Slope-Soaring Made Easy – Simon Burch

With clean, renewable and abundant power available free of charge, great views, and minimal equipment requirements, slope soaring must surely be the best of all RC flying disciplines. In the right conditions, the wind can provide sufficient power to fly fast low passes and big, dramatic aerobatic manoeuvres for as long as your TX and RX batteries will last, while gentle breezes can enable a 'floaty' glider to stay in the air for hours without the bother of having to seek out those elusive and ephemeral thermals.

A Kema 90 "traditional" aerobatic glider at St Agnes Head, Cornwall

Of course, that's only my opinion, but I hope to persuade you to give it a try. The aim of this article is to convince you that slope soaring, while certainly challenging, is not too difficult, and to provide some useful guidance for those all-important first steps.

Slope soaring models can be simple and cheap, and with no motor to worry about, they require minimal ground support equipment. Of course, it's possible to spend a very large amount of money on an ultra-light carbon fibre wunderplane, but the simplest and cheapest models are capable of delivering bags of enjoyment too. The choice is yours. They come in many shapes and sizes, from small 25" span 'bank flyers' to large scale gliders. Some exotic models are capable of reaching very high speeds; indeed, the current world speed record for a model aircraft is held by a slope soaring glider (548mph). Others are 'floaty' models optimised for relaxing flying in gentle breezes. A popular sub-genre of slope soaring which is worth a special mention is Power Scale Slope (PSS), where unpowered scale or semi-scale models of powered aircraft such as warbirds and jets are flown as gliders.

How does it Work?
The principle of slope soaring is very simple: wind blowing up a slope generates a rising current of air known as 'orographic uplift' (see Figure (i)). Model gliders can use this to gain height – just like full-size gliders, hang-gliders, para-sails and birds. For simplicity, I'll refer to this rising air as 'lift'. Note that it is independent from any thermal activity – although that might be present too. Classic slope soaring with a heavy-ish model requires a fairly brisk breeze – say 10-12 mph or more – and, to generate the best lift, it needs to be blowing within plus or minus 20° of perpendicular towards the slope. Very little lift is generated beyond 40° off the perpendicular (see Fig (ii)).

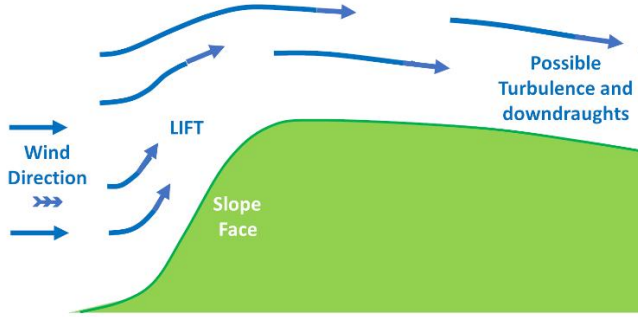


Fig (i) - Orographic Uplift

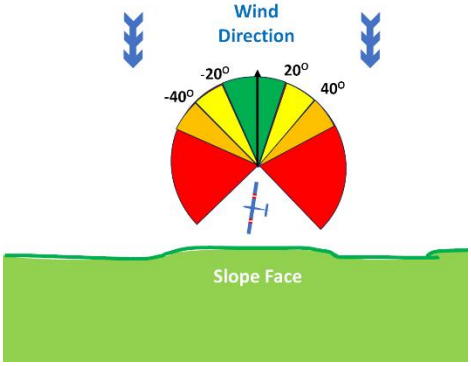


Fig (ii) - Wind Angle and Lift

Wind blowing away from a slope (ie down the hill) can sometimes generate lift too, but that's a subject for another article entitled 'Dynamic Soaring'.

Slope Model Characteristics
Slope lift is usually stronger and more consistent than lift from flat-field thermals, so traditional slope soaring gliders are usually more heavily built, more robust, and have a higher wing loading than thermal gliders. These features help the glider to penetrate into stronger winds, and enhance their stability in turbulent conditions. They also help the models to cope with landings on rough ground. Slope landing sites are usually uneven and covered with tough vegetation such as heather or gorse; they often have a liberal scattering of tussocks, stones and rocks. Expect a slope model to have no undercarriage apart from, perhaps, a skid or wheel mainly for scale appearance); a solid nose; an all-sheet fuselage and reinforced wing leading edges. Tailplanes can be particularly vulnerable to damage on landing, so T tails and V tails, which provide additional ground clearance, are a common feature.

Banded-on wings are still frequently used; these allow the wings to move independently from the fuselage should they strike an object on landing, which reduces the chance of damage. Of course, it's also possible to fly thermal gliders using slope lift, but only in very light wind conditions and in places where there is a suitable landing area.

Starting Out

If you are a complete newcomer to RC flying, I suggest that slope soaring isn't the ideal place to start - although it is entirely possible. Instead, I recommend learning the basics on a thermal glider (pure or electric), or standard fixed-wing power trainer, before venturing out onto the windy slopes. Even if you are already a reasonably competent RC flyer, I strongly recommend being accompanied by an experienced slope flyer for your first attempt and consider a buddy lead. Slope flying isn't particularly difficult, but there are pitfalls and each site has its own unique characteristics. Guidance from someone who knows what they are doing, and has experience at the site, is invaluable. Even now, I try to seek advice from local flyers before trying out a new site – something which the advent of social media has made a lot easier. You'll find that slope flyers tend to be a relaxed, friendly people who are only too willing to help.

Slope Trainer Models

For those starting out in slope soaring, as with any RC discipline, it is important to choose the correct type of trainer. Traditionally, the Chris Foss Middle Phase glider, using rudder and elevator control, was justifiably considered to be the 'go to' primary slope trainer. This model has the advantage of being available with two wing options – with or without ailerons - allowing a beginner to start with a simple rudder-elevator version, and then move on easily to an aileron model. This popular kit is still available.

Chris Foss Middle Phase – a Superb Slope Trainer

Of course, there are numerous other similar types which are just as suitable for those first steps. My own first slope soarer was a semi-scale rudder-elevator Cambrian Slingsby Capstan. This is a good-looking model, and it is still available in kit form. My second slope soarer was a Precedent Hi-Fly; not as good-looking as the Capstan, but probably a better trainer. Sadly, this excellent kit is no longer produced, but they occasionally come up on eBay. If you are happy with building from plans, your choice is huge; there are numerous classic slope soarer designs available on Outerzone and other such sites.

