But relative to the ground, the aircraft is changing from an into-wind path (no drift, groundspeed least) to across the wind (maximum drift, groundspeed equalling airspeed) to a downwind path (no drift, groundspeed maximum) to another cross-path with drift now in the opposite direction.

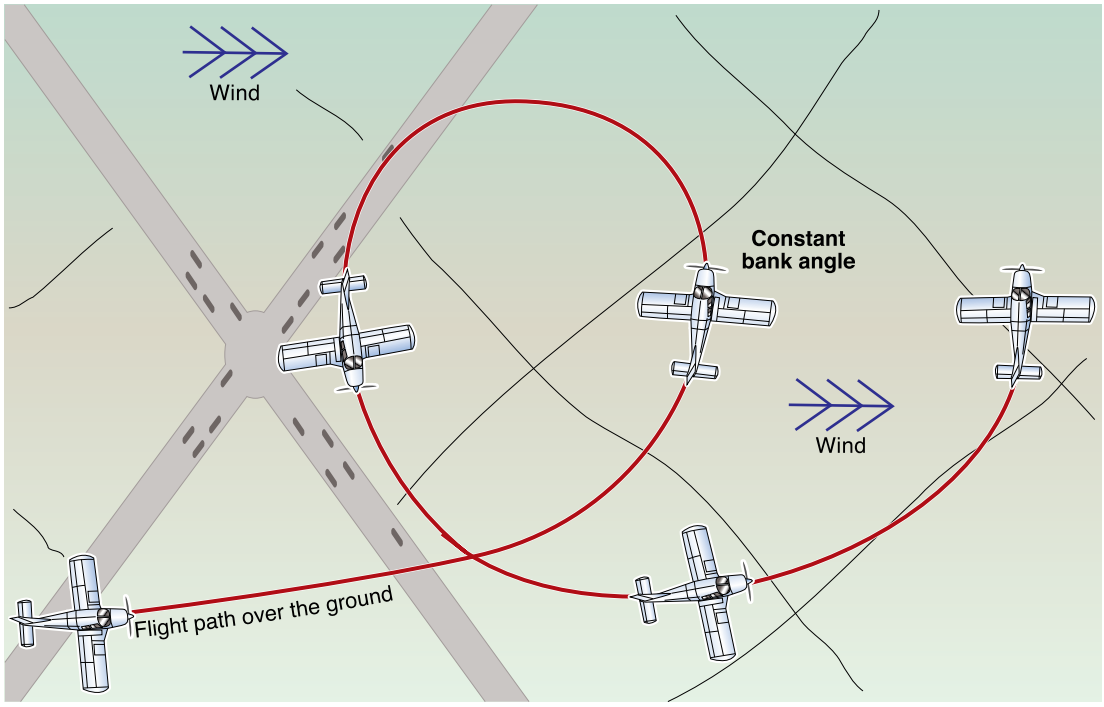

Figure 18-9 Aircraft path relative to the ground

It can be a trap if the pilot tries to compensate for the apparent drift or speed by making control adjustments. The most dangerous is when going from the downwind path to a crosswind path and trying to stay within a feature on the ground. Display pilots know this situation well. There is a great danger of an accelerated stall. There is a further danger if on the downwind segment, the pilot feels too fast (which observation will indicate) and reduces power and speed when turning across the wind. This will further risk a stall. The pilot must cross-refer to airspeed and be sensitive to any excessive back pressure that may be wrongly applied. If in doubt, or uncomfortable, level the wings and climb.

Windshear

The wind usually moves in layers over smooth ground (laminar flow) and increases in strength as you move further away from the ground. An added complication is a change in direction of each layer. The changes in velocity are the result of the friction forces between the ground and the lower layers causing the wind to slow down near the surface. Any change in wind speed or direction with change in height is referred to as *windshear*. Since when flying near the ground, the aircraft's flightpath is paramount, then windshear is significant.

There are two concerns:

- immediate but transitory effects on airspeed and stability; and
- changes to flightpath.

