HIAPER CLOUD RADAR

Instrument Operations and Data Quality

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HCR Team

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OUTLINE

HCR Design

HCR Specification

User Interface

Spatial Resolution and Sensitivity

CSET Operation

Pointing Issue Update & Correction

Radiation Safety

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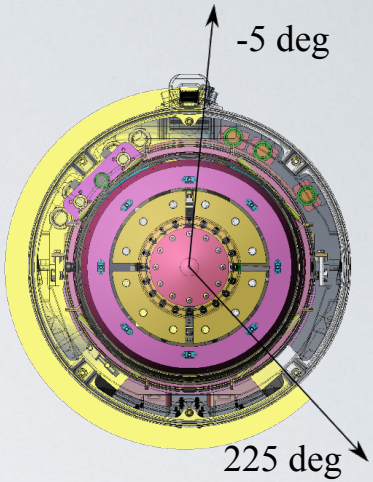
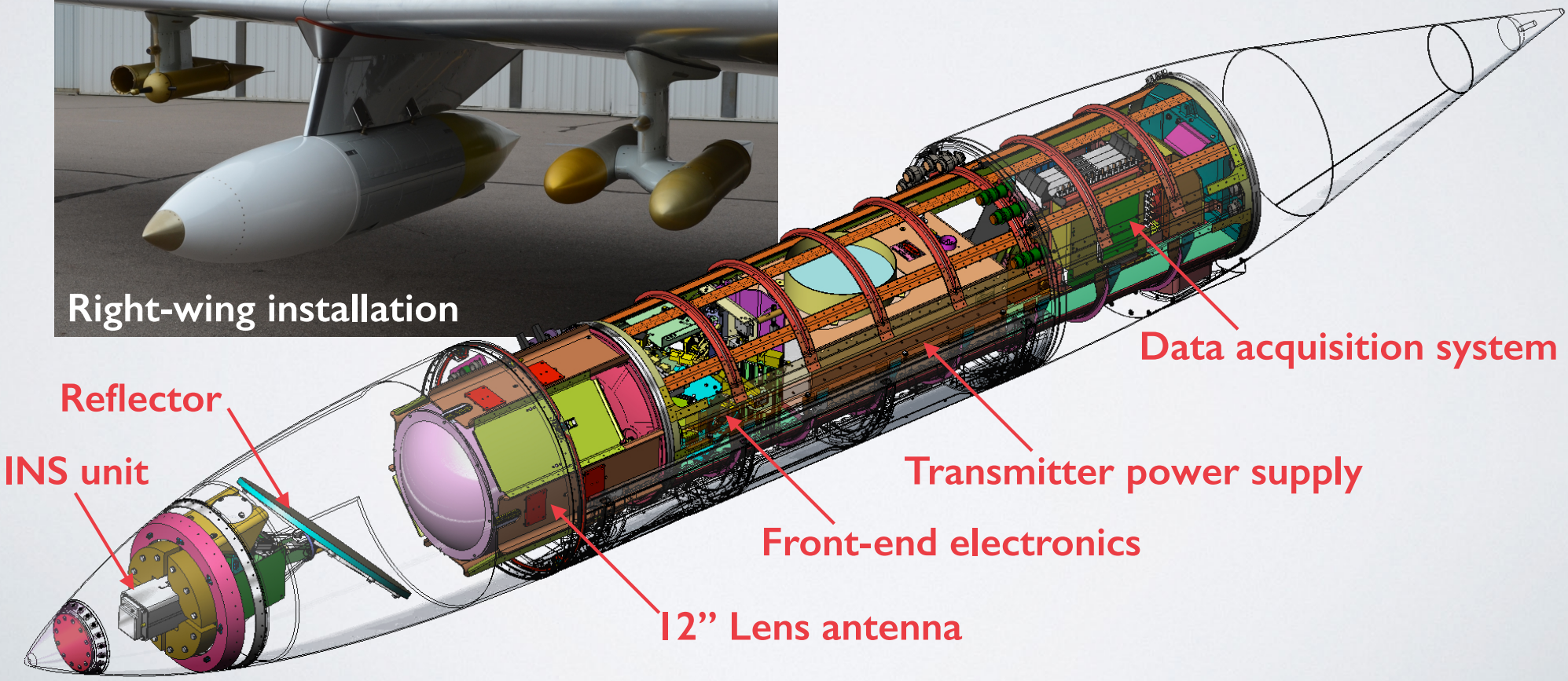
POD-BASED RADAR SYSTEM

