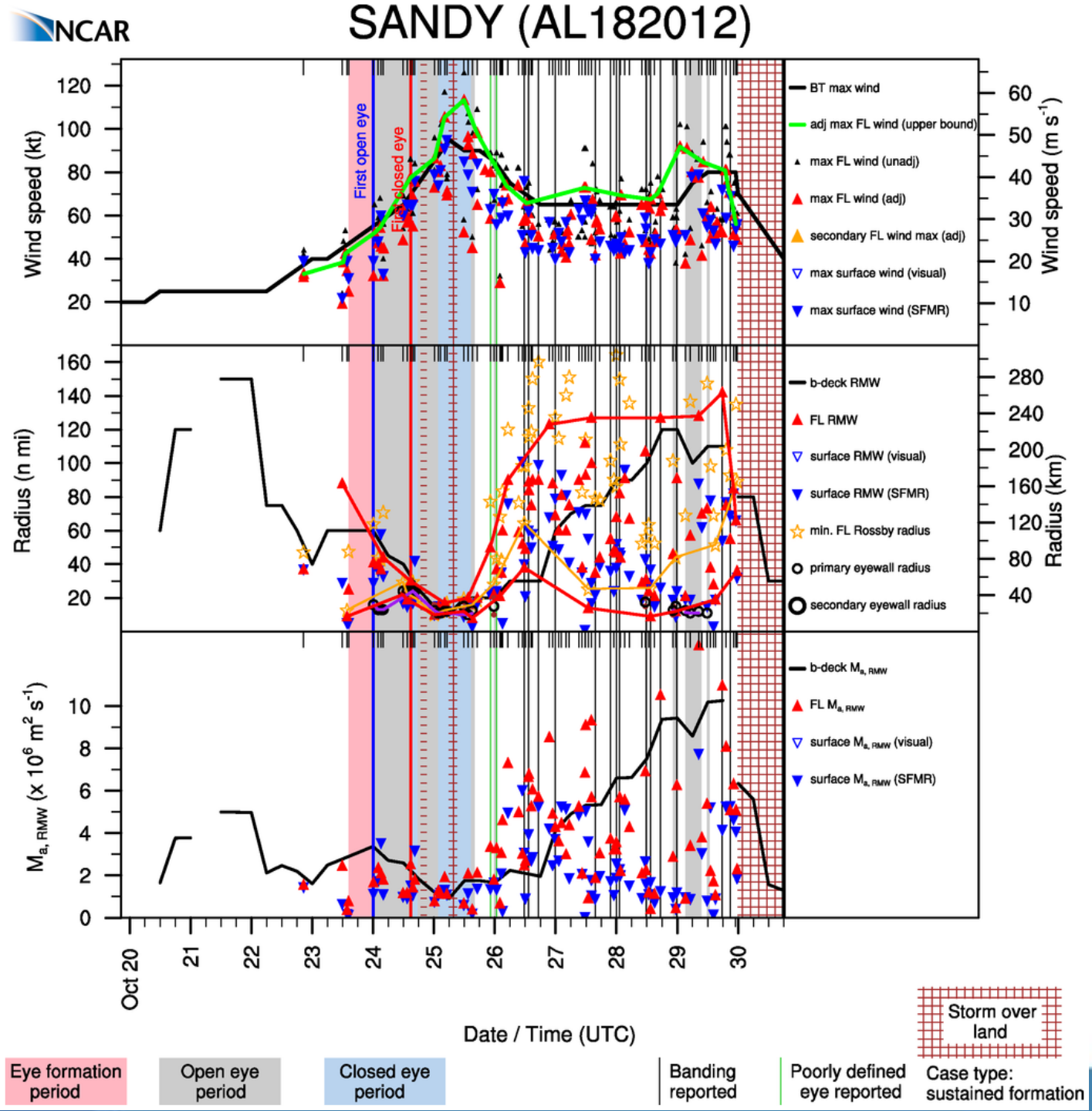
Note: The following information applies to the 2012 operational version of HWRF.

