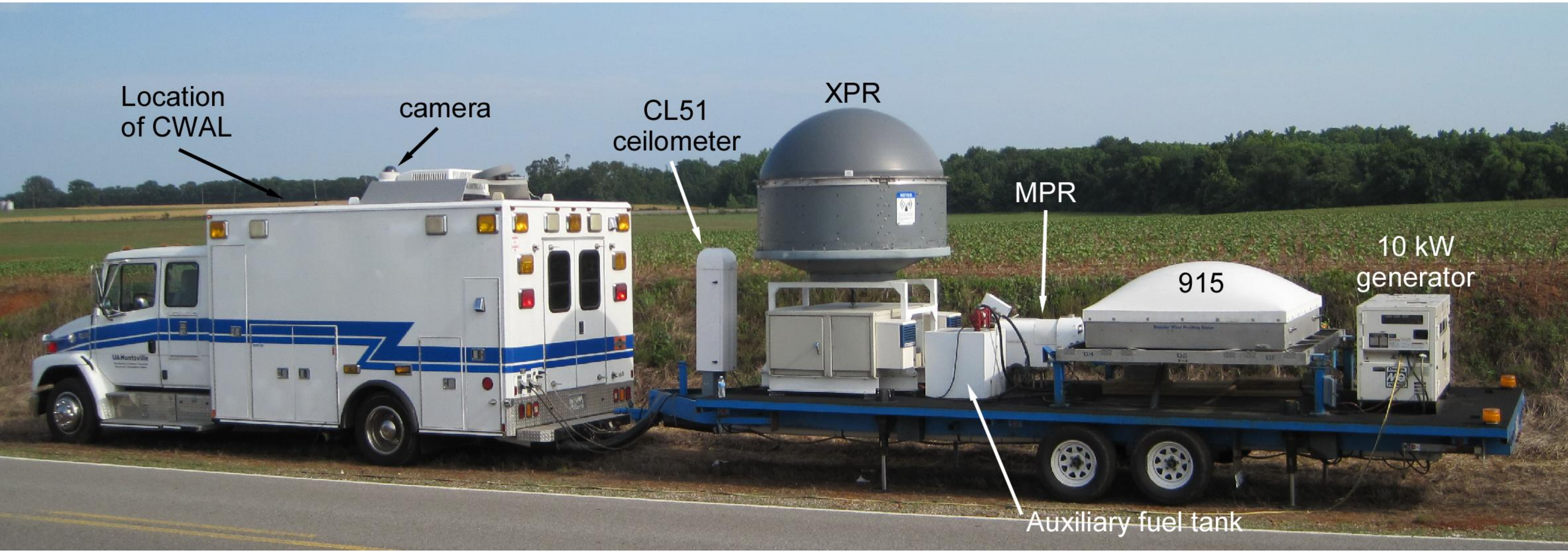
Summary of UAH instruments and operations for the OWLeS campaign

Kevin Knupp
University of Alabama in Huntsville

Mobile Integrated Profiling System (MIPS)



Instruments and their measurements:

915 MHz wind profiler (915): wind profiles (5-30 min average), vertical motion, backscatter, boundary layer height (typical vertical resolution: 60 m

Microwave Profiling Radiometer (MPR): profiles (1 min) of temperature and humidity, integrated water vapor

X-band Profiling Radar (XPR): profiles (6 Hz) of reflectivity factor and radial velocity (vertical particle motion)

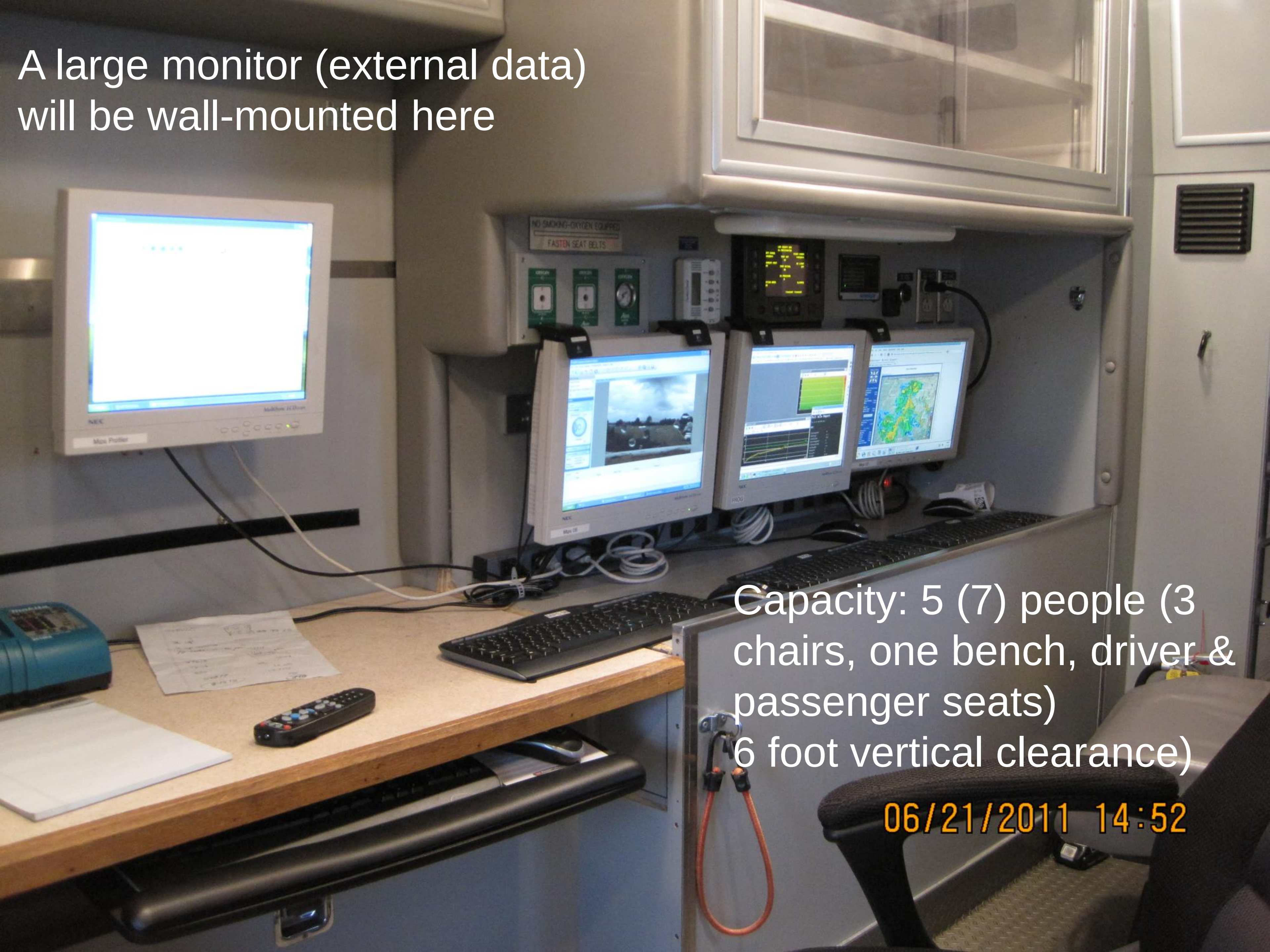
Ceilometer: profiles (6 s) of attenuated backscatter from aerosols