Me With my Cambrian Slingsby Capstan (Tregonning Hill Cornwall 1980)

Any of the models that I have suggested, or similar ones, would be an excellent choice for a slope beginner; however, if I were starting out now, I probably wouldn't choose any of them. Instead, I'd opt for a 2-channel foamie flying wing, such as the SAS Wildthing or Dreamflight Weasle. These simple models might be eschewed by purists, but they are cheap, light and incredibly robust; they can withstand crashes that would turn a traditional balsa and ply model (known as a 'crunchie') to matchwood. They can routinely be landed (or semi-crashed) on ground that would be unacceptable for more fragile models. This feature effectively increases the number of useable sites, because a smooth-ish, flat area is not essential for landings; indeed, a fast landing on the slope face itself routine – though not recommended for beginners.

Flying Wings 'Yeti' Foamie Wing

Of course, flying wings tend to have less inherent stability than traditional rudder/elevator trainers, and their unconventional shape can lead to orientation problems. This means that they can be slightly more challenging to fly than a conventional model; however, with appropriate use of rates and exponential, they can possess surprisingly docile handling characteristics. Once you are confident enough, the rates and exponential can be adjusted to provide much more exciting and challenging aerobatic performance – albeit with less inertia than a heavier, conventional model. I would also want to prepare thoroughly by practising basic slope techniques on an RC simulator (more about this later).

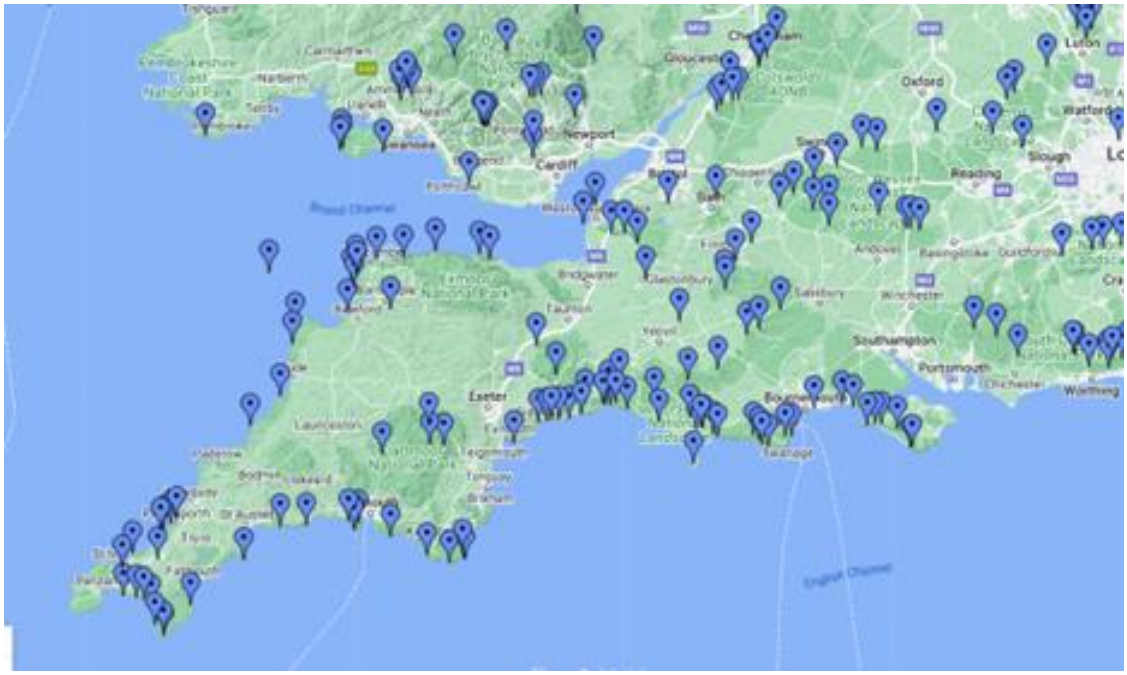
An added bonus with foam wing-type models is that they are so easy to transport. Many will fit on the parcel shelf of a car, and they are far less prone to damage from other items being thrown on top of them. Very little ground support equipment is needed at the flying site; other than the TX, I usually carry a reel of fibre-reinforced tape, a craft knife, and a small RX battery tester. All this means that a foam wing can be packed unobtrusively in the car on almost any trip, allowing you to take advantage of an opportunity to go flying should it arise. My own 'Yeti' flying wing fits nicely on the parcel shelf, and place folded coats, jumpers or waterproofs on top to protect it from the sun.

Ground Support Equipment and Batteries
One of the advantages of slope-soaring is that it doesn't need much additional ground equipment beyond the TX. One item that I would strongly recommend taking is an RX battery tester with a test load facility. This is a simple and cheap device which enables you not only to check the battery voltage, but also to check that it holds up under load. This is very important for slope soaring, because flights can be long and a strong RX battery is essential. Slope soaring is usually more dynamic than thermal soaring, and the servos are often in more-or-less constant use. I recommend that your RX battery should be the highest capacity NiMh or LiPo that will fit into your glider (commensurate with CG position), and it should be fully charged at the start of the session. Other than that, you might consider small tools for wing bolts and adjusting clevises, linkages etc, tape for minor repairs (and a means of cutting it), a spare RX battery, and spare wing bolts or bands. If you have a foamie, take some cocktail sticks for reinforcing field repairs.

Finding a Flying Site
The ideal slope site is a smooth escarpment ridge facing directly into wind, rising in excess of 100ft above flat ground, with a gentle dip slope or flat ground behind to provide a landing area. There should be no trees, buildings or other obstructions that might cause turbulence, and there should be a free car park with a café situated within easy walking distance of the flying area. There are many slopes in the UK that come close to meeting those criteria. Coastal cliffs can make excellent sites, with wind off the sea providing smooth lift, and the UK has some superb inland sites such as Long Mynd in Shropshire and Ivinghoe Beacon in Buckinghamshire.

