

Can we see precipitation properties moving through the melting layer?

Shuaiqi Tang, Jonathan Edwards-Opperman, Katie Verlinden, Nils Kuchler

Advisors: Matt Kumjian, Herman Russchenberg



Motivation



- **How does melting layer relate to precipitation properties above and below the melting layer?**
 - Does the melting layer homogenize particles?
 - Can any signals be tracked through the melting layer?
- **Can we diagnose precipitation processes through melting layer using precipitation radar?**
 - How do the velocity spectra change moving through the melting layer?
 - What can we tell from the radar data?

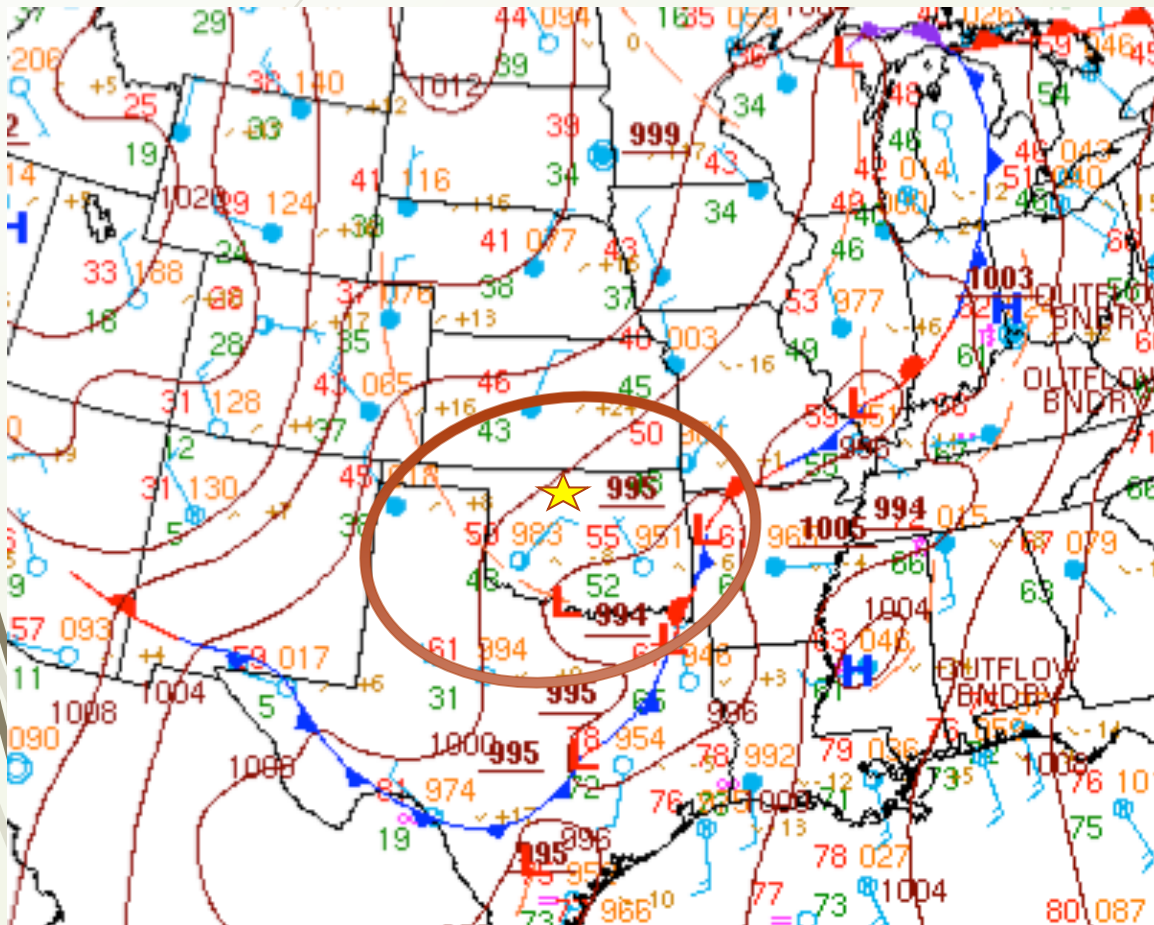
Instruments

- CSAPR: C-band scanning polarimetric radar
 - Reflectivity, velocity, differential reflectivity, specific differential phase, correlation coefficient, spectral width
- KAZR: Ka-band vertically oriented radar
 - Reflectivity, Doppler velocity, Doppler spectra
- Ceilometer
 - Backscatter, Cloud base heights
- Soundings
- Surface Meteorological Data
 - Disdrometer, rain gauge

