Wind shear

Learning to recognize a wind-shear region can help you sail more efficiently

BY BAYLOR FOX-KEMPER

Alison Langley

A building or hill creates a wind shear to leeward that often contains dramatic windshifts

Why are light winds gusty and variable in speed and direction while stronger winds are more constant? Knowing what makes the difference could give you an edge in a racing situation or help you find a better course while cruising. Unfortunately, there is no universal rule to describe the amount of variation in wind speed, because neither the atmosphere nor the ocean is a simple physical system.

But is it possible to predict a wind's variability? Fluid-flow studies of turbulent systems have shown that there are definite patterns in the variability, and that increased turbulence (eddies and variations over time) occurs near wind-shear regions. Therefore, the turbulence helps you find the wind shear, and vice versa.

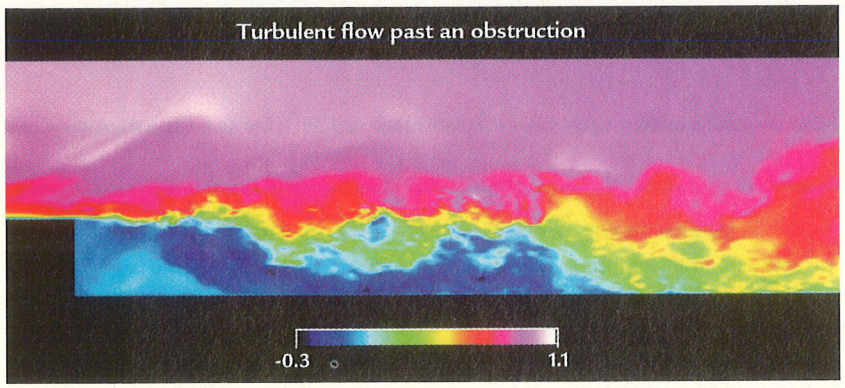

Image courtesy of Hung Le and Parviz Moin

This computer simulation demonstrates wind flows over an obstacle from left to right. Note how the eddies swirl in the shear region between the flow over the obstruction and its lee. Colors indicate the magnitude of downstream velocities; a pinker color indicates higher speeds

Wind shear is the term for a change in wind speed over distance in a direction that is perpendicular to the wind direction. It occurs, for example, when wind flows around and over a building or a large hill. Since the wind can't go through the obstruction, a lee exists for a distance downwind of the obstruction. The area between the flow and the windless lee is called the wind-shear region; it creates eddies and meanders that mix the winds flowing across the shear region (see figure).

If you have ever sailed to leeward of a shore that has trees or tall buildings or a hill, the shear region that is created for a short distance by these obstructions can make sailing very interesting. As you approach a shear area, the wind will start to vary in time as well as over distance as the eddies and meanders mark the mixing of air between the windy and windless areas.

If you see wind speed or direction starting to change with time, it is a good indication that you are approaching a shear region and the edge of a new wind. Although the edge will not be stationary, watching for changes in the ripples on the water's surface can give you a sense of its location and how far it tends to move with the eddies. Obviously, if you're in a good breeze, you should avoid crossing a shear region because the wind speed is going to drop. If you think that the wind ahead will have a better angle or be stronger, you should continue on at least to the edge of the shear region.

Wind shear is also caused by meteorological events. Similar sorts of turbulence can occur between cold and warm air masses as well as along the edge of a low- or high-pressure center. Barometric pressure changes are associated with wind speed (sometimes called geostrophic wind), and a change in wind speed under some conditions can cause enough shear to produce eddies and gusts. So whenever barometric pressure begins to change—in either direction—you should expect the wind to become gusty and more erratic in its direction. Even without looking at a barometer, you can assume that wind that is beginning to behave erratically is a good sign that the weather is about to change.

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