Radio Controlled Soaring Digest

April 2007 Vol. 24, No. 4

CONTENTS

April 2007
Vol. 24, No. 4

Front cover: Adam Weston launches his Encore into the fog at Tiger Mountain, near Issaquah, Washington. January 26, 2007. More about Tiger Mountain and the vortices that live there beginning on page 35 of this issue. Photo by Phil Pearson.
Canon PowerShot S2 IS, 1/1000 sec., f4.0, 47.4 mm

Back cover: Philip Randolph's Encore soars its way through snow clouds at Tiger Mountain, Issaquah Washington. February 23, 2007. Philip considers this “An Existential Portrait On One Of Those Days.”
Photo by Phil Pearson.
Canon PowerShot S2 IS, 1/1000 sec., f4.0, 34.3 mm

R/C Soaring Digest

Managing Editors, Publishers — B² Kuhlman

Contributors — Chris Boultinghouse, Jay Decker, Stephane De La Haye Duponsel, Mike May, Tom Nagel, Mark Nankivil, Philip Randolph, Matthieu Scherrer, Jerry Slates, Rene Wallage

Photographers — Dave Garwood, Martie Du Toit, Ariel Erefrid, Mark Nankivil, Phil Pearson, Piet L. Rheeders, Michael Shellim, Adam Weston

Contact — rcsdigest@themacisp.net
Web: http://www.rcsoaringdigest.com
Yahoo! group: RCSoaringDigest
AIM screen name: RCSDigest
Microsoft Messenger: rcsdigest

———————————————————

R/C Soaring Digest (*RCSD*) is a reader-written monthly publication for the R/C sailplane enthusiast and has been published since January 1984. It is dedicated to sharing technical and educational information. All material contributed must be exclusive and original and not infringe upon the copyrights of others. It is the policy of *RCSD* to provide accurate information. Please let us know of any error that significantly affects the meaning of a story. Because we encourage new ideas, the content of each article is the opinion of the author and may not necessarily reflect those of *RCSD*. We encourage anyone who wishes to obtain additional information to contact the author.

In the Air

This issue contains a rather enlightening piece on RC slope soaring in Israel, numerous examples of spectacular photography, a rather technical treatise on a problem of model aerodynamics, a new aircraft design, and a good portion of humor.

It's an issue which presents the best that our hobby/sport has to offer - enjoying nature and exploring new places, having fun with friends who share your passions, learning something about aero science, and seeing the results of artists at work. We hope you enjoy it!

June 20 - June 24 are the dates for the 5th Annual International JR Aerotow <http://www.horizonhobby.com/Articles/Article.aspx?ArticleID=1656&Page=1>. This world-class event will once again be held just outside Monticello, Illinois, at the Piatt County Municipal Airport. Mark Nankivil is planning to attend and will be sharing his impressions and photographs with *RCSD* readers in the August issue.

On the home front, we're still cleaning up from the storms of late last year, and work on our Redwing XC is slow. We're trying something new with regard to fuselage construction, and we're not sure if it will work out. Hopefully the next issue of *RCSD* will include a description of our materials and methods, along with our opinion as to whether or not we're successful. In the meantime, we have a lot of carving and sanding to do.

Time to build another sailplane!

B²

RC slope soaring in *Israel*

By Rene Wallage, with photos by Ariel Erefrid

The aeromodeling history of Israel is as old, if not older, than the State of Israel itself (i.e. 58 plus years). The Israel Aero Club (AMA equivalent) has faded black & white pictures of old timer free flight and early RC models with various propulsion systems.

The Israeli RC community is very diverse and vibrant. We even sport some international champions!

The slope soaring community is slightly younger. It started after the introduction of affordable RC systems.

Most slope soaring is done along the Mediterranean coastal dunes and cliffs, although there are some spectacular sites in the Negev desert in the south, and the Golan Heights in the north.

One of the best things I like about the slope community (as opposed to the Israeli RC community in general), is the enormous diversity of backgrounds. We have kids, students, and manual laborers rubbing shoulders with aeronautical engineers, senior surgeons, and high tech professionals. We even have a regular visitor from the US, who is captain on one of the airlines having layovers in Tel Aviv! It's just more proof that RC slope soaring is a great equalizer.