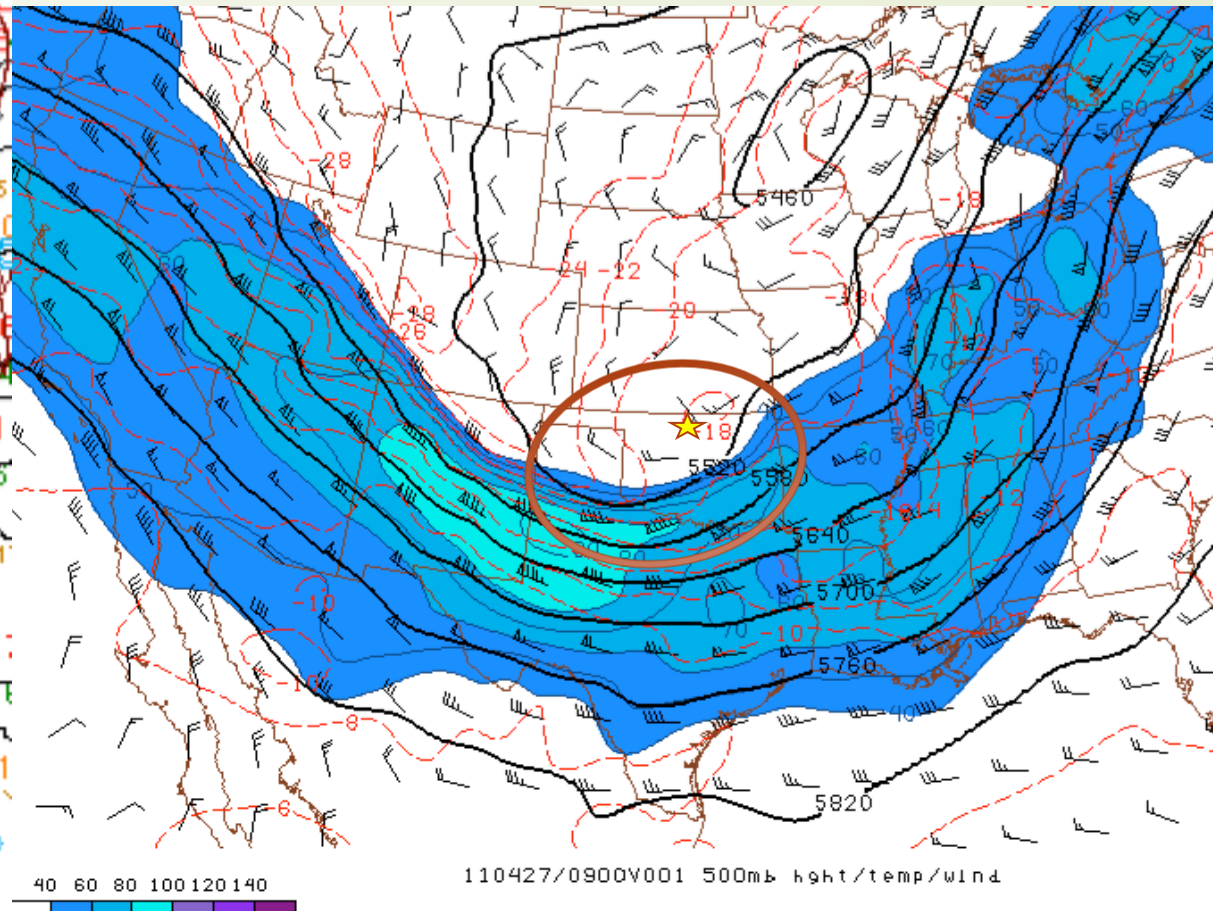


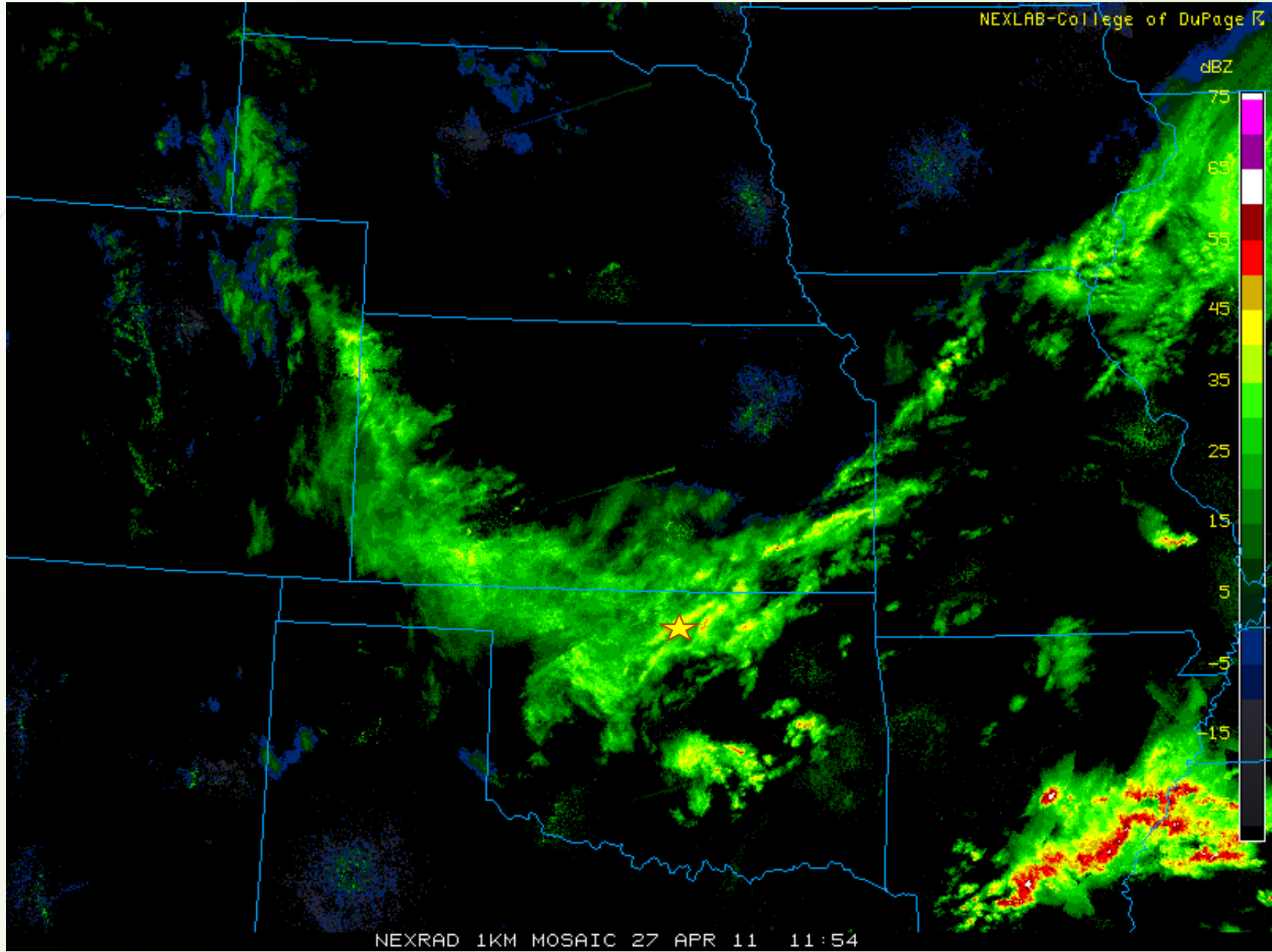
Synoptic Overview

Surface Analysis



500mb height/temp/wind

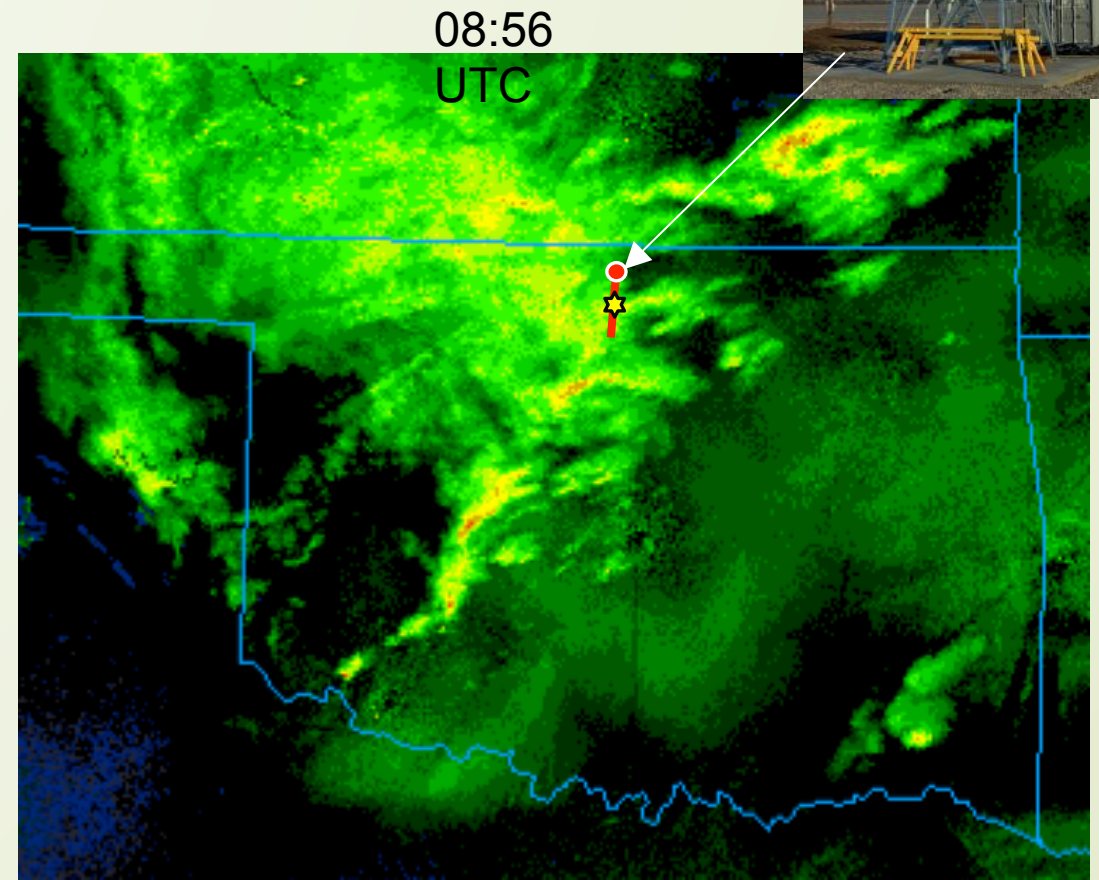




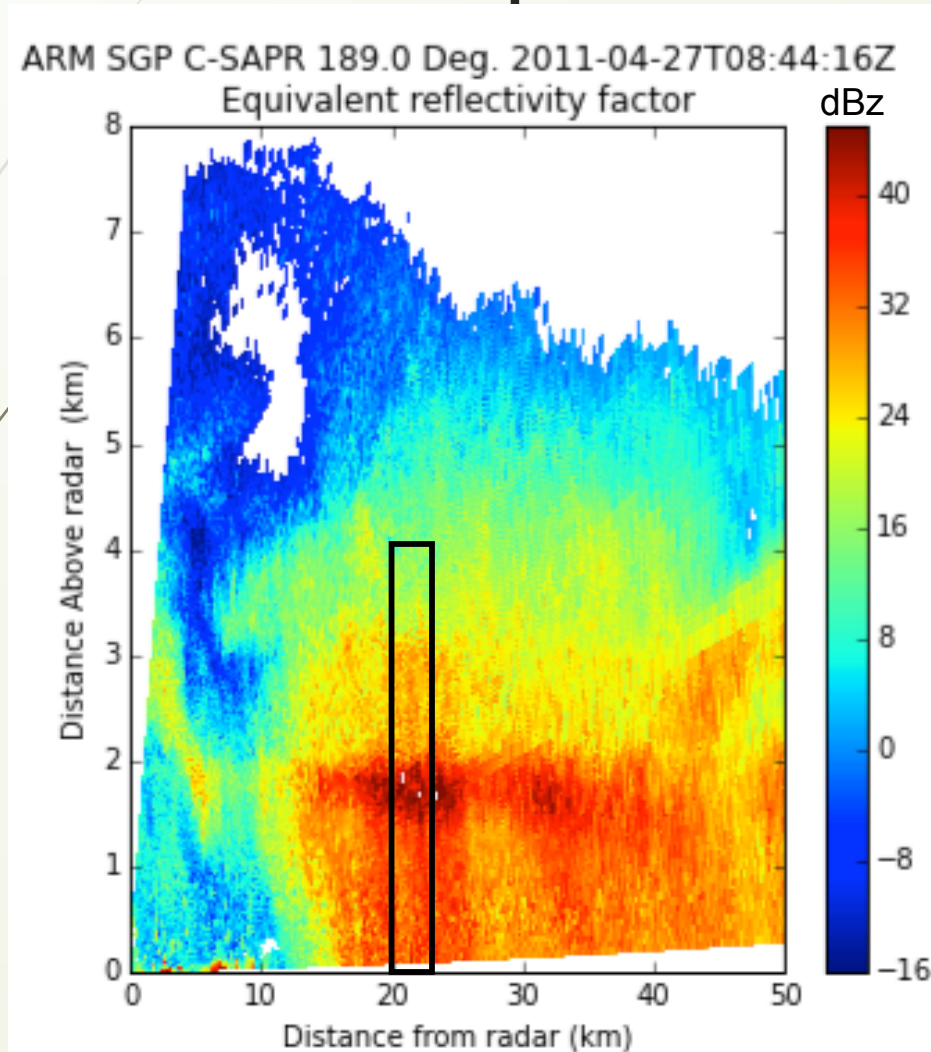
Event Overview

- Observations at ARM SGP Central Facility
- 27 April 2011
- 08:44UTC to 09:02UTC
 - CSAPR RHIs available over CF
 - Stratiform rain directly over SGP
 - Well-defined melting layer

C-Band ARM
Precipitation Radar
(CSAPR)

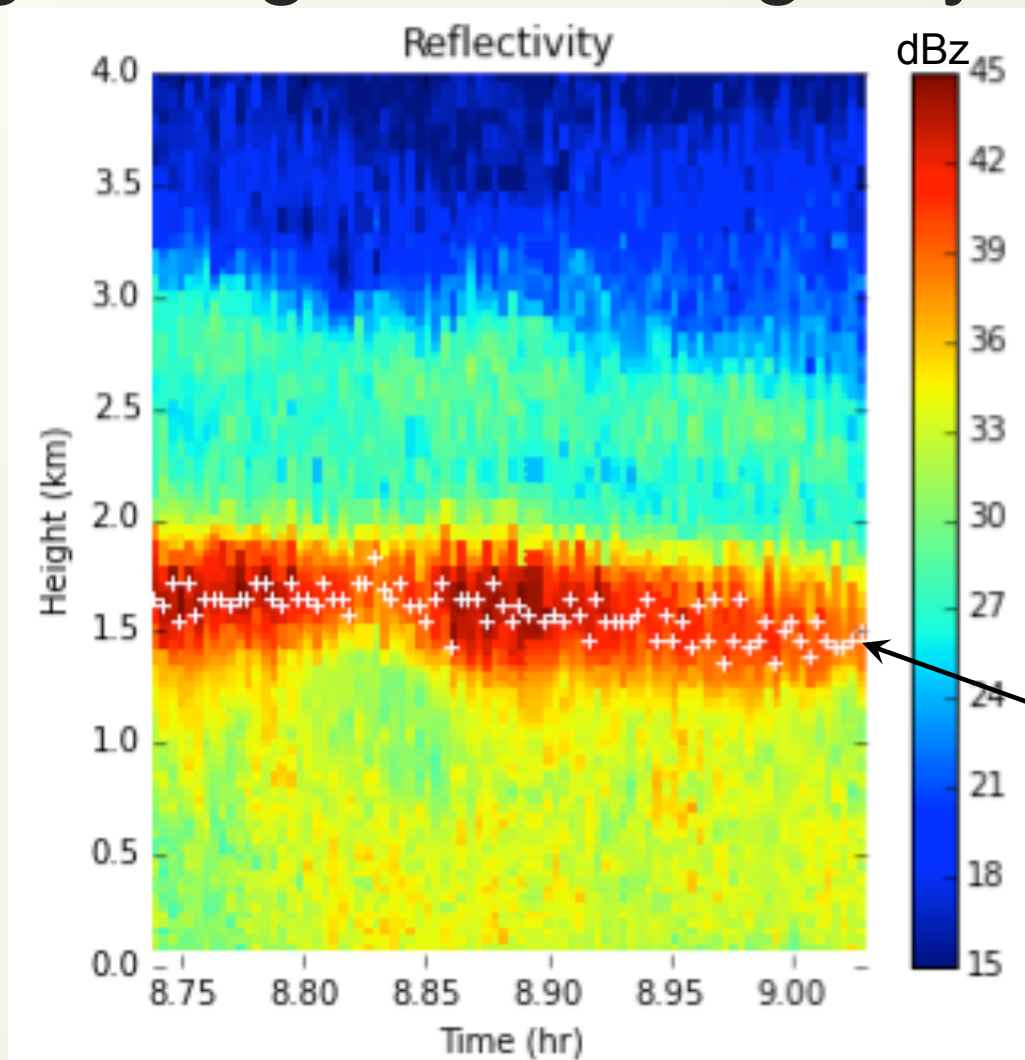


CSAPR Processing: vertical profiles over SGP CF



- Locate SGP Central Facility
- Calculate slant range corresponding to SGP location for each elevation angle
- Calculate height above radar level from given elevation angle
- Create time profile of each variable
- Iterate through all RHI files

Diagnosing the Melting Layer

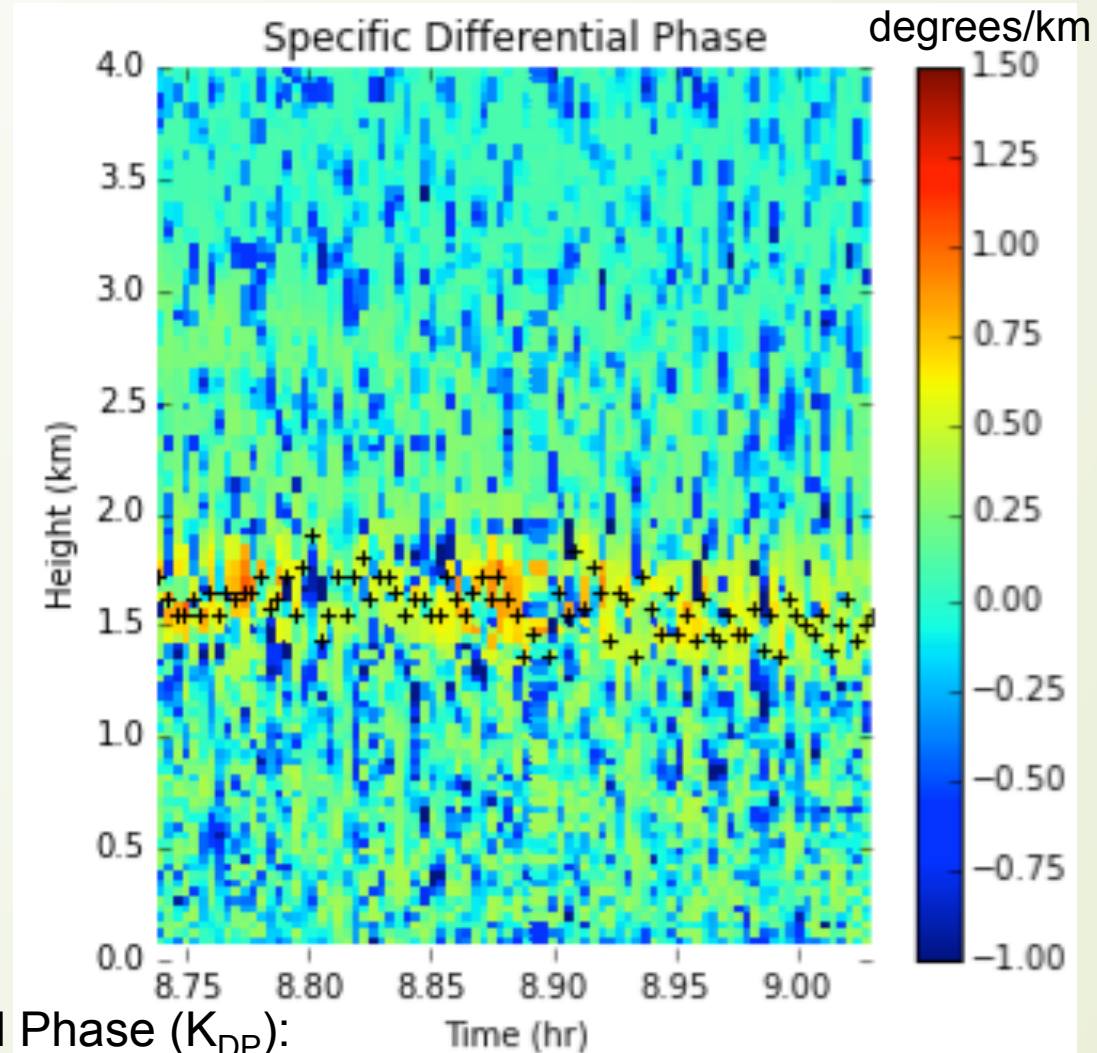


+: maximum reflectivity

Melting layer?

