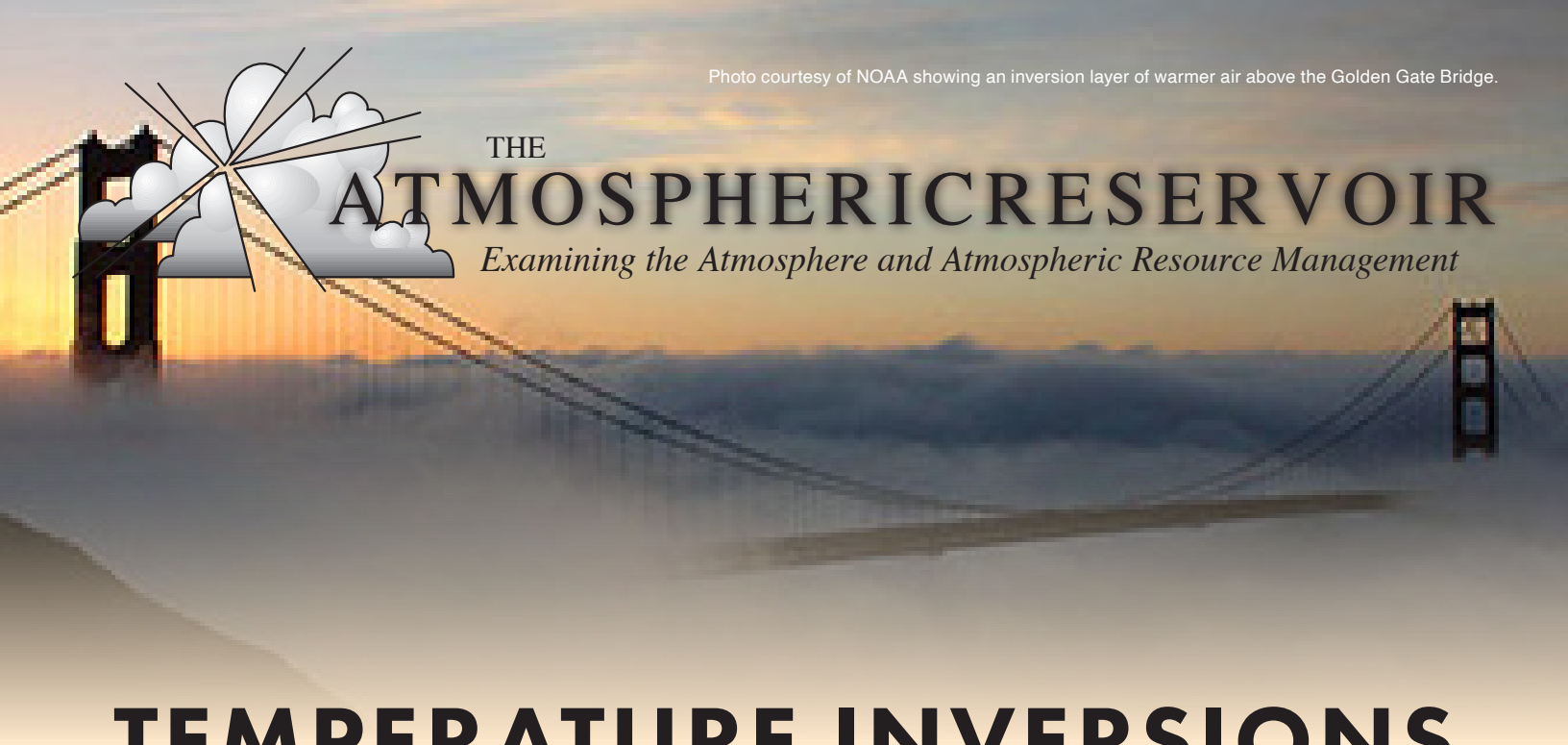

Photo courtesy of NOAA showing an inversion layer of warmer air above the Golden Gate Bridge.

THE
ATMOSPHERICRESERVOIR
Examining the Atmosphere and Atmospheric Resource Management

TEMPERATURE INVERSIONS

By Mark D. Schneider

By turning something upside down or reversing it we create the *inverse*. In terms of weather, an *inversion* means that air temperatures are actually increasing with height in a layer of the atmosphere instead of decreasing. Typically, a parcel of air cools as it rises because there is a decrease in pressure. When a layer of warm air forms above a layer of cooler air, this results in a stable layer that traps pollutants and other particles. As a result, visibilities are often reduced and populated areas can experience smog and unhealthy breathing conditions.

Inversions affect our temperatures in North Dakota more than we might think. Oftentimes, there are westerly winds carrying warmer air eastward from Montana into western ND during the cold season. This warmer air originates over higher terrain and then moves east over lower topography. If low-level temperature inversions are in place over areas of ND, this can prevent the warmer air from mixing downward through this stable layer. That's why it could reach 30°F in Bowman on the same afternoon that Bismarck has a high temperature of only 10°F.

We may complain about how windy North Dakota is, but there are benefits to a breezy day. Sometimes our winds actually prevent inversions from developing by providing enough turbulence to mix the air. This also helps to keep pollutants from reaching unhealthy concentrations in the air we breathe.

Radiation inversions are the most common type of inversion. Colder air can establish itself near the ground on clear nights when the winds are relatively calm and the earth's surface radiates its absorbed solar radiation back towards space. Without cloud cover to insulate the earth's lower atmosphere like a blanket and trap this outgoing energy, the air closest to the surface cools faster than the air above it and a radiation inversion develops.

Frontal inversions are associated with both warm and cold front passages. During a cold front passage, warm, less-dense air is displaced upwards by a "wedge" of cold, dense air. Prior to the passage of a warm front, warm, less dense air slides up and over the colder, dense air below it. In both types of frontal inversions, a layer of stratus clouds or fog may develop.

Subsidence inversions occur most frequently in summer and autumn under conditions of high pressure. Slow, sinking air in the middle or upper levels of the atmosphere warms by compression and results in a warm, dry, stable layer of air at lower levels. These conditions can persist for days or weeks during stagnant weather patterns.

Temperature inversions can also occur indoors, especially in buildings with poor air circulation. Your furnace produces warm air that rises from floor vents and can create a stable layer close to the ceiling. This results in your thermostat, usually located at a height within the colder air, continually telling the furnace to keep running. This is why ceiling fans are recommended during the winter months, to help mix the air vertically in your house and heat it more uniformly. So, keep a look out for inversions around you the rest of this cold season. Temperatures just might be the "inverse" of what you thought.

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