PERILS Data Overview, QC, Availability

Flexible Array of Radars and Mesonets
University of Illinois

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All FARM Data
Freely Available
with no restrictions or obligations
to all PERILS PIs and Collaborators

Available by FTP

By PERILS design, instruments are deployed
as parts of arrays to maximize success of integrated data,
not only individual sub-project goals.

Scientific success and maximum exploitation of integrated data sets depends on free sharing of data

FARM to Table

- Modern, repeatable, verifiable science requires raw data availability, as well as cited, and/or provided, specific, repeatable, methods.
- Heavily processed data ,
  e.g staggered-PRT velocity, Z, rho-HV,
  should be traceable back to raw observations.
- What are the ingredients in that data sausage?
- Do you trust that velocity or ZDR product, or clutter filter
- Can those fields be recreated?
- Are your analyses repeatable?

"You were right—I really didn't want to know how it's made, because that was incredibly boring."

FARM to Table

FARM makes available:

- Radar calibration files
- Raw time series (by mail)
- Code and formulas used for indexing , clutter filters, pulse pair or other, staggered PRT methods, filtering, parameter files used when converging IQ to processed products
- Inclinometer data and bubble level images
- ZDR birdbath time series and calibration adjustments
- Raw moments and corrected moments (e.g. raw ZDR and corrected ZDR)
- Data and code permitting staggered and individual short/long pulse velocity product (VShort, Vlong, Vstagger, ZH, ZV, etc.)
- Data allowing merged Frequency1 + Frequency2 calculations to reduce noise and error
- DORADE and CFRADIAL
- Level L0, L1, L2+ sounding data, *raw through filtered and processed,* EOL and SPC formats, including SHARPpy skewT plots
- Operator notes, gps
- READMEs describing navigation and other adjustments
- GURU deployment maps

There's much more available from radars than a few processed products

Maybe you like or don't like clutter filtered data

Maybe you want to reduce noise in, say, the ZDR field by combining independent Freq1 and Freq2 data

Maybe you don't like the staggered PRT Velocity speckling

Maybe you want 1-degree, or 0.2 degree beam indexing

Ask us, and we can work with you, going back to the raw I,Q data

PERiLS 2023 Data Collection Summary

Radar Summary

Operated:
Feb. 16 (IOP01) to Apr. 27, 2023 (IOP06)

COW:
Dual-pol
Multi-Doppler member

No Data
Data Available

DOW7:
Dual-frequency, dual-pol
Multi-Doppler member

DOW6:
Single-frequency, dual-pol
Chasing radar, filler radar, targeted at last minute
Ad hoc Multi-Doppler member

DOW6 filled in when other PERiLS radars were unavailable for some IOPs, to complete dual-Doppler lobes, and to conduct "chasing"/targeted missions.

Platform	IOP01	IOP02	IOP03	IOP04	IOP05	IOP06
COW1						
DOW6						
DOW7						
SCOUT1 Mobile Mesonet						
SCOUT3 Mobile Mesonet						
SONDE1 Soundings	8	7	7	8	5	3
SONDE2 Soundings	7	6	4	7	4	
SONDE3 Soundings	6	5	5	9	4	
SONDE4 Soundings	8	4	6	9	4	
SONDE5 Soundings	8	9	8	11	7	
PODs	13	13	13	13	13	8
Disdrometers	3	3	3	3	3	2

Radar Data QC Process

Basic Radar QC:

- Geo-reference (Heading, Lat/Lon, range-to-first-gate)
- Reflectivity Calibration/Correction
- ZDR Calibration/Correction
- Elevation Correction (COW)
- Custom beam indexing
- Default ground clutter filter
- Parsing (slicing sweeps)
- Metadata

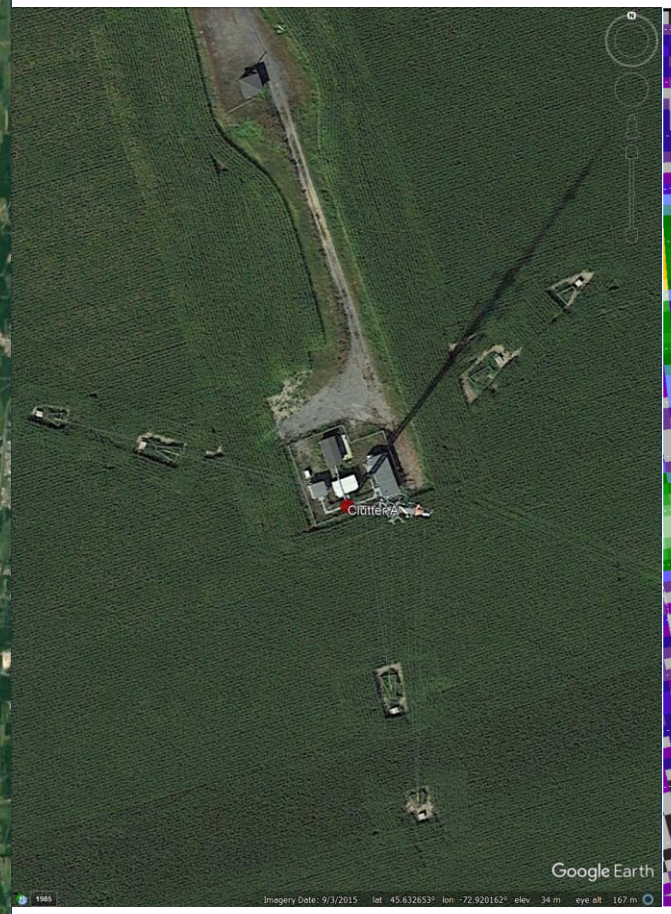
Auxiliary Documents and Documentation:

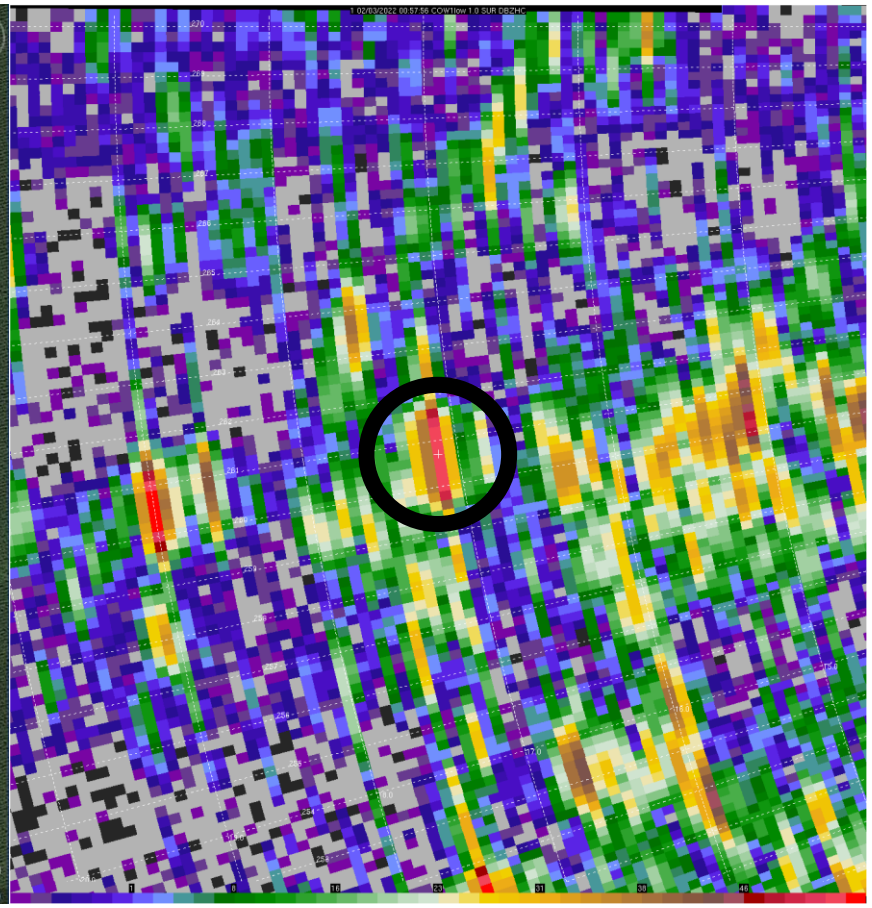
- READMEs
- Operator Notes
- Inclinometer Files
- Tuner log
- Mast Data
- Site/IOP, bubble level, weather Pictures
- Processing code
- Calibration files

Geo-Referencing via Clutter Targets

Ground Clutter: 4 – 9 targets (ideally one in each quadrant)