Surface measurements: T, RH, p, wind, solar radiation, long-wave radiation (all at 1 Hz)

Camera: visual images at 1 Hz

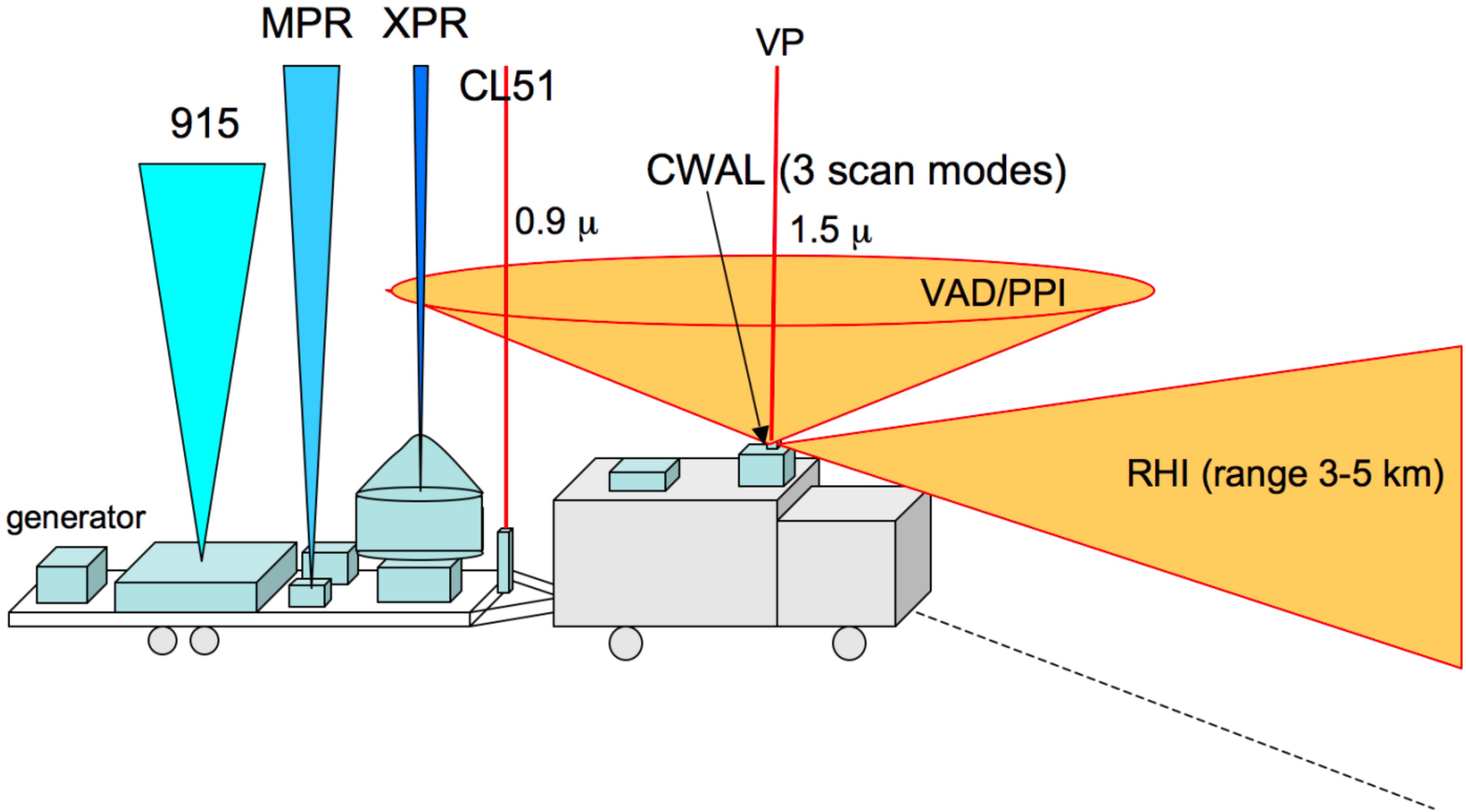
The MIPS is fully mobile and rapidly deployable

nd Profiling Radar
13M
13A
X÷2
148
7926A
06/21/2011 14:50


A large monitor (external data)
will be wall-mounted here
NO SMOKING-OXYGEN EQUIPPED
FASTEN SEAT BELTS
Capacity: 5 (7) people (3 chairs, one bench, driver & passenger seats)
6 foot vertical clearance)
06/21/2011 14:52

Schematic of scanning.

