Dual-Polarization Radar

NOAA NATIONAL WEATHER SERVICE October 2011

What is dual-polarization radar?

Dual-polarization radar (often called simply "dual-pol") is the next evolution of the existing National Weather Service WSR-88D radar network. ***The impact of dual-pol radar on the warning program could be as significant as the nationwide upgrade to Doppler radar in the 1990's.***

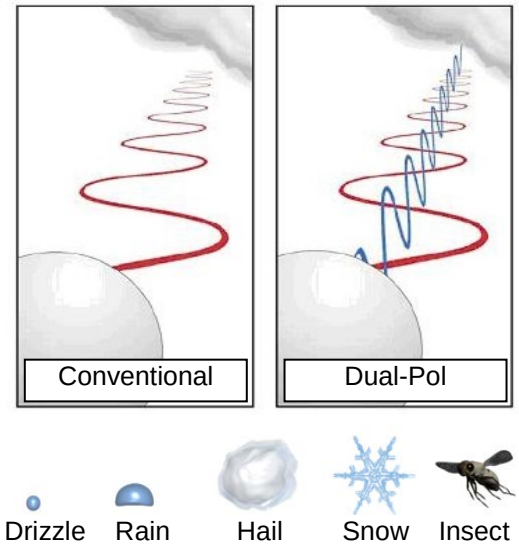
The Benefits

- Greater accuracy in precipitation estimates
- Distinguish very heavy rain from hail (leading to improved flash flood warnings and fewer severe thunderstorm warning false alarms)
- Increased forecaster confidence in warnings
- Distinguish winter precipitation types (leading to improved rain/snow/sleet discrimination)
- Possible longer lead times for warnings
- Confirmation of damaging tornado at close range to the radar
- Reduced ground clutter, noise

How It Works

Radars send out short bursts of radio waves called pulses. The pulses bounce off particles in the atmosphere and the energy is reflected back to the radar dish. A computer processes the returned signals and can deduce overall intensity of the target, the directions the particles are moving (using the Doppler effect), and the speed of their movement.

Dual-pol, or polarimetric, radars capitalize on the fact that precipitation types vary in size and shape. Specifically, dual-pol radars transmit pulses that have both horizontal and vertical orientations. The difference in energy returned from the horizontal and vertical pulses provides additional insight into the nature of the particles that are reflecting the energy such as their size, shape, and orientation.



Frequently Asked Questions

Has dual-pol radar been tested?

Yes. The National Severe Storms Laboratory (NSSL) conducted the Joint Polarization Experiment (JPOLE) in 2002-2003 to demonstrate the operational capabilities of polarimetric radar. During the experiment, data were delivered in "real-time" to the NWS and other users and NSSL scientists aided in the data interpretation. JPOLE proved that significant improvements in rainfall estimation, precipitation classification, data quality, and weather hazard detection were possible using polarized radar.

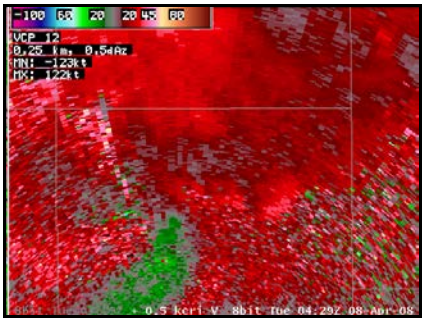
When will dual-pol radar be installed?

Nationwide NWS installations are scheduled for 2011-2013. The retrofit requires a 10 to 14 day outage of the radar.

Traditional Base Parameters

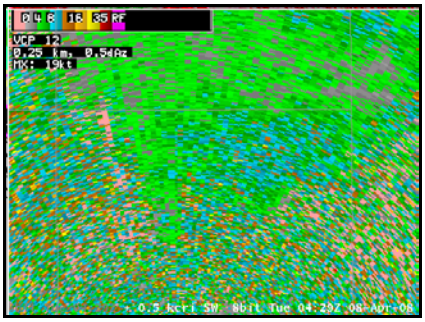
Super-Resolution Reflectivity

Measurement of energy reflected from the target back to the radar.



