ASR Atmospheric System Research

University of Colorado **Boulder**

1 2 3 4 5 6

Calibrated ARM Radar Wind Profiler Reflectivity Profiles for Precipitation Vertical Structure Research

Christopher R. Williams

Joshua Barrio

Smead Aerospace Engineering Sciences Department

University of Colorado Boulder

U.S. DEPARTMENT OF ENERGY

ARM / ASR VIRTUAL JOINT MEETING, 21-24 JUNE 2021

Join this poster's Zoom session (Wednesday, 3-4 pm):
https://cuboulder.zoom.us/j/97709065030

This poster describes developing ***New Data Products*** from the ARM Radar Wind Profilers (RWPs).

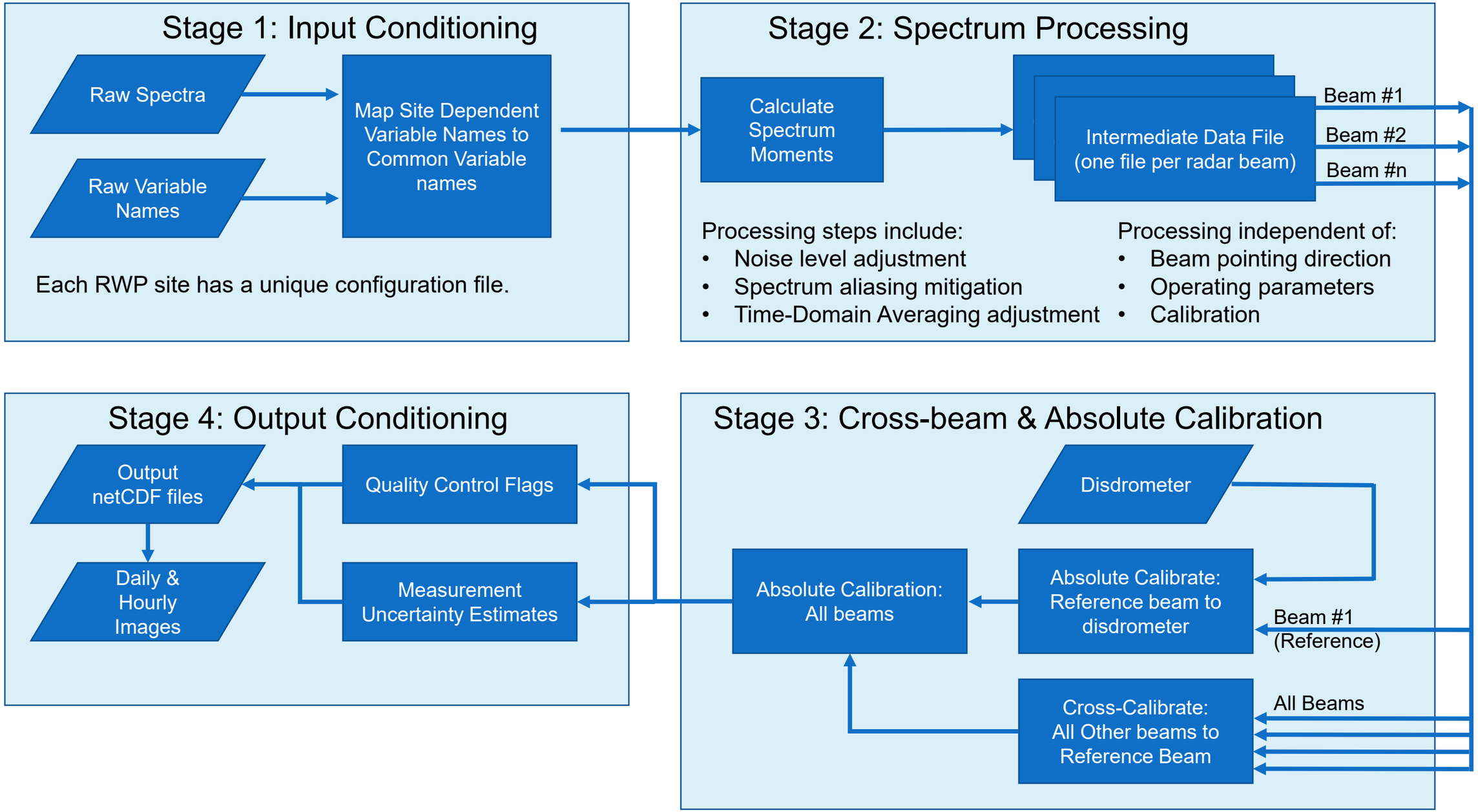
==========

Data products include:

1. Accurate RWP radial velocity spectrum moments
2. Calibrated RWP reflectivities (using disdrometers)
3. Improved horizontal wind estimates

2020 ASR New Data Product Research Project
DOE ASR award number: DE-SE0021345

RWP Processing Stages



Stage 2: Accurate Spectrum Power (SNR) Estimates

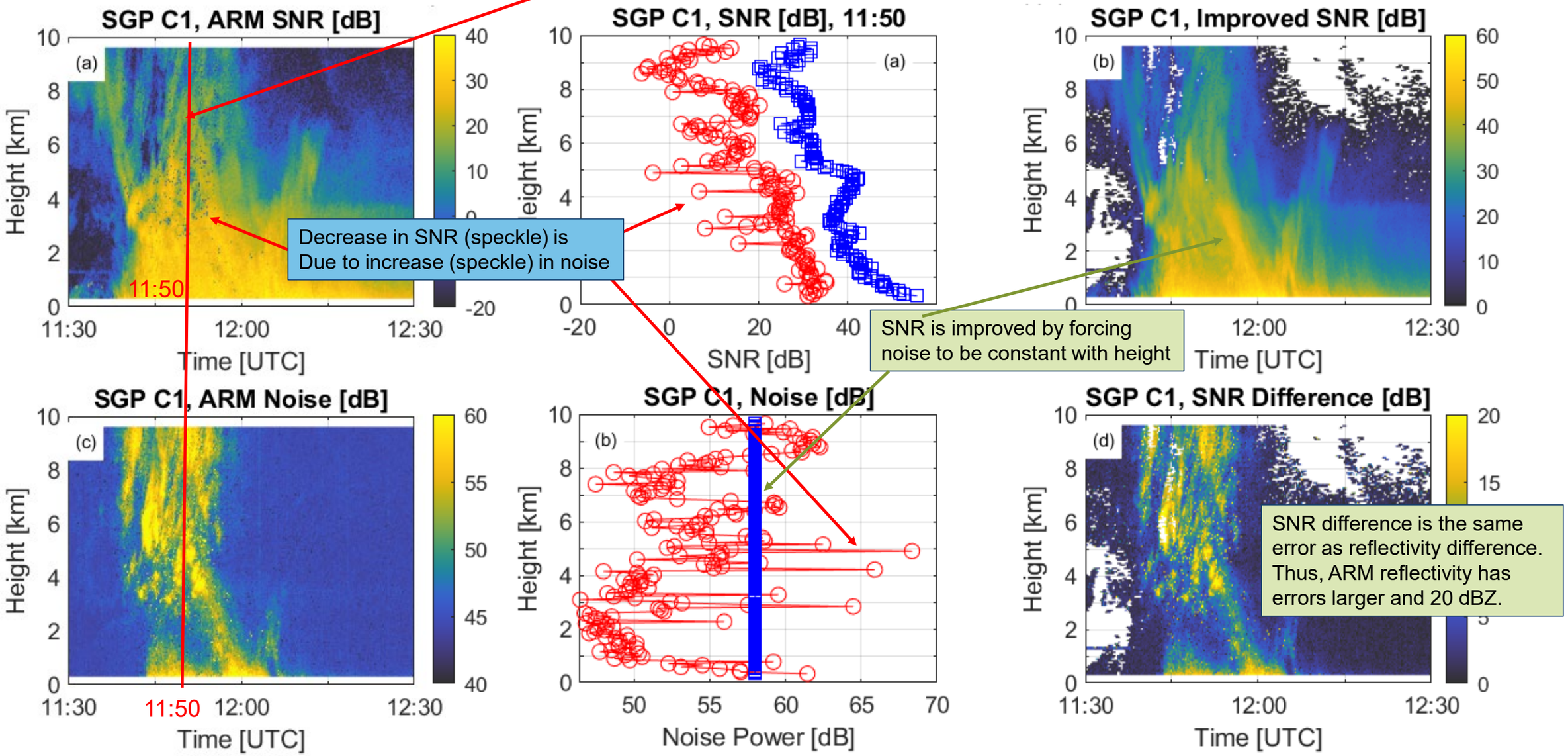
ARM signal-to-noise ratio (SNR) is incorrect because noise is not calculated correctly.