Our weekends are Fridays/Saturdays. Some pilots are religious observant and fly only Fridays, but there are plenty of others flying both days (weather and family permitting…).

Being on the eastern Mediterranean coast, there is no real defined "slope season." Most slope days year-round we enjoy winds ranging from 10 to 20 mph.

Yoav Harari and his daughter Shira fly at Bat Yam under the watchful eye of Yoav's brother, Eiran.

Two tailless foamies chase each other up and down the beach.

Drinking water, a hat, sunglasses and sun screen are a must almost all year round. We do get some winter storms, when winds reach 50-60 Mph (or more), rarely with rain, and sometimes even as cold as +10°C! Those are the days we huddle around the air conditioner set to "heat" and work on our next project.

Although we do have slope soaring competitions, the emphasis is on fun flying. The foamies far outnumber the crunchies on the slope, and we usually either give each other a wide berth, or one group grounds itself voluntarily to let the other group get some airtime as well.

By far the most popular slope soaring site for the past few years is in Bat Yam, just south of Tel Aviv. The site is a dune about 35-40 meters high, with a 50 by 70 meters rocky/sandy/grassy landing area. Most of the time it is accessible by regular family car. The nicest feature of the site (apart from the people) is the fact that in front of the slope is about one kilometer stretch of beach towards the sea. This means that if Mother Earth calls your plane for a consultation, there is no chance of a "splash." This feature makes it very attractive for beginning slope soarers.

There are other sites with better/higher slopes (or cliffs), but lack the stretch of beach and/or have no way of descending to the beach to retrieve a lost glider.

The past few months the wind has been very iffy at best, but now with spring in the air I've recycled my slope soaring packs, cleaned up my MiniWeasel, MonsterMugi, MPX Easy Glider and Unicorn, and am anxiously following www.windguru.cz. Wind forecast this weekend: due West 16-18 mph.

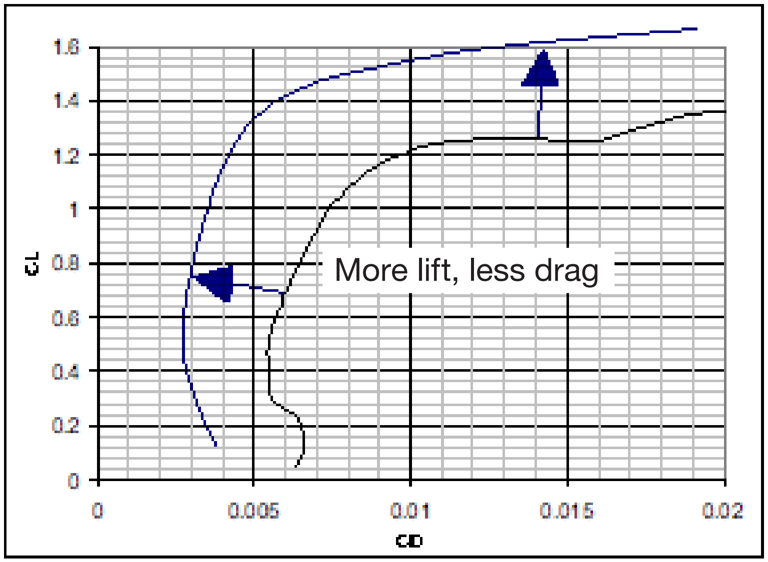
Yeeehaaaaa!!!

Above: Shachar and Eli, shooting the breeze after a hard day flying.

