Complementary Use of APR-2 and DAWN During CPEX

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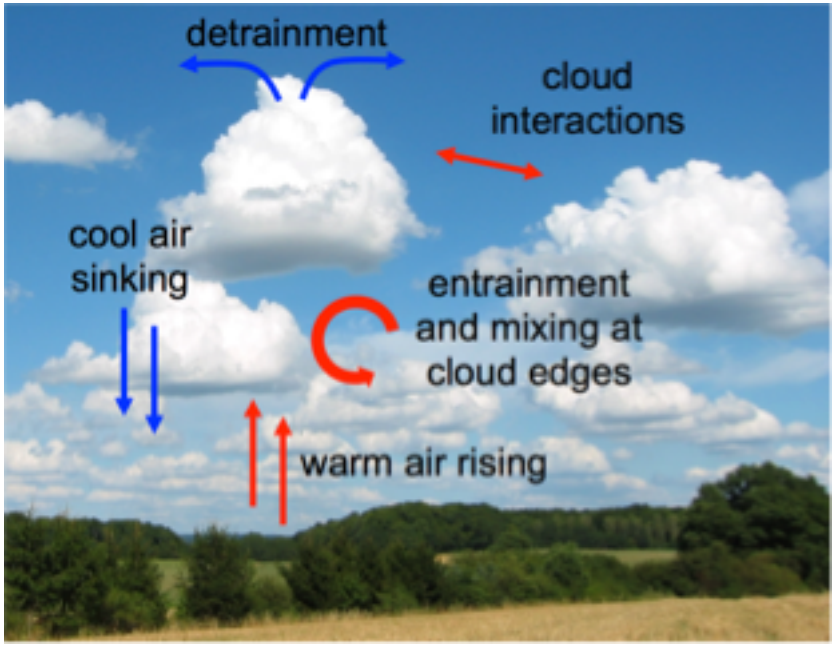
Air Motion and Convective Processes

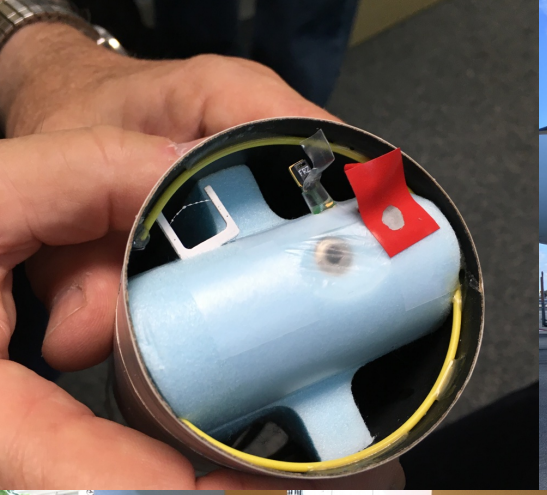
The mechanisms linking convection and cloud *dynamical* processes is a major factor in much of the uncertainty in both weather and climate prediction.

Further constraining the uncertainty in convective cloud processes linking 3-D air motion and cloud structure through models and observations is vital for improvements in weather forecasting and understanding limits on atmospheric predictability.

NASA's Convective Processes Experiment (CPEX) in May-June 2017, (based out of Ft Lauderdale), 100 DC-8 flight hours

Capture developing oceanic convection with JPL Ku/Ka-band APR-2 radar, and nearby "clear air" to capture 3-D wind structure from a Doppler wind lidar (DAWN)



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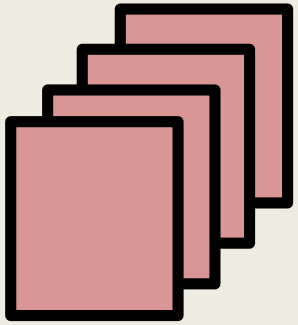
Investigation Design

Establish variability in (u,v,w)



LES ensemble initialized each flight date

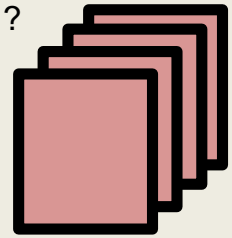
1

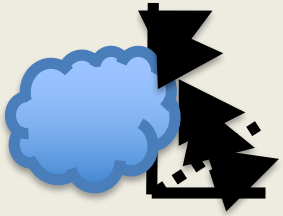
DAWN profiles (u,v,w)

DA

NU-WRF

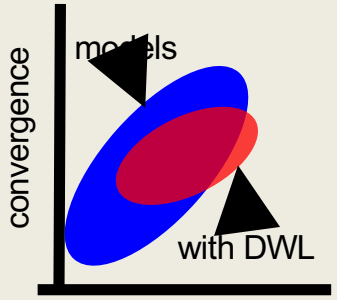
change to variability in (u,v,w) ?





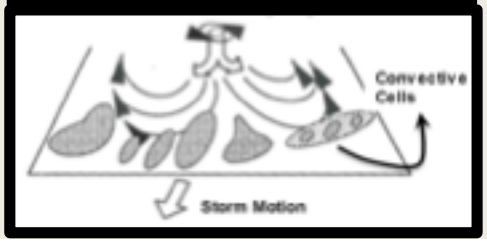
(u,v,w) not at all levels, away from cloud

2



GPM, ASCAT/ScatSat

joint distribution of cold pool size and convective organization



4

macro-scale

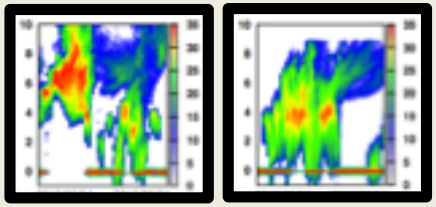
storm-scale

APR-2 Retrievals

APR-2 profiles of in-cloud *w*, microphysical structure

in-cloud *w* at 30-m levels

3



representation of convective cloud structures, vertical air motion

June 10 Study

Examined the three flight segments on this day, that Ed Zipser presented in his CPEX presentation at the recent AMS Tropical conference in Florida:

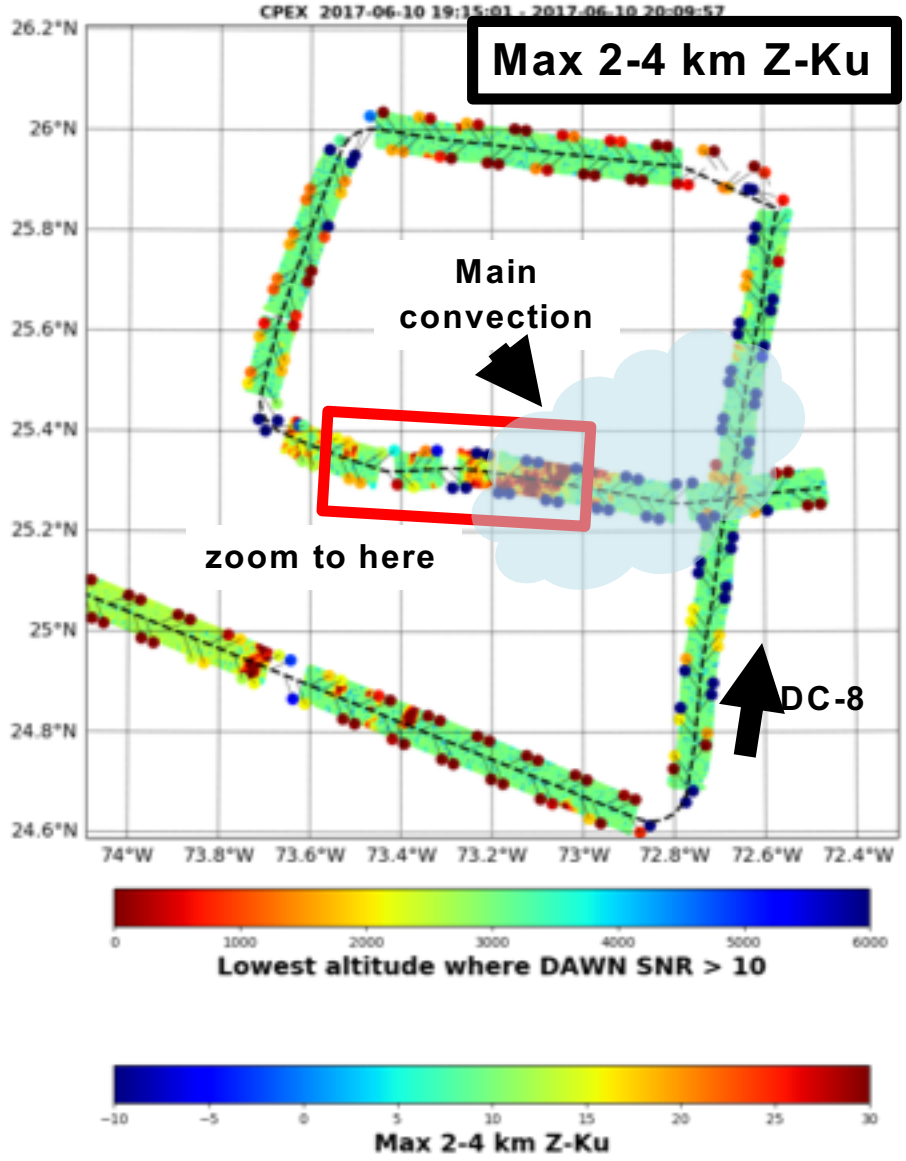
1) 1915-2010 UTC
2) 2030-2120 UTC
3) 2030-2230 UTC

