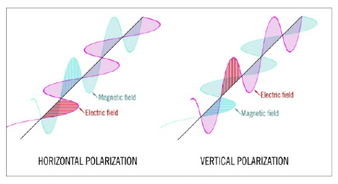

absorption is a direct conversion of electromagnetic energy to heat. The heat may be re-radiated again as electromagnetic energy, but this tends to be radiated at infrared wavelengths, not as microwave energy.

As a result, absorption by clear air and other gases, including water vapor, can actually attenuate the radar beam and reduce its ability to detect distant targets. The wavelength of the radar is critical for minimizing attenuation. Long-wavelength radars, such as the S-band systems, are less prone to this effect.

2.2.2. Scattering. The same process that causes electromagnetic energy to excite the electrons and produce heat also causes the molecules to behave as oscillating dipoles. They will *scatter* or "reflect" the electromagnetic energy at the same wavelength in all directions. That part of the scattered energy that returns back to the antenna is called *backscatter*, and provides the radar with meaningful information.

There are different types of scattering processes that redirect electromagnetic energy in different ways, governed largely by the size of the scatterer and the wavelength of the electromagnetic energy. For example if a particle has a diameter of approximately a fifth of the radar wavelength or less, the particle is considered to be isotropic and *Rayleigh scattering* will occur in all directions, including toward the antenna. If the particle size is greater, *Mie scattering* is the dominant mode, which *forward-scatters* most of the energy with relatively little backscatter. Even larger particles involve geometric (optical) scattering, which outside the topic of this book.

Figure 2-2. Electromagnetic polarization. An electromagnetic wave is actually made up of two fields oriented perpendicular to one another. The electric field is the component which is sensed by all operational radars, and when it oscillates horizontally with respect to the ground, it is said that the radar beam is horizontally polarized. Nearly all conventional weather radars, such as the WSR-57 and WSR-74, and pre-2011 WSR-88D use horizontal polarization exclusively. The dual-pol WSR-88D uses a clever scheme that transmits the radio energy with 45-degree polarization; i.e. imagine either of the beams pictured above rotated 45 degrees so that both are diagonal with respect to the ground. This provides a pulse with both polarization types. The receiver detects the horizontal and vertical polarization, as pictured above, of the incoming energy.

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