The Doppler wind lidar (CWAL) will be located in a separate trailer



Doppler wind lidar trailer

Dimensions: 8 x 16 ft

Two compartments:

- 8 x 12 ft (heater) with work space
- 8 x 6 ft (util, 7 kW gen)
- insulated

Will use power from MIPS

300 W flood lights on sides

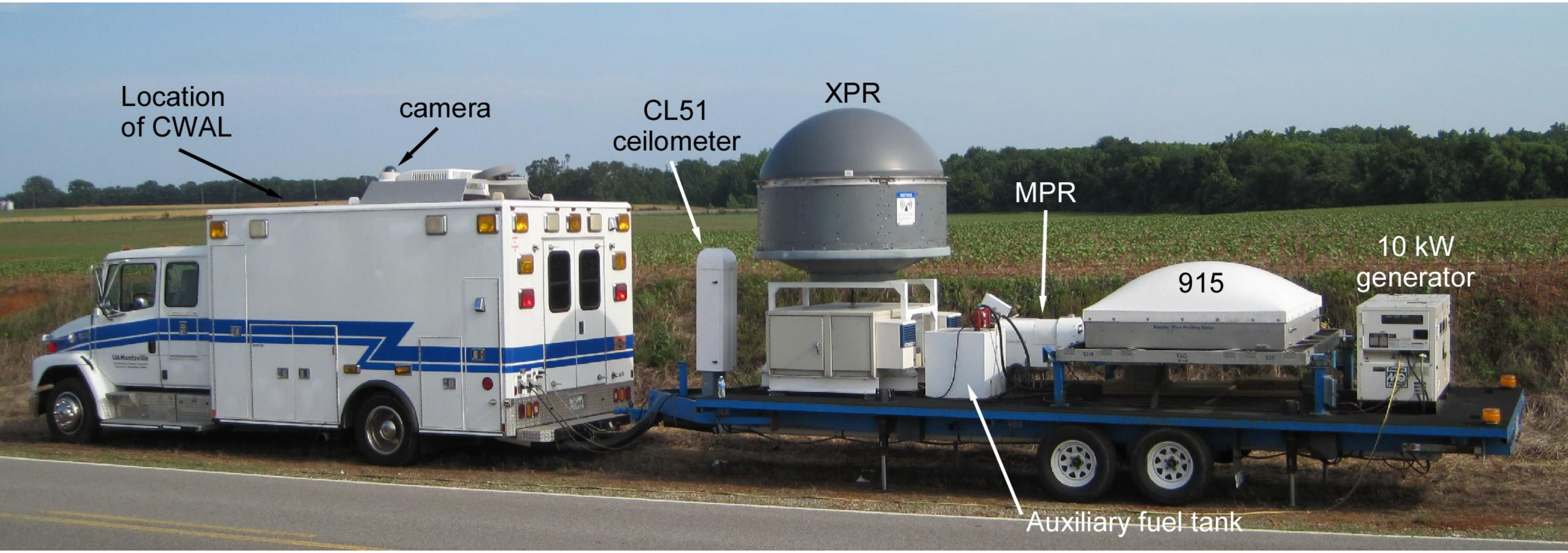
Work in progess

2009 Silverado 2500 HD 4WD (diesel)

Will tow trailer

Utility vehicle

Mobile Integrated Profiling System (MIPS)



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915 MHz wind profiler

Measurements:

- Horizontal wind profiles (variable averaging time, 30 min is typical)
- Dwell time: 20 s per beam
- Multiple operating modes (clear air vs. snow)
- Vertical beam measurements (40 s intervals)
  - SNR
  - W
  - SW
  - Doppler spectra

Parameter	***Value***
Frequency	915 MHz
Wavelength	33 cm
Peak power	700 W
Average power	10-50 W
Pulse duration	0.4, 0.7, 1.4, 2.8 μs (pulse coding)
Antenna type	Flat panel microstrip (phased) array Electronically steered beam: vertical, off vertical in 4 directions
Antenna size	1.8 m x 1.8 m
Gain	Not well known (new amplifier)
Beam width	9 deg
MDS	Unknown (not calibrated)
Gate spacing	Variable, except for pulse coding
No. range gates	Height of first gate: ~150 m
Dwell time	20 sec

