

**SOUTHERN HANG
GLIDING CLUB**

WINDSOCK

MAY

2019



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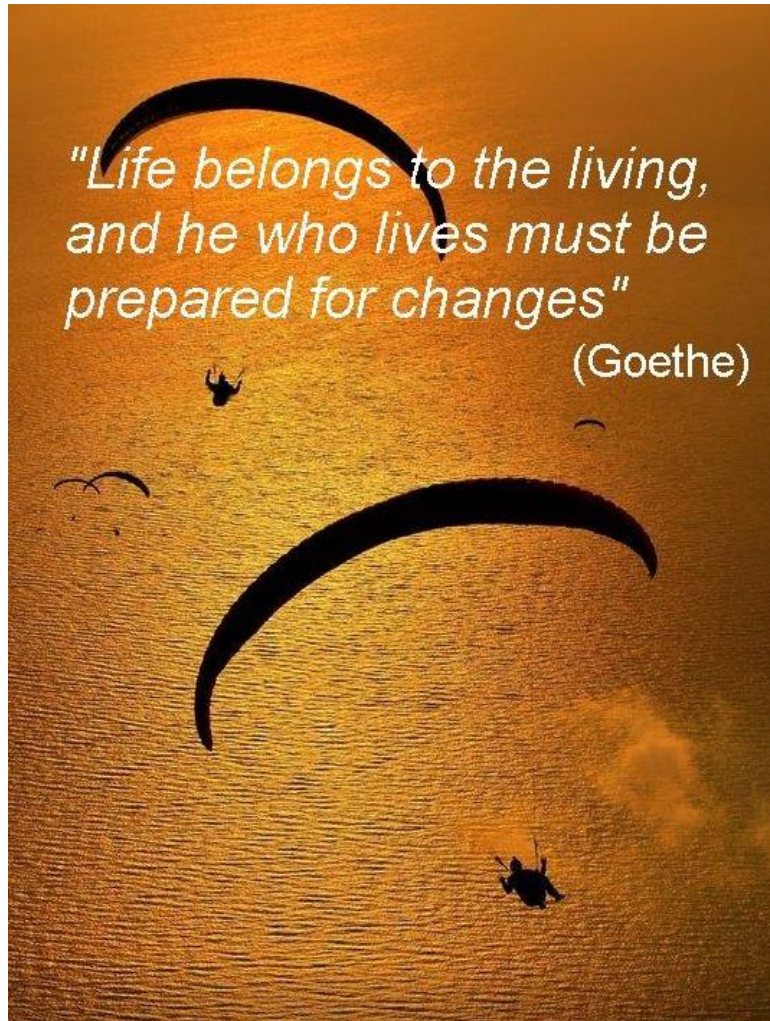
“Good judgment comes from experience. Unfortunately, experience usually comes from bad judgment”

1. Introduction

Welcome to the May 2019 edition of Windssock. We hope you enjoyed the last edition and its abundant bounty of information and advice.

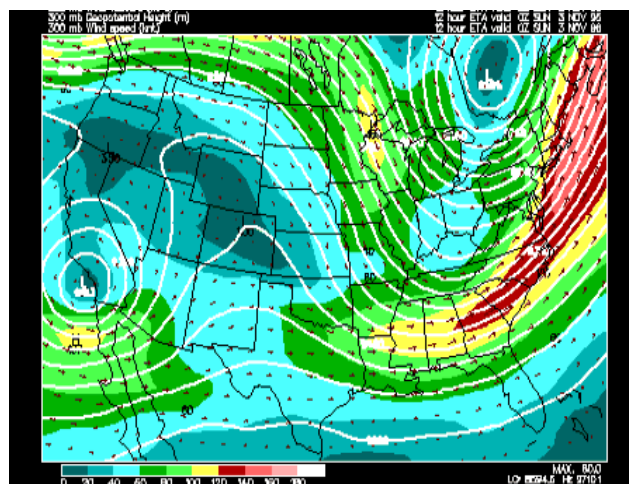
We have been grateful to receive contributions for publication from Alison Webb, Stefan Sykes, and 'Hairy' Dave Lewis, all Southern Club members. Here at WS HQ we are delighted and would welcome more, mainly because we have to write less. If you want to contribute an article then PLEASE get in touch sbnicholls1@gmail.com.

So off we go for another action packed adventure....



2. An Introduction To Jet Streams

A jet stream is a core of strong winds around 5 to 9 miles above the Earth's surface, blowing from west to east. Wind speeds can exceed 200 mph. This part of the atmosphere helps develop and steer weather around the globe, sometimes bringing storms, sometimes bringing very calm and settled days.



When were jet streams first 'discovered'?

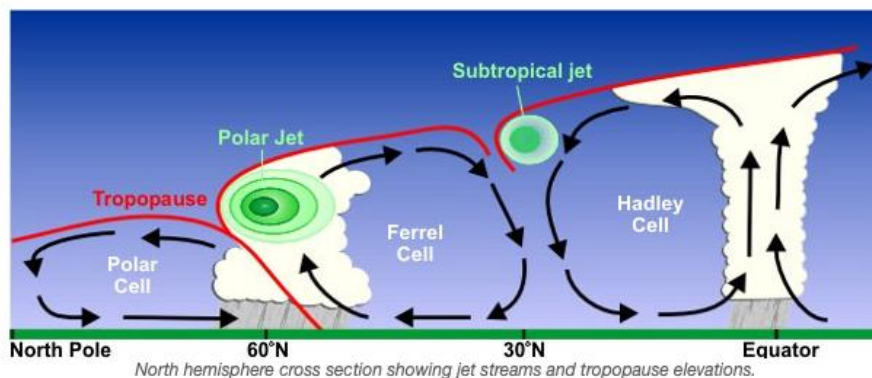
They were first 'discovered' in the 1920s, by a Japanese meteorologist named Wasaburo Ooishi. He used weather balloons to track upper level winds high above Mount Fuji. The term "jet stream" wasn't used until 1939 by a German meteorologist who used the term in a research paper?

Why do jet streams form?

They form where large temperature differences exist in the atmosphere. As the sun shines on the Earth, it warms some areas, particularly in the tropics, more than others, such as at the poles. As the Earth is heated, it warms the air just above it. The warmed air expands and becomes lighter than the surrounding air. It rises, creating a warm air current. Cooler, heavier air then pushes in to replace the warm air, forming a cool air current.



The Earth is split into two hemispheres, and air is constantly moving around to spread heat and energy from the Equator to the poles. Jet streams are the product of two factors: the atmospheric heating by solar radiation that produces the large-scale Polar, Ferrel, and Hadley circulation cells, and the action of the Coriolis force acting on those moving masses. The Coriolis force is caused by the Earth's rotation on its axis. On other planets, internal heat, rather than solar heating drives their jet streams. The Polar jet stream forms near the interface of the Polar and Ferrel circulation cells; the subtropical jet forms near the boundary of the Ferrel and Hadley circulation cells.



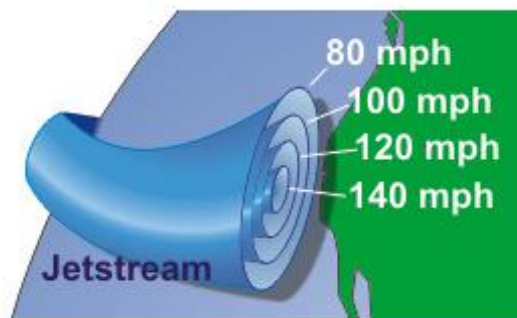
These large (groups of) cells, in each hemisphere, help circulate this air within the lowest part of the atmosphere, the troposphere. The jet stream therefore exists

largely because of a difference of heat, which in the northern hemisphere means cold air on the northern side of the jet stream and warm air to the south.

The sun's rays pass easily through the Troposphere as it is not heated directly by the sun, but absorbs radiated heat from the Earth. Various gases in the Troposphere, such as carbon dioxide, water vapor, and methane, trap this radiated heat and don't let it escape into space. The warming of the atmosphere through this heat absorption is known as the greenhouse effect. The boundary between the turbulent Troposphere and the calm, cold Stratosphere is called the Tropopause. It is here that the Jet streams are found.

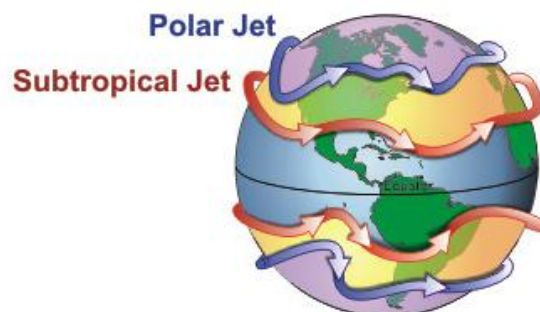
How strong are jet streams?

Jet streams are some of the strongest winds in the atmosphere. Their speeds usually range from 129 to 225 kilometers per hour (80 to 140 miles per hour), but they can reach more than 443 kilometers per hour (275 miles per hour). They are faster in winter when the temperature differences between tropical, temperate, and polar air currents are greater.



How many Jet Streams are there?

At most times in the Northern and Southern Hemispheres, there are two jet streams: a subtropical jet stream centered at about 30 degrees latitude and a polar-front jet stream whose position varies with the boundary between polar and temperate air. A reverse jet stream blows toward the west in tropical high altitudes during the Northern Hemisphere's summer. It is associated with the heating of the Asian continent and may help bring summer monsoons to the Indian Ocean.