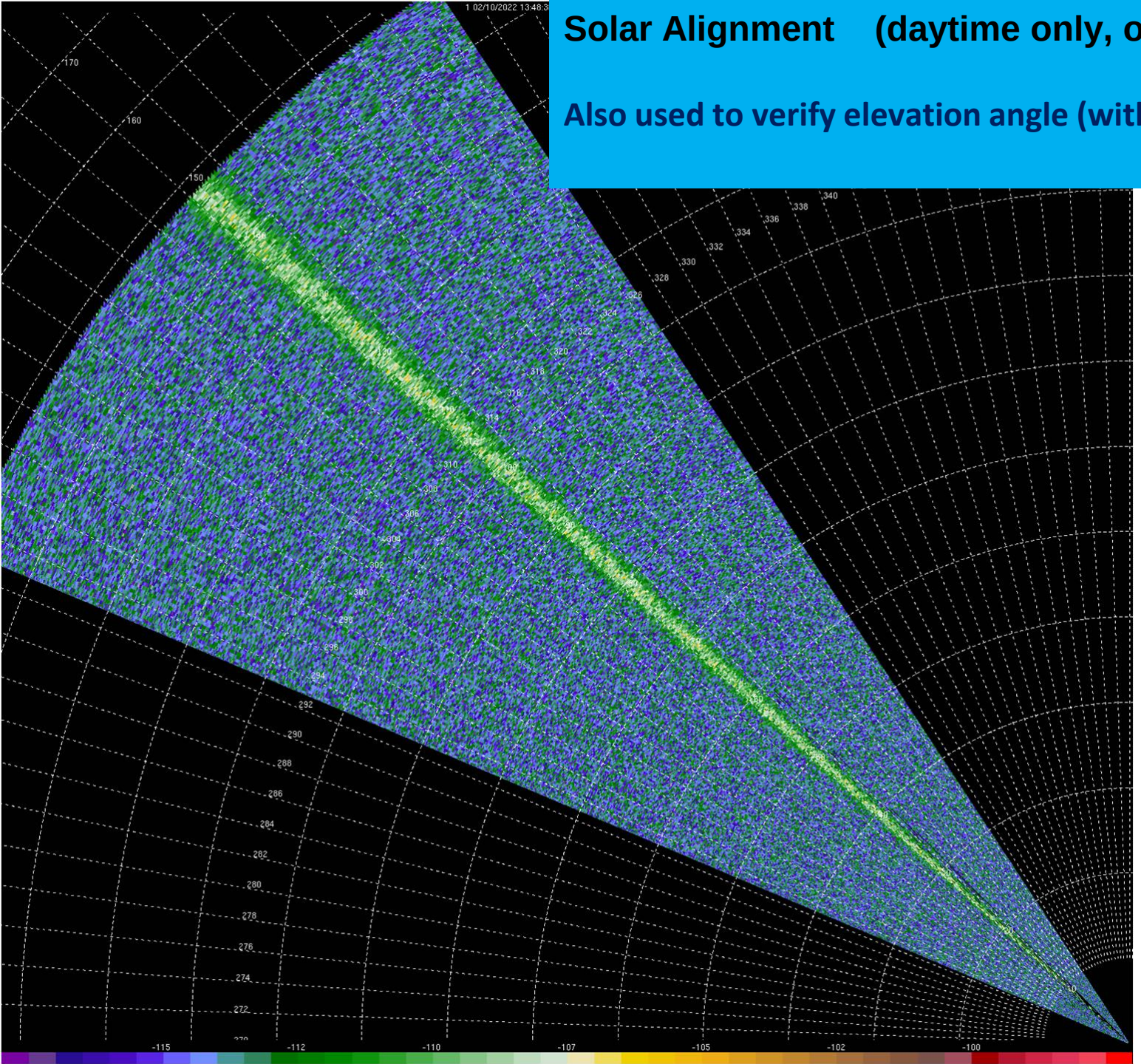
- Heading
- Range-To-First-Gate





Solar Alignment (daytime only, of course) (within 0.2)

Also used to verify elevation angle (within 0.1-0.2)



Z Correction/Calibration:

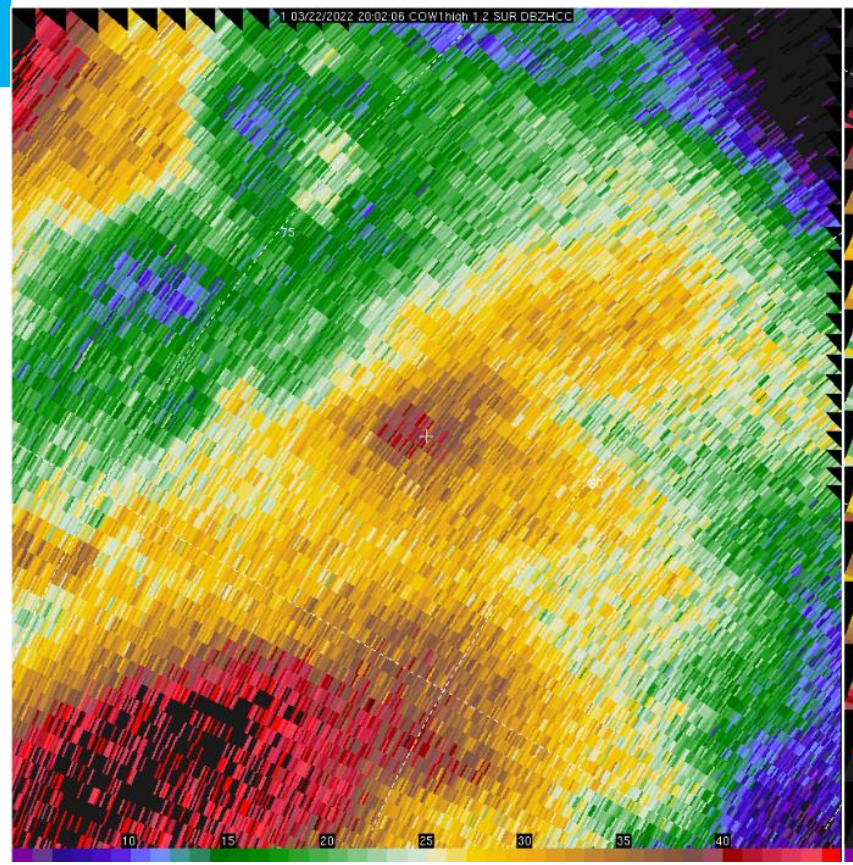
Moderate intensity precipitation (subjectively avoiding suspected attenuation and Mie scattering regions)

Most linear response region of receiver (-90 to -60 dB)