Woolacombe Bay in North Devon – Excellent in the UK's Prevailing Westerly Winds

There is an excellent Google Maps site called 'Slopehunter', which shows the location of slope sites and their favourable wind directions, mainly in southern England and Wales. Sadly, the site is not maintained; however, the physical geography of the UK doesn't change much, so it's still a useful reference. See https://goo.gl/maps/11TbatVGofoBWyon7



Slopehunter Screenshot

What does change, however, is regulation. The National Trust which, for many slope soaring sites, is the landowner has historically welcomed unpowered model flying. However, over the past couple of years, some slope sites have had model flying activity either banned completely or severely curtailed – allegedly under the influence of a quango called 'Natural England'. Rogue drone flyers haven't helped, but growing concerns about conservation, and in particular the disturbance of nesting birds, has undoubtedly led to an increase in restrictions. To the uninformed conservationist, drones are a nuisance and model aircraft are noisy, obtrusive and annoying things, and banning them is an easy option.

Of course, the reality is that slope-soaring must be one of the least obtrusive and most environmentally friendly air-sports of all, but breaking the rules won't help our case. The important thing for us is to make sure that we comply with any local restrictions. The best way to do this is to fly only at recognised sites, and ask local flyers for advice, and support any campaigns to retain flying sites.

For OMFC, our local slope soaring site is Wittenham Clumps. You can find a description on the website. The Clumps are low but they can sometimes offer good lift; however, they are usually very busy with walkers and picknickers, and the landing areas can be a little tricky. The site is best suited to 'floaty' gliders, or foamies that can withstand landing in brambles, revetments etc. Consequently, The Clumps are by no means perfect for slope beginners. White Horse or Ivinghoe Beacon are further away, but they are better sites to use for those early steps.

Slope Soaring Basics

Checks. Once you arrive at your carefully chosen site with your carefully chosen model, in a good 10-15 mph breeze, you'll be in a hurry to start flying. Don't be in too much of a rush, though; carry out the SWEETS checks, check your model in accordance with the BMFA's recommendations, and load-test the RX battery. I have seen a slope soarer launched without the RX being switched on, and the result isn't pretty. Personally, before committing my model to a launch over the slope, I'll often test-glide it out of the lift first – usually over the landing area if it's clear.

The Launch. Before your first launch, you should plan how you will make your approach pattern and landing (I'll cover how to circuit, approach, and landing later). Be ready to experience some nervousness – the first time that you launch a model over a cliff or hill, with no chance of making an immediate landing, it can be disconcerting. If there are other flyers around, check to see if there is an established pattern, and watch what they do. Do the SMART checks, walk out to a launch position near the top of the slope. You should feel the up-draughting air, and when you hold your model up ready for launch it should feel as though it wants to fly. At this point, I usually do a last-minute 'idiot check' with the controls, making sure that they are responding by waggling the right-hand stuck. Have a good look around, and call 'launching'. The model should require no more than a gentle throw, and it should start to climb more-or-less straight away. Allow the model to climb away from the slope, keeping it straight by using gentle rudder or aileron inputs. Control the rate of climb gently using elevator and take particular care to correct any tendency to pitch nose-up; this often happens as the model moves forward into stronger lift and, left uncorrected, it can quickly lead to a stall. If you find that you need an excessive amount of forward stick to hold the nose down, by all means re-trim, but consider landing – or asking your mentor to take control and land the model for you. Once on the ground, add some ballast to the nose to bring the CG forward, recentralise the trim, and try again.

Continue the climb, but don't go excessively high. Keeping the model at or just above head height will do. Once you're at a safe distance from the slope, you can begin your first turn – either left or right: it doesn't matter unless there are other aircraft about. Check it's clear, and begin your turn, let's say to the right, with gentle application of right stick. You shouldn't need too much up elevator to turn; the lift will tend to keep the nose up for you. Be ready: the wind will blow the model towards the slope quite quickly, so don't turn too much or too far: aim to track parallel to the slope. The nose will need to point slightly left towards the wind, and the model will 'crab' away from you to the right. Try to avoid allowing the model to drift towards the slope. If it does, don't panic: gently apply left stick and perhaps a little up elevator to correct this (see Fig (iii)).

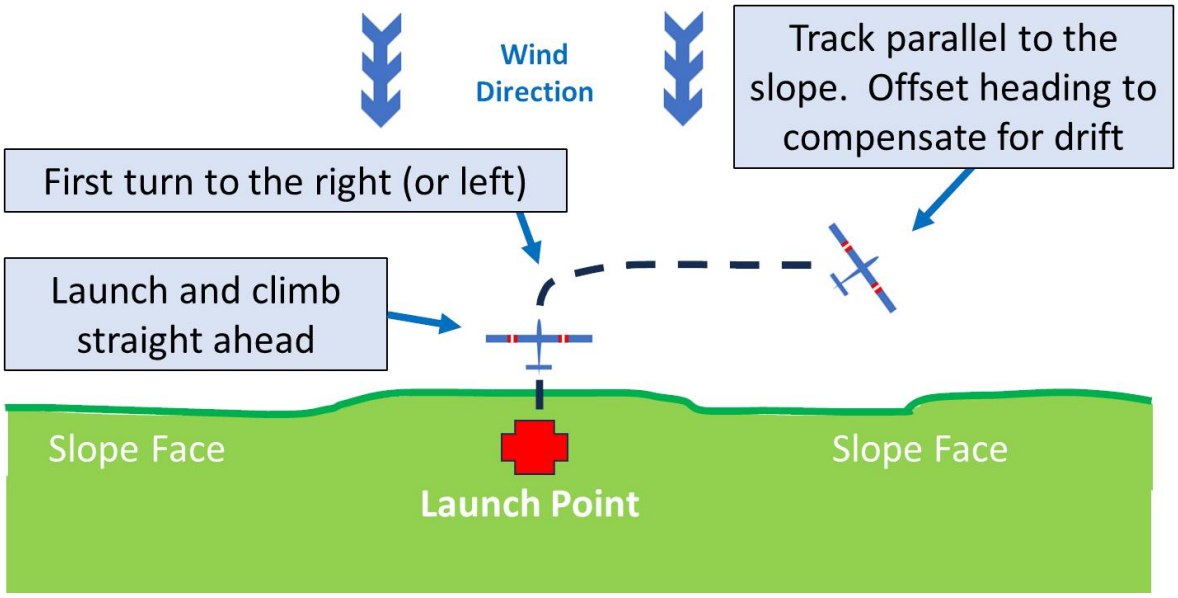


Fig (iii) - Climb and First Turn

Before the model gets too far away, start to turn left away from the slope. It will appear to slow down as it turns into the wind. Continue turning left, through the wind, until the model is tracking parallel with the slope from right to left; to do this, the nose will need to be offset slightly to the right (see Fig (iv)).

