

In-cloud vertical air motion retrievals in warm clouds

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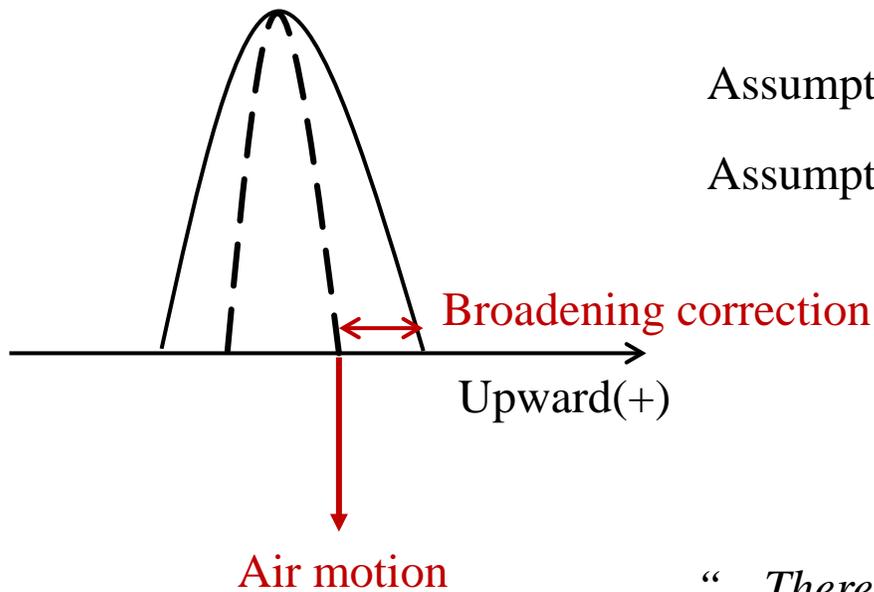
ASR
Atmospheric
System Research

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Motivation

“...Since the radar discriminates the droplets by velocity, the signals received in the velocity channel corresponding to the maximum upward velocity are associated with the droplets having the smallest terminal velocity...”

[Battan, L. J., 1964]



Assumption1: cloud droplets can be used as tracer of air motion

Assumption2: edge(upward) of doppler spectrum was the measurement of clouds

$$\sigma_0^2 = \sigma_D^2 + \sigma_T^2 + \sigma_S^2$$

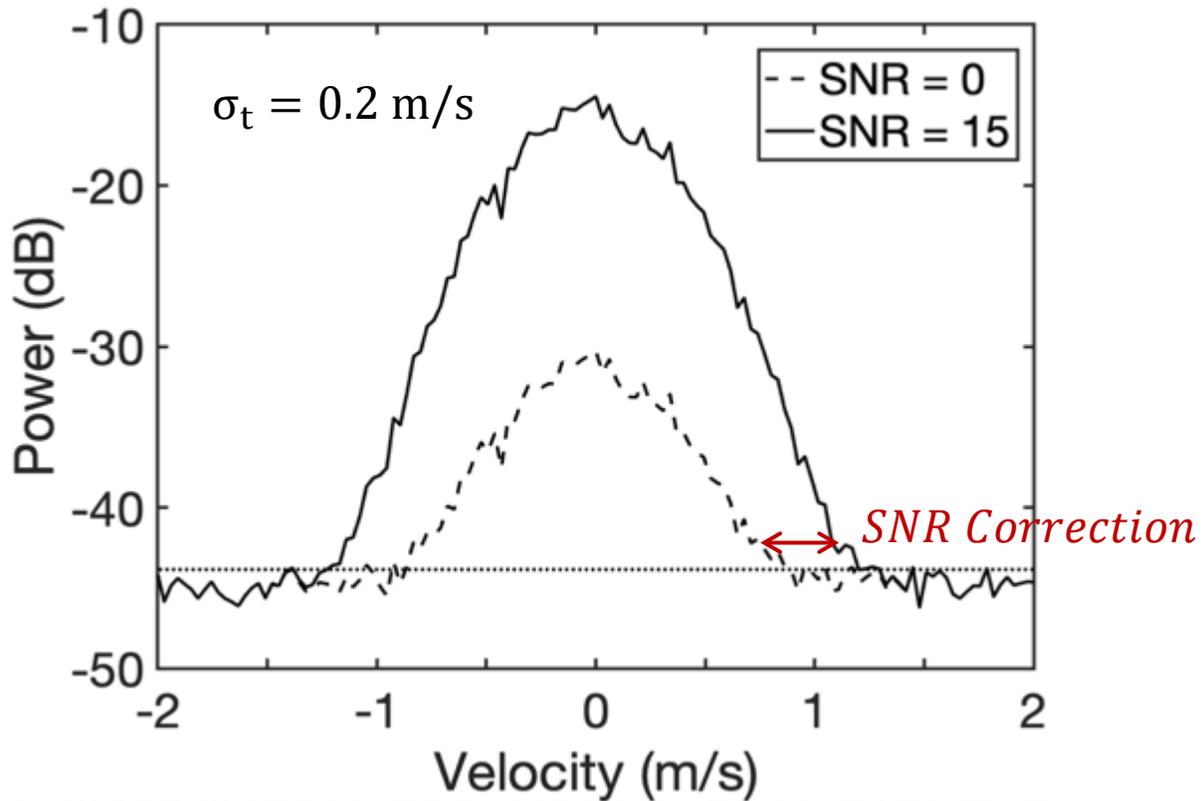
Air motion = upward edge – **broadening correction**

