HOW THE WSR-88D AND ITS NEW DUAL POLARIZATION CAPABILITY CAN BENEFIT THE WIND ENERGY INDUSTRY

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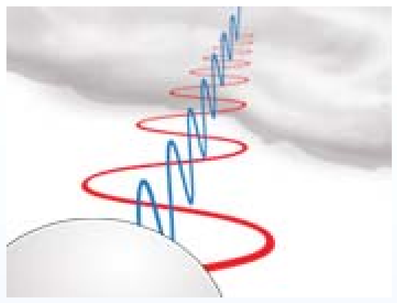
WSR-88D Network

- 160 Doppler radars operated by NWS, USAF, FAA throughout the US and overseas
  - Detects weather targets and storm-scale winds
  - Highly-sensitive receiver detects "clear air" boundaries such as dry lines, gust fronts, thunderstorm outflows; also birds, insects, smoke plumes, airborne dust
- Dual-polarization capability now installed at 121 sites; all by June 2013
  - Senses both the horizontal and vertical dimensions of hydrometeors
  - Many new capabilities to aid forecasts/warnings/wind power production efficiency



WSR-88D Can Help Increase Wind Farm Production

- Anticipate "Ramp" Events
  - Real-time radar data of winds, severe weather, winter weather (frozen/liquid)
- Day-Ahead Energy Production Forecasts
  - Radar data input for initialization of numerical weather prediction models
- Climatological Studies
  - "Forensic" studies of weather events that affect wind farm operations/ efficiency
- Real-time detection and forensic studies of Bird/Bat migration

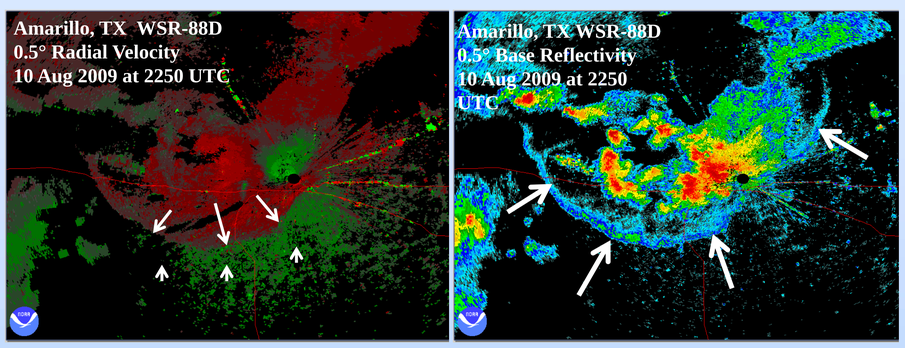
Real-Time Analysis of Ramp Events and 0-2 Hour Forecasts

The New Dual Polarization Variables

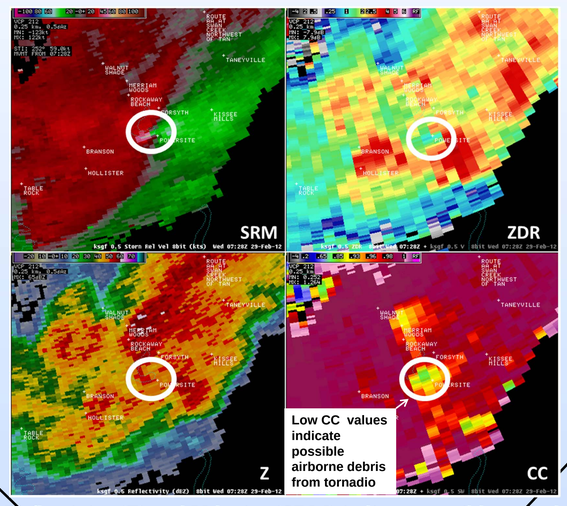
- **CC**: Correlation Coefficient
- **ZDR**: Differential Reflectivity (decibels)
- **KDP**: Specific Differential Phase (degrees/kilometer)

Detection of Wind Shift Boundaries

The WSR-88D can detect thunderstorm outflow boundaries. Comparing sequential reflectivity and velocity products, which are updated every 4 to 5 minutes, allows wind energy companies to estimate the on set of ramp events.