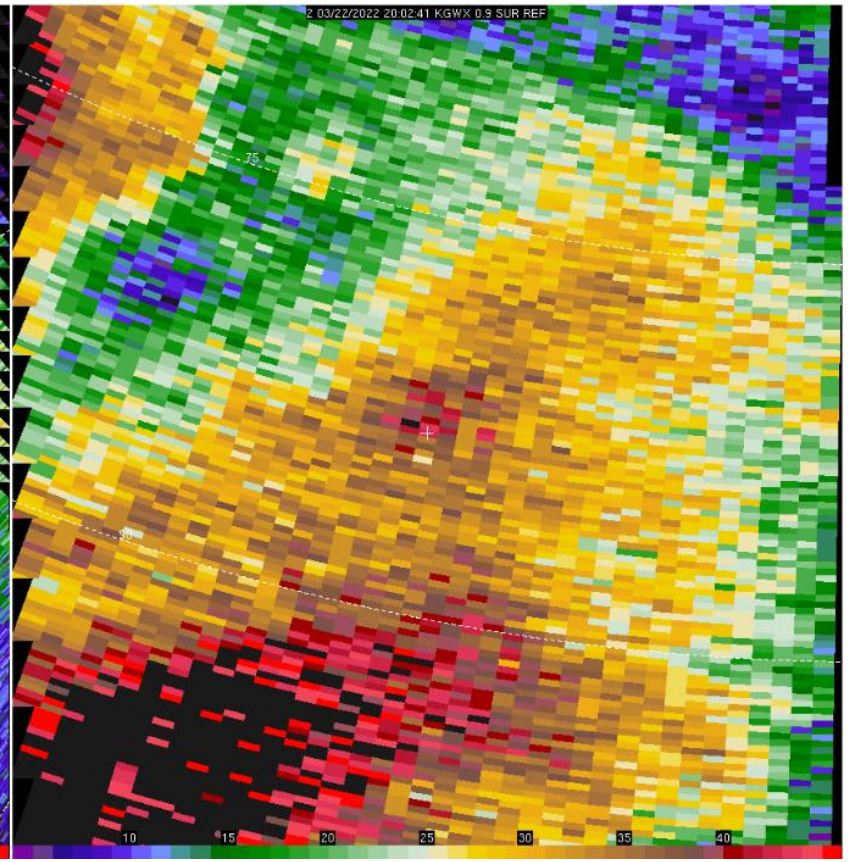
Match height/time with 88D

DO for all radars/frequencies and cross check

COW1

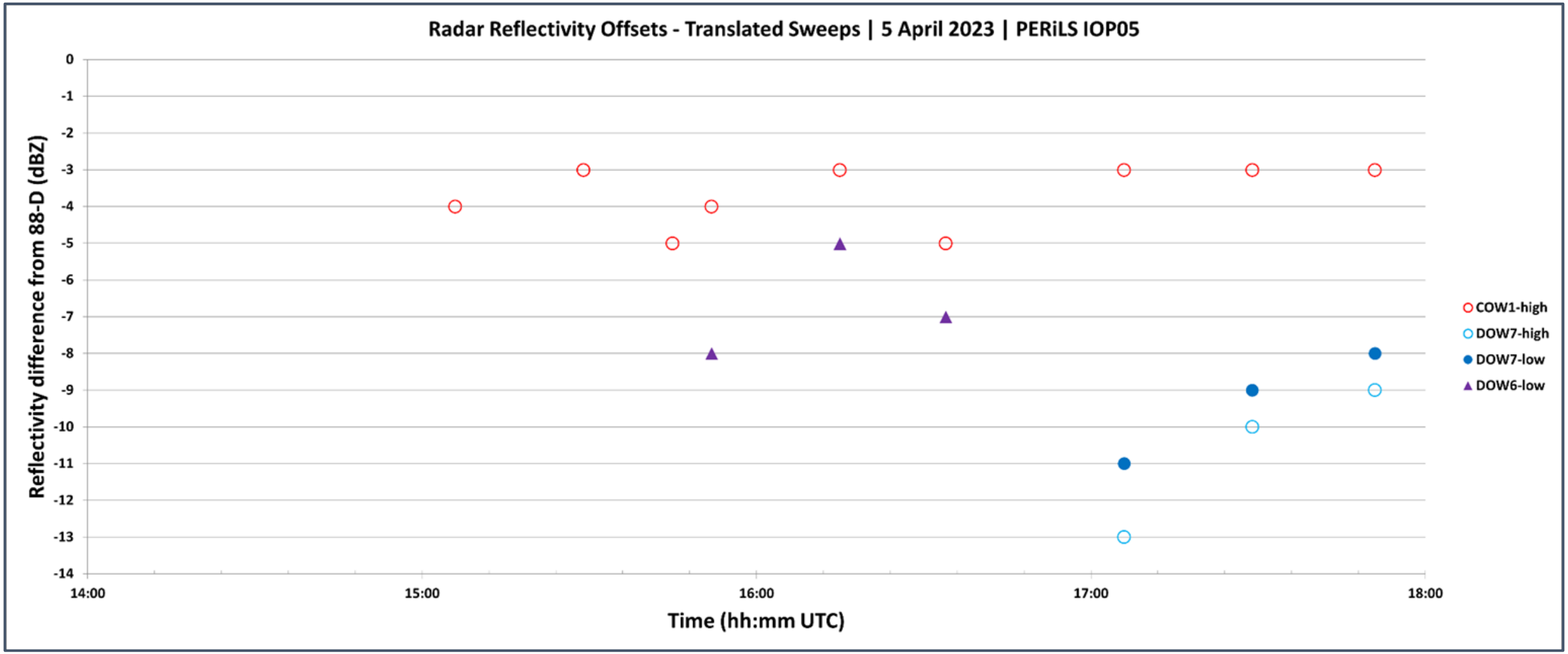


WSR-88D

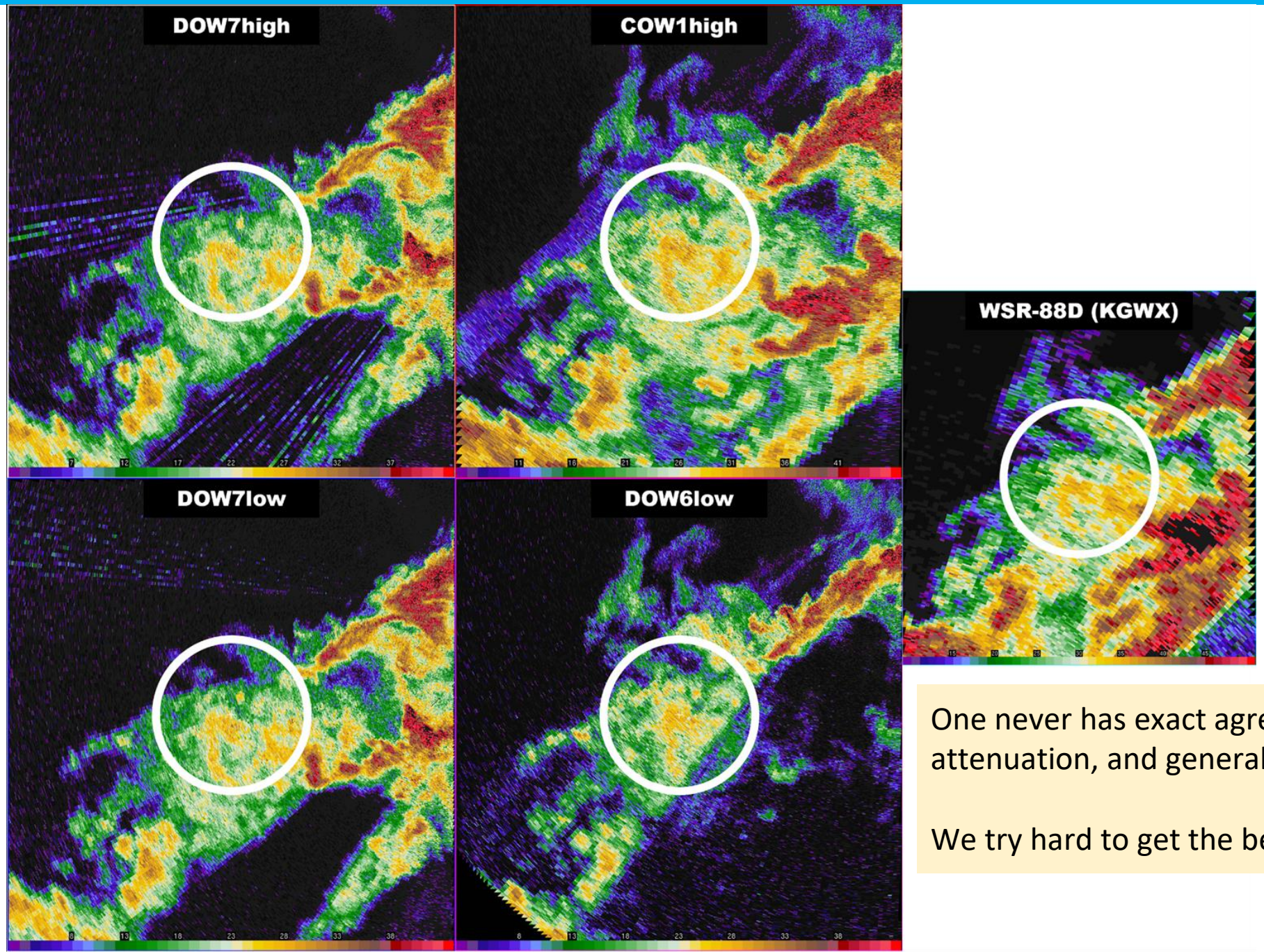


Z Correction/Calibration: Example from PERiLS 2023 IOP05

Decide a tolerance (+/-2 dBZ, for example) and apply an offset for particular time intervals



Z Correction/Calibration: Result



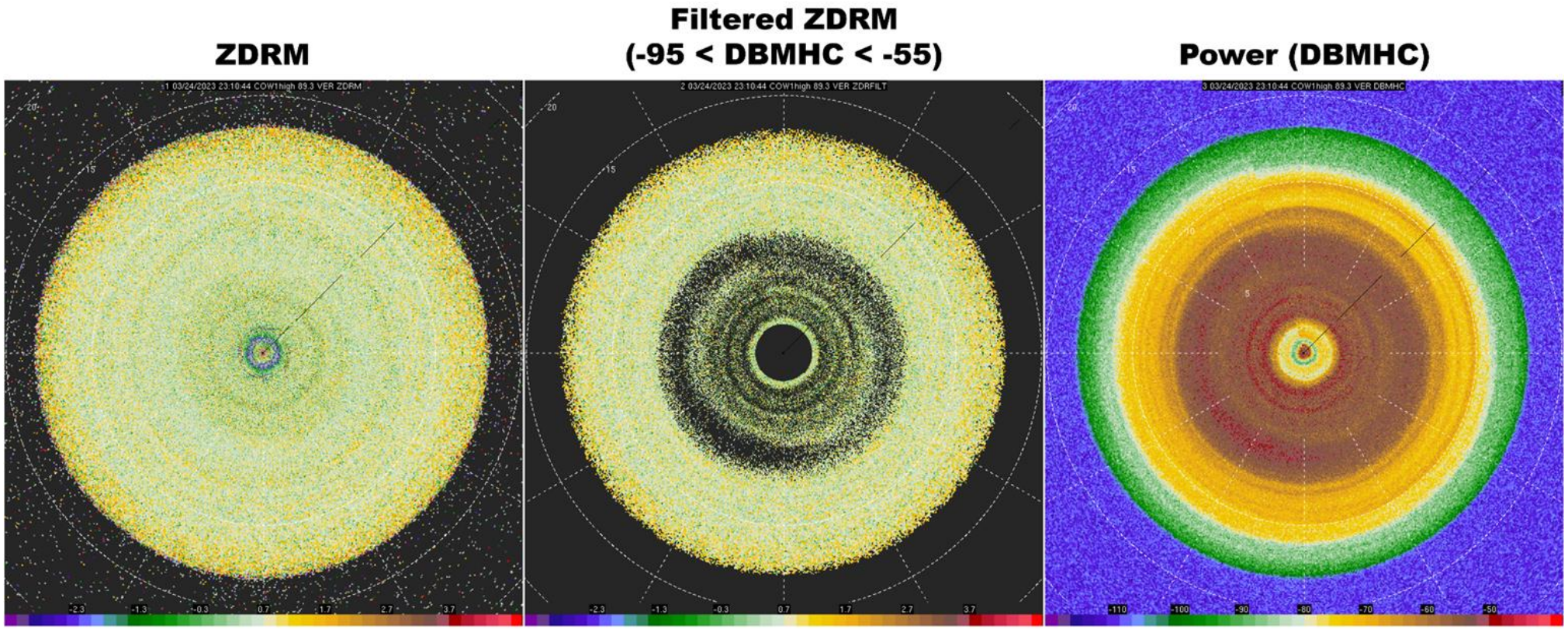
One never has exact agreement, due to geometry, attenuation, and general “radar-ness”

We try hard to get the best, consensus, Z values.

ZDR Correction/Calibration:

- Vertical (VER) scans in moderate precipitation every ~12 minutes
- In linear response region of receiver (-95 to -55 dB)
- Histogram of filtered ZDRM to get offset - find median
- Do for all radars/all frequencies AND cross check

Assumption: Hydrometeors/cloud particles have ∫ ZDR = 0 dB at vertical incidence (e.g. Gorgucci et al. 1999)



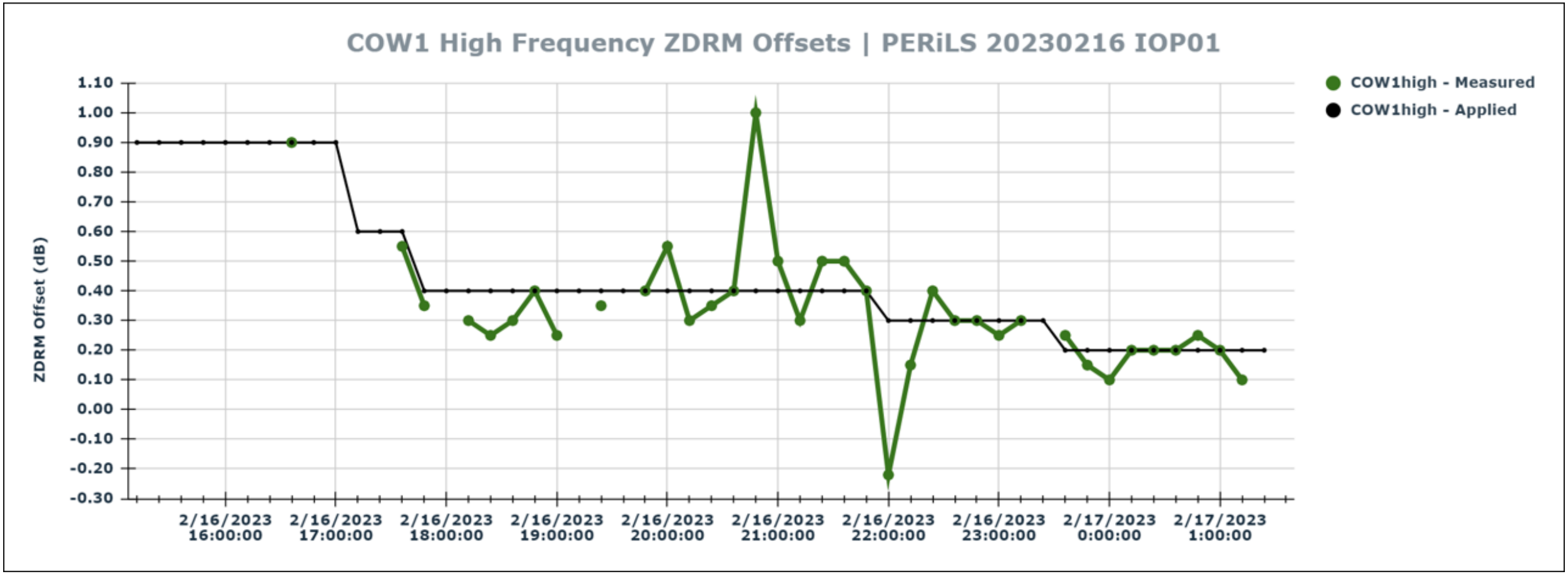

```
Message:      3.65 H
Message:      3.75 H
Message:      3.85 H
Finished!
Message: Counts Histogram in regular intervals of ZDRFILT
Message: From 03/06/2022 12:42:05.510 to 03/06/2022 12:42:17.553 for DOW7high
 at 89.0 deg.
Message:          Missing:      551 gates
Message:     Points below:       29 gates
Message:     Points above:      121 gates
Message: Points between:    42649 gates
Message:    Mean:      1.15
Message:    Sdev:      0.77
Message: Median:      1.15
Message:    Mode:      1.15
Message:              8       504      1000      1496      1992      2488
Message:              |         |         |         |         |         |

Message:     -1.95 H
Message:     -1.85 H
Message:     -1.75 H
Message:     -1.65 H
Message:     -1.55 H
Message:     -1.45 H
Message:     -1.35 H
Message:     -1.25 H
Message:     -1.15 H
Message:     -1.05 H
Message:     -0.95 H
Message:     -0.85 H
Message:     -0.75 HH
Message:     -0.65 HH
Message:     -0.55 HHH
Message:     -0.45 HHHH
Message:     -0.35 HHHHH
Message:     -0.25 HHHHHHH
Message:     -0.15 HHHHHHHHH
Message:     -0.05 HHHHHHHHHHH
Message:      0.05 HHHHHHHHHHHH
Message:      0.15 HHHHHHHHHHHHHHH
Message:      0.25 HHHHHHHHHHHHHHHHH
Message:      0.35 HHHHHHHHHHHHHHHHHHH
Message:      0.45 HHHHHHHHHHHHHHHHHHHHHHH
Message:      0.55 HHHHHHHHHHHHHHHHHHHHHHHHH
Message:      0.65 HHHHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      0.75 HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      0.85 HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      0.95 HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      1.05 HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      1.15 HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      1.25 HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      1.35 HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      1.45 HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      1.55 HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      1.65 HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      1.75 HHHHHHHHHHHHHHHHHHHHHHHHHHH
Message:      1.85 HHHHHHHHHHHHHHHHHHHHHH
Message:      1.95 HHHHHHHHHHHHHHHHHHH
Message:      2.05 HHHHHHHHHHHHHHHH
Message:      2.15 HHHHHHHHHHHHH
Message:      2.25 HHHHHHHHHHHH
Message:      2.35 HHHHHHHHH
Message:      2.45 HHHHHHH
Message:      2.55 HHHHHH
Message:      2.65 HHHHH
Message:      2.75 HHH
Message:      2.85 HH
Message:      2.95 H
Message:      3.05 HH
Message:      3.15 H
Message:      3.25 H
Message:      3.35 H
Message:      3.45 H
Message:      3.55 H
Message:      3.65 H
Message:      3.75 H
Message:      3.85 H
Finished!
```


