TORNADO-SCALE RADAR OVERVIEW

Howie “Cb” Bluestein, OU
Steve Frasier, UMass
Chris Weiss, TTU

The Texas Tech Ka-band (TTUKa) Mobile Doppler Radars

Specs

Transmit Frequency	34.86 GHz
Transmit Power	200 W peak, 100 W average
Transmitter Type	TWTA, up to 50% duty cycle
Antenna Beamwidth	0.49 degrees
Azimuthal Resolution	4.28 m at 500 m range
Range Resolution	~15 m (using conventional processing mode)
PRF	Variable, up to 20 KHz
Receiver	MDS: -118 dBm
Digital Signal Processor	Sigmet RVP-8
Platform Stabilization	Computer assisted hydraulic leveling system

Primary Science Objectives

- Tornado vortex structure
    - Horizontal – high wavenumber / multiple vortex
    - Vertical – wind speed reduction, secondary circulations
- Mapping of pre-tornadic vertical vorticity maxima (e.g., RFGF)
- Near-surface mesocyclone characterization
- VAD inflow profiling

One TTUKa radar will participate for the majority of the 2009 field phase

The Texas Tech Ka-band (TTUKa) Mobile Doppler Radars

Strategies

Fast-moving storm scenario: Redundancy with UMass W-band, rapid-scan DOW

Slow-moving storm scenario: Potential dual-Doppler coordination, baseline 5-10 km