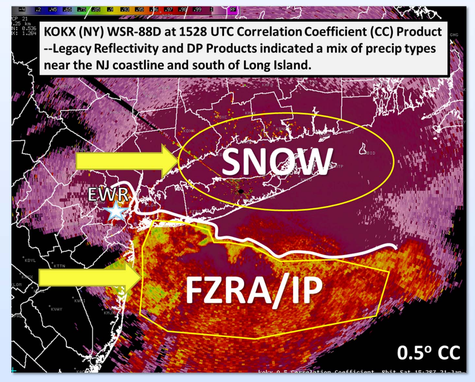
Additional Tornado Confirmation



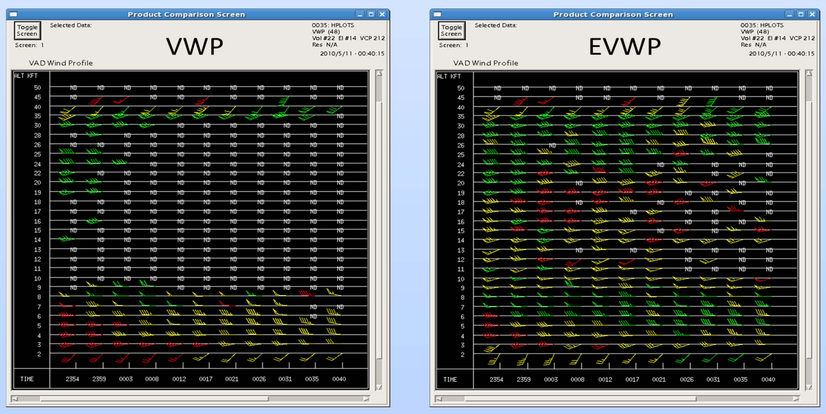
Reflectivity (Z) and Velocity (SRM) indicate possible tornado (note hook echo and velocity couplet in circle). Dual-Pol data (low ZDR and CC values in circle on right) can detect debris cloud, and help confirm a tornado is on the ground.

Delineation of Freezing/Frozen Precipitation

Very high CC values across Long Island and to the north, close to 0.99, indicate very homogenous mixture (pure snow) in resolution volume. The brighter colored areas (low CC values) of yellow and green to the south, indicate a mix of precip types, such as sleet and freezing rain. Newark Airport (EWR, at star in image) reported ice pellets at the time, verifying a change over from snow. Overall, dual pol products provide increased confidence to forecasters on detecting and predicting (in the short term) different types of frozen precipitation.

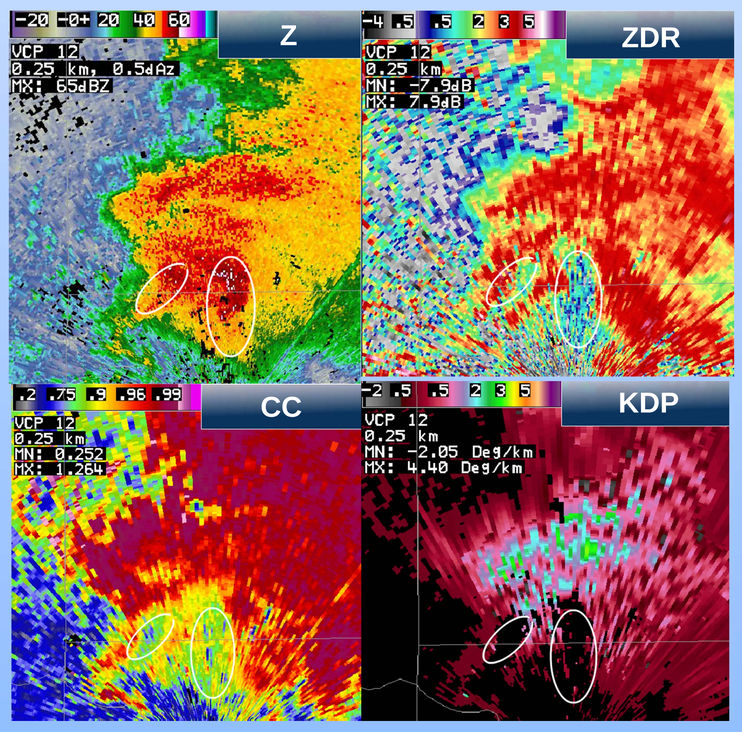


Enhanced Winds Aloft Estimates



Comparison of legacy vertical wind profile (VWP) and new Enhanced VWP (EVWP) product. EVWP improves availability and accuracy of wind estimates.

Improved Hail Detection and Hail Stone Size Determination

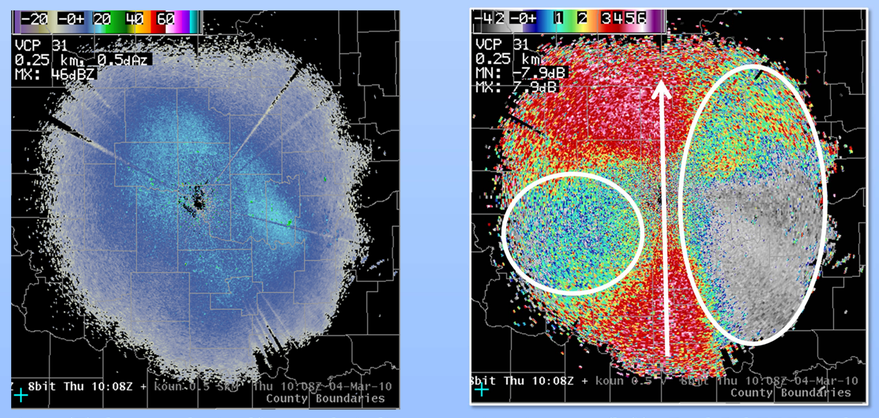


Dual Pol data provides forecasters and data users additional confidence of the occurrence, location and size of hail.

