

(01/23/2025)

The Tail-Doppler Radar (TDR) dataset is comprised of raw Doppler radar data (as recorded on the aircraft) and products derived therefrom for a given flight. Radar data point of contact for Level 1 and 2 data sets: Dr. Paul Reasor (Paul.Reasor@noaa.gov) and Dr. John Gamache (John.Gamache@noaa.gov). Point of contact for Level 3 data set: Dr. Michael Fischer (mike.fischer@miami.edu).

HRD's data use policy should be read before using any of the below TDR data sets:
https://www.aoml.noaa.gov/wp-content/uploads/2021/06/Guide-to-AOML_HRD-Data-Accessibility.pdf

References for the synthesis method (3D and vertical profile) and automated QC:

- (3D synthesis) Gamache, J. F., 1997: Evaluation of a fully three-dimensional variational Doppler analysis technique. Preprints, 28th Conf. on Radar Meteorology, Austin, TX, Amer. Meteor. Soc., 422–423.
- (3D synthesis) Reasor, P. D., M. Eastin, and J. F. Gamache, 2009: Rapidly intensifying Hurricane Guillermo (1997). Part I: Low-wavenumber structure and evolution. Mon. Wea. Rev., 137, 603–631.
- (Profile synthesis) Zhang, J. A., Rogers, F., Reasor, P. D., and Gamache, J. (2022). The mean kinematic structure of the tropical cyclone boundary layer and its relationship to intensity change. Mon. Wea. Rev., 151, 63–84.
- (Quality control) Gamache, J. F., 2005: Real-time dissemination of hurricane wind fields determined from airborne Doppler radar data. National Hurricane Center, 38 pp. [Available online at http://www.nhc.noaa.gov/jht/2003-2005reports/DOPLRgamache_JHTfinalreport.pdf.]

Filename convention: **YYYY** = 4-digit year; **YY** = 2-digit year; **MM** = 2-digit month; **DD** = 2-digit day; **A** = aircraft ID (N42/3/9=H/I/N); **I** = first (=1) or second (=2) flight of day for given aircraft starting 00 UTC; **HHMMSS** = UTC analysis time in hrs (HH), min (MM) and sec (SS); **HHMM** = UTC analysis time without sec; **HHMM_HHMM** = UTC analysis period (start_end)

Note: For flights crossing 00 UTC, times are reported on a 48-h clock

File format: *.w are legacy binary files. We encourage use of the netcdf-format files which contain additional metadata for analysis interpretation. **IMPORTANT** notes on the netcdf files:

- Gridding and Variable Name Changes: Beginning in 2021, the 3D analysis grids transitioned from regularly-spaced in latitude-longitude [1D position variable names: “**lats**” and “**lons**” (and sometimes “**lat**” and “**lon**” for older data sets)] to regularly-spaced Cartesian (consistent with the *.w files) [1D position variable names: “**x**” and “**y**”. New 2D variables “LATITUDE” and “LONGITUDE” contain the latitude and longitude position of each Cartesian grid point and are supplied as additional information.]
- Vertical Levels: Beginning with the 2021 Level 2 products, the lowest level (z=0) is flagged to avoid a prior misinterpretation of that level (fields there are *not* surface fields)
- Storm-relative Mapping and Storm-relative Winds: All analyses employ a system translation (e.g., storm motion), stated in the metadata, to map raw Doppler data to the common analysis time. Files with ‘_rel’ indicate that a constant system motion has been removed from the winds (i.e., “storm-relative” winds). Otherwise, winds should be interpreted as Earth-relative winds.

