The NCAR HIAPER Cloud Radar (HCR)

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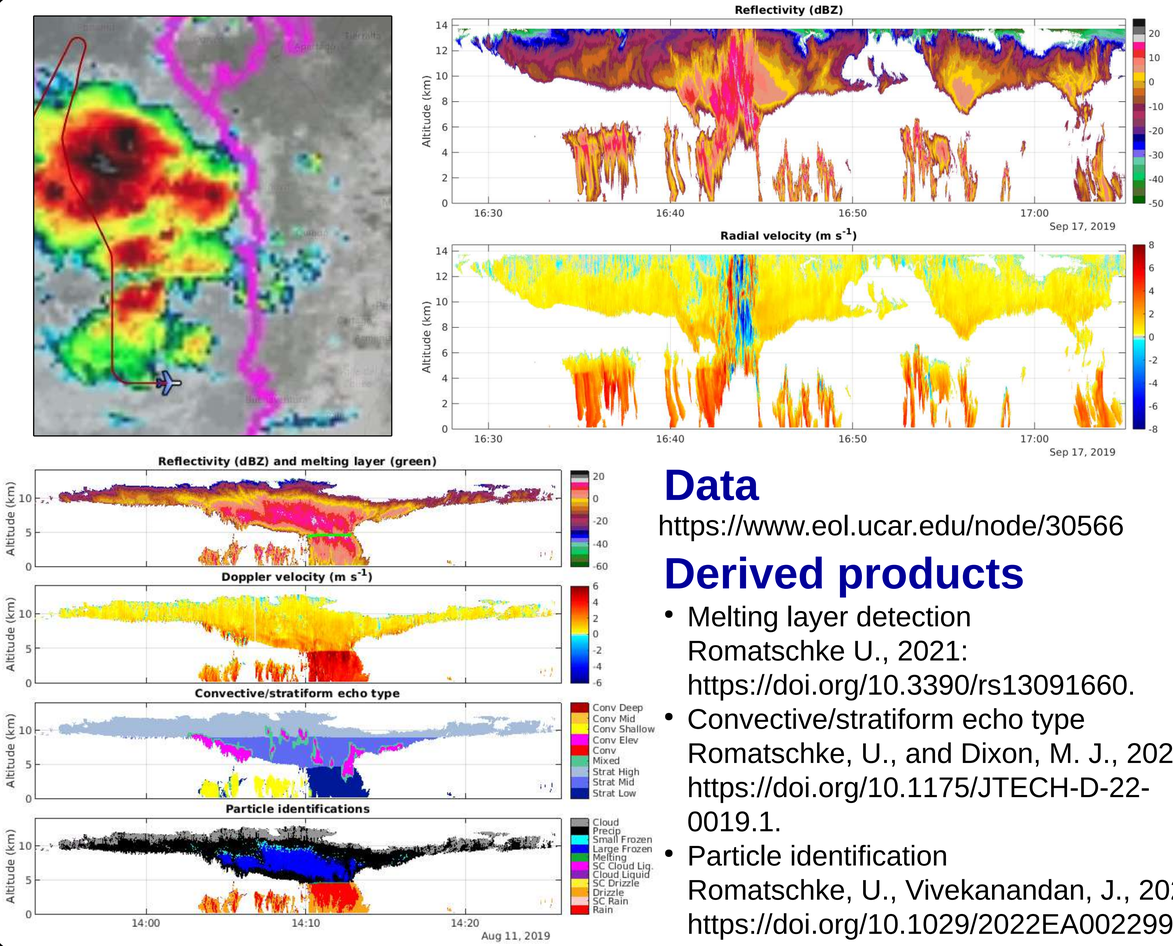
Specifications

Antenna	0.3 m, lens
Antenna gain	45.7 dBi
Beamwidth	0.73 deg
Transmit frequency	94.4 GHz
Transmit wavelength	3.2 mm
Transmitter	Klystron
Peak transmit power	1.6 kW
Pulse width	0.2 - 1.0 µs
Pulse repetition frequency (PRF)	up to 10 kHz
Range resolution	20-180 m
Unambiguous range	15 km, PRF=10kHz
Receiver bandwidth	20 MHz
Receiver noise figure	8.9 dB
Sensitivity	-37.0 dBZ at SNR=-10dB, 1 km, and 256 ns pulse
Typical reflectivity uncertainty	1-2 dB
Unambiguous velocity	+/- 7.75 m/sec, PRF=10kHz
Typical radial velocity uncertainty	0.2 m/s at W=2 m/s
Typical dwell time	100 ms

- Doppler and dual polarization capabilities.
- High resolution data (20 x 20 m).
- Stabilized beam: high-quality Doppler velocity even during aircraft turns, ascents, and descents.
- New digital receiver with improved sensitivity (6 dB).
- Deployed on the NSF/NCAR GV HIAPER aircraft (maximum altitude > 14 km, range > 9,000 km).
- Instrument description – Vivekanandan, J. et al., 2015: https://doi.org/10.5194/gi-4-161-2015.
- Data processing - Romatschke, U. et al., 2021: https://doi.org/10.3390/data6060066.



