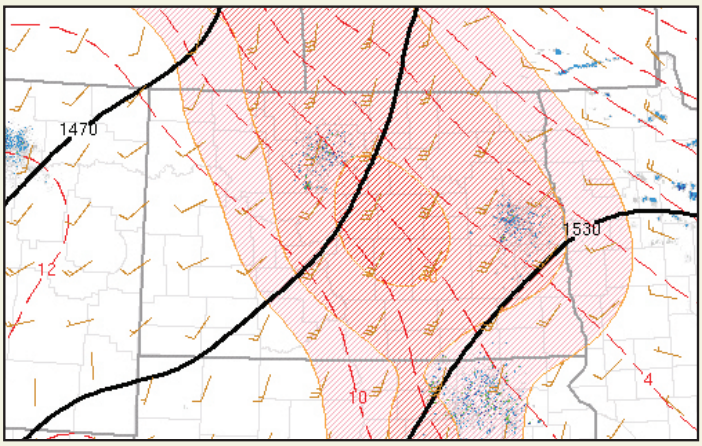
THE
ATMOSPHERICRESERVOIR
Examining the Atmosphere and Atmospheric Resource Management

"Warming up to Advection"

By Mark D. Schneider



Graphic of Warm Air Advection Courtesy of the Storm Prediction Center.

The American Meteorological Society's definition of *advection* is: the process of transport of an atmospheric property solely by the mass motion (velocity field) of the atmosphere; also, the rate of change of the value of the advected property at a given point. Simplifying that definition, we can make the statement that our winds transport environmental conditions from one area to another. Depending on the direction and speed of the wind, we can literally "import" these conditions into our state from locations hundreds of miles away. In North Dakota, we're most interested in the atmospheric properties of temperature and moisture and their effects on our day-to-day weather.

The last couple months have been characterized by many cool mornings and warm afternoons. Much of this can be attributed to the sun's heating of the lower atmosphere during the day and the earth radiating this energy back into space during the night. However, there's another factor that is often overlooked and very important to warming and cooling our atmosphere: temperature advection. Cold advection is easily visualized by arctic air masses bringing windy, blustery conditions south from Canada. These cold fronts are generally driven by high pressure to our north-northwest moving towards low pressure to our south-southeast. Now lets try to visualize a warm front moving into North Dakota from the west or southwest. Warm fronts can be driven by large-scale, or *synoptic*, weather patterns or they can be smaller, localized events such as downsloping winds off of higher terrain in eastern Montana. In both cases, winds carrying this warmer air can "replace" the cooler air that is oftentimes in place over our state, resulting in a significant increase in air temperatures. Last months' article discussed how temperature inversions can prevent this warm-up from occurring when vertical mixing is inhibited by the inversions' stable layer below the warm front.

Another important type of advection is moisture advection and it is the "life blood" of our agricultural industry. In spring and summer months when synoptic-scale weather patterns produce strong southerly wind flows from the Gulf of Mexico through the Central Plains and into our state, we are witness to moisture advection. Moisture advection sustains thunderstorms by sometimes providing a continuous source of water vapor to them as they move over North Dakota cropland. Without moisture advection, thunderstorms are limited to the water vapor in their immediate environment and destined to dissipate once the initial precipitation process is completed. Moisture advection can be visualized by imagining a river flowing through the air just above our heads, transporting trillions of gallons of water to the northern plains. The opposite can be true when harvest season approaches and farmers are waiting for their crops and soil conditions to dry out. Cool, dry northerly winds during the fall play a significant role in moisture reduction.

So the next time you venture outside and have your hat blown off by a strong gust of wind, remember that it's a sign of changing conditions. Our winds really do shape the environment we live in every day.

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