“...There appears to be a small(0.2 m/s) bias between the radar retrievals and aircraft measurements of vertical velocity. Such a bias could be possible if the radar retrieval significantly underestimated the spectral broadening correction terms...”

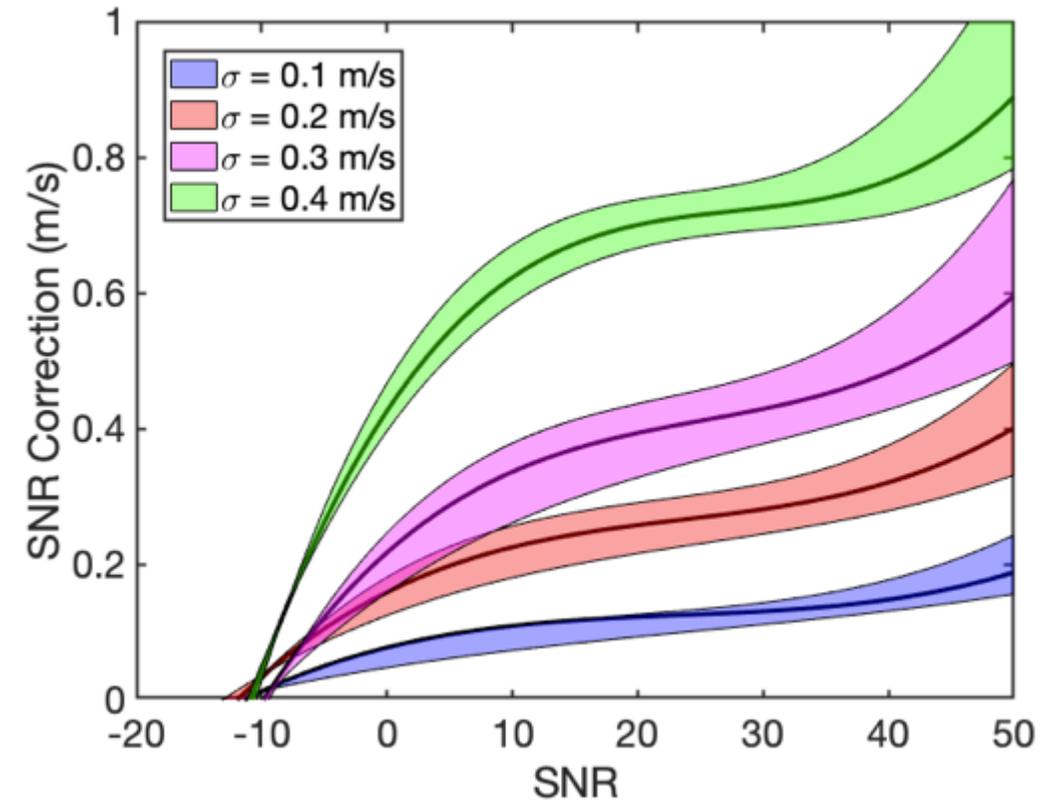
[Shupe et al., 2008]