- All radar electronics house in the pod
- Real-time antenna stabilization
- In-system INS ensures close proximity for radar motions
- Scanning from zenith to nadir

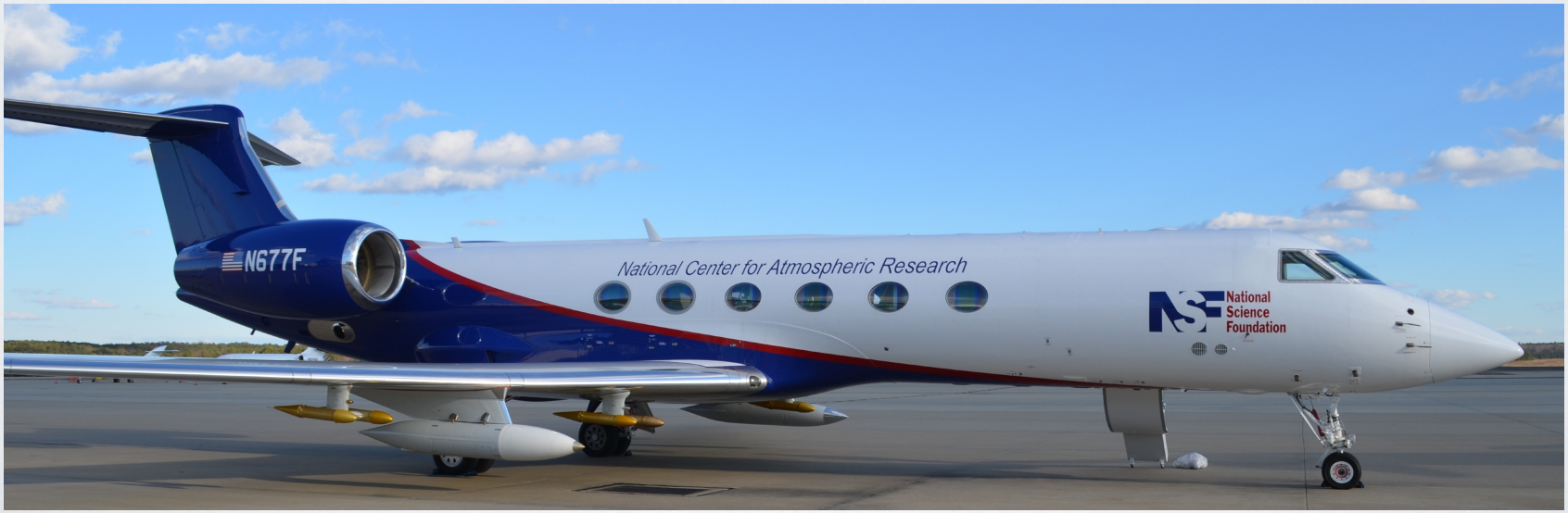



Right-wing installation



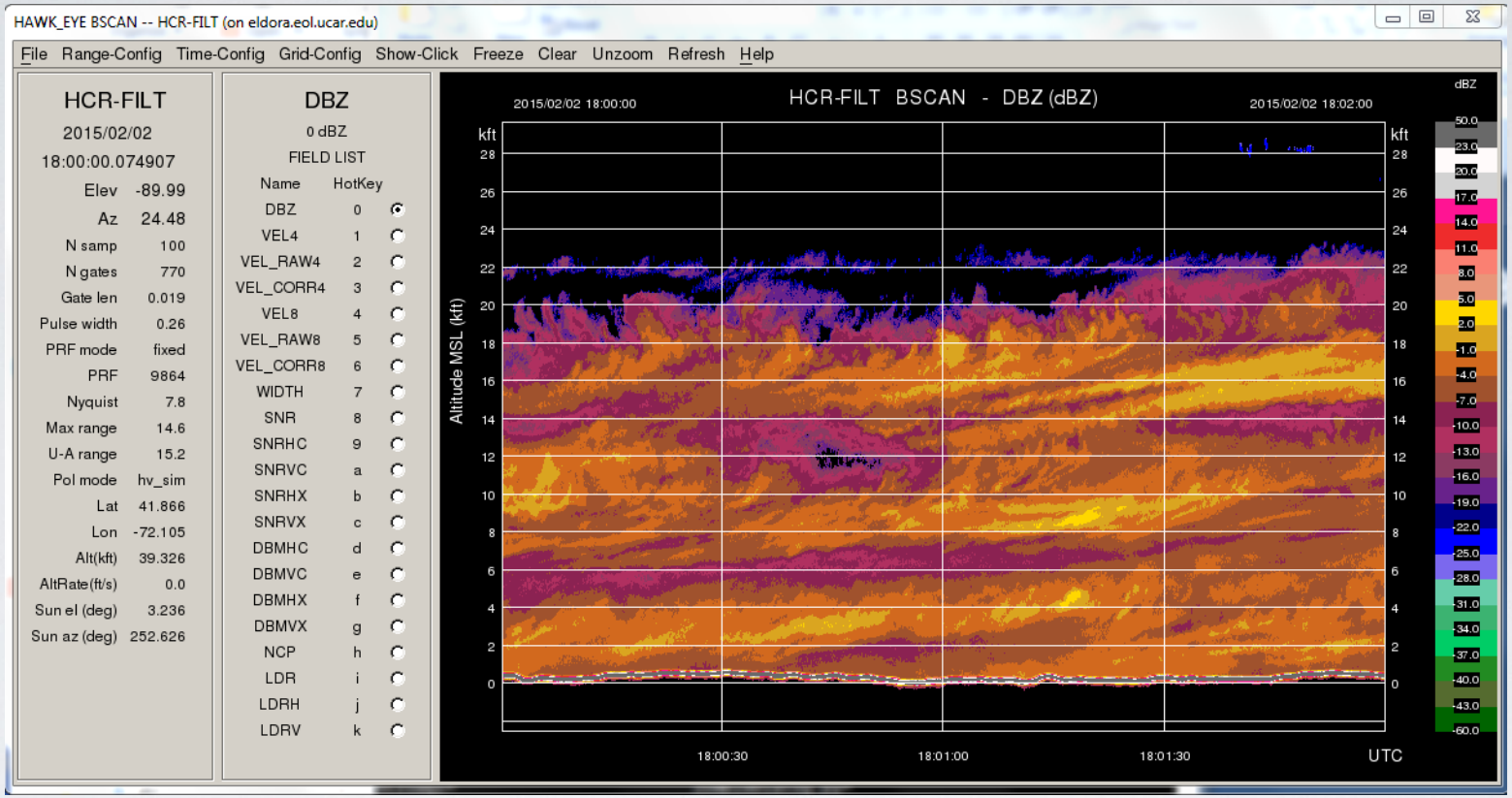
HCR SPECIFICATION

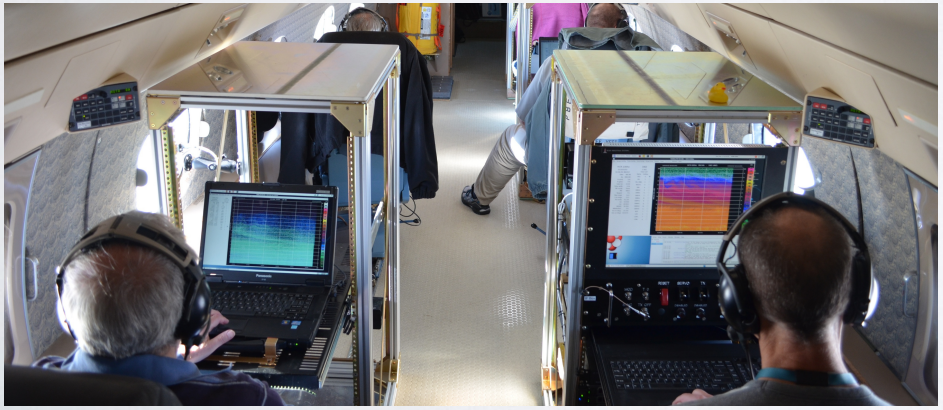
- Wavelength 3 mm (94.4 GHz)
- Beamwidth = 0.7 deg
- Range resolution = 20 ~ 150 m
- Along track resolution = 20 m @ 200 m/s ground speed
- Radar blind range = 150 m
- Sensitivity = -43.6 dBZ@1km, 512ns pw, 1000 pulse avg.
- Unambiguous velocity = +/- 7.5 m/s
- Unambiguous range = 14.78 km (48,500 feet)
- Standard 10 Hz CfRadial dataset for Z, Vel, W, LDR
- Time series data recorded every flight



HCR's first deployment Nor'easter

REAL-TIME DISPLAY





- Real-time display BSCAN
- Playback capability on plane and ground
- Multi-user capability
- Quick-look images to field catalog every 5 minutes

