NCAR

A New Historical Database of Tropical Cyclone Position, Intensity, and Size Parameters Optimized for Wind Risk Modeling

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Joint Numerical Testbed Program, RAL/NCAR

4:15 PM Wednesday, 20 April 2016
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National Center for Atmospheric Research

Extended Flight Level Dataset for Tropical Cyclones (FLIGHT+, v1.1) Released to Public Today!

- Dataset coverage
  - 273 cyclones
  - Atlantic, Eastern Pacific, Central Pacific, Western Pacific
  - 1999 to 2015
  - 7500 “good” radial legs
    - All typical flight level parameters included
    - SFMR surface winds
- Dataset characteristics
  - Standardized data from U.S. Air Force Reserve and NOAA Hurricane Hunter research flights
  - Extensive quality control measures
  - Automatic parsing of radial legs, translation to storm-relative coordinates, azimuthal and radial winds, etc.
  - High resolution data binned to 100-m grid
  - Modern, user-friendly format (NetCDF)

FLIGHT+ Dataset | About The Flight Level Dataset (FLIGHT+)

ABOUT THE FLIGHT LEVEL DATASET (FLIGHT+)

The second phase of this RPI-funded project has built a new dataset of standardized flight level data. This dataset covers all Atlantic, Eastern Pacific, and Central Pacific tropical cyclones with flight level data during the period from 1997 to 2015. The dataset also includes flights in certain Western Pacific TCs in 2008 and 2010. The flight level data is provided in both earth-relative and storm-relative coordinates at the highest temporal resolution available (e.g. 30-second, 10-second, or 1-second). Additionally, flight level data has been parsed by radial leg and interpolated to a standarized radial grid. Significant effort has been undertaken to quality control the data. The dataset was released to RPI member companies in August 2014. The dataset was released to the public on 20 April 2016.

Navigate this section

Use the links below to learn more about the data sources have gone into this dataset, to download the combined dataset and accompanying documentation, and to learn more about applications of this dataset.

http://verif.ral.ucar.edu/tcdata/flight/

This page was last updated 20 April 2016 by Jonathan Vigh.

What's New in the FLIGHT+ Dataset?

20 April 2016

Version 1.1 of FLIGHT+ is now released to the public. This version extends the dataset to include data from 2014 and 2015 and addresses the issues with the storm relative winds discussed below. Several new parameters have been added to provide additional information about the flight level pressure and time of the wind maxima. For a full description of the differences between v1.1 and v1.0, click here

19 January 2016

A couple errors have recently been discovered in the formulas used for the calculation of the zonal and meridional components of the wind center of the cyclone. The result of these errors is that some significant errors with magnitudes up to twice the cyclone translation speed have been introduced into some of the storm relative wind speeds that are contained in the Level 3 (L3) dataset product. If you are not using the storm-relative wind speeds of the L3 data products, you should not be affected by this issue. The earth-relative wind speed parameters are unaffected. A new version of the FLIGHT+ Dataset will be generated in the near future to address this issue and add some enhancd metadata concerning the maximum wind location of each radial leg.

22 August 2014

The FLIGHT+ Dataset has been released to the RPI member companies. The public release of the FLIGHT+ Dataset is planned for April 2016.

Hurricane Isabel

MSLP: 933 mb

VMAX: 140 kt

No wind radii in Best Track!

Hurricane Charley

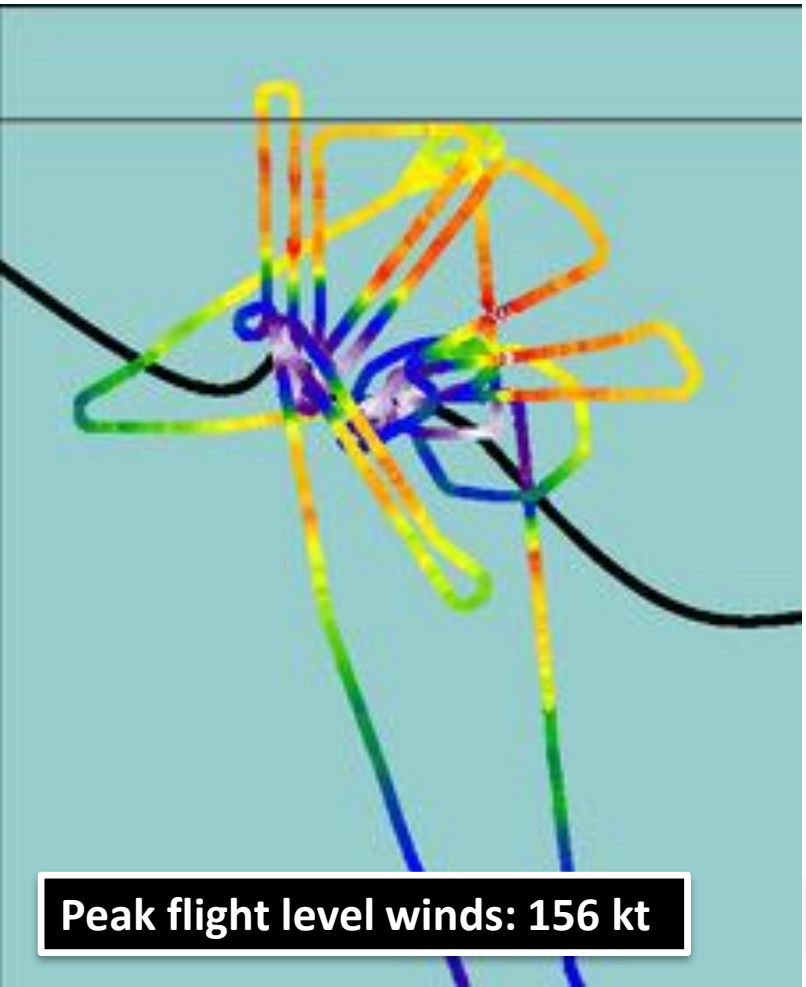
MSLP: 947 mb

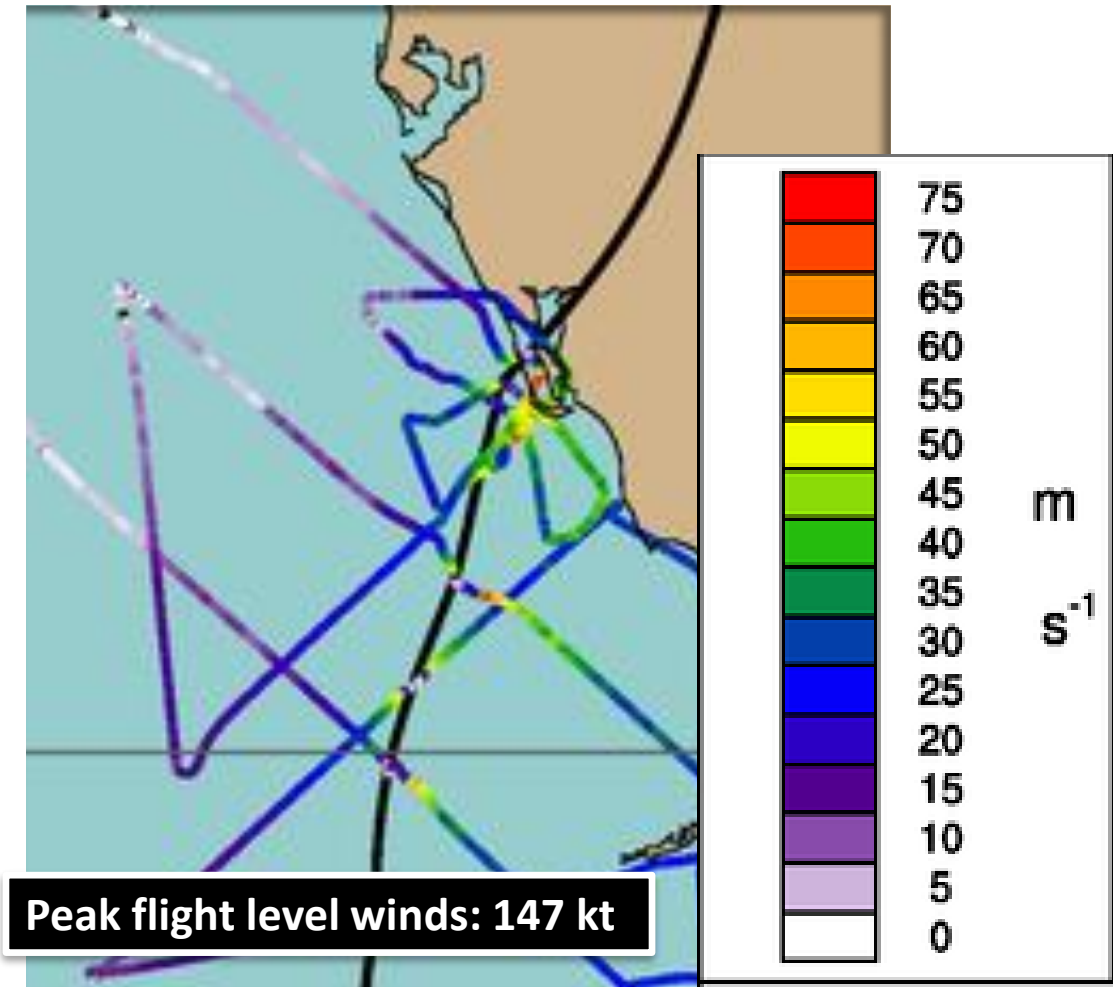
$15.1 billion damage

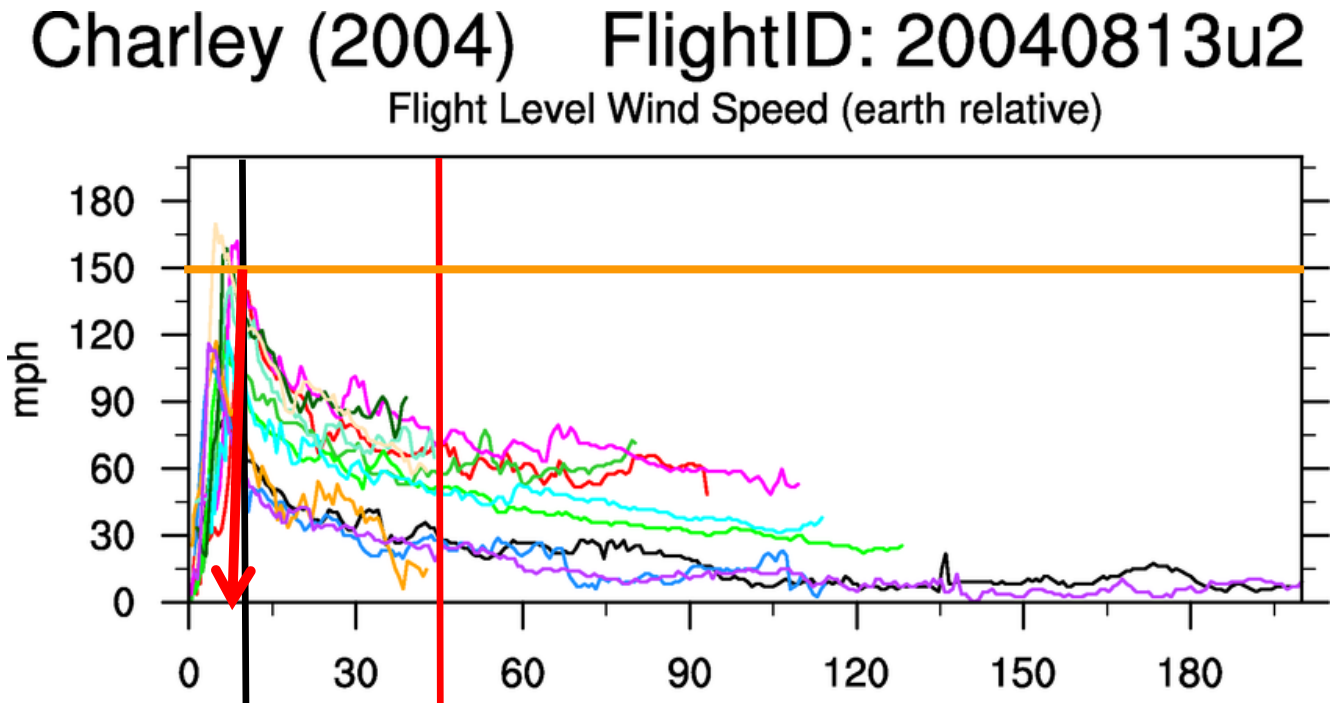
VMAX: 125 kt

64-kt wind radii: 20 20 10 10 (nm)