Model type:	Full physics, three dimensional dynamical model
Model timeliness:	Late
Model status:	Operational
Basins run in:	AL, EP, WP, and IO
ATCF TECH identifier:	HWRF
Forecast period:	0 to 126 hours
Included in TCGP:	AL, EP, CP, WP, and IO
Domain:	Three domains: D01 (parent domain): 216 x 432 points, 80 x 80 deg, 27 km grid spacing D02 (intermediate nest): 88 x 170 points, 11 x 10 deg, 9 km grid spacing D03 (inner nest): 154 x 272 points, 6.0 x 5.5 deg, 3 km grid spacing Domain top: 50 hPa
Vertical coordinate (# of levels):	Sigma-pressure hybrid coordinates (42 levels)
Grid:	Arakawa E-grid on rotated latitude and longitude projection
Cumulus parameterization:	Simplified Arakawa-Schubert (SAS) scheme
Microphysics parameterization:	Ferrier scheme
Boundary layer parameterization:	GFS PBL (non-local mixing)
Radiation parameterization:	GFDL radiation scheme
Ocean coupling:	Full 3D POM coupled in AL basin, 1D POM coupled in EP basin and no ocean coupling in WP and IO basins
Initialization method:	Grid-scale Statistical Interpolation (GSI) with vortex bogusing method
Initial and boundary conditions:	Analysis and forecast data of NCEP Global Forecast System
Primary contact:	Dr. Vijay Tallapragada, Hurricane Team Leader, NOAA/NWS/NCEP/EMC
Official model website:	http://www.emc.ncep.noaa.gov/index.php?branch=HWRF
Scientific documentation:	http://www.emc.ncep.noaa.gov/HWRF/HWRFScientificDocumentation2011.pdf
User's Webpage (community code):	http://www.dtcenter.org/HurrWRF/users/
User's Guide:	http://www.dtcenter.org/HurrWRF/users/docs/users_guide/HWRF_UG_v3.4a.pdf
HWRF Products Portal site:	http://www.emc.ncep.noaa.gov/gc_wmb/vxt/

Future Development – Phase III

Structure visualizations

- Add plots of structure and intensity data derived from VDMs
- Add plots of real-time flight-level data
- Add an overview plot which shows the history of storm location fixes for each storm
- Add data files of real-time structure parameters in a format that can be used for developing forecast aids for structure and intensity change