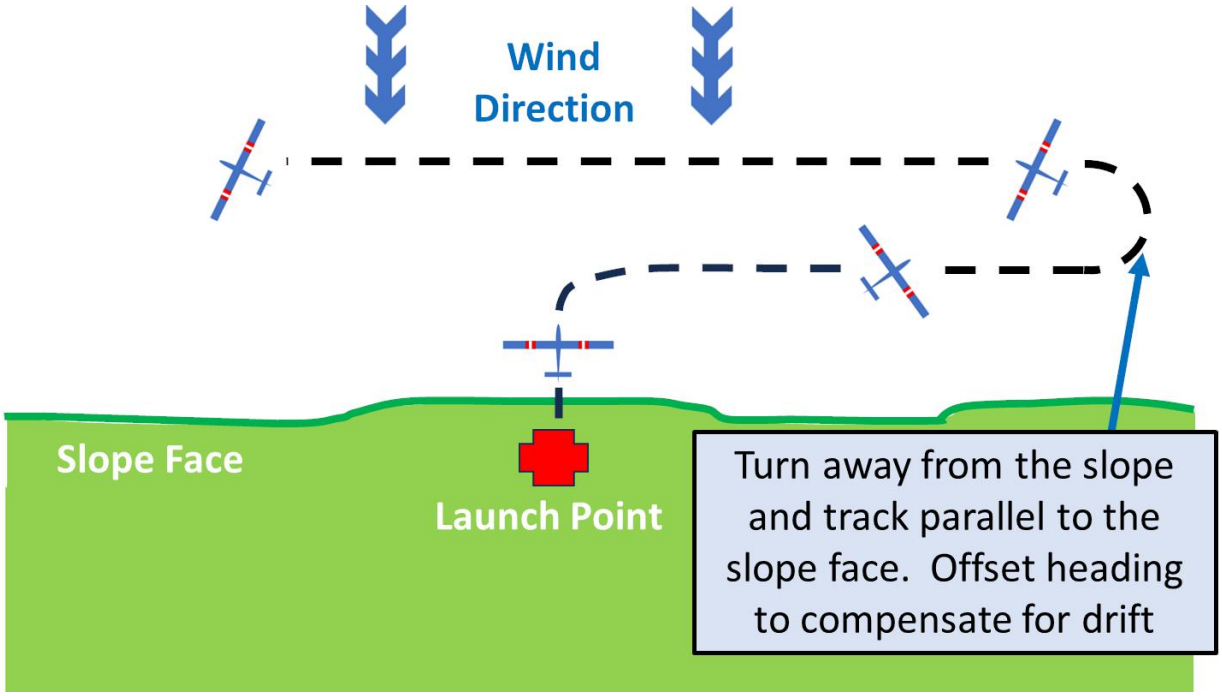


Fig (iv) - Second Turn to Parallel Slope Face

Again, don't let the model get too far away; as soon as you are ready, begin a turn to the right away from the slope, and continue the turn until the model is tracking from left to right along the line of the slope. Gradually, you can widen the turns and allow the model to drift slightly towards the slope on each leg, forming the classic 'figure of eight' training pattern (see Fig (v)).

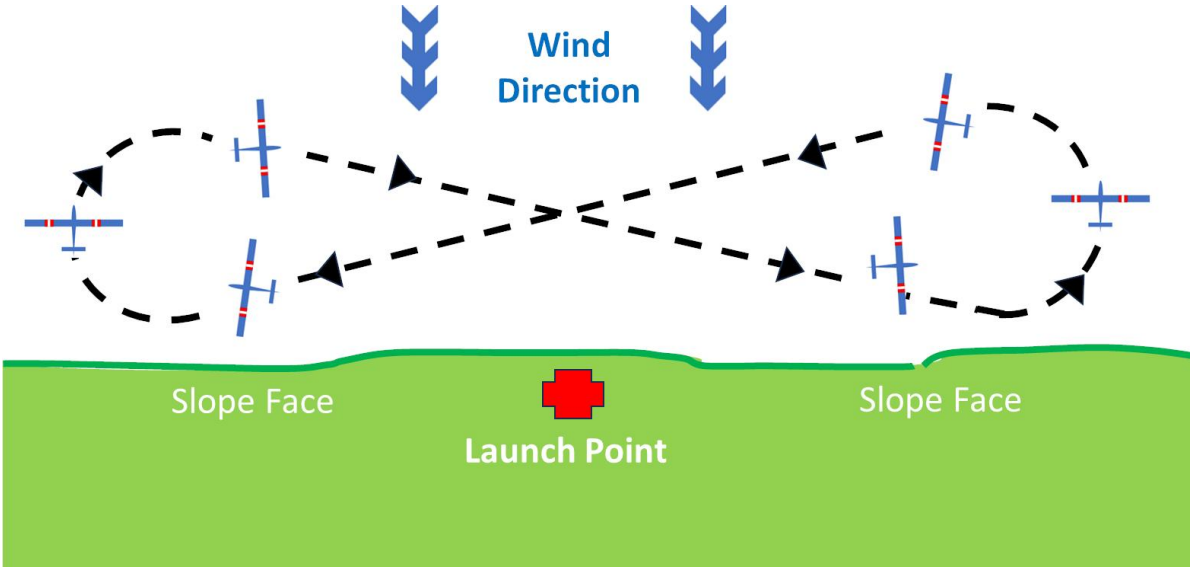


Fig (v) - Figure-of-Eight Pattern

Continue flying figure of eights until you are comfortable with the conditions and the way that the model is handling. You'll notice that the lift is variable; indeed, you might even encounter some 'sink'. If you do, simply fly back to an area where you know the lift is good. Be ready for turbulence; not all the model's unexpected movement is down to you.