E. Gorgucci, G. Scarchilli and V. Chandrasekar, "A procedure to calibrate multiparameter weather radar using properties of the rain medium," in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 37, no. 1, pp. 269-276, Jan. 1999, doi: 10.1109/36.739161

ZDR Correction/Calibration: Example from COW1 PERiLS 2023 IOP01

Decide a tolerance (+/-0.2 dB) and apply offsets for particular time intervals (volume by volume)

When measured ZDR offset > tolerance, these volumes are noted in READMEs (typically limited VER scan data for reliable offset)



READMEs

PROJECT NAME: PERiLS
IOP NAME: IOP01
IOP DATE: February 16 - 17, 2023

Author of README: Josh Aikins
Date of README: 8/18/2023

Radar Name: DOW7
Frequency: 9.35 GHz (low), 9.5 GHz (high)
File Format: dorade & cfradial netcdf
Date Translated: 7/7/2023

Number of Files: 2438 (high) + 2438 (low)
IOP Start Time (UTC): 16:39 2/16/2023
IOP End Time (UTC): 01:22 2/17/2023

Receiver Configuration:

Time (start – end)	Pulse Length (ns)	Gate Length (m)	Num. of Gates	Range (km)	Stagger	PRF (Hz)	Nyquist Velocity (m/s)
16:39:56 (2/16) – 01:22:13 (2/17)	500	75	1000	75	3/4	1666.7/ 1250	39.4 (high) 40.1 (low)

Scan Strategies:

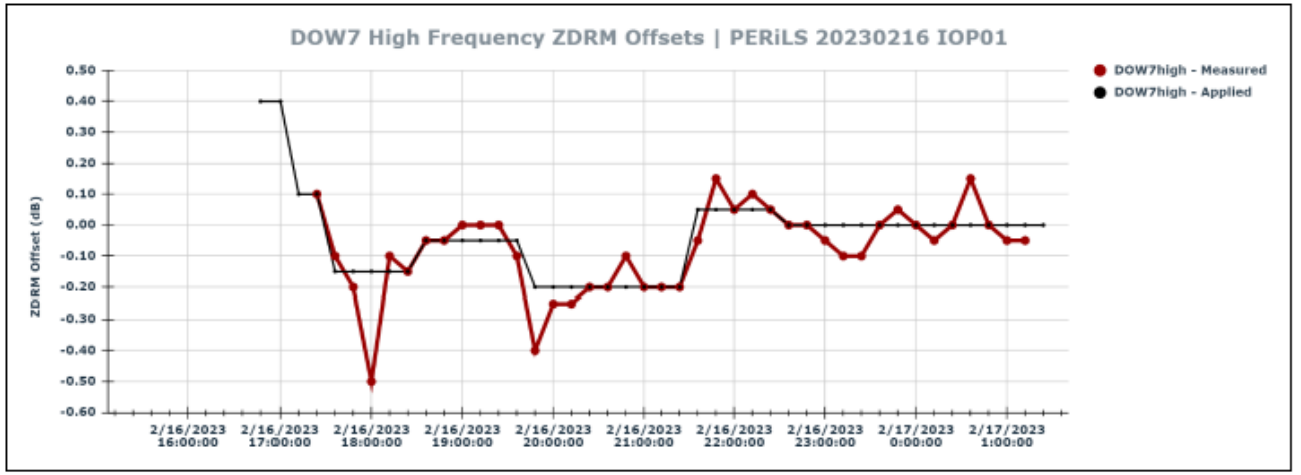
Time (start – end)	Regime / Scan ID	Rotation Rate	Sync	Vol. per sync	Elevation Angles	Azimuth Angles
16:39:56 (2/16) – 01:22:13 (2/17)	vol6m30 + vol31s + vertpos + Sync	30 - 31 deg/s SUR 50 deg/s VER	12 min	3	0.5° - 9.5° SUR (x27) 0.5° - 9.5° SUR (x27) 89° VER (x2)	0° - 360°

HEADERS / NAVIGATION

Latitude:	32.711021 N	Obtained from GPS + verified with Google Earth
Longitude:	88.172447 W	Obtained from GPS + verified with Google Earth
Altitude:	53 m	Approximated using Google Earth + USGS 3DEP
Heading:	276.7 deg	Solar Alignment + Clutter

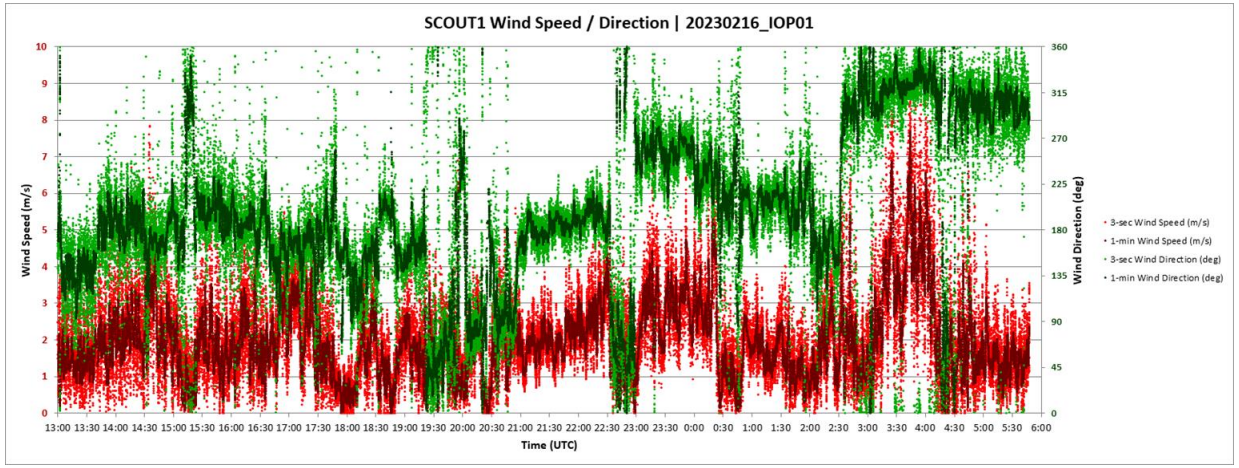
Applied ZDR Offset Corrections:

Time Start	Time End	ZDR Corrections (High)
02/16/2023 16:36:00	02/16/2023 16:59:59	-0.40
02/16/2023 17:00:00	02/16/2023 17:23:59	-0.10
02/16/2023 17:24:00	02/16/2023 18:23:59	0.15
02/16/2023 18:24:00	02/16/2023 19:35:59	0.05
02/16/2023 19:36:00	02/16/2023 21:23:59	0.20
02/16/2023 21:24:00	02/16/2023 22:23:59	-0.05
02/16/2023 22:24:00	02/17/2023 01:23:59	0.00