Data

https://www.eol.ucar.edu/node/30566

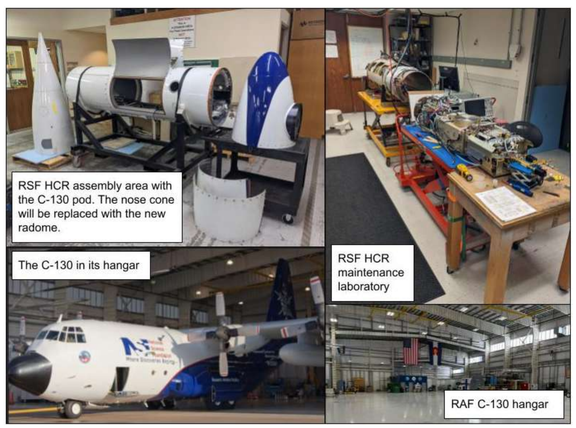
Derived products

- Melting layer detection
  Romatschke U., 2021: https://doi.org/10.3390/rs13091660.
- Convective/stratiform echo type
  Romatschke, U., and Dixon, M. J., 2022.: https://doi.org/10.1175/JTECH-D-22-0019.1.
- Particle identification
  Romatschke, U., Vivekanandan, J., 2022: https://doi.org/10.1029/2022EA002299.

Proposal: C-130 deployments

We propose to develop the capability to deploy HCR on the NSF/NCAR C-130 aircraft in an existing 29" under-wing pod.

- The C-130 currently shares the Wyoming Cloud Radar (WCR) with the Wyoming King Air aircraft. Shared use of one radar by two aircraft limits the number of field campaigns that can be supported by both aircraft.
- The C-130 has excellent low altitude performance and is ideal for studying the planetary boundary layer and lower to mid-troposphere.

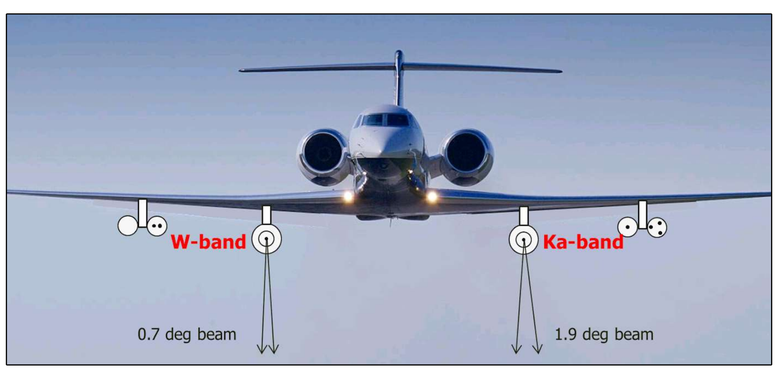


- The HCR complements the Airborne Phased Array Radar (APAR) development on the C-130.

Proposal: Ka-band

We propose to develop a Ka-band radar for concurrent deployments with the W-band HCR on the GV, the C-130, and on the ground.

- Dual-wavelength observations allow for enhanced derived products enabling new insights into cloud microphysical processes.
- A Ka-band radar would suffer less attenuation than HCR allowing for deeper beam penetration into heavy precipitation.
- A second wavelength improves velocity unfolding.
- Two radars on one aircraft enable simultaneous zenith and nadir pointing operations.



Proposal: Ground deployments and X-band

We propose to make HCR and the Ka-band radar available for ground deployments and to build a ground-based vertical pointing X-band radar.

- Triple-wavelength observations are the future of cloud microphysical retrievals.
- Lessons learned from algorithms developed for ground-based observations will inform the algorithm development efforts for airborne observations collected by the same radars.
- Re-use of the X-band transmitters that were used by the now retired ELDORA radar significantly reduces the cost of the X-band development.

X-band specifications	
Wavelength	3.2 cm
Frequency	9 GHz
Antenna diameter	1.5 m
Range resolution	20 m
Max range	30 km
Peak power	40 kW
Beamwidth	1.42 deg
Pulse repetition frequency (PRF)	5 kHz
Sensitivity	-21 dBZ
Pulse width	0.25-1.0 us
Nyquist velocity	40 m/s