Once again, if you encounter turbulence, avoid overcontrolling to compensate and fly back to an area of known smooth air. At this stage, I recommend making all turns away from the slope, and don't try anything ambitious until you feel comfortable with the new environment. Finally, don't fly too far away from the slope – there's a risk that you'll fly out of the lift and lose a lot of height….which you might not be able to recover!

Approach Pattern and Landing. Hopefully, you'll have planned how you are going to fly your approach and landing pattern before you launched so, assuming that nothing has changed since then, all that remains to be done is to execute that plan. If you've never seen a 'classic' slope approach and landing, it's worth asking your mentor to demonstrate it to you; if nothing else, a demonstration will prepare you for the slightly disconcerting pace of the downwind leg.

Let's assume that you've chosen to fly a right-hand pattern. Start by tracking the model along the line of the slope from left to right, at about 50ft to 100ft above the height of the landing area. This is lower than you might expect, but you need to keep clear of down-draughting, and it can be surprisingly difficult to lose sufficient height to make a landing. When the model is at a suitable distance to the right (in this case) of your position, call 'landing' and begin a turn to the right, to cross the slope face, onto the downwind leg.

The model should be well above the terrain but be ready for its groundspeed (not airspeed) to increase markedly as passes over the top of the hill. Don't be

tempted to slow down by raising the nose or you'll risk a stall, and take care not to fly too far downwind (see 'common approach pattern errors').

As the model flies out of the lift, it will start to descend; you might encounter some turbulence too, but don't worry. When it passes the landing point, begin another right turn. Depending upon your spacing from the landing point, you can either turn onto a 'base leg' or simply continue the turn into wind and onto the final approach. The model's groundspeed will slow reassuringly quickly as it turns into wind, but beware of a tendency for it to pitch nose-up. On the final approach, keep straight, control pitch attitude with elevator, and allow the glider to descend towards the landing point.

For the touchdown, try to keep straight; groundspeed should already be relatively low, so you'll need minimal flare. See Figs (vi) and (vii). Accuracy is not essential at this stage, and remember the old adage that it is better to walk 100m to pick up the model than 10m to pick up the wreckage.