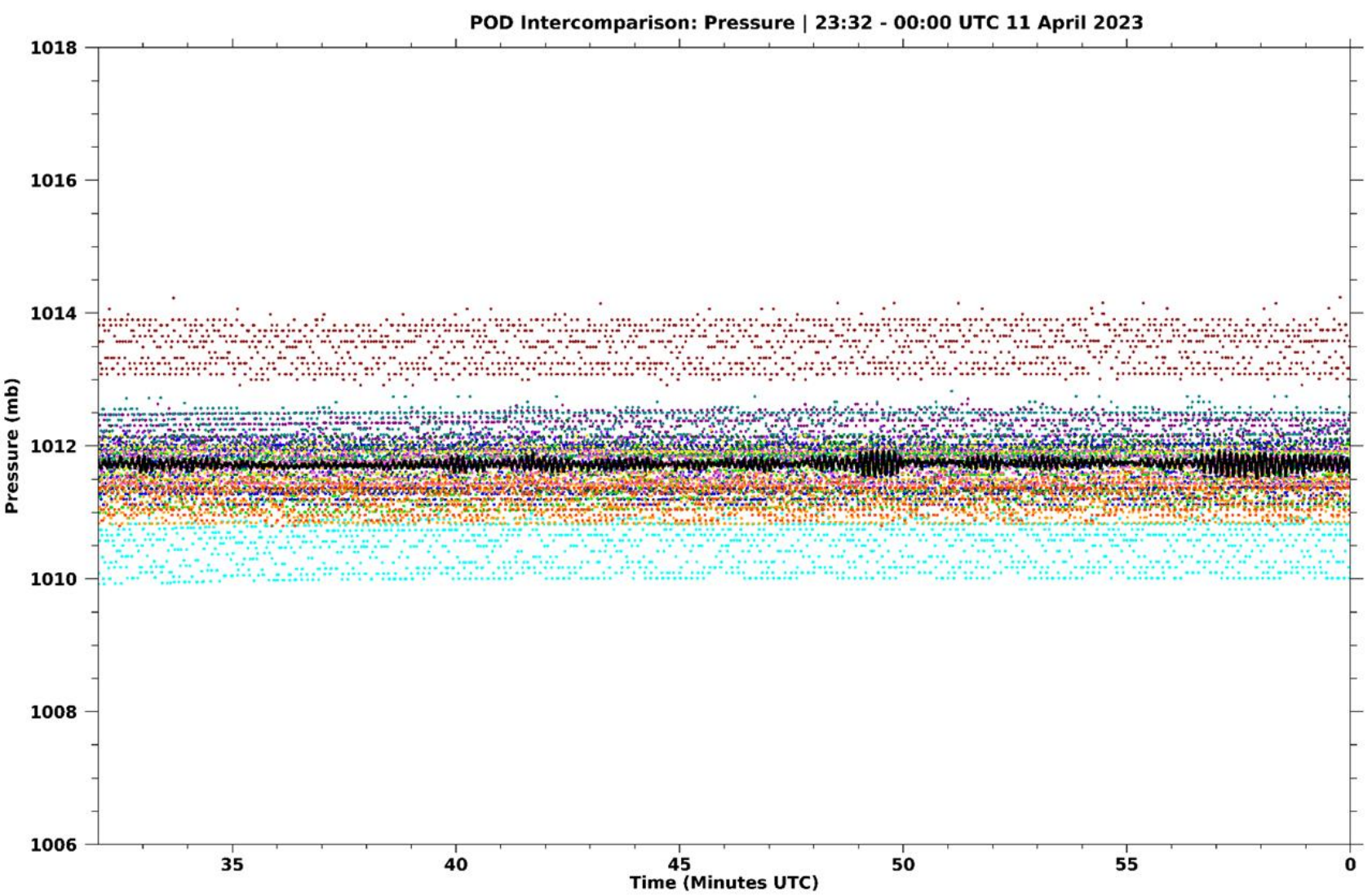
POD/Mesonet Data QC

- Trim data file to deployment period
  - POD: stationary deployment
  - MM: stationary + driving deployment (parking lot to parking lot)
- Import into EXCEL template
  - Input blade anemometer offset
  - Input POD/MM heading
  - Input pressure correction
  - SPECIAL: Replace blade anemometer wind data with sonic (if needed)
  - Wind directions fixed to True North (calculates U & V components)
  - Computes 1-sec, 3-sec, & 1-min centered averaged winds



U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
Stationary Threshold -->			1		Anemometer Offset -->		176.3				Pressure Offset-->	0														
					Blade Anemometer Spd/Dir Correction								Latitude	Longitude	1-sec	1-sec	1-sec	3-sec	3-sec	3-sec	3-sec	1-min	1-min	1-min	1-min	Corr
Heading	Heading	Stationary	Transect		Wind Dir Corr	Veh Spd	U obs	V obs	U veh	V veh	U true	V true			Wind Spd	Wind Spd	Wind Dir	U	V	Spd	Dir	U	V	Spd	Dir	Pressure
Override	Final				deg	m/s	m/s	m/s	m/s	m/s	m/s	m/s	dec	dec	m/s	kts	deg	m/s	m/s	m/s	deg	m/s	m/s	m/s	deg	mb
270	270	1	0		128.19	0.00	-3.24	2.54	0.00	0.00	-3.24	2.54	33.45481	-88.80888	4.1	8.0	128.2									997.8684
270	270	1	0		123.98	0.00	-3.25	2.19	0.00	0.00	-3.25	2.19	33.45481	-88.80888	3.9	7.6	124.0	-3.05	1.45	3.4	115.5					997.9496
270	270	1	0		81.9	0.00	-2.66	-0.38	0.00	0.00	-2.66	-0.38	33.45481	-88.80888	2.7	5.2	81.9	-2.38	0.80	2.5	108.7					997.9496
270	270	1	0		116.04	0.00	-1.23	0.60	0.00	0.00	-1.23	0.60	33.45481	-88.80888	1.4	2.7	116.0	-2.26	1.05	2.5	115.0					997.9496

POD Intercomparison: Pressure Offsets



POD_O | -0.04 +/- 0.18
POD_N | 1.77 +/- 0.28
POD_M | -0.51 +/- 0.18
POD_L | -0.54 +/- 0.22
POD_K | 0.02 +/- 0.21
POD_J | 0.48 +/- 0.28
POD_I | -0.21 +/- 0.29
POD_H | 0.04 +/- 0.30
POD_G | -1.26 +/- 0.30
POD_F | -0.14 +/- 0.30
POD_E | -0.05 +/- 0.30
POD_D | 0.04 +/- 0.29
POD_B | 0.39 +/- 0.29
POD mean | bias +/- 1SD

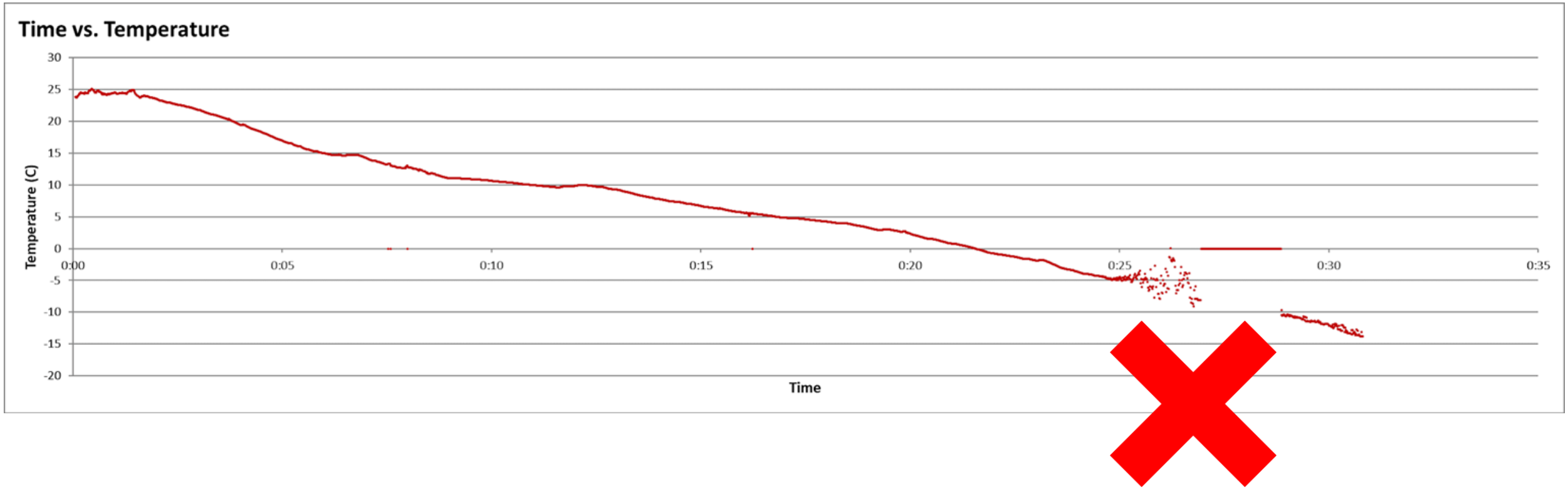
IOP Start/Stop Times

Soundings: QC Overview

- L0
  - Field Data Collection (GRAWMET Run 1)
  - Raw Time Series Analysis
  - Initial Conditions Verification (mistakes are made sometimes)
  - GRAWMET Run 2
  - Convert to CSV & remove descent data
- L1
  - Run through ASPEN Quality Control software (NCAR) - Removes bad data (new 2023!)
  - Output EOL formatted sounding file
  - Output ASPEN SkewT plots
  - Correct EOL file headers
- L2
  - Use modified FORTRAN scripts to interpolate EOL soundings to constant height (Hgt) and pressure (Prs) sounding files
  - Add objective QC flags (super-adiabatic T/Td, descent)
  - Add additional QC flags manually (visually bad/questionable) – data gaps, T/Td spikes (sensor failures)
  - Convert Hgt sounding files to SPC format
  - Ingest SPC soundings into SHARPpy & output skewT, hodograph, & indices
- README, User Guide, detailed QC overview available