Reflectivity (Z):

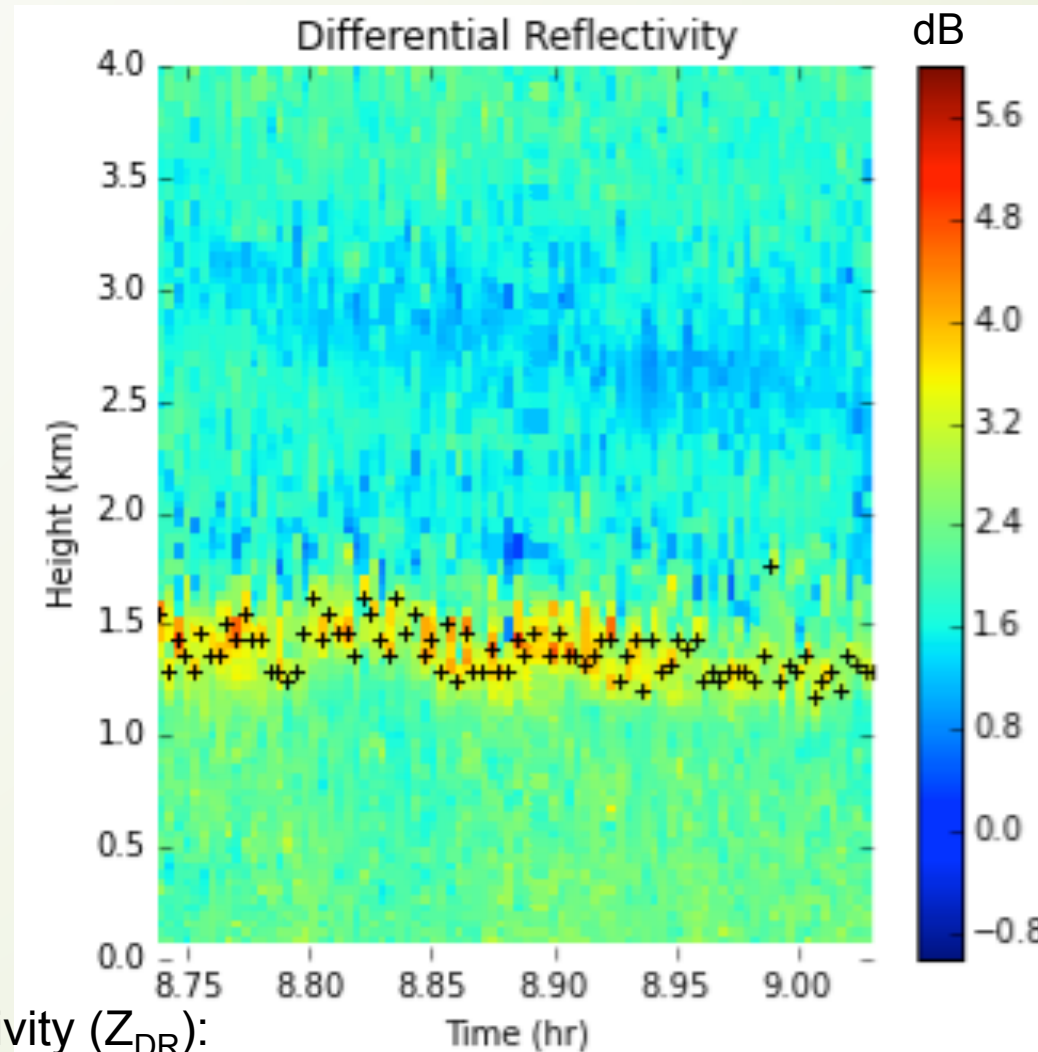
- Amplitude of backscattered radiation from particles within radar volume
- $f(\text{size, concentration, density, composition})$



+: maximum K_{DP}

Specific Differential Phase (K_{DP}):

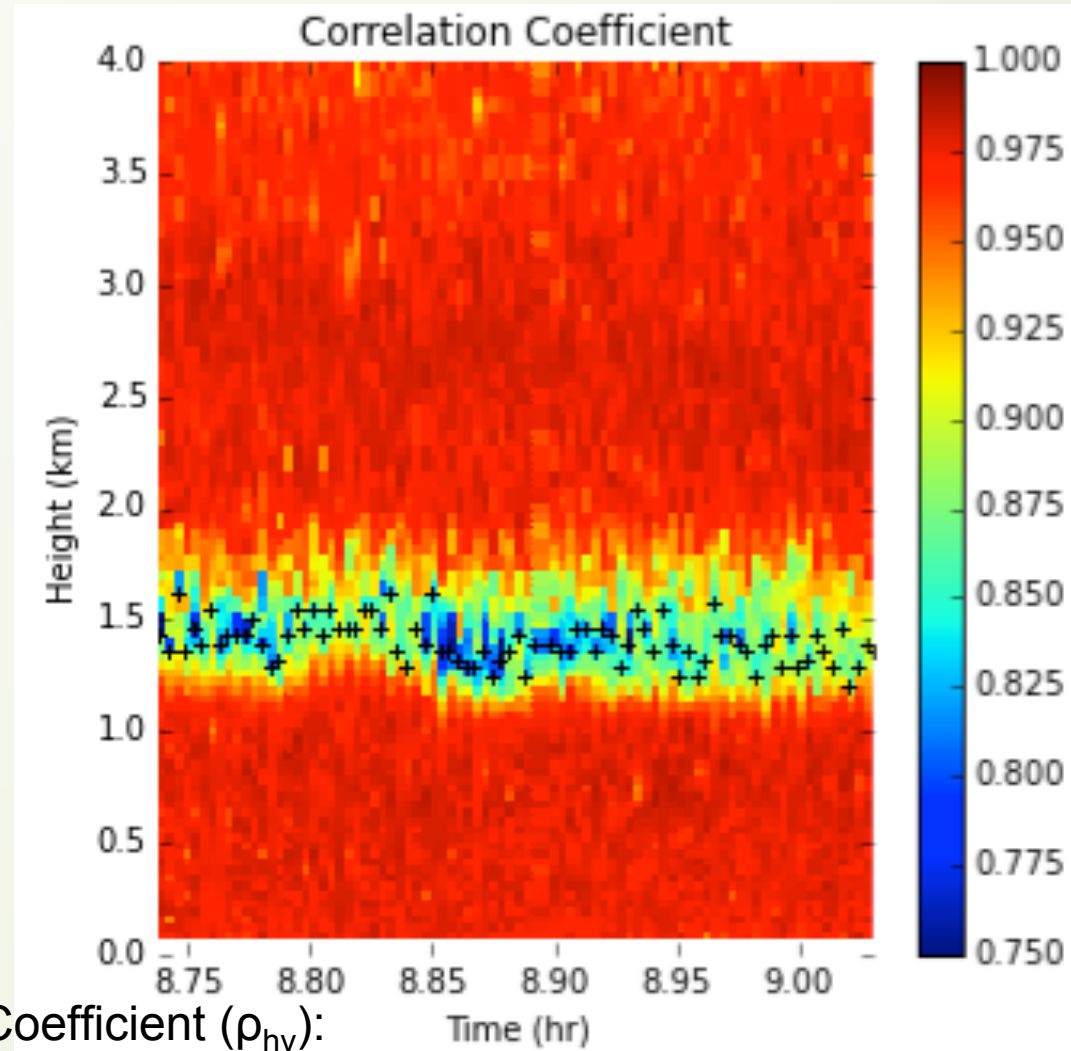
- Difference between horizontal and vertical phase shifts, $\phi_{DP} = \phi_h - \phi_v$
- $f(\text{size, concentration, composition})$



+ : maximum Z_{DR}

Differential Reflectivity (Z_{DR}):

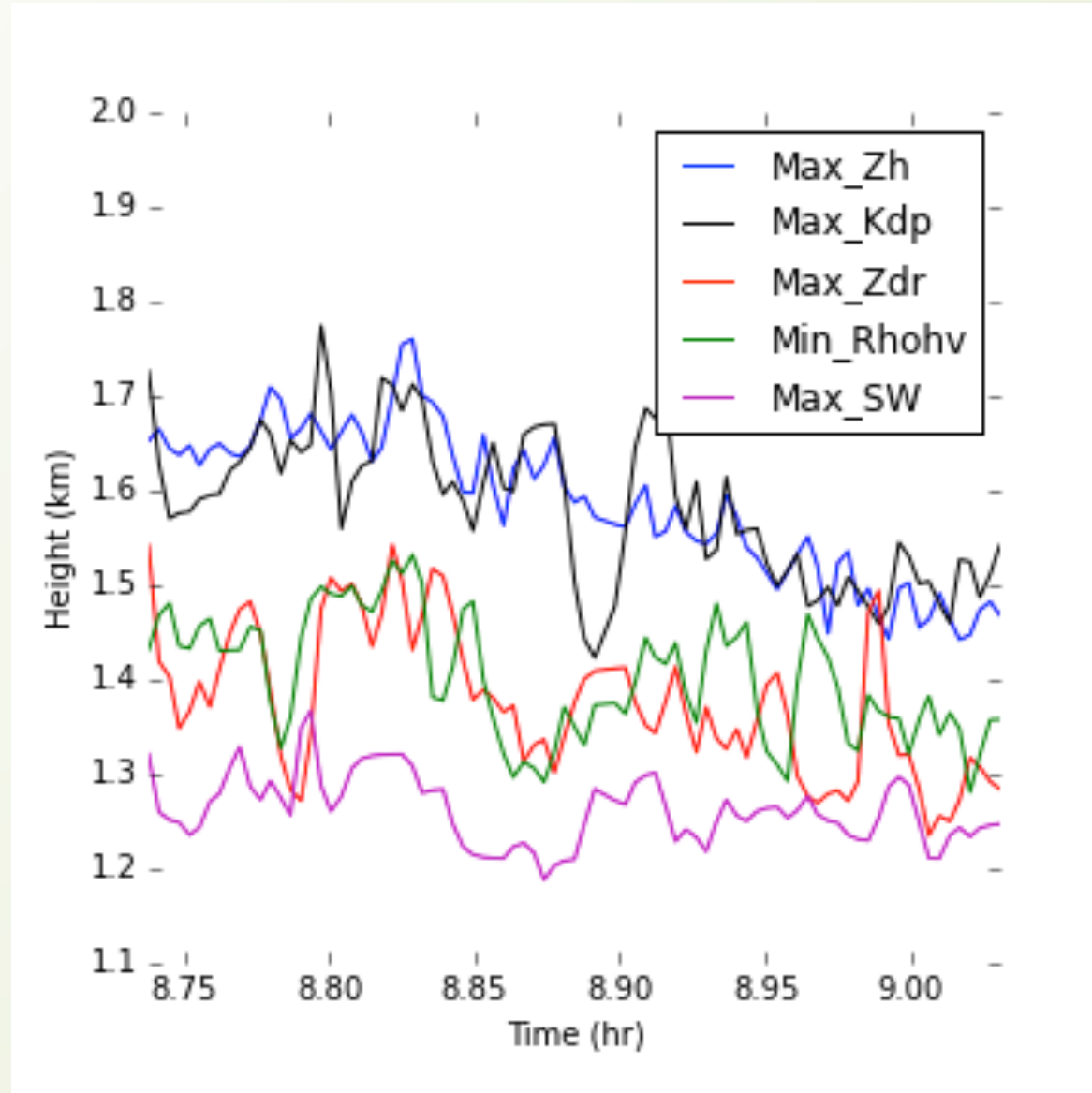
- Log_{10} of the ratio of the horizontal reflectivity to vertical reflectivity (spherical = 0)
- $f(\text{shape, density, composition})$