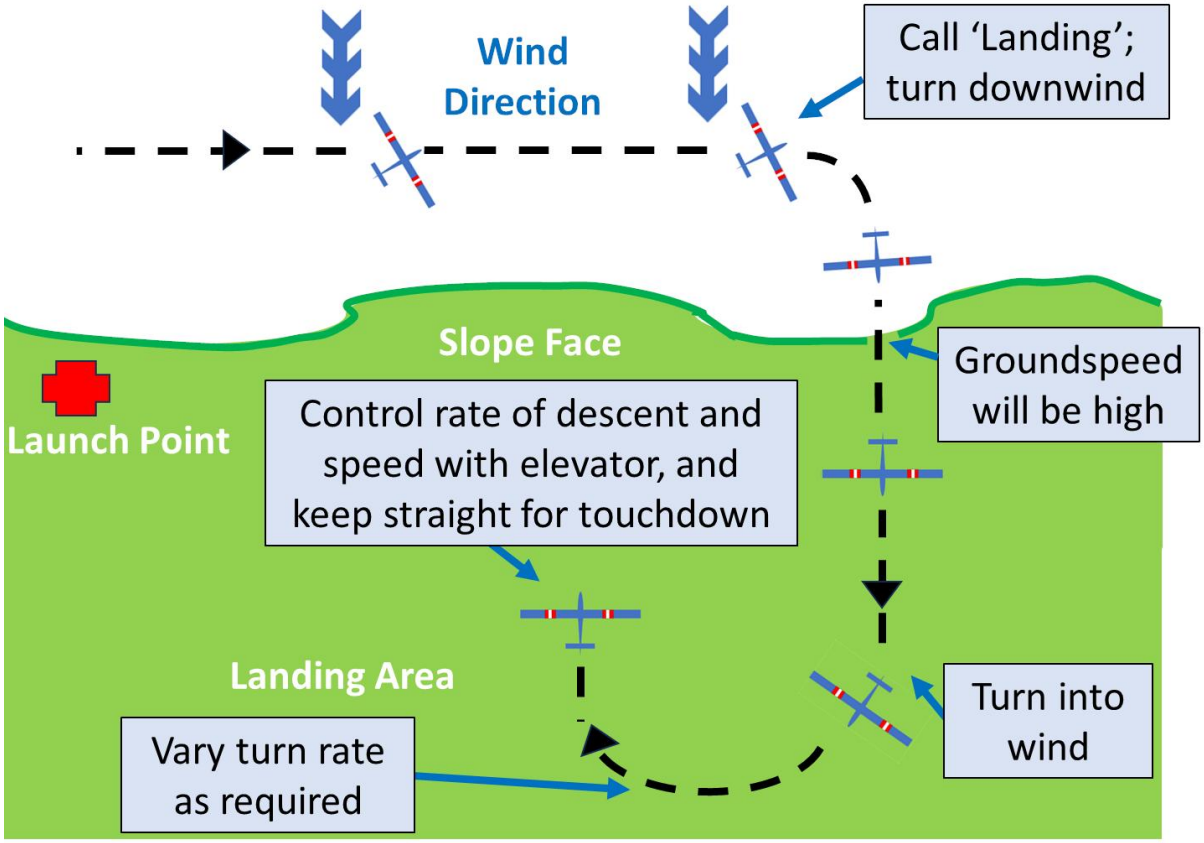


Fig (vi) - Classic Slope Landing Pattern

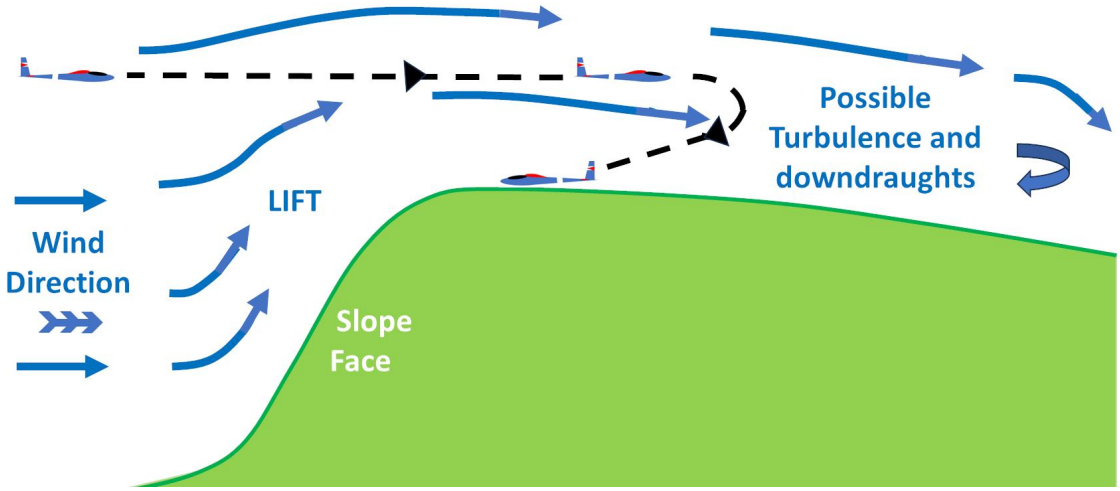


Fig (vii) - Classic Slope Landing Pattern (Cross Section)

The 'S' Turn Manoeuvre. If you find that you are too high at the end of the downwind leg, one method of losing the excess height before the final approach is use the 'S' turn technique (see Fig (viii)). Effectively, this increases the glider's ground track distance, allowing it more time to descend out of the lift, while keeping it clear of excessive turbulence and down-draughting.

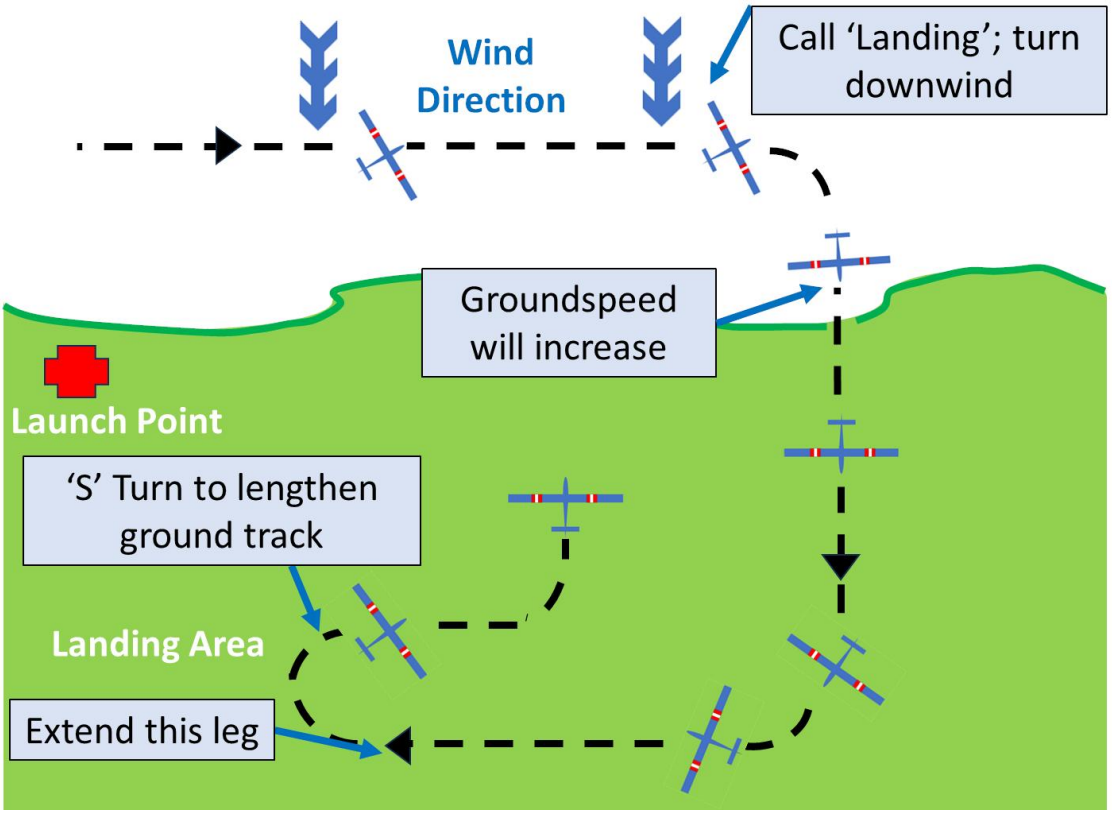


Fig (viii) - Using 'S' Turns to Allow More Space to Descend

Begin by extending the base leg cross-wind, taking care to allow for drift. At a suitable point, turn the glider towards the wind, and continue the turn to fly a

reciprocal track, again allowing for drift. When you judge that you are at a suitable height to begin your approach, turn into wind and land as before. It is possible to carry out more than one S turn, but avoid manoeuvring too close to the ground. Consider going around and trying again instead.

If you have an aileron/rudder/elevator model, it is also possible to lose excess height by side-slipping, but this can be a challenging manoeuvre if you're not familiar with it. More advanced models are often fitted with spoilers or crow-braking, which makes it much easier to lose height and/or speed, but these are complications which, as a beginner, you don't need.

The Go-around Manoeuvre. The main reason for conducting a go-around manoeuvre is because you are unhappy with your approach; however, there are others: for example, you might see an unexpected hazard (eg loose dog, or hikers), you are baulked by another model, or you can see that you will miss the landing point and end up in brambles or rocks. Don't forget that it can also be a good idea to use a planned go-around as a way of assessing the wind and turbulence conditions on the final approach path – a so-called 'dummy approach'. Of course, unlike a powered model, you can't simply open the throttle: you need to fly back into the lift. For this reason, you need to make your decision to go around early. Fortunately, the manoeuvre itself is very straightforward: simply turn into wind, keep the glider's heading as straight as you can, adjust pitch attitude to minimise the descent rate and fly back into the lift – see Fig (xi). Don't forget to make a clear 'going around' call as you fly back into lift.