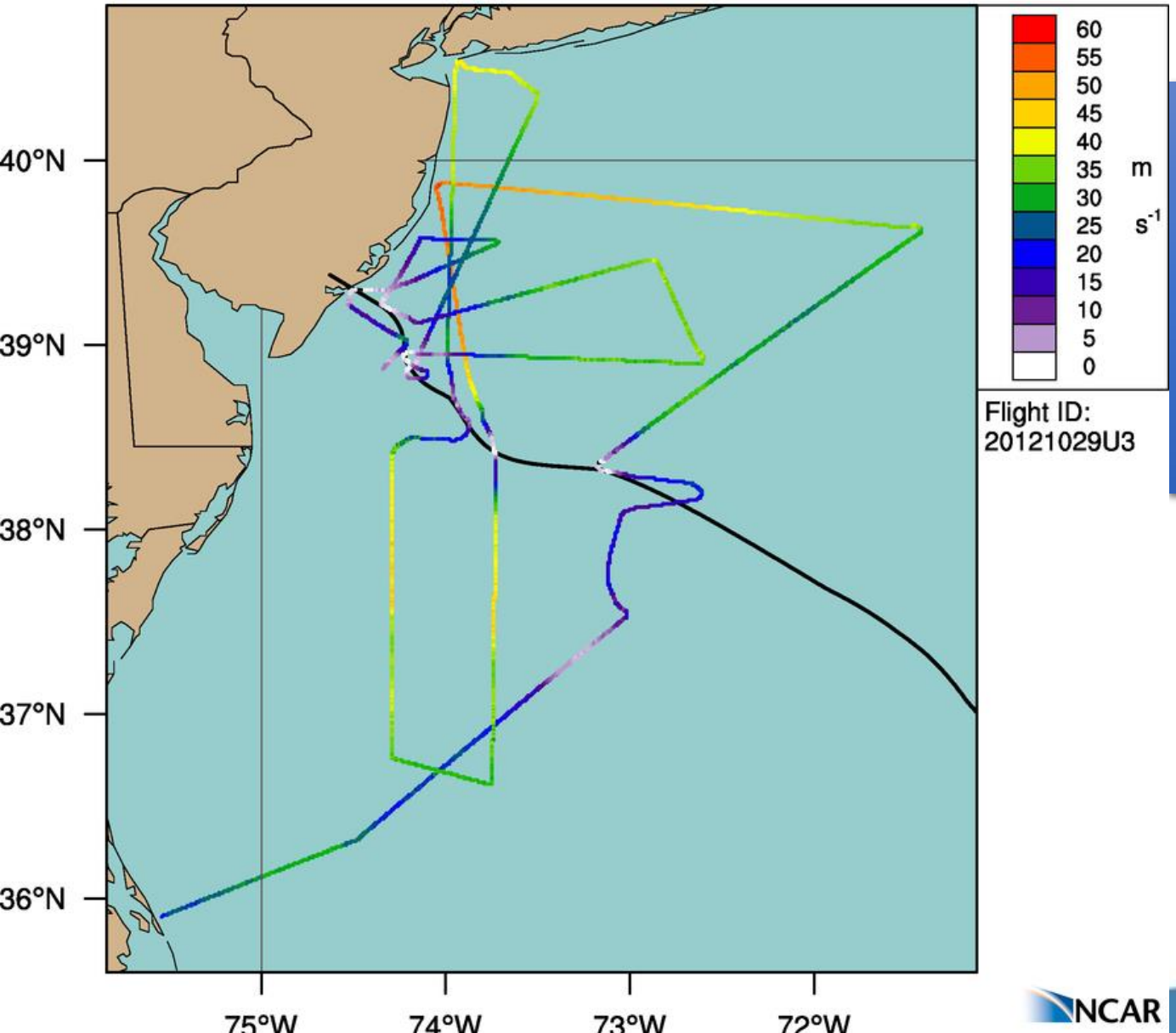


NCAR

1. Add visualizations of Vortex Data Messages over storm lifecycle

Hurricane Sandy

Flight Level Wind Speed



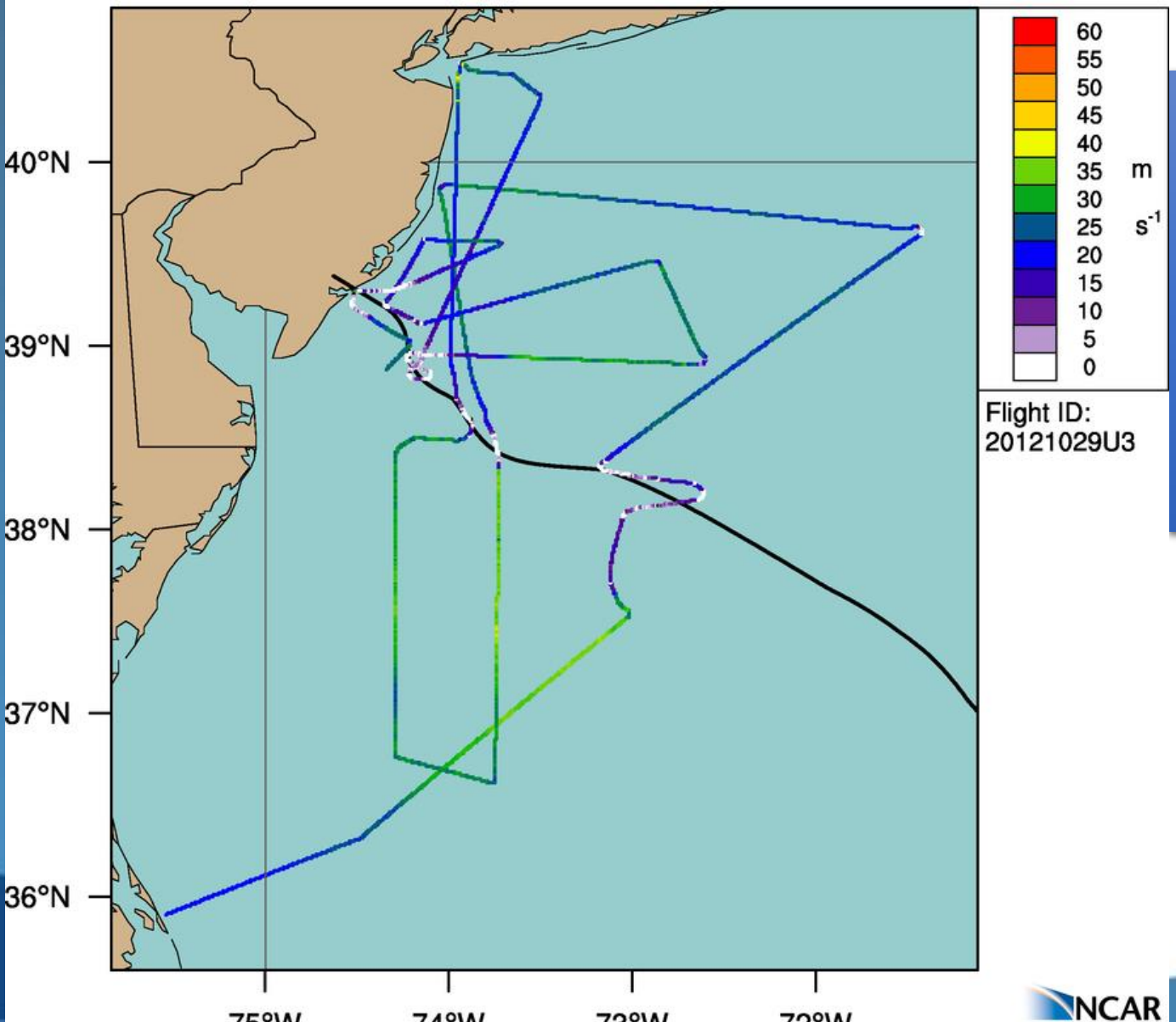
4. Add visualizations of real-time flight data from reconnaissance aircraft

NCAR

NCAR

Hurricane Sandy

SFMR Surface Wind Speed



- Add visualizations of real-time surface wind speed
- Add diagnostic comparisons between observations and model-simulated wind structure

Future Development – Phase IV

Retrospective archive

- Gather legacy model forecast aids for global basins
- Implement retrospective plots of these data for historic storms
- Run for historic storms
- Improves additional aspects of the user interface across the site

Web Services

- REST API
- Web-map service

Future Development – Phase V

Real-time Verification

- Compute real-time verification of model errors and biases
  - Usual metrics (track, intensity, size)
  - Additional metrics (precipitation, wind field, . . . storm surge, etc.)
  - Evaluation of models using synthetic trajectories