Level 1a – Raw TDR radials with standard real-time QC written to individual 360° SIGMET-format sweep files. P-3 and G-IV flight archives for fore- (*-MA-product_raw.tar.gz) and aft-pointing (*-SL-product_raw.tar.gz) antenna are located at

https://seb.oma.noaa.gov/pub/acdata/YYYY/RADAR_TDR/YYYYMMDDAI

Level 1b – Real-time TDR products generated on the aircraft using automated QC and synthesis methods, transmitted to a ground server, and archived *as is*. Users must adhere to data use policies for Level 1 products and are strongly advised to perform their own quality control of analyses. P-3 and G-IV flight archives are located at

<https://seb.oma.noaa.gov/pub/flight/radar/YYYYMMDDAI>

<Execution, O(1M)> Informational text output/error files produced during software execution

YYMMDDAI_HHMM_HHMM_analysis.tar

<Analysis, O(10M)> 3D wind/reflectivity, 2D vertical profile gridded analyses of QC'd TDR data

YYMMDDAI_HHMM_xy.(w)nc.gz

- 3D volume with 2-km (0.5-km) horizontal (vertical) grid spacing extending out 250 km from the grid origin (typically, the center of circulation at flight level)
- For N49, the spacing and domain can vary depending on the flight pattern

YYMMDDAI_HHMM_xy_rel.(w)nc.gz **Discontinued after 2021 season**

- Storm-relative wind

YYMMDDAI_HHMM_vert_in(out)bound.(w)nc.gz

- Along-track (1.5-km spacing) vertical profile with 150-m vertical grid spacing
- Wind derived from data *up to* 10-km from the flight track (see Zhang et al. 2022)
- The user is advised to reference the in(out)-bound flight track for context, as the profiles sometimes do not represent actual radials from the storm center

YYMMDDAI_HHMM_vert_in(out)bound_rel.(w)nc.gz

- Storm-relative wind

YYMMDDAI_HHMM_vert_in(out)bound_fall.(w)nc.gz

- Estimated fall speed (via dBZ-Vt relationship) removed from the Doppler velocity

<AWIPS, O(1M)> Wind and reflectivity products for AWIPS-2 ingest derived from analysis data

AWIPSMaxdb_YYMMDDAI_HHMMz.nc.gz

AWIPSWindComponents_YYMMDDAI_HHMMz.nc.gz

<Superob, O(1M)> QC'd TDR data averaged to regular azimuth/radius points about flight track

YYMMDDAI_HHMM_HHMM_radials.so.gz

Level 1b – Real-time TDR graphics generated during flights and archived at

<https://www.aoml.noaa.gov/ftp/pub/hrd/data/RTradar/YYYY/YYYYMMDDAI>

Level 2 – Post-processed TDR products generated on the ground after the end of hurricane season using automated QC and synthesis methods. Departures of QC, method and analysis parameters from those used in real time (Level 1b) are noted in a spreadsheet at the end of this document. Each analysis has been inspected and adheres to basic standards for research use. Strictly speaking, only analyses since 2020 are formally part of the Level 2 database. In the future, analyses from prior seasons will be added. Users must adhere to data use policies for Level 2 products and are strongly advised to perform their own quality control of analyses. P-3 and G-IV flight archives are located at

<https://www.aoml.noaa.gov/ftp/pub/hrd/data/radar/level2>

IMPORTANT: RED-highlighted analyses should not be used.

<Jobfile, 3K> Input parameters to the automated QC/synthesis software

YYYYMMDDAI_HHMMSS_jobfile.tar.gz

<Execution, O(1M)> Informational text output/error files produced during software execution

YYMMDDAI_HHMM_HHMM_analysis.tar

<Analysis, O(10M)> 3D wind/reflectivity, 2D vertical profile gridded analyses of QC'd TDR data

YYMMDDAI_HHMM_xy.(w)nc.gz

- 3D volume with 2-km (0.5-km) horizontal (vertical) grid spacing extending out 250 km from the grid origin (typically, the center of circulation at flight level)
- For N49, the spacing and domain can vary depending on the flight pattern

YYMMDDAI_HHMM_xy_rel.(w)nc.gz **Discontinued after 2020 season reprocessing**

- Storm-relative wind

YYMMDDAI_HHMM_vert_in(out)bound.(w)nc.gz

- Along-track (1.5-km spacing) vertical profile with 150-m vertical grid spacing
- Wind derived from data *up to* 10-km from the flight track (see Zhang et al. 2022)
- The user is advised to reference the in(out)-bound flight track for context, as the profiles sometimes do not represent actual radials from the storm center