1
2
3
4
5
6

Original ARM Moments

Profile at 11:50 UTC

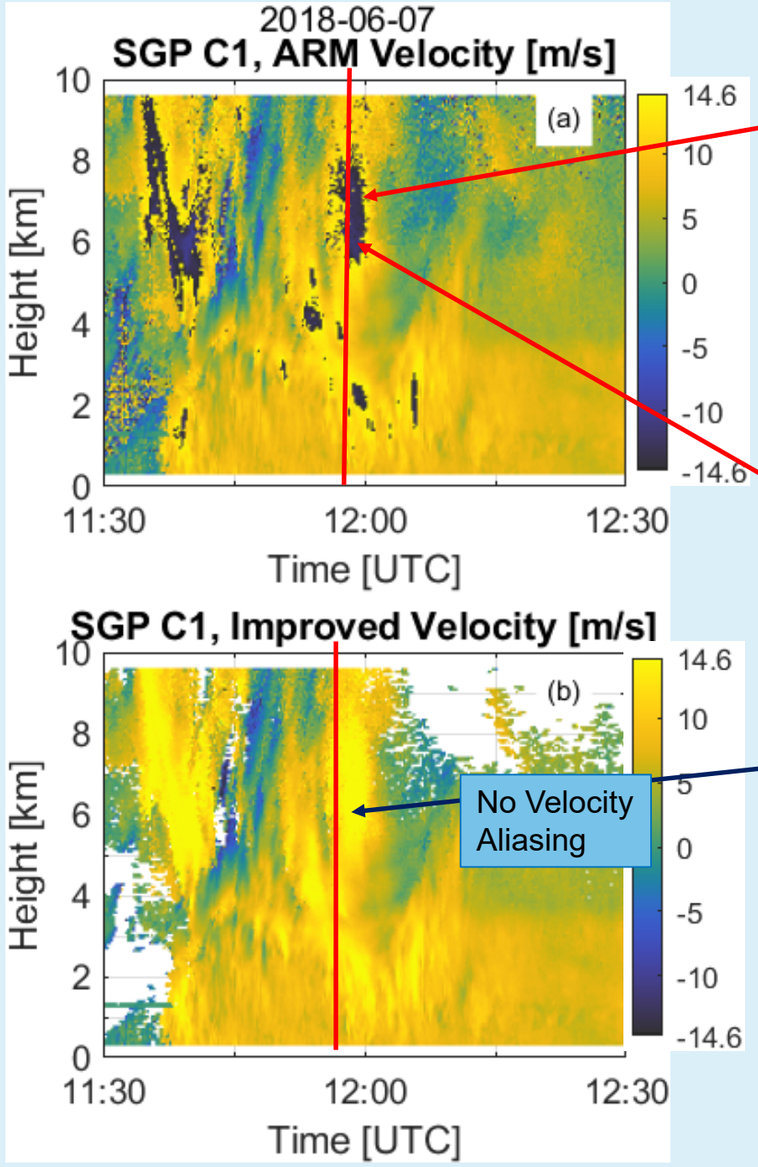
Improved SNR Moments



Stage 2: Doppler Velocity Spectra Aliasing

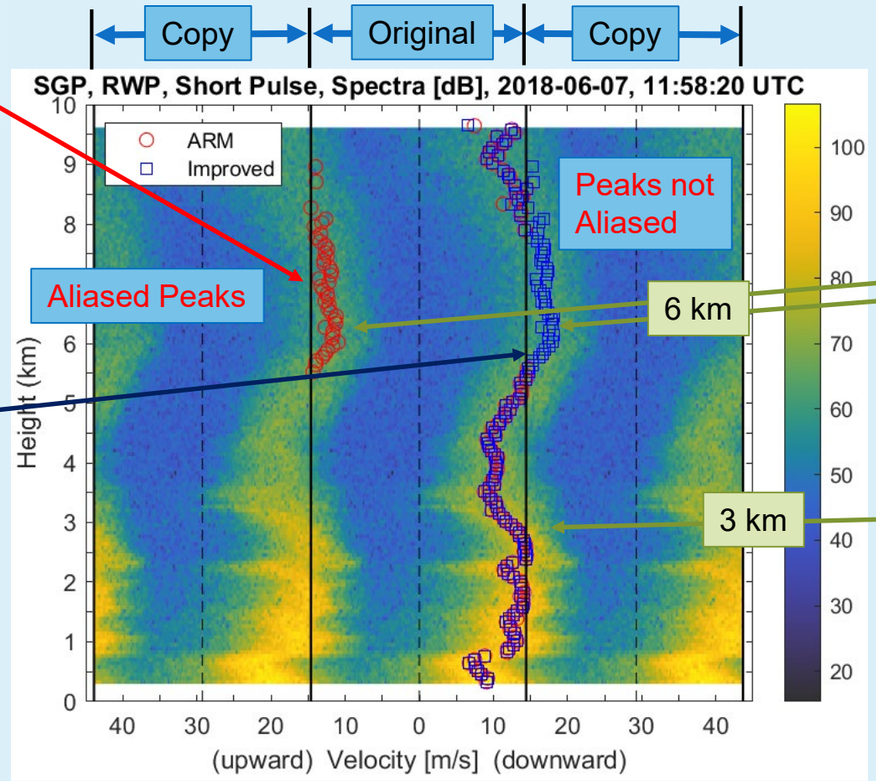
1
2
3
4
5
6

ARM Velocity Aliasing



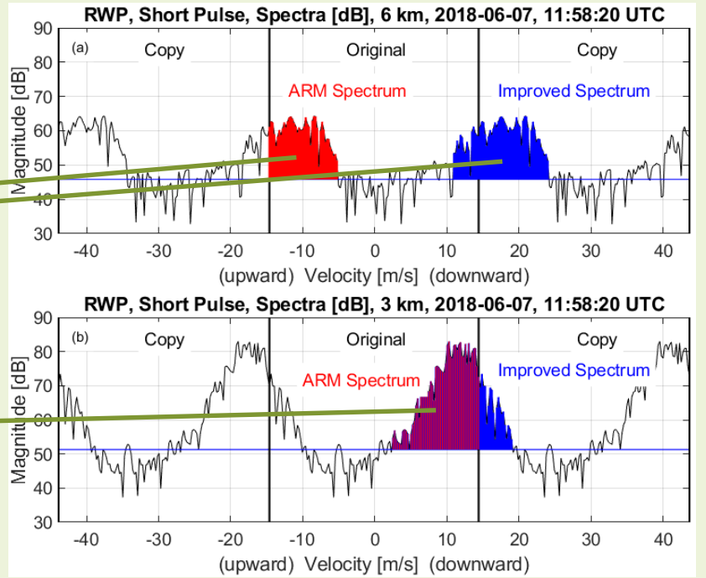
Spectra Aliasing Error #1:

- Peak could be aliased by $2V_{Nyquist}$ ($V_{Nyquist}$ = 14.6 m s^{-1})
- ARM Velocity moments are aliased by $2V_{Nyquist}$ when peak is aliased.
- Improved method replicates spectra and then follows peak up profile.