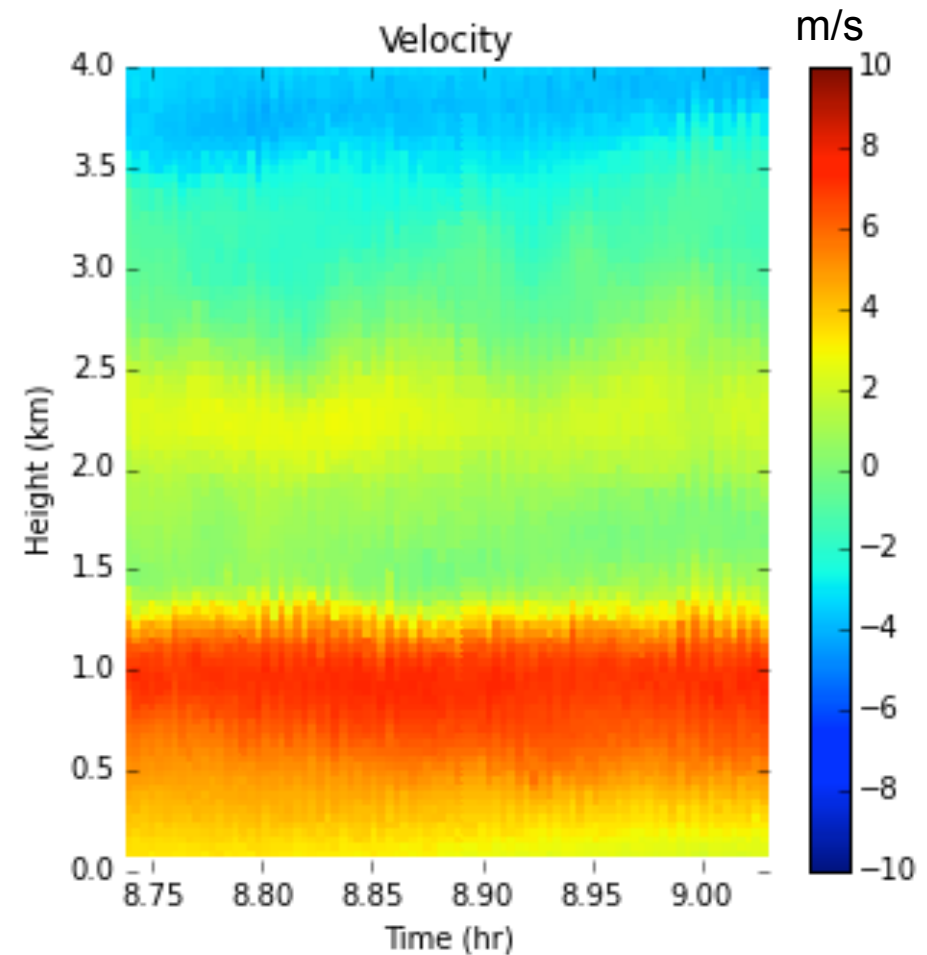
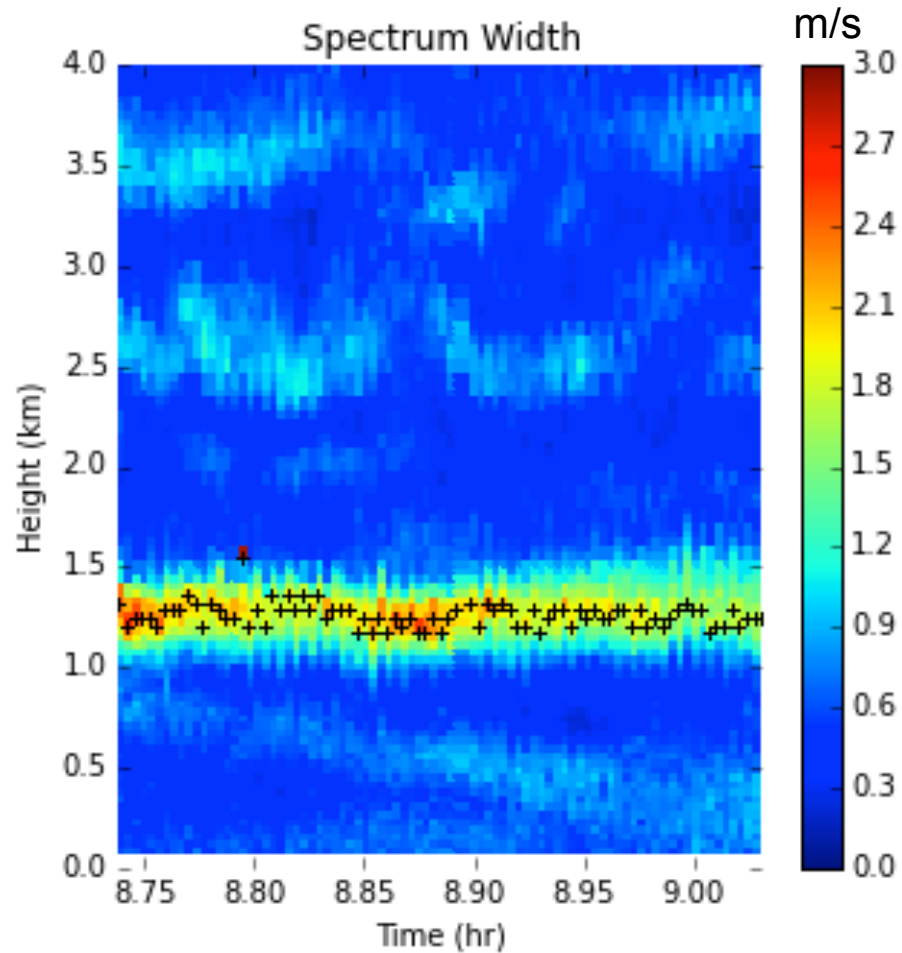
+: minimum ρ_{hv}

Cross-correlation Coefficient (ρ_{hv}):

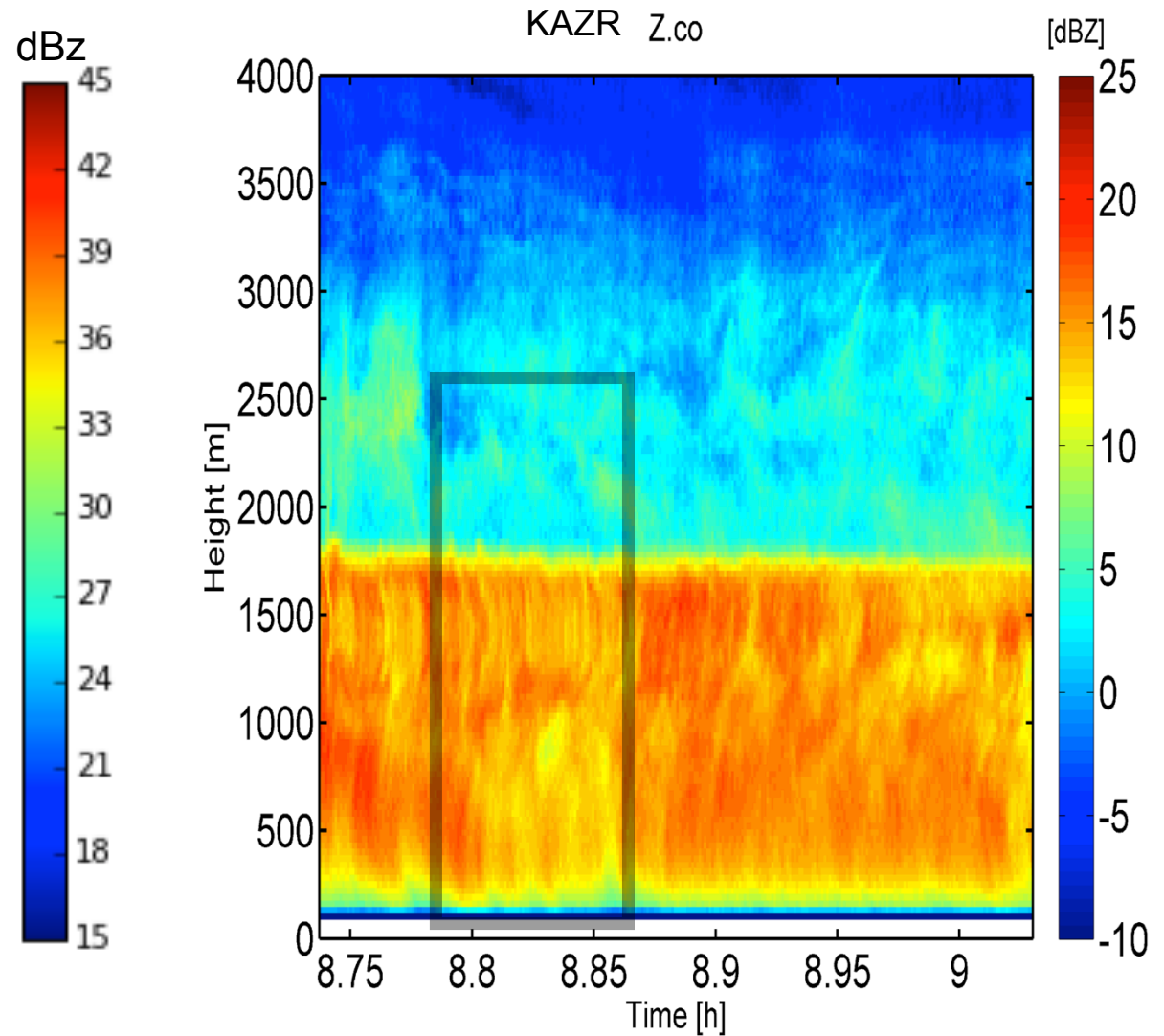
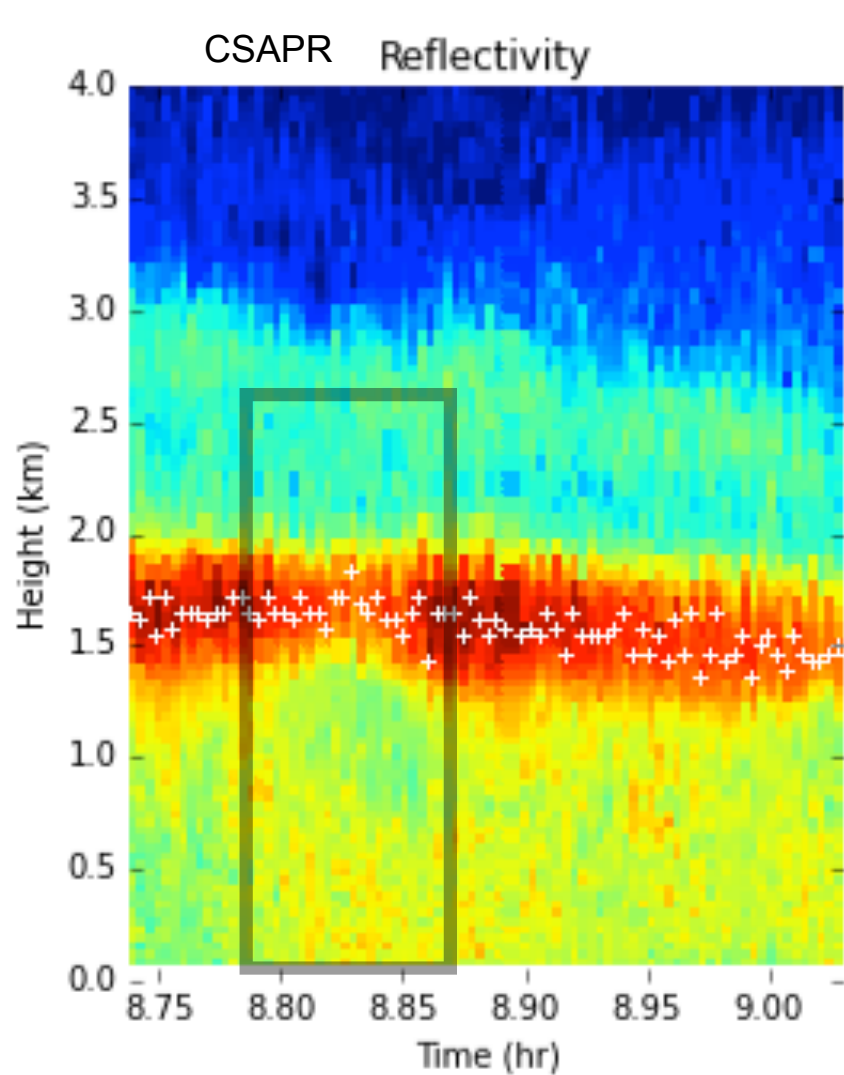
- How similarly horizontally and vertically polarized pulses are acting within a volume
- f(shape, density, composition)