PLOWS result: soundings + 915 SNR

Next slide

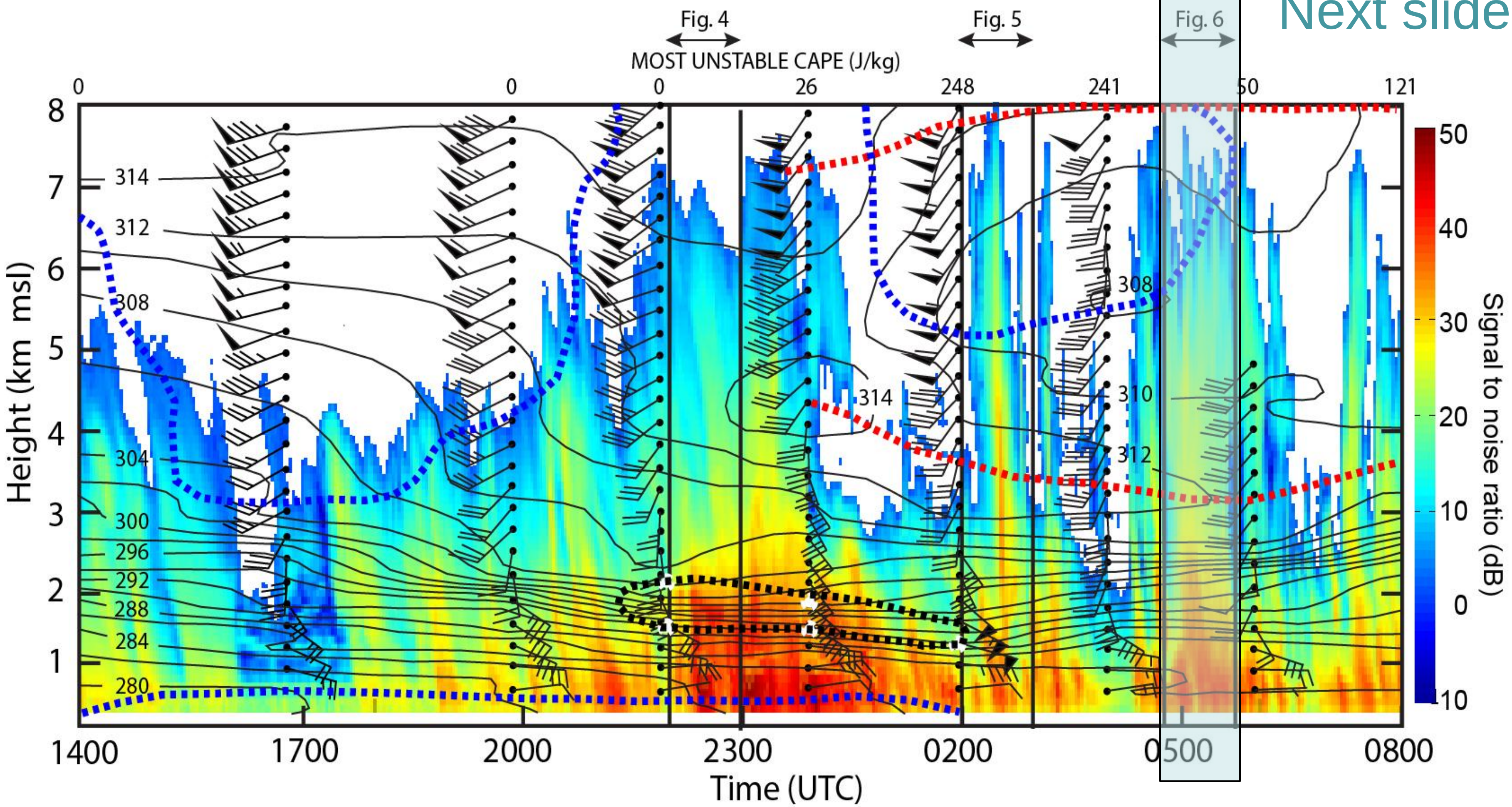


Fig. 3 Time section of the 915 MHz profiler SNR, θ_{ei} and winds derived from sequential rawinsondes from 1400 UTC 8 December – 0800 9 December 2009. The lower and upper red dashed lines denote, respectively, the mid-level θ_e maxima and the equilibrium level for ice saturated ascent. The region between the upper and lower blue dashed lines denote the region where air is saturated with respect to ice. The black dashed line is the 0° C isotherm. Temperatures across all of the cross section except within the black dashed line were below 0° C and precipitation fell as snow. The most unstable CAPE, determined from each of the soundings by lifting parcels above the frontal inversion, is listed across the top of the figure. (Rauber et al.,

915 MHz profiler moments and E field, 0415 - 0545

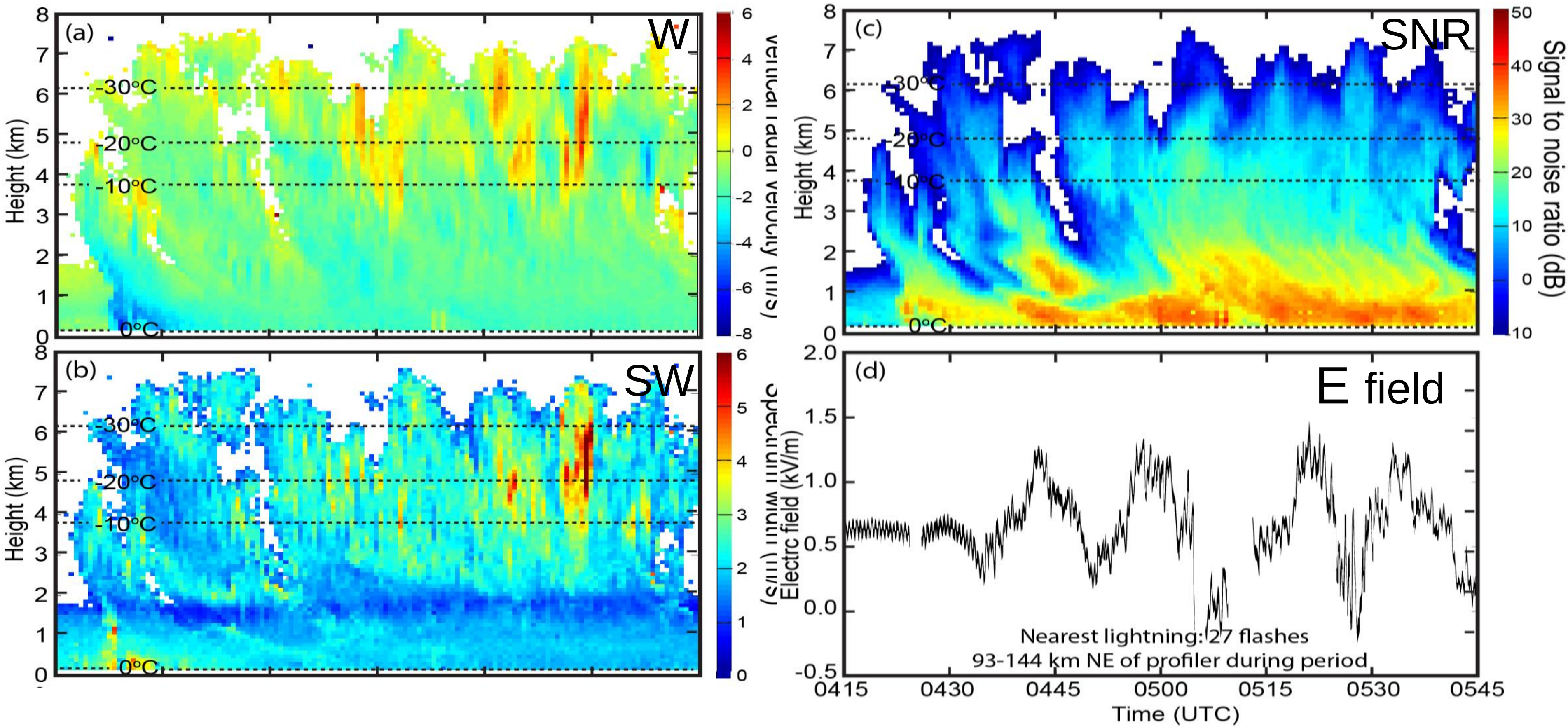


Figure 6: (a) Vertical radial velocity, (b) spectral width, and (c) SNR from the vertical beam of the 915 MHz profiler for the period 0415-0545 8 December 2009. Sounding derived temperatures are overlaid on the figures. (d) Surface electric field from the field mill for the same time period. (Rauber et al, submitted to JAS)