Radial Velocity

Movement of the target directly toward or away from the radar.

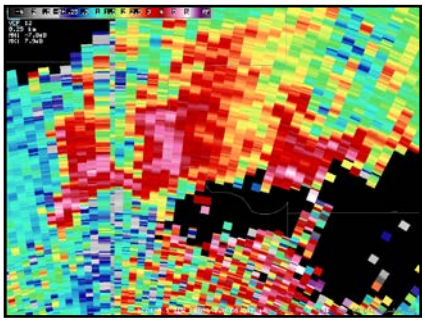


Spectrum Width

Velocity dispersion (distribution of velocities within a single pixel).

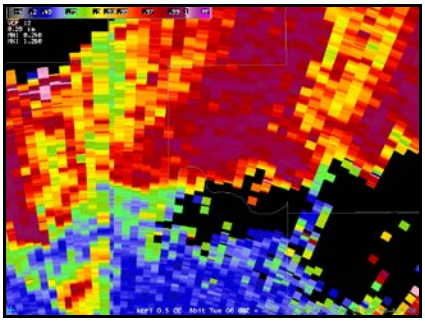
Polarimetric Parameters and Derived Fields

In addition to the traditional base measurements shown above, three new base fields are available. Many new derived fields will also be calculated from these base fields.



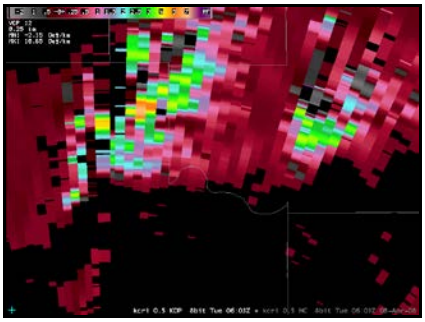
Differential Reflectivity

Ratio of the reflected horizontal and vertical power returns. It is a good indicator of drop shape, and thus a good estimate of average drop size and an excellent indicator of the presence of hail.



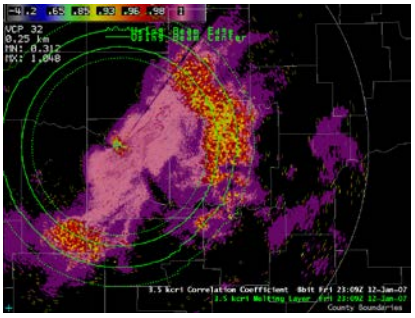
Specific Differential Phase

Comparison of the returned phase difference between the horizontal and vertical pulses (caused by the difference in the number of wave cycles) along the propagation path. It is a very good estimator of rain rate.



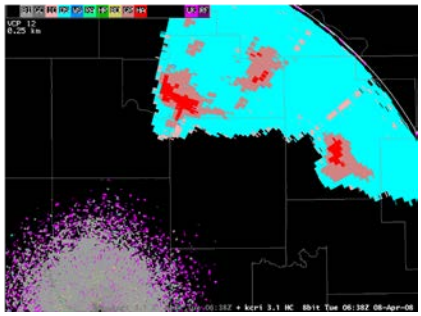
Correlation Coefficient

Statistical correlation between reflected horizontal and vertical power returns. It is a good indicator of mixed precipitation (such as rain and snow) and the best indicator of precipitation vs. non precipitation radar echoes.



Melting Layer

These are examples of the types of fields that can be derived from the above base data using software algorithms. In the example to the left, the melting layer (green graphic) has been calculated and overlayed on the Correlation Coefficient. To the right, we see an example of base data analysis by algorithms differentiating the types of targets (clear air returns, biologicals, and varying precipitation types).



Hydrometeor Classification

On the web:

Warning Decision Training Branch Dual-pol Courses ..... www.wdtb.noaa.gov/dualpol/outreach
National Severe Storms Lab ..... www.nssl.noaa.gov/research/radar/dualpol.php
National Weather Service ..... www.weather.gov