12B.13 THE JOINT POLARIZATION EXPERIMENT –
AN OPERATIONAL TEST OF WEATHER RADAR POLARIMETRY

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1. INTRODUCTION

In July of 2000, the initial planning meeting for the Joint Polarization Experiment (JPOLE) was held at the National Severe Storms Laboratory (NSSL) in Norman, Oklahoma. JPOLE will include the first operational test of weather radar polarimetry. Moreover, JPOLE will provide an opportunity to investigate many complimentary hydrological and meteorological scientific objectives.

Plans call for an experiment that will consists of two phases: a multi-seasonal test and evaluation period (using local facilities for the collection of verification data sets, to begin in the spring of 2002), and an intense observation period (using both local and community-wide facilities for the collection of verification data sets, to begin in the spring of 2003). During the first phase, data collection will be conducted to allow a detailed analysis of present (non-polarimetric) and future (polarimetric) WSR-88D rainfall and hydrometeor products. The second phase, with improved infrastructure provided by the addition of community-wide facilities for the collection of verification data sets, will focus on detailed investigation of proposed scientific objectives. The first phase will emphasize a demonstration of the utility of the polarimetric KOUN WSR-88D radar, and a test and evaluation of its engineering design and data quality. In addition, the second phase will address broad scientific objectives. This paper describes the goals and present plans for the JPOLE project.

2. JPOLE OPERATIONAL OBJECTIVES

The open systems development and polarimetric upgrade to the KOUN WSR-88D radar has been a tri-agency effort supported by the National Weather Service (NWS), Federal Aviation Administration (FAA), and Air Force Weather Agency (AFWA). As such, the operational objectives of JPOLE are designed to address the needs of these three agencies.

The overarching goals of JPOLE are to test the engineering design and determine the data quality of a polarimetric WSR-88D radar, demonstrate the utility and feasibility of the radar, and to collect data and information that will allow for a cost/benefit analysis to be performed. This will require a demonstration of the radar's ability to satisfy objectives that are of interest to the hydrological, meteorological, and aviation communities, such as to

- Improve Quantitative Precipitation Estimation (QPE)
- Improve streamflow forecasting
- Discriminate hail from rain and gauge hail size
- Identify precipitation type in winter storms (dry/wet snow, sleet, rain)
- Identify biological scatterers (and their effects on the wind measurements)
- Identify the presence of chaff (and its effect on precipitation measurements)
- Identify areas of ground clutter and anomalous propagation
- Provide improved initial conditions and constraints to numerical models for short term forecasts
- Investigate the feasibility of identifying aircraft icing conditions

The preliminary plans for addressing these objectives during the JPOLE operational demonstration are addressed in the following sections.

3. JPOLE OPERATIONAL DEMONSTRATION

The JPOLE operational demonstration will be conducted in two phases: a multi-seasonal test and evaluation period, to begin in the spring of 2002, and an intense observation period (IOP, during which additional facilities for the collection of verification data sets will be deployed to central Oklahoma), to begin in the spring of 2003. All data collection during both phases will focus on the collection of data sets to be used for a detailed comparison of conventional and polarimetric radar products. These product comparisons will be of fundamental importance to the test and evaluation of the polarimetric KOUN WSR-88D radar's capabilities.

The operational demonstration will also provide an opportunity to evaluate critical engineering and data quality issues. For example, the radar scanning strategy must be evaluated to assess compatibility with requirements of the existing WSR-88D radar system. Tests must be performed to assure a minimal degradation in VCP times, and no degradation in ground clutter filtering, anomalous propagation filtering, and range and velocity folding. The simultaneous transmission mode (Doviak et al., 2000) must be examined to calibrate polarimetric radar measurements,

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establish and verify engineering specifications, and investigate the short and long term stability of the measurements, the value of alternate ρ_{HV} and L_{DR} scans, and limits to any of the variables. Data quality must be assessed through a detailed comparison of the radar data to verification data sets (addressed in more detail below).