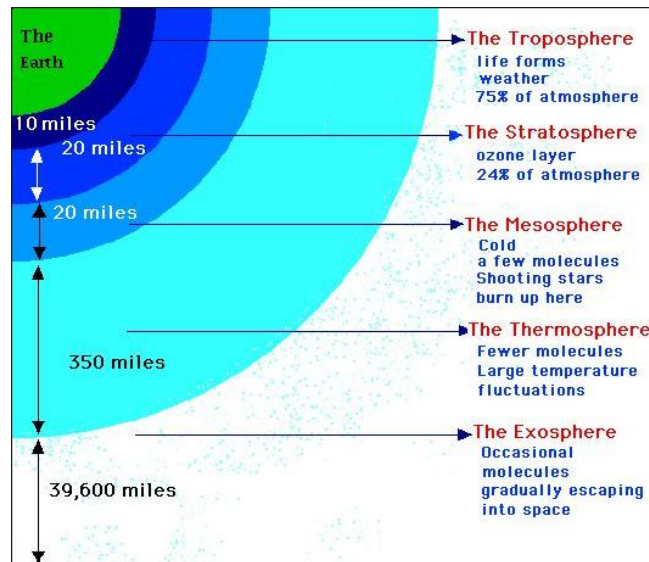


How do Jet Streams impact the weather?

Jet streams are found in the highest part of the atmosphere. The atmosphere has a layered structure. From the Earth upward, the layers are the Troposphere, the Stratosphere, the Mesosphere, the Thermosphere, and the Exosphere, which

merges with thin gases of space. The boundaries between the layers are not sharply defined, and they vary with latitude and season.

Weather occurs in the Troposphere. On average, this layer extends to an altitude of about 10 kilometers (6 miles), ranging from less than 6 kilometers (4 miles) at the poles to about 20 kilometers (12 miles) at the Equator. The top of the Troposphere is higher in summer than in winter. Because the Troposphere contains most of the atmosphere's water vapor, clouds usually form in this layer. Temperature decreases rapidly in the troposphere as altitude increases.



How do the seasons affect the Jet streams?

The seasons also affect the position of the jet stream. In winter, there is more of a temperature difference between the equator and poles so the jet stream is stronger and flows over the UK. This is why we tend to see wetter weather. The reverse is true in summer where there tends to be a smaller temperature difference. The position of the jet stream typically ends up to the north of the UK and we see calmer, drier weather.

Information included in this article was sourced from the UK/US Met centers and the University of Illinois. Information is provided freely and is used here without specific permission being required.

3. Will it be flyable tomorrow? – Alison Webb.

When you're finally released from the school environment and have the freedom to fly the Southern Club sites (and elsewhere), you'll need to know where to look for helpful local weather forecasts. Understanding these forecasts will help you to know which site to go to, and when, and be confident that the conditions you find are safe to fly.

Flying conditions research (where to begin)...

The following websites are those which I have found to be useful over the years I have been flying. They are by no means definitive and pilots will develop their own forecasting program using their own preferred 'go-to' websites or apps, to determine whether it's flyable or not.

Because the Club sites are all influenced, to some degree, by their proximity to the sea, I like to start by looking at Windguru surfing sites in the first instance:

- Devils' Dyke or Ditchling <https://windguru.cz/47914>, and
- Seaford for the other sites <https://windguru.cz/47916>.



These sites will provide a rough idea of whether a flying day is likely in the next few days and it is worth checking these sites on a frequent basis. Paraglider pilots should be looking for a wind speed of up to 9kts for inland flying, or up to 11kts for the coastal sites. At a glance, you can easily see the degree of prospective cloud cover and likely precipitation. But given that these are coastal site forecasts, should you see light wind strengths occurring in the next day or so, then you would need to look elsewhere for more refined forecast information.

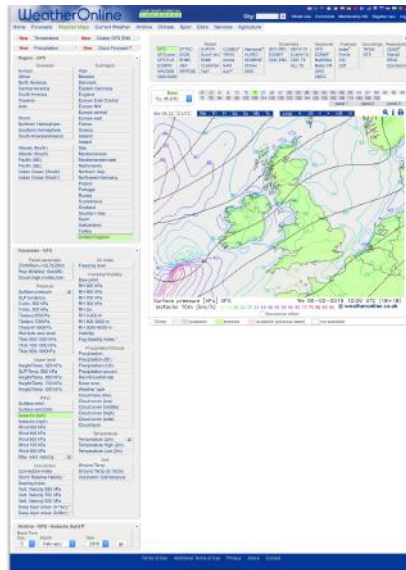
My preferred next step is to go to 'Windfinder' and I choose the Superforecast option, for an individual site, which will give you a more detailed three-day idea of the expected forecast. For example:

- Devils Dyke; https://windfinder.com/weatherforecast/devils_dyke (note the underscore)
- Bo-Peep; https://windfinder.com/weatherforecast/bo_peep (Note the underscore)

These forecasts are quick and easy to read but not particularly reliable: - so I then look at expert weather online GFS model. Here I check surface winds (which do account for the sea breeze convergence) and isotachs (a line on a map or chart connecting points of equal wind speed), which are shown in kph (but not knots). <https://bit.ly/2Sy2ZTC>. It is only then that I will have some confidence of accuracy.

For safe flying, a pilot should want a more three-dimensional look at what's going on in the sky up to cloudbase and beyond. It's always a good idea to check the Bracknell UK synoptic charts for the location and progression of any frontal systems.

Very helpfully these can also be found as part of the Notam info website – thank you Dave Massie! <https://notaminfo.com/synoptics>



From February onwards, expect more thermic days, and from mid-February XCs become more likely (perhaps unexpectedly), so you'll find it very helpful to study R.A.S.P. soaring forecasts and the Herstmonceux tephigram to refine your information still further. Again these can be found on Dave's Notam info site and tutorials can be found on the R.A.S.P. site to help you better interpret the information shown. In addition to the thermal updraft velocity readings, of further particular interest are:

- Surface wind (10m);
- Boundary level average wind (i.e. from ground to cloud-base)
- BL max up/down convergence – which will tell you the likely strength and advancement of the sea breeze convergence.

With practice you'll be able to tell from the tephigram:

- How unstable/stable the air mass is likely to be.
- When any ground inversion is likely to break.
- Thermal strength and height.
- Whether you can expect a "blue" cloudless sky or one filled with small cumuli with a marked high inversion to limit vertical development (hurray!).
- Will the clouds spread out horizontally and cut off further thermal formation or will an overcast sky hide thousands to tens of thousands of feet of unstable cloud, which wants to keep climbing?

Precipitation

Precipitation is particularly difficult to forecast accurately. If your checks suggest that rainfall may be due, search out a Rain Alarm App to determine the progression of bands of rain or occurrence of showers based on satellite data.

Club (Coaching) lectures

Whatever you do, it's a great idea to attend the club lectures and specifically those that cover weather forecasting e.g. R.A.S.P., and tephigram so as to help you get to grips with this vital information.

NB. Recently I have been checking the evolving Flybubble weather site <https://flybubble.com/weather/>. This site highlights all the Club sites flyable at any given time and includes upper wind strengths, cloudbase, and thermalling height.



Of course, remember...

Very often more than one site is due to be flyable on a particular day, so a Southern Club site report on Telegram from a pilot already on the hill can be decisive, bearing in mind that an early morning report of lighter-than-forecast winds may just confirm the existence of a ground inversion and later site reports, after the air has mixed vertically, will give you a better idea of where you should be heading.

A Comment about our coastal sites

Just a quick word about flying coastal sites where there are slightly different parameters to consider:- no need to consult R.A.S.P if you simply want to soar at Newhaven or Beachy Head (Herstmonceux is inland). At the coast, the factors you will need to know are:

1. The wind speed 2. wind direction and, importantly, 3. that the local air temperature is cooler than the surface temperature of the sea - the greater the temperature difference, the better will be the lapse rate and the consequent lift. If it's sunny you can expect thermals, mainly smooth sea thermals but at the Beachy bowl the terrain can generate mild land thermals too.

Newhaven and Beachy can provide glorious relaxed fun flying in good conditions when the air is rising cleanly up the cliff face/bowl but in marginal conditions lift can erode quickly, particularly if the wind drops and/or changes direction to an angle further from perpendicular to the cliff, and the air temperature rises all in rapid succession, so do ensure that you know the local tide times when you want to soar the cliffs because a bottom landing is beckoning. If you happen to be flying a more-downwind leg, you will need to turn into wind before you're down, so a dry pebbly beach will give you a better landing option. Conversely in buoyant conditions, if the wind is approaching top end for you when you launch and the air cools and the wind turns more on to the cliff, or strengthens, you'll gain height but need to top land back

at launch while you still can. If the tide is in you have nowhere else to go! So always allow an adequate safety margin.

Conclusion

Be repetitive and methodical and, over time, you'll develop your own program of weather checks to help keep you safe and cut down on the amount of time spent para-waiting. The suggestions contained in this article are just a selection to get you headed in the right direction. Update your information each morning, so you have the very best chance of being at the right place at the right time!

Most importantly, happy flying!



This article was written by Alison Webb; local pilot and SHGC member. Photographs are the property of David Webb and Mark Rubenstein. The Windsock team are enormously grateful for this article. Thank you Alison!

4. A 'Hairy' Guide to Batteries – David Lewis



Batteries cost us all, not just in price and inconvenience, but also because they all contain chemicals that we really shouldn't be disposing of by burying

them in the ground. I hope this will short guide help you make the most of them.

There I was, half way round a UK record triangle and the GPS died...

The base-line entry-level battery is the trusty Duracell type alkaline cell. These are great; cheap-ish, last well, have a long shelf life, and are available in every shop worldwide. Just the thing for a vario that uses very little power, and a new set will last a year or more. GPS and radio users will be all too familiar with a much greater rate of battery consumption and will know that re-chargeable are the thing for the job, either as a battery pack or separate cells.

It is worth noting that the while NiCd and Alkaline cells lose significant power in the cold, Lithium types are much less affected. They also have a capacity even greater than alkaline cells. Unfortunately they are expensive and require extremely accurate charging. Most such cells and chargers are a matched set. However, they could be worth considering if planning a trip somewhere seriously cold (or use underwear mounted instruments).