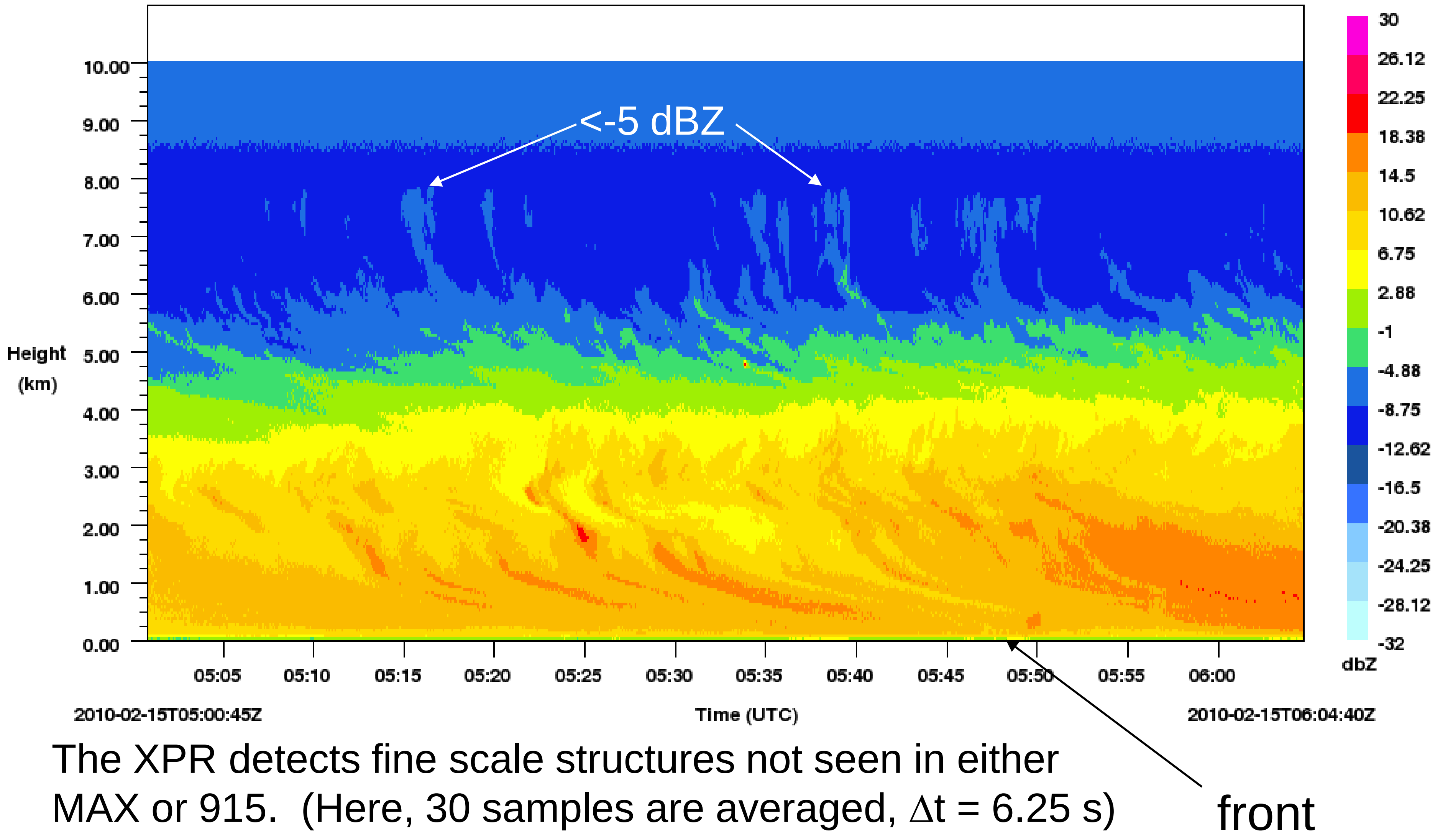
X-band Profiling Radar (XPR)

Measurements:

- Vertical profiles (6 Hz) of:
  - Z
  - W (= w + V_T)
  - SW
- Time series of I & Q (Precludes real-time display of Z and W)

Parameter	***Value***
Frequency	9410 MHz
Wavelength	3.2 cm
Peak power	25 kW (magnetron)
Average power	25 W
Pulse duration	0.178, 0.364, 0.965 μs
PRF	1000, 1200, 2000 s^{-1}
Antenna type	Parabolic reflector (circular)
Antenna size	1.8 m
Beam width	1.2 deg
MDS	-28 dBZ at 1.0 km AGL
Gate spacing	50 m
First range gate	70 m
Dwell time	1/6 sec (6 Hz sampling)