34-kt wind radii: 40 75 75 50 (nm)

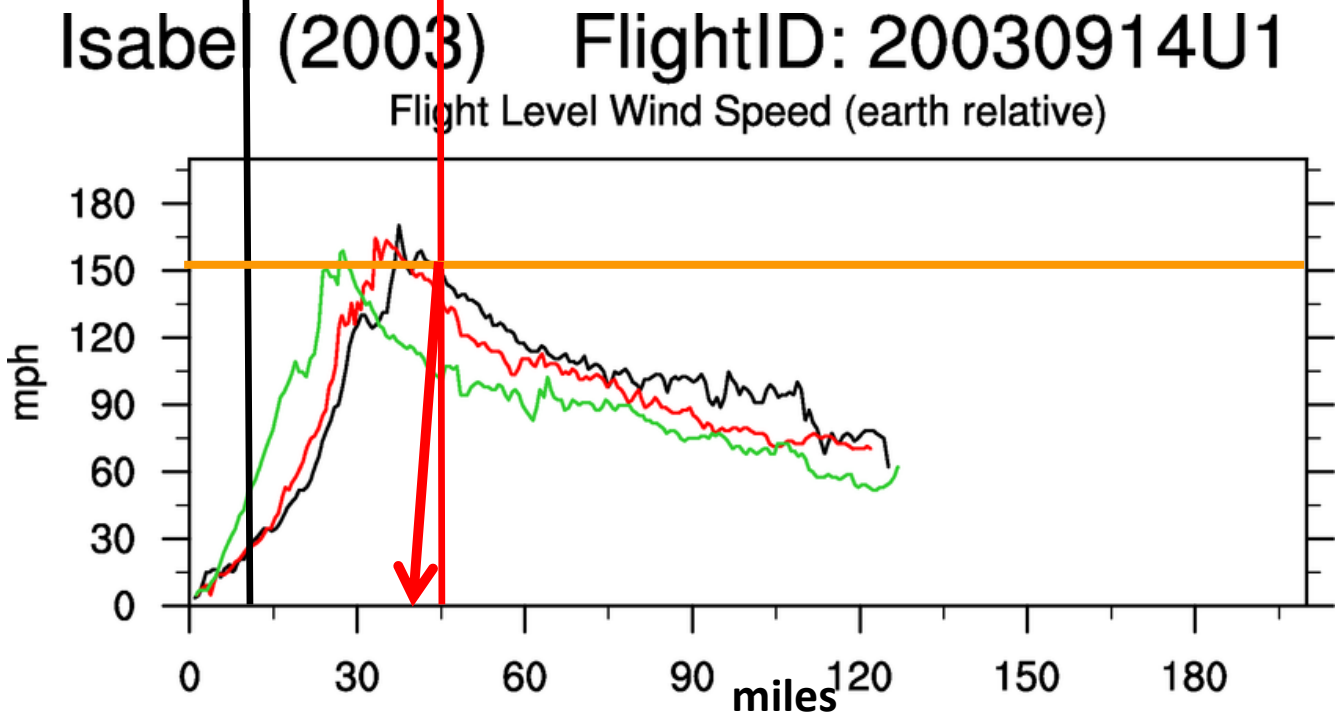






Radius of Category 4 winds:

~10.5 miles



Radius of Category 4 winds:

~39 miles

The Need

Better data needed to generate more realistic synthetic event sets for modeling wind risk

- Higher spatial resolution
  - HURDAT provides data at 0.1 deg (~6 miles)
- Higher temporal resolution
  - HUDAT is 6-hourly and only attempts to preserve fluctuations on order of a day – many fluctuations get smoothed out
- Better description of wind structure
  - HUDAT rounds vmax to 5 kt and size to 5 nm
  - HURDAT does not include RMW as a best-tracked quantity
  - HURDAT only includes wind radii information back to 2004
  - HUDAT does not include any wind radii for winds higher than hurricane-force

Tropical Cyclone Observations-Based Structure (TC-OBS) Database

- Revised/refined **observations-based estimates** of track (position), intensity, RMW, and size (wind radii)
- Time-dependent observations-based **uncertainty bounds**
- Azimuthal mean wind speed
- Spatial/temporal **coherence** of location of maximum wind
- All parameters provided at 1-hour intervals
- All asynoptic time points included in HURDAT2 are also included (including all landfall times)
- No rounding for positional data precision
- Ancillary parameters that indicate distance to land, translation speed/direction, and whether the cyclone was over land
- Additional wind radii at the Saffir-Simpson category thresholds:
  - 83-kt (Cat1/2), 96-kt (Cat 2/3), 113-kt (Cat 3/4), 137-kt (Cat 4/5)
- All HUDAT parameters included for comparison

General Methodology for Optimal Estimation from Observations

1. Filter/merge step: eliminate duplicatory or conflicting data, keep best observations

2. Traverse data using moving window centered on the target time for estimation

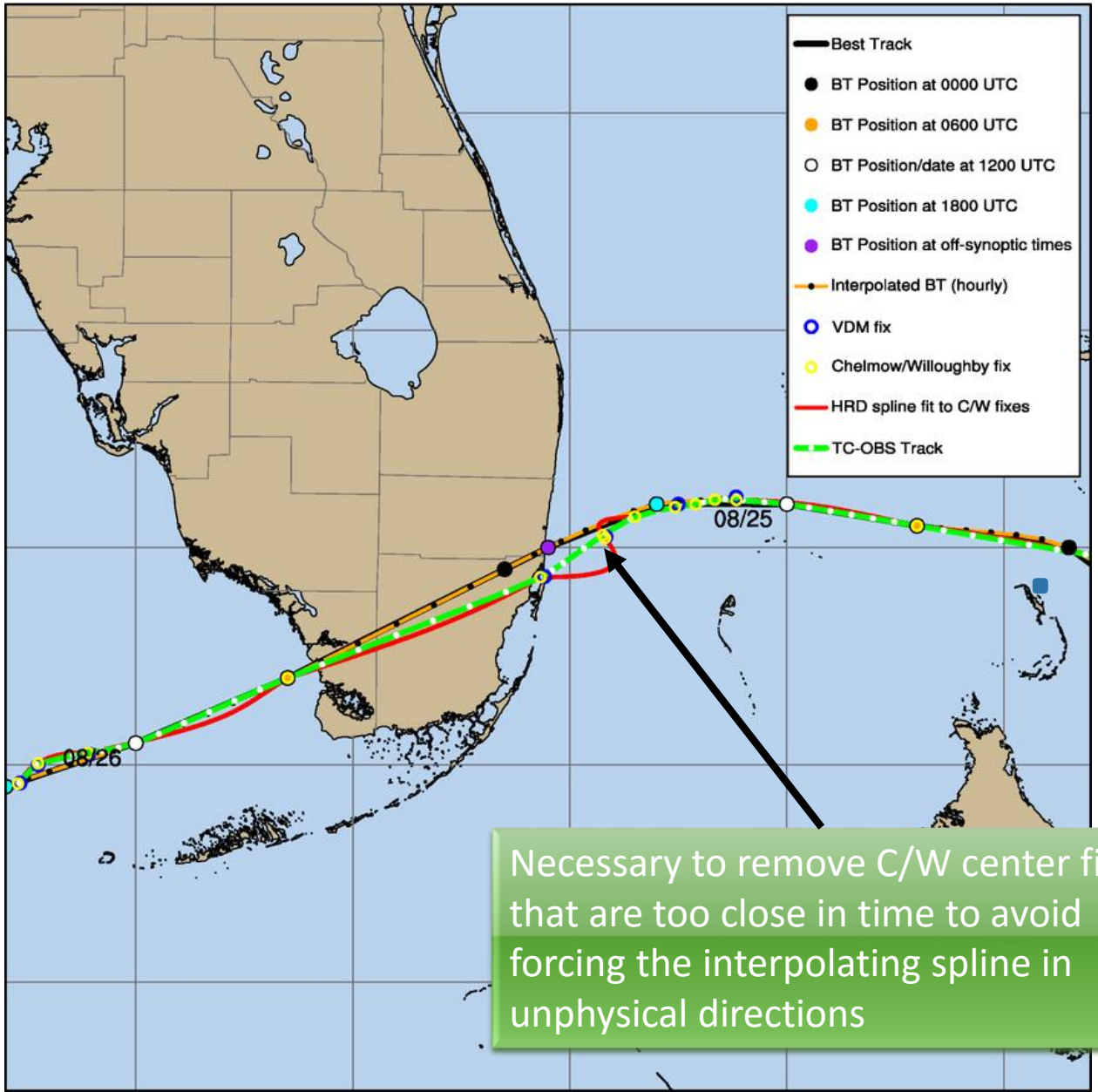
3. Determine # of effective data points using some sort of "goodness" criteria as well as nearness to time of interest

4. From # of effective data points, compute total observational weight, then compute background weight as residual weight

5. Optimally estimate parameter value as a weighted average of observations and background value

KATRINA (AL122005)