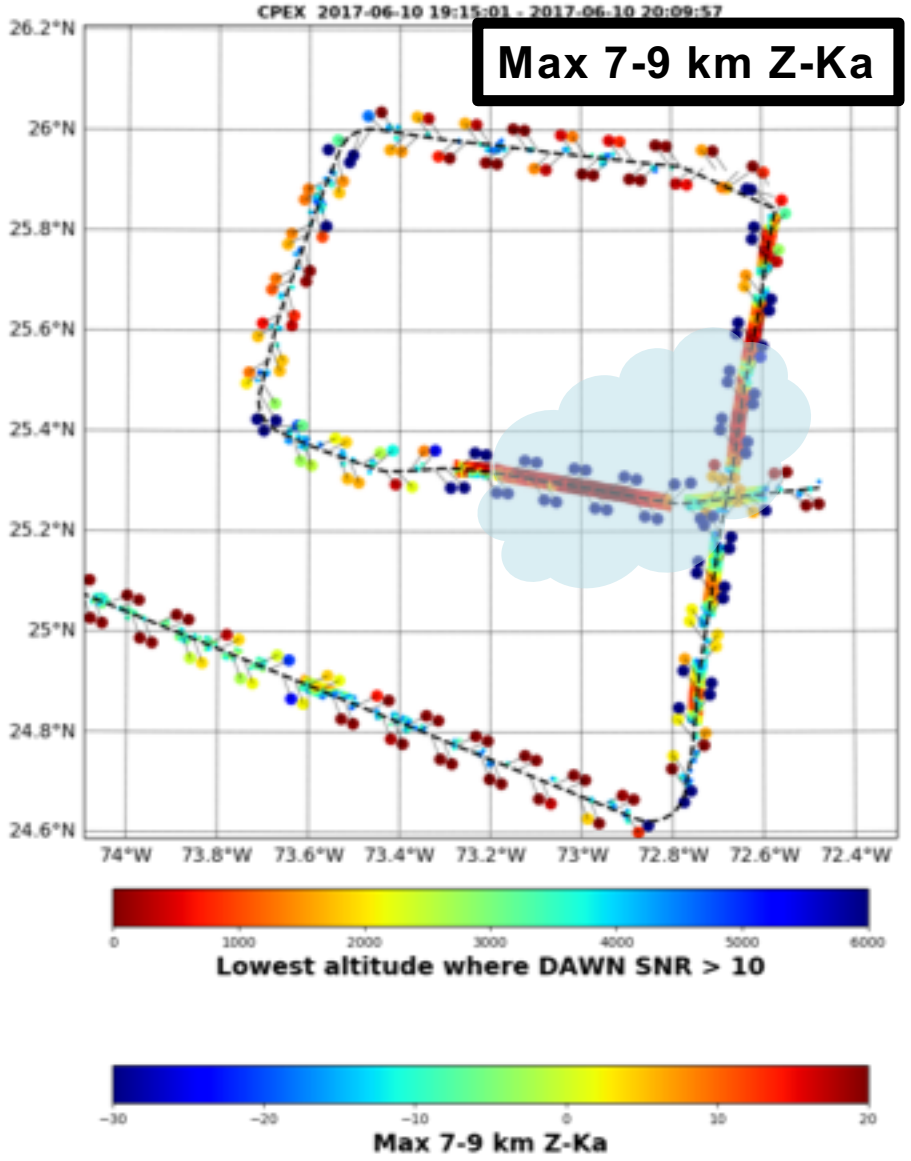
The APR-2 Ka (Ku)-band profiles were bin-matched to Version-4 DAWN LOS data to assess the utility of these data to be upper (lower) cloud presence.

While the profiles are location-matched, the viewing directions are not. APR-2 scans across track (23 positions), and DAWN stares (2-5 looks) at multiple azimuth angles for several seconds (as the DC-8 moves forward).

Complicates radar-lidar vertical velocity comparisons (use PROF instead)