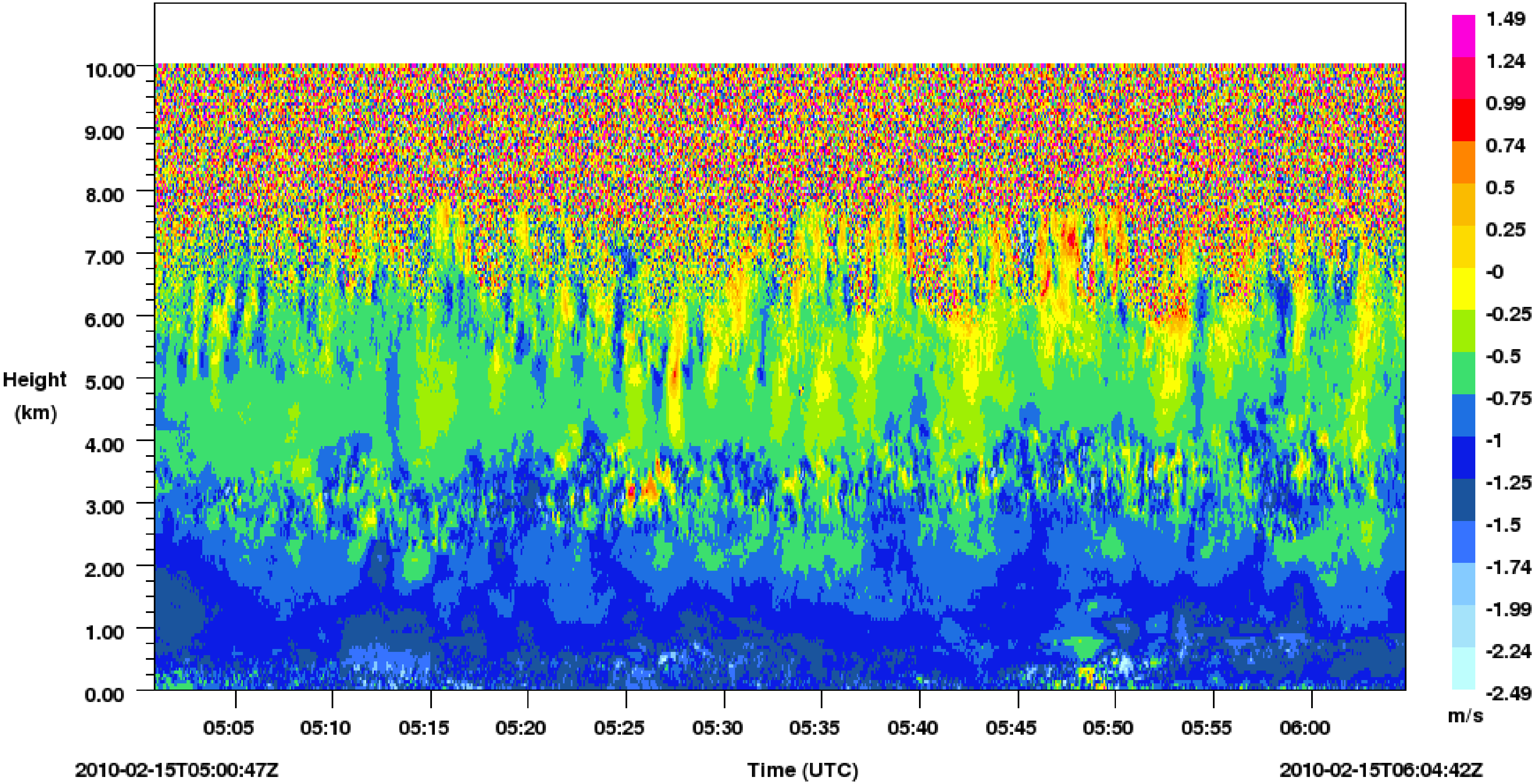
PLOWS example, 15 Feb 2010
XPR reflectivity (W), 0600 - 0605 UTC



The XPR detects fine scale structures not seen in either MAX or 915. (Here, 30 samples are averaged, $\Delta t = 6.25$ s)

[TSC: 10 m/s x 3900 s = 39 km]

PLOWS example, 15 Feb 2010
XPR velocity (W), 0600 - 0605 UTC



PRF = 1200 Hz, 250 pulses averaged, 0.208 s resolution

Here, a running average of 30 samples $\rightarrow$ 6.25 s resolution

CL51 ceilometer

Measurements:

Vertical profiles (6 s)

- Relative (calibrated) backscatter intensity
- Extinction measurements are possbile; the CL51 will be calibrated
- Cloud base height
- Aerosol backscatter

Parameter	***Value***
Wavelength	0.91 μm
Pulse energy	≥3 microjoules (μJ)
Average power	≥19 mW
Pulse length	10 m
PRF	6.5 kHz
Antenna type	lens
Lens diameter	148 mm
Beam divergence	0.15 mrad (0.009 deg)
Gate spacing	10 m
First range gate	10 m
Dwell time	6 s

Doppler wind lidar

Measurements:

- Scanning capability
  - Elev & azim, stare
- Variables
  - relative backscatter intensity
  - Radial velocity

Parameter	***Value***
Wavelength Polarization	1.55 μm Depolarization capability
Pulse energy	10 microjoules (μJ)
Average power	≥19 mW
Pulse length	22.5 m
PRF	15 kHz
Antenna type	lens
Lens diameter	75 mm
Beam divergence	50 μrad (0.009 deg)
Gate spacing	15-50 m
First range gate	70 m
Dwell time	Variable (0.2 – 1.0 s, typical)

Doppler wind lidar (cont.)