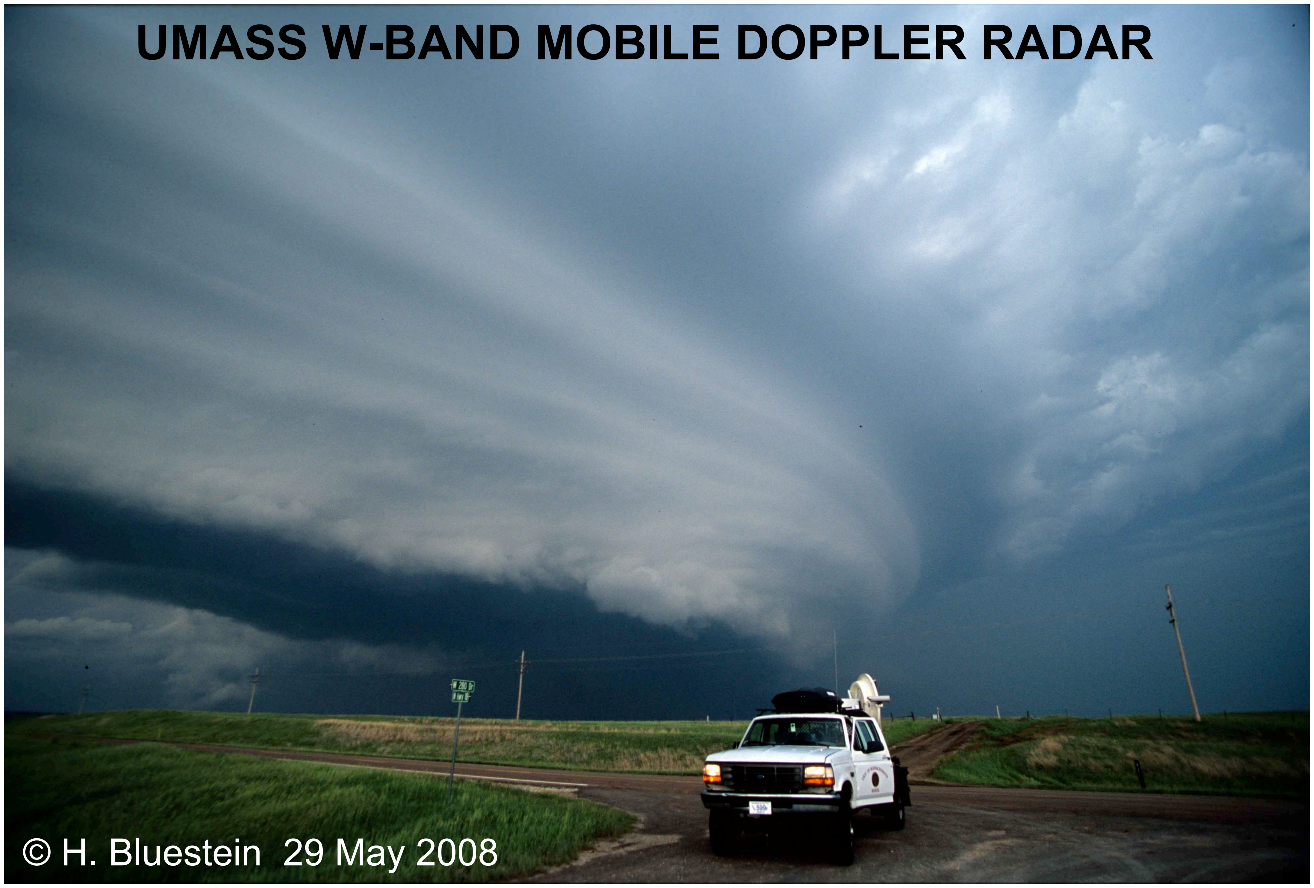
Additional Points

- Radome will be added March 2009.

- Important to have TTUKa scanning over StickNet array during passage of updraft region. Dual-Doppler lobes with other tornado-scale radars would be preferred at these locations when conditions permit.

- Regarding dual-Doppler lobes, would radar coordinator handle the placement of tornado-scale radars?

- Baseline placement very sensitive to estimated attenuation.



BEAMWIDTH	0.18^0	(AT 3 km RANGE ~ 10 m AZIMUTHAL RESOLUTION)
PULSE LENGTH	30 m	
PEAK POWER	1.2 kW	

MAX. UNAMBIGUOUS VELOCITY ± 40 m s^{-1} WITH STAGGERED PRT

MAX. UNAMBIGUOUS RANGE 12 km

MAX. AZIMUTHAL/ELEVATION SCAN RATE 10^0 s^{-1}/14^0 s^{-1}

DEPLOY TIME	~ 5 min (WITH HYDRAULIC LEVELERS)
UN-DEPLOY TIME	~ 3 - 4 min

BORESIGHTED DIGITAL VIDEO

SCIENTIFIC OBJECTIVES

• ESTIMATE THE RADIAL PROFILE OF WIND IN TORNADOES

• ESTIMATE THE VERTICAL VARIATION OF WIND NEAR THE GROUND IN TORNADOES

• DETERMINE THE REFLECTIVITY FIELD IN TORNADOES

• DETERMINE THE TEMPORAL VARIATION OF WIND AND REFLECTIVITY IN TORNADOES AND DEVELOPING/DECAYING TORNADOES

• RELATE TORNADO STRUCTURE AS A FUNCTION OF TIME TO WIND AND REFLECTIVITY FIELDS ON THE TORNADO CYCLONE/MESOCYLONE SCALE

• MEASURE VERTICAL SHEAR PROFILES IN THE CLEAR-AIR BOUNDARY LAYER JUST UPSTREAM FROM UPDRAFT BASES IN SUPERCELLS, PRIOR TO TORNADOGENESIS (EVADs)

• ATTEMPT DUAL-DOPPLER ANALYSIS OF A TORNADO (OR AROUND A DEVELOPING TORNADO, IN CLEAR AIR, AT VERY CLOSE RANGE) WITH VERY FINE SPATIAL RESOLUTION, USING THE TTU Ka BAND RADAR AND THE UMASS W-BAND RADAR

DEPLOYMENT STRATEGIES

- FAST-MOVING STORM: ONE-SHOT DEAL, POSSIBLE SHORT DUAL-DOPPLER, INTERCOMPARISON WITH TTU Ka BAND RADAR, SECTOR SCANS AT LOW ELEVATION ANGLE ONLY

- SLOW-MOVING STORM: POSSIBLE DUAL-DOPPLER AT A NUMBER OF ELEVATION ANGLES, RHIs ACROSS TORNADO WHEN MATURE, SECTOR SCANS AT ONE ELEVATION ANGLE ONLY PRIOR TO TORNADOGENESIS (~ EVERY 10 s); AFTER TORNADO HAS APPEARED, VOLUME SECTOR SCANS (UP TO ~ HALFWAY TO CLOUD BASE)

•• BASELINE 3 – 10 km, AT RANGES OF 3 – 10 km

•• EVADs ~ 5 - 20 km UPSTREAM FROM UPDRAFT BASE

OTHER ISSUES

- COORDINATION BETWEEN Ka AND W-BAND RADARS
- FINDING PARKING SPACES!
- ANY OTHER SUGGESTIONS FOR USES OF THE Ka AND W-BAND RADARS?