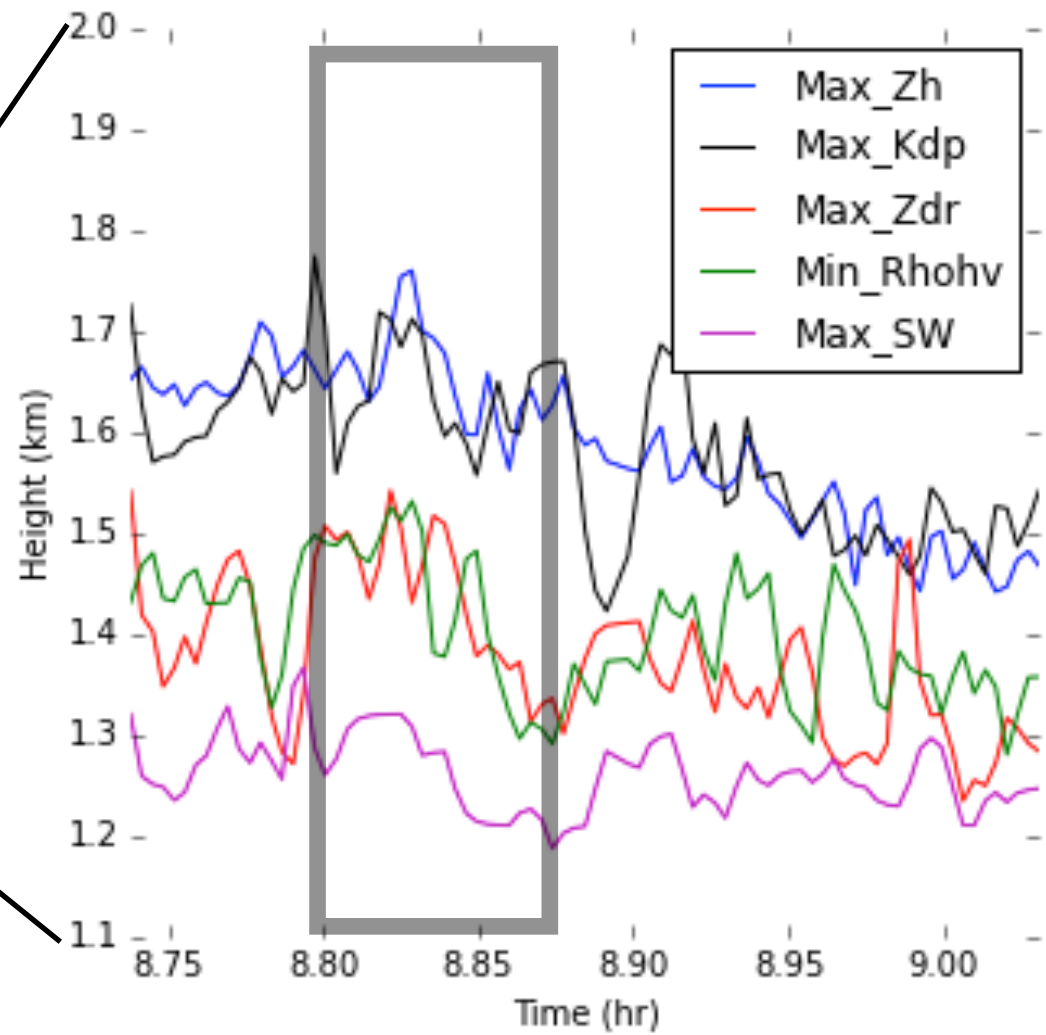
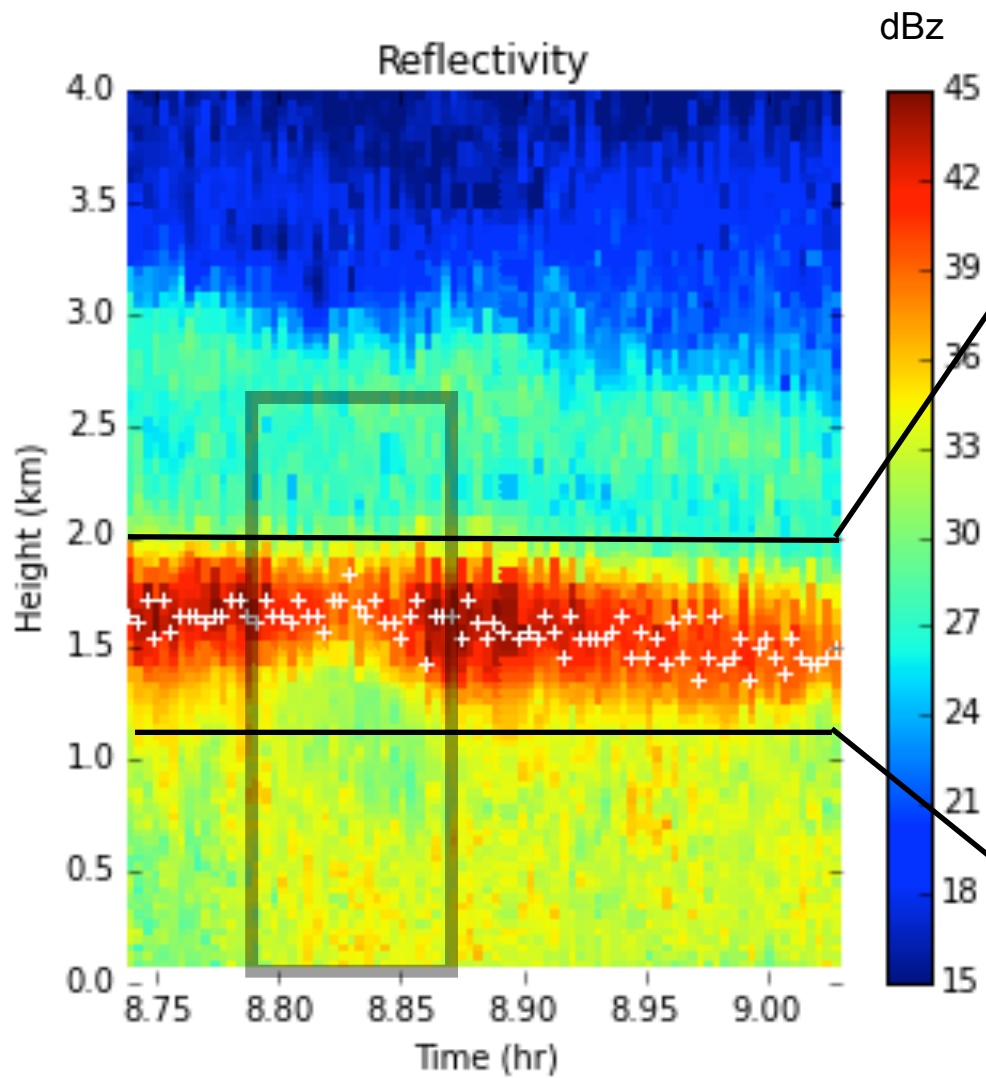


Spectral Width - Doppler Velocity Relationship

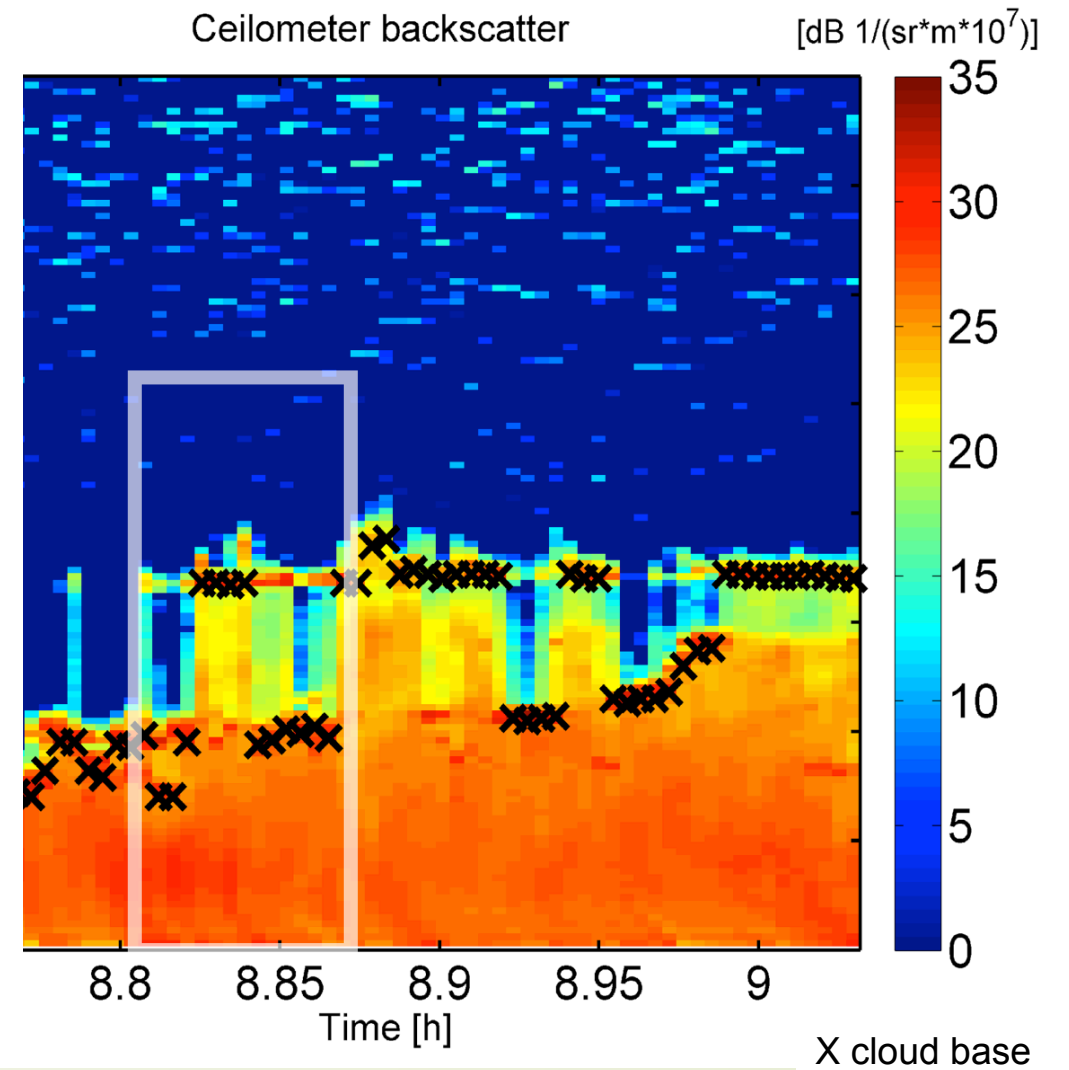
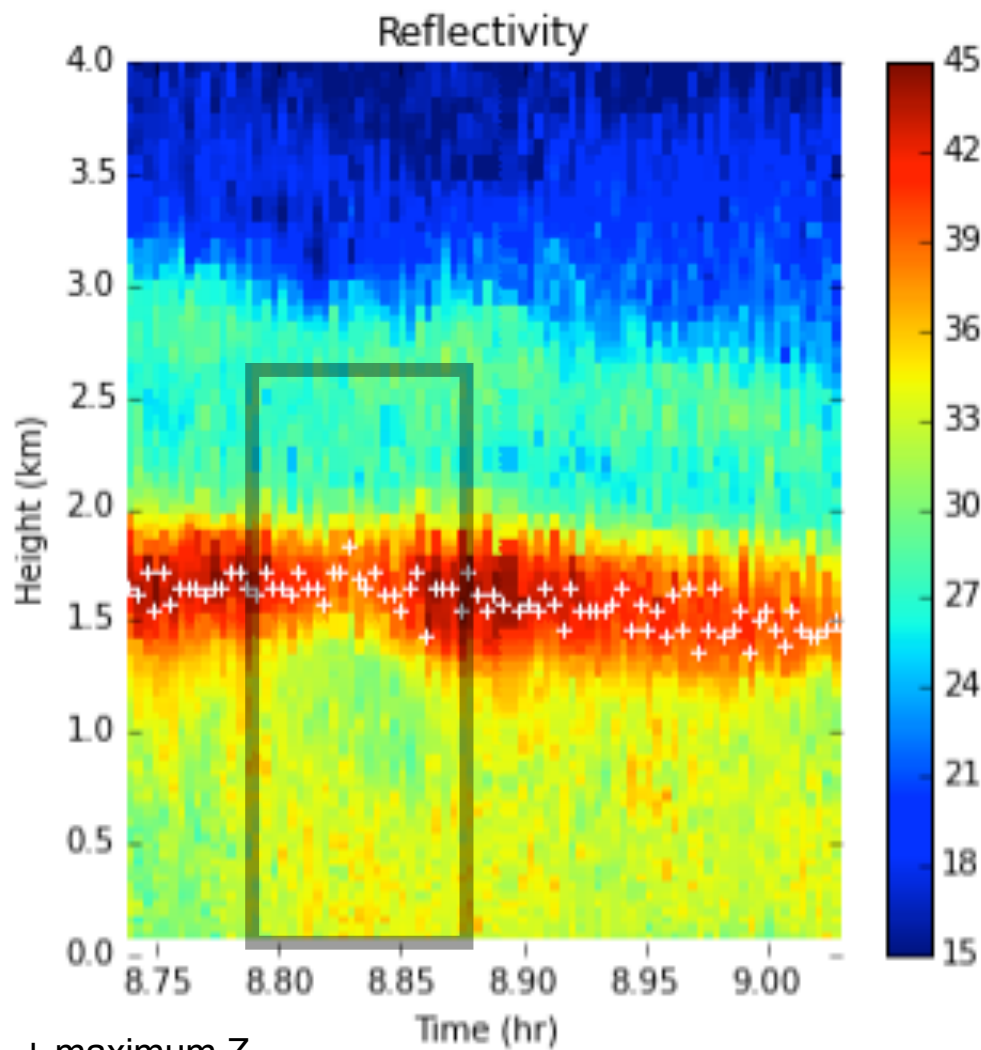