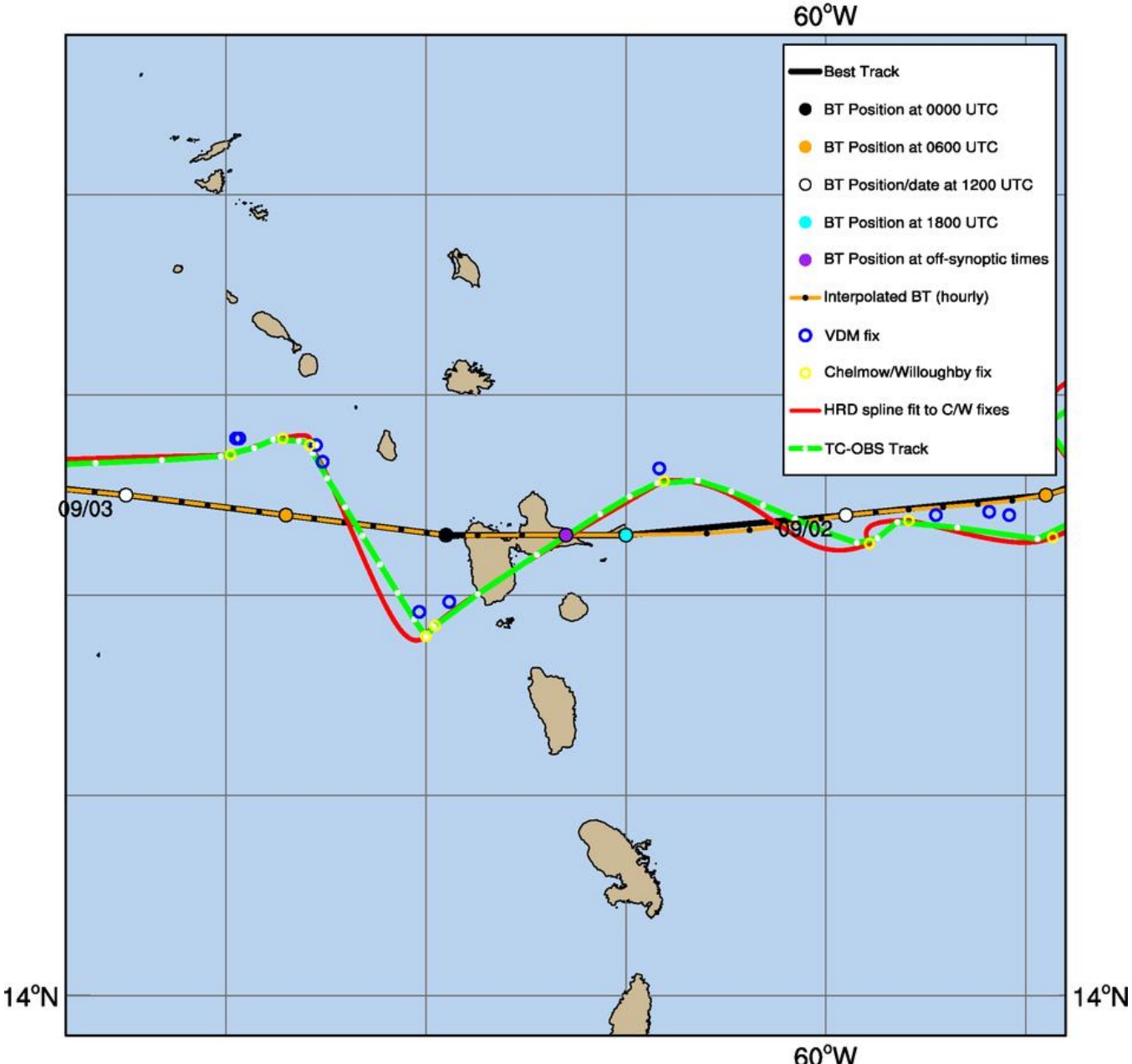
Comparison of Cyclone Position Information



Necessary to remove C/W center fixes that are too close in time to avoid forcing the interpolating spline in unphysical directions

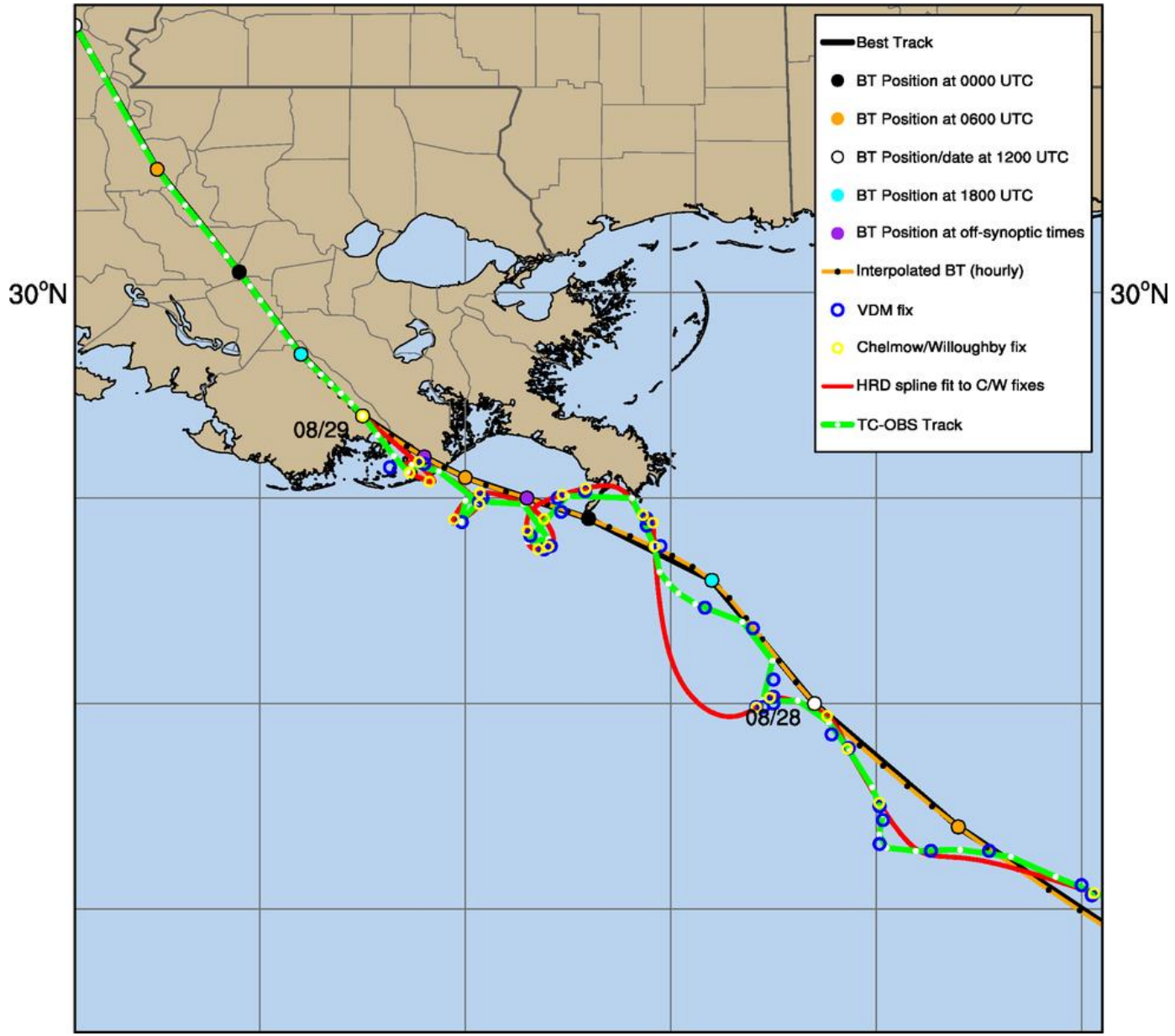
ERIKA (AL062009)

Comparison of Cyclone Position Information



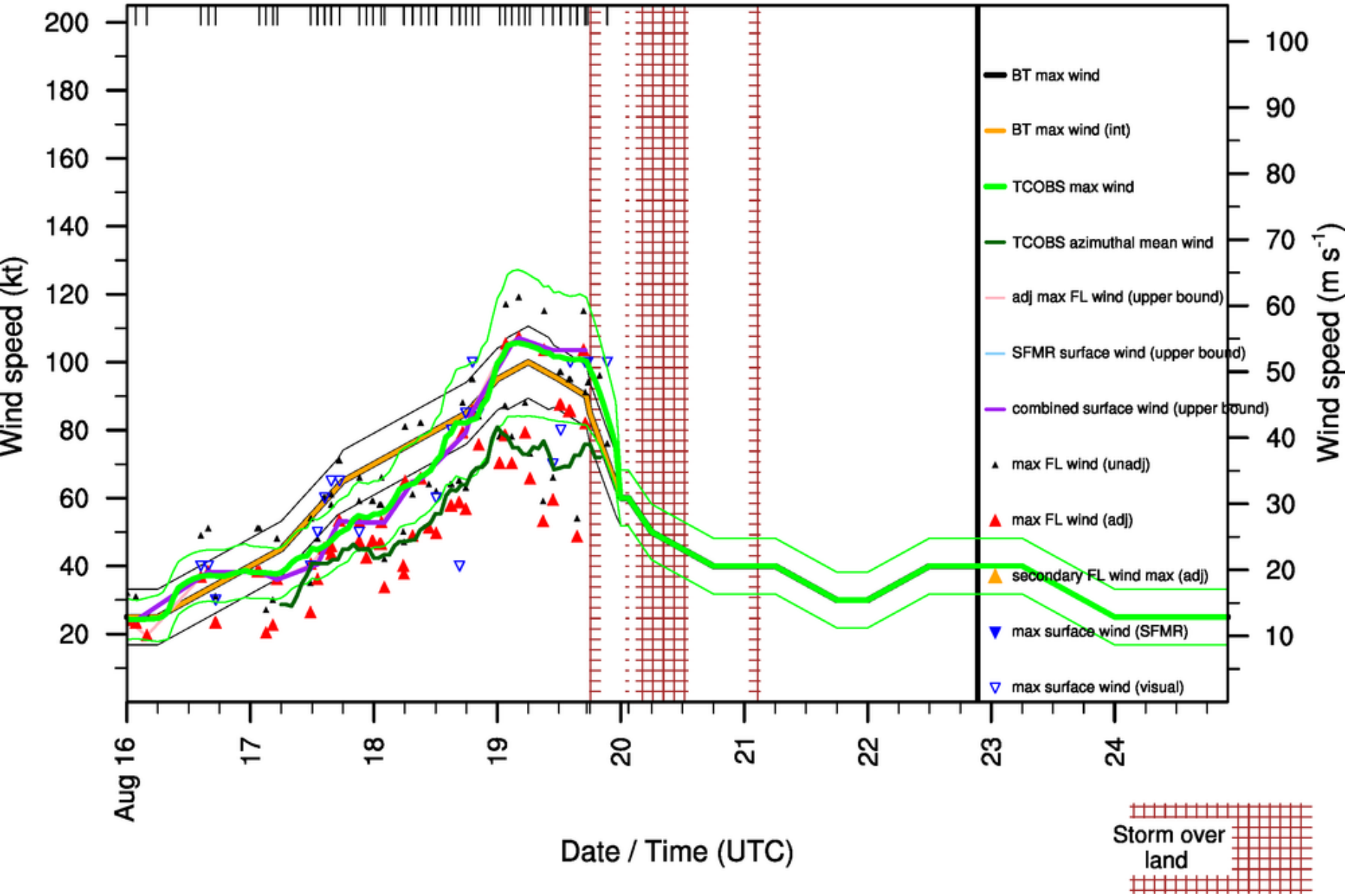
ISAAC (AL092012)

