THE

ATMOSPHERIC RESERVOIR

Examining the Atmosphere and Atmospheric Resource Management

How Do Weather Radars Work?

By Mark Schneider

In the last edition of the Atmospheric Reservoir, we discussed the recent improvements made to the North Dakota Atmospheric Resource Board (NDARB) weather radars in Bowman and Stanley. Here, we'll discuss how radars work and how to interpret their data.

RADAR is an acronym for RAdio Detection And Ranging. A radar emits beams of electromagnetic radiation and then "listens" for the backscattered returns from ground, air, and precipitation targets. The amount of energy returned helps determine the number and size of the targets in that volume of air. In addition, the amount of time between when a beam is transmitted and when the returned energy is received determines the distance of the target relative to the radar's location. This information is typically displayed on a computer screen for use in weather analysis, forecasting, or general observation.

In order to correctly interpret a radar image, it's useful to understand the units for measuring reflected electromagnetic radiation. The units "dBZ" are expressions of radar reflectivity on a logarithmic scale, similar to the Richter scale, which measures earthquake intensity. A logarithmic scale allows data covering a large range of values to be reduced to a more manageable set of numbers. The consequence, however, is significant as the following example shows: A radar "echo" or storm that has the strength of 50 dBZ is *ten times* stronger than one of 40 dBZ, and *100 times* stronger than a 30 dBZ storm.

WSR-88D Doppler Weather Radar located at the National Weather Service Forecast Office in Bismarck.

Sometimes radars show echoes in the immediate vicinity around them even though the sky is clear and no precipitation is falling. This is what meteorologists call ground clutter. It can occur when the radar beam detects nearby fixed objects like trees, buildings, or terrain. Usually ground clutter only occurs close to the radar, but it can also occur at great distances if the radar beam becomes distorted by the atmosphere and is deflected toward the ground.

In the last 20 years, Doppler radar is a term that has become quite common, but what are the differences between Doppler and conventional radars? Doppler radars have the ability to determine the velocity of targets by comparing the radar beam's initial frequency with its returned frequency. This difference is called the Doppler Shift and it can be used to easily determine the motions of targets detected by radar. A good example of this is how the frequency, or pitch of a train whistle changes as it passes by. The Doppler Shift is also used by law enforcement radars to determine how fast a vehicle is moving.

Because of their ability to measure wind velocity, Doppler radars are essential tools to the National Weather Service for monitoring severe weather and issuing warnings and advisories. Wind events such as gust fronts, frontal passages, microbursts, and tornadoes are usually detectable within the Doppler wind velocity fields.

Weather radar technology has made leaps in advancement since its development during World War II. The future will inevitably bring further advances in radar technology, making it an even more essential tool to our well-being.

Atmospheric Resource Board
North Dakota State Water Commission
900 East Boulevard, Bismarck, ND 58505
(701) 328-2788
http://swc.nd.gov

ND Weather Modification Association
PO Box 2599, Bismarck, ND 58502
(701) 223-4232