The Wind Essay, Research Paper

The Wind

Wind can tell us many things about weather conditions. A person knowledgeable about local weather can take the temperature and dew point, wind data and altimeter setting and make a pretty good estimate of what the present weather is. He can throw away all but the wind and still give you an approximate weather outlook.

There is a simple key to understanding wind: Variations in pressure from place to place create wind, because air tends to flow from high pressure to low, as water flows from high ground to low. This phenomenon has led to the creation of a model to explain worldwide air circulation. Because cooler air is denser than warmer air, its pressure is higher. As air at the equator warms and rises, the pressure in the area lowers. Heavier, cooler air tends to flow toward the low, and as it does, it causes the warmer air to flow upward and poleward, where it cools and develops higher pressure. This air, in turn, will then tend to flow back toward the equator. The same principle of circulation–from areas of high pressure to areas of low–also governs the circulation around the high- and low-pressure areas that move across our country.

Isobars are lines drawn on a map to link points of equal atmospheric pressure. The textbook rule says that wind flows parallel to the isobars, but this appears to conflict with the basic principle of flow. If air flows from high pressure to low, shouldn’t its movement be perpendicular to the isobars? The answer is that the rotation of the earth deflects the wind flow about 90 degrees, causing the air to circulate around the pressure systems instead of directly from one system to another. In the Northern Hemisphere, the flow is clockwise around high-pressure areas and counterclockwise around lows. This fact gives us a start on wind-based weather information.

If you stand with your back to the wind, low pressure will be to your left. If there’s a strong crosswind component aloft, worse weather is ahead if the wind is from your left and better weather if the wind is from your right. Knowing these basics of wind flow will never take the place of a good weather map and the information we get from the National Weather Service, but it can be helpful when the forecasts are all going sour.

The strength of wind flow is governed by how much the barometric pressure changes within a given distance. As they tell you in basic meteorology, the closer the isobars are to each other, the stronger the wind. Strong winds mean the highs are very high and the lows are very low.

Air assumes the properties of the area over which it flows: Warm air comes form the south, cold air from the north. Moist air comes from over water, dry air from over large land masses. The vigor with which the wind blows is an indication of how much moisture, or how much dry air, is overspreading the area. Winds in the middle and high levels tell the meteorologist a lot, too.

Wind speeds around highs differ from those around lows. A high is usually large in area and the pressure change near its center tends to be gradual. Also, because of friction effects, the surface winds tend to flow clockwise and outward (about 30 degrees) around a high. The wind is thus light and the weather usually good near its center. The flow around a low is counterclockwise and inward, so the wind tends to accelerate nearer the center, which is usually small compared to the center of a high.

The strength and direction of wind flow also provide excellent clues to approaching weather. If a cold front passes your location, a good northwesterly flow of cold, dry air settling in behind it is an indication that the high behind the front is of respectable size and strength. If the flow behind the front is weak, the high probably doesn’t amount to much, and the odds of having a prolonged period of good weather following the front are slim. If the weatherman mentions an approaching low-pressure system but the winds outside are light, the low is probably far away or weak. If the wind is freshening rapidly, the low is probably strong. The stronger the wind circulating around the low, the more severe will be any storm associated with it. Furthermore, as lows deepen the circulation around them increases while the movement of the low across the country slows.

Severe blows occur when the upper winds are cold and the lower winds are warm. This creates instability and ideal conditions for vertical development. The reverse situation causes long periods of relatively stable bad weather in the wintertime: Warm air running over cold air is the cause of snow and ice storms as well as of foggy days.

Wind often tips us off about what is going to happen to winter weather. Again, if the northwesterly flow following a cold frontal passage is strong, the usual pattern of weather behind such a front is likely to hold. If the northwest wind is weak, it means warm, moist air will probably soon start overspreading the cold air near the surface. If, after the front passes, the wind shifts to the northeast, watch out. The flow ahead of a cold front is usually from the southwest, so a surface-wind shift to the northeast as the front passes your area means that nothing much is working to push out that southwesterly flow. The situation is likely to become one of cold, northeasterly breezes at the surface, warm, southwesterly breezes aloft, and poor weather until the basic pattern changes. When the high behind the front lacks the strength to push any farther, the front becomes stationary and the weather goes bad.

Wind carries many messages. These vary by area; a northeast wind can mean one thing in one part of the country and something else in another. The messages can change with the seasons, but they always mean something. Many things other than pressure systems affect the wind. The relationship between wind and surface terrain is important and logical. Wind moving up a mountain slope is an updraft; wind moving down a slope is a downdraft.

Mountains make and modify the general winds, too. As air moves through a mountain pass, its velocity can increase to much more than the average wind speed in the area because of a venturi effect. The friction effect of rough terrain can also alter the general wind flow over a mountainous area. Wind is formed in and by mountains even when there is not much general air-mass flow. During the day, heated air flows up the mountainsides, creating updrafts at the ridges and lifting moisture to build the cumulus clouds that decorate mountain ranges on summer days. Thunderstorms frequently develop along the ridges on warm and muggy days. In the evening, when the heating ceases, the reverse happens and cool air flows down the mountain slopes.

The proximity of water to land can cause wind. Sea breezes develop and flow from water to land during the day as the land warms. Cumulus clouds are likely to form over land, and the air beneath them will be bumpy even though the air over the adjacent water is smooth. In the evening, the flow will be likely to reverse itself and move from land to water. This is an example of just basic circulation.

Plain dry ground also has an effect on wind. Surface friction can cause the wind to change direction, usually by about 30 degrees when measured at 2,000 feet and at the surface. In the Northern Hemisphere, the change is counterclockwise as you descend, so a southwesterly wind at 2,000 feet would change to a more southerly wind at the ground. Surface friction also causes a decrease in wind speed; this explains why the wind tends to blow hardest in the plains. There’s less friction as the wind moves across the flat, almost treeless surface, so the velocity is nearly as strong on the ground as it is a few thousand feet high.

Even the time of day does things to wind, and this is at least in part related to friction effects. As previously mentioned, heating on a summer day often causes cumulus clouds and an increase in surface wind. After sunset, however, the cooling of the surface results in increased stability at the lower levels; the clouds dissipate and the wind dies. Radiational cooling maximizes the effect of friction, so that even if pressure systems are the cause of a daytime wind, the surface wind can become calm at night.

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? Surface winds accelerate and undergo horizontal divergence when blowing from a rough to a smooth surface. Surface winds slow and undergo horizontal convergence when blowing from a smooth to a rough surface. Horizontal divergence causes air to descend and horizontal convergence causes air to rise? (online weather studies, 162).

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? A mountain range that intercepts a flow of humid air may induce a cloudy, rainy climate on its windward slope and a dry climate on its leeward slopes. The dry region may extend some distance downwind of the mountain range? (Online Weather Studies, p.115).

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? Mountain-wave clouds form when a mountain range deflects the horizontal wind into a wave-like pattern that stretches downwind. Clouds develop on the wave crests where air ascends and is cooled by expansion. Clouds are absent in the wave troughs where air descends and is compressionally warmed?(online weather studies, p.129).

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?Forecast U.S. Winds? The Weather Channel. May 2000. http://www.weather.com/

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Ruzic, David N. ?Lecture-Discussion #8 on Wind Energy.? Board of Trustees University of Illinois. 1998. http://starfire.ne.uiuc.edu/ne201/course/topics/wind/ (14 May. 2000).

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