Comparison of Cyclone Position Information

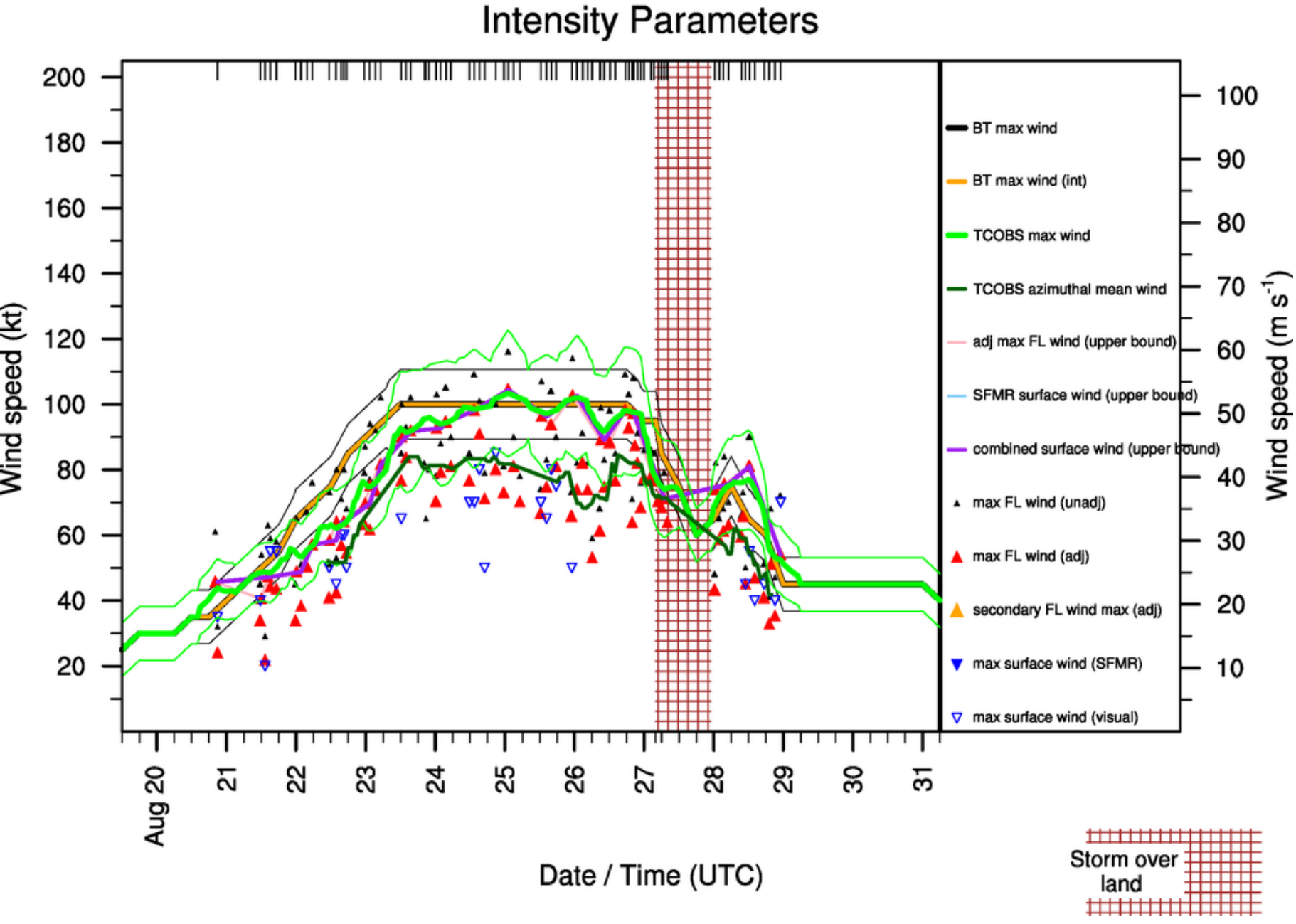


BOB (AL031991)

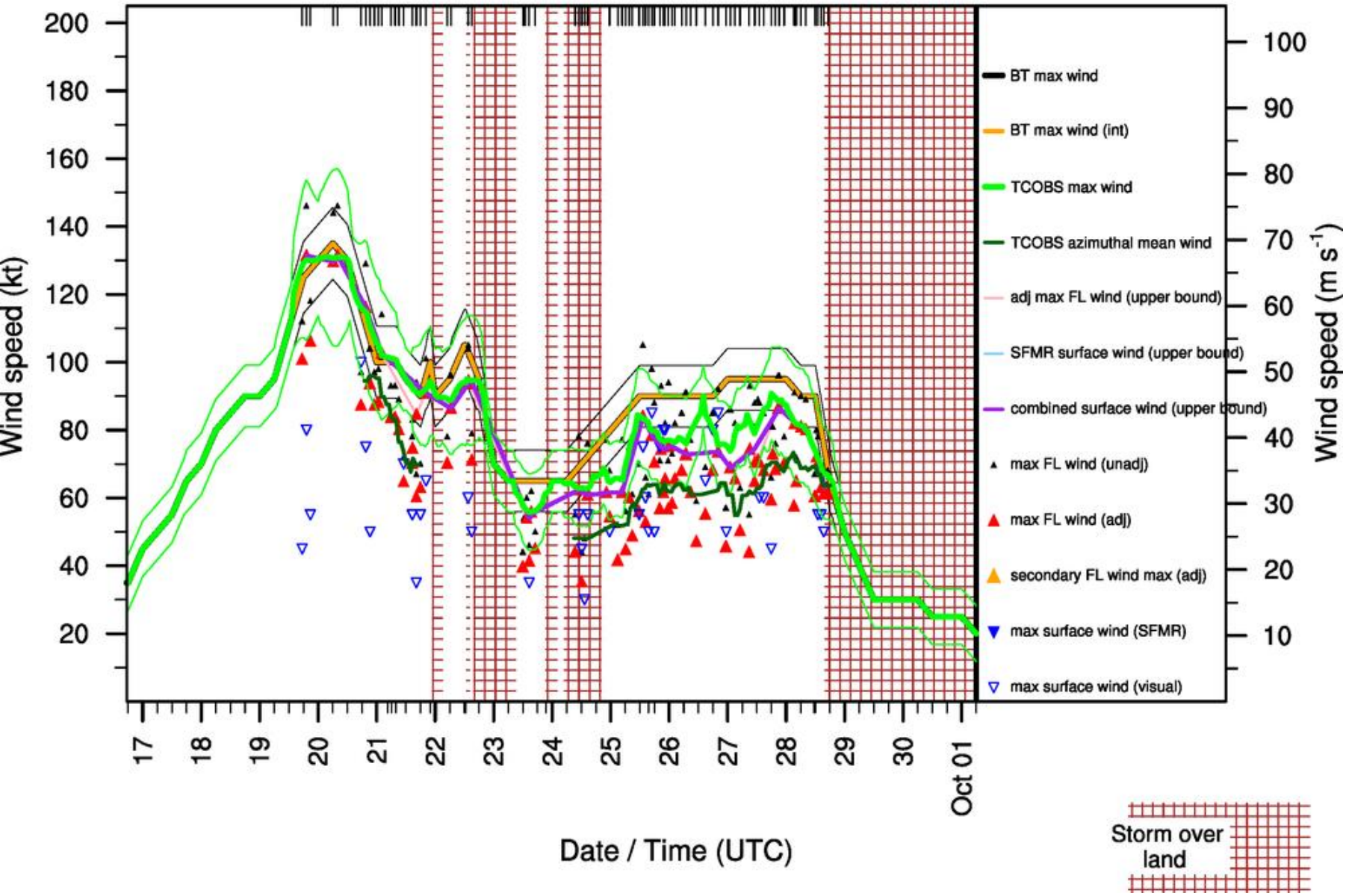
Intensity Parameters

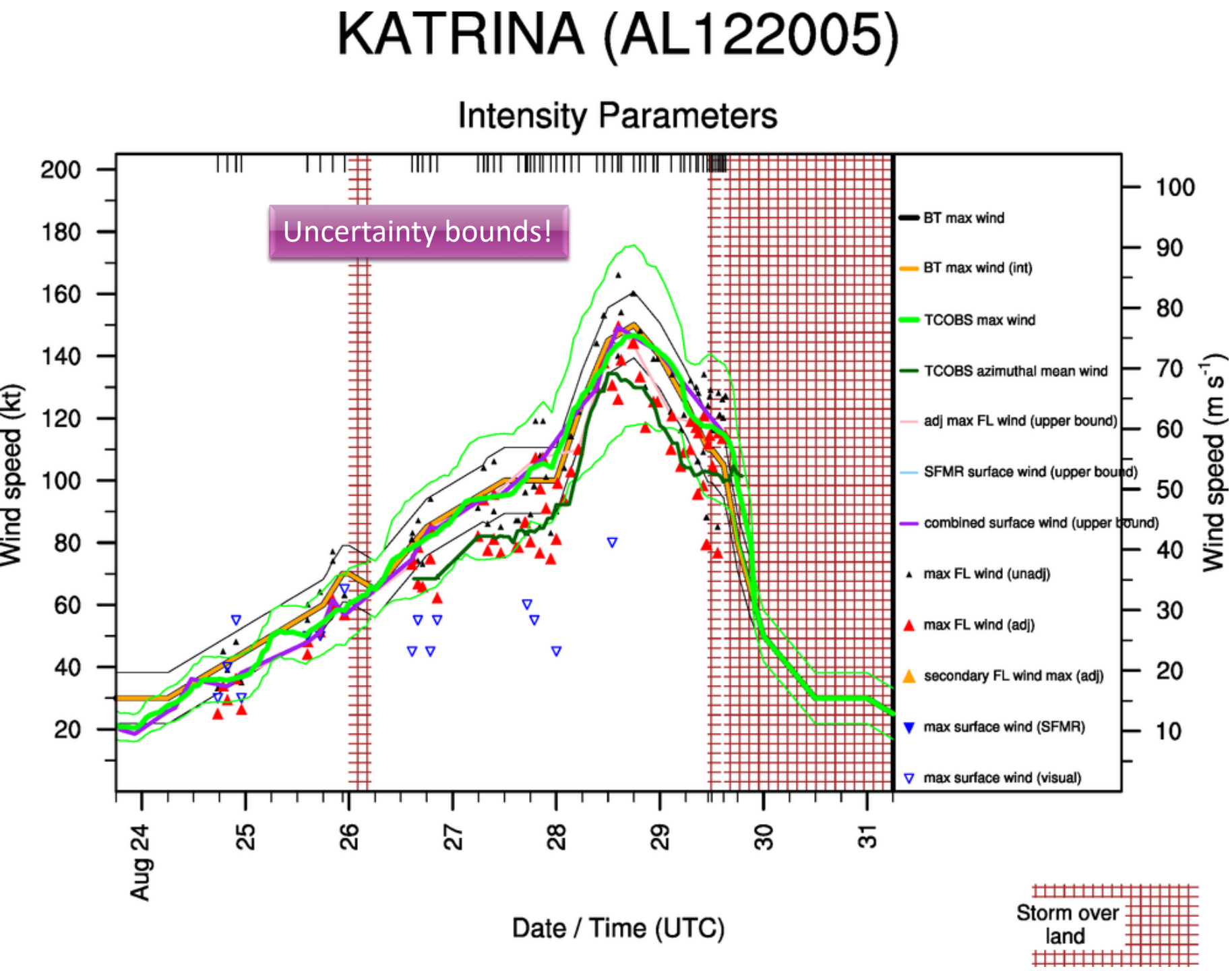


BONNIE (AL021998)

