Chapter 10: Soaring Techniques

Introduction

Many glider pilots enjoy searching for lift to gain altitude. Staying aloft often involves finding and staying within the strongest part of any updrafts. This chapter covers some basic soaring techniques that assist with that task.

In the early 1920s, soaring pilots discovered how to remain aloft using updrafts deflected by the hillsides they used for launch. Soon afterward, they discovered thermals in the valleys adjacent to the hills. In the 1930s, the discovery of mountain waves, which were not yet well understood by meteorologists, allowed glider pilots to make the first high-altitude flights. Since thermals occur over both flat terrain and hilly country, they remain the most-used type of lift for glider flights today.

As a note, glider pilots refer to rising air as lift, which differs from the lift generated by the wings. This chapter refers to lift as the rising air within an updraft and sink as the descending air in downdrafts.

Thermal Soaring

Successful thermalling requires several steps: locating the thermal, entering the thermal, centering within the thermal, and exiting the thermal.

When locating thermals, glider pilots look for nearby lift indicators. In sufficiently moist air and if and thermals rise high enough, cumulus clouds (Cu) (pronounced "cue") form. Glider pilots look for Cu in the developing stage, while the cloud builds from the thermal underneath it. The base of a developing Cu appears sharp and well defined. Dissipating Cu have a fuzzy appearance and little lift or sink underneath. [*Figure 10-1*]

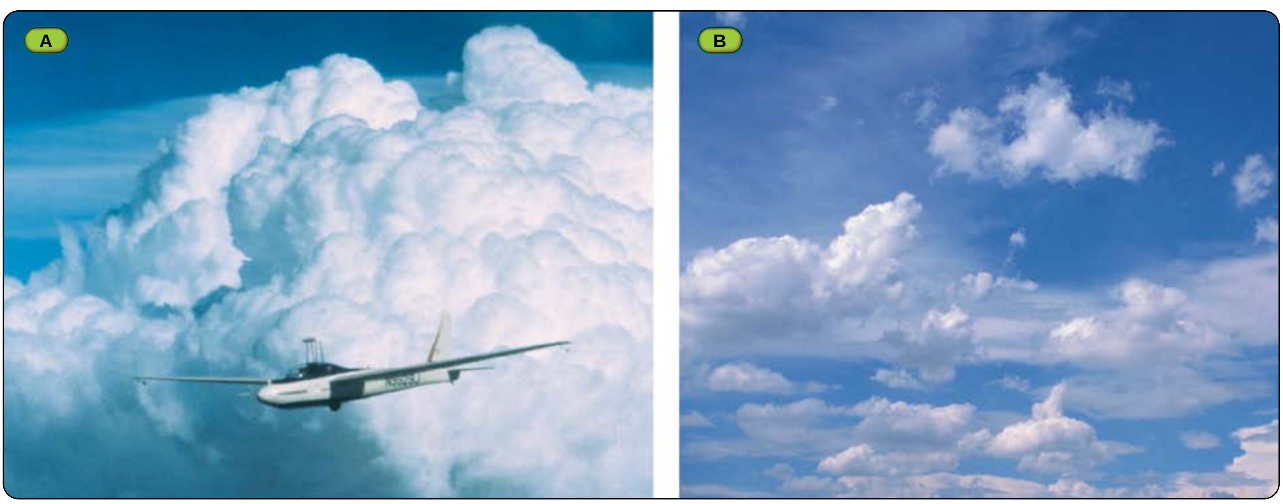

Figure 10-1. *Photographs of (A) mature cumulus, which can produce good lift, and (B) dissipating cumulus.*

The lifetime of Cu often varies during a given day as Cu that develop early in the day may change into well-formed and longer-lived clouds. A promising Cu in the distance may also start dissipating, and glider pilots refer to such Cu as rapid or quick cycling, which means the Cu forms, matures, and dissipates in a short time.

Sometimes Cu cover much of the sky, which makes seeing the cloud tops difficult; however, the cloud bases also indicate the presence and strength of thermals. Generally, a dark area under the cloud base indicates a deeper cloud and a higher likelihood of a thermal underneath that spot. Since several thermals can feed one cloud, darker areas under the cloud may indicate a stronger thermal. At times, an otherwise flat cloud base under an individual Cu has wisps or tendrils of cloud hanging down, which indicate a particularly active area and the presence of warm rising air. Note the importance of distinguishing features under Cu that differentiate potential lift from virga. Virga consists of precipitation in the form of rain, snow, or ice crystals that descend from the cloud base and evaporate before striking the ground. Virga may signal that the Cu has reached towering cumulus or thunderstorm status. [Figure 10-2]

Figure 10-2. *Photographs of (A) towering cumulus, (B) cumulonimbus (Cb), and (C) virga.*

Lift near a cloud base often increases dramatically in a concave region under an otherwise flat cloud created by especially warm air. When trying to leave the strong lift in the concave area under the cloud, glider pilots can find themselves climbing rapidly with cloud all around. Adherence by a glider to the minimum distance below a cloud as listed in 14 of the Code of Federal Regulations (14 CFR) part 91, section 91.155, normally prevents an accidental climb into a cloud. In addition, maintaining the minimum separation gives a glider pilot the opportunity to avoid an aircraft operating under instrument flight rules in, near, or emerging from a cloud.

As any thermal rises from the surface and reaches the convective condensation level (CCL), a cloud begins to form. At first, only a few wisps form. The initial wisps of Cu in an otherwise blue (cloudless) sky indicate where an active thermal has begun building a cloud that will grow to a familiar cauliflower shape. When crossing a blue hole (a region anywhere from a few miles to several dozen miles of cloud-free sky in an otherwise Cu-filled sky), getting to an initial wisp of Cu can provide lift from the thermal underneath. On some days and depending on the moisture in the air, these wisps undergo no further development and provide the only indication of thermals.

Lack of Cu does not necessarily mean lack of thermals. If the air aloft is cool enough and the surface temperature warms sufficiently, thermals form even without enough moisture for cumulus formation. These dry, or "blue thermals" can be just as strong as their Cu-topped counterparts. Glider pilots sometimes find these thermals by chance while gliding. However, other indicators may exist and can make the search for thermals less random.

Other Indicators of Thermals

Another circling glider may indicate the presence of a thermal. Circling birds may also indicate thermal activity. Thermals tend to transport various aerosols, such as dust, upward with them. When a thermal reaches an inversion, it disturbs the stable air above it, spreads out horizontally, and deposits some of the aerosols at that level. Depending on the sun angle (and the pilot's type of sunglasses), haze domes may indicate dry thermals. If the air contains enough moisture, haze domes often form just before the first wisps of Cu.

Glider pilots talk about a house thermal or thermals that seem to form over and over in the same spot or in the same area. Glider pilots new to a soaring location should ask the local pilots about favored spots—doing so might make additional tows unnecessary. While some thermals may arise from consistent sources, no one can guarantee that a thermal currently exists where one existed before. In addition, if a thermal has recently formed, it takes time for the sun to reheat the area before another thermal might form at the same location.

On days without airborne indicators to mark thermals, pilots can look for clues on the ground. For example, in drier climates, dust devils often mark thermals triggering from the ground. At certain times of the day in hilly or mountainous terrain, the sun's radiation may strike a particular slope at or near a right angle. [*Figure 10-3*] A sun facing slope receives more energy per unit of area and can warm the surrounding air more effectively. Darker ground or surface features heat quicker than grass covered fields. Huge black asphalt parking lots can produce strong thermals. A large tilled black soil field can be a good source of lift if the pilot can find the associated narrow plume of rising air. Thermals often form where hills exist since slopes tend to be drier and heat better than surrounding lowlands. Finally, cooler air usually pools in low-lying areas overnight and takes longer to warm during the morning. Pilots might avoid searching for thermals from those areas early in the day.

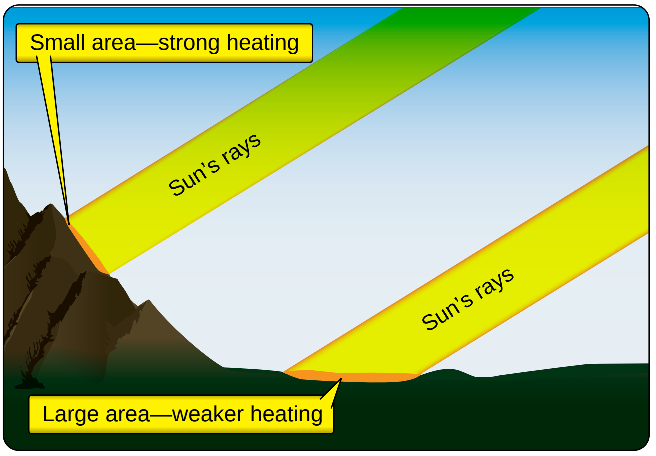

Figure 10-3. *Sun's rays are concentrated in a smaller area on a hillside than on adjacent flat ground.*

Other subtle ground markers exist. An open field surrounded by shade usually results in a space where the air suddenly warms. A town surrounded by green fields results in a rise in temperature since the town surfaces absorb more heat than the surrounding farmland. Likewise, a yellowish harvested field gets warmer than an adjacent wet field with green vegetation. Wet areas tend to use the sun's radiation to evaporate the moisture rather than heat the ground. A field with a rocky outcrop might produce better thermals since rocks can't hold moisture. Rocky outcrops along a snowy slope heat much more efficiently than surrounding snowfields. While searching for smaller features works at lower altitudes, pilots can use their knowledge of ground heating when at higher altitudes by avoiding areas such as a valley with many lakes.

Wind

Wind influences thermal structure and location. Strong shear can break thermals apart and effectively cap their height. Strong winds at the surface and aloft often break up thermals, making them turbulent and difficult or impossible to use. On the other hand, as discussed in Chapter 9, Glider Flight and Weather, moderately strong winds without too much wind shear sometimes organize thermals into long streets, which can provide lift when they lie along a cross-country course line. [*Figure 10-4*]

Figure 10-4. *Photograph of cloud streets.*

If suspecting the presence of waves associated with a thermal above the cloud, the pilot can climb in the thermal near a cloud base and then head toward the upwind side of the Cu. Often, only weak lift exists in smooth air upwind of the cloud. Once above cloud base and upwind of the Cu, the pilot should find climb rates of a few hundred fpm in the thermal wave. The glider can climb flying back and forth upwind of an individual Cu, or by flying along cloud streets if they exist. When thermal waves exist without clouds, the pilot should climb to the top of the thermal and penetrate upwind in search of smooth, weak lift. Without visual clues, thermal waves prove difficult to work. Sometimes the pilot stumbles upon a thermal wave by chance.

In light wind conditions, pilots should use a slanted search pattern. For instance, in Cu-filled skies, glider pilots need to search upwind of the cloud to find a thermal. How far upwind depends on the strength of the wind, thermal strength on that day, and distance below cloud base (the lower the glider, the further upwind the glider needs to be). The pilot should consider the fact that windspeed does not always increase at a constant rate with height and the possibility that wind direction can change dramatically with height. [*Figure 10-5*] Pilots can estimate wind direction and speed at a cloud base by watching cloud shadows on the ground.

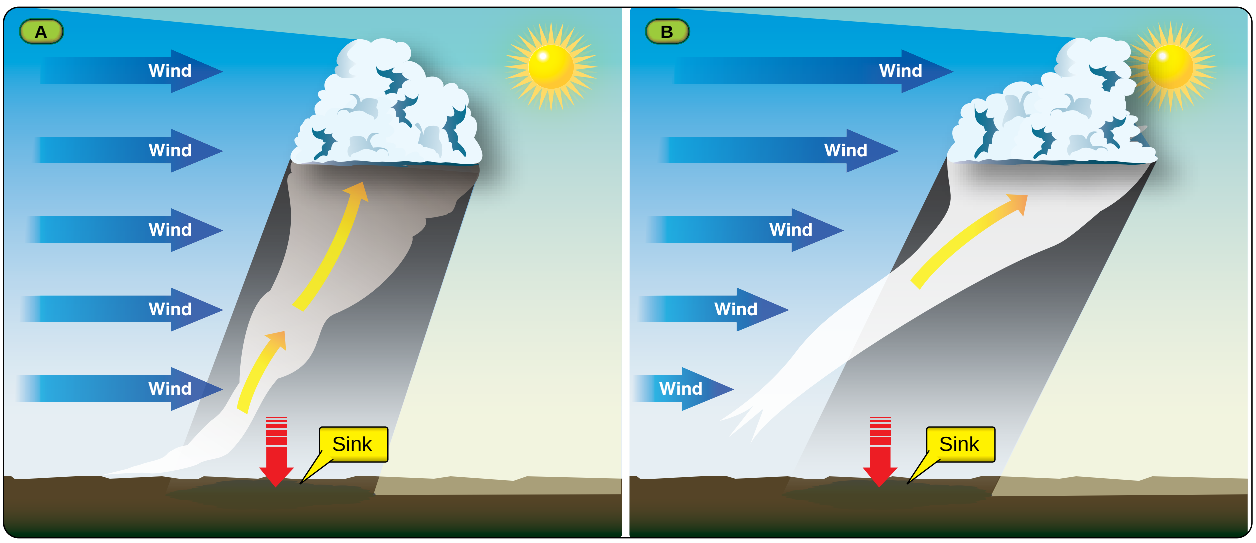

Figure 10-5. *Thermal tilt in shear that (A) does not change with height, and that (B) increases with height.*

Pilots can find where thermals appear in relation to clouds on a given day and use those encounters to determine how to search that day. If approaching Cu from the downwind side, heavy sink may occur near the cloud. From that position, the pilot should head for the darkest, best-defined part of the cloud base, then continue directly into the wind. Depending on the distance below cloud base, the pilot should find the lift forming the cloud about the time the glider passes upwind of the cloud. If approaching the cloud from a crosswind direction (for instance, heading north with westerly winds), the pilot can also estimate the thermal location from previous encounters that day. If only encountering reduced sink, lift may exist nearby, and a short leg upwind or downwind may locate the thermal.