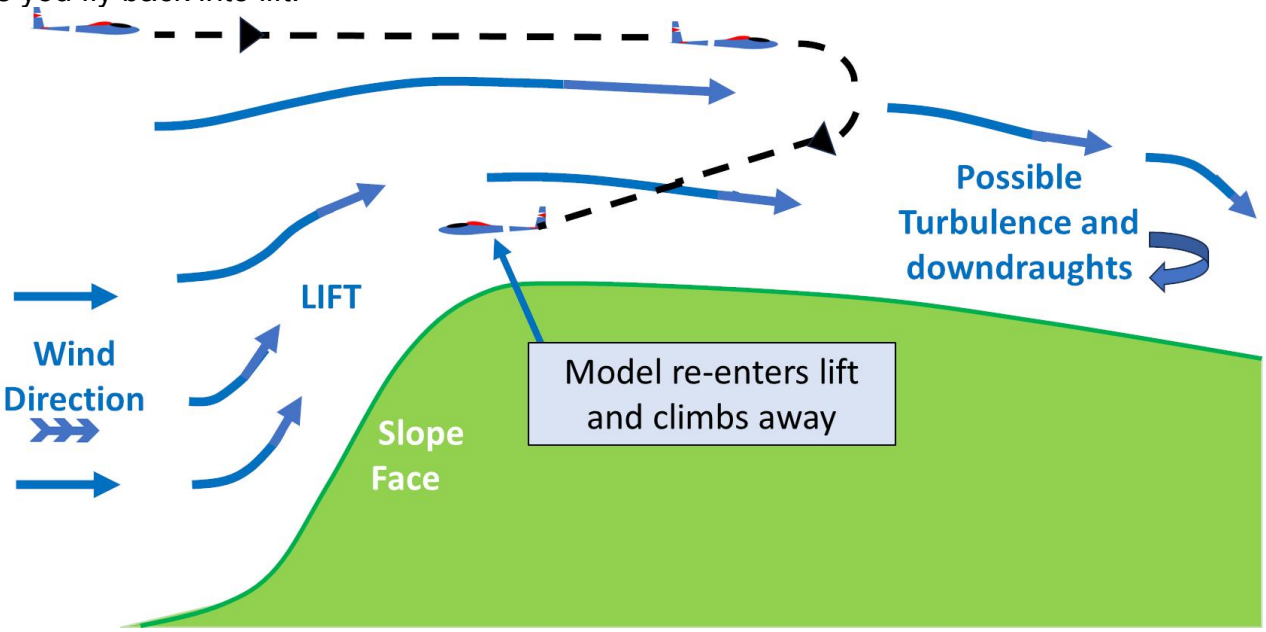


Fig (viii) High Approach to a Go-Around

Common Approach Pattern Errors. Clearly, there are numerous possible errors that you can make during a slope soaring session, and most of them are common to all RC disciplines. However, in my experience, there are three common errors that have specific implications for slope landing approaches. These are as follows:

1. **Allowing the Nose to Rise During the Final Turn**. As the glider's groundspeed increases on the downwind leg, it gains inertia. Some of this inertia will be retained by the glider as it turns into wind, increasing its airspeed - and therefore lift. This results in a very marked tendency for the nose to pitch up at the end of the turn onto final, which can lead to unwanted height gain. If this happens, there is a good chance that you will be too high to make a landing, so a go-around is probably the best option.

2. **Raising the Nose on the Downwind Leg.** As it turns downwind, the glider's groundspeed increases - as already mentioned. This is common to all RC aircraft; however, slope-soaring tends carried out in windier conditions, so the effect is often much more marked. This leads to a tendency for beginners to raise the nose to reduce speed, resulting in a climb and possibly a stall. If you make this error, lower the nose to avoid the stall - and don't hesitate to turn into-wind and go-around. If you do stall, carry out a recovery. If you have sufficient height, turn into wind and go-around: if not, you will be forced to land out of the landing area. On the approach, use pitch (ie elevator) to reduce speed as much as you can without stalling, adjust heading if necessary to avoid people, animals, property and obstructions (in that order), and land 'in the rough'.

3. **Allowing the Glider to Fly too far Downwind.** The glider's increased groundspeed on the downwind leg means that it covers distance more quickly. If it is not turned onto the base leg/final turn soon enough, there is a risk that it will fly into down-draughting and turbulence. This will make it more difficult to control. As the distance between the flyer and the model increases, orientation becomes harder, and there is a real risk of losing the model as it is blown further away. If you find yourself flying too far downwind, turn into wind as soon as you can. There is little chance of carrying out a go-around so, once again, you'll almost certainly be forced to land out of the landing area as in (2).

Chris Foss Phase 6

That's it for the Basics! Once you're confident with flying from the slope, it's worth moving on to a more capable model as soon as you can. The classic 'improver's' model is the Chris Foss Phase 6; while it doesn't have spoilers or crow-braking, it does have excellent flying characteristics and it's great for learning and perfecting aerobatics.

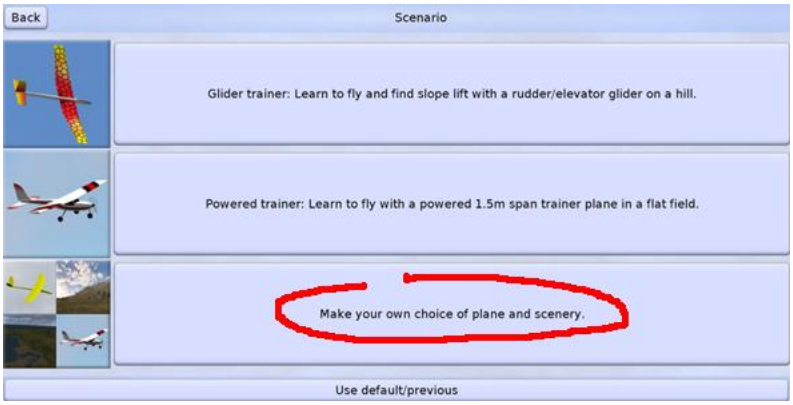
My own ‘next step’ model was a Keith Humber ‘Kema 90’, which is a plan-built alternative to a Phase 6 (available on Outerzone). It’s 25 years old and I still fly now; in fact, I haven’t moved on from it. Compared with modern high-performance (and high cost!) carbon fibre models, traditionally-built models like the Phase 6 and Kema 90 can seem a little staid, but it depends upon what you want from your flying. Speed, gentle duration, aerobatics or scale: the choice is entirely yours. PSS is certainly an attractive option for many flyers, and there is an association devoted to this discipline (PSSA). Scale or semi-scale jets and warbirds make good slope soarers, and often all that’s needed is an old scale model with its motor removed and replaced with a nose weight. Arguably, one of the best uses for an old 600 can motor is nose ballast for a PSS model. Scale gliders are very popular; the constant lift provided by the slope means that attention to weight and drag is less important than it is with a thermal glider, which means that it’s easier to incorporate detail and structure. There are some truly superb scale glider kits available, and it is a pleasure to see them in the air.