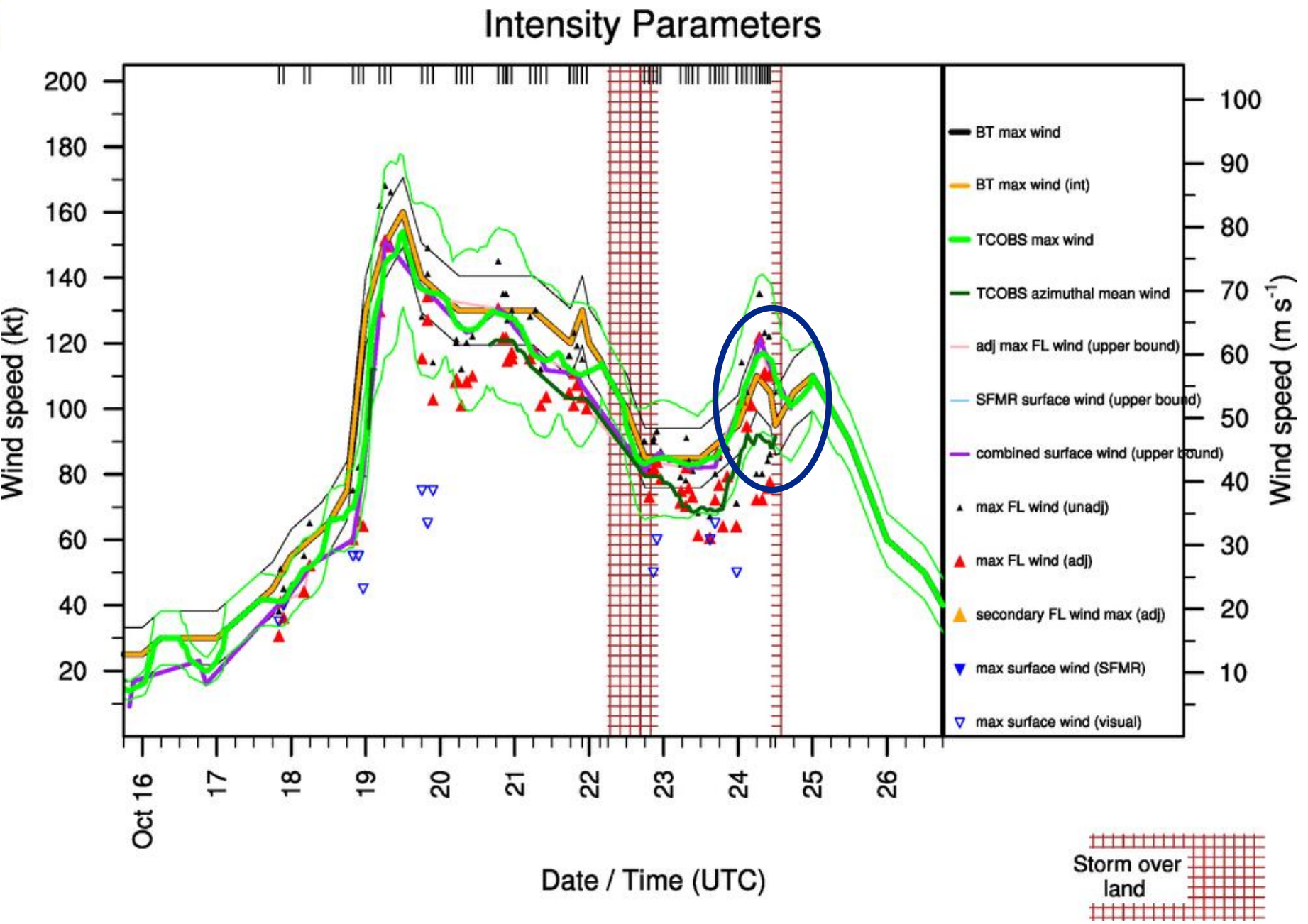


GEORGES (AL071998)



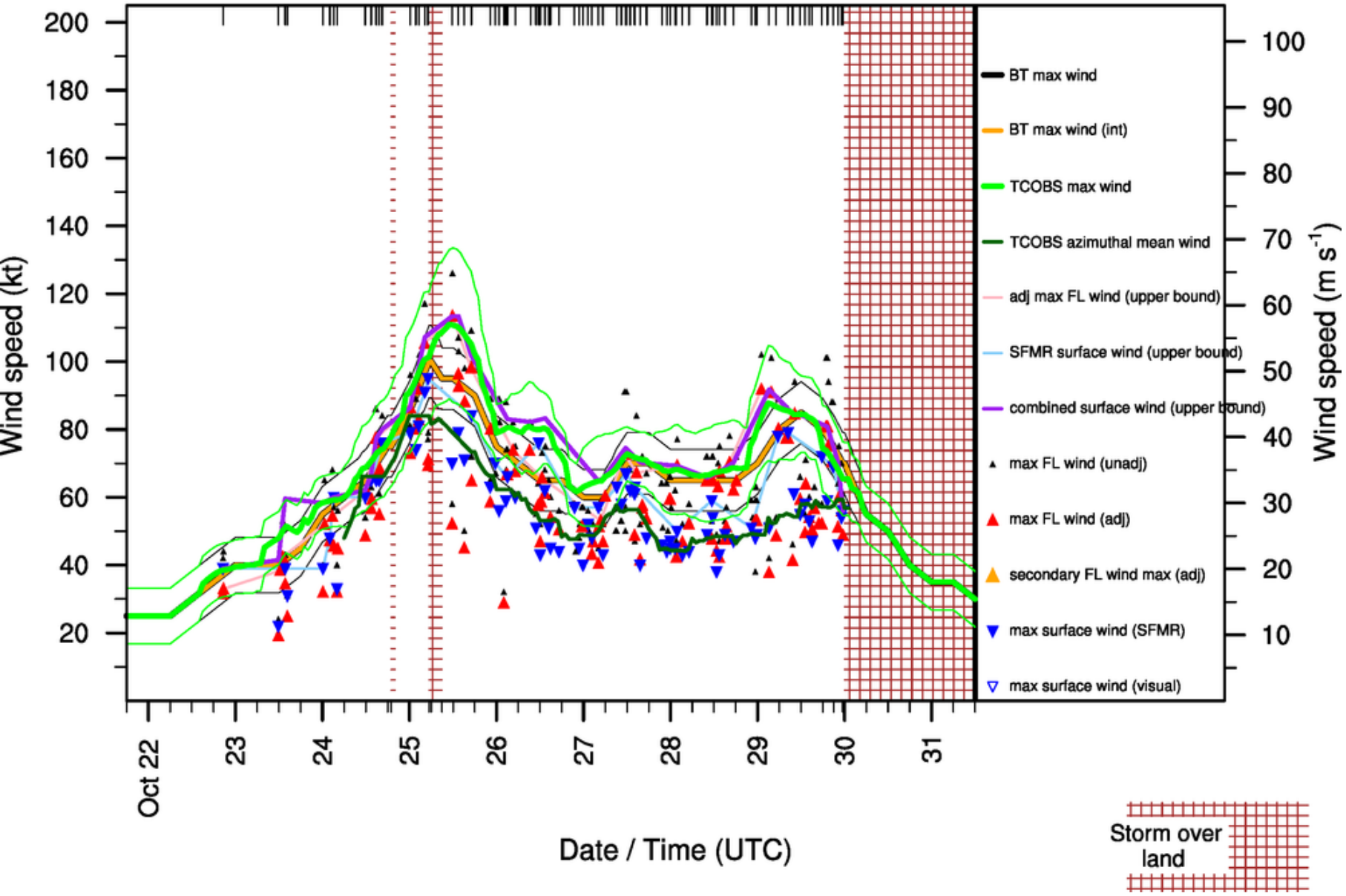

KATRINA (AL122005)
Intensity Parameters
Uncertainty bounds!
Wind speed (kt)
Wind speed (m s-1)
Date / Time (UTC)
Aug 24
25
26
27
28
29
30
31
BT max wind
BT max wind (int)
TCOBS max wind
TCOBS azimuthal mean wind
adj max FL wind (upper bound)
SFMR surface wind (upper bound)
combined surface wind (upper bound)
max FL wind (unadj)
max FL wind (adj)
secondary FL wind max (adj)
max surface wind (SFMR)
max surface wind (visual)
Storm over land

WILMA (AL252005)

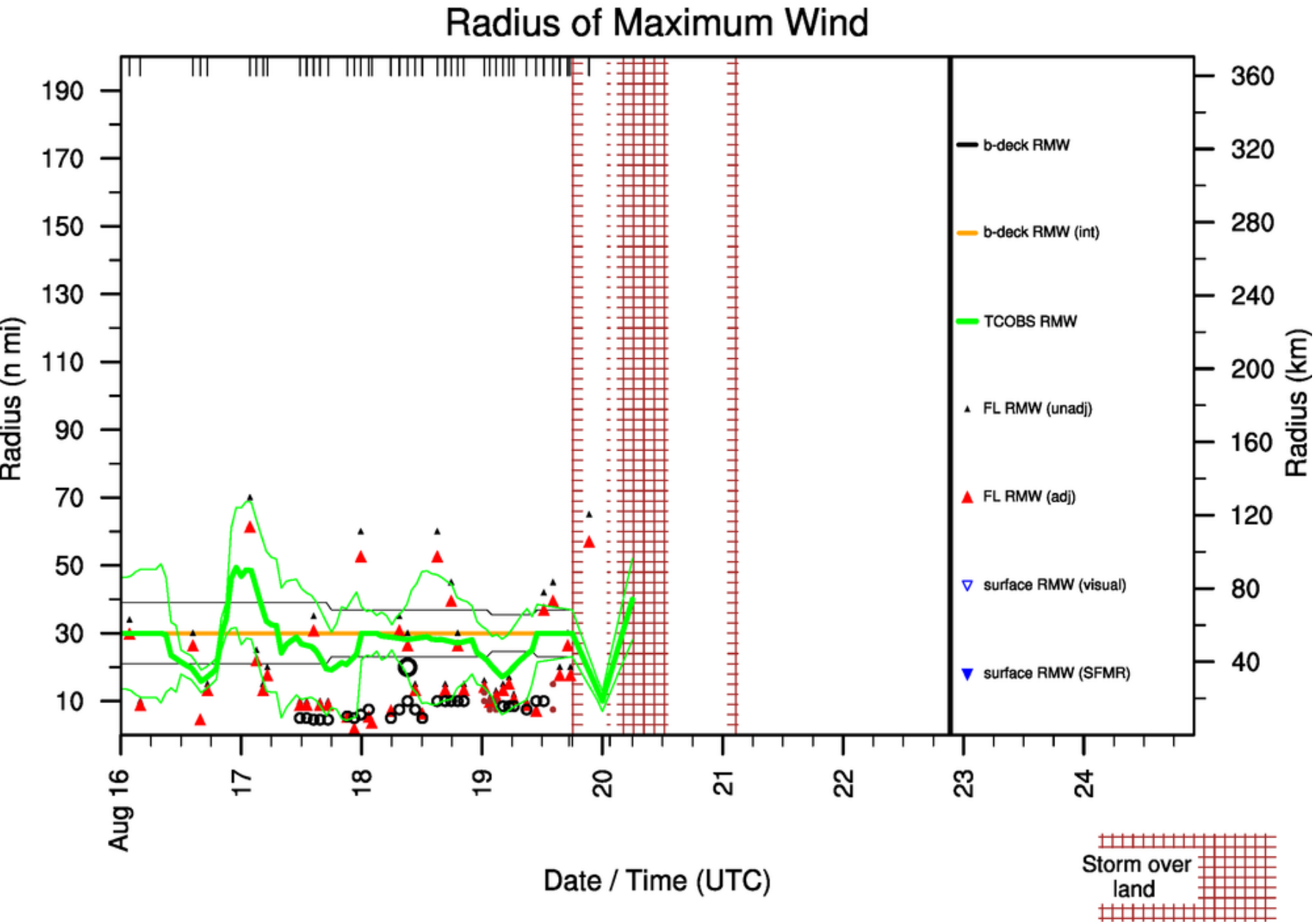


SANDY (AL182012)