Thermals also drift with the wind on cloudless days, and similar techniques can locate thermals using airborne or ground-based markers. For instance, if heading toward a circling glider but at a thousand feet lower, the pilot can estimate how much the thermal tilts in the wind and head for the most likely spot upwind of the circling glider. When in need of a thermal, pilots might consider searching on a line stretching upwind to downwind once under or over the circling glider. This may or may not work; if the thermal is a bubble rather than a column, the pilot may miss the bubble. The pilot in sink should limit the search if not finding lift. Searching for a thermal in sink near one spot, rather than leaving and searching for a new thermal can consume a lot of altitude.

Cool, stable air can also drift with the wind. Pilots should avoid areas downwind of known stable air, such as large lakes or large irrigated regions. [*Figure 10-6*] On a day with Cu, a big blue hole in an otherwise Cu-filled sky indicates a stable area. If the area is broad enough, a detour upwind of the stabilizing feature might conserve a lot of altitude.

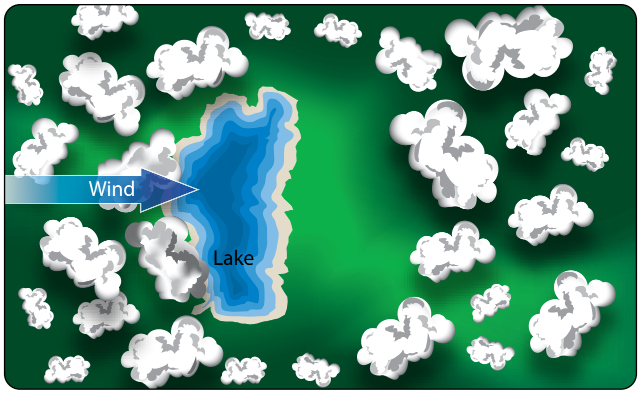

Figure 10-6. *Blue hole in a field of cumulus downwind of a lake.*

The Big Picture

With a sky full of Cu and if gliding in the upper part of the strongest lift, the pilot should focus on the Cu, and make choices based on the best clouds. At lower altitudes glider pilots may find it difficult to associate thermals with clouds above. If that happens, the pilot should use the Cu to find areas that appear generally active and then focus more on ground-based indicators, like dust devils, a hillside with sunshine on it, or a circling bird. When down low, the pilot can accept weak climbs. Often the thermal cycles again and rewards patience.

When searching for lift using the best speed to fly, L/D~MAX speed plus corrections for sink and any wind, allows a glider pilot to cover the most ground for a given altitude loss. See Chapter 5, Glider Performance, to review shifting of the glider polar for winds and sink.

Entering a Thermal

Oddly enough, increased sink often indicates a nearby thermal. Next, the pilot feels a subtle or obvious positive G- force, depending on the thermal strength. The "seat-of-the-pants" indication of lift occurs faster than shown by any variometer, which lags slightly. The pilot should reduce speed to between L/D and minimum sink and note the trend of the variometer needle (should be an upswing) or the audio variometer going from the drone to more rapid beeping. At the right time in the anticipated lift and in a perfect scenario, the pilot rolls into a coordinated turn at just the right bank angle and speed to center within the thermal.

Before going further, what vital step was left out of the above scenario? VISUALLY CLEAR THE AIRSPACE BEFORE TURNING! Pilots sometimes forget that basic primary step before any turn as the variometer attracts a lot of pilot visual attention upon entering lift. Low-altitude flight and a glider without an audio variometer increase the likelihood of this omission.

To help decide which way to turn, the pilot determines which wing seems to lift when entering the thermal. For instance, if the glider gently banks right when entering the thermal, the pilot should CLEAR LEFT, then turn left. A glider on its own tends to fly away from thermals. [*Figure 10-7*] Pilots who maintain a light touch on the controls can sense proximity to a thermal and avoid letting thermals continue to bank the glider away from the thermal. If no thermal-induced banking occurs, the pilot decides arbitrarily which way to turn. Note that new soaring pilots often turn in a favored direction. This could cause pilot inability to fly reasonable circles in the other direction. If this happens, the pilot should make a conscious effort to thermal in each direction half the time to improve proficiency and as preparation for thermalling in traffic.

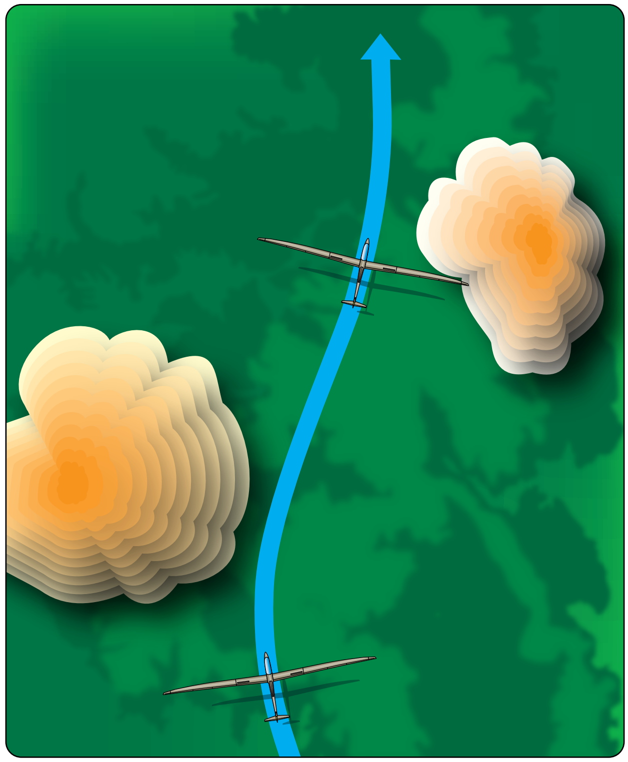

Figure 10-7. *Effect of glider being allowed to bank on its own when encountering thermals.*

As a glider encounters lift on one side, the wing in the stronger lift will start to rise, and some gliders will tend to slip laterally as indicated by the yaw string. The glider pilot should apply aileron pressure to bring the climbing wing down not just to level the wings, but to bank further to begin the turn into the lifting columns of air. If the rising air on one wing results in a sideslip, a turn toward the head of the yaw string should also bring the glider into the rising air.

Inside a Thermal

Optimum climb occurs when the pilot uses proper bank angle and speed after entering a thermal. Under ideal conditions, pilots use the shallowest possible bank angle at minimum sink speed. However, thermal size and associated turbulence usually do not favor this combination.

Bank Angle

The glider's sink rate increases as the bank angle increases, and the sink rate begins to increase more rapidly beyond about a 45° bank angle. A 40° compared to a 30° bank angle may allow for circling in the stronger lift near the center of the thermal. Maximizing thermal lift takes practice. The optimized bank angle depends on the size and strength of the thermal. Normally, the pilot does not use bank angles exceeding 50°, but exceptions exist. A pilot might use a bank of 60° to stay in the best lift. Thermals tend to be smaller at lower levels and expand in size as they rise higher. Therefore, a pilot generally uses a steeper bank angle to remain in lift at lower altitudes.

Thermalling illustrates the importance of understanding and training in steep turns (as previously discussed in Chapter 7: Launch & Recovery Procedures & Flight Maneuvers.) A steep turn during thermalling causes the outer wing to travel faster than the inner wing and results in an overbanking tendency. While the pilot holds aileron pressure against the turn to balance the lift between the wings, this pressure causes additional drag on the lowered wing and could result in a skid and lead to a spin entry. Applying slight top rudder pressure and slipping gently during a steep turn can compensate for the increased drag of the inside wing and result in better overall climb performance. Glider pilots should consult their flight instructors regarding the proper technique for steep turns during thermalling.

Speed

Flying at minimum sink speed for the G-load on the glider optimizes the climb in a well-formed thermal and light turbulence. Flying in thermals either above or below this speed will degrade glider performance. As discussed in Chapter 3, decreasing the airspeed in a turn will decrease the radius of the turn. The examples in this paragraph assume a minimum sink speed of 60 mph. At a 30° bank angle, decreasing speed from 60 to 40 mph decreases the radius of the circle by almost 250 feet. While this reduced radius may place the glider closer to strong lift near the thermal center, glider performance will suffer from the increased rate of descent while flying at an airspeed below the minimum sink speed. An increased bank angle to achieve a smaller diameter circle may provide better optimization. For example, while maintaining a minimum sink speed of 60 mph, increasing the bank angle from 30 to 45 degrees will decrease the turn radius by over 175 feet. Increasing the bank angle from 30 to 60 degrees will decrease the turn radius by over 275 feet. While some gliders can safely fly several knots below minimum sink speed to reduce the turn radius, the increased sink rate at lower speeds may offset any gain achieved.

Pilots should avoid thermalling speeds well below minimum sink speed due to the increased risk of a stall and the lack of controllability. Distractions while thermalling may include studying the cloud above or the ground below, quickly changing bank angles without remaining coordinated, thermal turbulence, or abrupt maneuvers to avoid other gliders in the thermal. The pilot may allow the airspeed to decay to the stall speed or may increase the bank angle thereby increasing the load factor and the stall speed. This increases the risk of an inadvertent stall. While thermalling, any stall recovery should occur instinctively and without delay. Without prompt corrective action a spin entry could occur, depending on the stall characteristics of the glider or if in turbulent thermals. Additionally, at airspeeds well below minimum sink speed, a lack of airflow over the wings and control surfaces may make the glider less controllable during stall recovery or during any abrupt maneuvers. Glider pilots should carefully monitor speed and nose attitude at lower altitudes. Using sufficient speed ensures that the pilot, and not the thermal turbulence, controls the glider.

Centering

Pilot opinions differ regarding how long to wait before rolling into a thermal after encountering lift. Some pilots advocate flying straight until the lift has peaked. Then, they start turning back into stronger lift. If using this technique, pilots should not wait too long after the first indication of decreasing lift. Other pilots favor rolling into the thermal before lift peaks, thus avoiding the possibility of losing the thermal. However, turning into the lift too quickly causes the glider to fly back out into sink. The choice depends on personal preference and the conditions on a given day.