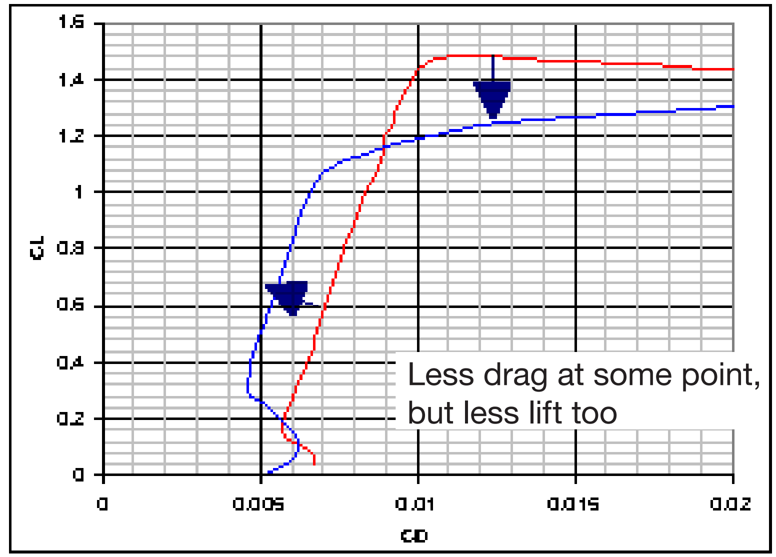
Right: That blue frame building is about 600 meters away, but Ariel's 270mm telephoto lens makes it look much closer.

Which C_L are you really flying? - and - Some ideas about aerodynamic optimization

Matthieu Scherrer , matthieu.scherrer@free.fr



What would be great to do…



…and what is possible to do.

For the scientific modeler, many tools are available on the Internet for optimizing sailplane aerodynamics.

Xfoil gives access to very refined airfoil characteristics, whereas programs as Nurflugel or AVL give an insight into finite wing design. Finally, tools like MIAReX or XFLR5 merge both views, i.e. Xfoil and finite wing.

So, this is very cool. You can compute C_L and C_D for wings over large variations of many parameters (angle of attack, Reynolds number, planform, etc.). The task might be simply expressed for the aerodynamic geek:

"L/D augment you shall"

Nevertheless, when performing optimization, we do observe that an aerodynamicist's life is not that easy. It is not possible to enhance any part of the glider polar, but there are often trade-offs to accept, as shown in the graphs on the opposite page.

Then comes the question:

What is best to optimize, and where should we put our efforts?

This study is trying to answer this question through a statistical study of what our sailplanes experience during flights.

Recording a flight

The first step is to be able to evaluate C_L during flight. This is not necessarily an easy task.

Lift coefficient is given by:

$$C_L = Nz \frac{V_1^2}{V_{CAS}^2}, \quad \text{with} \quad V_1 = \sqrt{\frac{2g}{\rho_0} \frac{m}{S}}$$

With Nz being the acceleration normal to the glider, V_1 the speed of the glider for $C_L = 1.0$ in standard condition (function of wing loading, m/S), and V_{CAS} is airspeed (calibrated airspeed).

This is all you need to know during the flight to compute C_L.

First I tried using a portable GPS in recording mode within "big sailplane." It was difficult to trust the values obtained, as:

- The rate of measurement is low - one record per second maximum.
- You have to evaluate the acceleration Nz from the path, which is not that accurate.
- You have to evaluate wind at any altitude, since GPS speed is ground speed.