Fascinating Feature

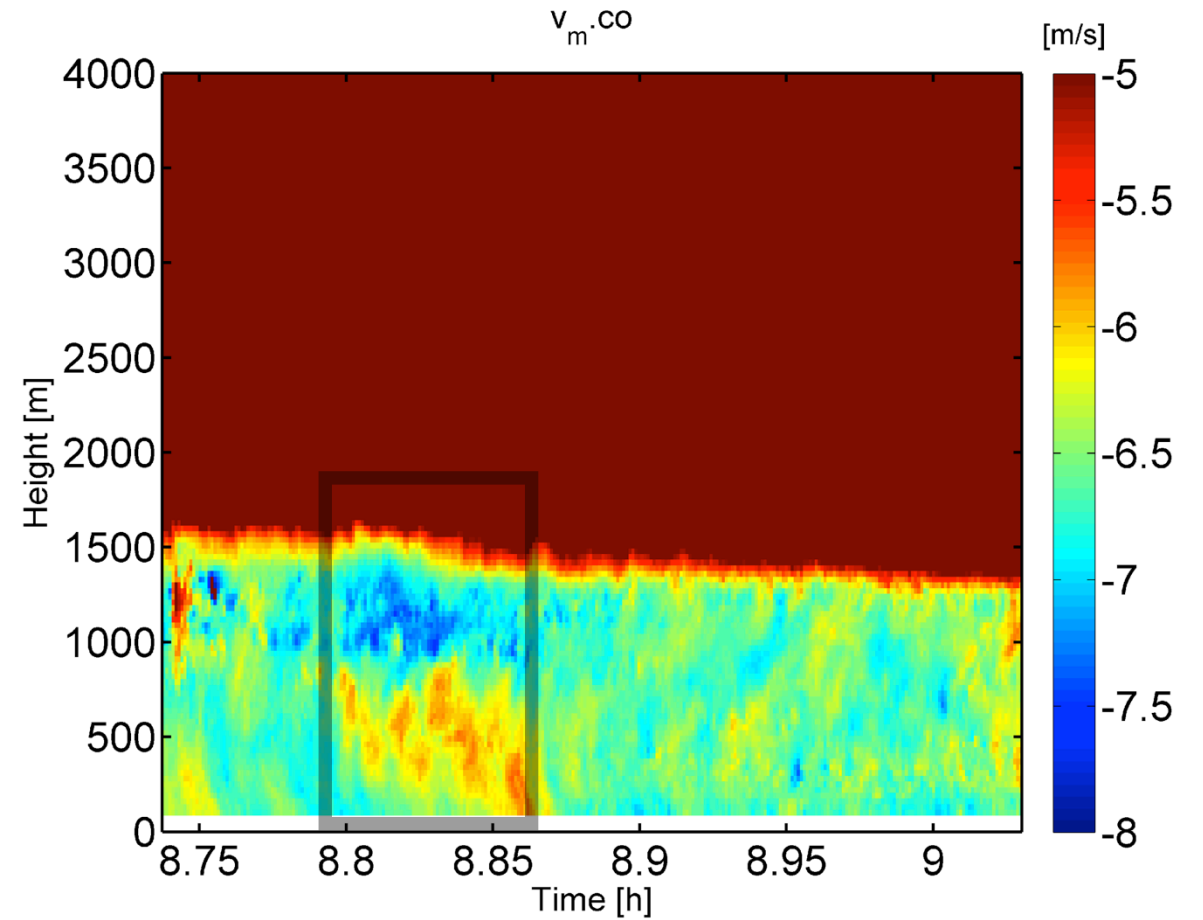
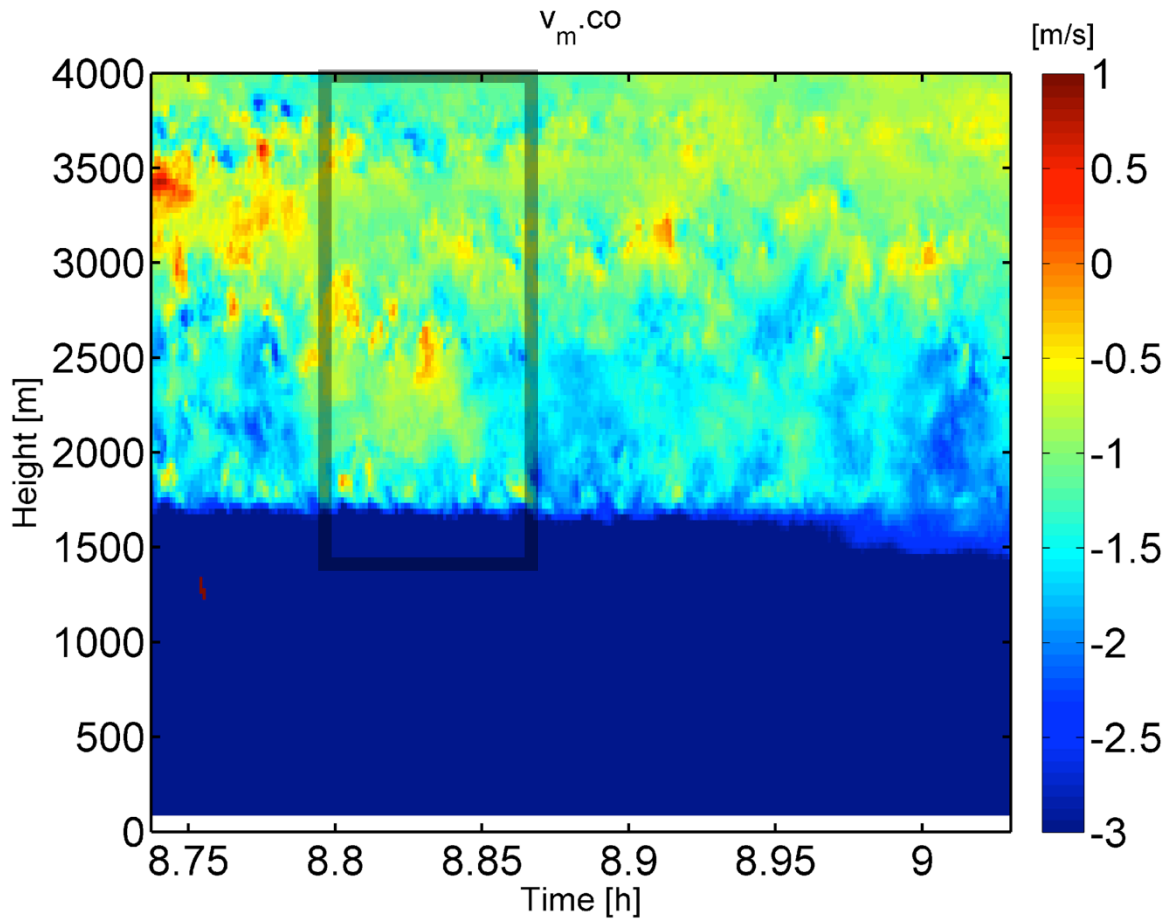




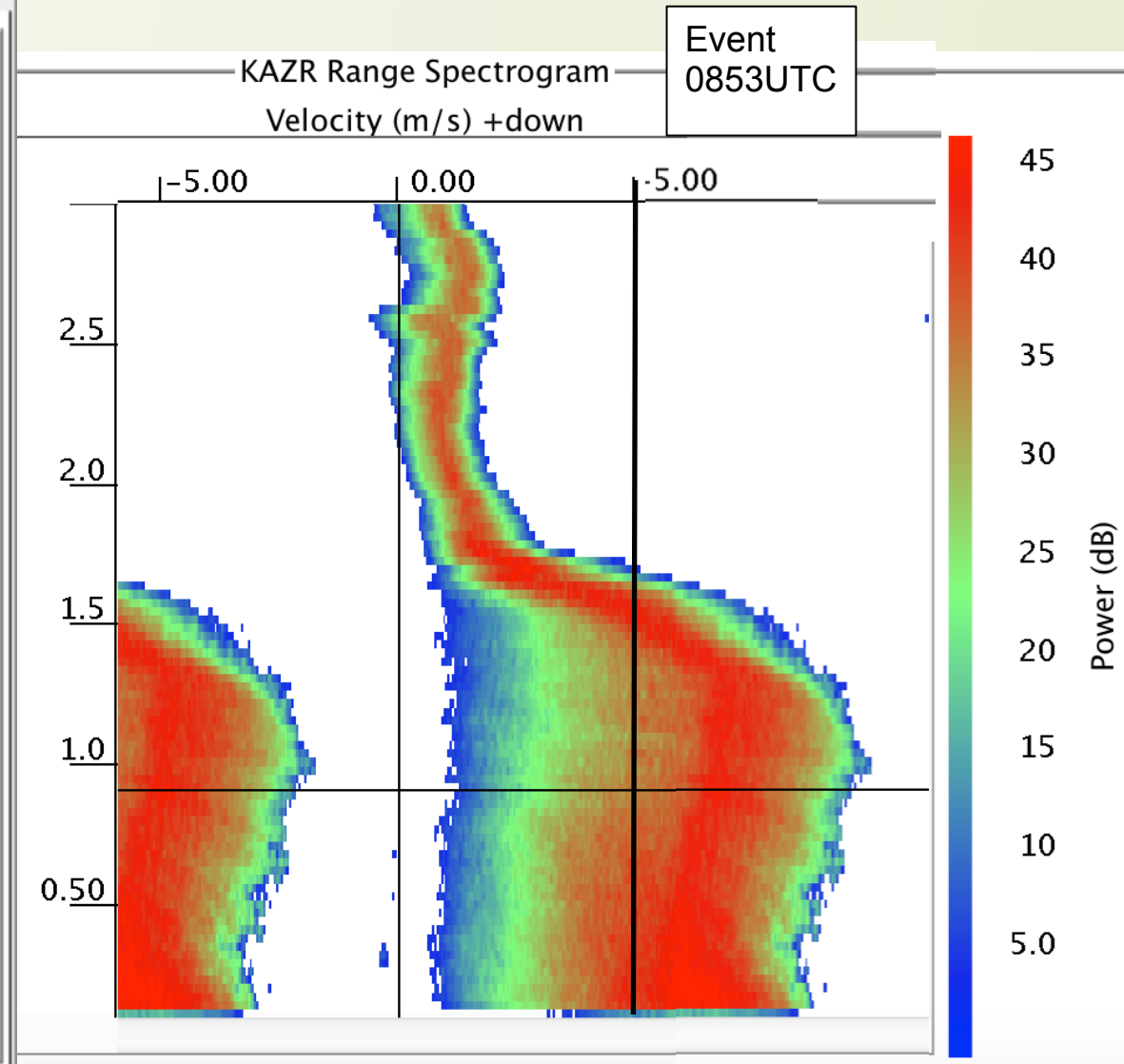
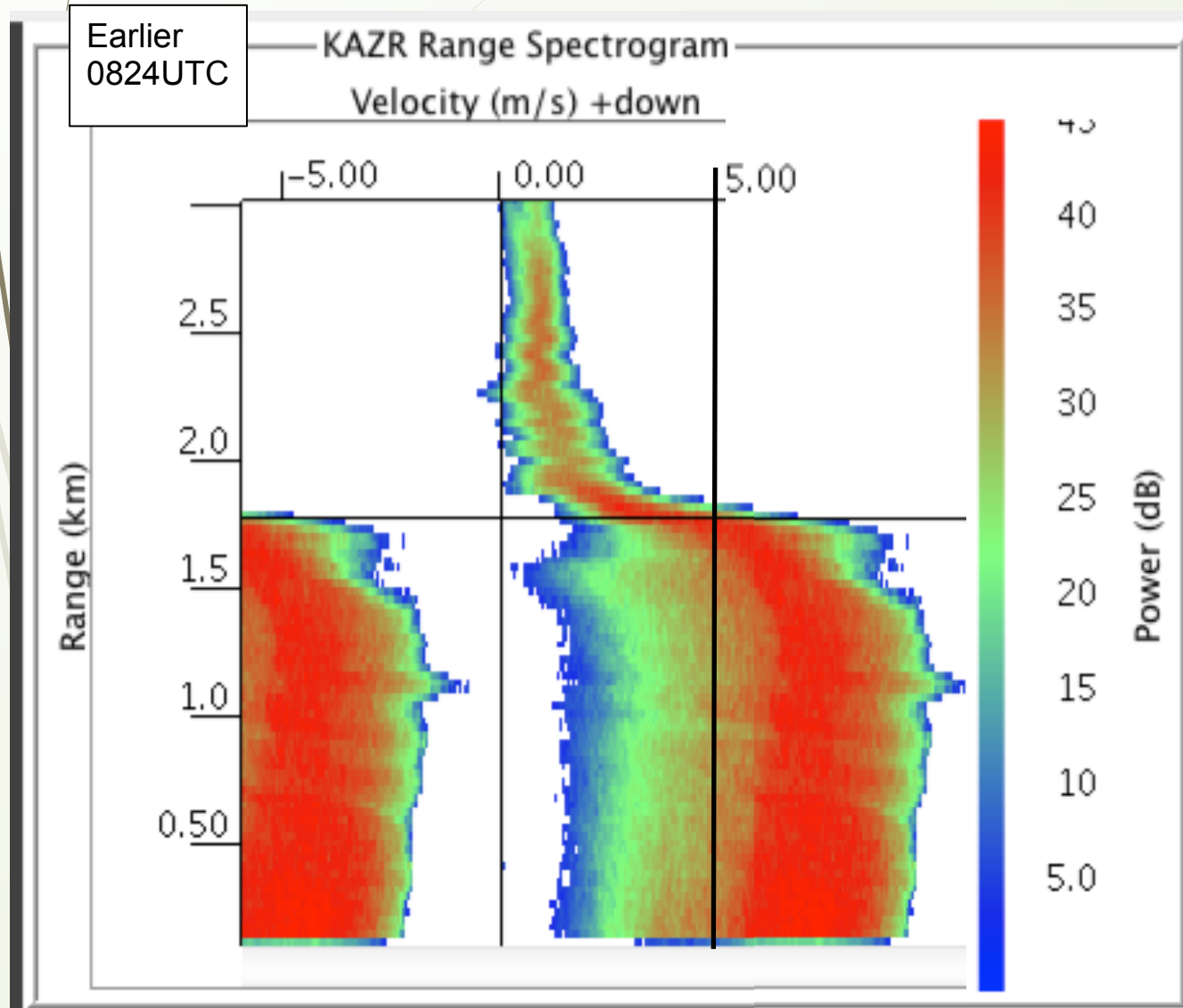
Reflectivity & Ceilometer Backscatter