Often upon entering a thermal, the glider experiences lift for part of the circle and sink for the other part. The pilot should determine where the best lift exists and move the glider into it for the most consistent climb. If the pilot turns in the wrong direction and almost immediately encounters sink, a 270° correction may correct the error. [*Figure 10-8*] The pilot should complete a 270° turn, straighten out for a few seconds, and if encountering lift again, turn back into it in the same direction. The pilot should avoid reversing the direction of turn since that procedure takes more time, covers more distance, and may lead away from the lift completely. [*Figure 10-9*]

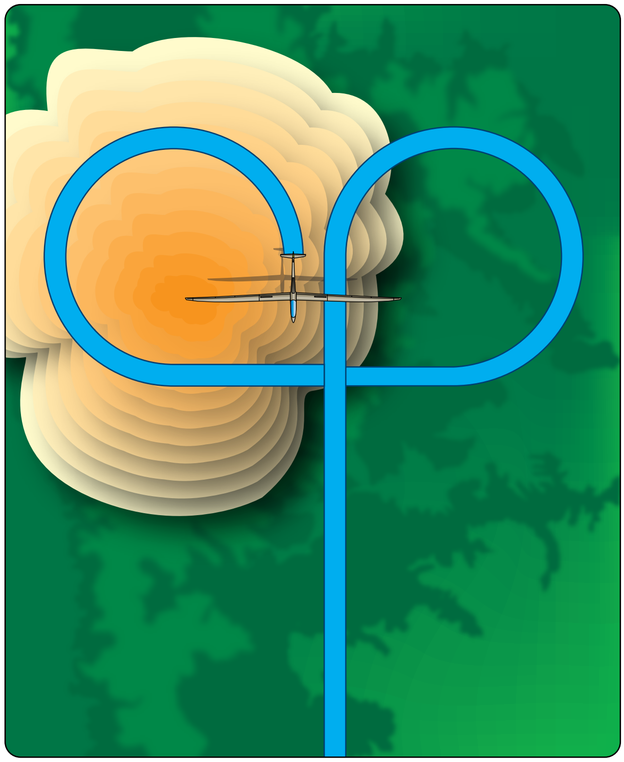

Figure 10-8. *The 270° centering correction.*

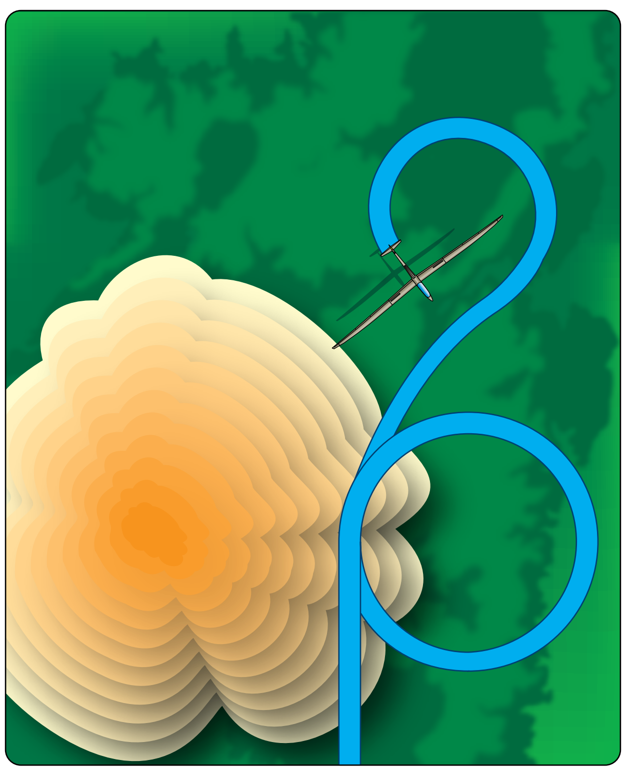

Figure 10-9. *Possible loss of thermal while trying to reverse directions of circle.*

If stronger lift exists on one side of the thermal, the pilot can use one of several centering techniques. One method involves noting the current position with the best lift: for instance, toward the Northeast or toward some feature on the ground that the pilot can see under the high wing when at the current point of best lift. [*Figure 10-10*] On the next turn, the pilot can adjust the circle by either straightening or shallowing the turn toward the stronger lift. The pilot should anticipate the turn and begin rolling out about 30° before the heading toward the strongest part. This allows rolling back toward the strongest part of the thermal rather than flying through it and turning away from the thermal center. How long a glider remains in a shallow bank or straight depends on the size of the thermal. Since gusts within the thermal can cause airspeed indicator variations, the pilot should pay attention to the nose attitude.

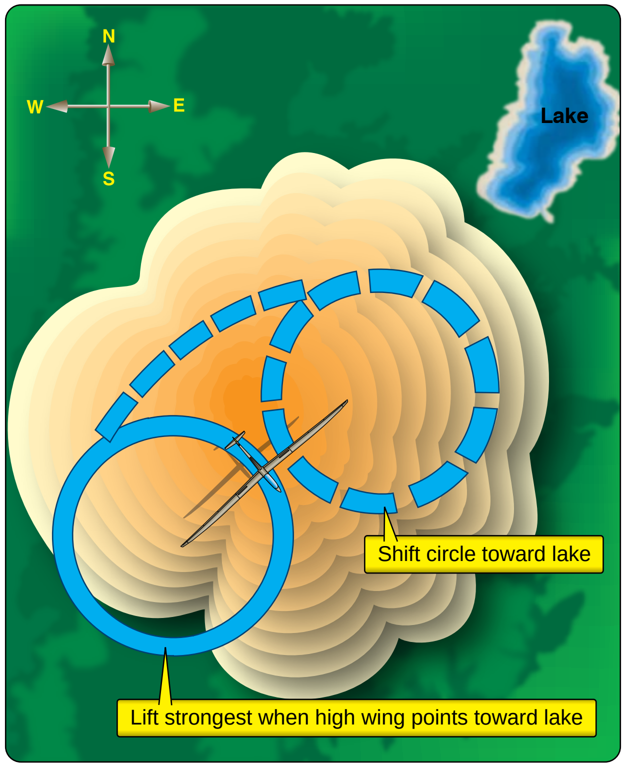

Figure 10-10. *Centering by shifting the circle turn toward stronger lift.*

A pilot can use other techniques as depicted in the three scenes of *Figure 10-11* and as described below. The pilot should:

1. Shallow the turn slightly (5° or 10°) when encountering weaker lift, then when encountering stronger lift again as indicated by increase in positive G-force or the variometer, the pilot resumes the original bank angle. If shallowing the turn too much, the glider may fly completely away from the lift.

2. Straighten or shallow the turn for a few seconds 60° after encountering the weakest lift or worst sink indicated by the variometer, then resume the original bank angle. This accounts for the lag in the variometer since the actual worst sink occurred a couple of seconds earlier than indicated.

3. Straighten or shallow the turn for a few seconds when the stronger seat-of-the-pants surge is felt. Then, the pilot should resume the original bank and verify the result with the variometer trend.

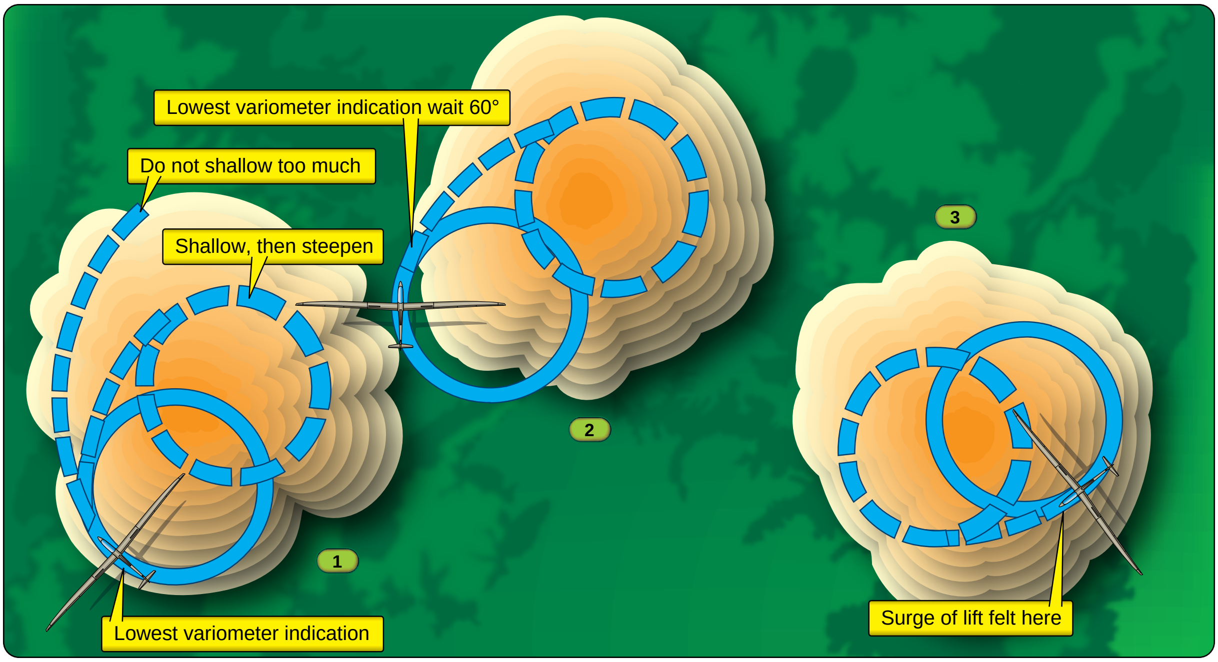

Figure 10-11. *Other centering corrections.*

New glider pilots should develop proficiency centering using one of the above methods first, and then experiment with other methods. As an additional note, thermals often deviate markedly from the conceptual model of concentric gradients with lift increasing toward the center. For instance, it sometimes feels as if two (or more) nearby thermal centers exist, which can make centering difficult. Glider pilots should continually adjust, and recenter to maintain the best rate of climb.

Other gliders can help pilots center a thermal as well. If a nearby glider seems to be climbing better, the pilot can adjust the turn to fly within the same circle. Similarly, if noting a bird soaring close by, a turn toward the soaring bird may lead to a better climb. Soaring birds have a much tighter turning radius than a glider, so they can stay in the strongest center of the lift while the glider pilot circles around them.

Collision Avoidance

Collision avoidance takes priority over aerodynamic efficiency when sharing a thermal with other gliders. The first glider in a thermal establishes the direction of turn, and all other gliders that join the thermal should turn in the same direction. Ideally, two gliders in a thermal at the same height or nearly so should position themselves across from each other so they can maintain visual separation. [*Figure 10-12*] A pilot should enter a thermal in a way that does not interfere with gliders already in the thermal. Pulling up to bleed off excess speed in the middle of a crowded thermal would create a hazard to other gliders. Safe technique involves bleeding off speed before reaching the thermal. Announcing the entry to the other glider(s) on the radio (if equipped) may enhance collision avoidance.

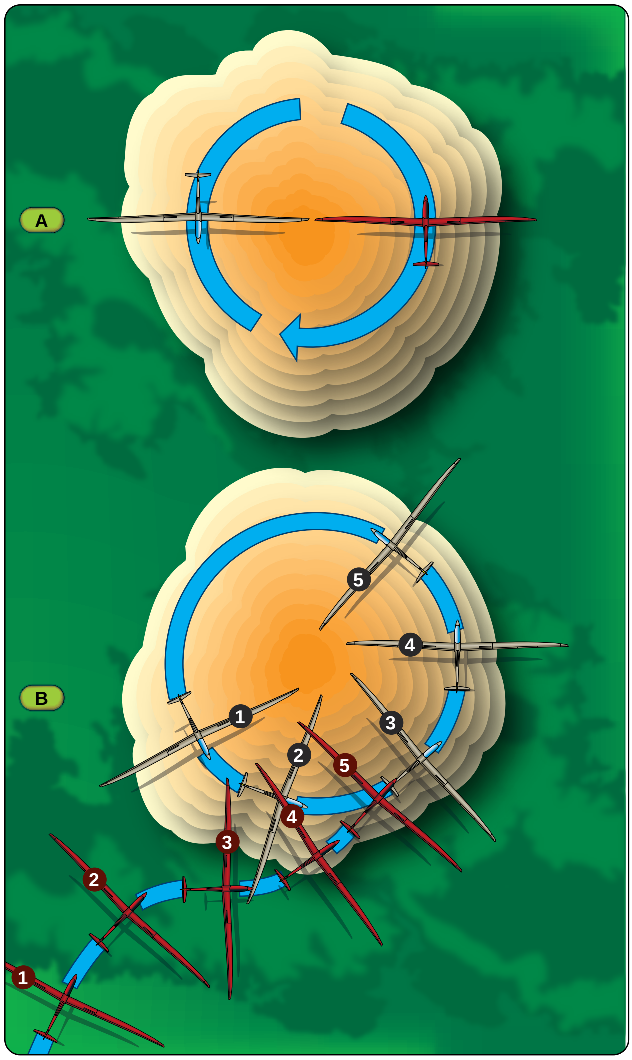

Figure 10-12. *Proper positioning with two gliders at the same altitude. Each number corresponds to the position of both gliders at a given time.*

Different types of gliders in the same thermal may have different minimum sink speeds, which makes it more difficult for each glider to remain directly across from the other. Each pilot should remain in visual contact with the other glider. Radio communication may help avoid a collision, but too much talking clogs the frequency and can impede the broadcast of another pilot's message. Pilots should not fly directly above or below another glider in a thermal since differences in performance, or even minor changes in speed, can lead to unexpected altitude changes. If a pilot loses sight of another glider in a thermal and cannot verify the other glider's position via a radio call, the pilot should leave the thermal. After 10 or 20 seconds, the pilot can come back around to rejoin the thermal in a better position to see the other traffic. Unsafe thermalling practices make a mid-air collision more likely, which could result in fatalities.

Exiting a Thermal

When exiting a thermal, appropriate methods can preserve some altitude. The pilot should increase speed as needed to penetrate any sink often found on the edge of the thermal and leave the thermal in a manner that does not hinder or endanger other gliders. While circling, the pilot scans the full 360° of sky. This allows the pilot to continually check for other traffic in the vicinity and decide where to go for the next climb. Experienced pilots often decide where to go next while still in lift.

