Where is the Wind?

(WhereWind.pps PowerPoint presentation instructor notes)

Introduction:

This presentation was conceived out of a need to teach helicopter pilots an easy method of how to determine the wind direction while flying, and without ground-based aids. Over the years, I have observed that many helicopter pilots are never really taught a good way to determine the direction from which the wind is coming. Some pilots and CFI's accumulate hundreds, and occasionally, thousands of hours without ever developing a method for quickly and efficiently determining the wind direction.

I originally taught this method over thirty years ago using a chalkboard and later, a white board. Then, as my technological acumen progressed, I used an overhead projector with hand-drawn slides. Several years ago, I finally converted the lesson to PowerPoint, an ideal medium for teaching this type of subject. Although I'm still a novice with PowerPoint, I hope the presentation and these notes will prove complete enough for the fledgling or experienced pilot to gain some benefit from viewing them. I welcome constructive critique. Enjoy!

Slide 1: Title slide - no narration necessary.

Slide 2: There are many ground-based ways to determine the wind direction. Unfortunately, many new helicopter pilots are only taught these ground-based ways ….. and never learn how to do it without these aids.

Blowing smoke, Blowing dust – this is an ideal way to determine the direction of the surface wind. Likewise, steam from factories also is good for determining the wind direction. However, more often then not in the environment in which we fly, these ground-based aids are not available.

Waves on water – waves are a good indicator of the wind direction. The troughs and peaks of waves generally run perpendicular to the direction of the wind. 4-6 knots of wind velocity generates short wavelets. 7-10 knots of wind generates large wavelets with occasional foamy crests. 11-16 knots of wind velocity generates "white caps" which are waves on which the crest of the wave breaks downwind.

Wind lines on water – wind lines are generated with as little as a few knots of wind speed. They run with the wind, not perpendicular to the wind. As the wind speed increases, the wind lines become more defined. On a pond or other body of water with an observable shore, as the wind travels across the land and across the water, it "skips" from the land to the water, leaving a calm zone near shore. This identifies the upwind side of the body of water.

The length of the calm zone is determined by the difference between the height of the shore and the level of the water, and the velocity of the wind. The higher the land is above the water, the larger the calm zone is on the upwind side. Likewise, the faster the wind velocity, the more likely the wind will travel farther before contacting the water and generating wind lines.

Slides 2 - 4: Flagging - this occurs when the ambient wind is normally in one direction, above 5-10 knots for the majority of the growing season of the plant. Flagging is most common near shorelines and other areas of predictable wind flow such as mountain passes.

Slides 5 - 7: Self-explanatory – we make wind equal and opposite the direction of travel. On a no-wind day, landing down-wind is not a concern.

Slides 8-13: Some folks get spooked at the mere mention of vectors, but all pilots should try to understand this simple concept, because every motion a helicopter has is the consequence of some vector. Indeed, the E-6B wind computer is merely a device for adding a vector of wind to the vector of motion of the aircraft and then displaying the WCA and GS of the aircraft.

Slides 15-16: As Billy and Bob fly Northbound toward their practice area, they notice that while flying in trim, the heading of the aircraft is a bit to the right of their ground track, i.e., the nose of the aircraft is "crabbing" a bit to the right. This is depicted in slide 16 as the green arrow. The blue arrows depict the aircraft's direction of travel.

When queried on FAA Private and Commercial Pilot check rides how the pilot determines the wind direction (in light of an obvious crab angle), some pilot applicants reply that they believe that the wind "blows the nose of the aircraft downwind," thereby demonstrating a significant misunderstanding of the effect of wind on an aircraft. Some students are actually taught this by their CFI.

Slides 17-19: Obviously, wind coming from anywhere on the right side of the aircraft will give the aircraft a right crab angle. A right quartering headwind will give approximately the same right crab angle as will a right-rear quartering tailwind. Therefore, if unable to determine whether the wind is directly from the right, right front or right rear, the best thing to do in the event of an emergency landing, is to "split the difference" and turn toward the right side of the aircraft. That way, chances are pretty good that the aircraft will at least have *some* headwind component on descent and landing.

Slide 20-23: If there is any perceptible crab angle (right or left), all the pilot has to do is to turn the aircraft toward a reference point directly to the right or left of the aircraft and roll out with the ground track of the aircraft going toward that reference point. Remember, the cyclic controls the direction of travel, not the pedals. In forward flight, the pedals are merely anti-torque devices and absent a change in torque, the pedals should be placed so the aircraft is in trim.

Slides 21-26 should be self-explanatory. One doesn't have to be flying in any given cardinal direction to make this work well. No matter which direction you are flying, you just need to identify that you have a crab angle and to which side the aircraft is crabbing. Turn in the direction of your crab angle and roll out about 90 degrees from your previous heading. Make sure you are in trim and notice your new crab angle, if any. That way, you will identify the wind direction from within 10-20 degrees or so – a perfectly acceptable determination of wind!

After consciously practicing this method for a while, you will not even need to do the 90 degree turn. However, rolling out after 90 degrees of turn during the first turn of the high recon is handy for determining the wind for pinnacle and confined area work. This is because you instantly know the direction of the wind and can compensate so the aircraft doesn't get "blown downwind" during the high recon. You will already know the wind direction before beginning the recon! Then, merely make your bank angle shallower on the upwind side of the recon and steeper on the downwind side to keep a fairly symmetrical high recon around your proposed landing area.

Slides 27-30: We know from the previous discussion that the crab angle is determined by the sum of the relative wind caused by the velocity of the aircraft and the ambient wind caused by Mother Nature. As we slow the aircraft down during an approach with a wind from the side, the crab angle gets skewed as the wind has a greater effect on the vector "wind triangle."

The helicopter, when flown in trim, is a big wind sock . It will "self-modify" the crab angle to suit the conditions as the aircraft speed is increased or slowed. This is easily demonstrated in the classroom by doing an E-6B wind correction angle problem for an aircraft heading Northbound at, say, 80 knots with wind from the East at 15 knots, and doing the calculation for the same aircraft Northbound at 40 knots with the same 15 knot wind from the East. If kept in trim, the aircraft will automatically yaw in the direction of increasing wind influence until the pilot “slips” the aircraft out of trim to align the skids with the direction of travel.

A good demonstration of this concept for students is to, early in the training, take an aircraft at altitude and fly with a cross wind at cruise speed. Note the crab angle. Then, while making sure the aircraft is kept in trim, slow the aircraft, keeping the aircraft in trim and on the same *ground track* with the cyclic. Obviously, as you slow down, the nose of the aircraft will naturally yaw in the direction of the increasing crosswind influence (the direction the wind is coming *from*) and the heading will change. If you slow to just above hover speed, the aircraft will turn directly into the wind. As you accelerate, the reverse happens.

Slides 31-34: Our helicopter is truly a good wind sock and will always tell us where the wind is coming from. It is essential, however, to fly the aircraft in trim for this to work well. Pinnacle and confined landings often mandate that we approach a bit cross wind and thereby must at some point 'slip' the aircraft to align the skids with the direction of travel in case we need to approach to the ground. However, when it comes time to 'slip' the helicopter, we should by that time have a good handle on the wind direction and speed.

Conclusion:

To some pilots, all this material may seem very elementary. However, many pilots were never taught how to determine the direction of the wind and were forced to learn it through experience. Hopefully this presentation will help those just starting out as students or new CFI’s to better understand how to determine the wind direction …. all the time.

Tailwinds!

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