Now we're in 2019, most new devices have in built Li-ion batteries, usually with the charge controller built into the device and complete with a pretty accurate battery level indicator. Finally we have most things chargeable with the same miniature USB power supply and no longer need a bag of different chargers weighing more than the devices themselves. Such Li-Ion cells are happiest when floating around 70% charge and like a fairly slow charge for best life. When they're finally worn out, don't just bin the whole device if it's a sealed unit. There's no such thing as a sealed unit - almost anything can be opened and the batteries inside are usually a standard and replaceable type. One major problem with lithium-based cells is that they're mostly made in China from materials mined in Chinese occupied Tibet. The hidden health, social and environmental cost of these batteries is huge, so it's good to make them last and dispose of them properly for recycling when finally worn out.

Re-chargeable batteries

These include NiCad (Nickel Cadmium) and NiMH (Nickel Metal Hydride), either as separate AA cells or as a pack. They have a lower voltage than alkaline, so your torch will be dimmer and your vario battery indicator will be reading flat even with a fully charged NiMH. That's why in some instruments you will have the option to 'tell' the

software what type of batteries you're using. NiCad cells are now largely displaced by NiMH, which behave in much the same way but have significantly greater capacities. A typical AA NiCad is 700 mAh, where 2500 mAh NiMH are now common. For the uninitiated, consider mAh to be a volume – the clever chemists have squeezed over three times as much electricity in each one!

Both kinds suffer from memory effect and early death from abuse, although they're getting better all the time. The solution is simply to flatten them after use before giving them a full charge. Treated well, they should last for hundreds of cycles with negligible reduction in performance. They should never be allowed to go completely flat, so it's best to flatten using an electronic device designed for use with rechargeable batteries, which switches itself off at the correct level of discharge (e.g., GPS, radios). If they're going to be out of use for a while, they should be stored flat. They will self-discharge in a few months anyway. That fact makes them unsuited to use in a vario, because they will have gone flat of their own accord long before all the power is used. It's best to keep batteries in sets to ensure they are matched. If a set seems to have lost performance, test each one in turn in a single-battery powered toy and bin the offender.



The high capacity of batteries is achieved by squeezing in lots of surface area of plates inside the same AA package size. To do that means the innards of the battery have to be thinner and are fragile. Very high capacity batteries can be expected to die of old age sooner than lower capacity items. All are sensitive to physical damage. Drop one on a concrete floor and if it's not dead immediately, its days will be numbered.

The correct way to charge an AA cell of either kind is to give it trickle charge of about 150% of the rated capacity, for example:

A NiMH battery has a capacity of 1600 mAh written on the side. That means it can give out 1600 milliAmps for 1 hour. (Think of mA as being flow rate, pints per hour.) So to charge to 150%, the required charge is $1.5 * 1600 = 2400$ mAh

A good charge rate is 10% or less of rated capacity (that makes 160 mA for my NiMH). More than 30% is only for special cells, at risk of explosion! I have an old NiCad charger that says it gives out 65 mA, so the question is, how long does it need to provide the 2400 mAh required to satisfy my new NiMH batteries?

(Charging time) = 2400 mAh / 65 mA = 36.9 hours

In this way, you can work out how to fill all of your collection of various batteries without cooking or exploding any. Any that get hot to the touch are either past fully charged, being charged too fast, or just knackered. Better still is the use of accurately controlled pulse chargers which ask each individual battery what it would like, hundreds of times a second. Let me know if you find a cheap source!

This article is written By David (Dave) Lewis (aka Hairy Dave), AP, Tandem Pilot, Sites Officer and Firlie resident. An earlier version of this article has appeared in Sky Wings. It is used with permission.

5. 'Newbie' CP and Club RR member Stefan Sykes comments on his early flying experiences.



After the long weeks of windiness during November and December I was rather trepidatious whilst waiting up at Devil's Dyke. I was there to meet a man named Phil and we had arranged to meet by the windsock near the car park; he had posted on the SHGC website that this weekend was ON!

As a low time flyer my membership of the Southern Hang Gliding Club brought me an additional sub-membership of the prestigious Red Ribbon Club – those flyers with under 10 hours post CP airtime. The red ribbon is designed to indicate to other flyers that, as a novice, you need some extra room in the air, on the ground and perhaps some additional advice on where the landing site is and the nearest toilet.

I had not flown since completing my CP in October in Bulgaria with Fly 4 Seasons and that really felt like years ago. Although many new flyers are good and patient and wait for the right weather in the UK to chase up a hill and learn the ground skills necessary to begin their craft, sneaking off to a far-off warm place to do it is just superb and so worth the CO2. Having done the EP in Algodonales (with Zero Gravity) in August, I decided then that the follow-up had also to be done in the heat and easy promise of fine flying weather – even at the end of October!

My EP was rather unconventional; I had admitted to a taster day 10 years previous and so ended up in a group with the most marvellous bunch of misfits. They had come from all over the place with hugely varying skills, but a well-honed ability to drink and eat large volumes; we were like family. All had done their CPs already, but all wanted more guidance whilst flying. This meant tandem flying for me and a coach in the air for them. With the weather pretty perfect, this meant I learned to soar and

battle thermals before I learned to ground handle properly. Save your frowns of disdain, however, as the wind died totally later in the week and so I did my two days of running up and down hills, too. I did find, actually, that playing with a tiny speed wing really got my skills up for reverse launches.

Bulgaria was a surprise; clear and warm at the end of October with two sets of mountains running east west across the entire nation all the way to the Black Sea. Gav and Daz, always professional, drove us around many of the excellent sites as the wind kept changing direction. The fall back site of a hillock in the middle of a flat valley, was only used twice and was very helpful in raising landing quality and accuracy skills. After several days of developing take-offs and some excellent flights, we came back to earth with a final day of wind-bound groundwork – it's money in the bank – as Gav says.

Anyway, back to the Dyke. Finally Phil appeared wearing a huge hi-vis coat, unzipped so it flapped about in the breeze, and shorts...shorts! It's December! Phil is the leader of the RRC and posts frequently as to the likely weather and the prospects. Full of vim, handy quips and an astounding memory for names, Phil lead us around the site, telling us all, pulling out of us our knowledge and generally introducing us to everyone – even the flyers in the short air above us. We even got Phil's fashion tips concerning to the appropriateness of wearing of shorts in all weathers.

The wind was tailing off, so we all unfurled our wings and managed a fly – five minutes for me before I landed a little way down the slope. The second was a top to bottom as the wind had died. The next weekend, however, with my virgin Dyke flight behind me, the wind was perfect and I flew for nearly an hour and a half with a top land coming together on the third pass (me with big-ears), as the wind just didn't seem to want us out of the air.



This article was written by Stefan Sykes and details his experiences of becoming a CP and joining the Club. Thank you Stefan for your excellent contribution.

6. Thermalling Technique (Part Three)

My favourite part of flying is undoubtedly thermalling; in fact, thermalling may be my favourite thing to do in life. There's nothing like hooking a sharp-edged, positive ripper of a thermal and riding it upward for a couple of miles. My least favourite part of flying is also thermalling; those days when everyone else goes up flying straight and you hit the

deck like a dropped park bench -- repeatedly. On those days you're glad you landed alone so no one else can hear you scream.

Thermal theory

A little more thermal theory is useful to understand how to fly them. Thermals close to the ground are often quite small and relatively violent. As they rise they tend to join together, smooth out and expand. Pressure also tends to influence thermal formation; high-pressure days tend to produce smaller, sharp-edged, "punchy" thermals. Lower-pressure days can produce very strong thermals obviously, but they tend to have mellower edges and be larger in size.

The day's lapse rate also influences thermal strength; a hot day with a very strong lapse rate will produce stronger thermals. Think of a very warm piece of air rising out of a collector (see parts one and two in this series) on a day with a strong difference in air temperatures between the ground and say 5,000 feet above it. A thermal will rise quite quickly in this situation. An inversion is the opposite, and not surprisingly thermals usually stop or at least slow down at inversions.

The above factors (and hundreds more but this is a start) give each day its thermal "profile." If you launch on a clear blue day (indicating high pressure) with a good lapse rate (you checked the day's soundings), then you might expect sharp-edged, strong thermals. If, however, the sky is filled with soft cumulus and looks somewhat hazy due to moisture, then you might expect softer thermals. The first thermal of the day provides some good clues about what's happening; if it rips you upward and all you have to do to stay in it all the way to base is turn a bit then you're off to a good start. If it's small and difficult to stay in then ends abruptly 1000 feet later and you can't take it any higher, then you know the day will be more difficult. I take a mental note of three important characteristics with each thermal I use during the day. What is my average climb rate? Not the spikes, but the true climb rate as expressed by a 20-second average? How high do I get before it totally falls apart, and are there any altitudes that seem tricky to keep climbing through? And finally, what are the size and drift of the circles I'm making?

The climb rate tells you what to expect as the day progresses; climb rates tend to improve until late in the day, and thermal size also tends to increase as the day wears on (sink too unfortunately). If you're getting solid 600fpm climbs, then it's probably not worth stopping in 100fpm on a glide unless you're low (anything going up when you're low is great). The peak thermal altitude is also useful; if you are getting to 6,000 feet AGL consistently but a strong thermal suddenly "stops" at 4,000 AGL then you've probably lost it and should search for it. However, if the thermal stops at 5,800 feet then it's most likely done and time to go on glide. Remember that the peak altitude of the thermals should increase as the day progresses. On good days, it's not uncommon to see thermals in the morning only reach 4000 AGL, then 6000 AGL at noon, 10,000 at 2:00 p.m. and 14,000 at 5:00 p.m. This progression is generally less in the mountains but still observable.