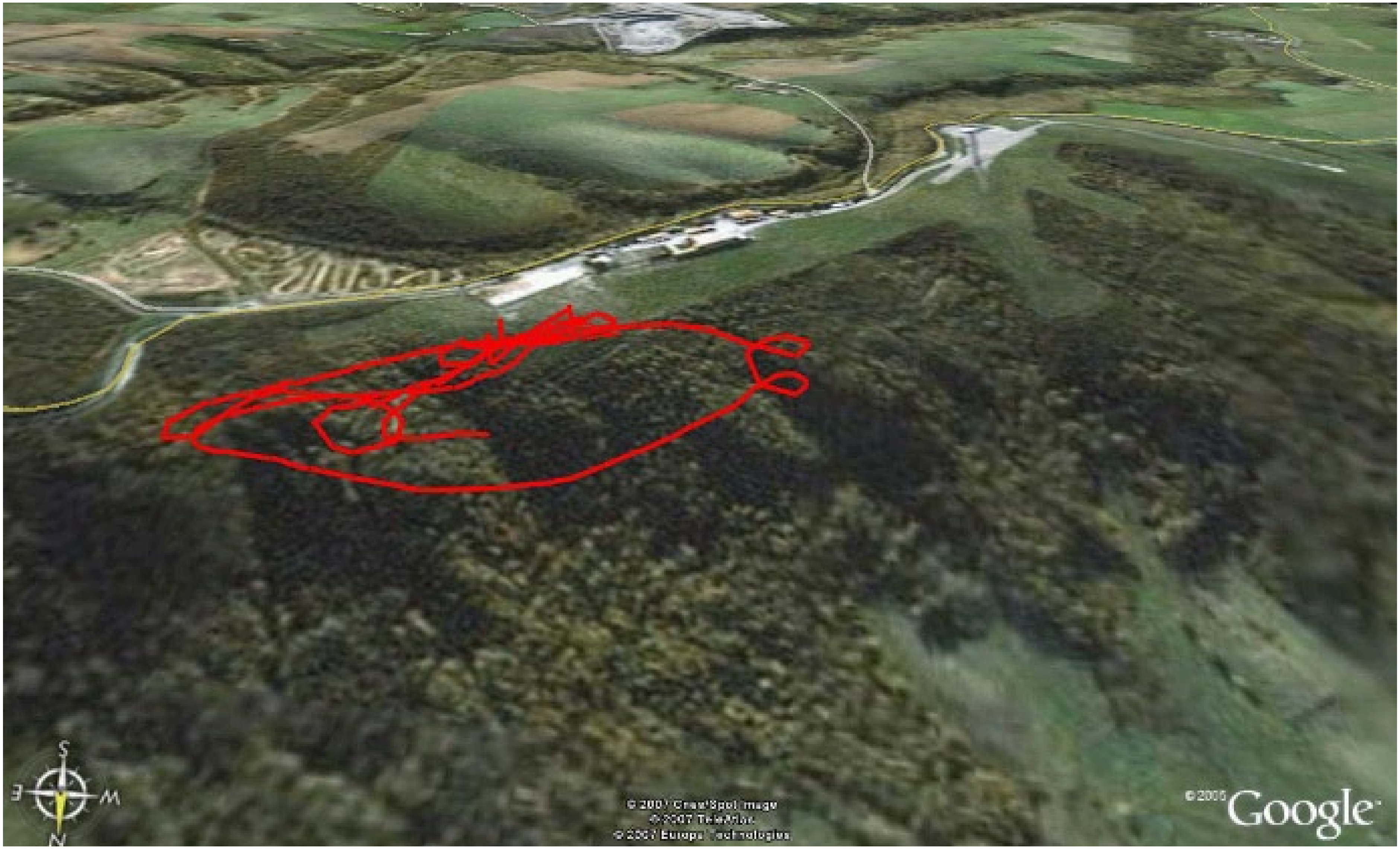
To put it in a nutshell, you have to extract much information from scarce recording. This ends in quite a large uncertainty about C_L values.

I then bought an "off the shelf" recording system, namely the system from Eagle Tree Systems <http://www.eagletreesystems.com>. It was difficult to get the system sent over to France, as the post office and customs did not help in the process. But the Eagle Tree company was professional and I finally received my logger.

It includes:

- Onboard recorder from which you can upload data to a computer using USB.

Eagle Tree Systems telemetry hardware and software on CD-ROM



Recorded flight path, as plotted in GoogleEarth

• An airborne emitter and its ground interface with LCD display for live measurement checking and variometer.
• A set of sensors: altitude, total pressure (for V_{CAS}), and servo signals as basics. Were added: acceleration on two axis (Nz, Nx), GPS and electric motor parameters.
• Software for the interface with PC, and parameterization of all data, airborne and on the ground.

The system is very well prepared for non-specialist users, meaning you just have to plug everything right, and follow the instructions as written in the user guide. If needed you can also have support directly from the Eagle Tree guys.

Using such a recording system gives access directly to V_{CAS} and acceleration Nz through the different sensors. This is exactly what we need for evaluating C_L! GPS is also used to have a full picture of the path.