As noted earlier, however, the primary goal of JPOLE is a transfer of polarimetric radar technology to an operational arena. Therefore, it is imperative that real-time data collection be conducted in collaboration with operational hydrologists, meteorologists, and aviation users, whose insight will be of vital importance to the evaluation of WSR-88D radar products. In preparation for this collaboration, NSSL has developed a real-time polarimetric radar display system that will provide NSSL Cimarron polarimetric radar rainfall and hydrometeor identification products to the NWS Forecast Office in Norman, Oklahoma in the spring of 2001 (the NSSL Cimarron radar products will be replaced with those from the KOUN radar in the spring of 2002). Further coordination work will be required to establish a similar demonstration capability for the FAA and AFWA.

4. JPOLE INTENSE OBSERVATION PERIOD

While JPOLE is primarily designed to be an operational demonstration project, the infrastructure provided by the operational test and evaluation requirements present a unique opportunity to investigate several complementary (hydrological and meteorological) scientific objectives. In the spring of 2003, a JPOLE IOP is therefore being planned for central Oklahoma. The primary goals of the IOP are to 1) collect dense, ground-based and airborne verification data sets that can be used to assess the KOUN radar data and product quality, and 2) collect high-quality, hydrological/meteorological data sets that can be used to investigate several scientific objectives, which are crucial towards advancing knowledge that will lead to future improvements of polarimetric radar algorithms. The JPOLE operational demonstration data collection will extend into this IOP.

Since the JPOLE planning meeting, scientists from a number of educational institutions and government agencies have submitted scientific objectives that are being now combined into a JPOLE Science Overview Document that will serve as a template for the design and future operations plan of the JPOLE IOP. Preliminary plans call for the deployment of several ground-based and mobile facilities to central Oklahoma for the spring of 2003. These include, a research polarimetric radar that can be strategically placed in central Oklahoma to provide both a source of high-quality data that can be used for a comparison with the KOUN radar data (as well as provide input for hydrological distributed modeling studies), research aircraft to provide in situ microphysical data, and ground based rain gauge networks, disdrometers, and hail chase vehicles. Several groups have also expressed an interest in bringing Ka-band and X-band polarimetric radars that can be used for radar intercomparison, and precipitation and aircraft icing studies.

Other JPOLE scientific objectives follow

Hydrological Objectives

- Verify and compare radar rainfall estimates and improve radar rainfall estimators
- Investigate DSD variability
- Measure streamflow and runoff
- Conduct hydrologic modeling

Meteorological Objectives

- Improve physical understanding of polarimetric signatures
- Verify and improve hydrometeor classification schemes
- Develop and verify hydrometeor quantification schemes
- Investigate the use of polarimetric hydrometeor information in cloud resolving models

5. SUMMARY

The Joint Polarization Experiment will represent the first operational test of the polarimetric KOUN WSR-88D radar. Present plans call for an experiment that essentially consists of two phases: a multi-seasonal test and evaluation period and an intense observation period. Both phases will focus on the collection of data sets to be used for a detailed comparison of conventional and polarimetric radar products, which will be of fundamental importance to the test and evaluation of the radar's capabilities. Additional facilities available during the intense observation period will provide much needed verification data sets and allow for a detailed investigation of several hydrological and meteorological scientific objectives. Critical engineering and data quality issues will also be examined.

As a tri-agency experiment supported by the NWS, FAA, and AFWA, JPOLE will strive to provide a demonstration of the operational benefits to each agency. As such, work is currently progressing to coordinate real-time data collection with operational hydrologists, meteorologists, and aviation users, whose insight will be of vital importance to the evaluation of WSR-88D radar products.

6. REFERENCES

Doviak, R. J., V. Bringi, A. Ryzhkov, A. Zahrai, and D. Zrnic, 2000: Considerations for polarimetric upgrades to operational WSR-88D radars. *J. Atmos. Oceanic Tech*., **17**, 257-278.