Managing Expectations

Glider pilots should adapt quickly to whatever the air has to offer at the time. While thermalling techniques become second nature with practice, pilots should expect to land early if unable to find sufficient lift as part of normal flying experience.

Ridge/Slope Soaring

Efficient slope soaring (also called ridge soaring or ridge running) involves flying in the updraft along the upwind side of a ridge. Although the concept seems simple, slope soaring presents significant hazards and places demands on the glider and the pilot. Thorough preflight planning and route planning include ridge selection based on the current winds.

Surface winds of 15–20 knots perpendicular to the ridge optimize ridge soaring. Wind flow within 45° of the perpendicular line also provides adequate lift. Winds less than 10 knots might produce adequate ridge soaring depending on the terrain, but with 10 knots of wind or less, pilots should avoid flying low over any ridge due to the possibility of encountering sink. Local ridge pilots know about of these conditions. [*Figure 10-13*]

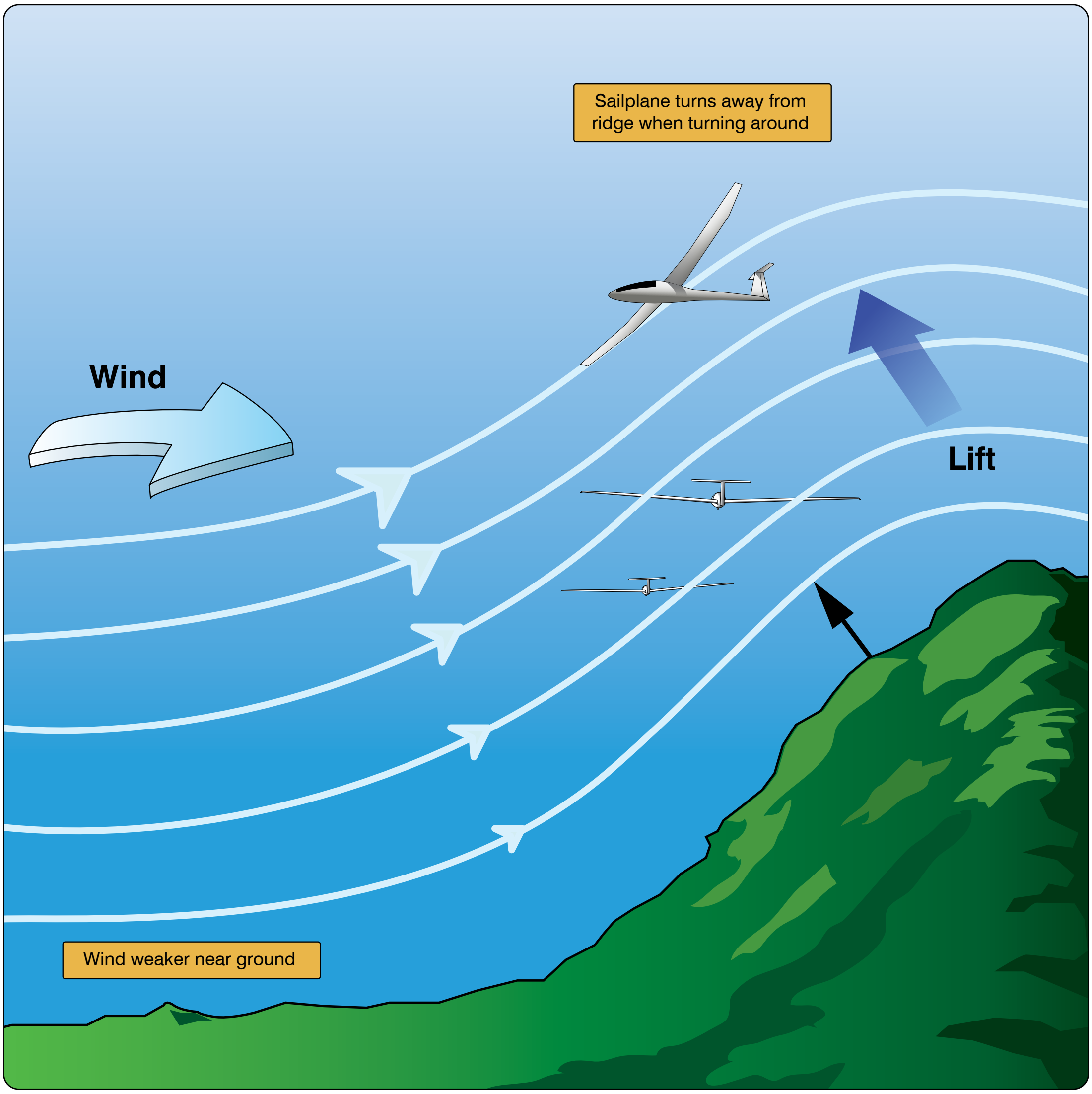

Figure 10-13. *Ridge wind flow.*

Airflow follows the hill or ridge shape. The pilot can imagine a flow of water around the ridge instead of air. However, air can compress and may develop local variations and eddies. [*Figure 10-14*]

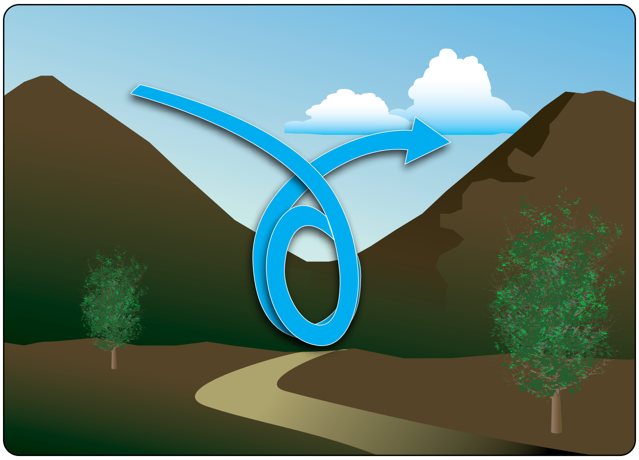

Figure 10-14. *Airflow generally follows the hill's shape.*

The more complicated the ridge, the more erratic and hazardous the airflow may become. [*Figure 10-15*]

Figure 10-15. *Irregular profiles may create a hazard.*

Traps

Since traps or dangers exist during ridge soaring, glider pilots should obtain instruction when first learning to ridge soar or slope soar. Pilots should approach the upwind side of the ridge at a 45° angle, so that a quick egress away from the ridge can occur in the absence of lift.

NOTE: When approaching the ridge from downwind, approach the ridge at a diagonal. If excess sink is encountered, this method allows a quick turn away from the ridge. [*Figure 10-16*]

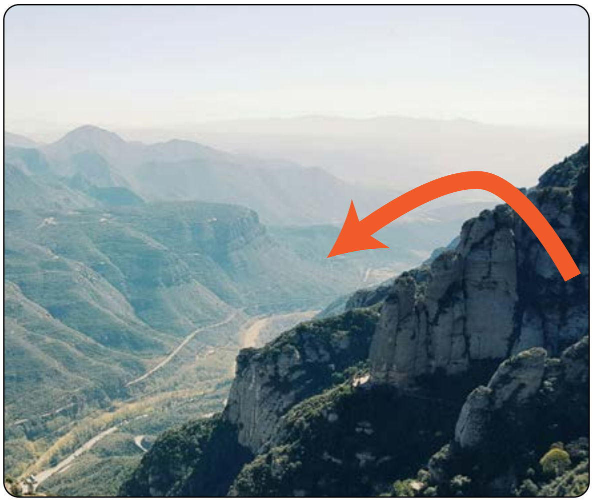

Figure 10-16. *Approach ridges diagonally.*

If gliding above the ridge, an appropriate crab angle prevents drifting over the top into the lee-side downdraft. For the new glider pilot, crabbing along the ridge may seem strange, and the pilot might resort to uncoordinated control input to point the nose along the ridge. This could result in an inefficient and dangerous skid toward the ridge.

Thermal sink can turn the glider upside down, a phenomenon known as upset. A thermal may appear anywhere. When it appears from the opposite side of the ridge, it has strong energy. When flying in complex conditions (winds and thermals), fly with extra speed for positive control of the glider. DO NOT fly on the ridge crest or below the ridge on the downwind side. [*Figure 10-17*]

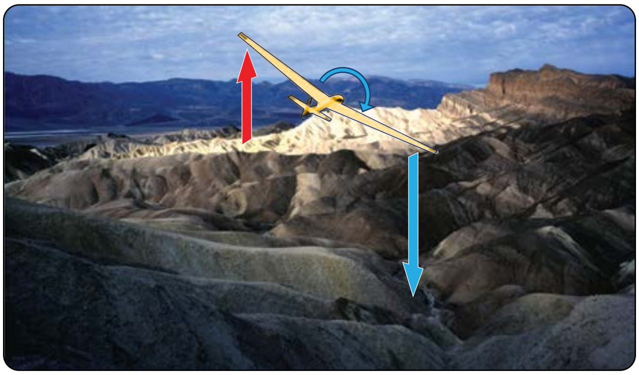

Figure 10-17. *Thermal sink can roll the craft toward the mountain.*

Whenever flying downwind, groundspeed and the radius of any turn will increase. [*Figure 10-18*]

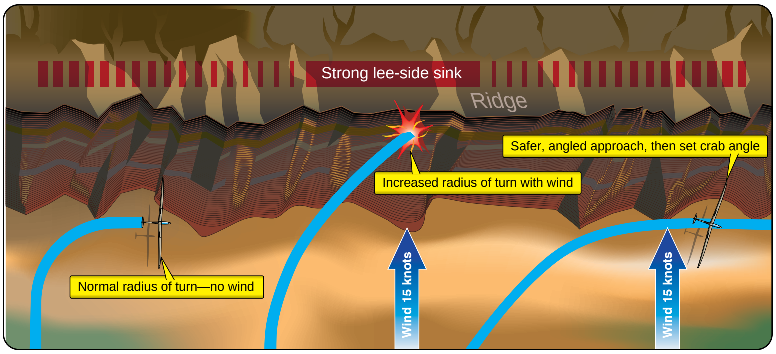

Figure 10-18. *Flying with a wind increases the turn radius over the ground, so approach the ridge at a shallow angle.*

In theory, to obtain the best climb, the pilot should fly at minimum sink speed. Since minimum sink speed gives less margin above stall speed, flying at this speed near terrain may create danger. Maneuverability at minimum sink speed may not provide for adequate control near terrain, especially if gusty wind or thermals complicate the ridge lift. When gliding at or below ridge-top height, the pilot should fly faster than minimum sink speed—how much faster depends on the glider, terrain, and turbulence. When the glider climbs to at least several hundred feet above the ridge and when shifting upwind away from it within the best lift zone, the pilot can reduce speed.

NOTE: When flying close to the ridge, use extra speed for safety—extra speed gives the glider more positive flight control input and enables the glider to fly through areas of sink quickly. [*Figure 10-19*]

Figure 10-19. *When flying close to a ridge, pilots use extra speed for more control and to pass quickly through sink.*

Procedures for Safe Flying

Several procedures enhance safe slope soaring and allow many gliders to use the same ridge simultaneously. The following paragraphs and *Figure 10-20* explain the procedures.