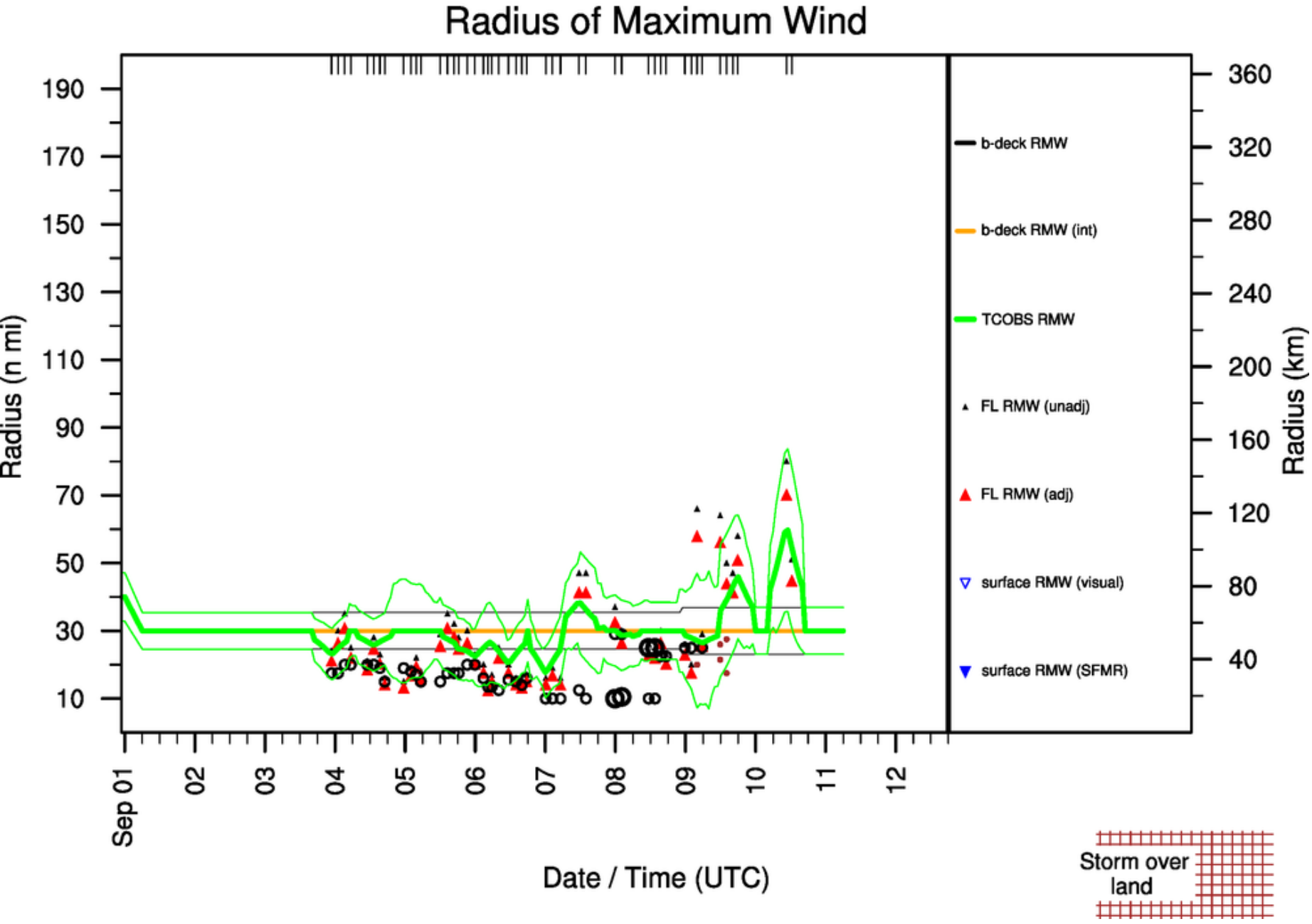
Intensity Parameters



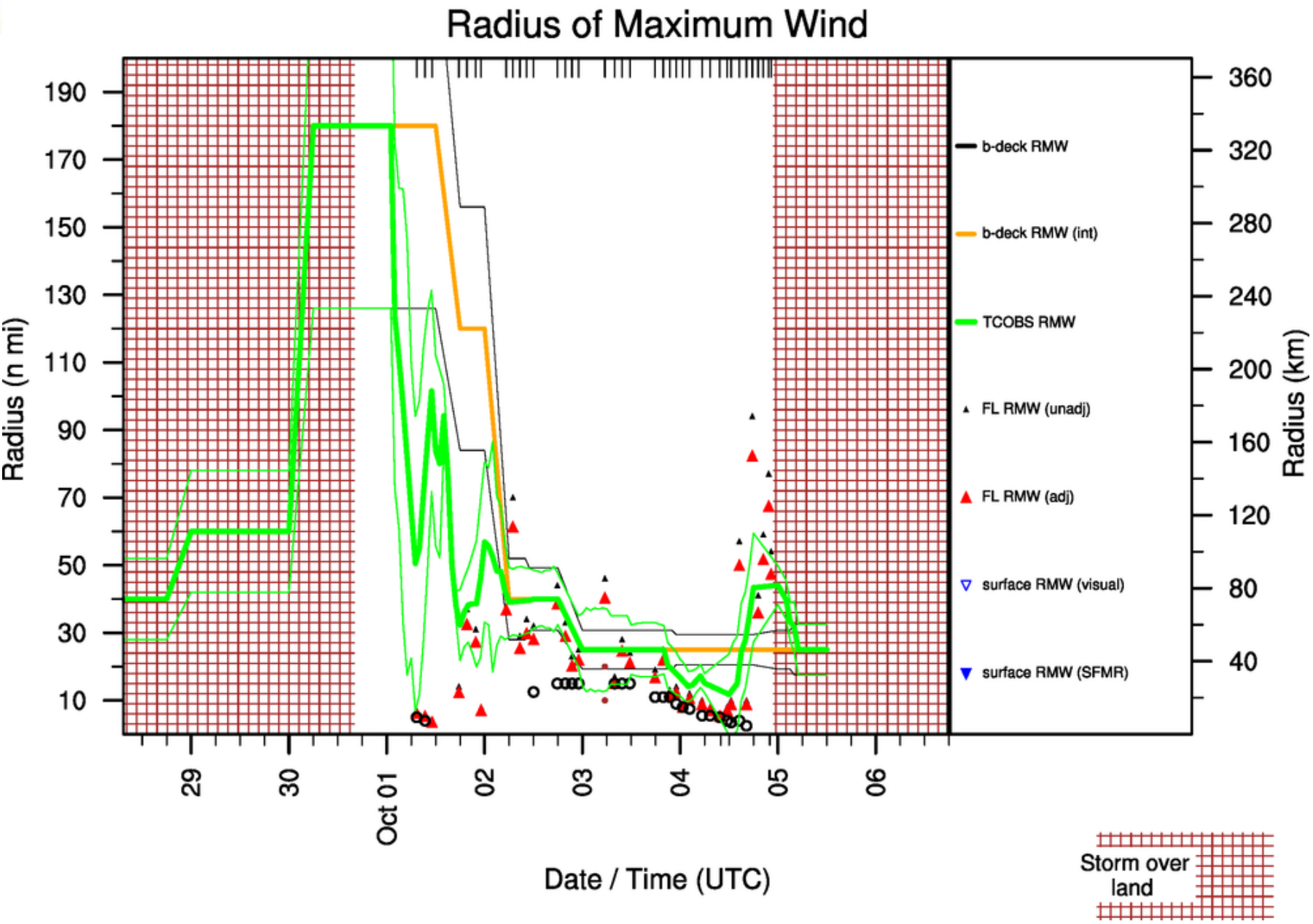
BOB (AL031991)



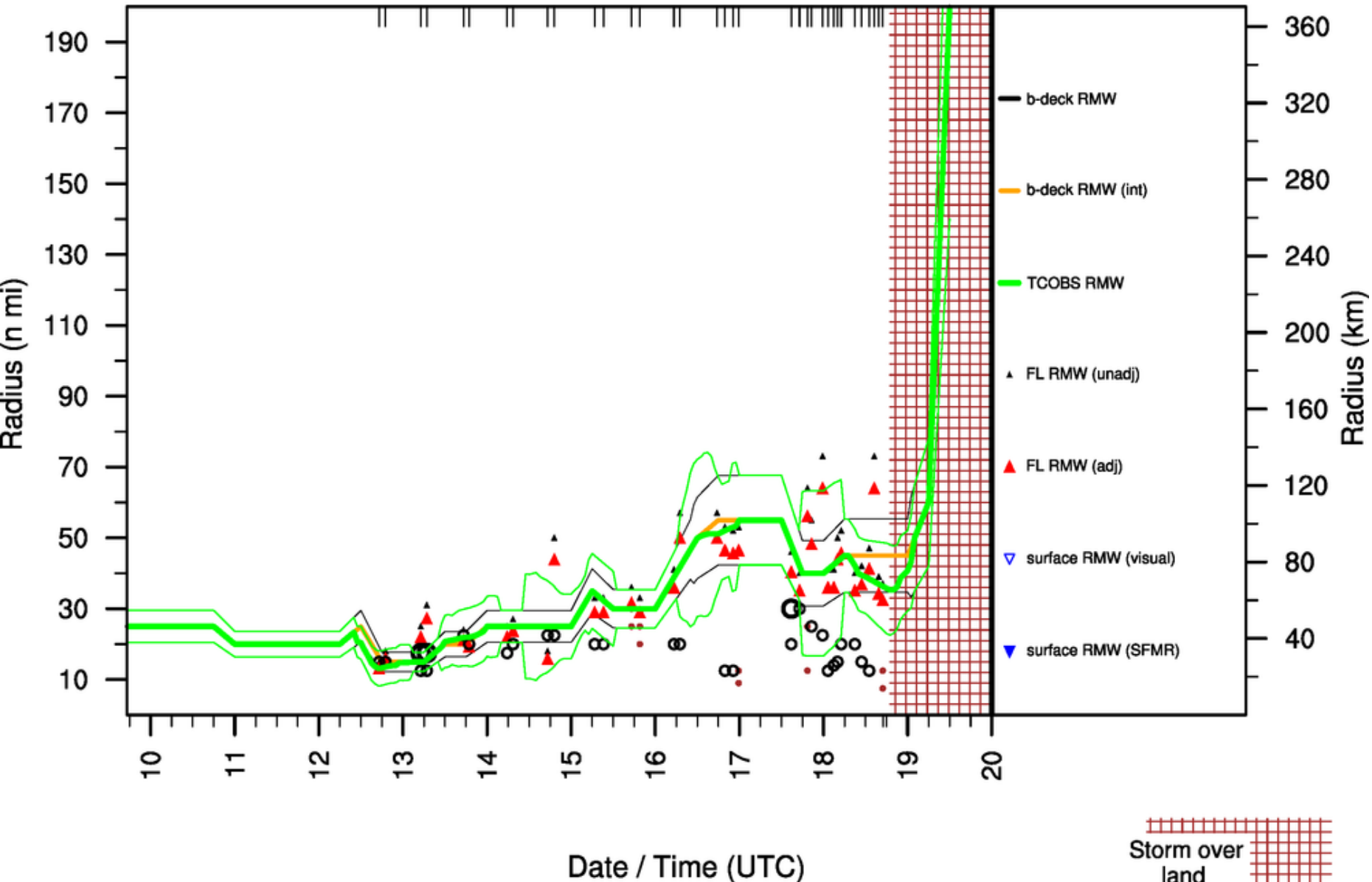
LUIS (AL131995)