YYMMDDAI_HHMM_vert_in(out)bound_rel.(w)nc.gz

- Storm-relative wind

YYMMDDAI_HHMM_vert_in(out)bound_fall.(w)nc.gz

- Estimated fall speed (via dBZ-Vt relationship) removed from the Doppler velocity

<AWIPS, O(1M)> Wind and reflectivity products for AWIPS-2 ingest derived from analysis data

AWIPSMaxdb_YYMMDDAI_HHMMz.nc.gz
AWIPSWindComponents_YYMMDDAI_HHMMz.nc.gz

<Superob, O(1M)> QC'd TDR data averaged to regular azimuth/radius points about flight track

YYMMDDAI_HHMM_HHMM_radials.so.gz

<O-A, O(1M)> Difference between (average) Doppler radial velocity and TDR analysis value
projected onto the radial for each 3D grid cell

YYMMDDAI_HHMM_xy_O_minus_A_aft(fore).w.gz **Added in 2021 Level 2 products**

Level 3 – Tropical Cyclone Radar Archive of Doppler Analyses with Recentering (TC-RADAR)

currently contains 1193 swaths of TDR observations and 355 flight-merged analyses from the P-3 Level 2 database for storms occurring in the North Atlantic, eastern North Pacific, and central North Pacific basins. Observations span all points of the TC lifecycle, ranging from pre-genesis disturbances, to mature hurricanes, to storms nearing extratropical transition. Please note that TDR analyses prior to 2020 have not undergone the same rigorous examination and, thus, are only loosely regarded as “Level 2”. Users must adhere to data use policies for Level 3 products and are strongly advised to perform their own quality control of analyses. The swath and flight-merged netcdf archives and README are located at

<https://www.aoml.noaa.gov/ftp/pub/hrd/data/radar/level3>

2020 HFP TDR POST-PROCESSING (LEVEL 2)

DOCUMENTATION

Storm Name	Flight ID	Tasking	Pattern	Peak Intensity During Flight	Tail #	Level 1b Analysis Time (UTC)	Reprocess Level 1b? (Y/N)	Level 2 Analysis Time (UTC)	Level 2 Upload Date (MM/DD/YY)	Reprocessing Notes
TS Cristobal	2020060511	EMC	Lawnmower	40 kt (TS)	NOAA43	2200	Y	2140	04/12/21	Issue: Upper-level noise along flight track; Original: 10/10 dB (aft/fore dBZ mask), 3-km dx, 0.9 SQL; Final: Reconfigured lawnmower analysis, weak w anomaly remains along flight track (associated with high-altitude flight level)
						2354	Y	2217	04/12/21	Issue: Upper-level noise along flight track; Original: 10/10 dB (aft/fore dBZ mask), 0.9 SQL; Final: Reconfigured lawnmower analysis, weak w anomaly remains along flight track (associated with high-altitude flight level)
						2510	Y	2455	04/12/21	Issue: Upper-level noise along flight track; Original: 10/10 dB (aft/fore dBZ mask), 0.9 SQL; Final: Reconfigured lawnmower analysis, weak w anomaly remains along flight track (associated with high-altitude flight level)
						2546	Y	2625	04/12/21	Issue: Upper-level noise along flight track; Original: 10/10 dB (aft/fore dBZ mask), 0.9 SQL; Final: Reconfigured lawnmower analysis, weak w anomaly remains along flight track (associated with high-altitude flight level)
TS Cristobal	2020060611	EMC	Butterfly	45 kt (TS)	NOAA43	2115	Y			Original: 15/20 dB (aft/fore dBZ mask), 0.9 SQL; Final: Removed and placed in first-pass analysis
						2206	Y	2206	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.9 SQL; Final: Absorbed old first analysis into this first pass
						2319	Y	2319	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.9 SQL
						2428	Y	2428	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.9 SQL; Final: Adjusted center southward
TD8	2020072311	NHC	Alpha	35 kt (TS)	NOAA43	2330	Y	2330	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL; Final: Slightly adjust motion dir for all
						2502	Y	2502	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL; Final: Shift center S and W
						2629	Y	2629	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL; Final: Extend outbound leg substantially
TS Hanna	2020072411	NHC	Alpha	40 kt (TS)	NOAA43	1137	Y	1137	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL; Final: Slightly adjust motion dir for all, extend inbound period
						1306	Y	1306	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL; Final: Adjust profile end time
						1436	Y	1436	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL
TS Hanna	2020072412	NHC	Alpha	55 kt (TS)	NOAA43	2533	Y	2533	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL; Final: Slightly adjust motion dir for all, extend inbound period
						2628	Y	2628	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL; Final: Extend outbound leg and add ferry portion
HU Hanna	2020072511	NHC	Alpha	70 kt (Cat 1 HU)	NOAA43	1143	Y	1143	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL; Final: Slightly adjust motion dir for all
						1243	Y	1243	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL; Final: Truncate inbound profile
						1327	Y	1327	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL; Final: Extend ferry portion
HU Isaias	2020073111	EMC	Butterfly	70 kt (Cat 1 HU)	NOAA43	1003	Y	1003	04/12/21	Original: 15/20 dB (aft/fore dBZ mask), 0.75 SQL, TS setting; Final: Hurricane setting for all, truncate inbound profile