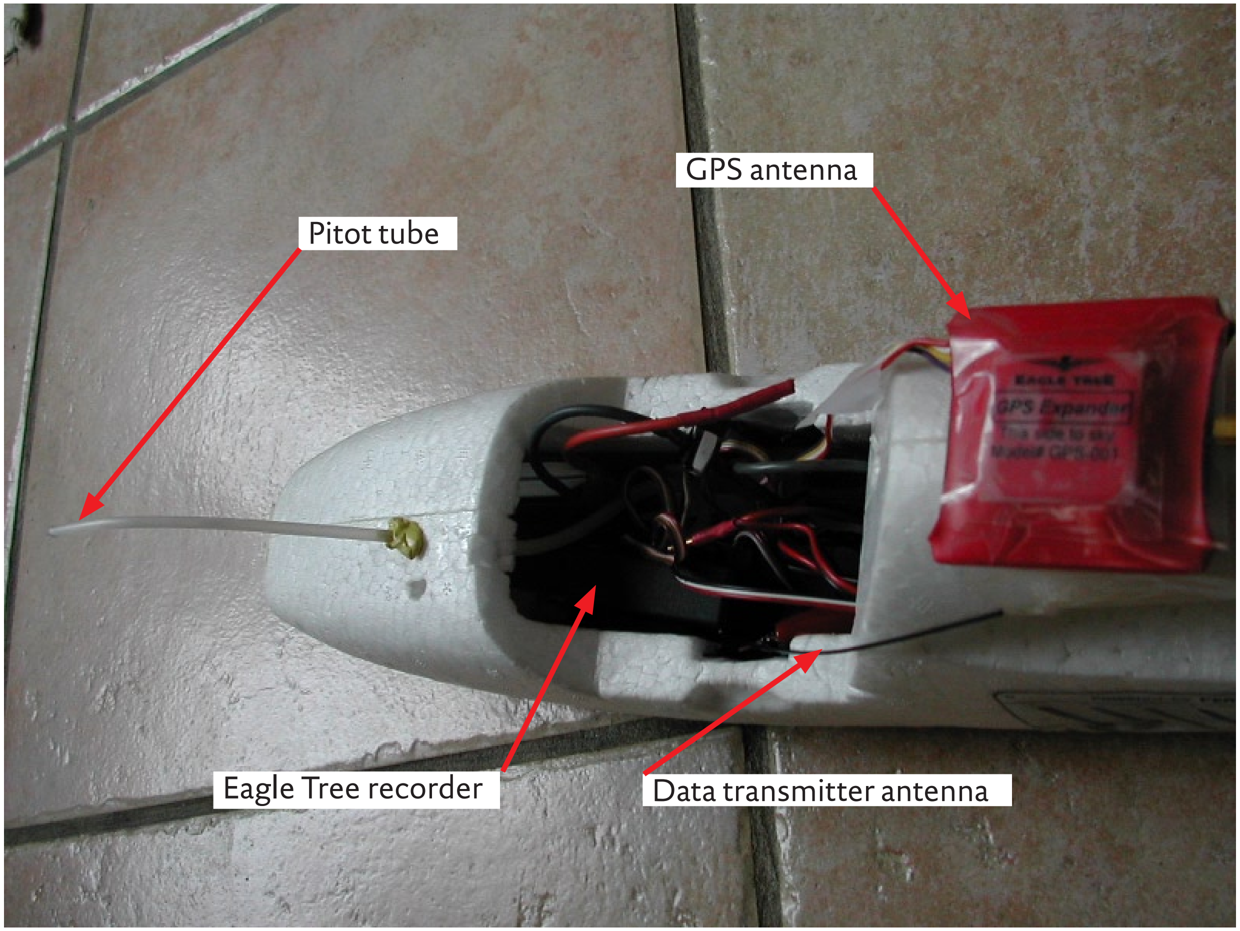
I have installed the system in three different gliders up to now:

• A multiplex Easystar used as a test-bed for learning to use the system.
• My F3I "Jade" home-designed sailplane, with 3.85m span and weighing 4.6kg, flown both towed and on the slope.
• Aerobatic sailplane "Voltij" from Aeromod, flown at the slope. It has a symmetrical airfoil, meaning it can fly as well positive or negative.

