Meteorological Observations in Support of Dual Polarization Research

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Weather Radar Research
Motivation

- Support NOAA’s mission to provide improved weather and water information by collecting valuable validation datasets to be used in dual-polarization algorithm development.

Success of polarimetric radar research conducted at the NSSL has been contingent upon the availability of data from a vast network of observational facilities located in Oklahoma.
Much of the data critical to the success of polarimetric radar research at the NSSL comes from fixed-site facilities whose collocation with a S-band polarimetric radar are unique to Oklahoma.
Rain Gauge Networks
The Oklahoma Mesonet

- Automated network of 116 remote meteorological stations across Oklahoma.
- Unique in its ability to measure variety of environmental conditions at sites across an area as large as Oklahoma.

The Oklahoma Mesonet has proven critical to dual-polarization research by:

- Providing 5-minute rainfall data used to develop and test polarimetric rainfall estimation algorithms, especially at large distances from the radar.
- Providing thermodynamic data used to quality control polarimetric hydrometeor classification designations.
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Consists of a network of instrumented sites over the Little Washita and Fort Cobb watersheds.

Fort Cobb watershed is also instrumented with 3 US Geological Service discharge stations.

The Micronet has proven critical to dual-polarization research by:

- **Little Washita:** Providing high-density (~ 5 km) rainfall data used to develop and test polarimetric rainfall estimation algorithms.

- **Fort Cobb:** Providing combined rainfall and stream flow data used to investigate the response of hydrologic models to polarimetric rain estimates.
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The NSSL 2D-Video Disdrometer

Data Collection Summary:

- Dataset includes over 50,000 one-minute Drop Size Distributions (DSDs) with $R > 0.1$ mm h$^{-1}$.
- DSD measurements have been made on >300 separate days over an 8 year period.

The NSSL 2DVD has proven critical to dual-polarization research by:

- Providing a large precipitation dataset used to develop dual-polarization precipitation estimation algorithms to be deployed with the polarimetric WSR-88D.
- Providing a large, comprehensive dataset that documents differences in DSD characteristics over a wide variety of seasons and precipitation regimes.
Permanent KFFL Field Facilities:
- WASH Oklahoma Mesonet site
- NOAA 403 MHz and OU 915 MHz wind profilers
- NSSL vertically pointing 24.1 GHz Micro Rain Radar
- OU 2D-Video Disdrometer
- Piconet rain gauge network

KFFL has proven critical to dual-polarization research by:
- Providing datasets used to better understand the vertical microphysical structure of precipitating clouds, leading to improved polarimetric algorithm performance.
Kessler Farm Field Laboratory

Radar Reflectivity (dBZ)

Doppler Velocity (m/s)

Spectrum Width (m/s)

Height (km)

11:20 11:40 12:00 12:20 12:40

Height (km)

11:20 11:40 12:00 12:20 12:40 13:00

Time (UTC)

ZDR (dB)

pHV

Height (km)

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5

Zh (dBZ)

5 6

4

3

2

1

0

-5 -10 -15

-10 -5 0 5

-15 -10 -5 0 5

-15 -10 -5 0 5
Oklahoma Lightning Mapping Array

The OK-Lightning Mapping Array:
- Consists of 11 stations, all located to the west of the KOUN radar.
- Measures VHF sources emitted by each segment of a lightning flash.
- Accurately measures 3D lightning characteristics to a range of ~100 km from network center.

The Oklahoma Lightning Mapping Array has proven critical to dual-polarization research by:
- Providing 3D lightning signatures used to investigate relationships between electrical, kinematic, and radar-derived microphysical structures.
Oklahoma Lightning Mapping Array
Tornadic Supercell

- Midlevel rings of $Z_{DR}$ and $\rho_{HV}$ formed just prior to a F2 tornado.

- Midlevel $Z_{DR}$ and $\rho_{HV}$ rings were visually correlated with a ring in lightning source density, which was centered on the maximum in vorticity.

- $Z_{DR}$, $\rho_{HV}$, and lightning source density rings dissipated when tornado lifted.
Volunteer Observation Networks

Winter Precipitation Identification Near the Ground (W-PING)

Hail Size Discrimination Experiment (HaSDEx)

Volunteer Data Collection:
- Advertised by local television stations and newspapers, NOAA web pages, and schools.
- Web-based training materials are provided.
- Volunteers provide observations using a web-based form.
- Quality controlled by NSSL student employees.

The Volunteer Observation Network has proven critical to dual-polarization research by:
- Providing valuable validation datasets used to improve the performance of the polarimetric precipitation type classification algorithm.
Summary

Meteorological Observations in support of Dual Polarization Research:

- Support NOAA’s mission to provide improved weather and water information.
- Critical to the success of NSSL polarimetric radar research by providing valuable validation datasets.
- Used extensively to develop rainfall estimation and precipitation type classification algorithms to be deployed with the polarimetric WSR-88D.
- Include data from fixed-site facilities whose collocation with a polarimetric radar are unique to central Oklahoma.
- Provide an opportunity for NSSL scientists to participate in ongoing collaborations with OU faculty and students.