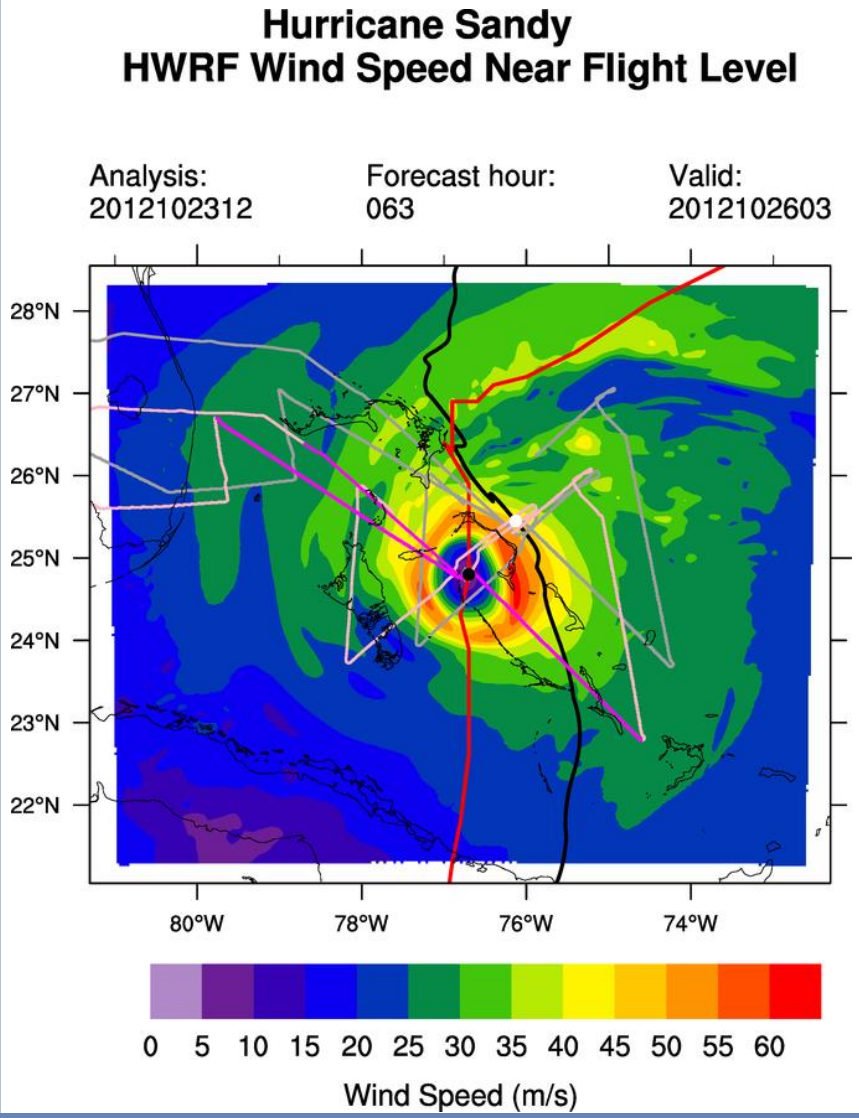
- Display plots and/or animations of model trends: d(prog)/dt
- Real-time model scorecards

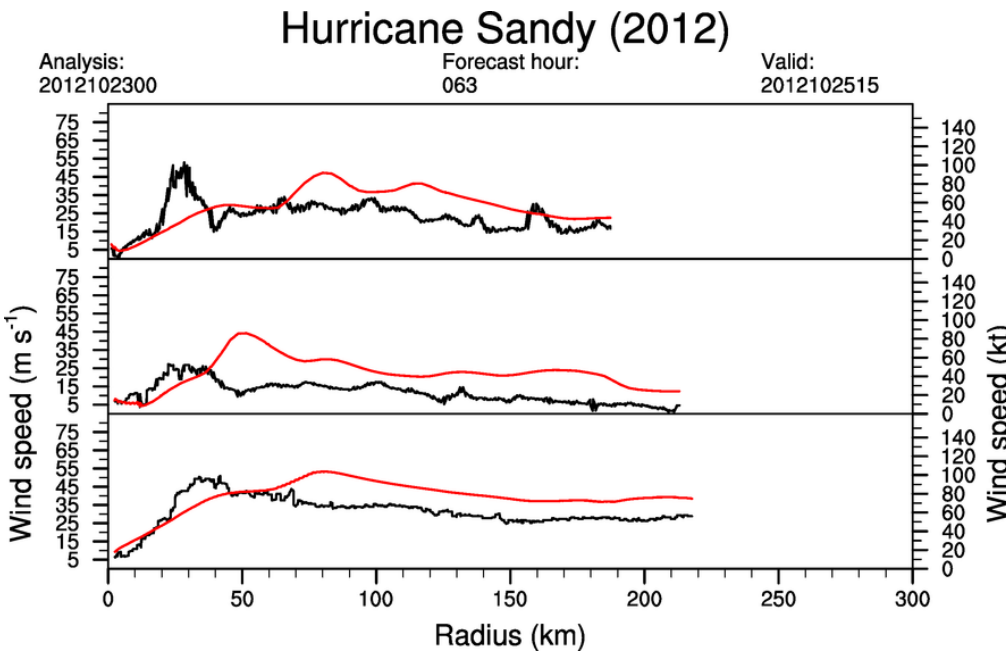
Additional Desired Capabilities

- Add more models from around the world
- Add basins that get TCs on a rare basis
  - Mediterranean Sea
  - South Atlantic
- Add support for multiple languages
  - Spanish
  - Mandarin
  - French
- Add translation for both time and wind speed averaging periods
- Add more official information from various agencies