Finally, the size and drift of your circles at various altitudes also tells you what to expect on the next climb and information on wind speeds aloft. This tells you what angle your thermal will be flowing from a collector so you can intersect that line I (note-very strong thermals will have no problem pushing the wind around them like a bridge abutment in the river).

Coordinated circles, not swings

OK, so you're flying along and your vario starts beeping with the good noises. What to do? First, did your glider surge forward or fall back behind you just before the beeps? If it went behind you then you're probably dealing with a "gust." Wait and see if the beeping continues or goes back to sink. If it's a thermal and the beeping increases, turn. I don't worry too much about which direction; if one side of the glider is noticeably more pressurized or higher above you, then lean meaningfully in that direction and pull on the brake smoothly. How much pull? Higher pressures in your glider indicate a stronger thermal, meaning you can pull harder you can. However, the most common mistake in thermalling is to pull too aggressively on the inside brake. When you pull too hard on the inside brake your body tends to swing to the outside of your turn in a small wingover. Then your body swings back under the glider, you lose the turn and fly straight out of the thermal. Many pilots then crank another wild-ass turn to try and get back into the thermal; I flew this way for about five years before getting it figured out. What you want to do is fly in a "coordinated" banked turn. This is like riding a bicycle; you and the bike are at the correct bank angle for your speed and the sharpness of the turn. One of the most common problems pilots have is maintaining a consistent circle while thermalling; I expect you know what I mean! The correct technique is to start a turn with a smooth, controlled lean and simultaneous progressive inside brake application. The glider will bank up, your body will follow it, and due to centrifugal force you will continue to stay outside the glider's circle and smoothly ride the thermal up. Jerking the brake instead of applying smooth increasing pressure will just swing you to the outside of the glider-- then you'll swing back under it, repeat. The glider will also remain over your head in a true coordinated turn; if it falls behind you, reduce brake. If it threatens to surge in front of you, apply a quick correction while maintaining your lean and turn.

If you can't figure out what I mean, pull on one brake sharply and release it; you'll swing out from your glider then back under it, usually with an oscillation or two as a bonus. Then try leaning hard for a second or two then go back to neutral lean; you'll swing out to the side of your glider then back under it, but not as much. Now smoothly lean, pull gently and progressively on the brake and hold it; you'll enter a gentle spiral dive or circle, same thing. This is what you want.

Airspeed and bank angle are directly related; the higher the bank angle, the more airspeed you need to keep the turn coordinated (think of a spiral dive). The lower the bank angle, the less airspeed you'll feel on your face. Thermals are seldom perfectly consistent; this means you will have to continually adjust your brake and lean to maintain a coordinated turn. If your airspeed starts decreasing and the glider levels out, lean a little more, let up on the outside brake a little bit, and increase your airspeed and bank angle. If your air speed increases suddenly, lean a little less, pull a bit more on the outside brake, and maintain your bank angle. If you can learn how to thermal in a coordinated bank then you are well on your way to thermalling efficiently.

Centering: The mental map

OK, so your vario is beeping like mad; how long do you wait before turning? If the day's thermals are small and you're low, start turning immediately after you're sure you've hit something (not just a gust). Rules of thumb about waiting two seconds etc. are meaningless in my experience. You've found lift, initiate a smooth banked turn and see what happens. If you climb really well for a quarter circle and then start sinking, open your circle up a little bit in the direction you found the best lift then tighten as the lift increases; notice the pressure in your wing and how your butt feels in the seat, not just the vario beeping, these are critical clues. Listen to the noise in your ears as well; with practice, you can actually hear the different air flows as you fly

through lift or sink; if you can't hear the air then get a new helmet. At some point in your circle everything will add up to the best lift as defined by your vario, wing pressure and lift under your butt. If you're flying a coordinated 360 then it's relatively easy to develop a mental map of where the best lift is in each 360; don't worry about the ground, but where you encounter the best lift within each circle. Try to develop a "mental map" of what's happening in each 360.

To fly toward better lift, maintain a coordinated turn, just reduce the bank slightly as you come back around the 360 and move the centre of your circle over a little bit toward where you got the best lift. NEVER STOP CIRCLING. Once in the best lift, tighten the circle up slightly while maintaining a coordinated turn. Perhaps you get solid lift for half the turn, general sink for half the turn. Move the circle in the direction of the best lift again. Now you get solid lift for three quarters of the turn and less lift for one quarter. Move it again. Now you're climbing solidly for the full revolution of your turn at +400 fpm average, but one portion of your circle is going up at +600 and another at only +200. If you weren't in a coordinated turn, and most pilots aren't, this would probably be due to the oscillations inherent in thermalling in an uncoordinated turn and you would not have a clue what's actually going on. But you know to thermal in a coordinated manner, so you move your circle toward the +600 and eventually lock in a perfect 1000fpm climb all the way to base. Irregular thermals may give irregular "instantaneous" readings on your vario, so focus on getting the best average climb rate that you can. Hang gliders and sailplanes can use all kinds of funky ovals and figure-eights to get better average climbs, but I have found paragliders climb best flying coordinated, continuously adjusted circles (or straight if the thermal is big enough!).

Circle size and bank angle

I find 1 thermal with 30-45 or more degrees of bank on days with small, strong thermals, 15 to 30 on lower pressure days and almost flat on days with light, wide thermals. The extremes of bank angles come in dust devils (almost vertical) versus flying straight and flat while climbing like mad under a big cloud; somewhere between these two extremes is the correct angle for your thermal on that day. Every glider responds differently to brake force and the amount of lean; what works for one pilot on his glider usually has little to nothing to do with yours. However, every glider will circle in a coordinated manner, and the feeling is unmistakable once you get it.

Here are a few scenarios to help pick bank angles for thermalling. Say you're flying along in -600 fpm and suddenly you're screaming up at +800. You turn, then go down at -400, so you move your circle toward the +800 but can't lock it in despite continually re-centering your circle. You probably need a higher bank angle and smaller circle. If you're very low in a small thermal, you may only be able to get half a turn in. Do your best to just improve how much of each circle you spend in lift; you'll lock it eventually as you climb. Another scenario: you're flying along in -600 when your sink rate starts to decrease smoothly to zero sink, then +200, then +300. I would keep flying straight until the lift starts to decrease, then initiate a relatively gentle bank and centre on the best average climb rate. A relatively gradual, consistent rise in your climb rate is a sign of a large thermal. Often you can find very strong cores in large thermals that will offer much higher rates of climb, but in general the larger the thermal, the less bank angle the better to maximize your climb rate. Some bank angle is usually good; a glider won't turn in a coordinated circle without it, but you can fly in a coordinated turn with equal brake using lean; watch a good pilot fly and you can tell he or she is often controlling the glider primarily with lean and modest adjustments to the outside brake.

There is no correct number of pounds to pull on your brakes while thermalling or distance to pull them down (1/4 brake is meaningless across a range of gliders), but there is a correct amount of brake to pull and lean to maintain a coordinated turn. It's like riding a bike; no one can tell you how to do it, but you stay upright when it works. I generally thermal with roughly twice the amount of brake pressure on the inside brake than the outside, and adjust my turn primarily with lean and the outside brake. You will probably do it differently, but know a good coordinated turn when you hit one.

Don't change directions when thermalling, especially when low. There are three good reasons for this; First, changing directions messes your coordinated turn up and you have to fly straight for some time between turns which usually takes you away from the lift (all directions but one lead away from the lift). Second, you lose your mental "map" of where the best part of your circle was. Third, the direction change will cause your vario to beep in all kinds of interesting but non-helpful ways. It is almost always better to simply move your circle over toward the better lift than try to switch directions and fly toward it.

If you're having a hard time maintaining a coordinated turn, try flying a bit faster; use more lean and less inside and outside brake. Many pilots try to fly a perfectly flat circle; in truly massive lift this works well, and your glider may have its best sink rate with a fair amount of brake on. However, I find flying a bit faster with a mild bank often enables me to lock in the thermal's best lift. Don't confuse what works well while ridge soaring with what works best thermalling, it's a very different game.

What to do when you lose the lift

First, know if you're at the top of the thermal or not. If every thermal so far has ended at 6,000 AGL and you're at 5,700 then forget about it and go on glide. But if you're climbing well at 3,000 AGL and lose the thermal then it's time to go into search mode. If there's any wind at all, the thermal is probably either directly down or upwind of you. The first thing to do is expand the size of your circle and pay attention to your mental map. If you were climbing at +200 fpm and then start sinking at -600 on the upwind portion of the 360, open the circle up back downwind. If the sink improves to -400 and then -200, move it even more downwind. If nothing good happens, try moving upwind; again, an improvement in sink is as relevant as finding more lift, work toward the area of lesser sink. Also pay attention to your groundspeed; it will generally increase as you follow the air flowing into a thermal, but decrease if you're bucking the wind flowing into a thermal by flying away from it (remember that thermals, especially when low, pull or entrain air into them). If I'm low on windy days I tend to fall out the upwind edge of the thermal. If I'm high on a windy day I tend to fall out the downwind edge of the thermal. I have no idea why, but that's how it works.

I've seldom encountered thermals that are smooth cylinders from the ground to base; the trick is to follow your vario, wing and seat pressure up in the best lift with continual gentle adjustments to your coordinated circle.

More clues for better thermalling

If the outside of your wing loses pressure suddenly and ruffles or takes a mild collapse, you've just found a relative difference in lift. Perhaps you're in +600 and your outside wing just hit some +50; you want to move your circle away from the area you just took the turbulence in and toward the better lift. If you're thermalling in a gaggle and see someone take an outside wing deflation ahead of you in the circle, then it's probably worth tightening your circle away from that area and then opening it slightly to fly toward the better lift, tightening the circle as you encounter better lift.