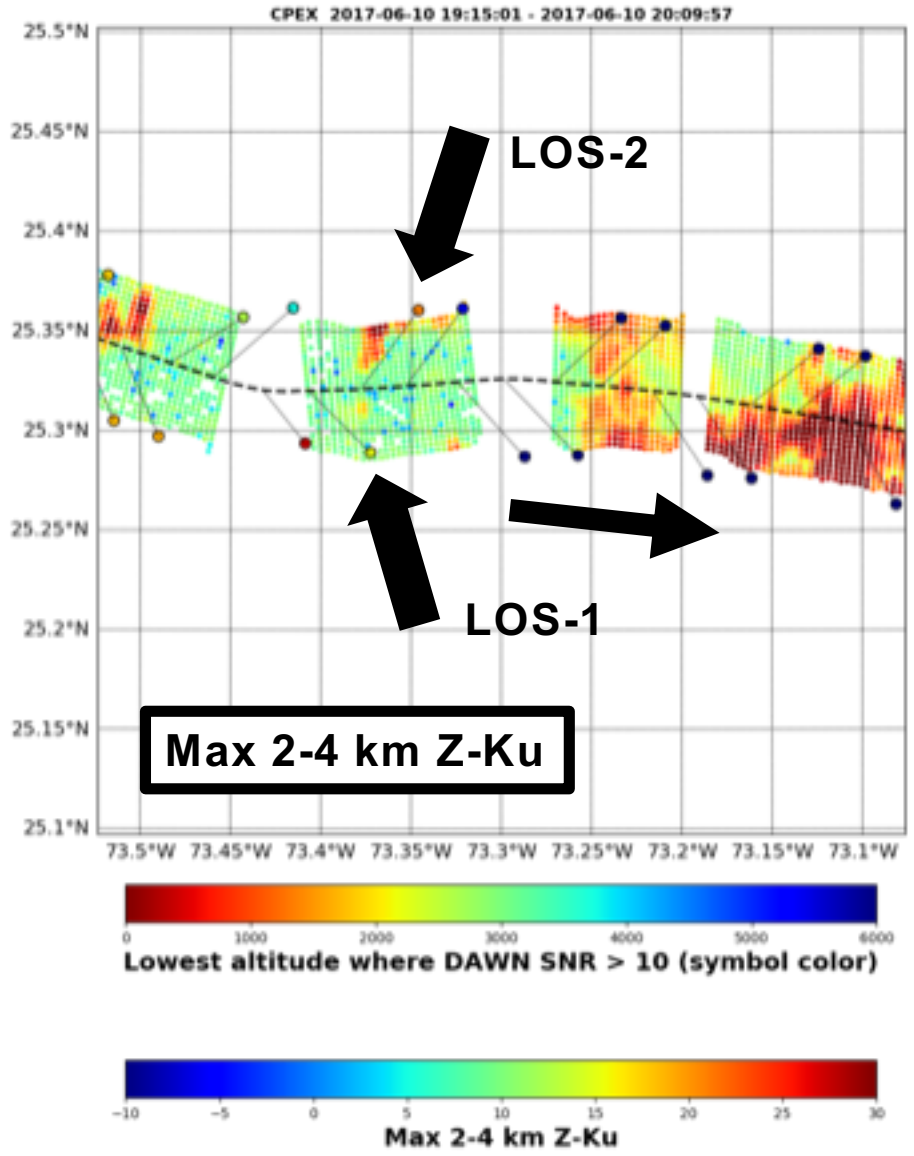
Segment 1: June 10, 2017 1915-2010 UTC

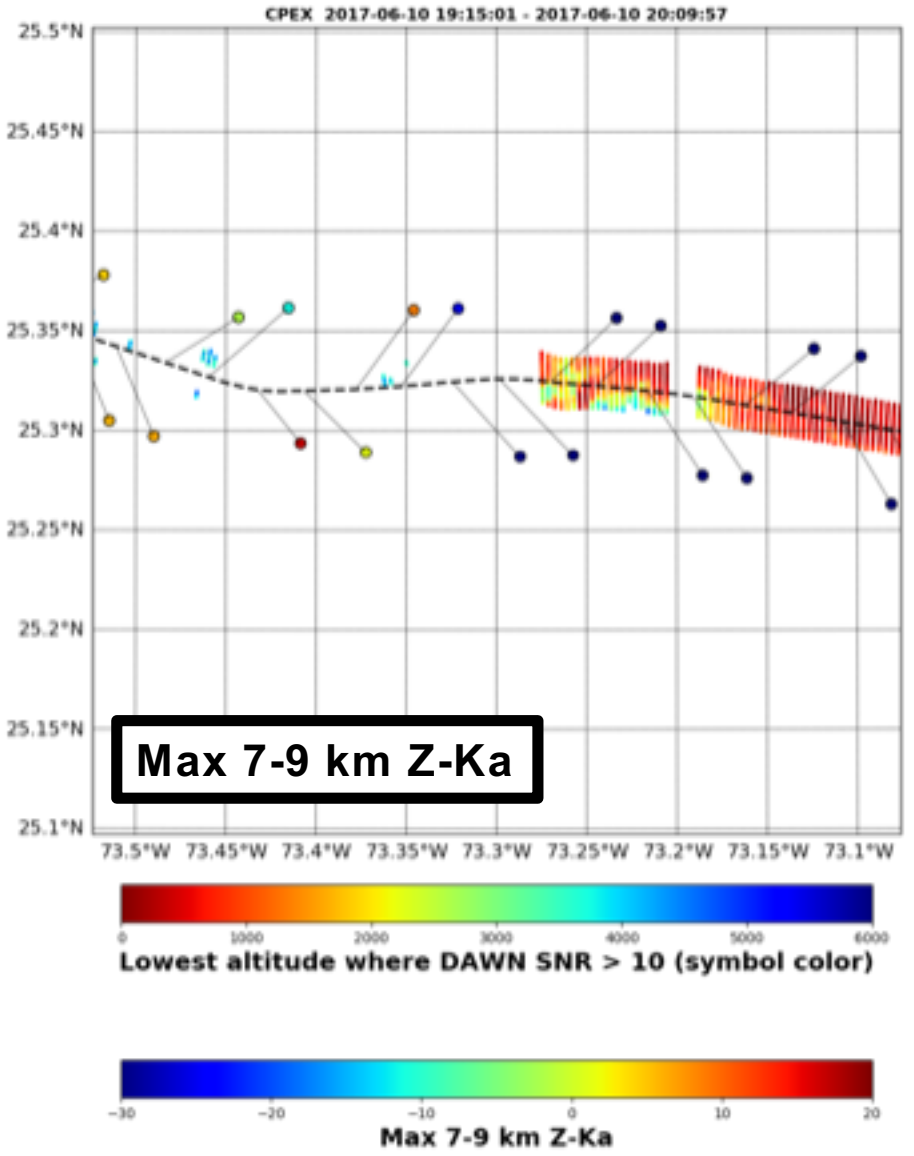




Line segments indicate top-to-surface path for each DAWN LOS profile

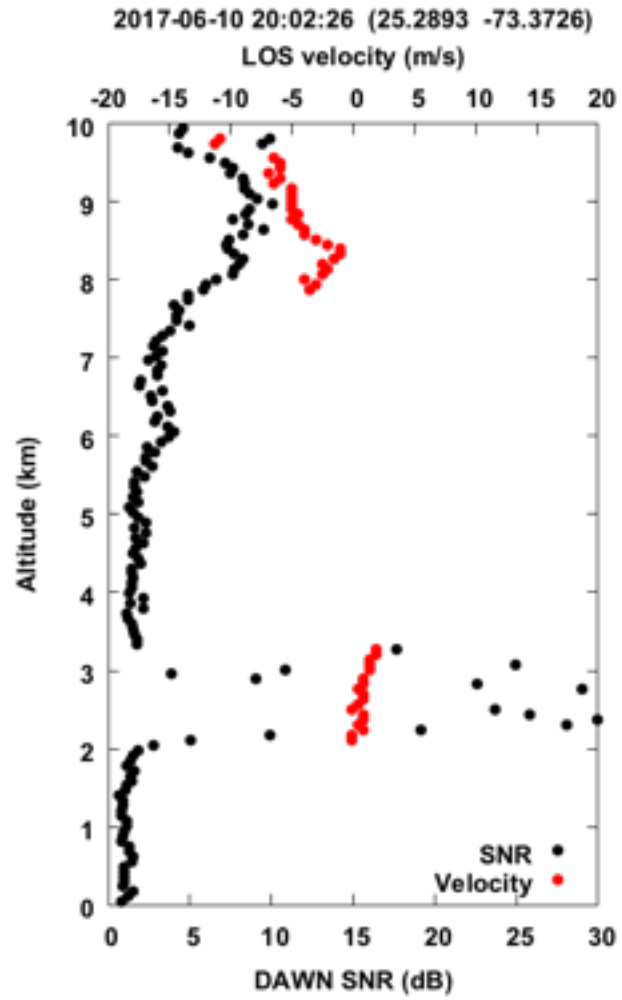
June 10, 2017 Near 1926 UTC Zoom-in

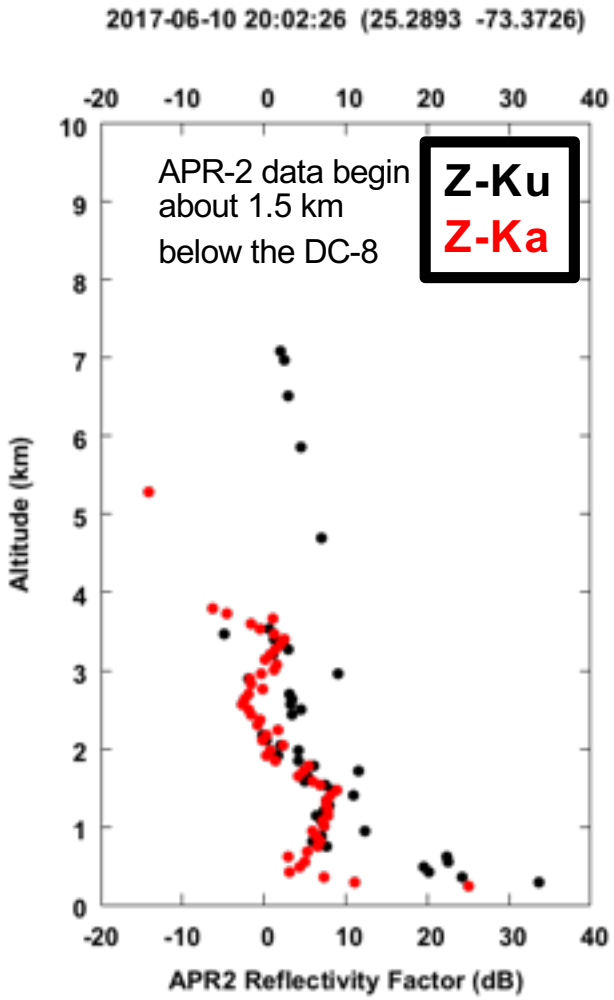


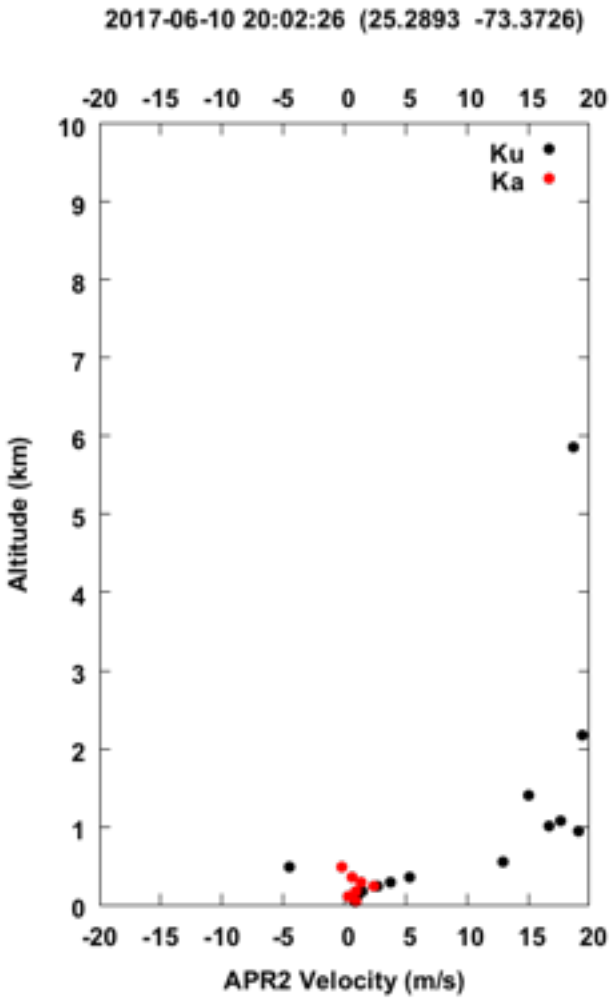


Line segments indicate top-to-surface path for each DAWN LOS profile

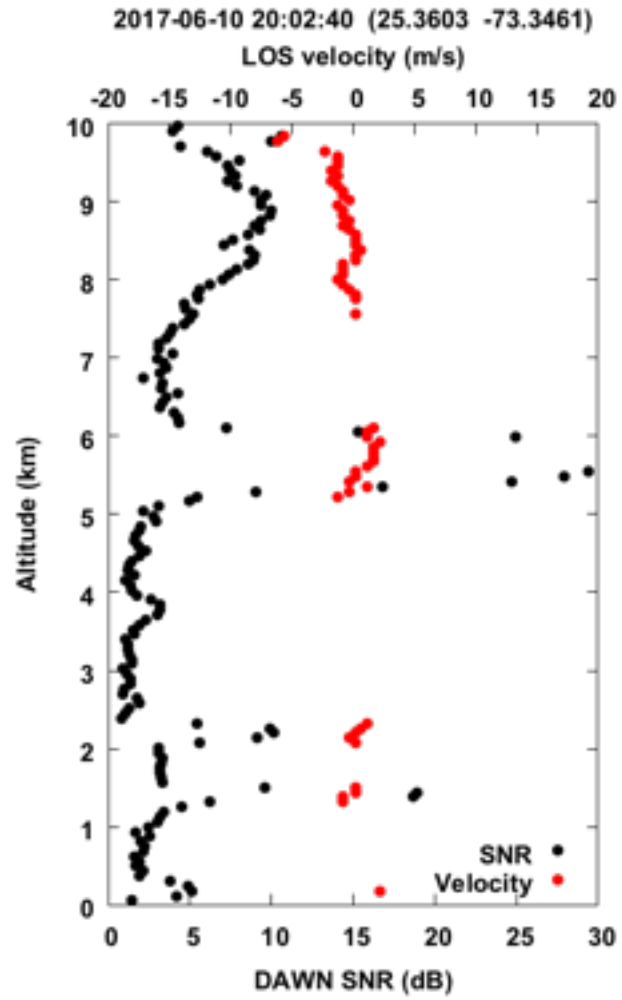
June 10, 2017 2002 UTC LOS 1 DAWN (left) APR2 (mid, right)

