Radar Observation of Severe Weather

Jeffrey Taylor
National Weather Service
Greenville/Spartanburg

Presentation Outline

- *Overview of meteorological radar*
  - *Its humble beginnings*
  - *How it has advanced*
  - *What the future might hold……*
- *How the NWS uses radar*
- *Examples of storm signatures observed by NWS Doppler radar*

Its Humble Beginnings….

- *During WWII, military radar operators noticed "noise" in returned echoes from weather elements like rain, snow, and sleet*
- *After the war, military scientists began developing technologies to use this radar data*
- *By the early 1950s, groups in the US and Canada had developed the first operational weather radars*
- *Many would consider these early radars primitive compared to current radar technology*

How it has Advanced…..

- *Meteorologists soon realized how useful radar could be for observing severe weather*
- *Between roughly1950 and 1980, radars were built by weather services/bureaus around the world*
- *The majority of these radars could only measure reflectivity*
- *During the late 1960s and early 1970s, the National Severe Storms Laboratory (NSSL) began developing meteorological Doppler radar and dual-polarization technology*

How it has Advanced…..

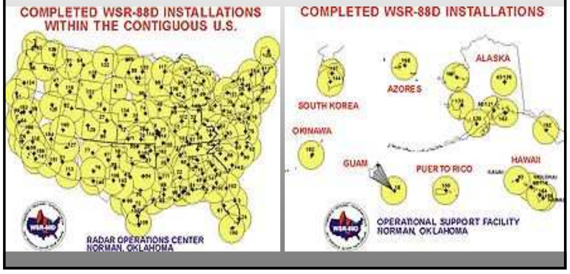
- *Between approximately 1980 and 2000, many conventional radars were replaced with Doppler radars*
- *Doppler radars provide velocity and spectrum width data in addition to reflectivity data*
- *Increased computing capabilities have produced a plethora of new radar products*
- *Many of these products are used daily by forecasters*

What the Future Might Hold…..

- *Over the past 10 years or so, NOAA/NSSL has been developing dual-polarization technology*
- *Dual-polarization radars provide much more information on precipitation type*
- *Widespread deployment of these radars is expected in the near future*
- *NOAA has also been experimenting with phased-array radar technology*

How the NWS Uses Radar

- *The NWS, DOD, & FAA currently operate a network of 159 WSR-88D radars*

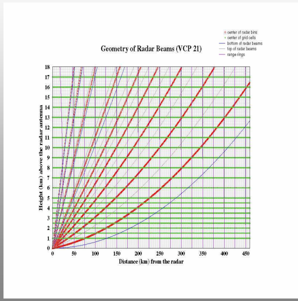


A Few Facts About the WSR-88D

- *10 cm wavelength (S-band)*
- *2 primary operating modes*
  - ***Slower scanning clear-air mode***
  - ***Faster scanning precipitation mode***
- *3 primary data types*
  - ***Reflectivity***
  - ***Velocity***
  - ***Spectrum Width***

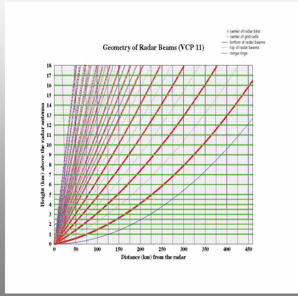
How the NWS Uses Radar

- *The WSR-88D incorporates different scan strategies depending on the current weather situation - on the right is VCP 21*



How the NWS Uses Radar

- *This image displays VCP 11 which is better suited for rapidly evolving thunderstorms/severe weather*

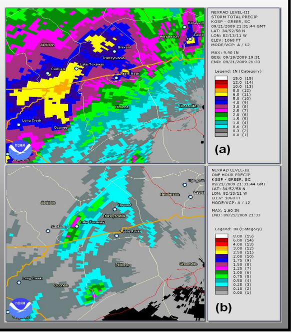


How the NWS Uses Radar

- NWS forecasters use the WSR-88D Network for many things:
  - ***Precipitation detection and estimation (i.e., is it raining & how much has fallen?)***
  - ***Vertical wind profile generation***
  - ***Storm location and propagation***
  - ***Storm intensity/strength***
  - ***Downburst & tornado detection***

Precipitation Detection & Estimation

- *Upper panel displays radar derived storm-total precipitation*
- *Lower panel displays radar derived 1-hour precipitation*



VAD Wind Profile Generation

- *A VWP is a time-height display of horizontal winds computed above the 88D radar.*
- *They are useful for monitoring wind shear (speed & direction) and jet stream evolution.*