Most pilots tend to fly the "pattern" in a thermal rather than really watching the climb rates of the other gliders; if everyone climbs better in one half of their circle than the other, move your circle toward the better lift; you'll climb above the other gliders quite quickly using this tactic.

If someone is out-climbing you off to one side then move your circle to them; there's no heroism in climbing slowly by yourself. If you see the glider in front of you in a gaggle start climbing like mad, you may want to start tightening your circle immediately so you are in a higher bank angle as you hit the rising air and can "grab" more of it; again, fly the thermal, not the other pilots.

Look for pollen, plastic bags, bugs and other debris in your thermal. Birds in general and Swifts in particular will almost always be in the best part of a thermal; follow them immediately. Swifts and other small birds seem to eat the bugs that are drawn into thermals; if you see a group of them swarming upward, jump in with them even if doing so requires a short glide. Because thermals are pulling air into them, trash often automatically centres itself in a thermal; I've climbed thousands of feet in the company of newspapers or other debris.

Some days produce thermals that seem to want to spit you out; most of the time I've found that this is due to flying with too large a circle. Think of a spout of water shooting upward; if you stick your wing into the centre and keep your circle within the column, you'll go up. But find the edge and you'll lose pressure on the outside of your wing. This creates drag; you lose your bank angle and tend to get "pulled" out to the side.

Try flying with your vario turned off; Chris Mueller and many other top pilots often fly long distances without their varios! I don't want to get too esoteric here, but how your glider feels in lift becomes clear if you focus on the clues. Turning your vario off forces you to pay attention to what's really happening with your glider in different currents of air. I've learned a lot in the last year by playing this game, especially in gaggles where I can watch other gliders.

The smoothest air is often right in the core of a strong thermal, and your glider will be more pressurized and stable if you are flying a higher bank angle; if I'm climbing quite fast, I know that the edge of the thermal is likely to be quite turbulent. I've never flown away from a very strong thermal, as I know I'll hit turbulence doing so; the best things you can do is lock into the core and take it to base.

The most extreme variations between sink and lift tend to be below five hundred feet off the deck; you're flying along in 600 down and suddenly you're ripping at 1000 up, then falling out of the sky again. However, the best true average climb rates tend to be higher in the thermal until it cools to the point where it won't give you any more lift. I often will see spikes of over 1500 fpm low to the ground on days where I can't get more than 600fpm climbs on the 20-second averager. A thermal's real climb rate is what you can get out of it on the averager, not the "spikes." I often hear pilots say, "Dude, I got 2000 fpm today!" They are almost invariably referring to the lift spikes and not their true rate of climb. The only place in the world I've seen true 2000fpm climbs is the Owens Valley in July, but crank a hard uncoordinated turn and you can easily create your own 1000+fpm "thermal" as your vario swings up and beeps happily; this is a lie, but many pilots will believe it and keep creating their own thermals with wild turns where there is nothing.

Finally, all of the above writing is just my own theory based off sailplane books, conversations with other pilots and personal experience. What really matters is your

own theory; question it and refine it continuously for best results. If someone out-climbs you in a thermal it may be due to the glider, but it's much more likely that they did something you didn't. Don't curse yourself as they ascend faster. Instead, try to figure out why? Are they using larger circles or smaller? Did they move their circle into better lift and you didn't follow? I don't believe anybody is born a better pilot than someone else, but some pilots do think about what they are doing and try to do better. Remember, in the end, the best pilot is the one having the most fun.

This article is part three, and the final part in a series written by Will Gadd. Part one (January 2019) covered how thermals form and release from the ground; Part two (March 2019) covered the relationship between thermals and clouds.

Despite the best efforts of the Windsock Editorial Team we have been unable to contact Will Gadd and formally receive his permission to publish.

7. Climbs in Foreign Climes: A Guide to Piedrahita, Spain

This feature first appeared in XC Magazine and is reproduced (with modest edits) in this edition of Windsock with the kind permission of the Editor Ed Ewing. Anyone who hasn't already subscribed to this excellent magazine then why ya' waiting...!

To whet your appetite:

- **Hit the fabled convergence, and you can go a long way quickly.**
- **A tarmac road to a groomed launch above a laidback Spanish town.**
- **Fly April to October – with epic skies in the spring and midsummer.**
- **A great place for new XC pilots to build up airtime and distance.**



Winging it down to Piedrahita town after another big XC day. Photo: Jérôme Maupoint.

WHY GO?

It's Europe's flatland Mecca – and one of the world's most reliable comp venues.

WHERE IS IT?

Spain. You're a pilot FGS Try Google maps!

WHAT'S IT LIKE?

Piedrahita is a small, ancient town on the edge of the Castilian tablelands, where the ground abruptly rises up to the Gredos Mountains. It's perfectly placed for latching on to the 300+km convergence line that sets up here. A lively market town, Piedrahita doubles in population during August when it hosts a series of fiestas.

The principal launch, Peña Negra, is directly above the town and easily reached in 20 minutes by tarmac road. It faces NW, yet the shallow slope of the mountain allows heating and thermals from late morning. Classic XC flying can be had from April to the end of September, with the most booming conditions from mid-June towards the end of July. August tends to be very reliable, but with a later start as the inversions break later... not so bad for those dedicating themselves to late nights and fiestas!

The classic route follows the N-110 highway northeast across the flatlands and parallel to the mountains. A flight of 50km eastwards to the medieval walled city of Avila is a regular run for even inexperienced XC pilots, and 100km out-and-returns and even 200 km open distances are regularly achievable.

Fast and easy access makes for quick re-launches, and the smooth magic air that sets up over the valley on most evenings is the perfect antidote to anyone feeling blue because of an early bomb-out.

Although famed for long distance flatland flying, there's also great potential for mountain flying in the Gredos Mountains to the west and south. However, be aware that the area is isolated, and bombing out can involve lengthy retrieves.

FLYING CONDITIONS

Good thermic conditions with little breeze in the open flatlands, though generally stronger at the pass some 20km from launch. Base in August is generally above 3,000m, and often in excess of 4,000m. You need to be in the air by 1.30 pm as the thermal breeze at launch can become very strong by mid-afternoon. Normally reliable thermals start from 11.30 am, later in August.

WHEN TO GO

April to October offer good thermal flying and XC potential. May to September for epic cu-filled skies. August tends to be bluer and hotter but reliably flyable.

ALTITUDE

Cloud base: 3,200m

Launch: 1,900m

Landing: 1,000m

HANG GLIDER ACCESS

Easy. There's a tarmac road to launch and a large car park right next to the rigging area. The site was dramatically improved in 2009, with the launch slope angle increased for improved light wind launches.

MUST BE FLOWN

Fly amongst huge gaggles of migrating storks in July. Lose yourself in the vast flatlands of Castile chasing the convergence clouds to the northeast. Look down first

on the castle of Avila, then later the Roman aqueduct in Segovia, and know you've flown a long way. Tick off your first 100km – or maybe 200...

DANGERS AND ANNOYANCES

With strong easterly winds the take-off is sheltered, but winds further out can be strong and turbulent. With a westerly the wind will be stronger at the pass and in the next (Ambles) valley. For both strong east and west winds the safest area to land is in the flatlands near to Piedrahita. The winds increase as you move towards the pass with a westerly, and beyond the Col at Santiago de Collado with an easterly. There's airspace beyond Avila, which can be easily avoided by flying further to the north.

ACCOMMODATION

There are four hotels and many houses to rent, but official camping sites are uncommon.

GUIDES AND COURSES

Steve Ham has lived and guided in Piedrahita since 1991 (search www.flypedrahita.com).

EXPERT'S OPINION

"Easy flying with a great mix of the best of flatland and big mountain flying." Steve Ham.

TAKE THE FAMILY

Piedrahita is a popular summer destination for Spanish families escaping the oppressive heat of the cities in August. These are mountains... There are many rivers and forests, or there's an open-air swimming pool in Piedrahita in the grounds of an 18th century palace, modelled after Versailles. Enjoy!

RAINY DAYS

Salamanca, 60km to the north, is the cultural capital of Spain with its historic university and range of monuments. The historic towns of Avila and Segovia are also well worth visiting. In spring the River Tormes offers the best white water kayaking and rafting in central Spain. The area is bordered by a number of regional parks with excellent walking trails.

GETTING THERE

Madrid (Barajas) airport is 200km away. You can get a bus from Madrid direct to Piedrahita for €14. (Take the metro from the airport to La Estacion Sur de Autobuses – the metro stop is called Mendez Alvaro). By car Piedrahita lies on the National highway N-110, some 50km east of Avila. Hitchhiking in central Spain is uncommon and takes time (Blame General Franco, if you must!).

8. Traffic Rules: Thermalling Versus Soaring: Who Has Right of Way?

When soaring a hang-glider or paraglider, there is a simple rule that dictates the traffic flow – follow the ridge with the slope close on your right, return with the slope farther away to your left. This adheres to the international standard: when approaching an aircraft, avoid a collision by turning to pass on the right.

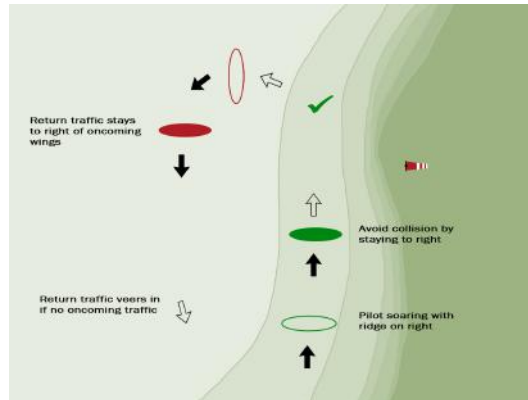


Diagram 1: Normal soaring pattern

When someone begins thermalling right, close to the ridge, there are two rules that point against them: the pilot to the right has right of way, and the one with the ridge to his right has right of way.