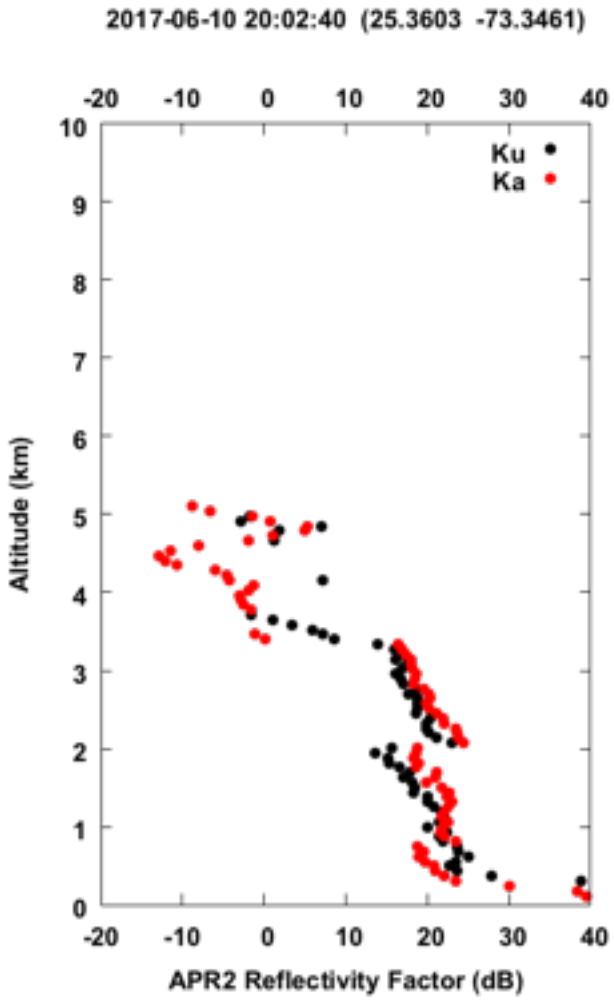


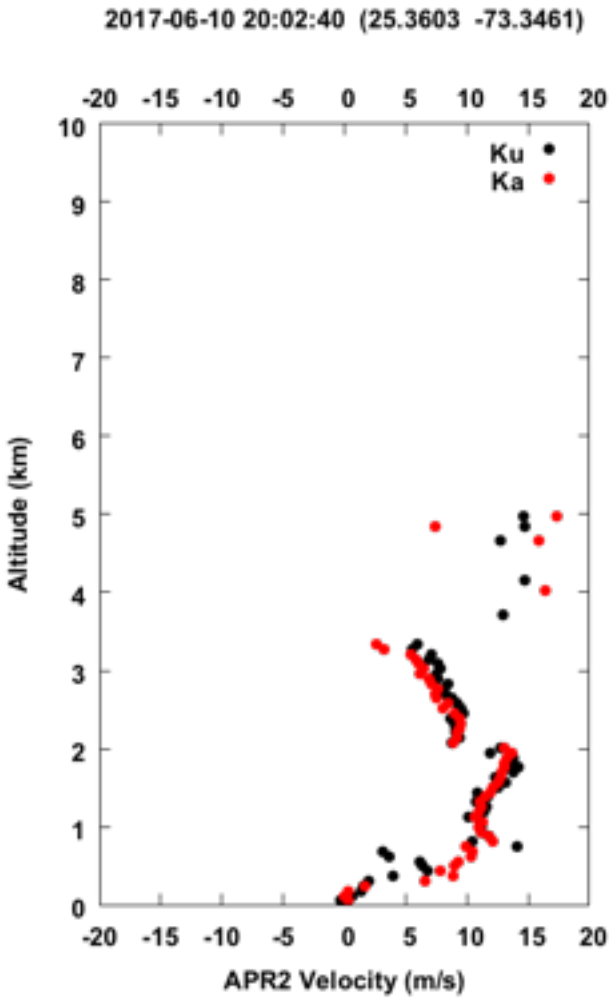




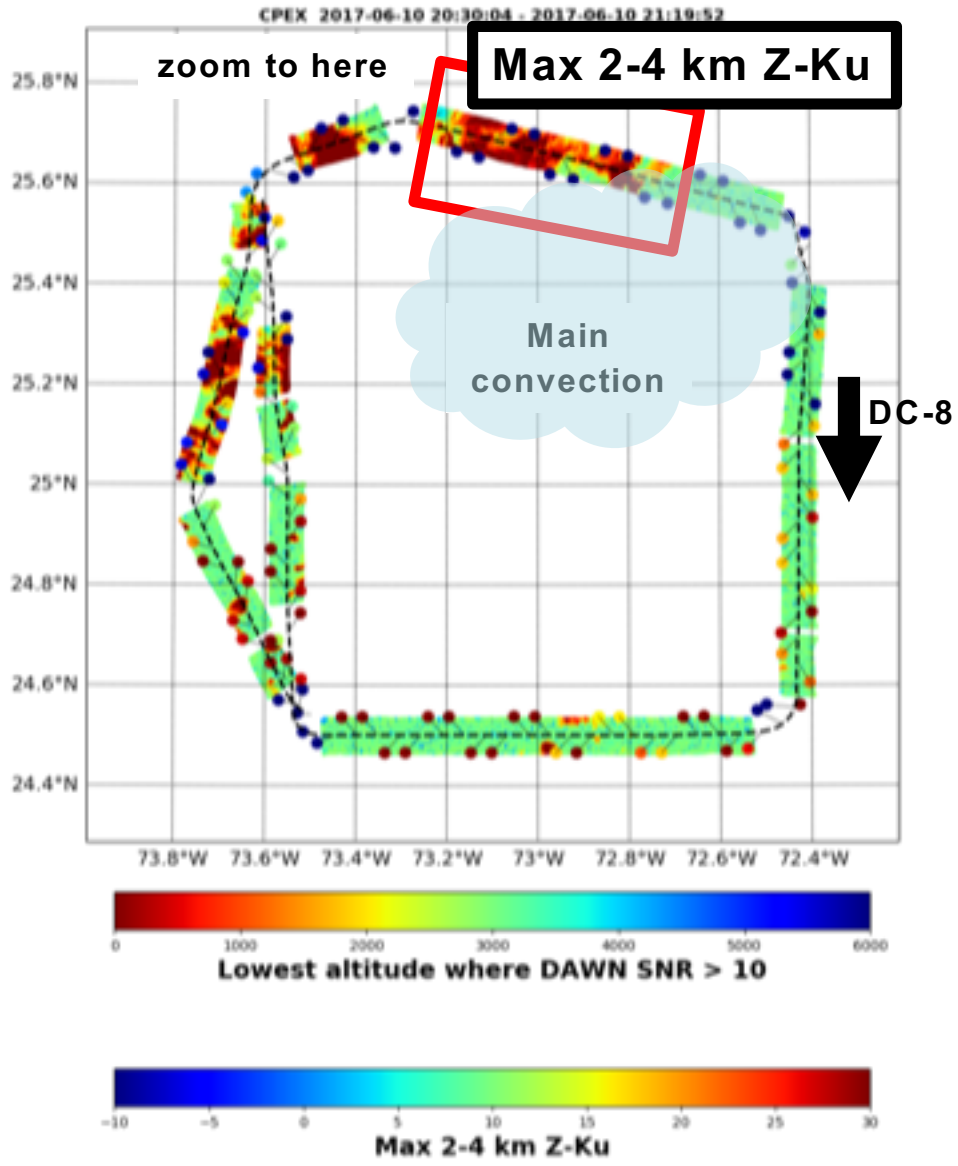
June 10, 2017 2002 UTC LOS 2 DAWN (left) APR2 (mid, right)