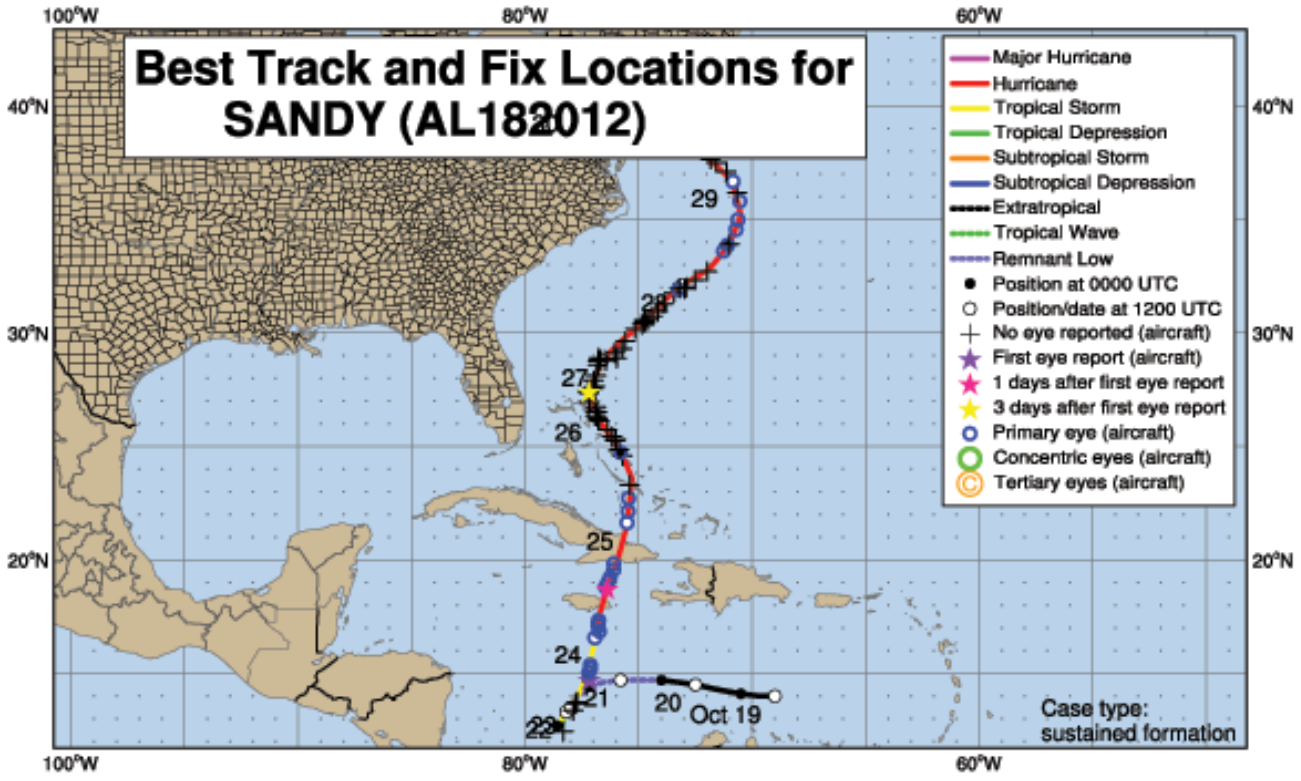
Add Synthetic Profiles to Evaluate Model Wind Forecasts

NCAR





HWRF's wind field is too broad and too symetric



- Add visualizations of storm track history
- Add zoomed map of current location so users can tell if the storm is following the forecast track

Experience so far

- TCGP has filled an important niche in the space between operations and research
- Lack of open data policies among many operational modeling centers make it difficult to achieve the dream of providing global coverage
- Lack of (funded) support has made it difficult to achieve further development
- Nevertheless, progress continues
- There are many areas for potential collaboration with STI

- **Localizing hazard information and intersecting this with vulnerability to obtain risk is the next frontier**