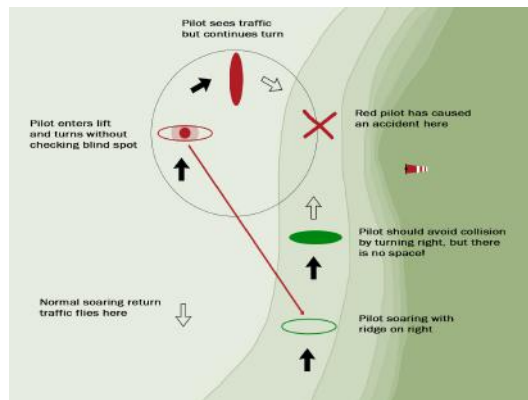


Diagram 2: Sudden thermal turn causes chaos

Swinging onto the ridge and scattering the flock (as the red pilot does) is very dangerous. Yet it happens because some pilots believe they have a right to thermal. Where does this belief come from?

It comes from a *conflicting* rule: pilots joining a thermal must do so in the same direction as the established thermalling traffic. So a thermalling pilot does not expect anyone to fly into the space downwind of him. A conflict in the rules is a precursor to an accident, so take note: this is a potentially dangerous situation! Let's think this through.

What is an established thermal? I'd suggest it requires more than one full 360-degree turn. This gives other pilots enough time to perceive the pattern. If you cannot complete a full 360-degree turn in clear air, then do not begin to thermal. If you are at the same height as the ridge soaring traffic, you'll do just as well in a steady soaring beat.

The last thing an inexperienced soaring pilot needs is a pilot swinging in at high speed from the side (surprise!) forcing an awful choice of banking right and spanking into the ridge or flying left into the middle of turning traffic. In crowded marginal conditions, it's best to avoid thermalling near the ridge and let the simpler pattern of ridge soaring traffic establish itself.

But let's assume the situation is happening already. What should you do? Adopt a

defensive flying strategy:

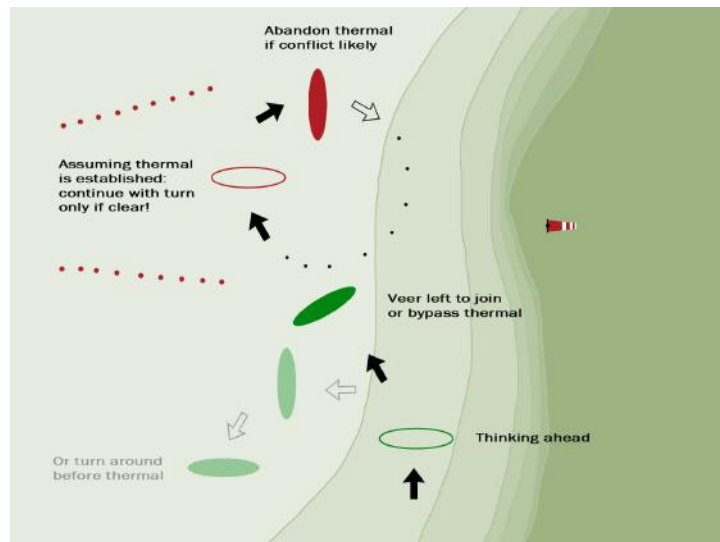


Diagram 3: Thermalling pilots drift onto ridge

Soaring pilot

If you're approaching circling pilots, you should alter your soaring path to feed into the direction of flow, which might mean veering off the ridge (left in Diagram 3). This assumes an established thermal that has drifted onto the ridge, so you've had some time to notice the circling pilots. The established pattern means it's unlikely there is any return traffic blocking this move out. If you choose to bypass this thermal, the left side is the best side to bypass it on. By looking ahead, you have put yourself in the best position, where you have the most options. Don't fly straight along the ridge, downwind of the circling gliders, in the narrowing gap between ridge and thermal.

In Diagram 2 (solid green), a hard 90-degree left turn will still get you out of trouble, so it's a skill you should practice, but you shouldn't be forced to do this. That's reactive flying, and isn't nearly as smart.

If you're thinking far ahead and can identify the thermalers early enough, you can turn around to avoid it altogether – simple!

Thermalling pilot

It takes time and experience to be able to thermal, particularly close to the ridge, so you're more likely to be the senior pilot, and should fly in a way that harmonises with the juniors nearby. At the outlined red position in Diagram 2, check your blind spot for traffic that would be compromised by your turn. At the solid red position, abandon your dangerous right turn, and instead veer left and slot into a ridge soaring lane.

In the established thermal of Diagram 3, as the thermalling pilot you must be very cautious as the thermal drifts into the soaring lanes. Remember, there is no clear right of way, there is a conflict of rules and you're drifting into it.

If in doubt, return to the thermal at a better moment, search further along the ridge or push further upwind before attempting to thermal. Regardless of how you interpret the rules, it's the duty of every pilot to fly in a manner that avoids a collision.

This article was written by the team at Flybubble and is reproduced with permission. Incidents resulting from pilots know knowing or not understanding the rules have happened on the Club's sites. Please make sure that you don't fill up the Safety Officer's (already busy) workload with another, easily

avoidable, incident.

9. Spring Time Considerations

And, in a parallel universe, far, far away, spring has sprung, the sun shines, the air is warmer, the birds are on the wing. Out of the garage, after a long winter's hibernation, comes the glider. What could possibly go wrong...?

The sun is spending more time above the horizon, birds are soaring, it's actually getting warm during the day, ahhh it's spring!

Had to dig my glider out from under a pile of junk and blow off the dust. There's a nagging voice that I should have sent the glider off for an inspection and reserve repack while it was still Winter. I said out loud, to override the sensible voice in my head, "It can't hurt to take advantage of at least one weekend, it look so good and all my friends are heading out." It's amazing how one weekend leads to another and another and then it's mid Summer and that inspection and reserve repack are destined to get done the following Winter. Chances are that I'll never need that reserve anyway.

The sky is clear; it's a crisp morning, but quickly warming. It's early in the season and it doesn't seem like conditions could be too strong, maybe someone else will have checked the weather. Where are those notes on how to check the weather, does checking the weather ever pay-off anyway? What was the rule about checking for NOTAMs, there won't be any XC anyway, will there? You just have to fly what you get, if you can get off launch, that's all that counts. Gotta fly no matter what, a little excitement is a good thing. It doesn't matter if I chose to add a little risk to my life, if I'm dead and they close the site because of my accident, what will I care? This pattern could continue throughout the summer, it's amazing how one weekend leads to another and then another and getting into the habit of studying the weather forecasts, and making sense of what conditions are best, never seems to happen, oh well.

How embarrassing, just laid out the glider upside down, hope no one saw that bonehead move. Man oh man, just hooked the glider to the harness with everything's all screwy, and everyone is watching, they must be laughing. What can anyone expect, that I might have gone out to the park and worked through my stuff and practiced some launches before getting out to the mountain? Who really has time for that kind of anal behaviour? Must admit, the tension is mounting, if only I could get off launch, I'm really good in the air, maybe should have done some practice at the park. Maybe a forward launch will go better, can't afford to blow a 6th try at a reverse launch. Whoops, while facing forward for the launch a gust came through and the glider was blown over some rocks, only 2 attachment points got pulled out, should be "ok", if it will launch it should fly just fine.

Sure wish I'd had something better than a bicycle helmet, looks like my nose is flat as a pancake from the face plant, will blood clean off the glider? While turning the glider right side up it was easier to undo the leg straps to move around, would have been nice to have found them undone during a pre-flight - how does that pre-flight checklist read? Hope someone helps get me out of this tree, has a tree saw, has a rope, called emergency services and knew the coordinates of where I'm hanging. Wait, it looks like everyone is having so much fun flying that they don't want to help

me! Maybe they can't see me down here, sure wish the radio battery were charged, guess 5 months in the closet drained the battery.

Now there are 2 more broken lines and a slight 15-inch rip in the wing from the tree landing. Might have to send the glider off next week for a repair, then the inspection can get done and the reserve can be repacked. I should probably go through the reserve deployment sequence with an instructor at some point, not now though.

Great, lost yesterday to that silly leg-strap pre-flight error, but today seems ok, at least the sky is mostly blue; those higher clouds look like space ships. Wonder if anyone will show up with the weather forecast stuff today, seems like no one had a clue yesterday. Got to get off launch, maybe my friend can spot me. Yippee, 'in the air again, like a brood of geese we fly through the ridge lift.' Man is this harness uncomfortable, need to let go of the brakes to grab the seat and get myself just right. What's with the guy yelling something about following ridge rules, I was here first, he should have gotten out of my way - jerk. Seems as though the wind is picking up, I'm right over the top of the hill and can't seem to penetrate forward. Whew, just barely made it out and away from the hill, would have been loads easier if the speed bar **had been hooked up, need to remember it next time, where's that pre-flight check list?**

Can't seem to get down to the LZ, going to have to land in that tree-lined drive way. Pulling big-ears is done with the outer "B" line, right? Oh crap, pulled the one outer "B" and the glider is spinning, guess I should pull the brake on the other side. Now the glider is spinning to the other side and I've got a terrible riser twist, how come my reserve won't pull out of the deployment bag? Now that I'm looking at the reserve I see I wasn't pulling the handle but the side strap, should have looked at the handle. Should I land on my butt or my feet, how does that PLF position work?

Had no idea heaven would provide such a great view of the flying site. Too bad about the site being closed, too bad about the whole sport being regulated because it turned out there was a NOTAM for no VFR flights on the day of my wreck. It's spring, get it? Study, practice, review take it easy.

This article was sourced from the Eagle Paragliding website listed under the tab "Dixon's Notes". No author of the work is recorded. The Windsock team have approached Eagle Paragliding to ask permission to reproduce this. Unfortunately, to date, this has not been forthcoming.

