The Rapid X-band Polarimetric Radar Community Instruments and Facilities

David Bodine, Tian-You Yu, Boonleng Cheong, Howard Bluestein, Pierre Kirstetter, Robert Palmer, David Schvartzman, Mark Yeary, and Hsiu-Wei Hsu
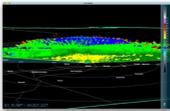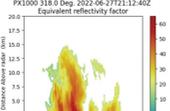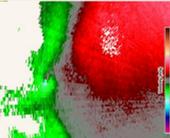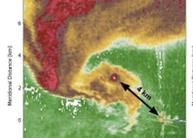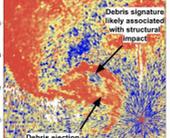
The Rapid X-band Polarimetric Radar (RaXPol)

- RaXPol is a rapid-scanning dual-polarization radar, capable of up to 180º/s pedestal rotation
  - Acquires 20-s volume scan when scanning 10 different elevation angles
- Using frequency hopping, RaXPol acquires independent samples faster than traditional radars (Pazmany et al. 2013)
- RaXPol is requestable as an NSF Community Instrument and Facility (CIF): https://cif.arrc.ou.edu/cif.html

RaXPol Specifications

Frequency	9.73 GHz (X-band)
3-dB Beamwidth	1.0º
Polarization	Dual-linear (SHV, **AHV**)
Transmitter Type	**1.6-kW Solid-State Power Amplifier (SSPA);** 800 W per channel
Range Resolution	≥ 3 m
Duty Cycle	10%
Pulse Length	0.1–100 µs

RaXPol Field Experiments

NASA IMPACTS (2022-2023)	Winter storms in the Northeast US	
NSF ESCAPE (2022)	Sea breeze thunderstorms near Houston, TX	
NSF PERiLS (2023–2024)	Quasi-linear convective systems and mesovortices in the Southeast US	
Univ. of Nebraska (NREO-2025; NSF Track 1)	Deployments coordinated with UNL's radar meteorology class	
NOAA LIFT (2025)	Low-level observations of supercells and tornadoes in the Southern Plains	
NSF PAPEL (2026; NSF Track 2)	Rapid-scan observations of thunderstorms and electrification processes	
Purdue Univ. SPOTTR (2026; NSF Track 1)	Deployments supporting Purdue's summer field course	

Transmitter Upgrade: Solid-State Power Amplifier

- RaXPol's original 20-kW TWT has been replaced by a pair of 800-W solid-state power amplifiers (1.6-kW peak power)
- Leveraging pulse compression waveforms, improved sensitivity can be obtained compared to the previous system configuration with a 20-kW transmitter (Kurdzo et al. 2014; Salazar Aquino et al. 2021, 2024)
  - Progressive pulse compression (PPC) will be used to mitigate the blind range
  - Application-specific pulse lengths are being designed (50+ µs for clear-air applications, 1-10 µs for severe weather applications)
- Very high effective bandwidth (50 MHz) provides range resolution of 3 m

Pulse compression and rapid scanning:
- Option 1: Use progressive pulse compression waveforms with frequency hopping
- Option 2: Apply 30–50 m range averaging to 3-m measurements to acquire independent samples without frequency hopping
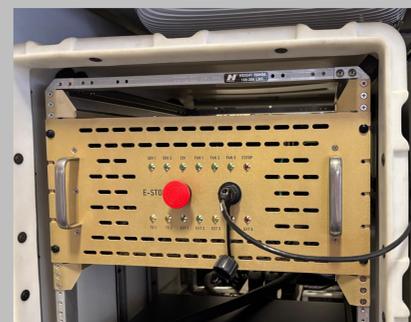
Conclusions and Future Plans

- RaXPol will be deployed this year for a lightning field campaign (PAPEL) led by OU and Texas Tech University (Track 2 deployment)
- RaXPol will join Purdue University's SPOTTR class as part of a Track 1 educational deployment
- The ARRC has built several X-band passive bistatic receivers which will be used to acquire rapid 3D wind retrievals (20–30 s analyses)

CIF and Data Archive Webpages
- CIF requests: https://cif.arrc.ou.edu/cif.html
- RadarHub: https://radarhub.arrc.ou.edu/archive/raxpol/