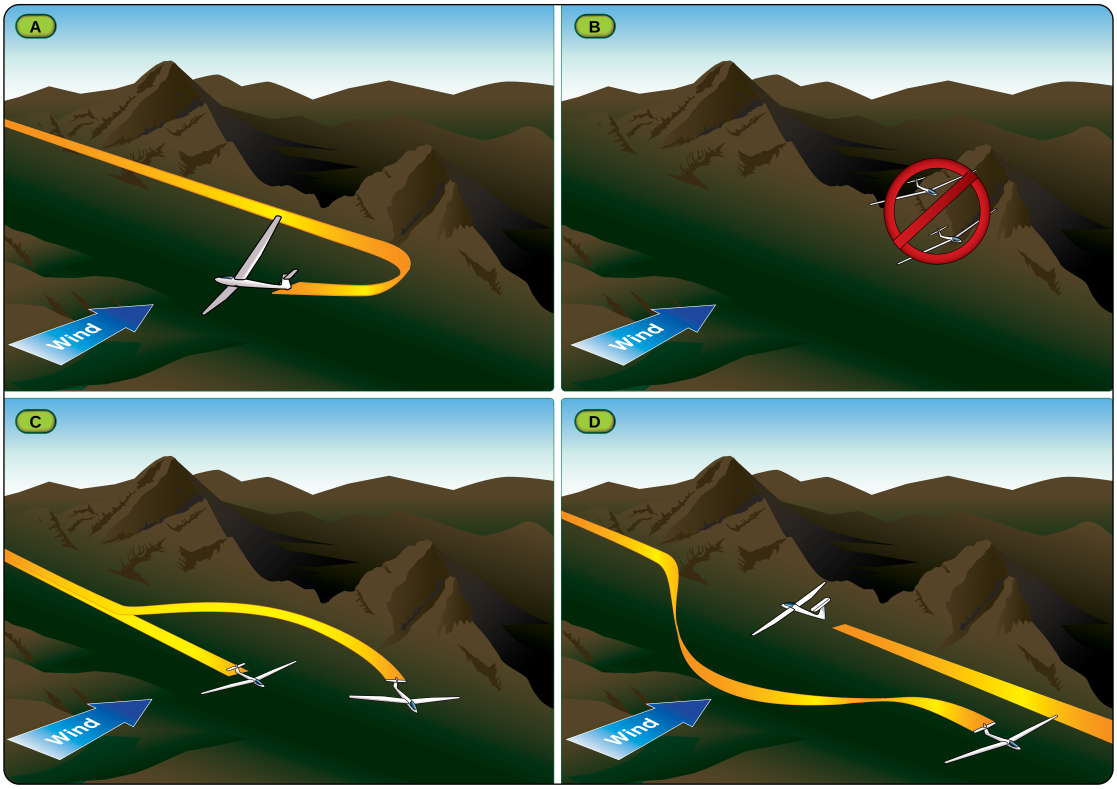

Figure 10-20. *Ridge rules.*

The pilot should:

- Make all turns away from the ridge. [*Figure 10-20A*] A turn toward the ridge creates unnecessary risk, even if positioned well away from the ridge. The groundspeed on the downwind portion of the turn may increase dramatically and lead to a collision with the ridge. Even if above the ridge, a downwind turn may take the glider over the ridge crest and into heavy sink.

- Not fly directly above or below another glider. [*Figure 10-20B*] Pilots in gliders in close vertical proximity might not see the other glider. A slight change in climb rate between the gliders can lead to a collision.

- Pass another glider on the ridge side, anticipating that the other pilot might turn away from the ridge. [*Figure 10- 20C*] If the space available to pass appears inadequate or if the overtaking glider encounters sink, turbulence, etc., it may maneuver away from the ridge. The passing glider should either turn back in the other direction (away from the ridge if spacing permits) or fly upwind away from the ridge and rejoin the slope lift as traffic allows. If using a radio, the pilot passing can try to contact the pilot of the other glider and coordinate. Procedures may differ outside of the United States.

- Understand that Title 14 of the Code of Federal Regulations (14 CFR) requires both aircraft approaching head-on to give way to the right. If a glider with the ridge to the right does not have room to move in that direction, the glider with its left side to the ridge should give way as needed. [*Figure 10-20D*] In general, gliders approaching head-on are difficult to see; therefore, when piloting the glider with its right side to the ridge, the pilot should ensure the approaching glider yields early on. While ridge soaring, pilots should enhance their vigilance. The use of a radio may provide additional safety. Pilots should look at 14 CFR part 91, section 91.111, Operating near other aircraft, and section 91.113, Right-of-way rules: Except water operations.

Bowls & Spurs

With wind blowing at an angle to the ridge, bowls or spurs, formations with recessed or protruding rock formations extending from the main ridge, can create better lift on the upwind side and sink on the downwind side. If at or near the height of the ridge, the pilot can detour around the spur to avoid the sink, then drift back into the bowl to take advantage of the better lift. [*Figure 10-21*] After passing such a spur, the pilot should consider any other traffic and not make abrupt turns toward the ridge. If soaring hundreds of feet above a spur, the pilot may consider flying over it and increase speed in any sink. This requires caution since a thermal in the upwind bowl, or even an imperceptible increase in the wind, can cause greater than anticipated sink on the downwind side. The pilot should always have an escape route available.

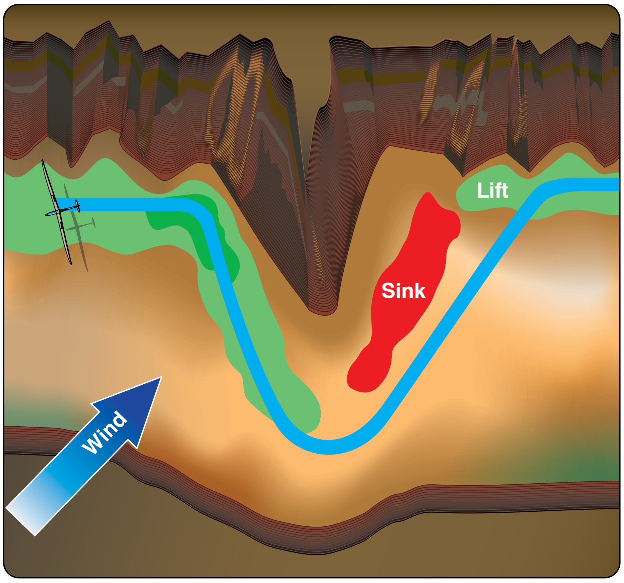

Figure 10-21. *Avoid sink on the downwind side of spurs by detouring around them.*

Slope Lift & Thermalling

Combinations of thermals with slope lift can occur, and slope soaring can provide lift when thermals temporarily shut down. A pilot encountering a thermal along the ridge can make a series of S-turns with each turn into the wind. The glider can drift back to the thermal after each turn if needed. The glider pilot should never continue the turn toward the ridge. Speed helps to control any encounter with strong sink that can occur on the sides of the thermal. The maneuver takes practice, but when done properly, the pilot can make a rapid climb in the thermal to a point well above the ridge crest, where thermalling 360° turns can begin. Even when well above the ridge, the pilot should use caution and ensure the glider does not drift into the lee-side sink during a slow climb. Before trying an S-turn, the pilot should ensure it would not interfere with other traffic along the ridge. [*Figure 10-22*]

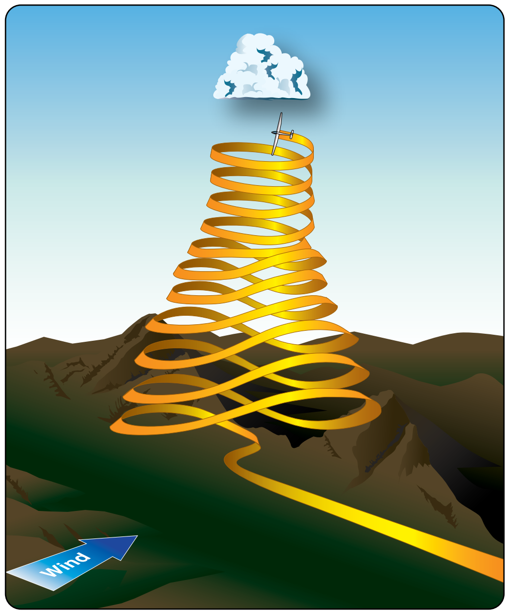

Figure 10-22. *One technique for catching a thermal from ridge lift.*

A pilot can use a second technique for catching thermals when slope soaring by heading upwind away from the ridge. This works best when Cu mark potential thermals, and aids timing. If not finding a thermal, the pilot should cut the search short while still high enough to dash back downwind to the safety of the upwind slope lift. [*Figure 10-23*]

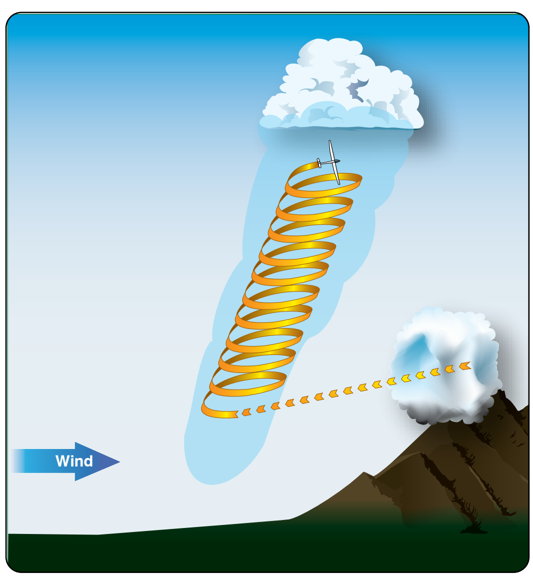

Figure 10-23. *Catching a thermal by flying upwind away from the slope lift.*

Obstructions

A risk of collision exists when flying at extremely low altitudes along a ridge (tree top level). Obstructions include wires, cables, and power lines, all of which the pilot might not see. The pilot should ensure completion of an adequate reconnaissance when flying at these altitudes. Aeronautical charts show high-tension towers that have many wires between them, and soaring pilots familiar with the area can also provide useful information regarding local ridge obstructions.

Tips & Techniques

Observe the ridges slope for collectors or dividers of the wind flow and determine which of the slopes could gather wind flow. [*Figure 10-24*] Due to the changes in wind direction and or sun angle, wind flow can change in a few minutes.

Figure 10-24. *Analyze sloping ground for collectors and dividers of wind.*

- Collectors include mountain/ridge bowls and ends of canyons that can offer extreme areas of lift when the wind blows into them. Remember to have a way out.
- Dividers are ridges parallel with the wind and separate airflow. A collector downwind from a divider may receive more airflow, making better lift possible.

The downwind side of any ridge or hill produces turbulence and sink. Larger or higher ridges and greater wind velocities create wider areas of turbulence. During these conditions, the pilot should remember to keep the seat and shoulder harness tight. Sink calls for speed, and turbulence and speed stress the glider airframe and reduce pilot comfort. Pilots should not exceed glider limitations set forth in the GFM/POH including the design speed for maximum gust intensity (Vb). [*Figure 10-25*]

Figure 10-25. *Expect turbulence and sink on the downwind side of any hill.*

Pilots should assume airflow starts down at the ridge crest. While steep ridges with narrow ridge tops can collect thermal action from both sides of the crest and the best lift may exist directly above the crest, the pilot should not plan to use that lift and always remain upwind of the crest. [*Figure 10-26*]

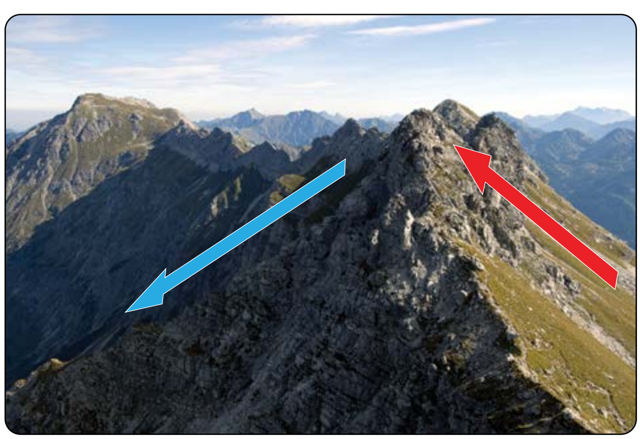

Figure 10-26. *The crest is where rising air starts back down.*

Deeply shaded areas along the ridge often enhance sinking air. If strong lift exists on the sunny side of the ridge, then strong sink usually exists on the shady or dark side of the ridge. This often happens with low sun angles in the late afternoon. [*Figure 10-27*]

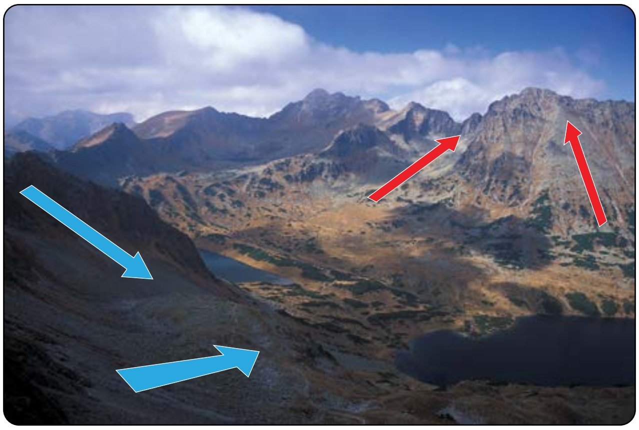

Figure 10-27. *Deep shade can enhance sink.*

A thermal source occurs where drainage areas along the ridge meet. For example, an area with numerous ridges or peaks that slope down into a valley. Canyons or large bowls hold areas of warm air.

Cloud streets may form above the ridge. A glider pilot can try to climb in a thermal to reach these streets. Pilots can use fast cruising speeds under these streets but should stay upwind of the ridge when using the air circulation marked by the streets.

Since glider pilots tend to seek the same known good conditions for lift, thermals and areas of ridge lift can attract significant traffic. Pilots should remain alert for conflict with other aircraft including low flying airplanes and helicopters that use the same area. Sharing a common radio frequency for traffic calls may enhance safety, but nothing replaces a good visual scan for other aircraft.