10. Turbulence

When an isolated airflow moves slowly, there is no exchange within its layers and we call it **laminar flow**. However, if its speed is increased, beyond certain value, the flow becomes turbulent by itself. **Turbulent flow** means chaotic movements of air particles in random directions. The switch from laminar to turbulent depends on the flow properties (*dimensions, viscosity*) and roughness of neighboring surfaces. The rising (*cigarette*) smoke starts laminar, accelerates upward and once reaches a critical speed for the given conditions, it becomes turbulent by itself.

Practically, winds of more than 5-6 m/s are considered to be turbulent and the intensity of turbulence increases with the square of wind speed (WS^2).

Flying in turbulence is dangerous because if there is no smooth airflow around it then the wing stops working like a wing. Flying paragliders in turbulence means experiencing stalls, spins, collapses, sudden lift/sink/turn, not reaching safe landing because of height loss. It's unpleasant even for experienced pilots and even birds lose their elegant style in turbulence.

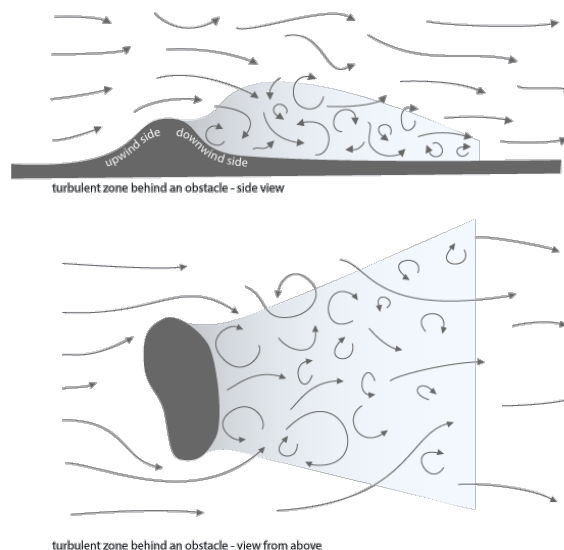
Despite its chaotic nature in the invisible air, turbulence can be indirectly observed, studied, predicted and avoided. There are several sources of turbulence:

The classic case is the **mechanical turbulence** caused by wind's interaction with solid objects (trees, buildings, terrain). The smoother shaped and smaller size objects create less turbulence. Objects, which block wind well, create bigger turbulence behind.

The acceleration of the flow around the **turbulence source** creates suction zones, which promote the creation of big **vortexes**. Their shape, dimensions and intensity depend on the object shape (profile), wind strength and air mass properties. Circular motion conserves energy and we can say that vortexes live their own life. In steady winds and stable air, some object profiles can create long lasting vortexes behind called **rotor**. If wind drops, vortex loses momentum. If wind increases, the gust can literally push the vortex downwind where it dissipates into promoting and suppressing each other smaller and smaller vortexes. Still isolated vortexes can travel surprisingly far, since their initial circular motion helps preserve momentum.

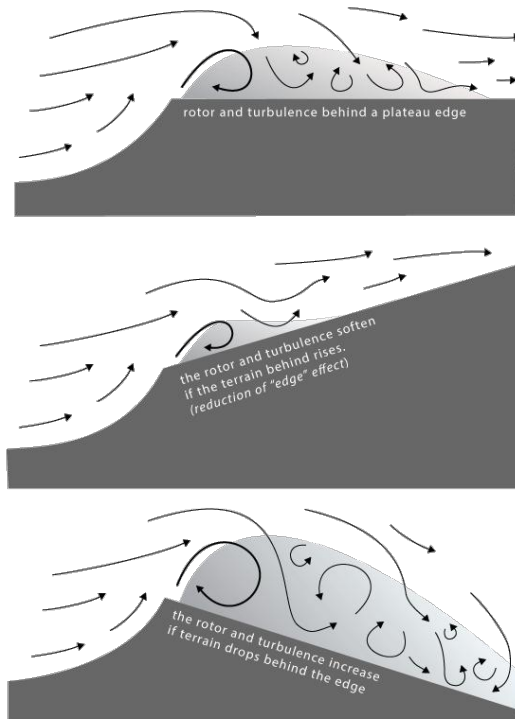
Both stationary (rotor) and travelling vortexes initiate smaller rotations next to them and the newly formed free air vortexes initiate more neighboring rotations. As a result, the turbulence zone is expanding behind the obstacle but its intensity decreases further away from the turbulent source.

As a rule of thumb, the **turbulent zone** extends 7 times the height of the obstacle (it's unsafe to land within 700 meters behind a 100 meter high hill), but again it all depends on object's shape, air mass properties and square of wind speed. If wind speed doubles, means the energy of turbulence will quadruple.



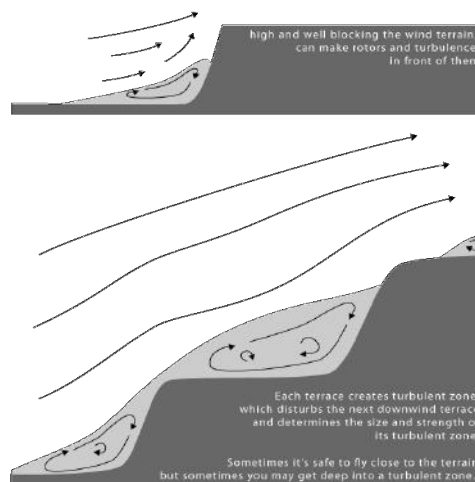
Windward sharp edges require special attention as they initiate vortexes. Even slight change of wind direction can activate one edge and deactivate another.

A classic case is the rotor and turbulence behind the edge of a plateau or a terrace. There are many take offs at the edge of a plateau where pilots have problems inflating their wing inside the rotor and raise it in the undisturbed flow above. Top landings in such places should be far behind the edge. The terrain behind can increase or decrease the “edge effect”.

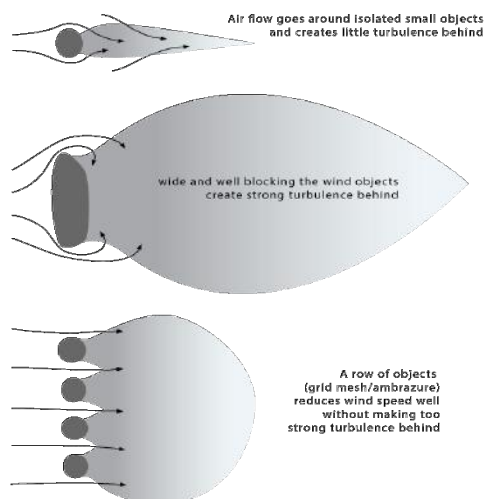


A high vertical slope can even create rotor and turbulence in front of them. It's not so energetic like the turbulence behind the edges and pilots sometimes call it “dead air” because they may fall in parachutal stall, but collapses and surprising back wind may also occur. NB. Windssock Team - Expect this at phenomenon at Beachy Head

Multiple terraces (edges) create multiple turbulent zones, which disturb the next one downwind because even slight change of wind strength and direction decide the role of the next edge and resultant intensity of its turbulent zone. Often experienced pilots fly safe close to the terrain, but unlike beginners they "read" the conditions, the irregularities, and anticipate the resultant turbulent zones and possible variations.



Airflow goes around tiny single objects without making strong turbulence behind. A dense group of objects or a single wide object, which blocks the wind well, will create strong and a big zone of down wind turbulence. A group of similar size objects with openings between them (resembling mesh grid) slow down the wind without creating strong turbulence behind.



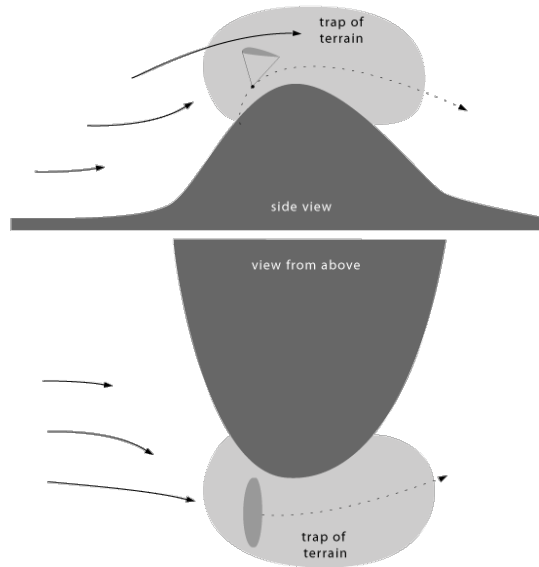
Tree lines are broadly used to protect fields and roads from strong winds, which dry the soil, pile snow or cause icing. Solid walls are not so good because their vortex patterns have the effect of concentrating zones of strong wind streams hitting the ground. The efficient uniform decrease of wind speed, behind tree line, causes pronounced vertical wind gradient, which may cause sudden stalls or increase of ground speed behind them.

The turbulence behind obstacles is reduced and even disappears when many streams of wind bring order in the chaos and restore the initial wind speed and directions.

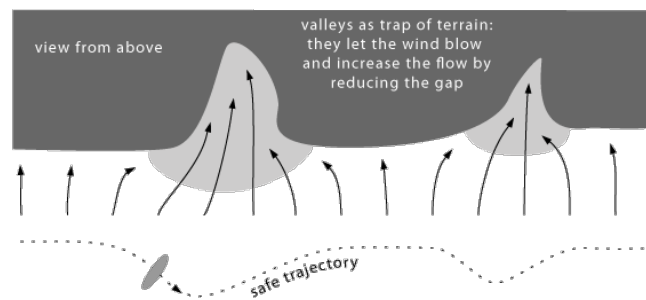
When you "read" the terrain for possible turbulence, keep in mind the so-called **traps of the terrain**. These are zones, which can restrict your freedom of movement due to strong sink or wind against the direction you want to go.