HU Sally	20200914I1	EMC	Rotated Fig-4	85 kt (Cat 2 HU)	NOAA43	1540	Y	1540	04/12/21	Original: 0.9 SQI, Final: extend ferry portion
						1713	Y	1713	04/12/21	Original: 0.9 SQI
						1816	Y	1816	04/12/21	Original: 0.9 SQI, Final: Remove profiles
						1935	Y	1935	04/12/21	Original: 0.9 SQI
HU Sally	20200914N2	NHC	Synoptic	85 kt (Cat 2 HU)	NOAA49		N			MA only TDR, No INE corrections file
HU Sally	20200914H1	EMC	Rotated Fig-4	85 kt (Cat 2 HU)	NOAA42	2205	Y	2205	04/12/21	Final: Extend ferry portion , shift center W
						2343	Y	2343	04/12/21	Final: Shift center S and W
						2444	Y	2444	04/12/21	Final: Truncate outbound profile
						2606	Y	2606	04/12/21	Final: Extend ferry portion
HU Sally	20200915I1	NHC	Alpha	70 kt (Cat 1 HU)	NOAA43	1420	Y	1420	04/12/21	Original: 0.9 SQI; Final: Slightly adjust motion dir for all
						1516	Y	1516	04/12/21	Original: 0.9 SQI; Final: Shift center W
						1634	Y	1634	04/12/21	Original: 0.9 SQI
						1746	Y	1746	04/12/21	Original: 0.9 SQI
						1855	Y	1855	04/12/21	Original: 0.9 SQI
						1936	Y	1936	04/12/21	Original: 0.9 SQI; Final: Shift center S and W, remove outbound profile
TS Teddy	20200915N1	NHC	Synoptic	55 kt (TS)	NOAA49		N			MA only TDR, No INE corrections file
HU Teddy	20200916N1	NHC	Synoptic	85 kt (Cat 2 HU)	NOAA49		N			MA only TDR, No INE corrections file
HU Teddy	20200917H1	NESDIS	Figure-4 + OW	120 kt (Cat 4 HU)	NOAA42	1525	Y	1525	04/12/21	Final: Bit too much WS removed at 1 km in all passes
						1657	Y	1657	04/12/21	
						1738	Y	1738	04/12/21	OW
						1806	Y	1806	04/12/21	OW
						1827	Y	1827	04/12/21	OW ; Final: Extend ferry portion
HU Teddy	20200917I1	OAR	Butterfly	120 kt (Cat 4 HU)	NOAA43	2245	Y	2245	04/12/21	Original: 0.9 SQI; Final: Extend ferry portion
						2434	Y	2434	04/12/21	Original: 0.9 SQI
						2545	Y	2545	04/12/21	Original: 0.9 SQI
HU Teddy	20200918H1	NESDIS	Figure-4 + OW	110 kt (Cat 3 HU)	NOAA42	1607	Y	1607	04/12/21	
						1704	Y	1704	04/12/21	

Total	149*	146+?
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