KAZR Doppler Velocity

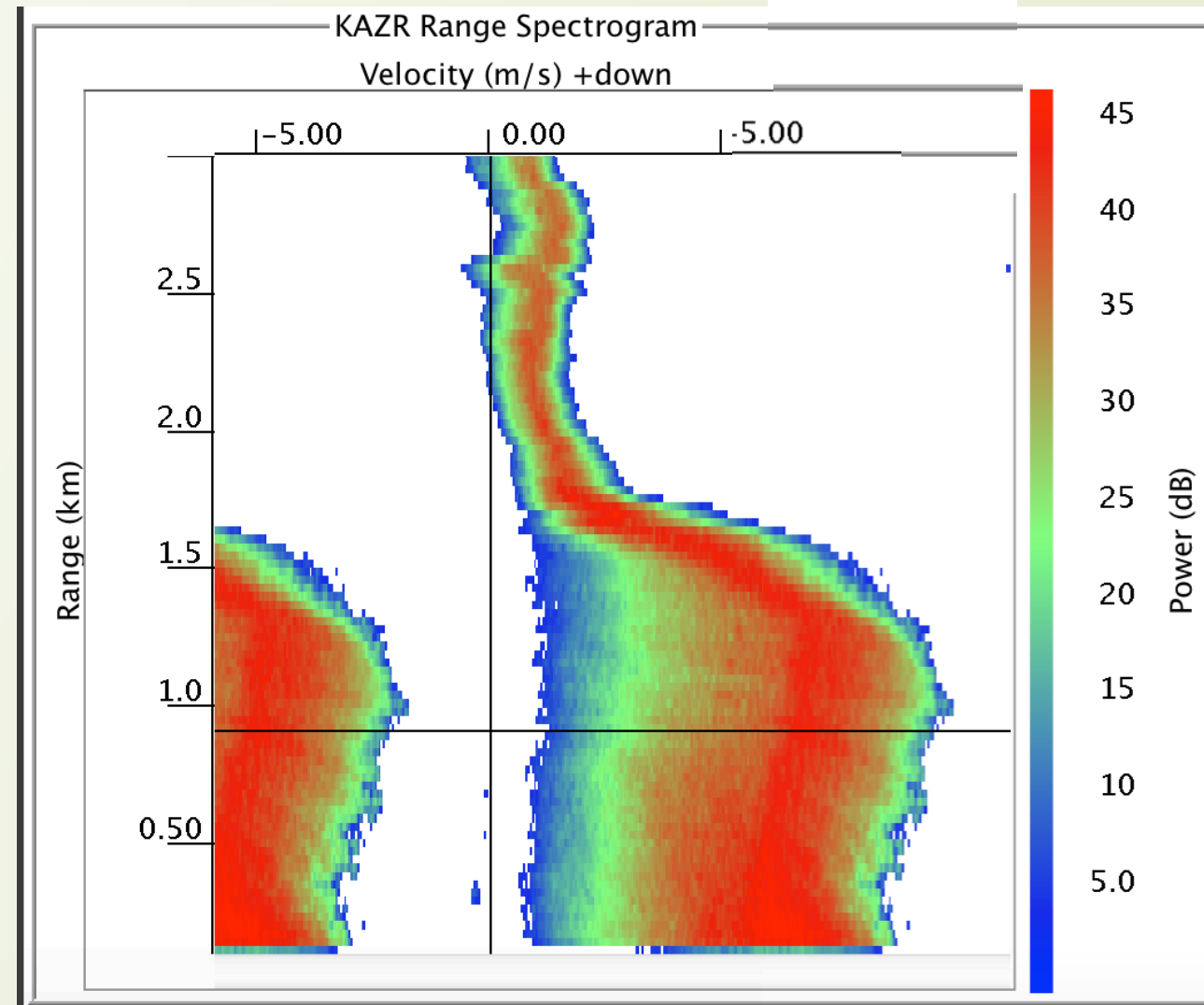
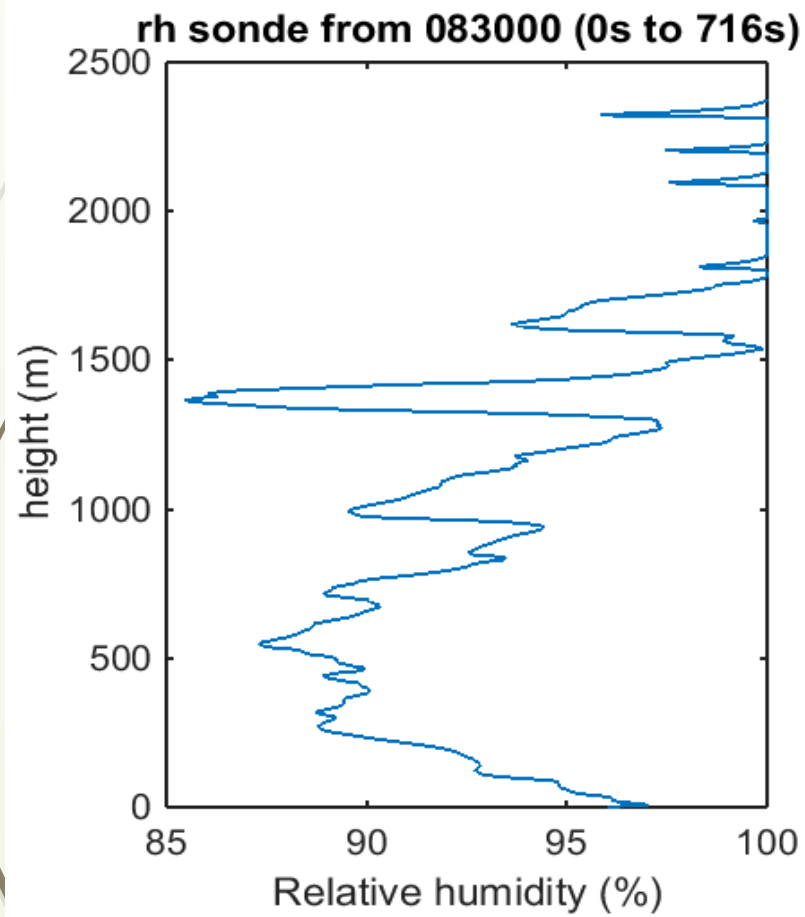



Velocity Spectral Width Decrease




Evaporation of Small Droplets below ML

Observed sounding was launched approximately 15min before beginning of radar data



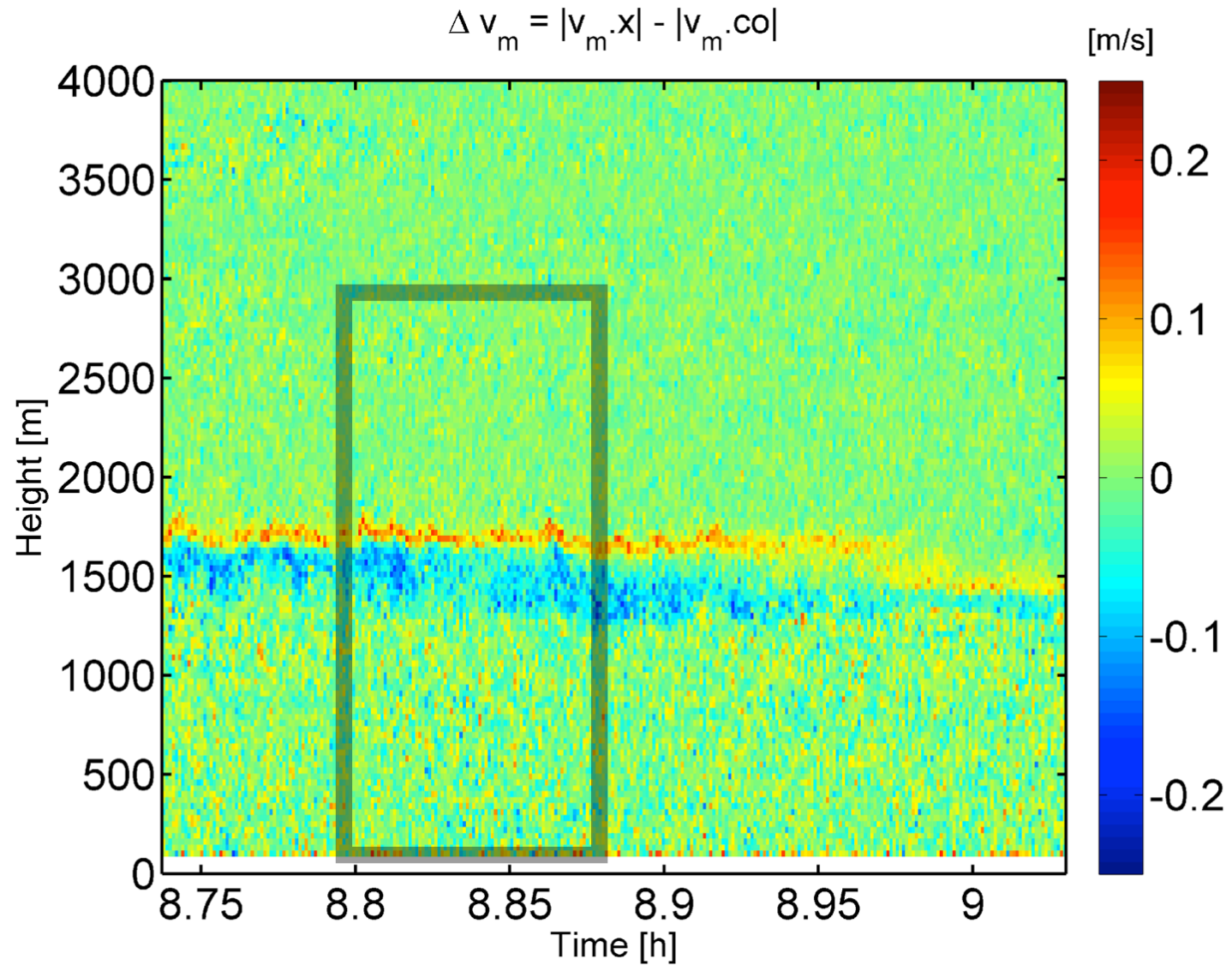


Initial Questions



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KAZR: Velocity_{xpol} - Velocity_{copol}