"Giant" (>2 in) hail case of Dual-Pol Z, ZDR, CC, and KDP products from KOUN WSR-88D on 10 May 2010. "Baseball" size hail at the ground was reported in the white circled areas.

WSR-88D 30-meter Tower and Radome

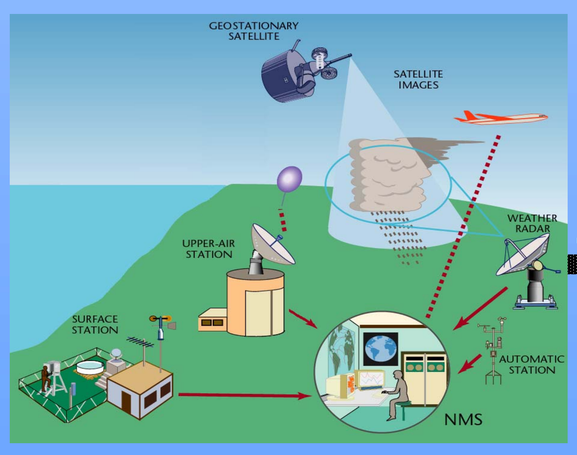
Enhanced Signatures of Migrating Birds

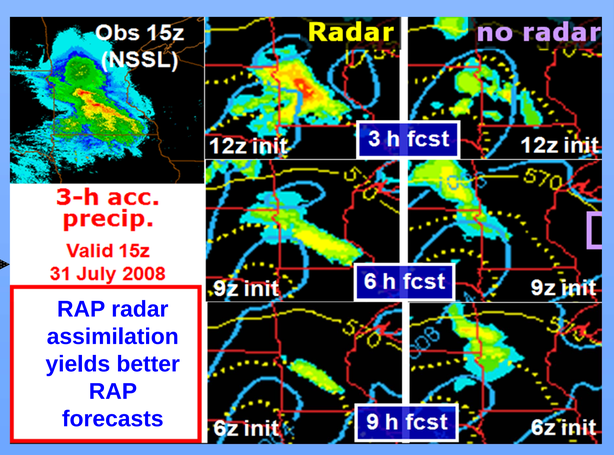


Reflectivity (Z) does not, by itself, strongly indicate an avian signature (left). Dual-Pol ZDR product (right) shows corridor of positive ZDR (arrow) and lobes of negative ZDR (ovals). Positive ZDR usually indicates avian head/tail orientation parallel to radar beam. Negative ZDR indicates head/tail orientation perpendicular to radar beam. Can improve bird detection, and potentially help identify number and type.

3- to 12-Hour and Day-Ahead Forecasts

- Numerical weather prediction model output is used by wind energy companies to make day-ahead energy production forecasts
- NOAA's National Center for Environmental Prediction (NCEP) assimilates WSR-88D Level II reflectivity data into the Rapid Refresh (RAP) Model to improve short-term forecasts

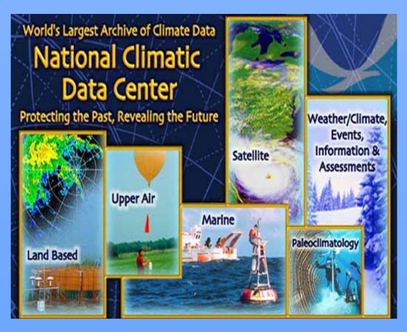




How to Obtain WSR-88D Dual-Pol Data

Real-Time Data

- Real-time WSR-88D Level II data (3 legacy moments and 3 new Dual Pol variables) are available from 140 WSR-88Ds. NWS sends these data to three distribution nodes where private sector users can obtain the data: Purdue University, Education and Research Consortium of the Western Carolinas, and the University of Oklahoma.
  - For more information visit: **http://www.roc.noaa.gov/WSR88D/Level_II/Level2Info.aspx**
- NWS sends real-time radar products (Level III) from 156 WSR-88D and 45 FAA Terminal Doppler Weather Radars; available at: **http://www.nws.noaa.gov/tg/rpccds.html**



Archive Data

- Can support forensic and climatology studies of:
  - Significant weather events
  - Wind assessments
  - Bird migration
- Level II and Level III data are available, at no charge, from NOAA's National Climatic Data Center (NCDC).
- For more information visit: **http://www.ncdc.noaa.gov/oa/radar/radarresources.html#welcome**

Summary – What Dual-Pol WSR-88D Data Can Do For The Wind Industry

- Aids short-term forecasts for wind farm operators and commercial weather forecasters
- Helps the wind-energy industry make better production decisions
- Important input to initializing numerical weather prediction models
- Provides thousands of virtual data points of weather information

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