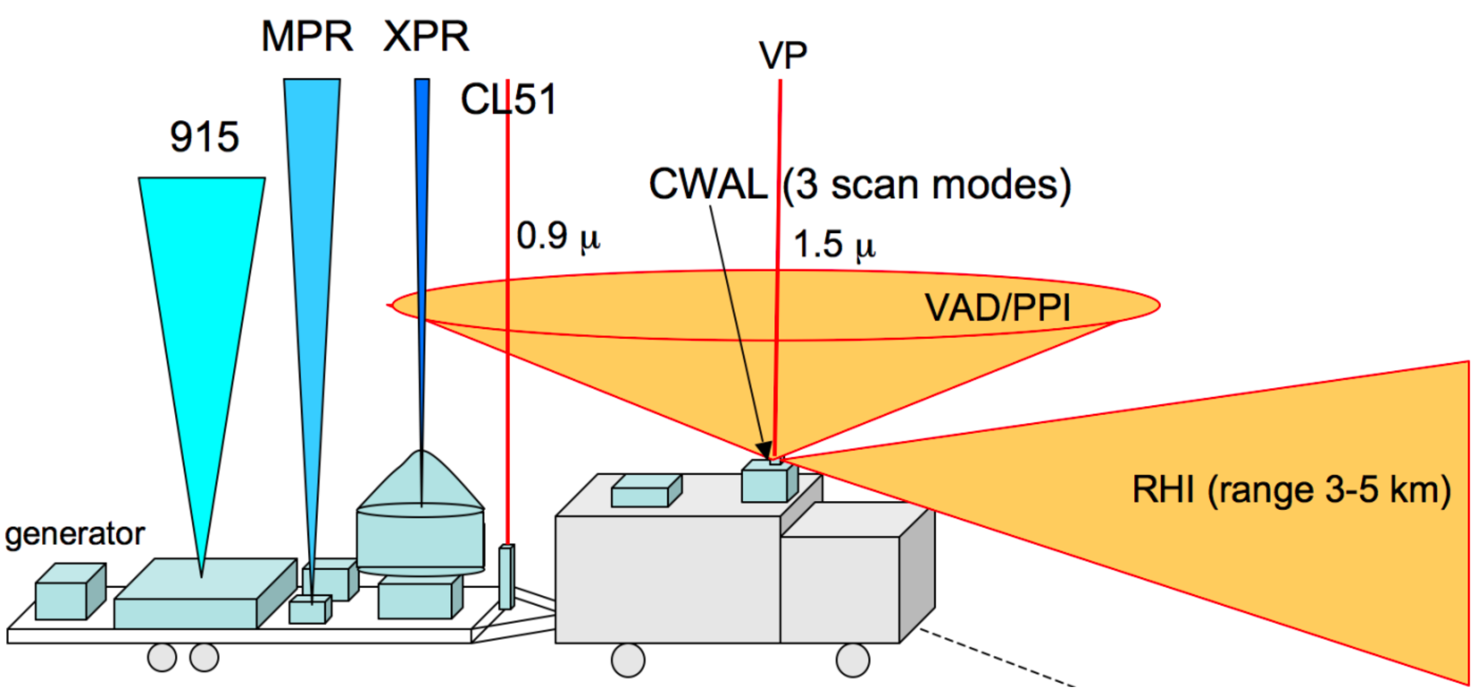
Possible uses:

a)Surface layer wind profiles over water (RHI scans)

b)Wind profiling within the surface layer (360° scans)

c)Variance in V_h and w (horizontal and vertical stare)

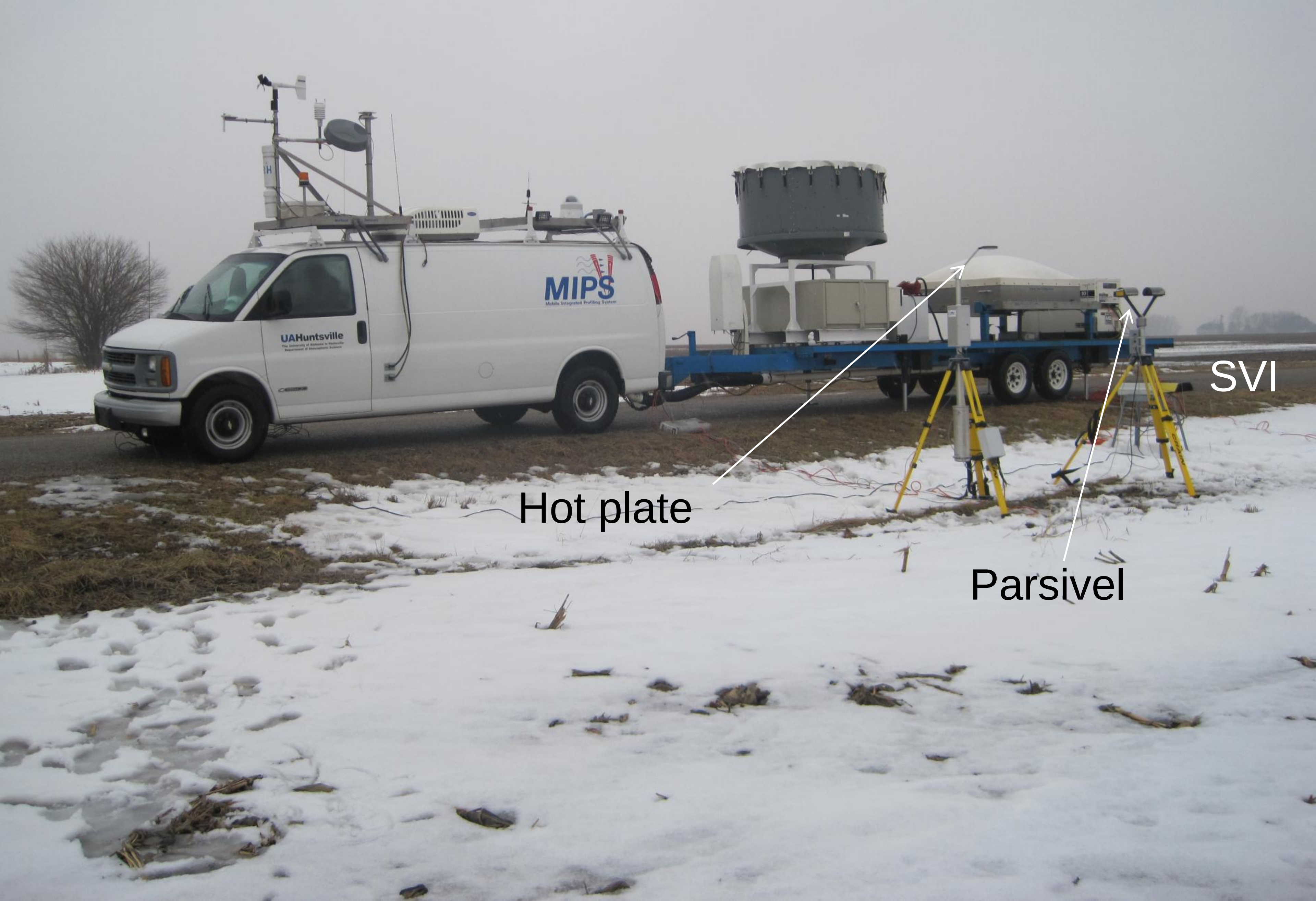
d)Precipitation profiling (RHI scans, followed by vertical stare)