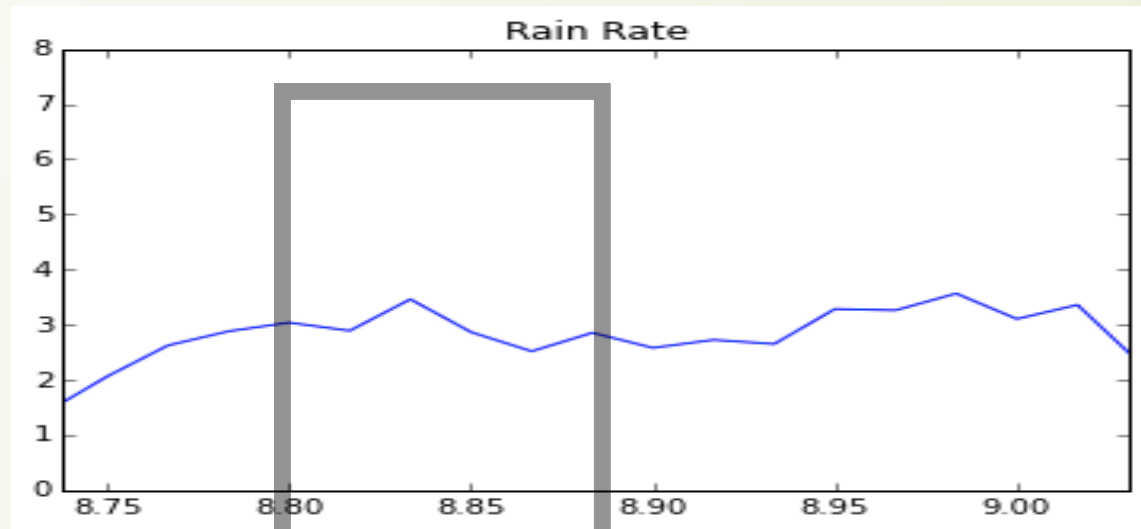


Extra Slides

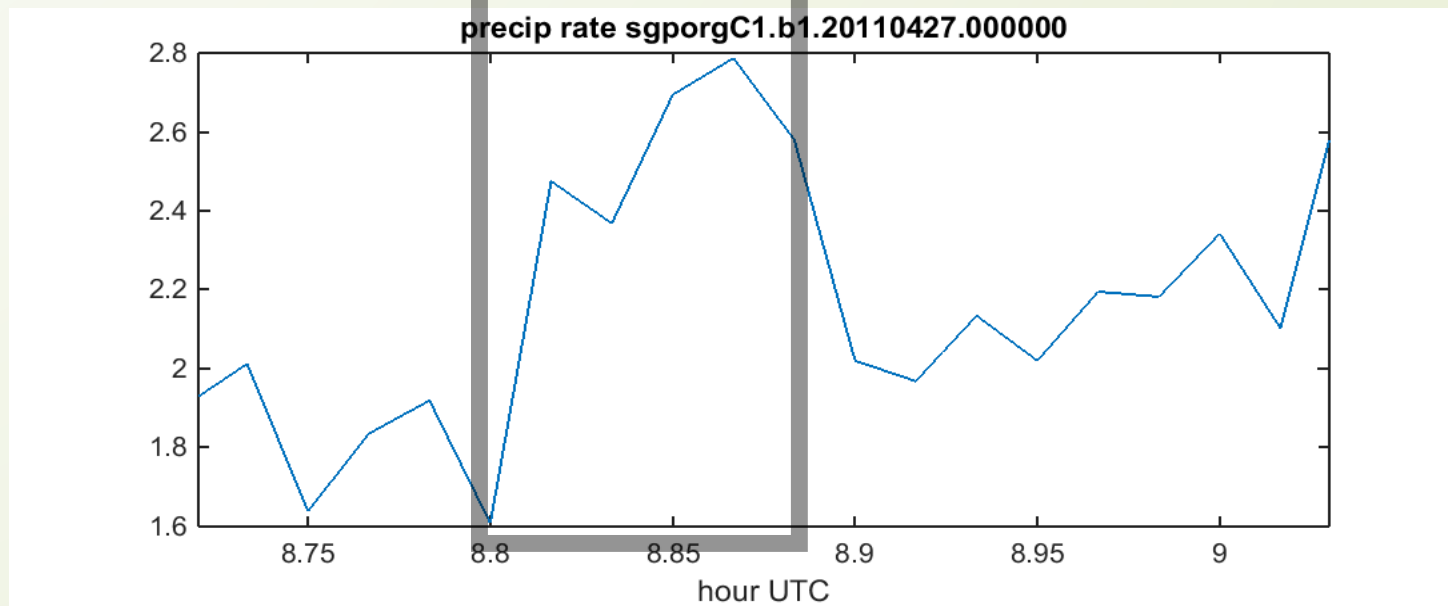


Surface rain rate

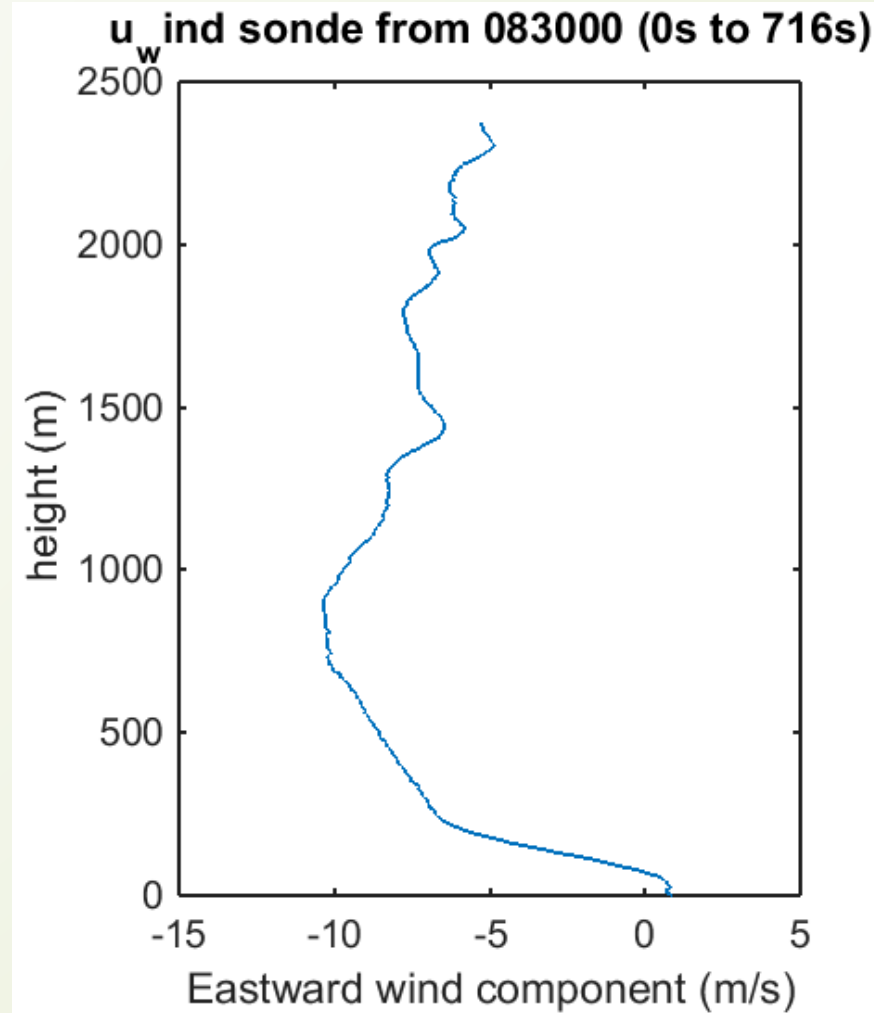
distrometer

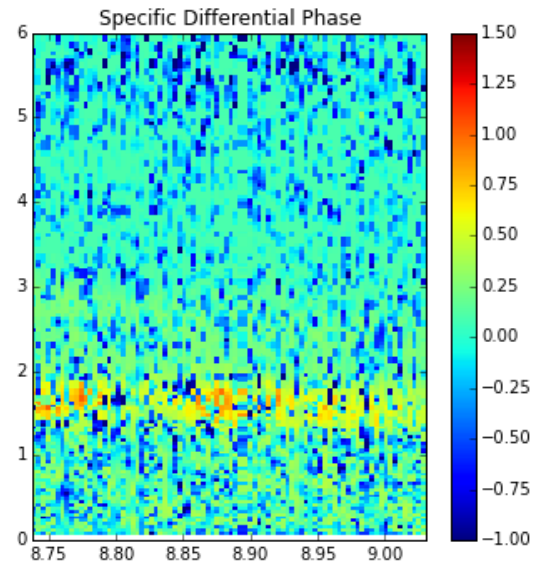
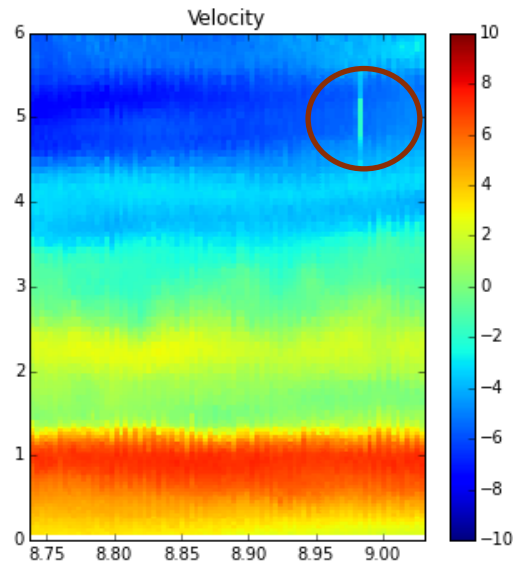
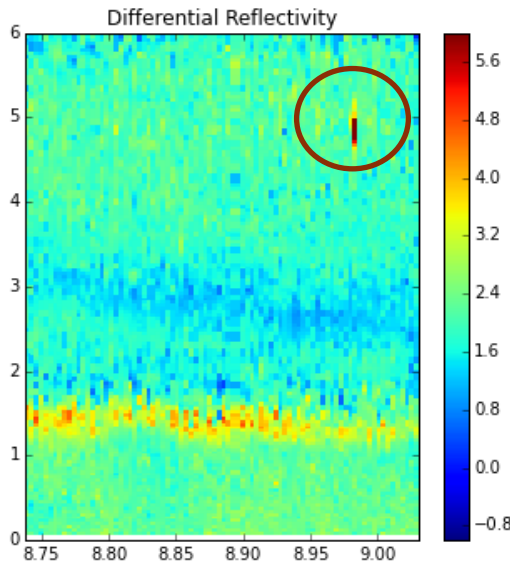
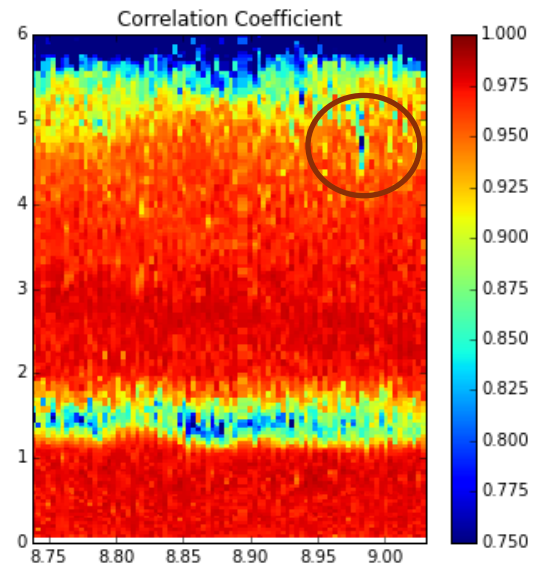
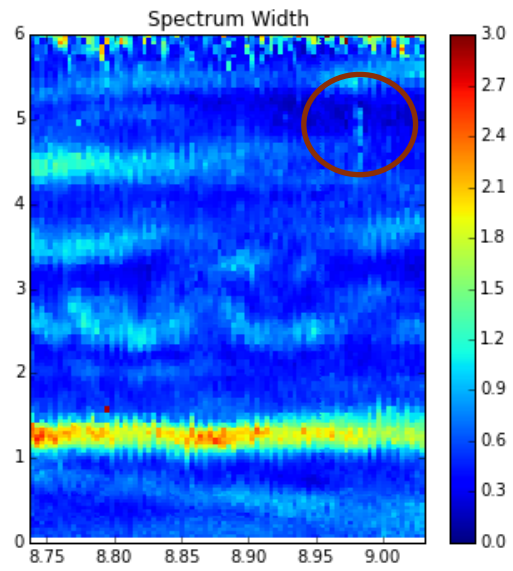
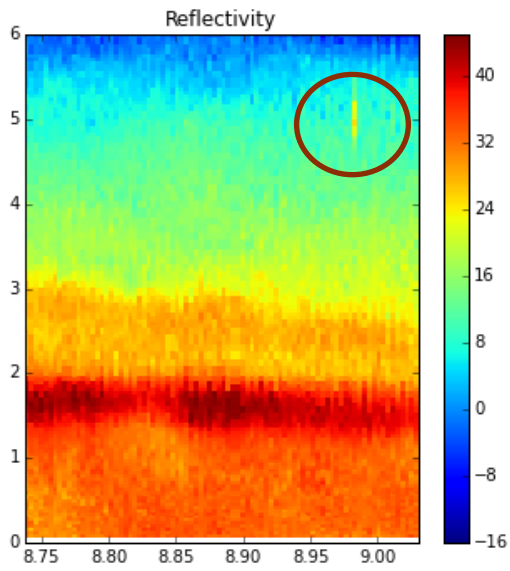


Optical rain gauge



Sonde U-wind





AIRPLANE!!!!