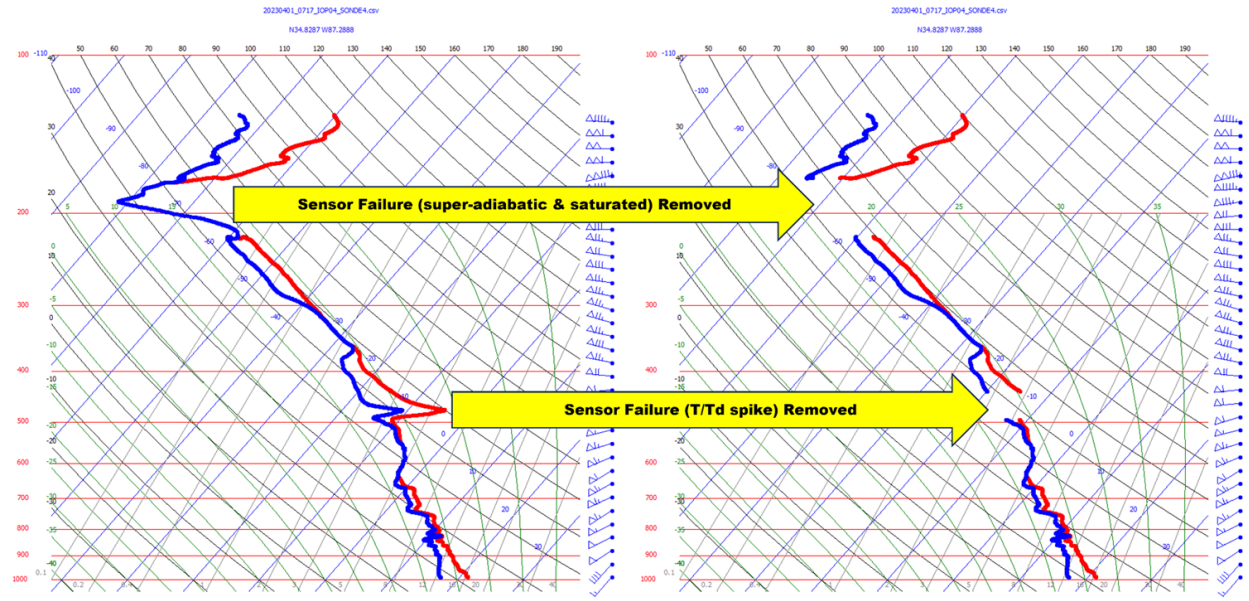
L0 - Raw Time Series Analysis

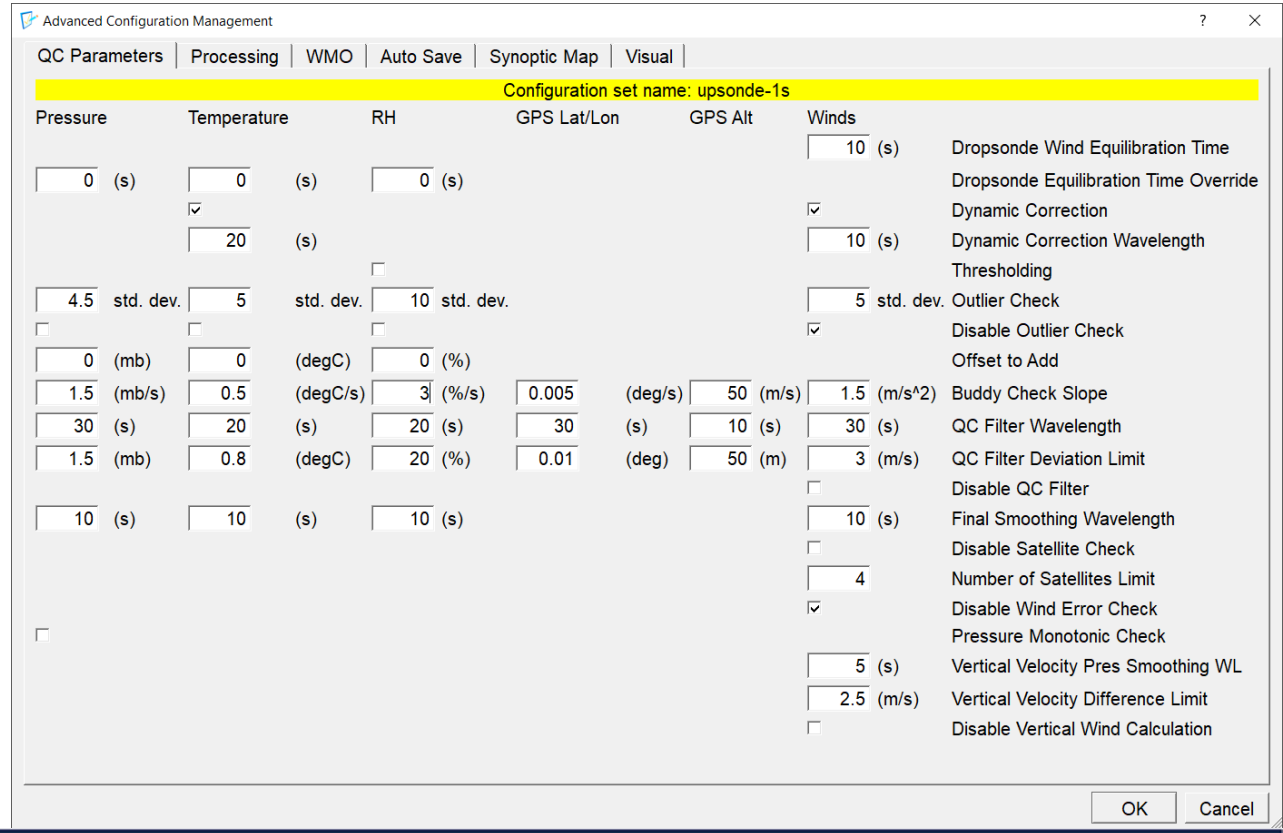
- T sensor failure example



L1 – ASPEN QC

- Atmospheric Sounding Processing Environment (ASPEN)
  - https://www.eol.ucar.edu/content/aspen
  - Outlier, buddy, limit, filter checks
  - Smoothing
  - Remove bad T/Td layers (sensor failures)

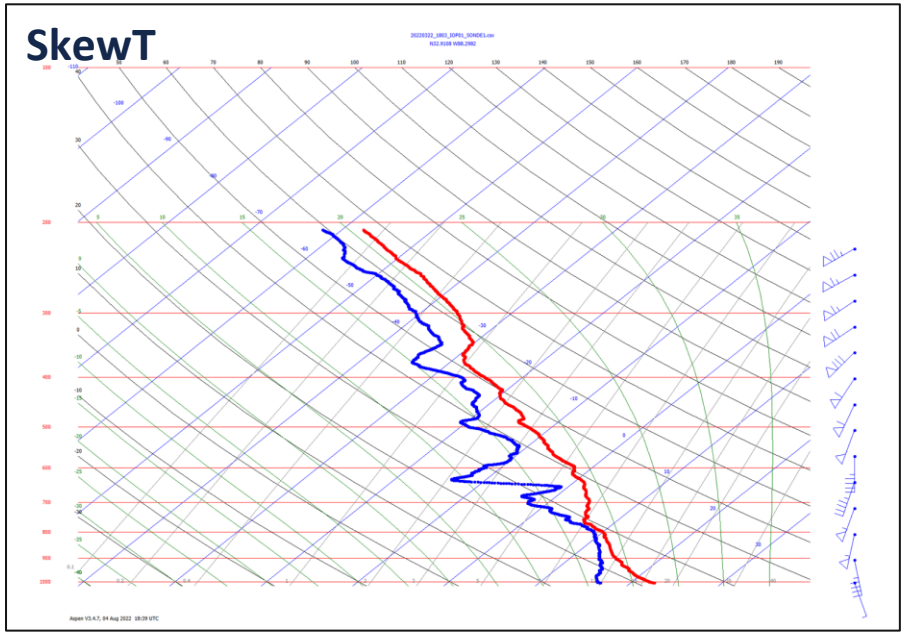




L1 – ASPEN QC

- Output:
  - EOL sounding file
  - SkewT plot
  - Summary PDF

SkewT



EOL

```
Data Type/Direction:                    FARM Mobile Radiosonde/Ascending
File Format/Version:                    EOL Sounding Format/1.1
Project Name/Platform:                  PERiLS/FARM_Mobile
Launch Site:                            SONDE1
Launch Location (lon,lat,alt):          88 17.89'W -88.298150, 32 54.65'N 32.910800,    49.10
UTC Launch Time (y,m,d,h,m,s):          2022, 03, 22, 18:03:37
Sonde Id/Sonde Type:                    18043739/GRAW DFM-09
Reference Launch Data Source/Time:      unknown/unknown
System Operator/Comments:               /
Post Processing Comments:               Aspen V3.4.7; Created on 04 Aug 2022 18:36 UTC; Configuration editsonde
/
  Time    -- UTC  --    Press    Temp    Dewpt    RH     Uwind    Vwind    Wspd     Dir      dZ     GeoPoAlt     Lon          Lat        GPSAlt
   sec    hh mm   ss      mb       C       C       %      m/s      m/s      m/s      deg      m/s       m          deg          deg         m
-------- -- -- ----- -------- ------- ------- ------- -------- -------- -------- -------- -------- --------- ----------- ----------- --------
   -1.00 18  3 36.00 1003.60   22.50   16.63   69.00   -1.74     4.79     5.10   160.00  -999.00    49.10   -88.298150   32.910800  -999.00
    0.00 18  3 37.00 1003.40   22.35   16.48   68.97   -1.74     4.80     5.11   160.05     3.45    50.88   -88.298150   32.910800    49.10
    1.00 18  3 38.00 1002.96   22.25   16.38   68.97   -1.80     4.88     5.21   159.74     3.80    54.62   -88.298190   32.910860    53.80
    2.00 18  3 39.00 1002.48   22.16   16.30   68.97   -1.88     4.98     5.32   159.37     4.22    58.87   -88.298220   32.910930    58.60
    3.00 18  3 40.00 1001.94   22.09   16.24   69.03   -1.96     5.09     5.46   158.95     4.54    63.48   -88.298260   32.910990    63.40
    4.00 18  3 41.00 1001.39   22.01   16.20   69.16   -2.05     5.21     5.60   158.55     4.74    68.26   -88.298290   32.911050    68.20
    5.00 18  3 42.00 1000.84   21.94   16.18   69.37   -2.14     5.33     5.74   158.17     4.82    73.09   -88.298330   32.911120    73.00
    6.00 18  3 43.00 1000.28   21.88   16.17   69.62   -2.22     5.45     5.89   157.81     4.83    77.92   -88.298370   32.911180    77.80
    7.00 18  3 44.00  999.73   21.83   16.17   69.83   -2.31     5.57     6.03   157.49     4.79    82.71   -88.298400   32.911250    82.60
    8.00 18  3 45.00  999.19   21.78   16.15   69.95   -2.39     5.69     6.17   157.24     4.76    87.46   -88.298440   32.911310    87.30
    9.00 18  3 46.00  998.64   21.73   16.12   69.99   -2.47     5.81     6.31   157.00     4.77    92.17   -88.298470   32.911370    92.10
   10.00 18  3 47.00  998.10   21.69   16.08   70.01   -2.55     5.93     6.46   156.74     4.82    96.87   -88.298510   32.911440    96.90
```

Summary

Description

- 20220322_1803_IOP01_SONDE1.csv

Processing Steps

- QC processing completed (in less than 1.0s)
- Levels created (in less than 1.0s)
- WMO message coded (in less than 1.0s)
- Tabs updated (in 3.0s)
- Levels created (in 1.0s)

