Producing Calibrated Radar Wind Profiler (RWP) Precipitation Products

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Motivation

Radar Wind Profiler (RWP) observations can be divided into two meteorological regimes: rain-free and rainy periods.

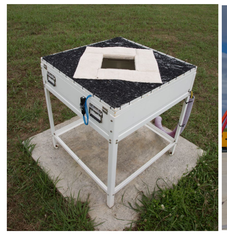
During rain-free periods, RWP observations are used to estimate horizontal wind and boundary layer structures.

During periods with rain, the vertical beam observations are used to study precipitation vertical structure.

However, the real-time RWP manufacturer processing routines are focused on producing rain-free radar products and do not produce calibrated products for precipitation research.

Therefore, this ASR Data Product project developed code to reprocess raw RWP observations specific for rain periods with cross-calibration against surface disdrometer observations.

Surface 2-Dimensional Video Disdrometer

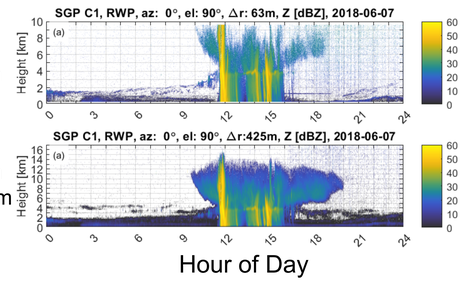


Radar Wind Profiler (RWP) at ENA

Precipitation Mode (Vertically Pointing Beams)

Short-Pulse
Δr = 60 m
Spacing = 60 m

Long-Pulse
Δr = 425 m
Spacing = 212 m



This poster highlights four outcomes from this ASR Data Product project:
1. Highlight key features of the RWP calibration procedure
2. Describe where to find 10-years of calibrated RWP data stored on the ARM Archive.
3. Describe where to find the Python code that performs this calibration
4. Describe the status of transferring PI generated code to the ARM Infrastructure so that ARM can produce calibrated RWP data at different RWP sites.

2. Calibrated RWP Data on ARM Archive

The calibration procedure was applied to over **10-years of RWP observations** at the Southern Great Plains (SGP) Central Facility (C1). The calibrated RWP products have been uploaded to the public ARM archive as a PI product and can be accessed here: https://doi.org/10.5439/1969962

3. Python Code

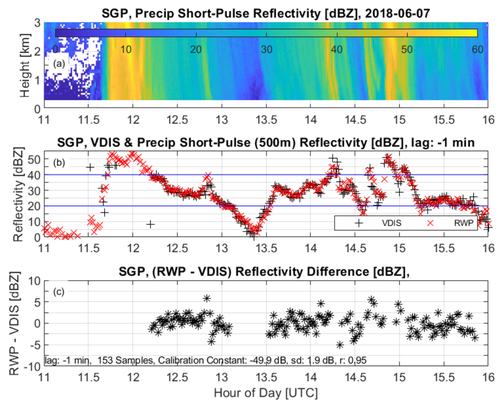
As required for this ASR Data Product project, the Python code is made available to the research community and can be found here: https://github.com/ChristopherRWilliams/RWP_Python_moments

4. Transferring PI code to the ARM Infrastructure

The developed Python code has been transferred to the ARM Infrastructure and is being implemented as a b1 RWP product available on the ARM Discovery Tool. The transfer process is almost complete. If you have access to ARM ServiceNow, you can view the status of this new product here:
ARM Service Now, Engineering Order Number: ENG0004503.

1. RWP Calibration Procedure

Calibrating an Individual Rain Event



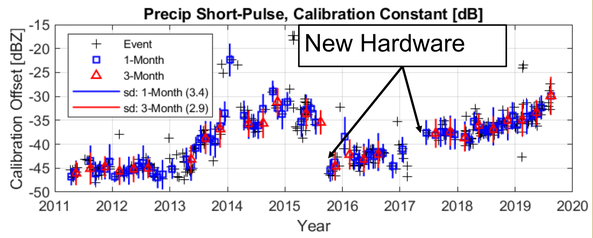
Calibrating Short-Pulse Beam
For every rain event, the **Short-Pulse** RWP radar reflectivity factor at 500 m is compared with surface disdrometer reflectivity factor.

The RWP calibration constant is adjusted until the RWP and disdrometer reflectivity factors agree.

Each rain event has a unique RWP calibration factor.

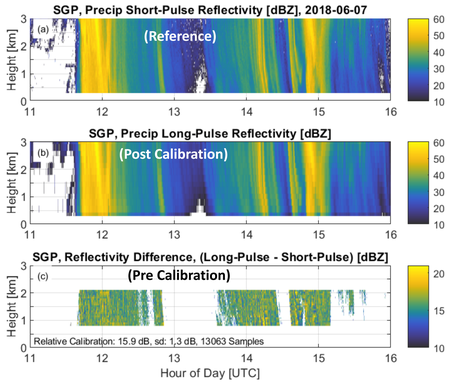
Key Results from 10-years of SGP RWP Observations
1. Over time, the RWP lost sensitivity at a rate of about 3 dB/year due to hardware aging and degradation.
2. Changes in hardware caused changes in calibration.
3. Calibration drift is slow enough that quarterly calibration constants are sufficient.

Calibration from 2011-to-2019

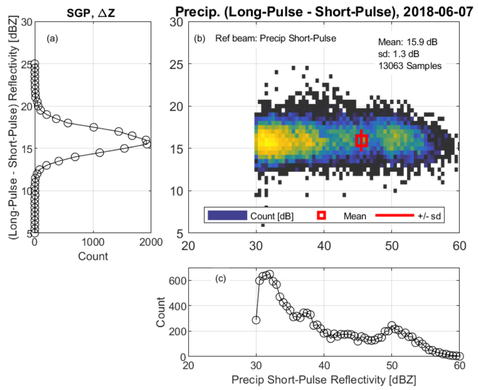


Calibrating Long-Pulse Beam
The Long-Pulse RWP mode is calibrated by comparing with calibrated Short-Pulse RWP mode reflectivity factors. Reflectivity difference is the relative change in calibration constants between Short- & Long-Pulse modes.

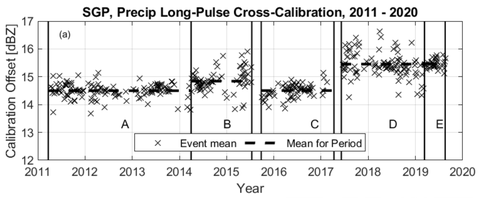
Use all near-by samples from 700 m to 2.1 km



Relative offset between Short- and Long-Pulse modes.



Key Results of Long-Pulse Calibration from 2011 to 2019
Since *relative* calibration between modes is determined by operating parameters, there is only a small change in calibration when new hardware is installed.



Full details are in the peer-reviewed publication:
Williams, C. R., Barrio, J., Johnston, P. E., Muradyan, P., and Giangrande, S. E.: Calibrating radar wind profiler reflectivity factor using surface disdrometer observations, Atmos. Meas. Tech., 16, 2381–2398, https://doi.org/10.5194/amt-16-2381-2023, 2023.