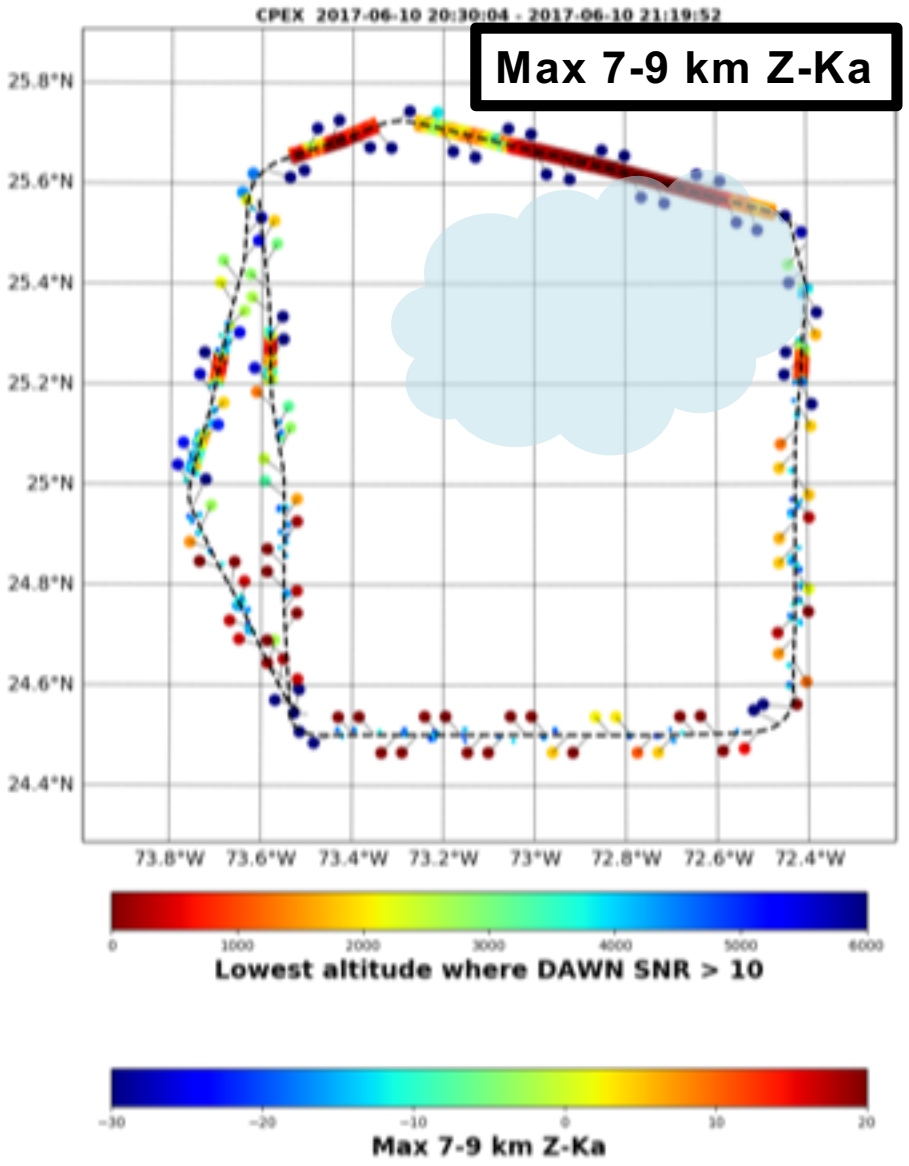






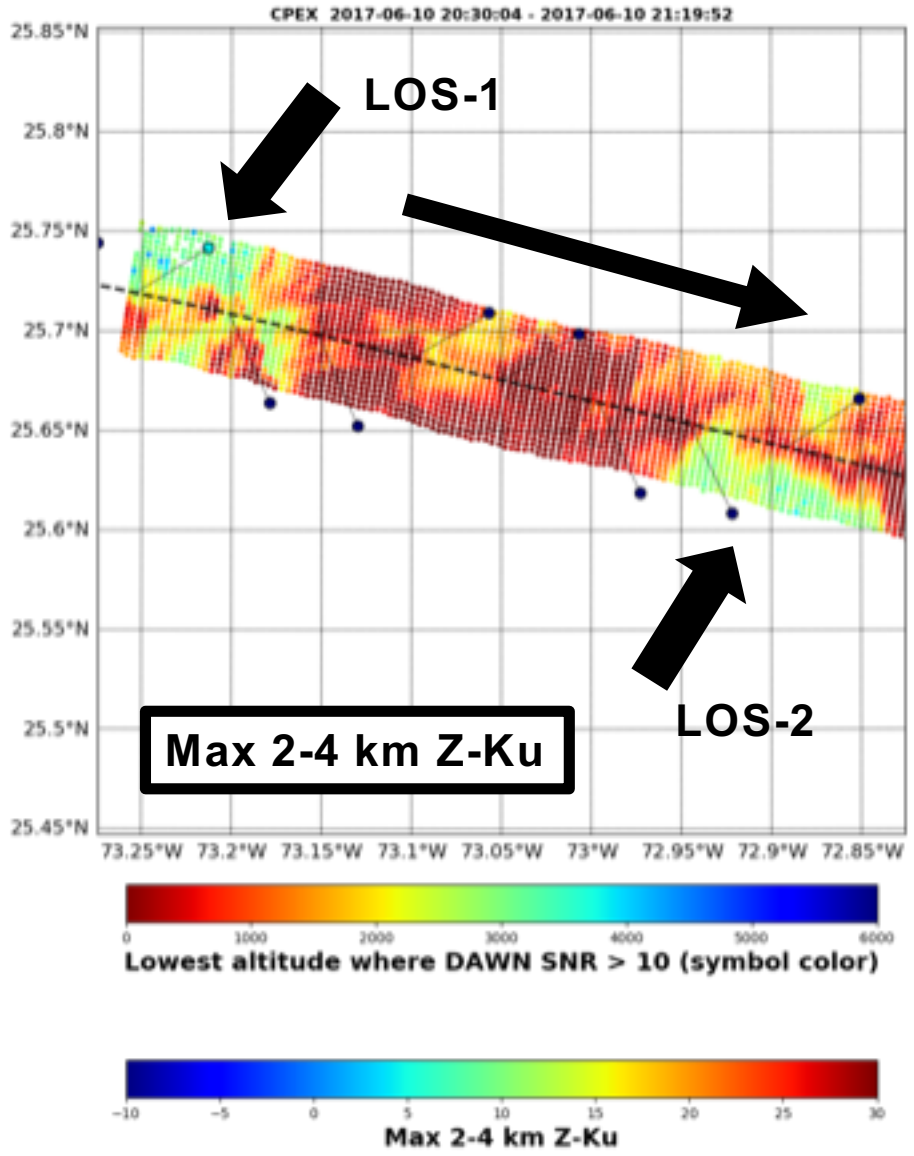
Segment 2: June 10, 2017 2030-2120 UTC

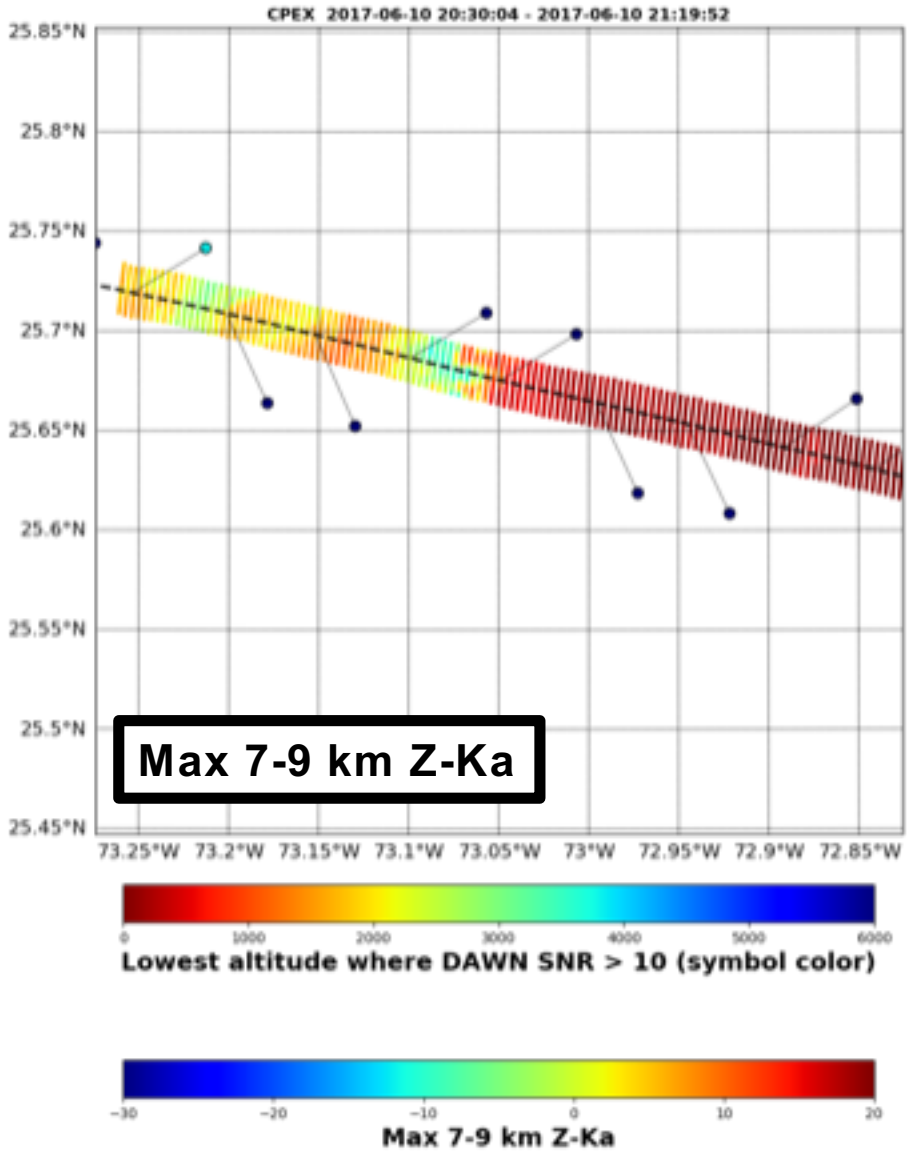




Line segments indicate top-to-surface path for each DAWN LOS profile

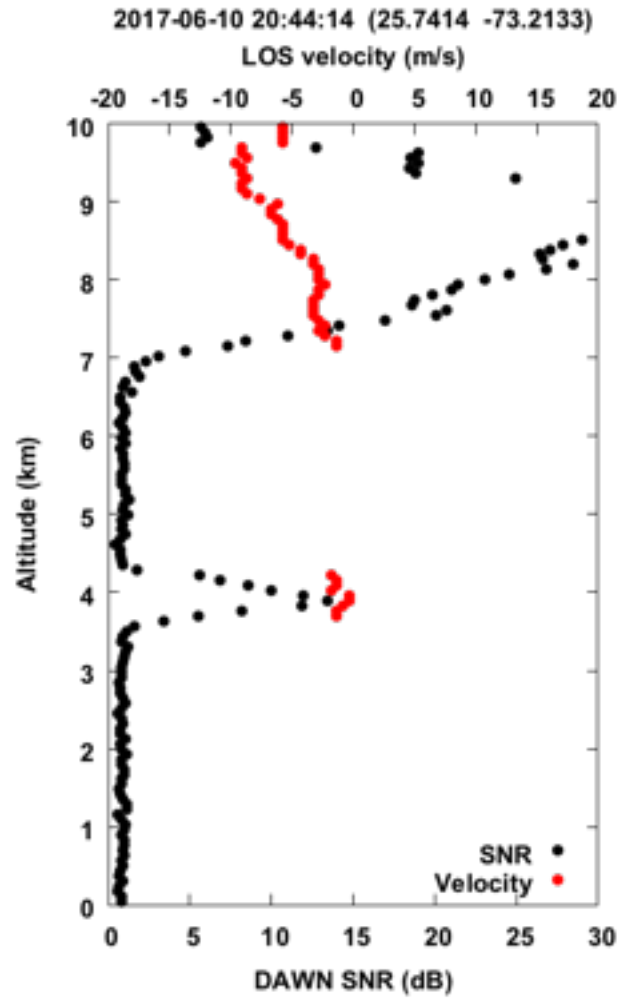
June 10, 2017 Near 2046 UTC Zoom-in

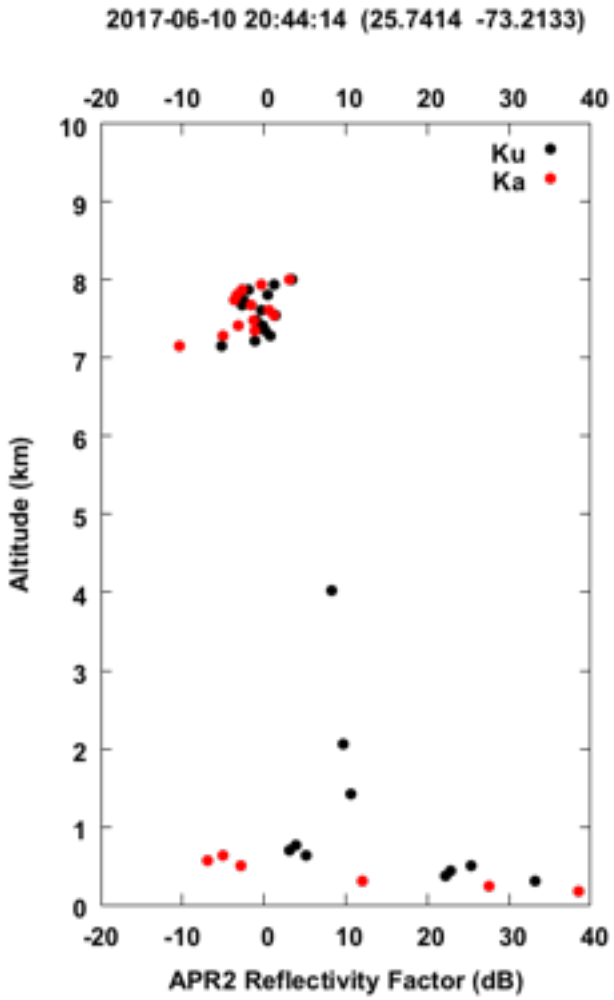