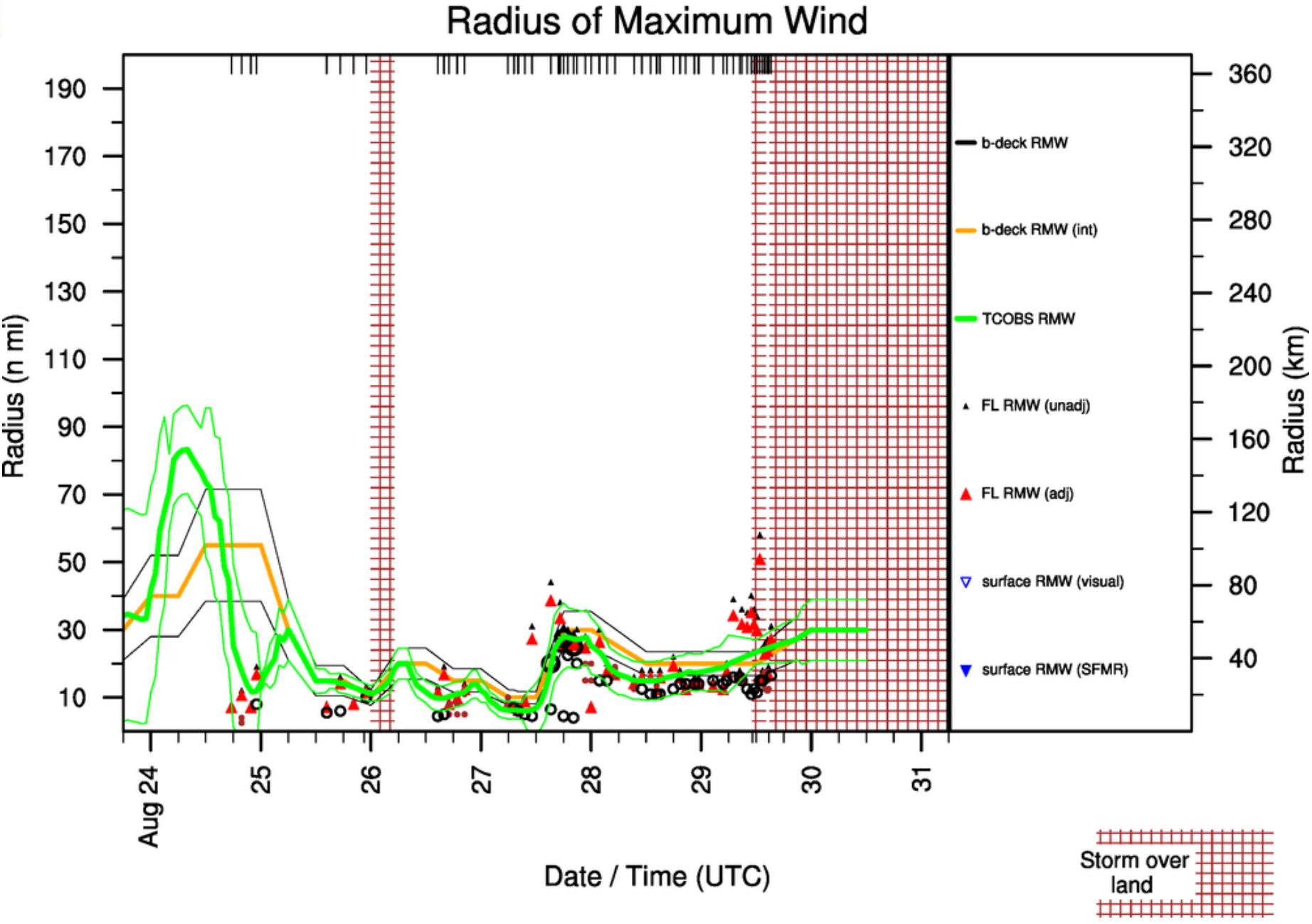
OPAL (AL171995)



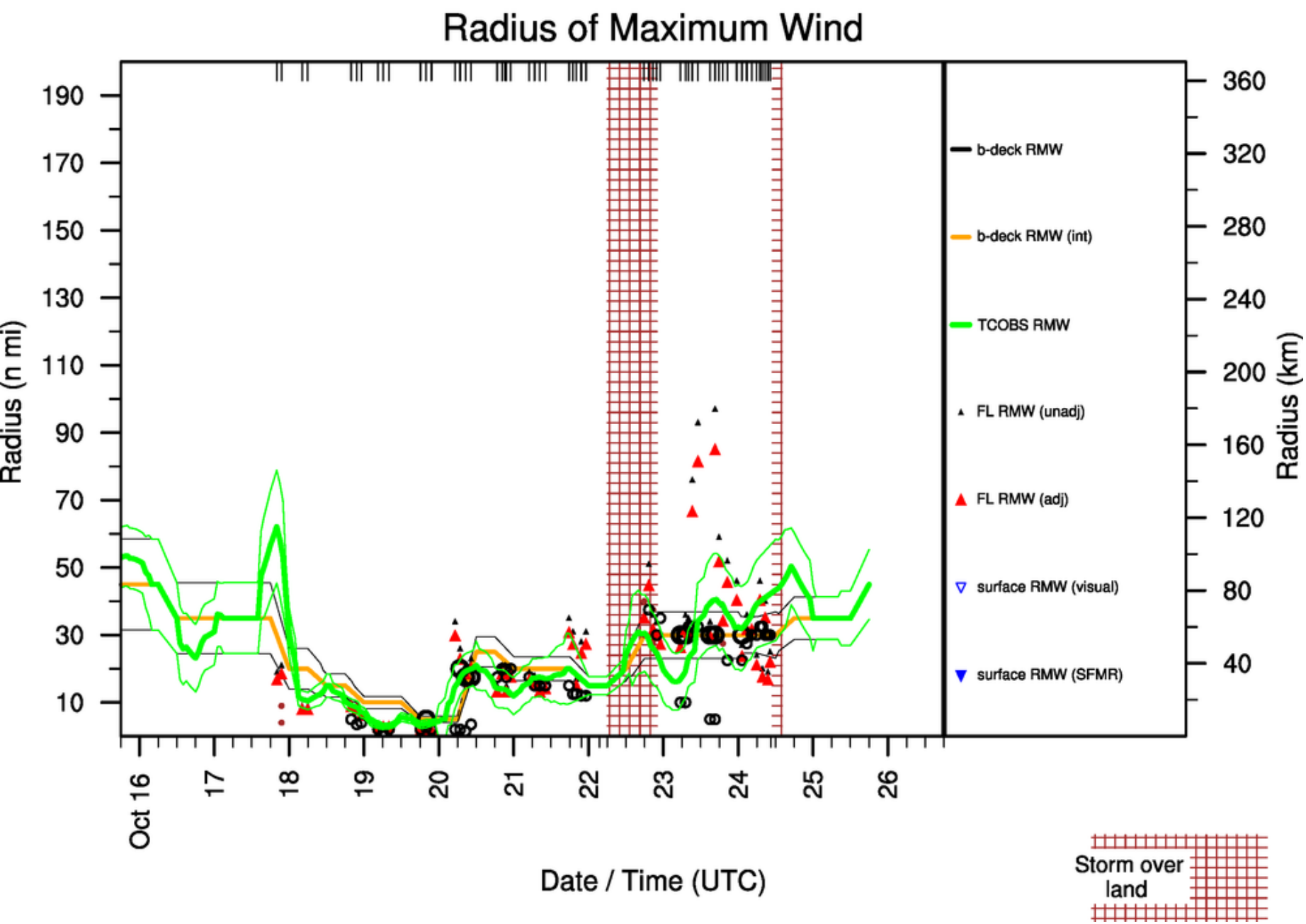
ISABEL (AL132003)



KATRINA (AL122005)

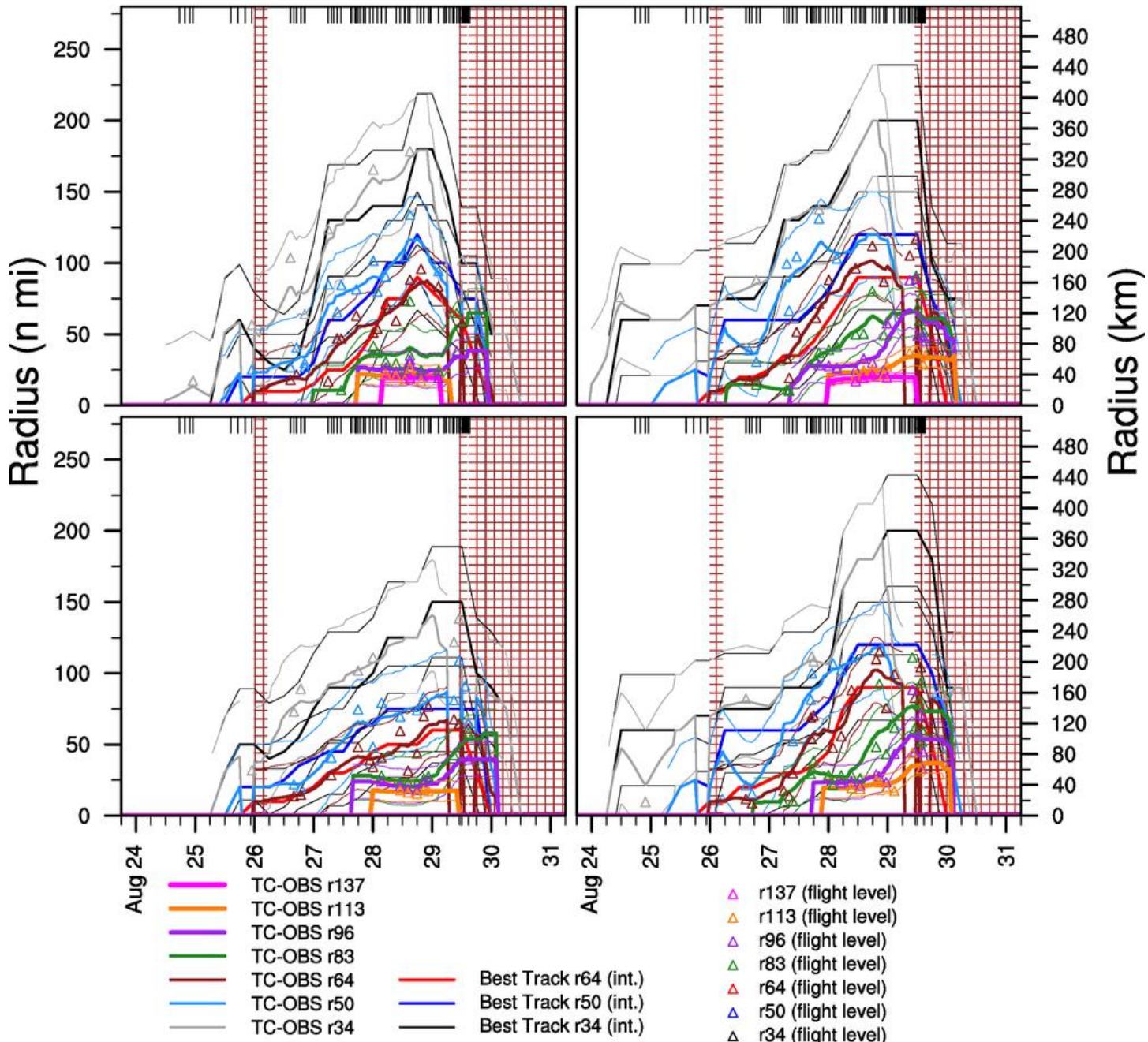


WILMA (AL252005)