Density altitude and true airspeed increase as the glider climbs. At 10,000 feet mean sea level (MSL), a pilot needs approximately 40 to 45 percent more room to maneuver. The air is less dense by 2 percent per one thousand feet of altitude gained. [*Figure 10-28*]

Figure 10-28. *At 10,000' MSL, 44 percent more room is needed to complete a turn due to density altitude.*

Wave Soaring

Almost all high-altitude glider flights use mountain lee waves as the primary source of lift. As covered in Chapter 9, Glider Flight and Weather, lee wave systems can contain separate rotor turbulence and smooth wave flow. The use of lee waves for cross-country soaring has enabled flights exceeding 1,500 miles, with average speeds of over 100 mph. [*Figure 10-29*]

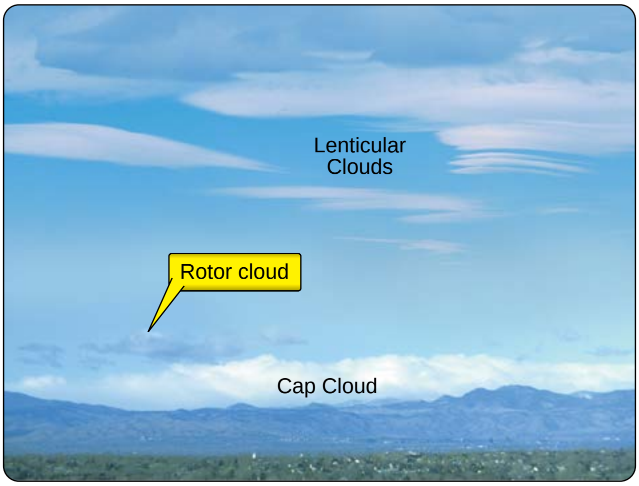

Figure 10-29. *Rotor and cap clouds with lenticulars above.*

Preflight Preparation

Special areas within the continental United States allow glider operations in Class A airspace above 18,000 feet MSL under visual flight rules (VFR). Air Traffic Control (ATC) may open a "wave window" to a specific altitude at specified times. Each wave window has its own set of procedures agreed to by ATC through a Letter of Agreement. Glider pilots should understand the special provisions in the letter of agreement before flying within a wave window.

A flight above 18,000 feet MSL requires extensive preflight preparation. Pilots planning wave flights to lower altitudes can reduce the list of preparation items accordingly.

14 CFR part 91, section 91.211 requires that crewmembers use supplemental oxygen for flight of more than 30 minutes above cabin pressure altitudes of 12,500 feet MSL up to and including 14,000 feet MSL. While above cabin pressure altitudes of 14,000 feet MSL, required crewmembers must use supplemental oxygen. Pilots should preflight the oxygen system, understand signs of hypoxia, know their reactions to high altitude, and consider using oxygen at altitudes well below 12,500 feet MSL.

When flying at high altitudes, the outside air chills the glider interior. Sunlight can help warm portions of the pilot's upper body, but the pilot's lower extremities and feet normally get cold. Pilots planning for a long flight in cold air should wear thermal underwear, warm socks, and shoes and have gloves easily accessible during the flight. Clothing with rechargeable electric heating components can provide hours of warmth.

True airspeed (TAS) becomes a consideration at higher altitudes. To avoid flutter, some glider manuals reduce never-exceed speed (V_{NE}) as a function of altitude. For instance, the Pilot's Operating Handbook (POH) for one common two-seat glider, lists a V_{NE} at sea level of 135 knots. However, at 19,000 feet MSL, it lowers to only 109 knots. Pilots should study the glider's POH carefully for any indicated airspeed limitations.

Some flights might not contact the wave. Sink on the downside of a lee wave can reach 2,000 fpm or more. In addition, missing the wave often means a trip back through the turbulent rotor. To reduce the workload and stress, pilots should calculate minimum return altitudes from several locations before flight. In addition, pilots should plan for worst-case scenarios and consider available off-field landing options if the planned minimum return altitude proves inadequate.

The pilot should begin with a normal preflight of the glider. In addition, the pilot should check the lubricant used on control fittings. Some lubricants get stiff when cold. The pilot should ensure the glider is totally devoid of excess water before flying into freezing temperatures. This includes checking the bottom of the fuselage where water can freeze around rudder and elevator cables and checking spoilers or dive brakes for water from rain or from melting snow cleared from the wing. Water in the spoilers or drive brakes at altitude can freeze and make them difficult or impossible to open. Checking the spoilers or dive brakes occasionally during a high climb helps avoid this problem.

The pilot should check for a freshly charged battery since cold temperatures can reduce battery effectiveness and affect the avionics. The preflight should include checking the radio and accessory equipment, such as the microphone in the oxygen mask. Other specific items to check depend on the systems in the glider.

A briefing with the tow pilot should occur before a wave tow. Prior to flight, the pilots should discuss routes, minimum altitudes, rotor avoidance (if possible), anticipated tow altitude, and other potential situations.

A pilot wearing a bail-out parachute on wave flights should check its proper fitting and use. When wearing a parachute, the seat can suddenly seem cramped. Once seated in the glider, the pilot should check for full, free rudder movement since larger than normal footwear can affect rudder control. In addition, given the bulky cold-weather clothing, the pilot should check canopy clearance. The pilot's head can break a canopy in rotor turbulence, so seat and shoulder belts should be tightly secured even if difficult to achieve with the extra clothing. Proper placement of the oxygen mask should make it easily accessible within a few seconds since the climb in the wave can be very rapid. Securing everything else before takeoff prevents disorder while encountering the rotor.

Getting into the Wave

Access into the wave occurs in two ways: soaring into it or being towed directly into it. Three main wave entries while soaring include thermalling into the wave, climbing the rotor, and transitioning into the wave from slope soaring.

At times, an unstable layer lower than the mountaintop has a strong, stable layer cap, which may support lee waves. A line of cumulus clouds downwind of and aligned parallel to the ridge or mountain range suggests the presence of these waves. With these conditions present, the pilot can avoid the rotor area and thermal into the wave. Whether lee waves are suspected or not, the air near the thermal top may become turbulent. At this point, the pilot should attempt a penetration upwind into the smooth wave. [*Figure 10-30*]

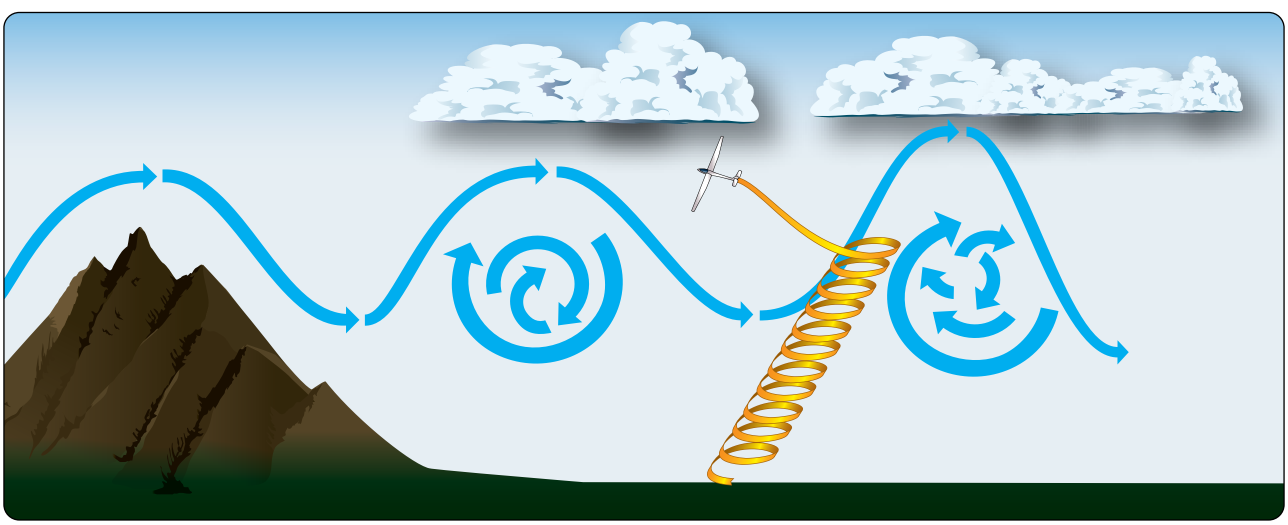

Figure 10-30. *Thermalling into wave.*

Depending on the topography near the soaring site, it may be possible to transition from slope lift into a lee wave created by upwind topography where multiple ridges exist. In this case, the pilot climbs as high as possible in slope lift, then penetrates upwind into the lee wave. With the lee waves in phase with the topography, the pilot can often climb from slope to wave lift without the rotor. At times, the glider pilot may not realize wave has been encountered until finding lift steadily increasing as the glider climbs. Climbing in slope lift and then turning downwind to encounter possible lee waves produced downwind of the ridge should generally not occur. Even with a tailwind, the lee-side sink can put the glider on the ground before contact with the wave.

Another possibility involves a tow into the upside of the rotor and a climb using the rotor to reach the wave. The technique relies on finding the rising part of the rotor. Since rotor lift usually remains stationary over the ground, this may involve flying a "figure-8" in the rotor lift to avoid flying downwind. The pilot can also fly several circles with an occasional straight leg or fly straight into the wind for several seconds until the lift diminishes followed by circling to reposition within the lift. Which choice works best depends on the size of the lift and the strength of the wind. Since the rotor may contain regions of rapidly changing and turbulent lift and sink, staying in it as well as simple airspeed and bank control may prove difficult. Inexperienced pilots should avoid using a tow to the upside of a rotor to reach the wave.

Towing into the wave occurs by towing ahead of the rotor or through the rotor. Complete avoidance of the rotor by towing around it will generally increase the time on tow, but the reduced turbulence increases the tow pilot's willingness to perform future wave tows. [*Figure 10-31*] If the launch site sits near one end of the wave-producing ridge or mountain range, a tow around the rotor and then directly into the wave lift becomes more feasible.

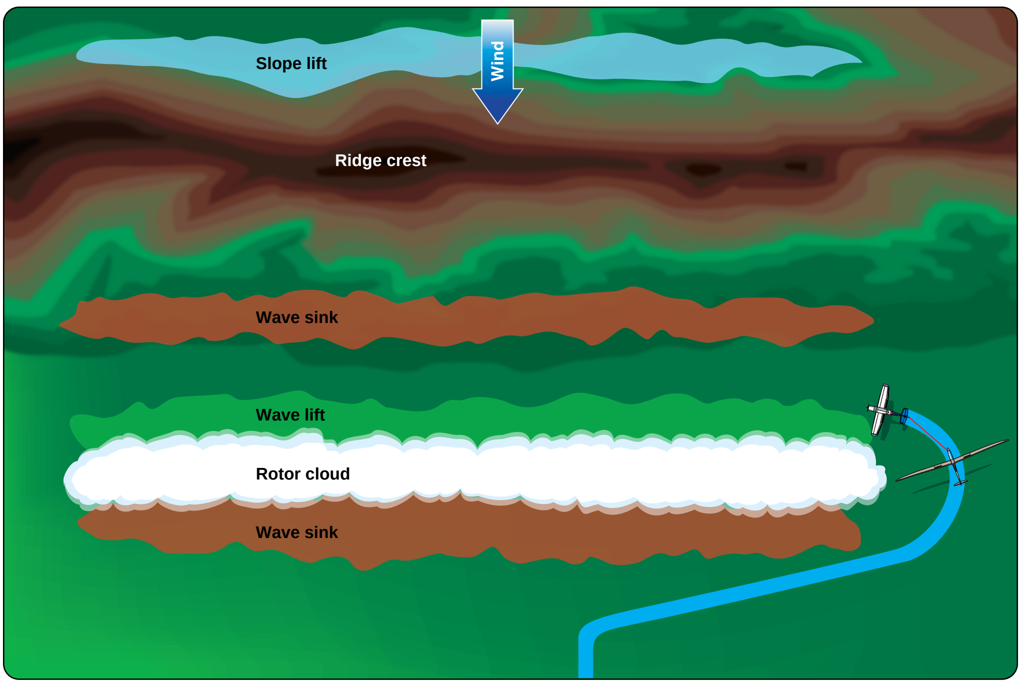

Figure 10-31. *A tow around the rotor directly into the wave avoids turbulence.*

Often, a tow directly through the rotor provides the only route to the wave. The tow will usually encounter moderate to severe rotor turbulence. The nature of rotor turbulence differs from a turbulent thermal. The rotor subjects the aircraft to sharp, chaotic horizontal and vertical gusts along with rapid accelerations and decelerations. At times, the rotor can become so rough that even experienced pilots will elect to remain on the ground. Any pilot without experience flying through rotors should obtain instruction before attempting a tow through a rotor.