Normally, we fly in light and moderate winds, but convex shapes like the top of the hill or a rib from the slope compress and accelerate the nearby flow more than the average winds around. It's called a **venturi effect**.

A classic accident is taking off in strong wind, being lifted up in venture zone and then forcefully being blown backward.



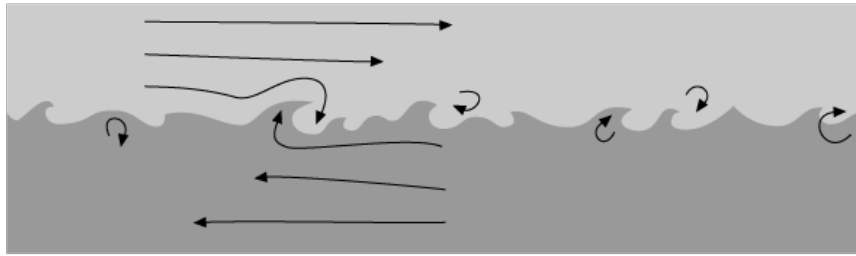
Apart from flow acceleration around convex shapes (venturi effect), the concave shape can also be a trap of the terrain. They can concentrate the flow in a narrow section and increase its speed beyond the paraglider max airspeed.



Also, big concave shapes like mountain valleys, ravines, and gullies, tend to concentrate the nearby sinking flow, which can quickly land the pilot on unsuitable place.

Frequent observations of water flow around river stones, smoke and other wind indicators help understand the various interactions with the terrain. Try to explain every significant change of flow direction and speed. Find “suction zones”, circulation zones, and flow penetration streams into them, creation and decaying vortexes, stationary, and travelling vortexes. You don’t (necessarily) have to remember the precise details but focus on the principles of flow nature. This may save your life one day.

When an air mass layer is moving in relative to another neighboring layer, then **shear turbulence** occurs around the bordering surfaces. The shear turbulence intensity depends on the relative movement and different properties of air masses (density, viscosity, temperature...).

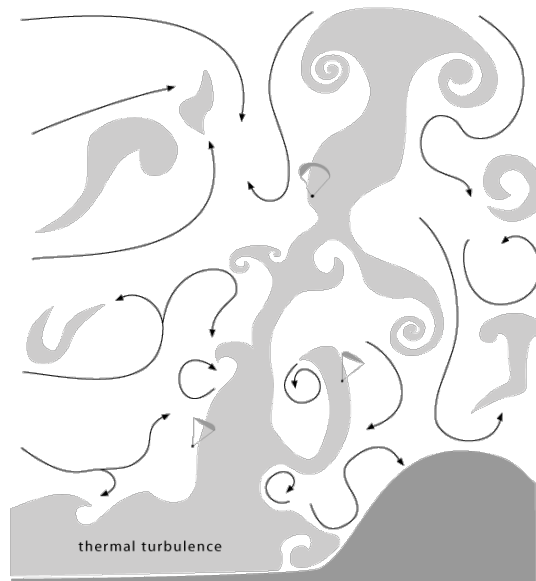


Shear turbulence between two layers moving with different speeds and directions

Classic example is when cool sea breeze wind enters inland under warmer air above. Frontal surfaces also have shear turbulence. Even thermals' surfaces create shear turbulence when rising through the surrounding cooler air.

Early in the morning, later in the evening, in autumn or in winter and at the coast we may experience mainly mechanical and shear turbulence. In the middle of the day, especially in summer and in mountains, the sun's heated surfaces create warm light volumes of air, (thermals) which rise throughout cooler and denser surrounding air.

Thermals can raise us to heaven, but can also throw us into to hell (a second later). Apart from the shear turbulence at the edges of rising thermals, thermals themselves are source of **thermal turbulence** because these thermals may comprise thousands of tons of air and WILL interact with surrounding air causing chaotic vortexes and turbulence inside and outside them.



Thermals are part of the invisible air and their effect can surprise us everywhere - on take off, higher up or near the clouds that they feed. Taking off in strong thermic conditions is the most common reason for accidents (collapses and stalls close to the ground).

Experienced pilots, who're using thermals to fly high and far, may (?!?) be ready to cope with their turbulence at all altitudes, and at any time, during the flight. Beginner's shouldn't envy the climbs of others, but first should learn fly actively and safe in turbulent conditions.

The best way to fight your enemy is to study and embrace it. Thermic turbulence comes in many variations and requires years of experience. As a beginner, observe

the wind on takeoff and compare it with the behavior of other gliders in the sky. Strong turbulence causes significant pitch, roll and yaw movements. Collapses of wingtips are common even for experience pilots. Study general meteorology and learn to assess the atmospheric instability for the given day.

When listening to other pilots, remember that **unstable air** might have a contrasting meanings – yes, good conditions for flying because there are thermals for soaring high and far but dangerous conditions because there is a possibility for thunderstorms and overdevelopment. **Stable** doesn't always mean lack of turbulence, because local thermal bubbles might get quite deformed and turbulent when they rise, find, hit, and squeeze through a stable layer (inversion). Some bored or crazy pilots might look for more dynamic and exciting conditions, while pilots with more sense might prefer relaxing conditions. Good or bad flying conditions are an individual 'thing'. It's better to ask experienced pilots more specific questions such as 1. Do you expect over development and the risk of thunderstorms? 2. Are the thermals turbulent? 3. Are there strong winds near cloud base? Gather more independent information and then decide yourself if it's a good or bad day for flying.

Cumulus nimbus and **thunderstorm clouds** have powerful vertical development and are extreme form of thermic turbulence, where apart from uncomfortable flying there are dangers of cloud suck, getting wet (easier stalls), icing (can tear the canopy), deadly electricity and sharp increase of wind (gust front, squall).

Some signs of thermic turbulence are:

- Gusty and variable wind on the ground. Especially when min and max winds are more than 50% from the average wind speed.
- It's more difficult to inflate and control your glider on take off in turbulent conditions. Thus, if you fail to take off 2-3 times, then consider it as a warning sign of turbulence and don't fly at all. Go practice ground handling in the flats and choose calmer conditions for flying. There are pilots who compensate their lack of glider control with crazy running or just rely on lucky lift to take them off. If you cannot control your glider well on take off, you won't have good control in the air too. Use inflation and prolong your control stage to let the glider "speak" what's the air like (doing)? Continue with the take off only if you're comfortable with the conditions.

Signs of thermic activity are:

- High soaring birds and gliders; dry leaves, grass or light rubbish lifted up by thermals; presence of fed by thermals cumulus clouds and their behavior; strong sun but fresh surrounding air;
- Energetic pitch, roll, course change, collapses and stalls of paragliders in the air. Even birds lose their elegant flying style in turbulence.
- Dust devils and other wind indicators (as tree leaves, flags, smoke, water surface) visualizing vortexes and turbulence.

For less turbulent experience, as a beginner:

- Avoid flying between 11am and 4pm in spring and summer when sun and thermic turbulence are strongest. Particularly in dry, arid, hot, countries.
- Avoid flying in more than 6 m/s average winds, especially if gusty and variable. Fast moving clouds and their shadows indicate strong winds, but there are also stationary clouds, which are product of strong winds and airwave motions. They are constantly being created (condensing) on the upwind and lift side and constantly dying (evaporating) on the downwind and sink side. These are called lenticular clouds and orographic caps.

- Fly when the ground is cool because it's overcast by clouds for a long time, or because it's green or wet after rain.
- Seacoast soaring is very relaxing because the laminar wind is formed and comes from the cool flat-water surface. Things might be very different 5 km inland, when thermals from sunny surfaces accelerate upward in the cool sea breeze air (strong wind with strong updrafts can be very turbulent).
- Mountain terrain is more turbulent than flatland or gentle hilly terrain.
- Humid air is less turbulent than dry air.

In thermic conditions, it's usually more turbulent at higher altitudes where thermals speed up and have joined together to form one large thermal and have more interactions with stronger winds or stable layers above. Of course there can be strong turbulence at lower altitudes too where thermals are still chaotic and influenced by the terrain. The most dangerous turbulence is the one close to the ground because there might not be enough time and height for the glider to recover from a situation or for opening of rescue parachute (the higher, the safer).

If you enter turbulent zone:

Trust your harness (it will hold you even if you are upside down – try this in your garage not on the hill mind!) and trust your wing (standard gliders are typically designed for 16 G loads and in turbulence you have max 3-4 G.

Help the paraglider recover faster by keeping it above your head (hands up if a gust pushes the wing backward; dab the brakes to stop any dives forward, then quickly release them to let the wing regain airspeed; if one side of the wing softens, immediately weight shift your body to the other side to let it carry more of your weight; bend your legs to let your body easily follow the glider's sharp turns). Don't panic holding the risers but work with your arms and body; If you can discover (guess?) the source of the turbulence to know in which direction to 'escape';

Exit the turbulent zone quickly by taking the shortest path plus flying slightly downwind (this increases your glide ratio). If possible, chose a direction which will increase your height above the terrain to give more space and time for recovery from any unexpected collapses, cravats, stalls, spins;

Maintain your course without directly opposing gusts and vortexes. Maintaining your airspeed is more important than your course (by pulling too much brake). Faster airspeed means high pressure inside the canopy and more resistance against collapses and stalls.

If turbulent zone seems everywhere (usually because of strong winds or a too deep entry inside a turbulent zone), then choose the biggest and cleanest air free from obstacles and the nearest landing field. Low dense forest can provide soft landing if things go horribly out of control (and you deploy your rescue parachute).

This article was written by Nikolay Yotov of Skynomad Paragliding www.skynomad.com. This is a BHPA [foreign] registered school. Skynomad are based in Sofot, Bulgaria and offer courses and training to PGF pilots; From beginner, to intermediate, up to and including full XC experience. This article is used with the kind permission of Nikolay, the author.

Remember...

