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Why does the wind in Colorado sometimes blow from the east?

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When the wind blows from the east, ammonia and other agricultural emissions produced in eastern Colorado can be transported westward into the Colorado Front Range, including Rocky Mountain National Park (RMNP). Increases in ammonia and other nitrogen-containing pollutants in RMNP are receiving increased attention because of their negative impacts on air quality and ecosystem health.

While prevailing winds in Colorado blow from the west, easterly winds (winds that blow from the east) are not as uncommon as one might think. Ground-level winds are strongly influenced by high and low pressure systems that can turn the winds easterly. Winds in the northern hemisphere rotate clockwise around a high (H) and counterclockwise around a low (L), as a result of a balance of forces between air pressure gradients and the earth's rotation.

Easterly winds occur on the southern side of highs. Winds that accompany these weather patterns are usually weak, however. Consequently, anytime a high pressure system forms to the north of our state, Colorado can potentially see light easterly winds. Easterlies are also present on the northern side of low pressure centers. Winds that accompany lows are typically much stronger than those brought about by highs. During the spring, a weather system called the Colorado Low often develops. When it travels south of Denver, it brings strong easterly winds to the Front Range. As air from the east is forced up along the eastern edge of the mountains, it cools and becomes saturated with moisture. This is the mechanism that produces many of our famous upslope snowstorms.

Upslope (easterly) winds are also common along the Front Range during Colorado summers. When sunlight heats a mountain slope, the air in contact with the surface warms, increasing its buoyancy. As this buoyant air rises upward along the mountain slope, air is drawn from further east to replace it. This pattern is known as a valley breeze. Those who have been in Colorado's high country in summer, when valley breezes are intensified by stronger solar radiation, may have experienced afternoon thundershowers associated with the rising air motions.

We can see the influence of these, and other, weather patterns on winds measured at various places in Colorado. Figure 1 illustrates the distribution of wind directions measured at Greeley, where the winter winds only blow from the east a low percentage of the time. In spring, the frequency of easterly winds increases substantially. The frequency of easterlies remains elevated in summer. As far away as Kansas and Nebraska, winds can turn easterly during the day as they respond to this circulation. As a result, Fort Morgan experiences easterlies for nearly one-half of the summer. Moving into fall, the frequency of easterlies again decreases.

Figure 1. Wind roses for Greeley, Co. illustrating the change in wind direction between winter and spring.