Methodology

Besides turbulence and wind shear, SNR also contributes to edge broadening

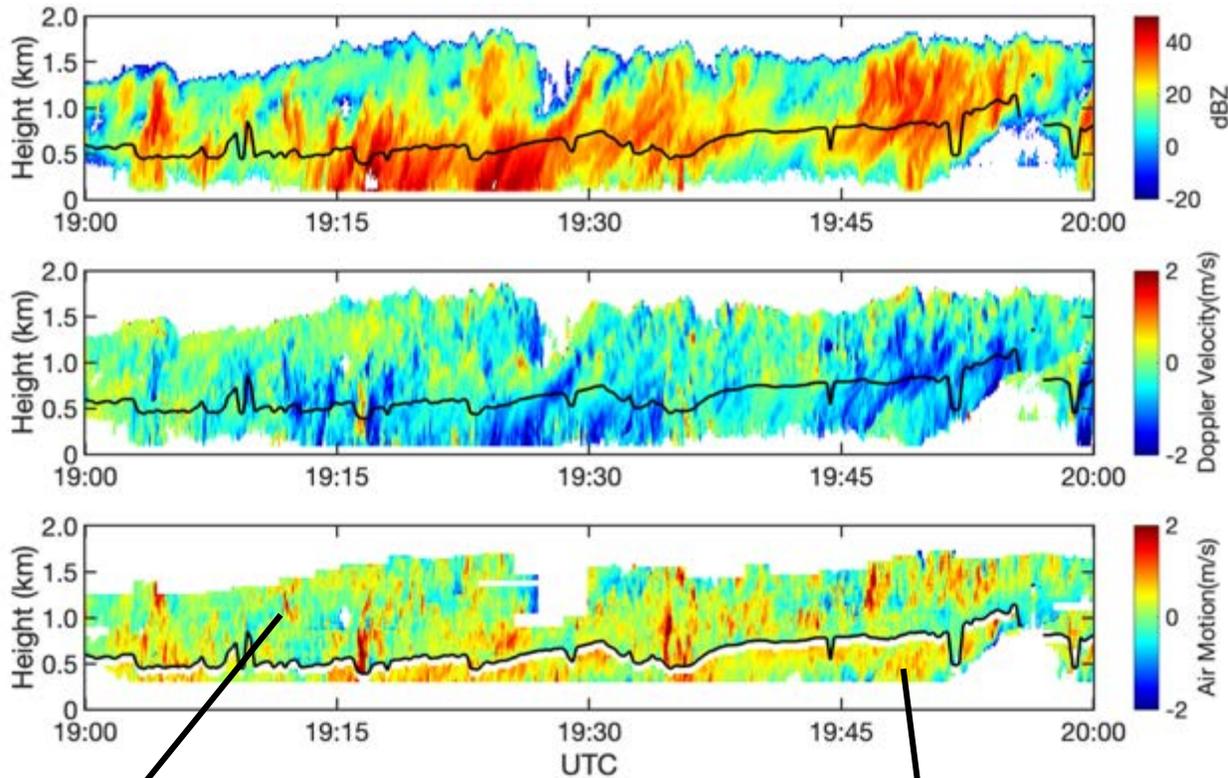


Air motion = upward edge - σ_T - σ_S - SNR correction



Verification

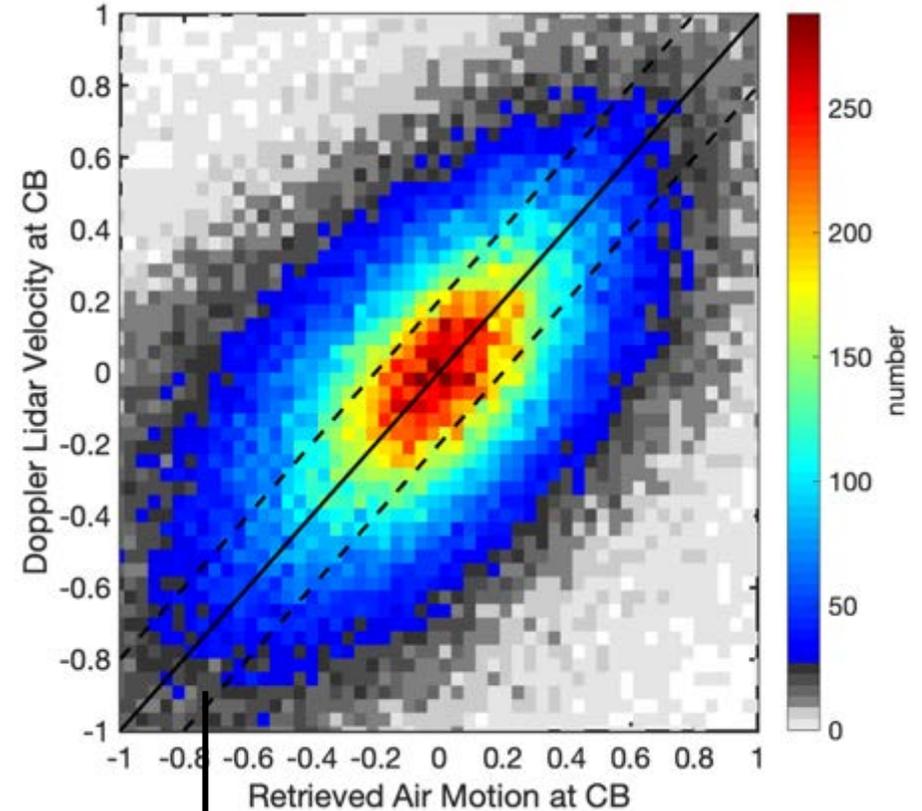
Case 20170618 on ENA



Retrieved air motion from spectrum

Independent retrieved air motion from *O'Connor 2005*

1-year cloud base velocity comparison with Doppler Lidar



Uncertainty ~ 0.2 m/s

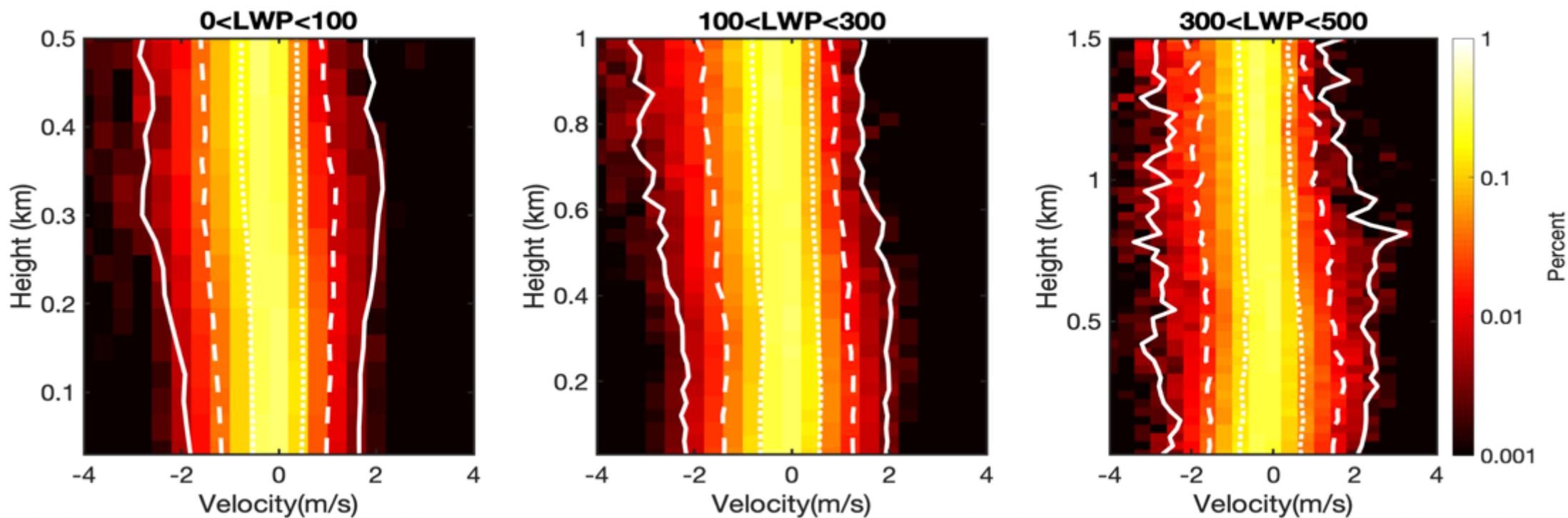
Develop a spectrum-based approach to retrieve air motion in warm cloud

- Applicable to all ARM sites
- Fill the observation gap between Doppler Lidar and Wind profile
- Pave the way for doppler velocity decomposition

Potential ability to investigate dynamical process in warm cloud

- Air velocity distribution in Cu/Sc
- Entrainment/detrainment
- Interaction between dynamics and microphysics

Preliminary Result



Verification

Air motion = upward edge - σ_T - SNR correction

Air motion = upward edge - σ_T

upward edge