During a tow through a rotor, the glider often gets out of position, and the glider pilot should attempt to maintain position horizontally and vertically. Turbulence too violent to handle may require an immediate release. Slack-producing situations occur commonly due to a rapid deceleration of the towplane. The glider pilot should recognize the onset of slack line and correct accordingly. The glider pilot should maintain the high-tow position because any tow position lower than normal runs the risk of the slack line coming back over the glider. On the other hand, the glider should fly no higher than normal to avoid a forced release should the towplane suddenly drop. Gusts may also cause an excessive bank of the glider, and it may take a moment to roll back to a level attitude. The pilot may need to use full aileron and rudder deflection for a few seconds.

The trend of the variometer often indicates the progress through the rotor. General downswings get replaced by general upswings, usually along with increasing turbulence. The penetration into the smooth wave lift can occur in a matter of seconds or it can occur gradually. The glider pilot should note any lenticulars above as a position upwind of the clouds helps confirm contact with the wave. If in doubt, the tow may continue for a few moments longer to confirm wave contact. Once confident of the wave lift, the glider pilot makes the release. If on a crosswind heading, the glider should release and fly straight or with a crab angle. If flying directly into the wind, the glider should turn a few degrees to establish a crosswind crab angle. The pilot should avoid drifting downwind and immediately losing the wave. After release, the towplane should descend and/or turn away and create separation from the glider. The glider and tow pilot should brief any nonstandard release procedures before takeoff. [*Figure 10-32* and *Figure 10-33*]

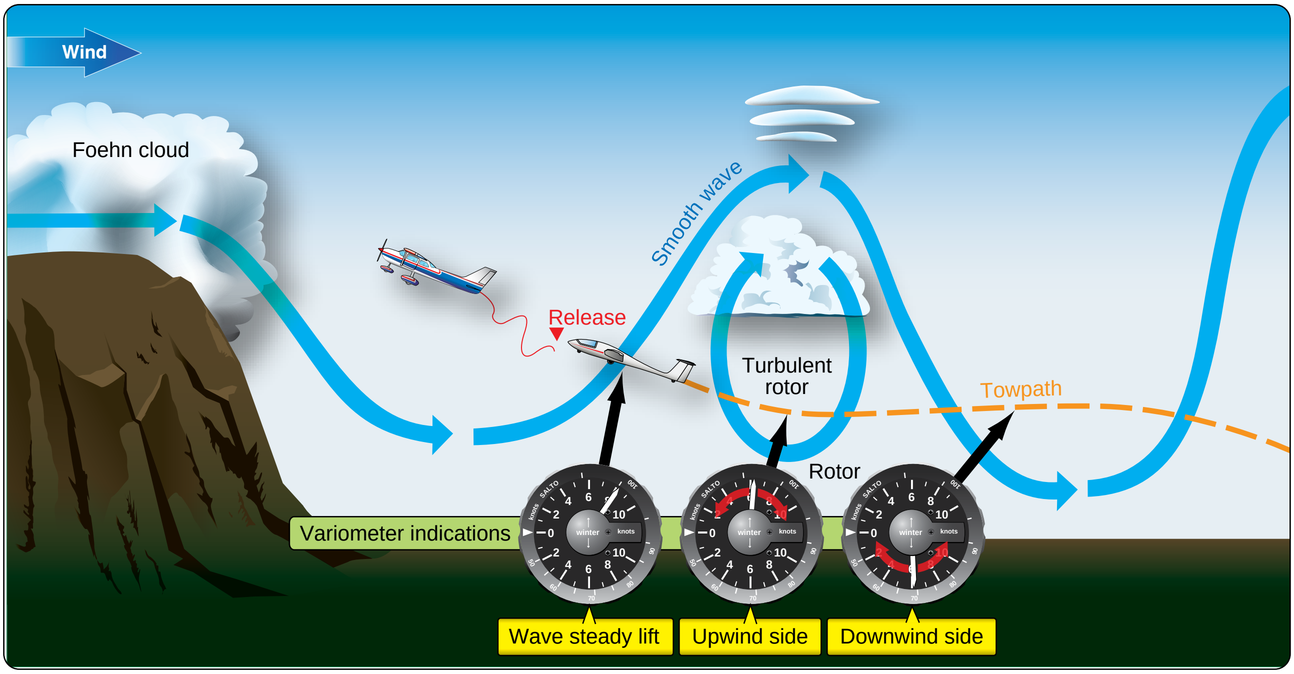

Figure 10-32. *Variometer indications during the penetration into the wave.*

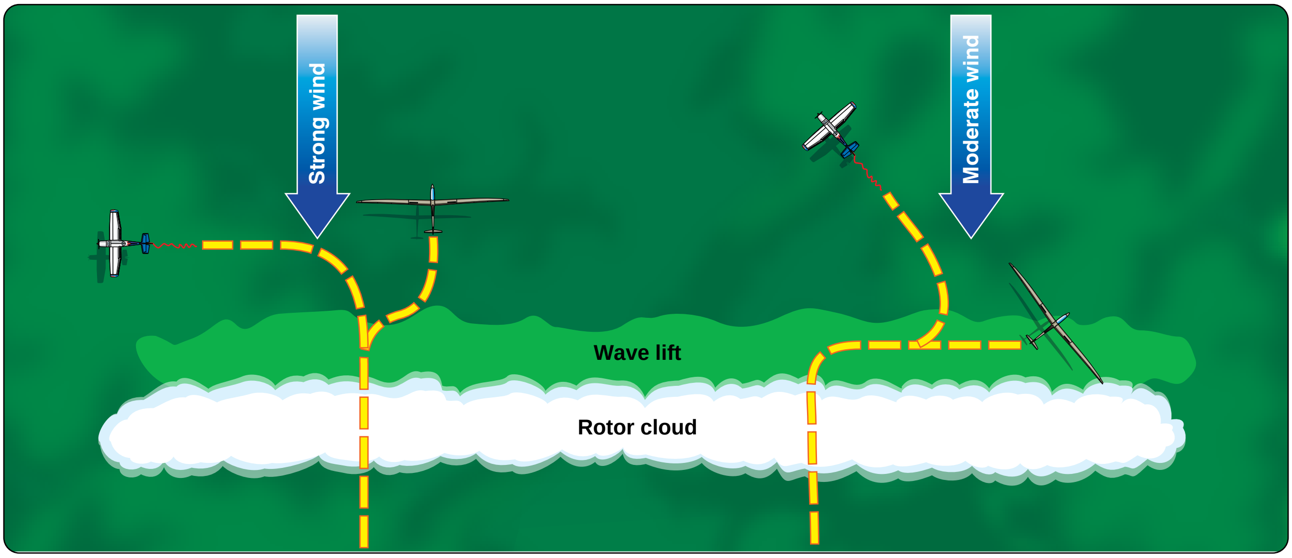

Figure 10-33. *Possible release and separation on a wave tow.*

Flying in the Wave

After wave contact, the best technique for utilizing the lift depends on the extent of the lift and the strength of the wind. In weak lift, the pilot should stay with the initial slow climb as better lift should develop as the climb continues. At other times, the variometer may peg at 1,000 fpm directly after release from tow.

In strong winds (40 knots or more), the pilot should find the strongest portion of the wave, point into the wind, and adjust speed so that the glider remains in the strong lift. The best lift usually occurs along the upwind side of the rotor cloud or just upwind of any lenticulars. In the best-case scenario, the required speed matches the glider's minimum sink speed. In quite strong winds, the pilot flies faster than minimum sink to maintain position in the best lift. Under those conditions, flying slower would allow the glider to drift downwind (fly backward over the ground) and into the downside of the wave. Once on the downside, getting back to the frontside requires penetrating a strong headwind. With strong lift, stronger winds aloft might push the glider downwind, so the pilot should monitor the position relative to rotor clouds or lenticulars. If no clouds exist, the pilot can use nearby ground references and increase speed with altitude as needed to maintain position in the best lift. In a wind not strong enough for the glider to remain stationary over the ground, the glider slowly moves upwind out of the best lift. If this occurs, the pilot should turn slightly from a direct upwind heading, drift slowly downwind into better lift, and turn back into the wind before drifting too far. [*Figure 10-34*]

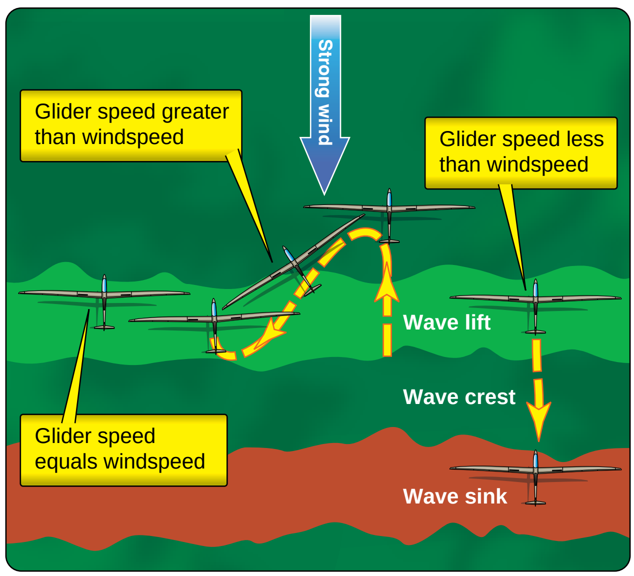

Figure 10-34. *Managing wave position with speed.*

Often, the wave lift moves over the ground since small changes in windspeed or stability can alter the wavelength of the lee wave within a few minutes. If lift begins to decrease while climbing in the wave, one of these things has occurred: the glider approached the top of the wave, the glider moved out of the best lift, or the wavelength of the lee wave has changed. In any case, the pilot can explore the area for better lift by searching upwind first. Searching upwind allows the pilot to drift downwind back into the rising part of the wave if not finding better lift upwind. Searching downwind first can make it difficult or impossible to contact the lift again if encountering sink on the downwind side of the wave. In addition, the pilot might exceed the glider's maneuvering speed or redline for rough air as gliding from the downwind to upwind could put the glider back in the rotor. [*Figure 10-35*]

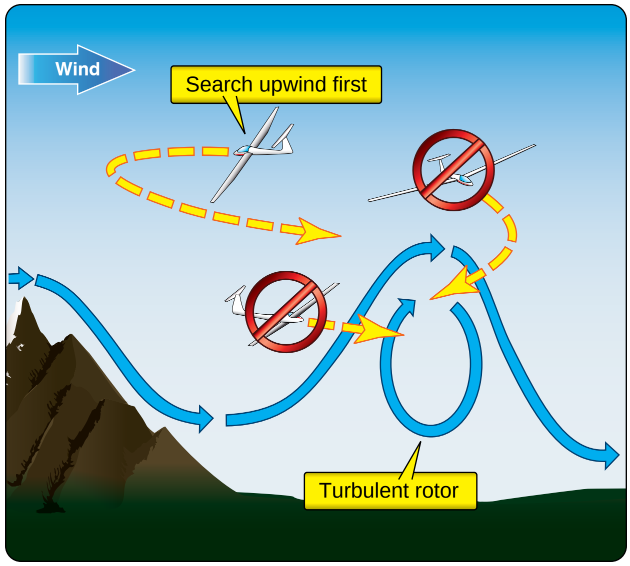

Figure 10-35. *Search upwind first to avoid sink behind the wave crest or the rotor.*

In moderate winds (20 to 40 knots) and if the wave extends along the ridge or mountain range for a few miles, the pilot can fly back and forth along the wave lift while crabbing into the wind. The pilot can use the rotor cloud or lenticular as a reference. All turns should occur into the wind to avoid moving to the downside of the wave or back into the rotor. When making an upwind turn to change course 180°, the pilot changes heading less than 180°, with the reduction in turn based on the strength of the wind. The pilot notes the crab angle needed to stay in lift on the first leg and can use that same amount of into-the-wind crab angle initially after completing the next upwind turn. With no cloud, ground references allow the pilot to establish and maintain the proper crab angle. While climbing higher into sufficiently strong winds, the pilot may transition from crabbing back and forth to a stationary upwind heading. [*Figure 10-36*]