Spectra Aliasing Error #2:

- ARM calculated moments are incorrect because aliased portion of spectrum not used in moment estimate.
- ARM method: Integration limits stop at spectrum edge
- Improved method: Integration limits extend to noise threshold.



6 km

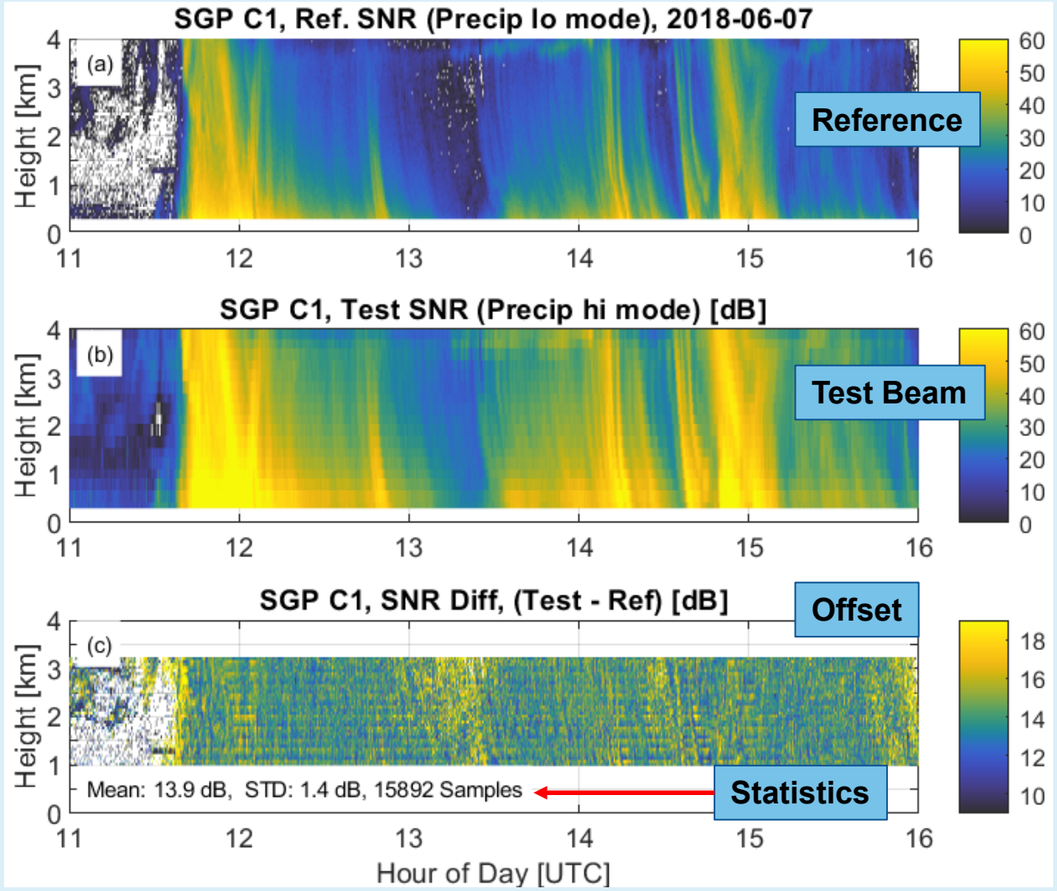
3 km

Stage 3: Cross-Beam and Absolute Calibration