QC Data Recovery Statistics

- 2826 raw data records
- pres : input file reported 2826 (100.0%) values, QC retained 2826 (100.0%), overall rate: 100.0%
- tdry : input file reported 2826 (100.0%) values, QC retained 2826 (100.0%), overall rate: 100.0%
- RH : input file reported 2826 (100.0%) values, QC retained 2826 (100.0%), overall rate: 100.0%
- winds: input file reported 2826 (100.0%) values, QC retained 2826 (100.0%), overall rate: 100.0%

QC Height Integration

- Downward integration starts @ 49.1m

QC for GPS Altitude

- Points which failed the limit check: 0
- Sats check not applied.
- Points which failed the buddy check: 0
- Points which failed the Q/C filter check: 0

L2 – Constant Hgt & Prs Interpolation + QC Flags

- Following Ciesielski et al. (2012):
  - Run modified FORTRAN scripts (webpage) on EOL sounding file
  - Output sounding data with constant height interpolation (5 m)
  - Output sounding data with constant pressure interpolation (1 mb)
  - Add quality control flags for pressure, height, temperature, dewpoint, & winds

- Objective QC checks
  - Super-adiabatic layers (T/Td < -15°/km) → flag = 2
  - Non-hydrostatic check (Height decreases) → flag = 2

STN	DATE	GMT	HTS	LAT	LON							
SONDE1	20220322	1803	49	32.91080	-88.29815							
NLVL =2372												
P	HT	TC	TD	DIR	SPD	QP	QH	QT	QD	QW	LON	LAT
1003.6	49.1	22.50	16.63	160.04	5.10	1	1	2	2	1	-88.29815	32.91080
1003.5	50.0	22.42	16.55	160.06	5.10	1	1	2	2	1	-88.29815	32.91080
1002.9	55.0	22.24	16.37	159.71	5.21	1	1	2	2	1	-88.29819	32.91087
1002.3	60.0	22.14	16.29	159.22	5.36	1	1	2	2	1	-88.29823	32.91095
1001.8	65.0	22.06	16.23	158.80	5.50	1	1	2	1	1	-88.29827	32.91101
1001.2	70.0	21.98	16.19	158.38	5.65	1	1	2	1	1	-88.29830	32.91108
1000.6	75.0	21.92	16.18	158.01	5.80	1	1	1	1	1	-88.29835	32.91114
1000.0	80.0	21.86	16.17	157.68	5.95	1	1	1	1	1	-88.29839	32.91121

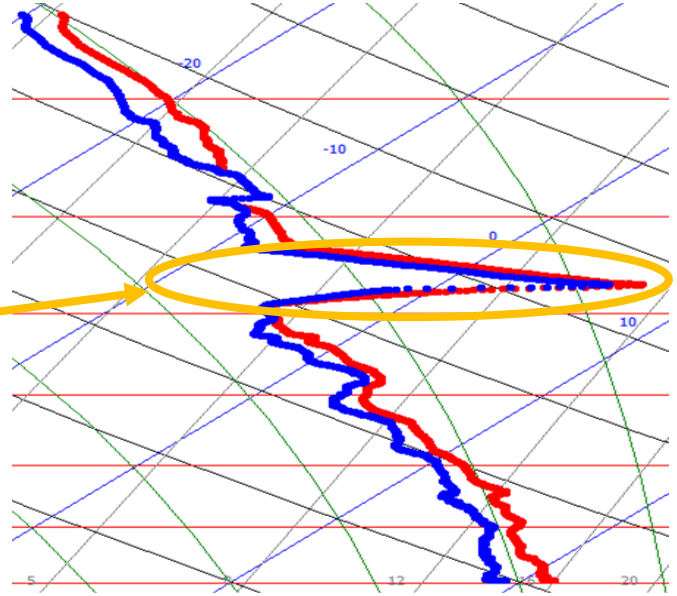
L2 Hgt

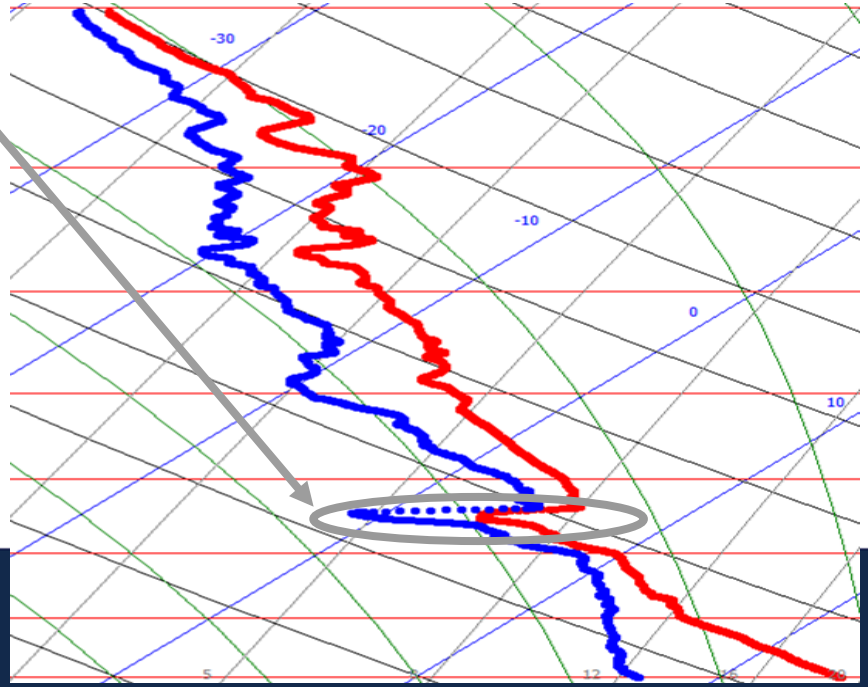
Flag	Meaning
1	parameter good
2	parameter objectively questionable
3	parameter visibly questionable
4	parameter objectively bad
5	parameter visibly bad
6	parameter interpolated
7	parameter estimated
8	parameter unchecked
9	parameter omitted/missing

Ciesielski, P. E., Haertel, P. T., Johnson, R. H., Wang, J., & Loehrer, S. M. (2012). Developing High-Quality Field Program Sounding Datasets, *Bulletin of the American Meteorological Society*, **93(3)**, 325-336. https://doi.org/10.1175/BAMS-D-11-00091.1

L2 – Visual QC Flags

- Add visual QC checks
  - T/Td “spikes” from sensor failures → flag = 5 (now removed by ASPEN, new 2023)
  - Missing height/pressure/GPS from RTS → flag = 3
  - T/Td near saturation in tropopause → flag = 3
  - Super-adiabatic layers likely affected by evaporation of wet sensor → flag = 3 (where not already flag = 2)





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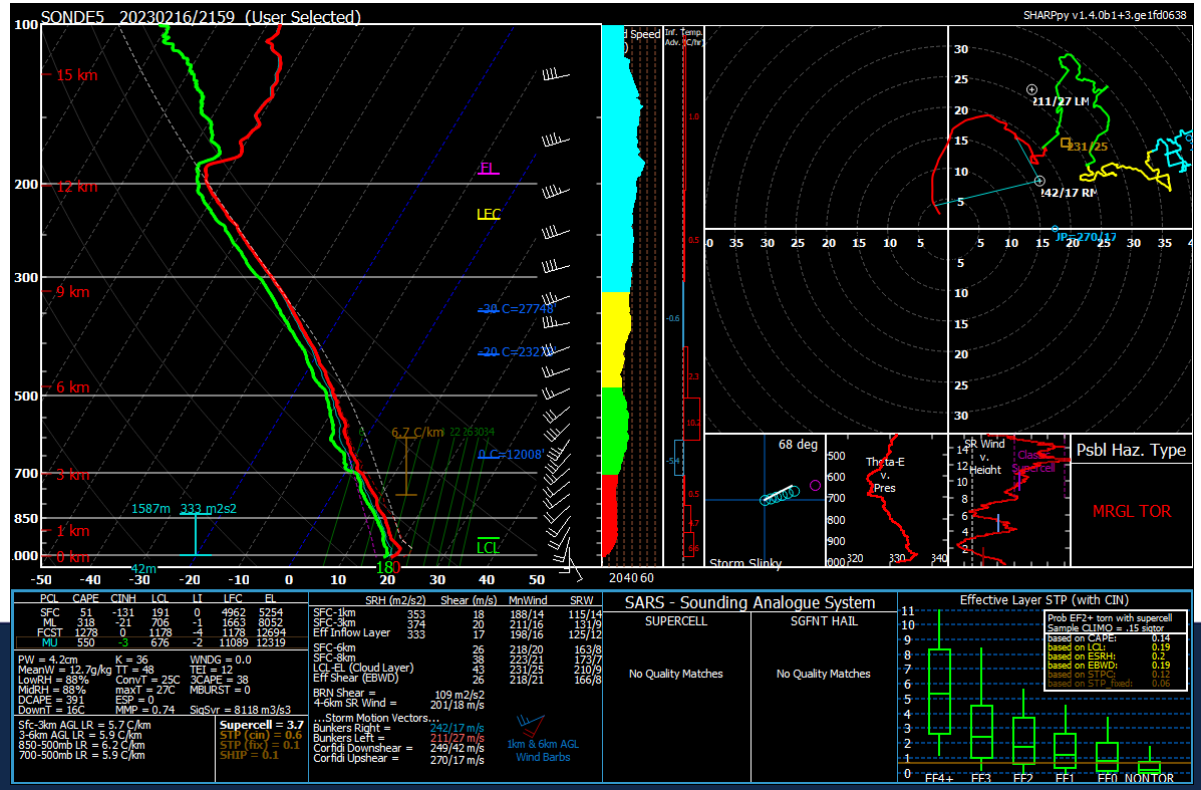
L2 – SPC+SHARPpy SkewT Plots

- Python script converts L3 Hgt sounding file to SPC format (keeps questionable data, removes bad data)
- Ingest SPC formatted sounding data into SHARPpy & output SHARPpy skewT plots with indices & hodographs.
  - https://github.com/sharppy/SHARPpy/blob/main/README.md
  - Currently using v1.4.0b1 binary (works on Windows 10)



Sounding README

- A README document is created for each Vehicle ID:
  - # of launches
  - Launch details (launch times UTC, location, ascent rate, max altitude, termination time)
  - Launch notes from the field
  - QC notes (issues found during QC process)
  - Brief QC methodology

PROJECT NAME: PERiLS
SOUNDING TEAM: SONDE3
IOP NAME: IOP01
IOP DATE: February 16 -17, 2023

Author of README: Paul Robinson & Josh Aikins
Date of README: 10/30/2023

Number of Launches: 6
Start-End Time (UTC): 16:30:08 UTC (02/16) – 00:56:55 UTC (02/17)

Radiosonde Type: GRAW DFM-09
Balloon Type: Kaymont 150 (150 g)
Processor: GRAWMET 5.16 software

LAUNCH TABLE

Launch Number	Launch Time (UTC)	Latitude (deg)	Longitude (deg)	Altitude (m)	Ascent Rate (m/s) (sfc-3km AGL)	Maximum Altitude (m)	Termination Time (UTC)
1	16:30:08	32.473000	-88.094503	45	4.0	13063	17:35:27
2	17:56:19	32.473000	-88.094503	45	5.1	17389	18:53:41
3	19:59:38	32.473000	-88.094503	45	4.7	11309	20:44:57
4	21:00:08	32.473000	-88.094503	45	5.5	15746	21:59:15
5	00:00:19	32.473000	-88.094503	45	4.7	13109	00:41:36
6	00:56:55	32.473000	-88.094503	45	5.8	20652	02:04:12

LAUNCH NOTES

Launch 1: None.
Launch 2: None.
Launch 3: None.
Launch 4: None.
Launch 5: None.
Launch 6: None.