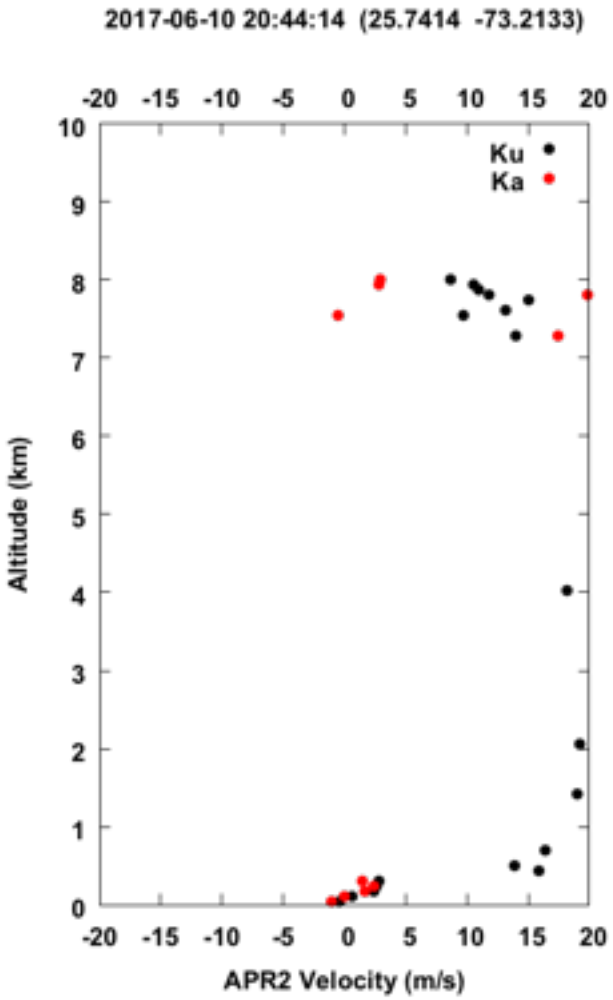


Line segments indicate top-to-surface path for each DAWN LOS profile

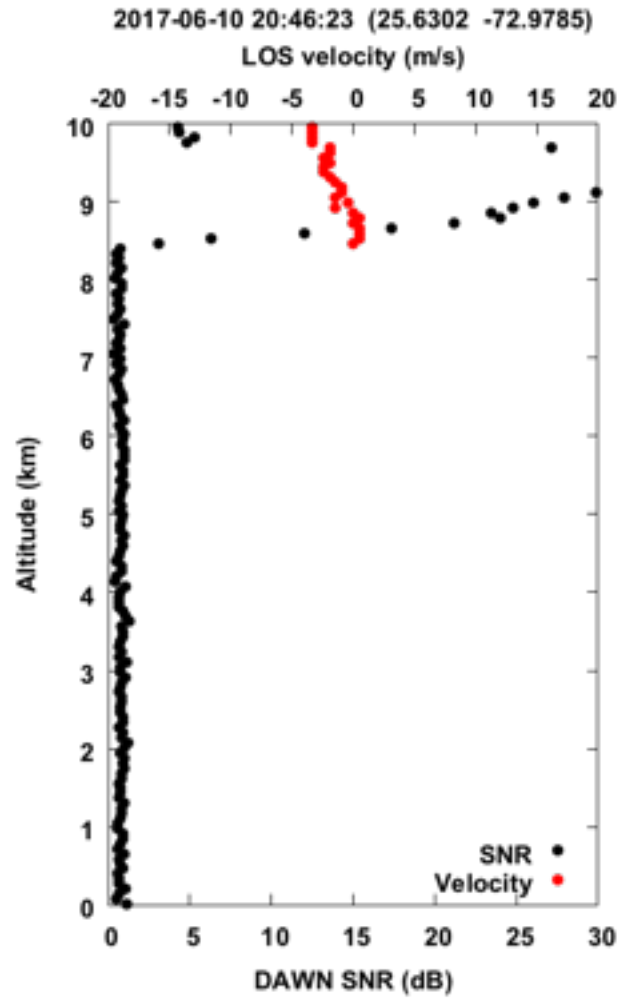
June 10, 2017 2044 UTC LOS 1 DAWN (left) APR2 (mid, right)

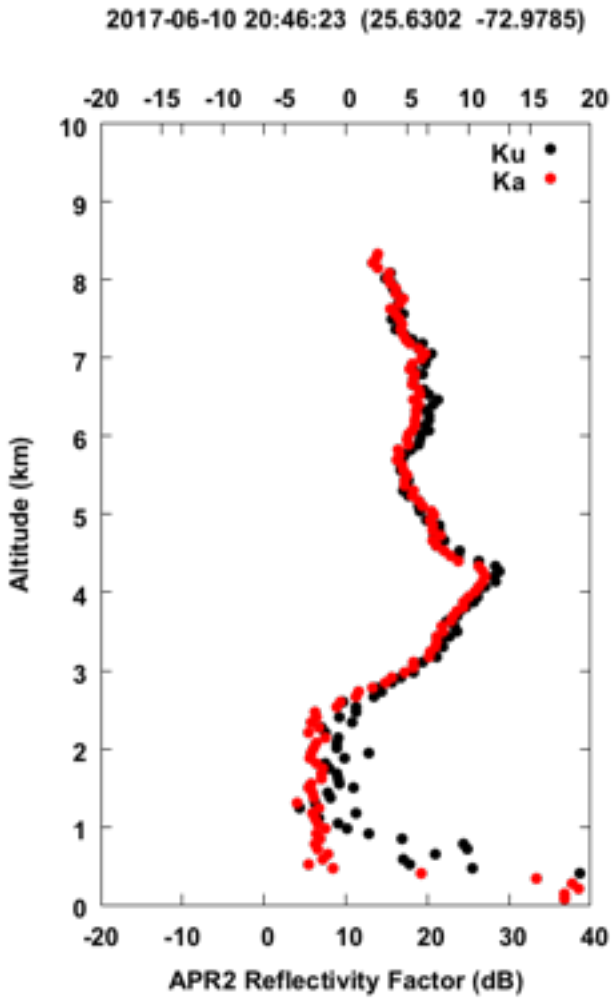


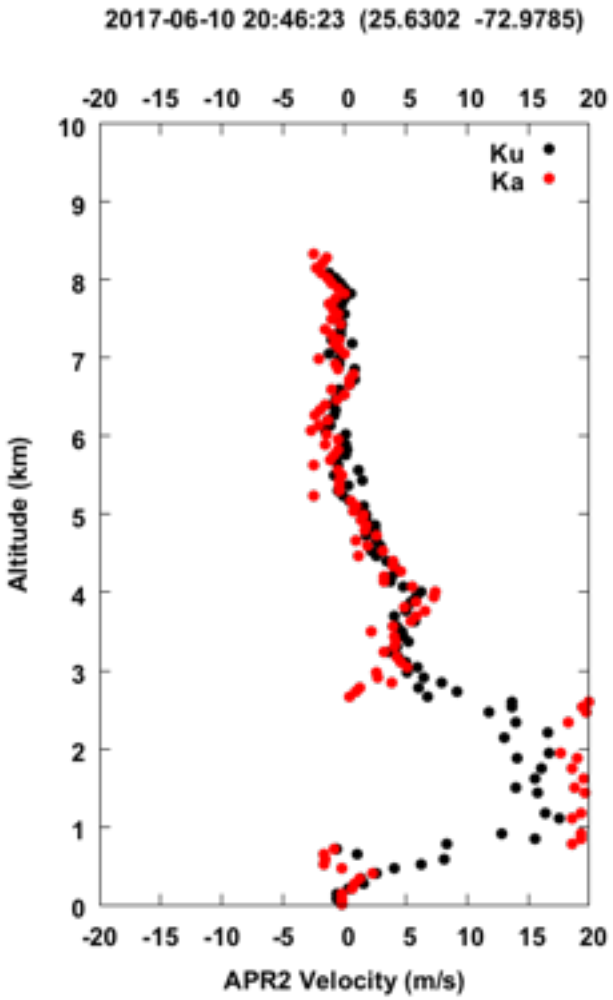




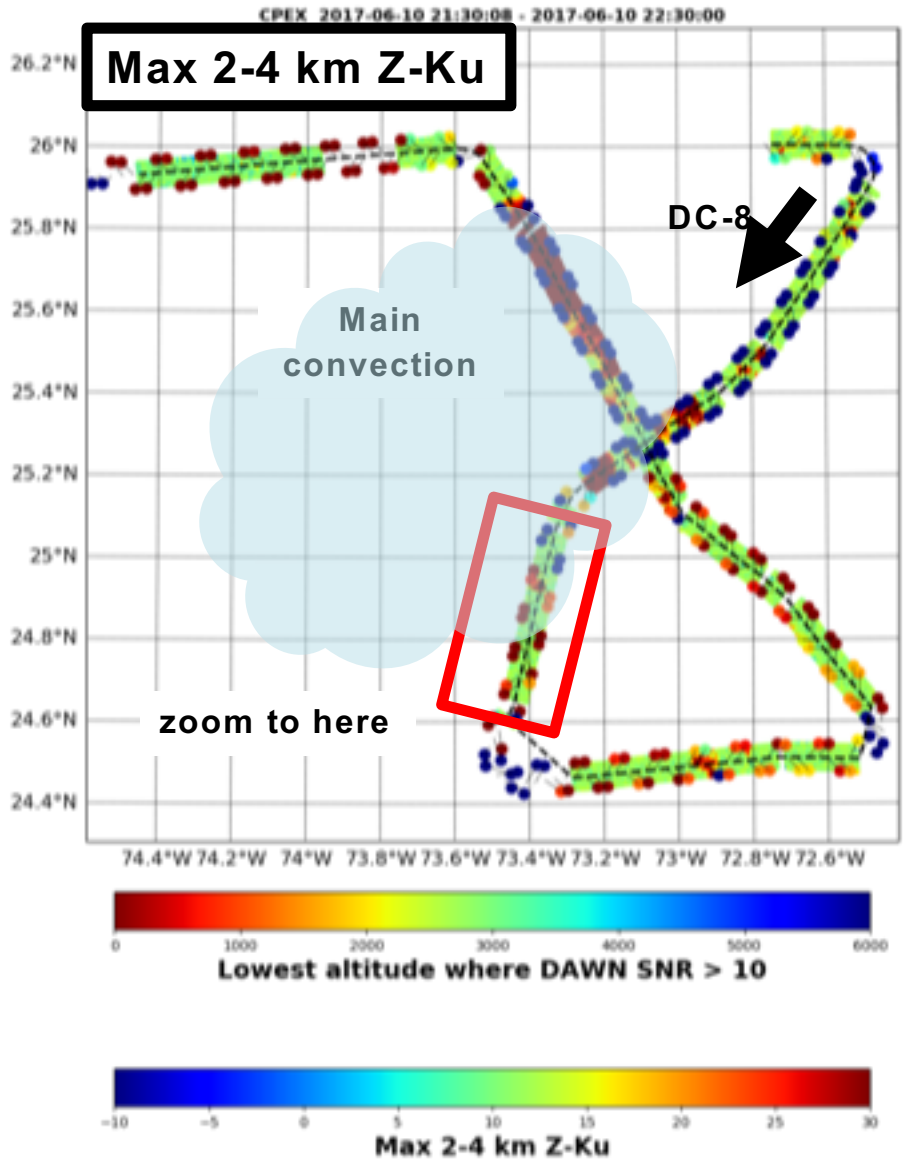
June 10, 2017 2046 UTC LOS 2 DAWN (left) APR2 (mid, right)