1
2
3
4
5
6

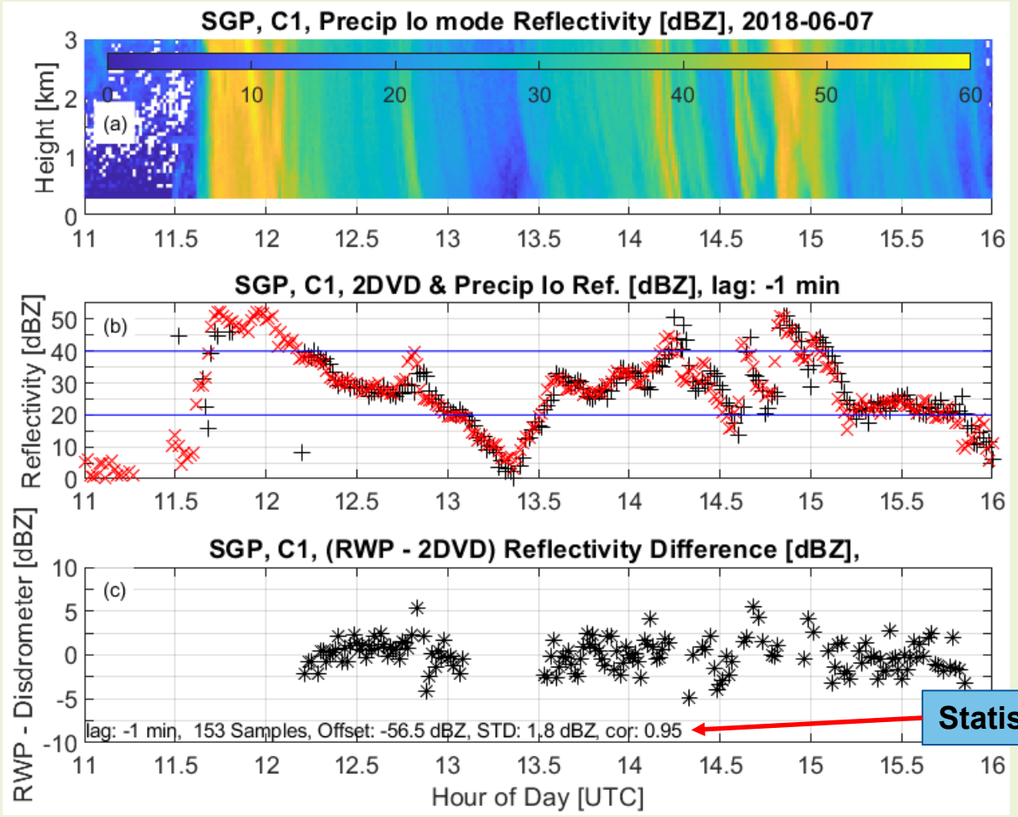
Cross-Beam Calibration:

- Choose a beam & define it as the reference RWP beam.
- For each rain event, find SNR difference between reference RWP beam and every other RWP beam.
- Mean SNR difference from RWP reference beam determines calibration offset for every other beam.