SPATIAL RESOLUTION

Range

3.3 Kft / 1km

37.2 m

10 Kft / 3 km

range resolution = 76.8 / 38.4 m

74.5 m

20 Kft / 6 km

112 m

0.7 deg beamwidth
512 / 256 ns pw

30 Kft / 9.1 km

149 m

40 Kft / 12.2 km

oversample with 19.2 m gates

SENSITIVITY

	Range
-43.6 dBZ	3.3 Kft / 1km
-38.76 dBZ	10 Kft / 3 km
-35.75 dBZ	20 Kft / 6 km
-34.0 dBZ	30 Kft / 9.1 km
-32.74 dBZ	40 Kft / 12.2 km

range resolution = 76.8 m

512 ns pulse width
1000 sample avg.

Range down	512 ns (76.8 m)	256 ns (38.4 m)
3280 / 1km	-43.6 dBZ	-37.6 dBZ
10,000 / 3 km	-38.8 dBZ	-32.8 dBZ
20,000 / 6 km	-35.8 dBZ	-29.8 dBZ
30,000 / 9.1 km	-34.0 dBZ	-28.0 dBZ
40,000 / 12.2 km	-32.7 dBZ	-26.7 dBZ

CSET OPERATIONS

Operations

- Periodic gain calibration during flights - 5 minute noise source cal
- One on-board operator

Maintenance & Repair

- All repairs will be performed in Sacramento.
- Nitrogen refill is required 1.5 hr prior to each flight.
- Limited computer issues can be addressed in Kona.

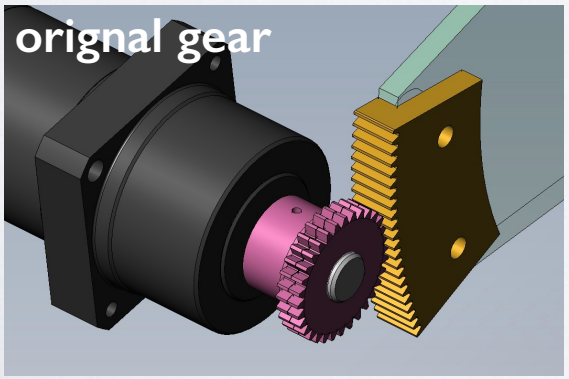
HCR POINTING ISSUE

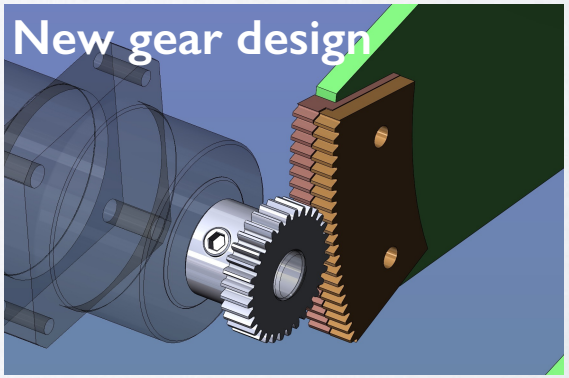
Vr Errors

- Due to pointing uncertainty that is not constant
- Magnitude of errors with current gears expected about 0.25 m/s
- Correction depends on using surface echo
- Nadir looking correctable
- Zenith looking not correctable