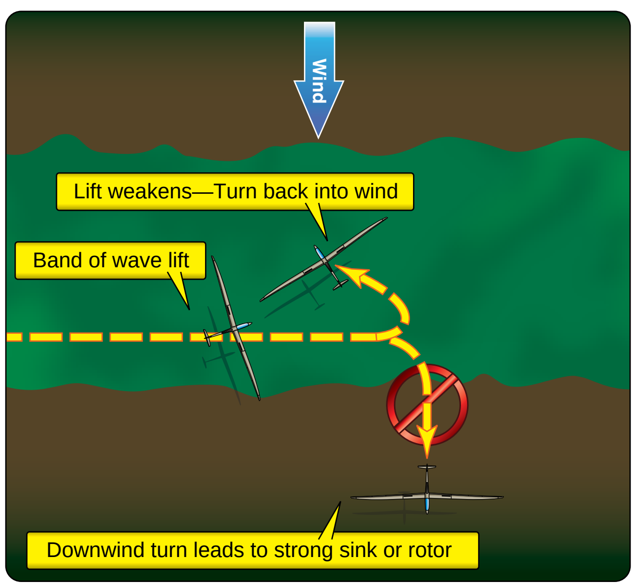

Figure 10-36. *Crabbing and turns in a wave*

Weaker winds (15 to 20 knots) may call for different techniques. Lee waves from smaller ridges can form in relatively weak winds of approximately 15 knots, and wave lift from larger mountains rapidly decreases when climbing to a height where winds aloft diminish. In a small area that still provides lift near the wave top, the pilot can fly shorter figure 8 patterns to reach the maximum altitude. The pilot can also fly an oval-shaped pattern straight into the wind in lift and fly a quick 360° turn to reposition and as it diminishes. If a consistent climb is not possible, the pilot can fly a series of circles with an occasional leg into the wind to avoid drifting too far downwind. In a sufficiently large lift area, the pilot can use a technique like that used in moderate winds. [*Figure 10-37*]

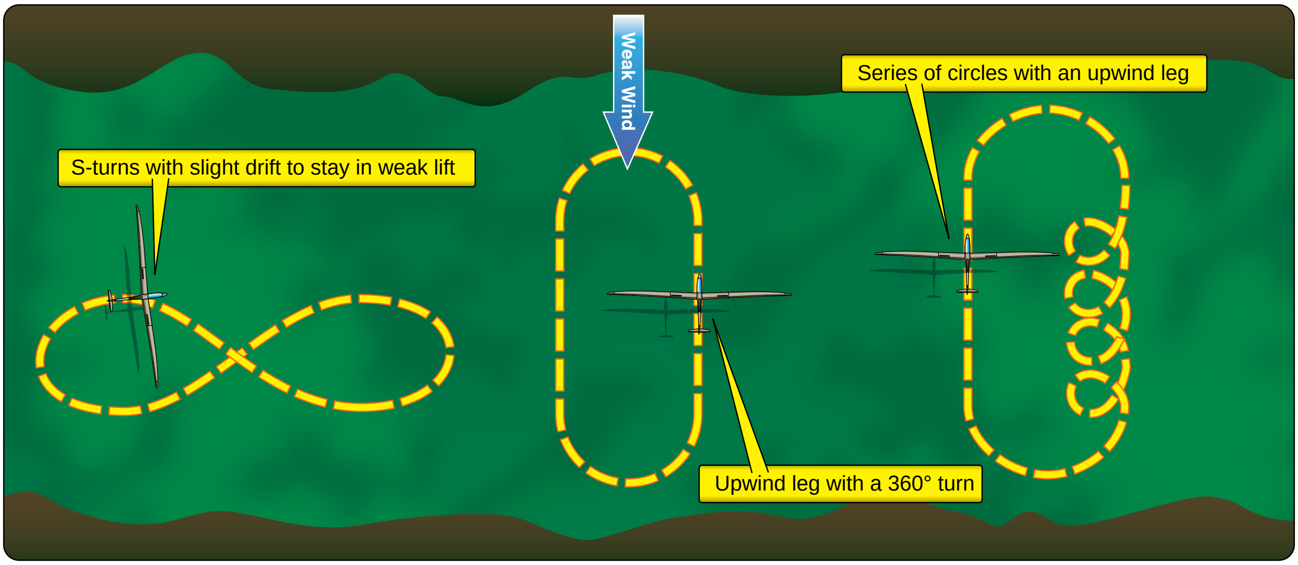

Figure 10-37. *Techniques for working lift near the top of the wave in weak winds.*

The discussion thus far assumed a climb in the primary wave. The pilot can also climb using any secondary or tertiary lee wave and then penetrate the next wave upwind. The success of this strategy depends on wind strength, clouds, the intensity of sink downwind of wave crests, and the performance of the glider. Depending on the height attained in the secondary or tertiary lee wave, a trip through the rotor of the next wave upwind could occur. Pilots should exercise caution if penetrating upwind at high speed. The transition into the downwind side of the rotor can be as abrupt as on the upwind side, so the pilot should reduce speed at the first hint of turbulence. In any case, the glider could lose a significant amount of altitude while penetrating upwind through the sinking side of the next upwind wave. [*Figure 10-38*]

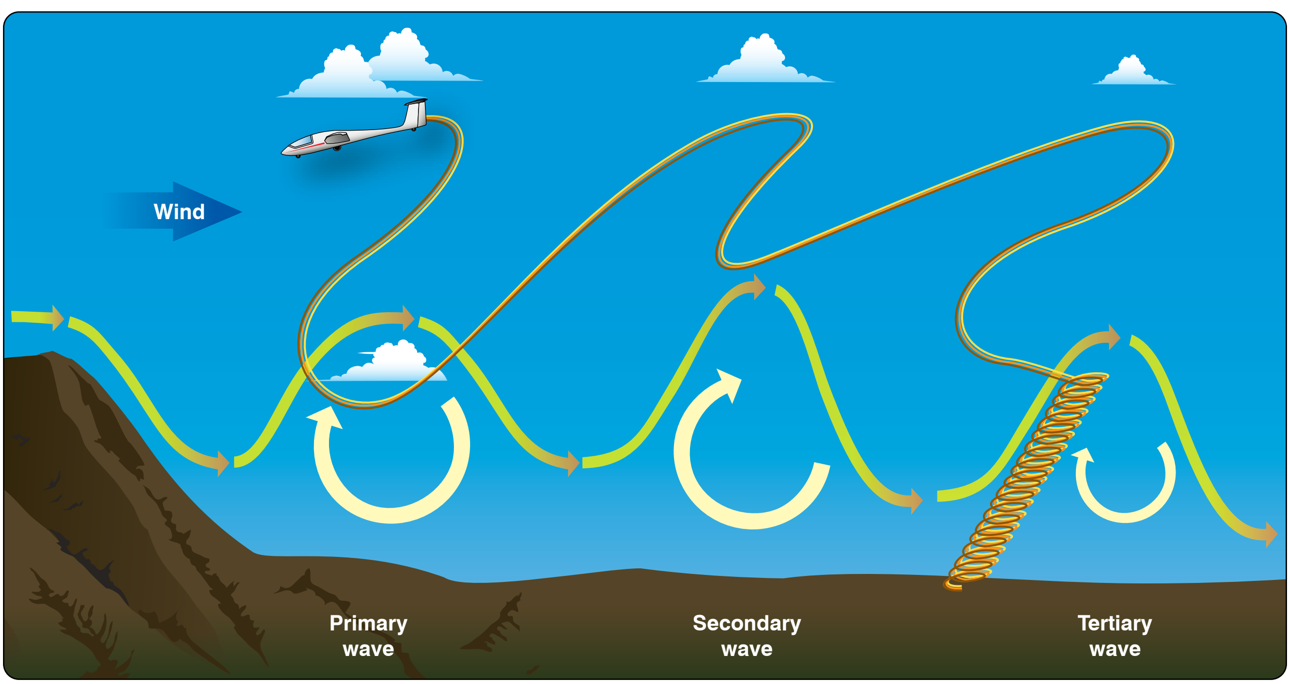

Figure 10-38. *Possible flightpath while transitioning from the tertiary into the secondary and then into the primary.*

The sink downwind of the wave crest can assist a pilot who decides to make a quick descent as sink can easily attain twice the strength of the lift encountered on the upwind side of the wave crest. Eventual descent into downwind rotor might also occur. An inadequate space between a rotor cloud and overlying lenticulars can prevent a safe downwind transition that might then occur with reduced visibility. In this case, the pilot can make a crosswind detour if a short ridge or mountain range produces the wave. If clouds negate a downwind or crosswind departure from the wave, a descent on the upwind side of the wave crest can occur. Spoilers or dive brakes may be used to descend through the updraft, followed by a transition under the rotor cloud and through the rotor. The pilot should control speed during flight through the rotor. In addition, lift on the upwind side of the rotor may make it difficult to stay out of the rotor cloud. This type of descent requires caution and emphasizes the importance of an exit strategy before climbing too high in the wave. Pilots should remember that conditions and clouds can evolve rapidly during the climb.

Some of the dangers and precautions associated with wave soaring include:

- Symptoms of hypoxia—check the oxygen system, and immediately begin a descent to lower altitudes that do not require supplemental oxygen. Do not delay!

- Extreme cold—descend before becoming uncomfortably cold.

- Severe or extreme rotor turbulence—exercise caution on tow and when transitioning from smooth wave flow (lift or sink) to rotor. Rotors near the landing area can cause strong shifting surface winds of 20 or 30 knots. Wind shifts up to 180° sometimes occur in less than a minute at the surface under rotors.

- Restricted vision—warm, moist exhaled air may cause frost formation on the canopy and restrict vision. Opening air vents may alleviate the problem or delay frost formation. The pilot can use heated panels or descend before frost becomes a hazard.

- Entrapment above clouds—wet waves associated with a great deal of cloud formation may close gaps beneath the glider and the pilot should descend in visual conditions before becoming trapped. If trapped above clouds, the pilot could attempt a benign spiral through the cloud as an emergency maneuver only if previously explored and stable for the glider in visual conditions.

- Inadvertent night flight—at sunset, bright sunshine still exists at 25,000 feet while the ground below gets quite dark. Know the time of actual sunset. Even at an average 1,000 fpm descent, it takes 20 minutes to lose 20,000 feet.

Caution: Flights under a rotor cloud can encounter high sink rates and pilots should approach those areas with caution.

Soaring Convergence Zones

Pilots can most easily spot a convergence zone in the presence of cumulus clouds. They may appear as a single well-defined straight or curved cloud street. The edge of a field of cumulus can mark convergence between a relatively moist or unstable mesoscale air mass from a drier or more stable one. Often, the cumulus along convergence lines have a base lower on one side.

With no cloud present, pilots can sometimes spot a convergence zone by a difference in visibility across it, which may be subtle or distinct. Even without any clues in the sky, conditions on the ground can indicate a convergence zone. Pilots can look for wind differences on lakes a few miles apart. A lake showing a wind direction different from the ambient flow for the day may indicate conditions that can create a convergence zone. Wind direction shown by blowing smoke can also indicate convergent conditions. A few dust devils, or a short line of them, may indicate the presence of ordinary thermals versus those triggered by convergence. Spotting these subtle clues takes practice and good observational skills and explains why a few pilots can continue soaring while other cannot.

The best soaring technique for this type of lift depends on the nature of the convergence zone itself. For instance, curtain clouds mark a well-defined, sea-breeze front, and the pilot can fly straight along the line in steady lift. A weaker convergence line often produces more lift than sink. An even weaker convergence line may simply serve as the focus for more frequent thermals, and the pilot can use normal thermalling techniques such as flying slower in lift and faster in sink along the convergence line. Some combination of straight legs along the line with an occasional stop to thermal might provide sufficient lift to stay aloft.

Convergence zone lift can at times become turbulent, especially if air mixes from different sources, such as along a sea-breeze front. The general roughness could indicate a convergence line. When narrow, rough, and strong thermals exist within the convergence line, the pilot can work these areas like any other difficult thermals by using steeper bank angles and more speed for maneuverability.

Combined Sources of Updrafts

Lift sources categorize into four types: thermal, slope, wave, and convergence. Often, more than one type of lift exists at the same time, such as thermals with slope lift, thermals leading to an existing wave, convergence zones enhancing thermals, thermal waves, and wave and slope lift. In mountainous terrain, all four lift types may exist on a single day. The glider pilot needs to remain mentally nimble to take advantage of various types and locations of rising air during the flight.

Rising air might not always come from these four lift categories. Sources of lift that do not fit one of the four lift types discussed probably exist. For instance, a few reports suggest pilots soared in travelling waves from an unknown source. At some soaring sites, debate exists over the classification of the type of lift. This should not create a problem if the pilot can work the lift as needed, get safely back on the ground, and ponder the source of lift after the flight.

Chapter Summary

Pilots should understand the source of lift they intend to use for a given flight. They should also understand how to maximize that potential lift and avoid spending extra time in sink. Learning to take full advantage of each kind of lift takes patience and experience. In the interest of safety, pilots should follow certain rules that apply to different soaring regimes. These include positioning the glider so the pilot can see other gliders in a thermal, yielding the right-of-way as needed when approaching another glider during ridge soaring, avoiding downwind turns that could bring the glider in contact with ridge terrain, respecting the potential for rotor turbulence, and knowing how to control the glider if encountering extreme turbulence during wave soaring. Since flying a glider involves dynamic conditions, a pilot should always have a place to land in mind should a landing become necessary.