Using an RC Simulator for Slope Training

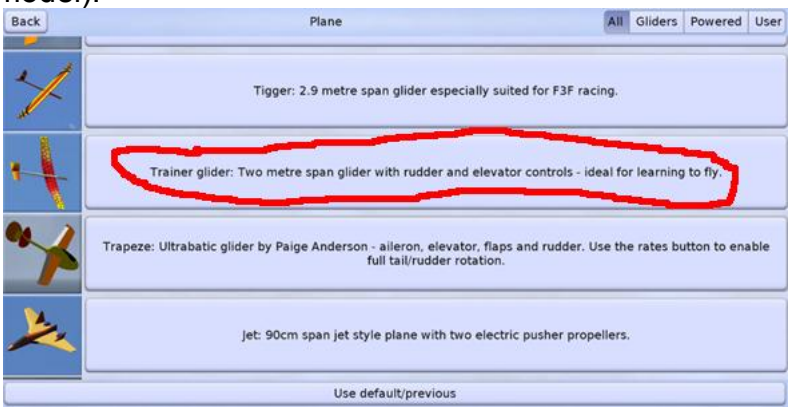
Finally, a word about RC simulation, which is an excellent way to prepare for slope flying. In some ways, it works better for slope soaring than it does for flat-field flying because it’s easier to keep terrain in view. I use a number of RC simulators but, for me, the most realistic one by some margin, in terms of slope soaring flight dynamics, is Picasim. You can practise all of the techniques that I’ve outlined in this article – and make the common errors - without risk. This is how I recommend that you set it up:

1. Open Picasim and select ‘Free-Fly’.

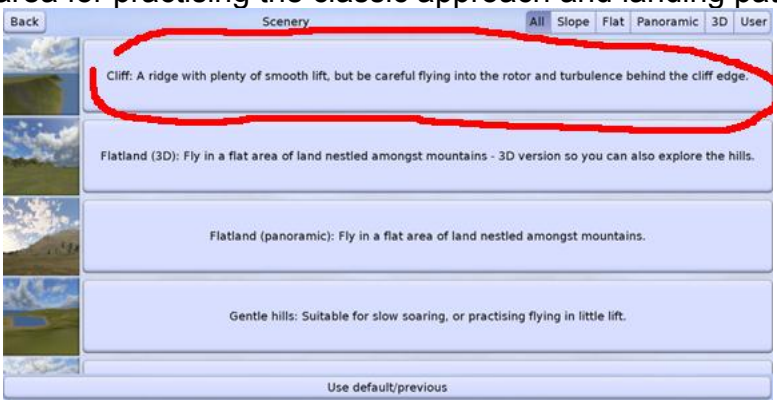
2. Select ‘Make your own choice of plane and scenery’.



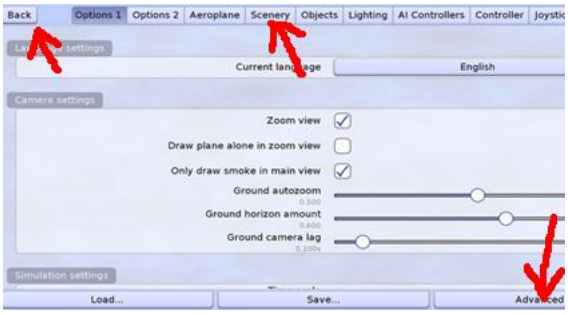
3. Scroll down and select the ‘Trainer Glider’ (a 2-channel rudder-elevator model).



4. Select the ‘Cliff scenery, and allow the simulation to load. The Cliff scenery is not photorealistic, but that doesn’t matter; the gusty wind sound effects give it a surprisingly convincing feel of a coastal cliff site. There are photorealistic slope soaring scenery options, but none of them has a suitable area for practising the classic approach and landing pattern.



5. Select ‘Settings’ (The cogwheel shape at the top). Select ‘Scenery’, then select ‘Advanced’ (bottom right of the screen). Adjust **all** the turbulence settings to about 0.2, and the rotor tendency setting to zero. You can increase these again once you are familiar with the techniques. I’d still be inclined to keep the rotor tendency at or near zero though; I’ve never encountered it to that degree over a landing area.



6. Press ‘Save..’ and save the setting as ‘Low Turbulence Cliff’ or something similar. Press ‘OK’, then ‘Back’ (top left). Now you’re ready to fly.

You’ll find your saved scenery file on the ‘Scenery’ selection page at the bottom of the list.

You’ll need to make sure that your TX rates and exponential are suitably set to get the best out of the simulation. The Glider Trainer model is excellent for starting out, but I recommend changing it for the Phase 6 as soon as you are confident to so; in my opinion, it’s the best model in Picasim, and on low rates it’s surprisingly docile.

Slope Soaring – Give it a Try!

Uffington White Horse Slope Site

I hope that this article has whetted your appetite to try slope soaring and given you some understanding of the basic techniques. If you have never tried it, you’re missing out on one of the most rewarding model flying disciplines. As an added bonus, slope soaring helps flyers to gain confidence with flying in windy and turbulent conditions; this effectively increases the number of flyable at their regular site. In my experience, slope flyers are so much more relaxed about flying in windy conditions at the Meadow. Of course, slope soaring has its drawbacks, but so does every aspect of model flying. In my opinion, the rewards are well worth the effort. With Picasim, you can try it in your living room first, but it can’t compare with the real thing.