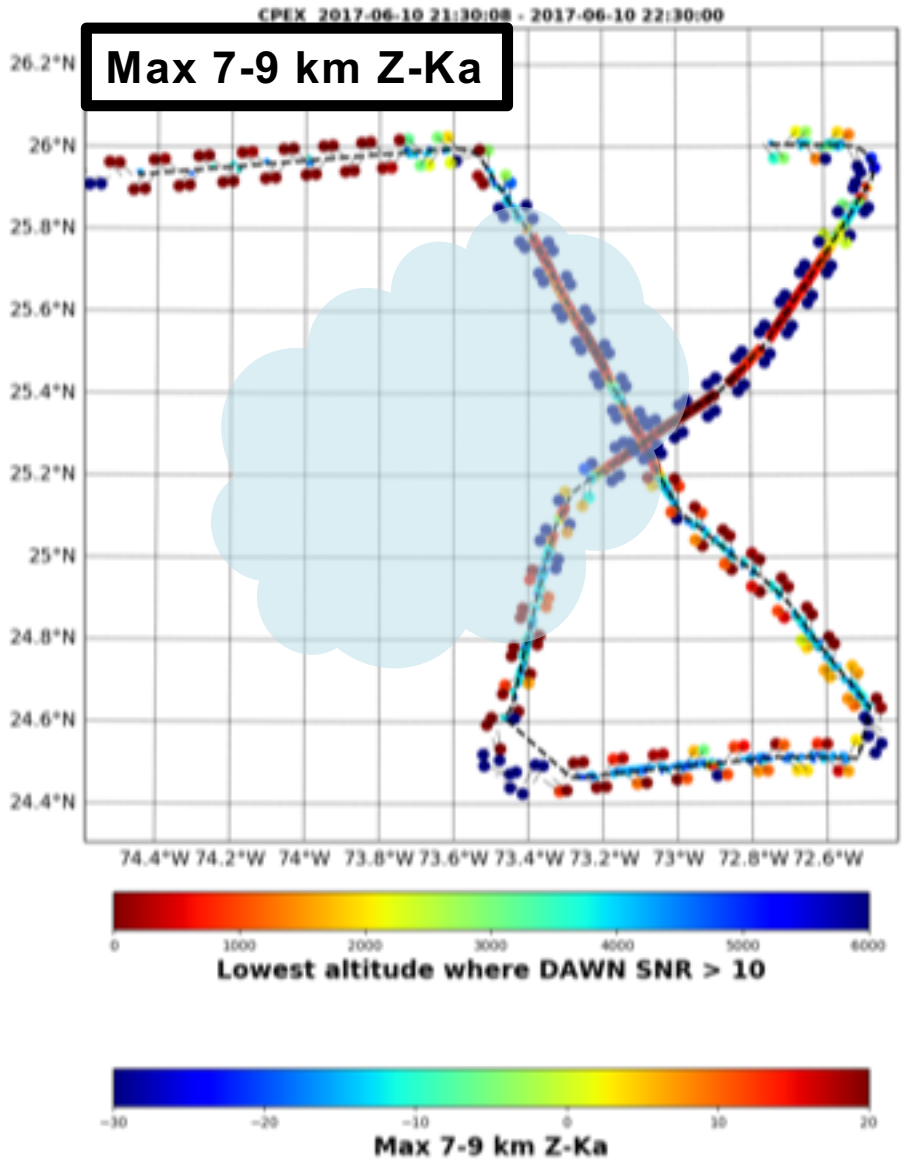






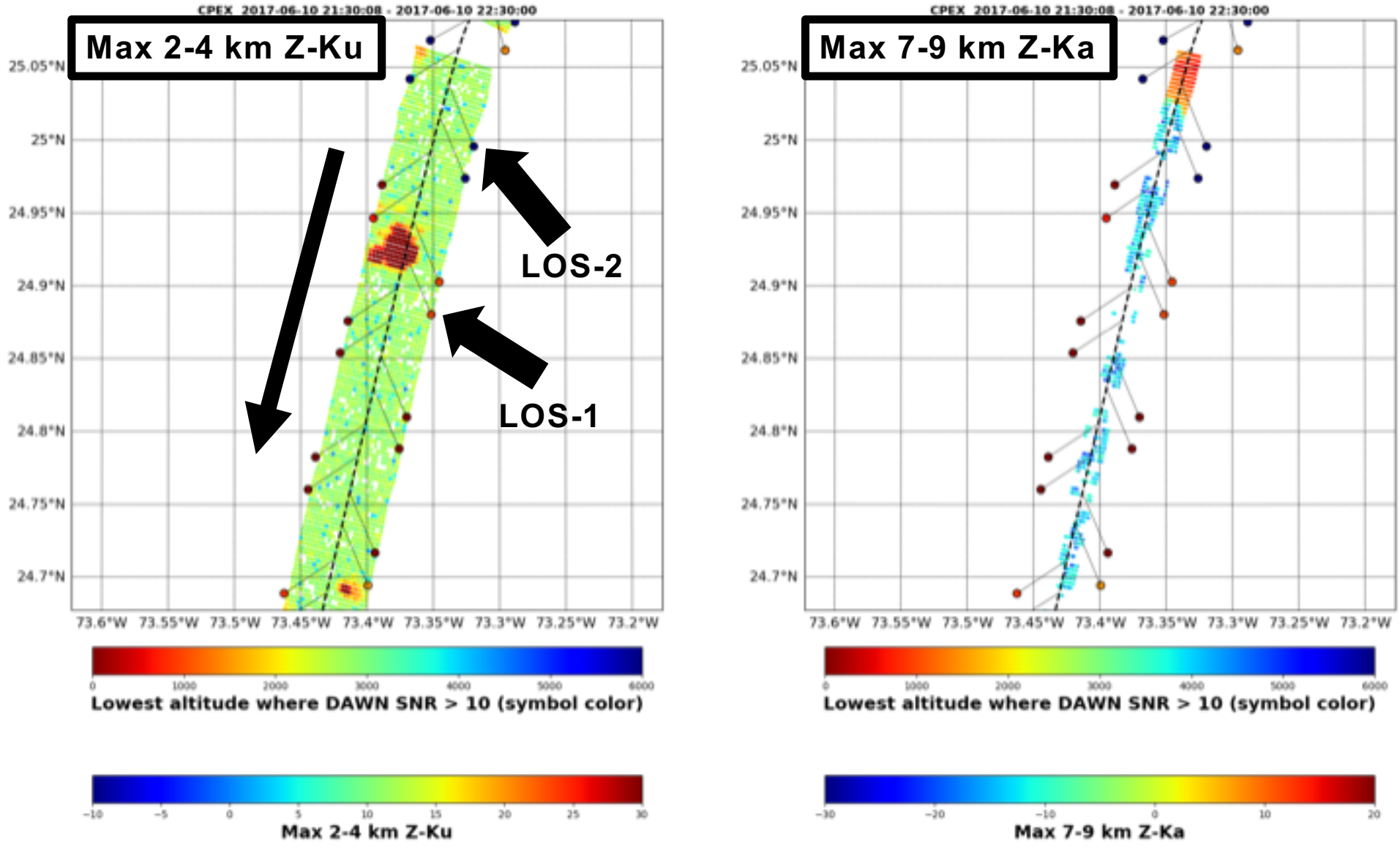
Segment 3: June 10, 2017 2130-2230 UTC





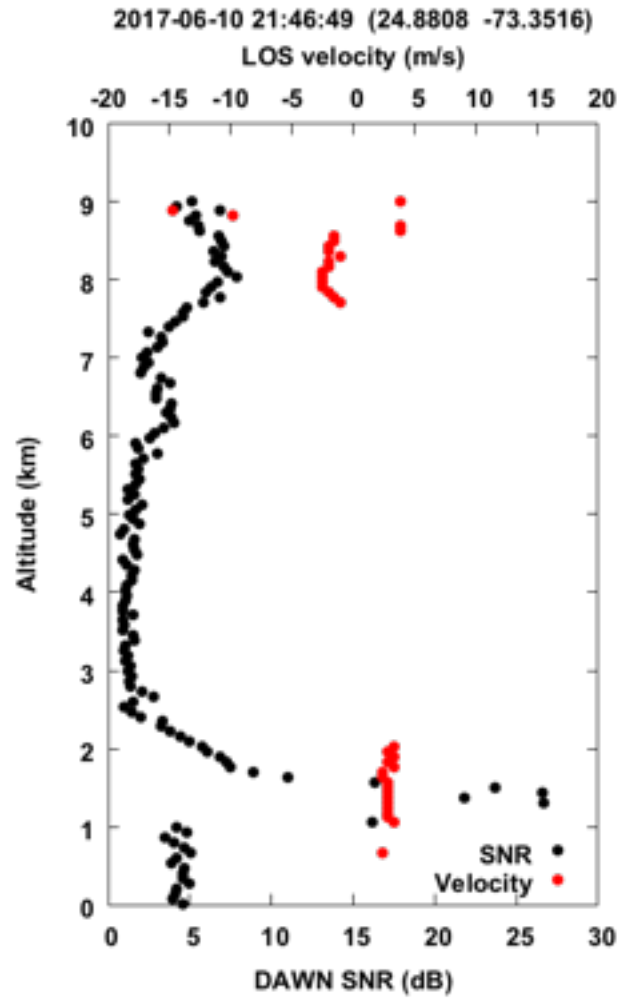
Line segments indicate top-to-surface path for each DAWN LOS profile