Mechanical modification

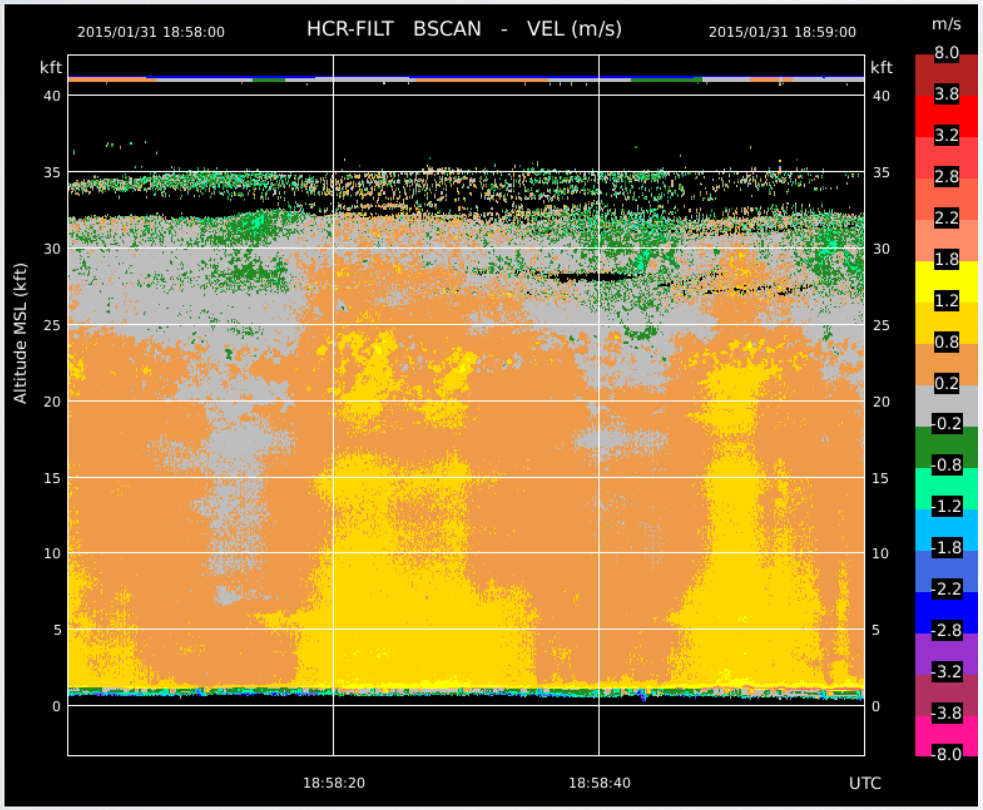
- Modified gears are installed for more accurate pointing
- Level of improvement will be verified in test flights