The greatest transitory effect is on aircraft with large momentum (greater mass and velocity: momentum = mass x velocity, where velocity is relative to the ground). This is because it takes the larger aircraft a finite time to accelerate or decelerate and to respond to airspeed fluctuations. It is a less serious problem in light aeroplanes although the turbulence and vertical gusts can more severely effect control and performance.

Take-Off & Climb

Taking-off into a headwind would normally mean that you would climb into an increasing headwind, which tends to increase your airspeed and increase the climb gradient (steepness). An increasing headwind leads to increased performance.

Taking-off downwind or in calm conditions in a windshear situation, risks climbing into an increasing tailwind.

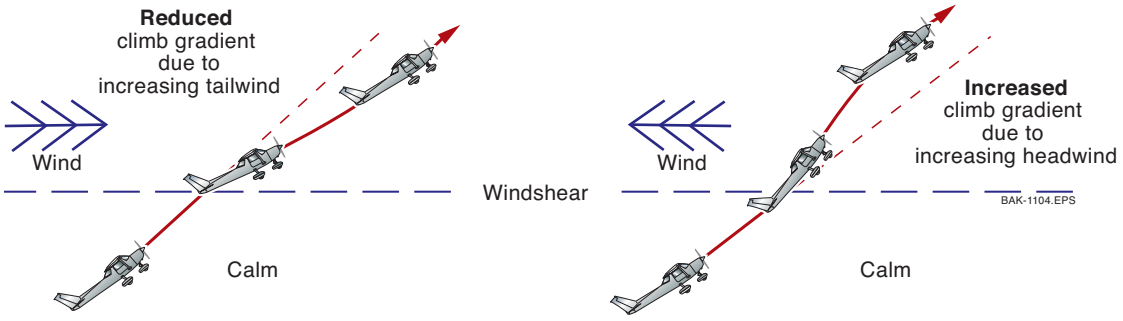

Figure 18-10 Effect of windshear in the climb.

The increased groundspeed causes the climb gradient to be degraded. Also, if you are climbing with full power set and at V_X, there is only a small margin above the stall speed. You cannot raise the nose to clear obstacles. Another situation to avoid is turning downwind soon after take-off. If there is a significant crosswind and you turn away from the wind, you risk a momentary loss of airspeed, an increasing groundspeed and a reduced climb gradient. It is better to turn into/towards a crosswind after take-off, if you can.

Taking-off in calm condition but with an increasing headwind is favourable for the same reasons.

When experiencing windshear, you can only leave full power set and adjust the attitude to restore the desired airspeed and flightpath - and gently turn away from rising terrain.

Cruise

Windshear in the cruise is not significant as you will be cruising within one layer of air. However, it can be a problem near hills – especially on the downwind (leeward) side.

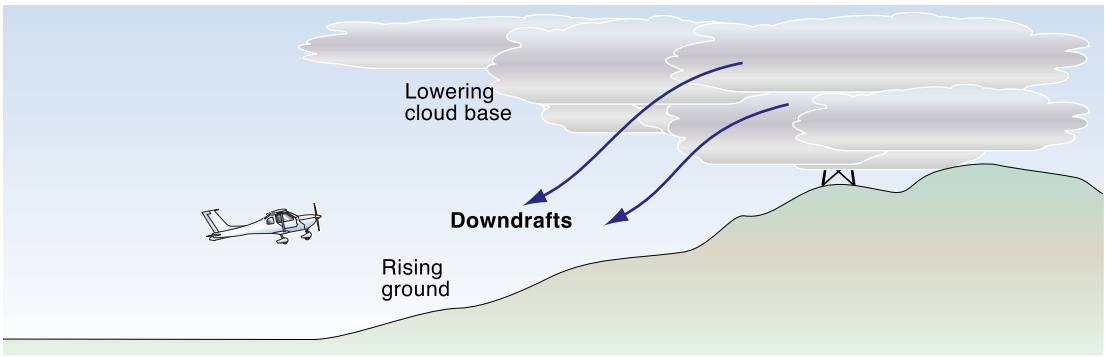

Figure 18-11 Be careful of rising ground, lowering cloud and downdraughts

Approach & Landing

On an approach to land, small but virtually continuous changes of power and attitude will be required to maintain the desired flightpath. You will need to be ready to correct any tendency to go above or below the flightpath. In near-calm conditions the aircraft will stabilise at a constant airspeed and attitude which together, will produce a stable groundspeed and rate of descent and consequently, a stable approach path to the aim point on the runway. However, the wind is rarely calm, particularly above ground level.