QUALITY CONTROL NOTES

Launch 1: The launch start time was adjusted by -6 seconds to 14:51 (elapsed time in mm:ss) in the time series data. Temperature and dewpoint were manually flagged as visually questionable during a temperature rebound layer 2895 - 3355 m (720 - 681 mb) directly above an objectively questionable super-adiabatic layer likely influenced by evaporative cooling as the sensor exited a moist cloud layer and entered dry air.

Disdrometers

Simple conversion from ATM4 format (88 lines per record) to CSV (one record per line)

Raw 10-s resolution data provided

ATM4

```
01:0000.000
02:0000.00
03:00
04:00
05:   NP
06:   C
07:-9.999
08:20000
09:00010
10:21710
11:00000
12:022
13:450123
14:2.11.2
15:2.11.1
16:0.00
17:12.3
18:0
19::36:42 3/3/2021 2
20:17:48:20
21:22.03.2022
22:FARM_P2S02
23:S02
34:0000.00
35:0000.00
```

CSV

```
Date/Time String, Station Name, Station Number, PARSIVEL Rain Intensity, PARSIVEL Rain Accumulation, Wx Code SYNOP wawa, Wx Code SYNOP ww, Wx Code META
yyyy-mm-dd hh:mi:ss UTC, xxxxxxxxxx, xxxx, mm/h, mm, Table 4680, Table 4677, Table 4678, see NWS, dBZ, m, s, 1, 1, deg C, xxxxxx, x.xx.x, x.xx.x, Amps,
2022-03-22 17:48:20, FARM_P2S02, S02, 0.000, 0.00, 00, 00, NP, C, -9.999, 20000, 10, 21710, 0, 22, 450123, 2.11.2, 2.11.1, 0.00, 12.3, 0, 0.000, -9.999
2022-03-22 17:48:30, FARM_P2S02, S02, 0.000, 0.00, 00, 00, NP, C, -9.999, 20000, 12, 21702, 0, 22, 450123, 2.11.2, 2.11.1, 0.00, 12.3, 0, 0.000, -9.999
2022-03-22 17:48:40, FARM_P2S02, S02, 0.000, 0.00, 00, 00, NP, C, -9.999, 20000, 10, 21708, 0, 22, 450123, 2.11.2, 2.11.1, 0.00, 12.3, 0, 0.000, -9.999
2022-03-22 17:48:50, FARM_P2S02, S02, 0.000, 0.00, 00, 00, NP, C, -9.999, 20000, 10, 21711, 0, 22, 450123, 2.11.2, 2.11.1, 0.00, 12.3, 0, 0.000, -9.999
2022-03-22 17:49:00, FARM_P2S02, S02, 0.000, 0.00, 00, 00, NP, C, -9.999, 20000, 10, 21819, 0, 22, 450123, 2.11.2, 2.11.1, 0.00, 12.3, 0, 0.000, -9.999
2022-03-22 17:49:10, FARM_P2S02, S02, 0.000, 0.00, 00, 00, NP, C, -9.999, 20000, 10, 21710, 0, 22, 450123, 2.11.2, 2.11.1, 0.00, 12.3, 0, 0.000, -9.999
2022-03-22 17:49:20, FARM_P2S02, S02, 0.000, 0.00, 00, 00, NP, C, -9.999, 20000, 10, 21707, 0, 22, 450123, 2.11.2, 2.11.1, 0.00, 12.2, 0, 0.000, -9.999
2022-03-22 17:49:30, FARM_P2S02, S02, 0.000, 0.00, 00, 00, NP, C, -9.999, 7094, 10, 21821, 0, 22, 450123, 2.11.2, 2.11.1, 0.00, 12.2, 0, 0.000, -9.999,
2022-03-22 17:49:40, FARM_P2S02, S02, 0.000, 0.00, 00, 00, NP, C, -9.999, 5426, 10, 21717, 0, 22, 450123, 2.11.2, 2.11.1, 0.00, 12.2, 0, 0.000, -9.999,
2022-03-22 17:49:50, FARM_P2S02, S02, 0.000, 0.00, 00, 00, NP, C, -9.999, 16502, 10, 21713, 0, 22, 450123, 2.11.2, 2.11.1, 0.00, 12.2, 0, 0.000, -9.999
2022-03-22 17:50:00, FARM_P2S02, S02, 0.000, 0.00, 00, 00, NP, C, -9.999, 19160, 10, 21721, 0, 22, 450123, 2.11.2, 2.11.1, 0.00, 12.2, 0, 0.000, -9.999
```

All FARM data from PERILS 2023 have been released (and 2022, of course)

2023 Radar data: COW1, DOW6, DOW7

Wurman, J., & Kosiba, K. (2023). *PERILS 2023 radar data (Version 1)* [Data set]. Flexible Array of Radars and Mesonets (FARM), University of Illinois. https://doi.org/10.48514/K7WX-NP56

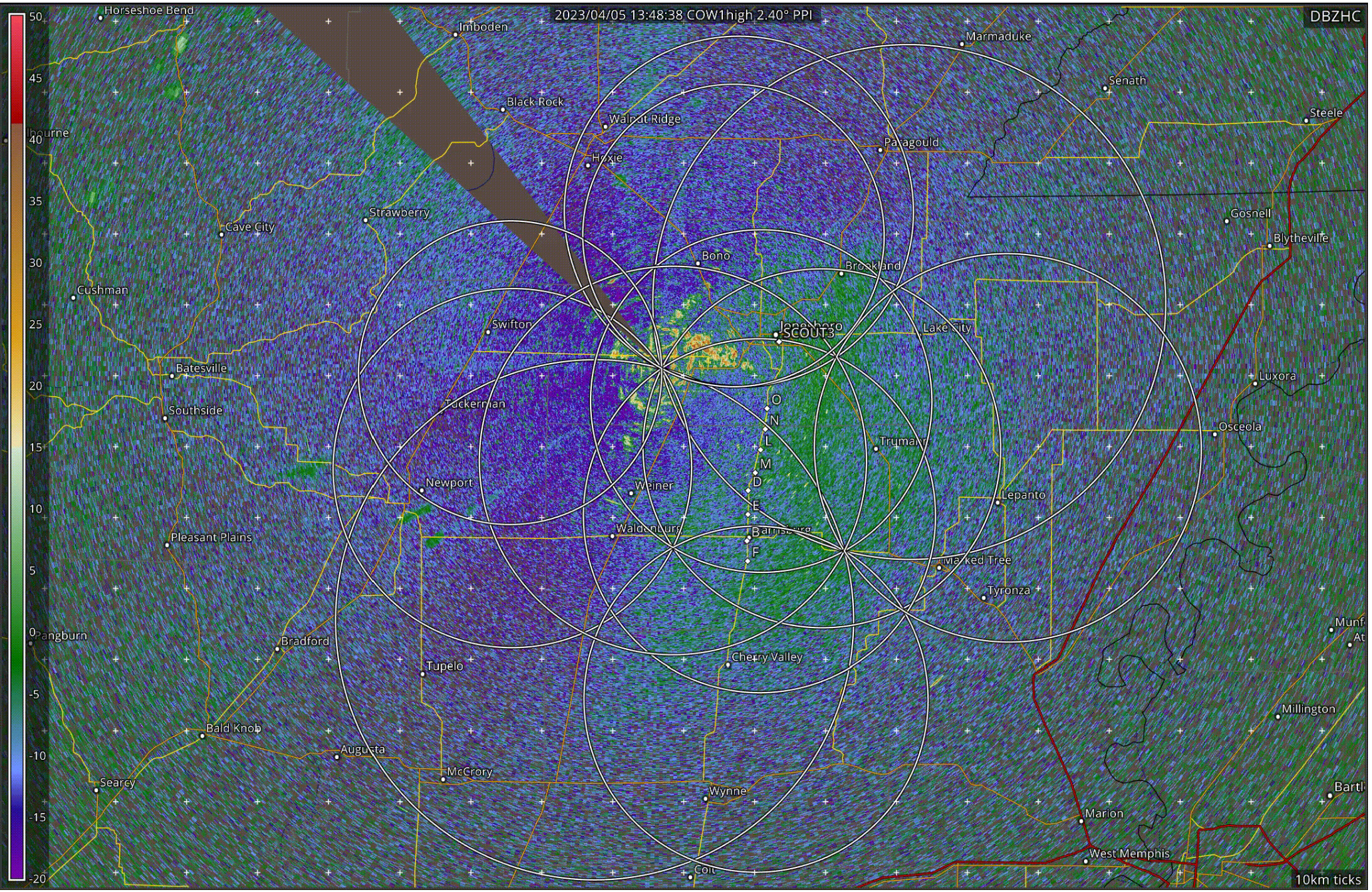
2023 Non-Radar data: MM, PODs, Disdrometers, Soundings, DOW meteorological masts:

Wurman, J., & Kosiba, K. (2023). *PERILS 2023 Mobile Mesonet, Sounding, Pod, and Disdrometer Data (Version 1)* [Data set]. Flexible Array of Radars and Mesonets (FARM), University of Illinois. https://doi.org/10.48514/S52C-MH37

Data for PERILS and other projects are available at:
https://publish.illinois.edu/dowfacility-upgrade/farm-data/

*Customized data (e.g. different indexing, raw I,Q time series, by request)

If you have questions relating to data, please contact the FARM Data Manager: **Josh Aikins (jaikins@illinois.edu)**



GURU2 Deployment Loops