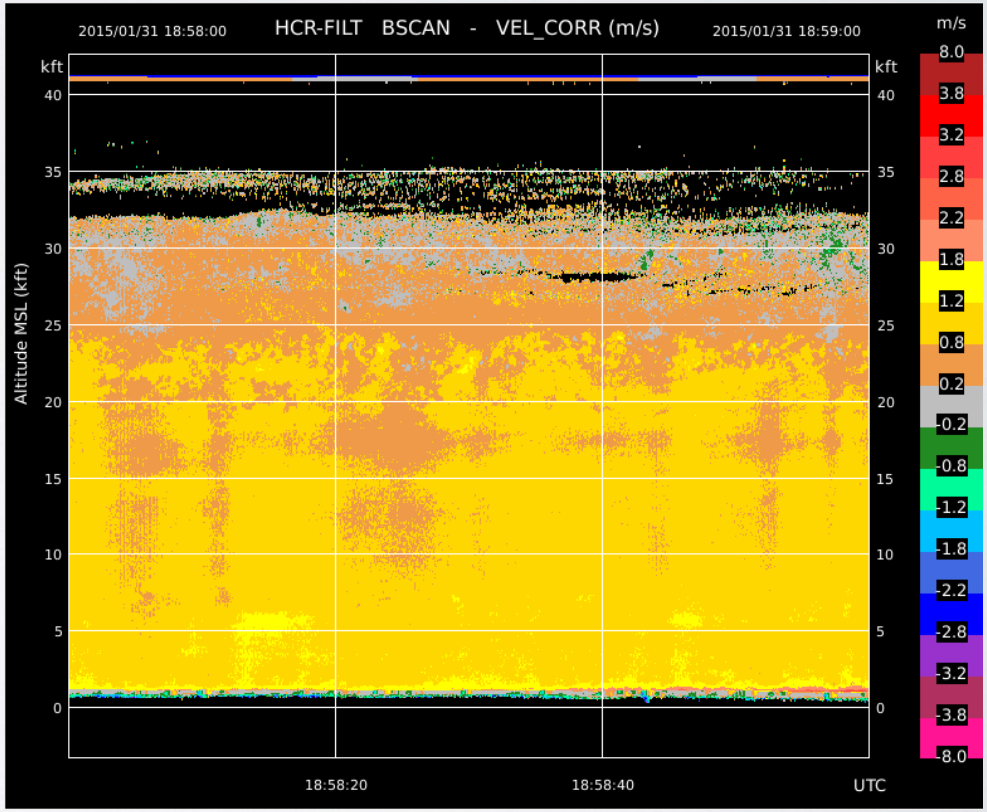


HCR POINTING ISSUE
EXAMPLE FROM NOR'EASTER

Without Surface Corrections

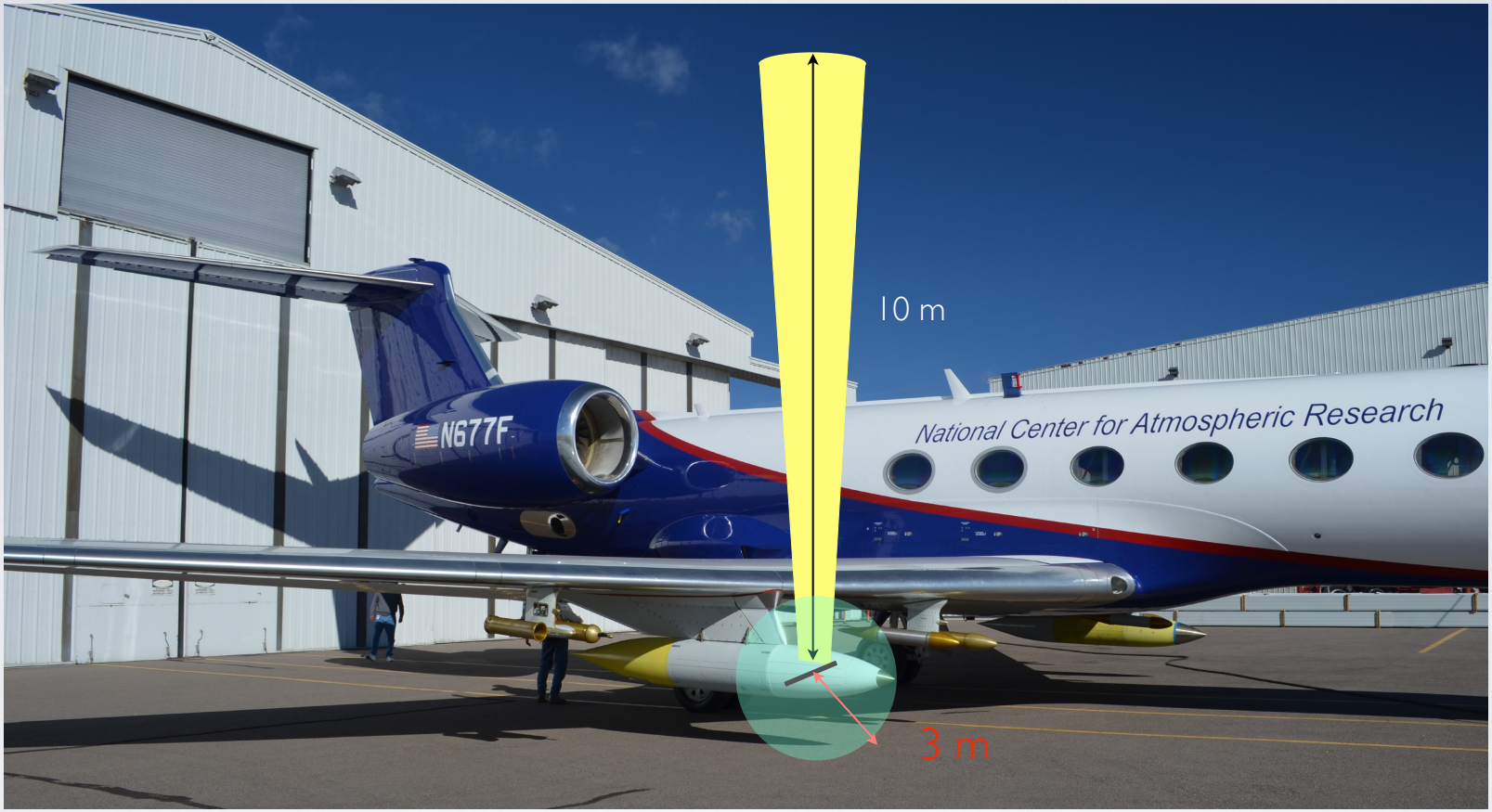


With Surface Corrections



RADIATION KEEPOUT ZONE

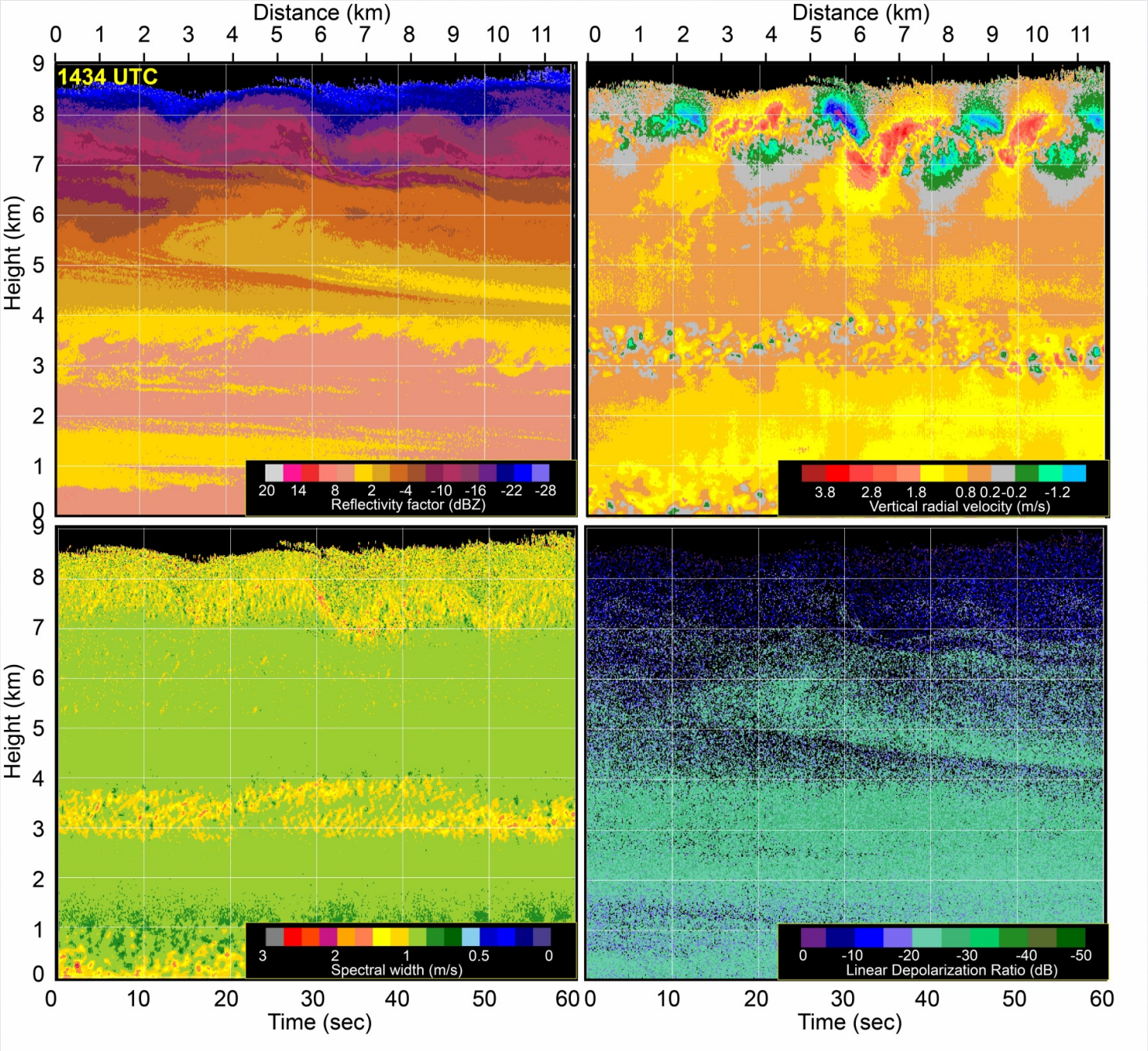
FOR HUMAN EXPOSURE



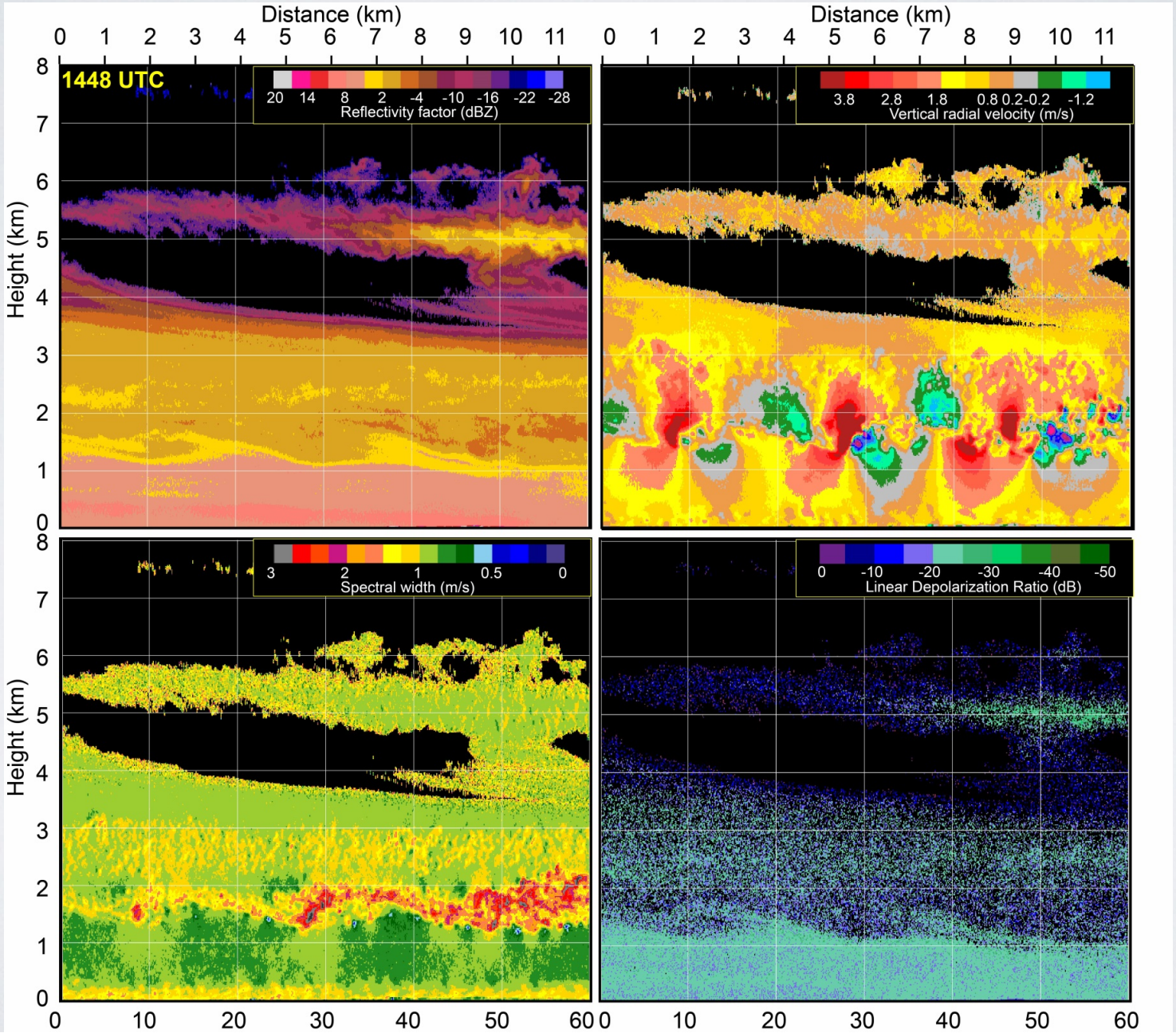
All around pod : 3 m (~9 feet)
Direct radiation: 10 m (~30 feet)
Ground ramp test: vertical pointing upwards