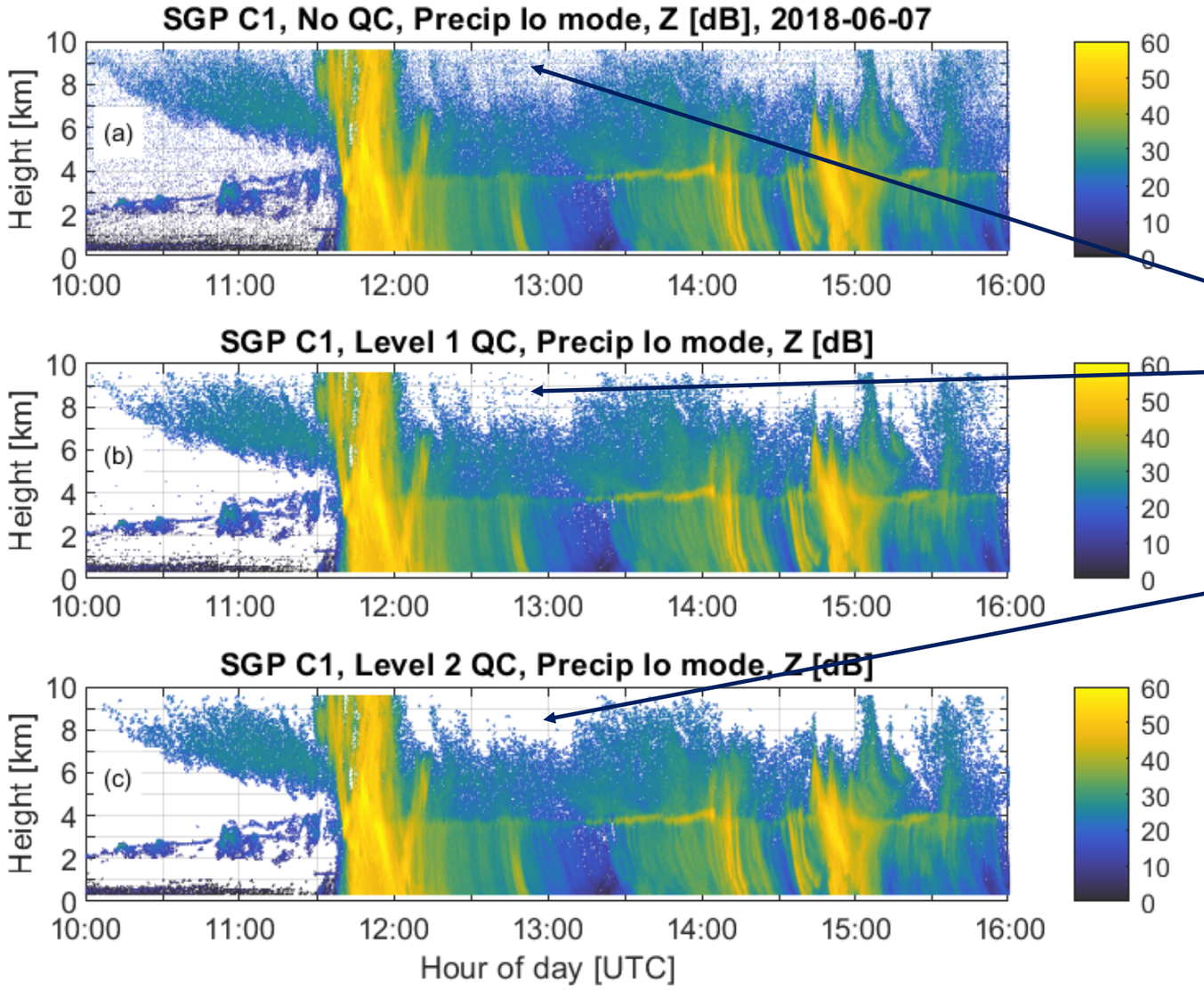


Absolute Calibration:

- Define disdrometer reflectivity as external calibration reference.
- For each rain event, determine calibration offset for RWP reference beam.
  - Use 1-minute averaged data
  - Shift RWP profiles in time between +/- 4 minute lags
  - Use disdrometer 20 -to- 40 dBZ reflectivities
- Mean reflectivity difference determines RWP reference beam absolute calibration.
- Using cross-beam calibration, every RWP beam is calibrated.



Stage 4: QC Flags and netCDF Data Files



All moments are saved to daily netCDF files.

Quality Control (QC) Flags are defined for every observation so that the end-user can choose their level of QC.

No QC: Raw moments without any constraints.

Level 1 QC: Requires 3 consecutive valid observations at an individual range gate (no height constraint). For this precip lo mode, 14 seconds between profiles, thus, 3 profiles is 42 seconds.

Level 2 QC: Require at least 4 valid observations within 3x3 (profile x gate) neighborhood. For this precip lo mode: (3x3) = (42 sec x 180 m).

Contact Christopher Williams for access to processed data files and images.

We would like to thank DOE ASR for funding and scientific support. Award Number: DE-SC0021345

ASR Atmospheric System Research

ARM

U.S. DEPARTMENT OF ENERGY

University of Colorado **Boulder**