THE
ATMOSPHERICRESERVOIR
Examining the Atmosphere and Atmospheric Resource Management

"Atmospheric Acoustics"

By Mark D. Schneider

When music performers choose concert venues, such as the Burning Hills Amphitheatre in Medora or the Belle Mehus Auditorium in Bismarck, they're usually aware of the influence that environmental conditions can have on sound quality. As sound leaves the performers' mouth or instrument, the surrounding air, objects and ground act to absorb and scatter it. The temperature, humidity, and many other properties of air are used to calculate its effect on sound. This could easily become an advanced Physics lesson; however, the important part to remember is that sound intensity decreases with distance and certain sound frequencies become distorted as they pass through the air.

The scientific term used to describe the loss of intensity in a type of flux (sound in this example) passing through a medium (the air) is *attenuation*. Attenuation increases as the distance from the sounds' source increases. Logically, this explains why two people can't carry on a normal conversation unless they're in the same room or in close proximity. The exception to this rule occurs when a temperature inversion (a condition when temperature increases with height in the atmosphere) causes the sound waves to bend or refract downwards, allowing sounds to be heard at great distances from their source.

Former MIT Physicist Cyril M. Harris made remarkable discoveries about sound absorption. One of his more interesting findings was that high frequencies are absorbed more than low frequencies, and the amount of absorption is dependent on temperature and humidity. Also, the presence of rain, snow or other types of precipitation can indirectly affect sound by changing the temperature and humidity of the air. Harris was well known for his work in design and construction of over 100 concert halls including the John F. Kennedy Center for the Performing Arts.

Because indoor air is relatively easy to regulate through heating, air conditioning, humidifiers, and dehumidifiers, performances can actually be enhanced by climate control systems. This is an important consideration by performance artists. Performers have been known to refuse certain venues because they're aware of poor acoustics that may not compliment their voices or instruments. In addition, instruments such as pianos require climate-controlled environments so that they remain in tune.

The speed of sound is not immune from the effects of our atmosphere. Sound propagates through air faster when temperatures are increased. However, it would be difficult to notice this occurrence unless you were a test pilot attempting to break the speed of sound!

Lastly, wind can influence atmospheric acoustics. You've probably been outside and heard the sound of a train, freeway, or other source on a given day, that you were unable to hear the very next day. A wind "gradient" can develop in the atmosphere that acts to bend sound waves either upward or downward. This ultimately determines the audible distance at which a sound can be heard.

Even though our atmosphere is complex and ever changing, there are certainly things that we can learn from it if we just "take a listen."

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