OWLeS configuration of the MIPS

1. 915 MHz Doppler wind profiler
2. X-band Profiling Radar (XPR)
3. 12-channel microwave profiling radiometer (MPR)
4. lidar ceilometer (Vaisala CL51)
5. Doppler wind lidar (1.5 μm – 2013)
6. Video camera (remote control)
7. Surface instrumentation (T, RH, p, wind, solar radiation, IR radiation)
8. Parsivel disdrometer
9. Electric field mill
10. TPI hot plate precipitation gage
11. Particle video imager (PVI, to be borrowed from NCAR)

PLOWS DEPLOYMENT



PLOWS DEPLOYMENT

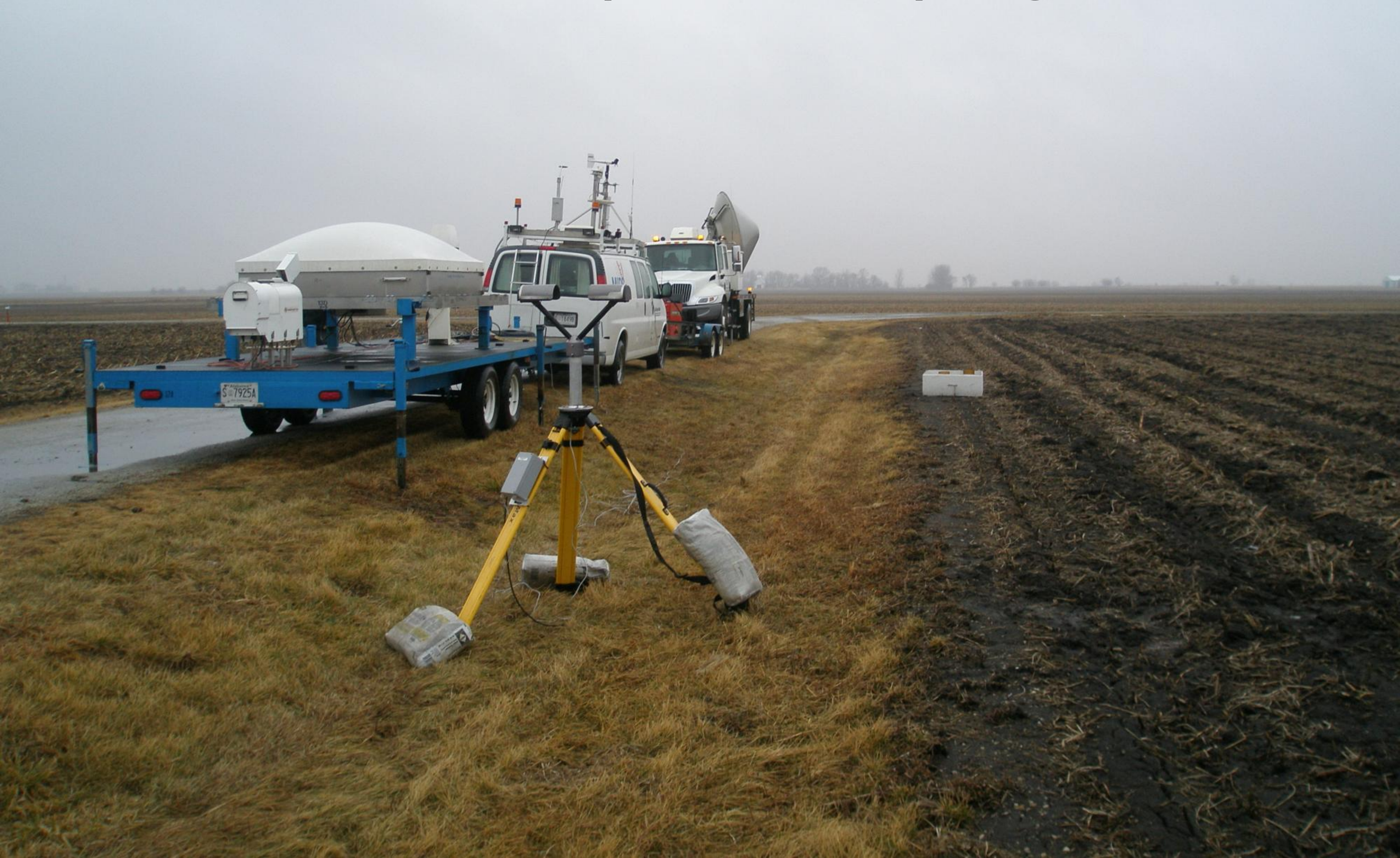
Some issues with surface instruments

- Exposure is important.
- Hot plate and Parsivel will perform better under laminar, low-wind conditions over a flat surface.
- Doppler wind lidar requires a clear view of the water surface if wind measurements over water are desired. The lidar can be separated (as far as needed) from the MIPS.
- Experience indicates that radar profilers (915, XPR) perform better when surrounded by trees (100 ft away, clutter issues)

Questions?

- kevin@nsstc.uah.edu
- http://vortex.nsstc.uah.edu/mips

MIPS and MAX co-located during PlOWS pilot campaign



Research facilities

- ***ARMOR***: *Advanced Radar for Meteorological and Operational Research (2004)*
  - *First dual polarization radar in the Southeast*
  - *Plans for "next generation" ARMOR*
- ***MAX***: *<u>Mobile</u> Alabama X-band* dual polarization radar
  - First mobile dual polarization radar (2007)
- ***MIPS***: *<u>Mobile</u> Integrated Profiling System (1998)*
  - *A truly unique platform*
- ***M3V***: *<u>Mobile</u>* Meteorological Measurement Vehicle (2003) (currently one, planning another)
- ***MABLES***: Mobile Atmospheric Boundary Layer Experimental Suite (2013): Doppler wind lidar, future tethersonde, future minisodar