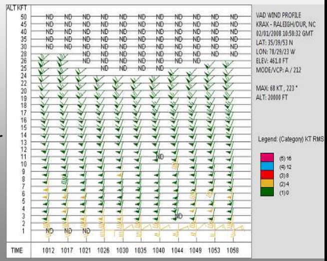


Image courtesy of NWS Forecast Office in Raleigh, NC

Storm Location & Propagation

- *This 88D radar image was taken in July of 2008 over the GSP forecast area*
- *Note the higher reflectivities in red; they are indicative of stronger thunderstorms*

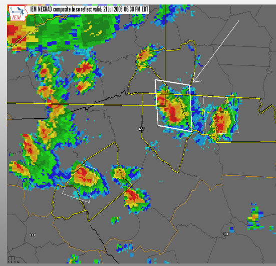
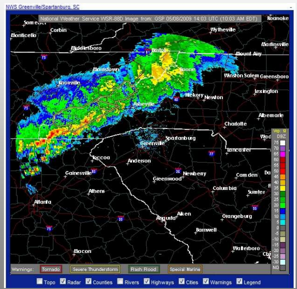


Image courtesy of Iowa State University - Dept. of Agronomy

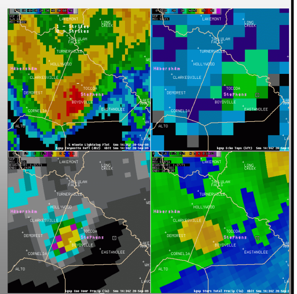
Storm Location & Propagation

- *This image shows a mesoscale convective system (or MCS) over the NC/TN border region in May of 2009*
- *Note the warning polygons over the state line*



Storm Intensity/Strength

- *Numerous radar derived products allow forecasters to estimate the size and strength of individual thunderstorms in near real-time*



Storm Intensity/Strength

- *The image on the right displays what meteorologists call a "three-body scatter spike" or "hail spike"*
- *This is a strong indicator that a thunderstorm contains large hail*

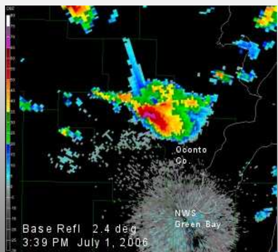


Image courtesy of NWS Forecast Office in Green Bay, WI

Downburst & Tornado Detection

- *Downbursts are strong downdrafts within thunderstorms that can produce damaging straight-line winds once they hit the ground and spread out*

Image courtesy of NOAA/National Severe Storms Laboratory

Downburst & Tornado Detection

- *Downburst detected by WSR-88D base velocity data.*
- *This event occurred near Tea, South Dakota on August 18th, 2006 (winds were estimated between 50-80 mph)*

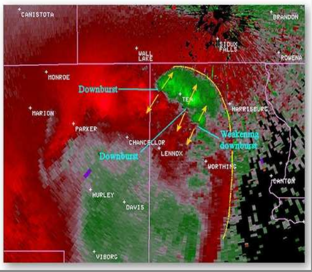
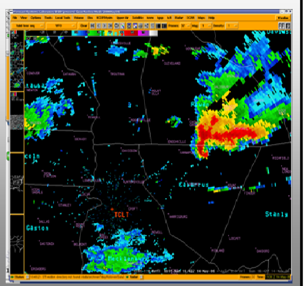


Image courtesy of NWS Forecast Office in Sioux Falls, SD

Downburst & Tornado Detection

- *Good example of a radar "hook echo" as seen in a reflectivity image*
- *The presence of this type of signature typically warrants a tornado warning*



Downburst & Tornado Detection

- *This image displays strong cyclonic circulation associated with a developing tornado near Oklahoma City on May 3rd, 1999*

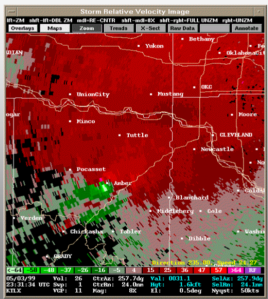
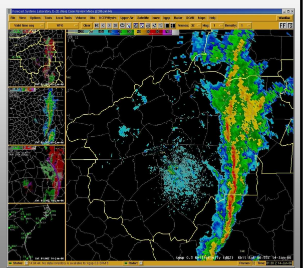


Image courtesy of NWS Forecast Office in Norman, OK

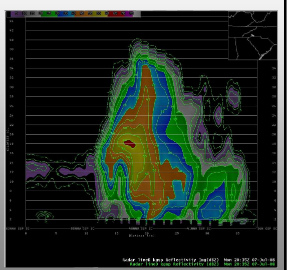
More Examples of Storm Signatures

- *Here is another example of an MCS over the GSP forecast area*
- *Note the characteristic "bow echo" signature in the reflectivity image*



More Examples of Storm Signatures

- *This image displays a cross-section of reflectivity through a mature thunderstorm near the NC/SC border on July 7th, 2008*



Thanks for your attention…

That's all I have……

Are there any additional questions?