In-flight: Vertical pointing downwards

* IEEE C95.1 1991 standard states 10 mW/cm2 maximum permissible exposure for uncontrolled/controlled environments (15 - 300 GHz)

DATA SAMPLE


Distance (km)
0 1 2 3 4 5 6 7 8 9 10 11
1434 UTC
Height (km)
0 1 2 3 4 5 6 7 8 9
20 14 8 2 -4 -10 -16 -22 -28
Reflectivity factor (dBZ)
3.8 2.8 1.8 0.8 0.2 -0.2 -1.2
Vertical radial velocity (m/s)
3 2 1 0.5 0
Spectral width (m/s)
0 -10 -20 -30 -40 -50
Linear Depolarization Ratio (dB)
0 10 20 30 40 50 60
Time (sec)

DATA SAMPLE


Distance (km)
0 1 2 3 4 5 6 7 8 9 10 11
1448 UTC
20 14 8 2 -4 -10 -16 -22 -28
Reflectivity factor (dBZ)
3.8 2.8 1.8 0.8 0.2 -0.2 -1.2
Vertical radial velocity (m/s)
3 2 1 0.5 0
Spectral width (m/s)
0 -10 -20 -30 -40 -50
Linear Depolarization Ratio (dB)
Height (km)
0 1 2 3 4 5 6 7 8
0 10 20 30 40 50 60