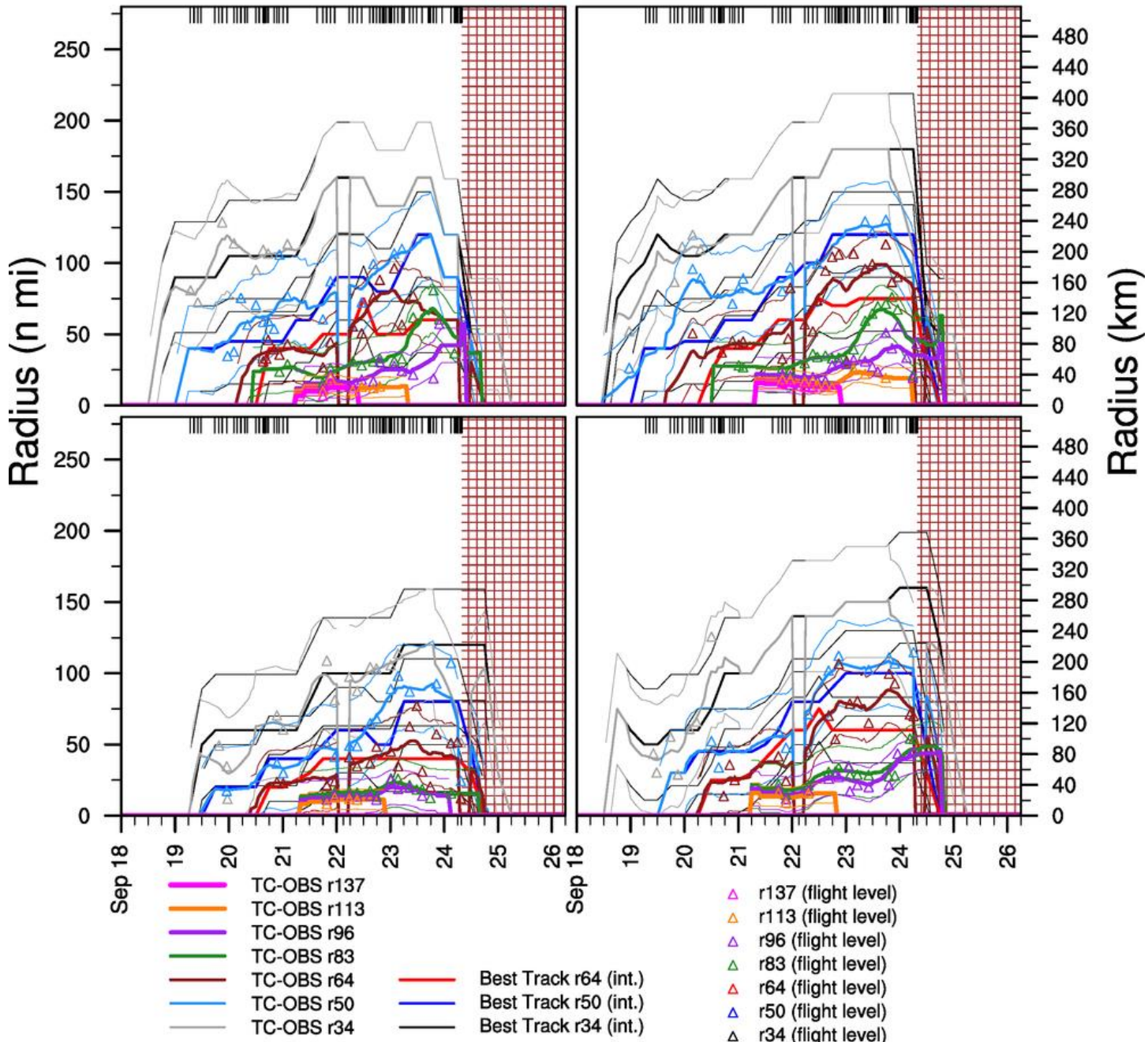
KATRINA (AL122005)

Wind Radii



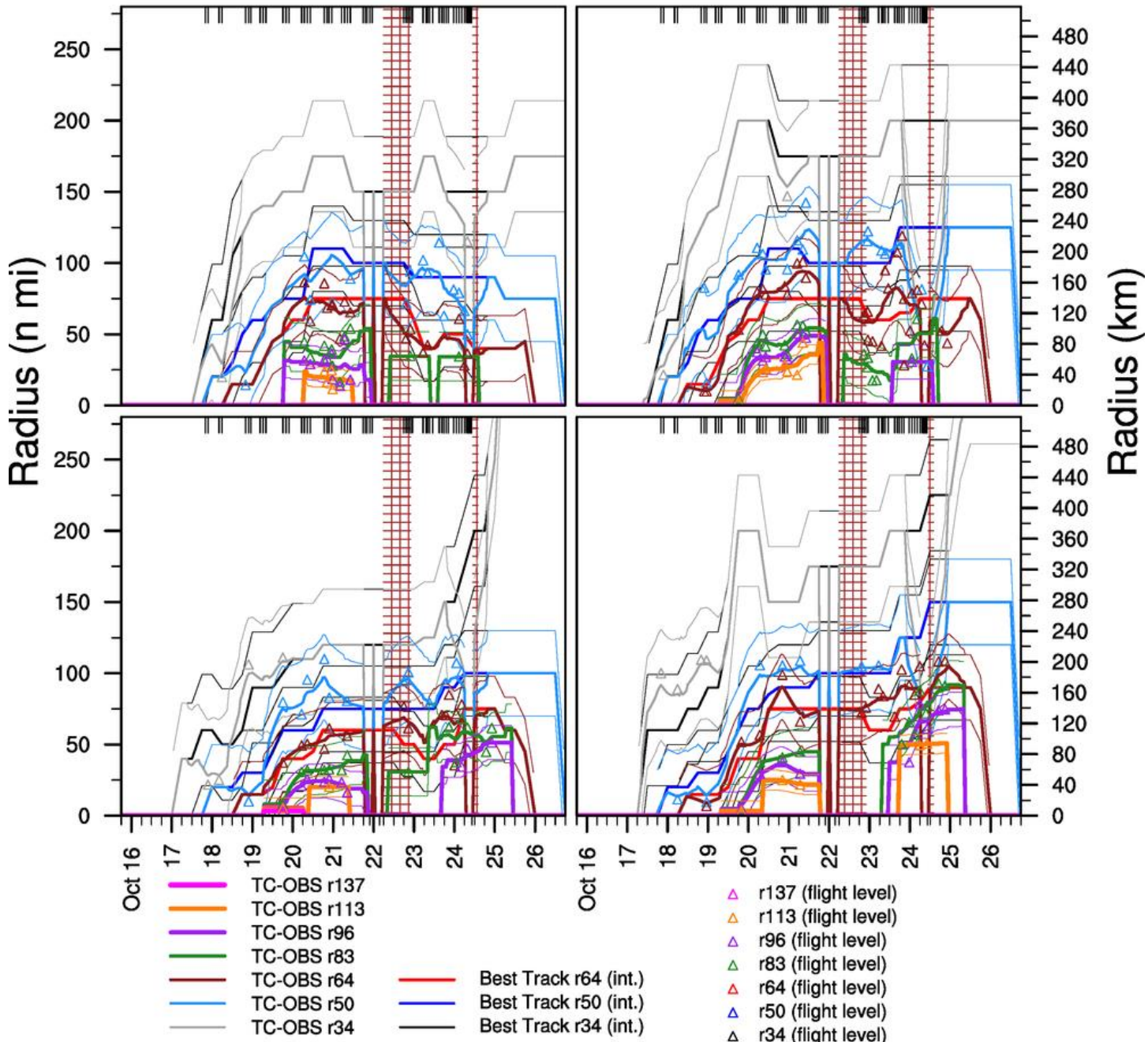
RITA (AL182005)

Wind Radii



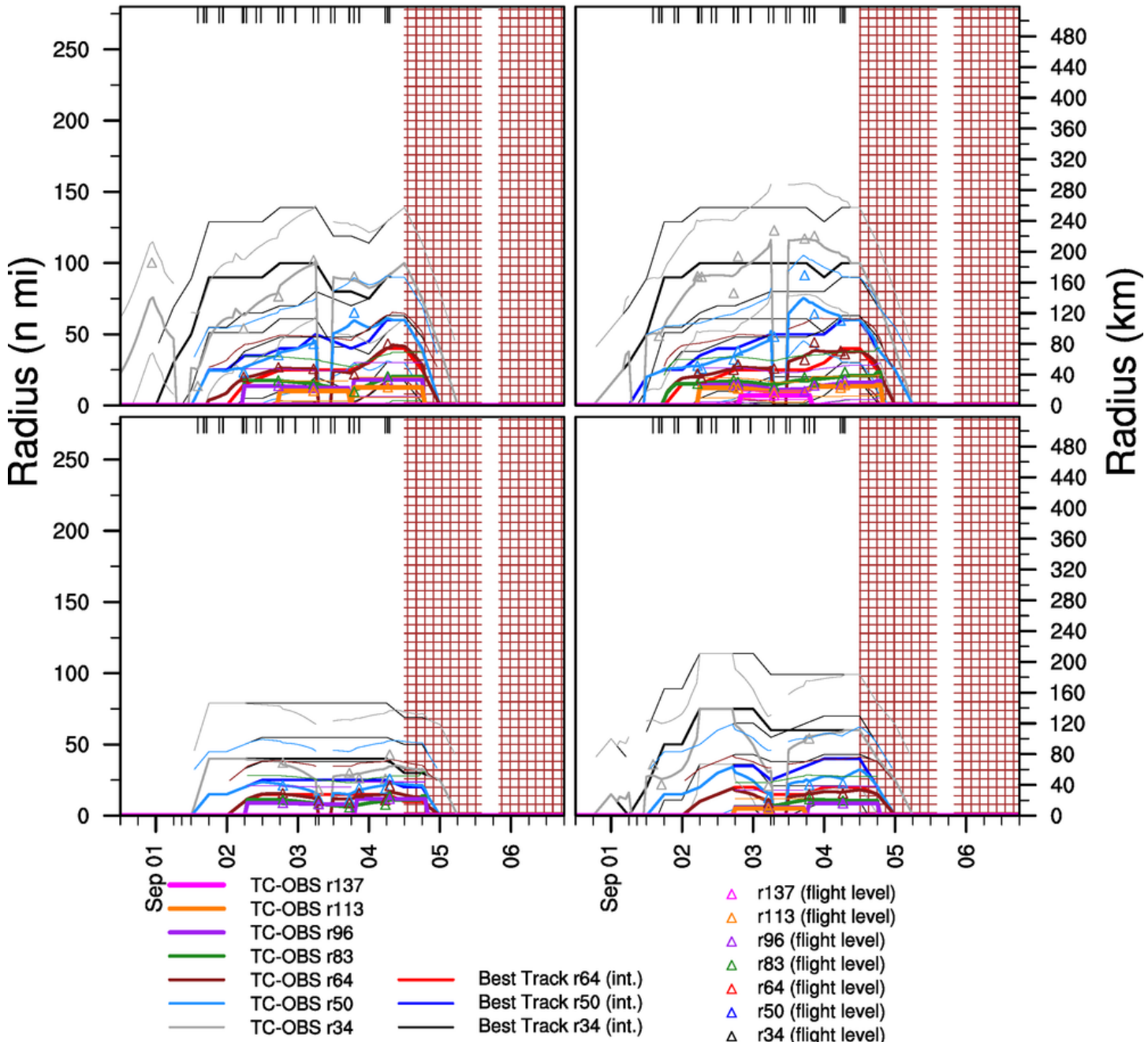
WILMA (AL252005)

Wind Radii



FELIX (AL062007)

Wind Radii



Future Work

- **Expand FLIGHT+ Dataset further back in time**
  - Calculate flight level pressure for all AFRES flights prior to 2004
  - Use HRD's reprocessed SFMR data
- **Use the vmax/rmax/wind radii data contained in the f-decks**
  - TAFB/SAB Dvorak fixes, AMSU, CIMSS, CIRA, ADT/ODT, SAR/ASCAT/QSCAT)
- **Update the QSCAT-R Dataset with quadrant-specific wind radii**
  - Use to refine r34, r50, r64, and r83 estimates
- **Include surface observations from land/buoys**
- **Apply/develop a new set of flight->surface reduction factors based on the FLIGHT+ Dataset**
  - Explore whether time-dependent SST information and dropsonde profiles can be used to improve flight->surface reduction factors
- **Examine the sensitivity of wind hazard risk using TC-OBS vs. HURDAT, case studies of damage for major landfalling storms**
- **Implement Bayesian and/or boot-strapping-based models to estimate uncertainty**
- **Estimate the actual uncertainty of the Best Track**