Consider an aeroplane on approach to land descending from an overlying tailwind into a calm wind. It is within a parcel of air that is moving over the earth at a certain speed. The aircraft has a constant airspeed but its groundspeed is the sum of the airspeend plus the tail-wind component. As it passes into the lower parcel of calm air, the aircraft will want to temporarily maintain its original groundspeed due to its momentum but its airspeed will decay - at the origianl rate-of-descent and power setting. As it stabilises, the new descent path will be steeper (no more 'push' from the tailwind) and will now be on a path to a point short of the original aim point. The rate-of-descent must be reduced by increasing power.

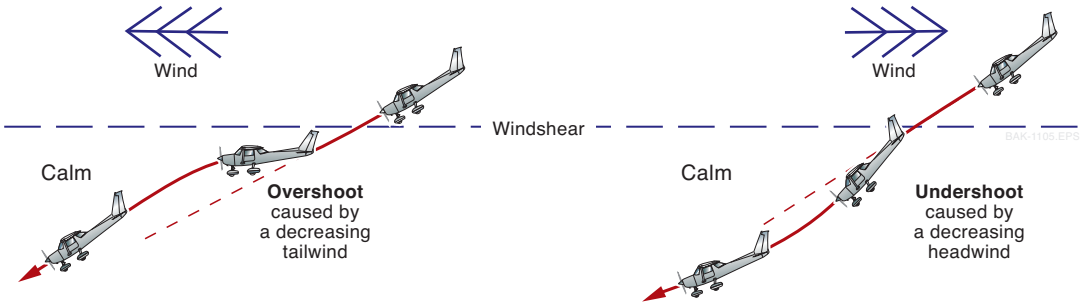

Figure 18-12 Effect of windshear in the descent.

This phenomenon is known as the '*undershoot effect*.' An *undershoot effect* due to windshear will occur when an aeroplane flies into the following conditions:

- a decreasing tailwind; or
- an increasing headwind (for instance, flying near the ground under a thundercloud); or
- in a downdraught (for instance, just under the base of a mature thunderstorm).

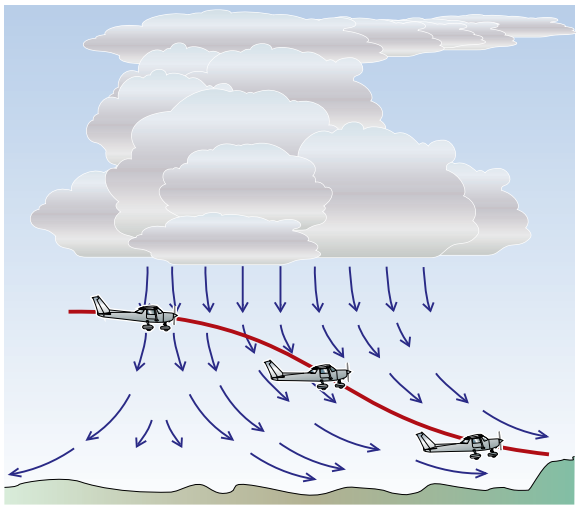

Figure 18-13 Severe downdraughts beneath cumulonimbus (Cb) storm cloud.

If the converse is true and the aircraft is descending from an overlying headwind (groundspeed is less than airspeed), into a parcel of calm air, then the flightpath tends to flatten - due to increasing groundspeed as it enters the calm layer. The pilot changes attitude to maintain the path but must reduce the power to increase the rate-of-descent. Since the effect of the windshear, in this case, is to cause a shallower approach path beyond the aim point, it is referred to as an '*overshoot effect*'. An *overshoot effect* due to windshear, will occur when an aeroplane flies into the following conditions:

- a decreasing headwind; or
- an increasing tailwind; or
- an updraught (e.g. a thermal).