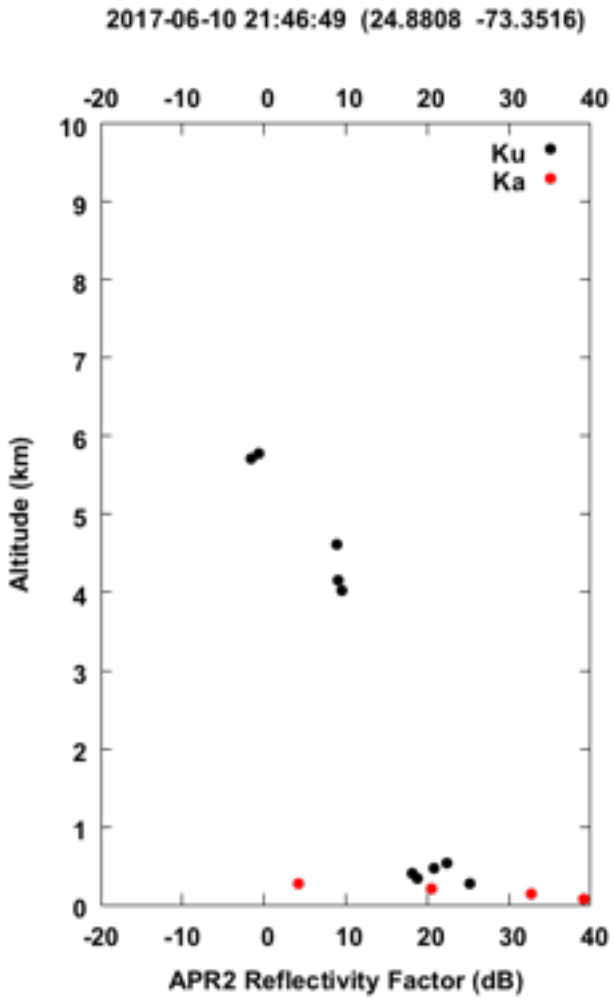
June 10, 2017 Near 2146 UTC Zoom-in

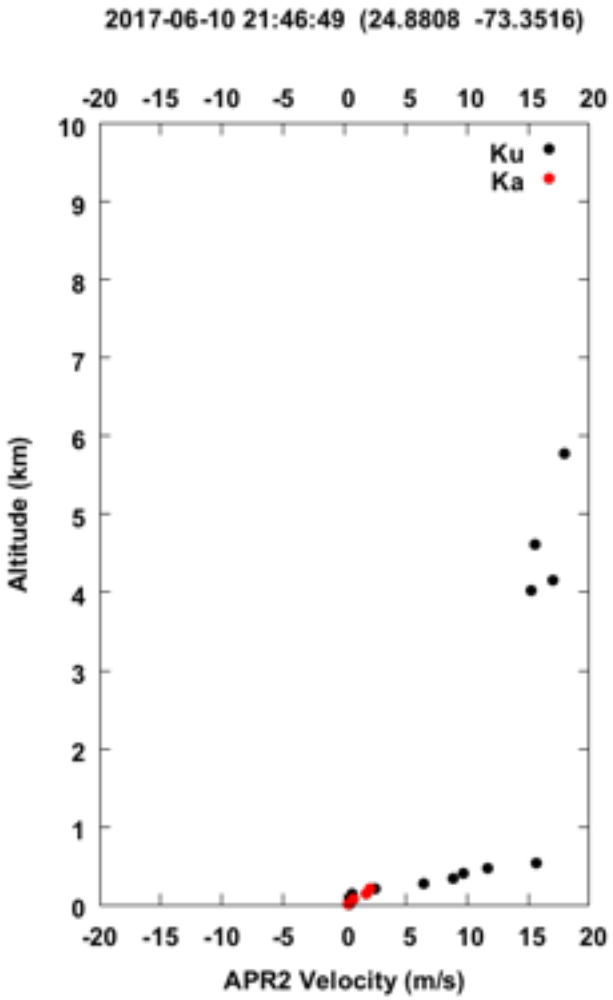


Line segments indicate top-to-surface path for each DAWN LOS profile

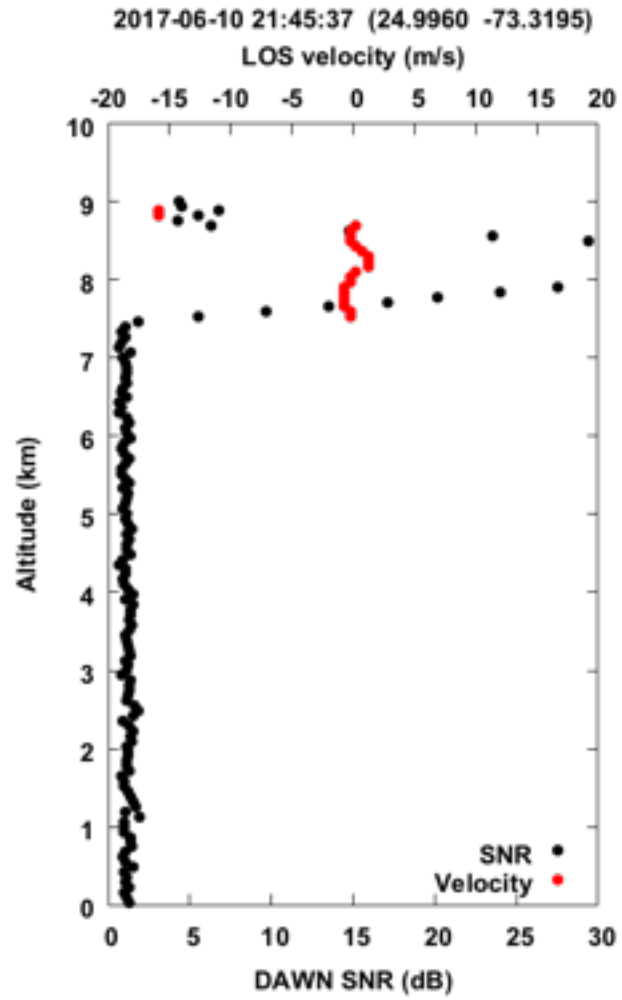
June 10, 2017 2146 UTC LOS 1 DAWN (left) APR2 (mid, right)

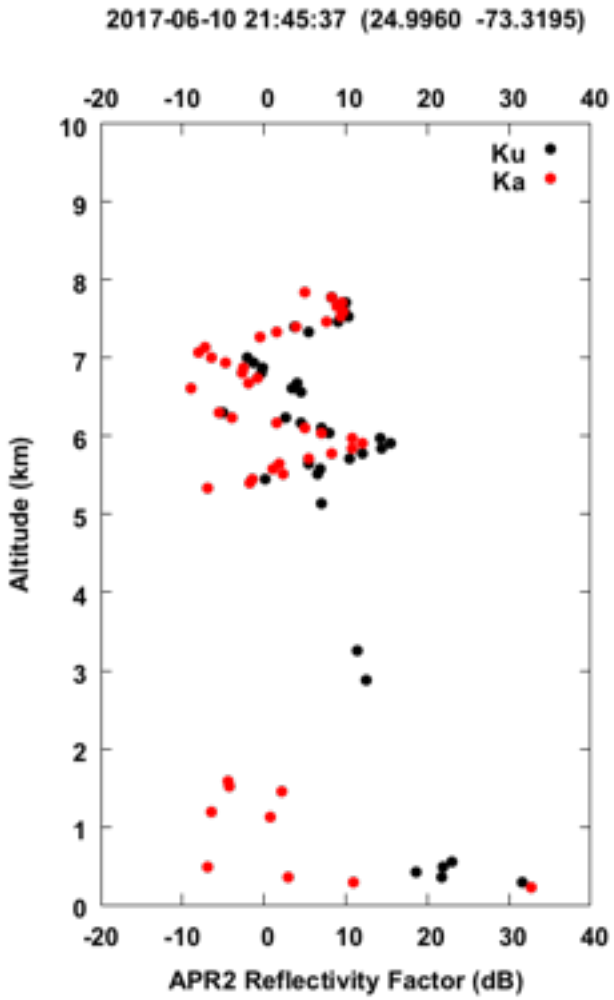


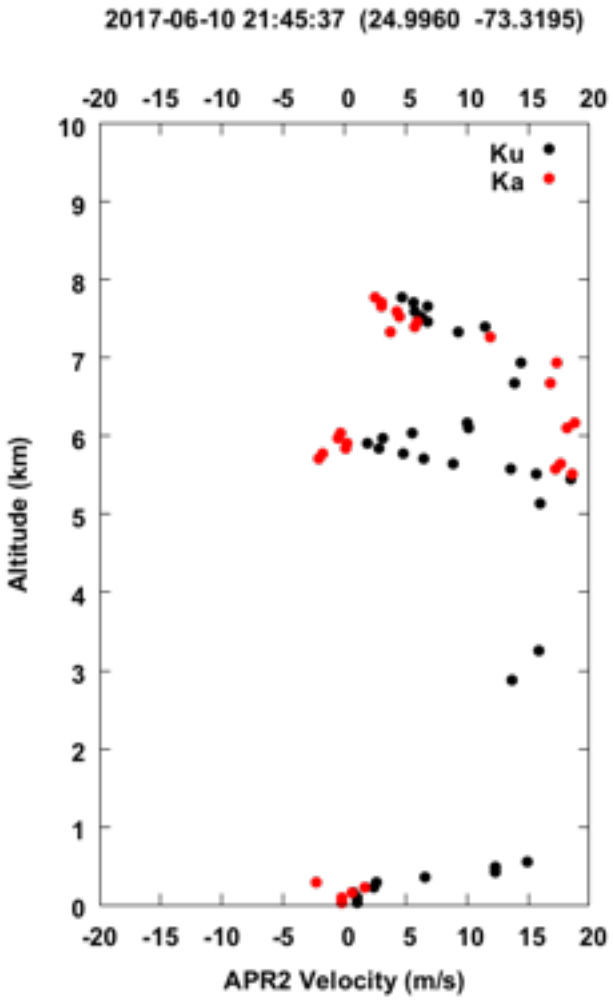




June 10, 2017 2145 UTC LOS 2 DAWN (left) APR2 (mid, right)







Summary

The APR-2 Ka (Ku)-band profiles were bin-matched to DAWN LOS data to assess the upper (lower) cloud presence

Preliminary results suggest that adjacent (or in some cases within) growing convection, many of the LOS views from DAWN found “holes” in the 3-D cloud structure and were able to reach near the surface.

Suggests that useful airborne lidar wind profiles can be obtained fairly close to growing convection.

Next steps: Assess model representation of convective cloud structure (structure, timing, location) and vertical air motion.

Heath, N. K., H. E. Fuelberg, S. Tanelli, F. J. Turk, R. P. Lawson, S. Woods, and S. Freeman (2017), WRF nested large-eddy simulations of deep convection during SEAC^{4}RS, *J. Geophys. Res. Atmos.*, 122, 3953–3974, doi: 10.1002/2016JD025465.

Parodi, A., and Tanelli, S. (2010). Influence of turbulence parameterizations on high-resolution numerical modeling of tropical convection observed during the TC4 field campaign. Journal of Geophysical Research *115*, D00J14.