Easytar electric sailplane

Voltij aerobatic sailplane

Jade F3i competition sailplane



Quick-and-dirty installation on board of Easystar test bed.

Some preparation is necessary to have quality measurements.

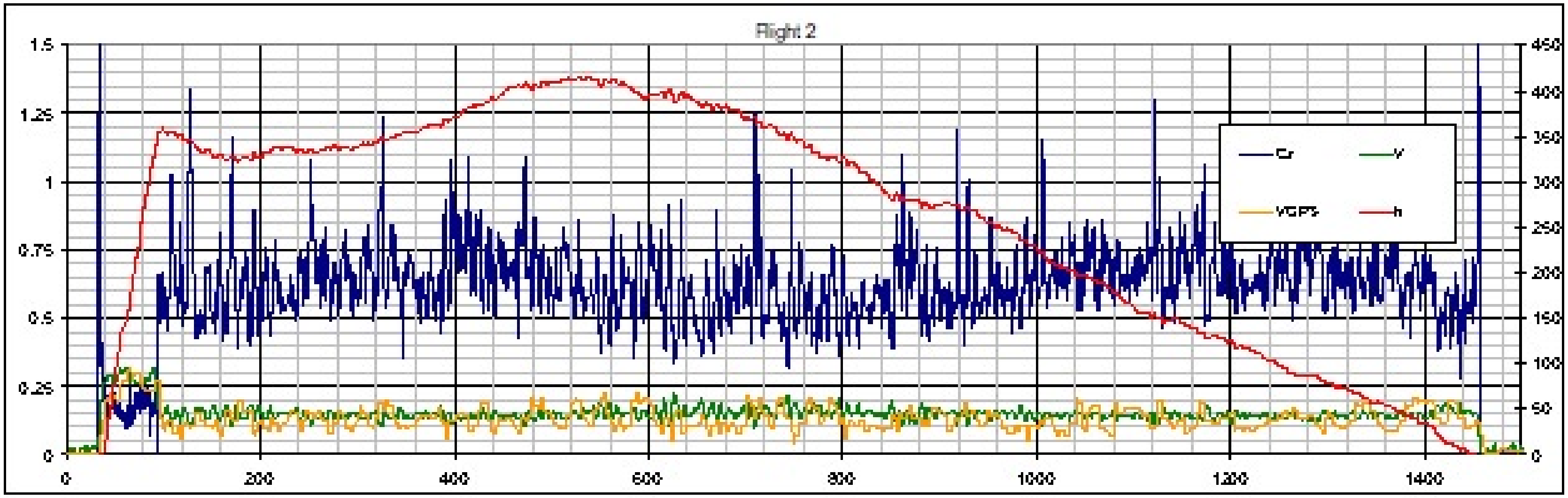
- You need to install a Pitot tube for measuring airspeed V_{CAS}. Recommendations are given in the Eagle Tree user guide.

Theoretically, measurement is sensitive to the location of both Pitot tube and static probe. I have investigated the accuracy of airspeed by comparing with GPS speed. I was able to repeatedly evaluate a 5kph wind in altitude, meaning the accuracy should be higher than 2.5kph.

- Acceleration sensor is to be calibrated, and needs to be installed as close as possible to the CG location (the wire for this sensor is somewhat short with respect to that).

Once everything is installed on board, using the system every day is easy. When you power the sailplane, the initialization of the system begins.

The dashboard is very useful for checking "live" that everything is running correctly. GPS coverage can be displayed, and all you need to do is wait for one or two minutes before enough GPS satellites are contacted.



Recording of an aero-towed flight with the Jade

This being made, you just have to fly the glider. The recording duration depends on the recording rate. I use two records per second, giving approximately one hour of recording with the full set of sensors. This duration can vary with the activity of the flight.

Examples of flight recordings

Here are given some examples of flight recordings. The most difficult thing is to remember what was done flying the whole flight sequence !

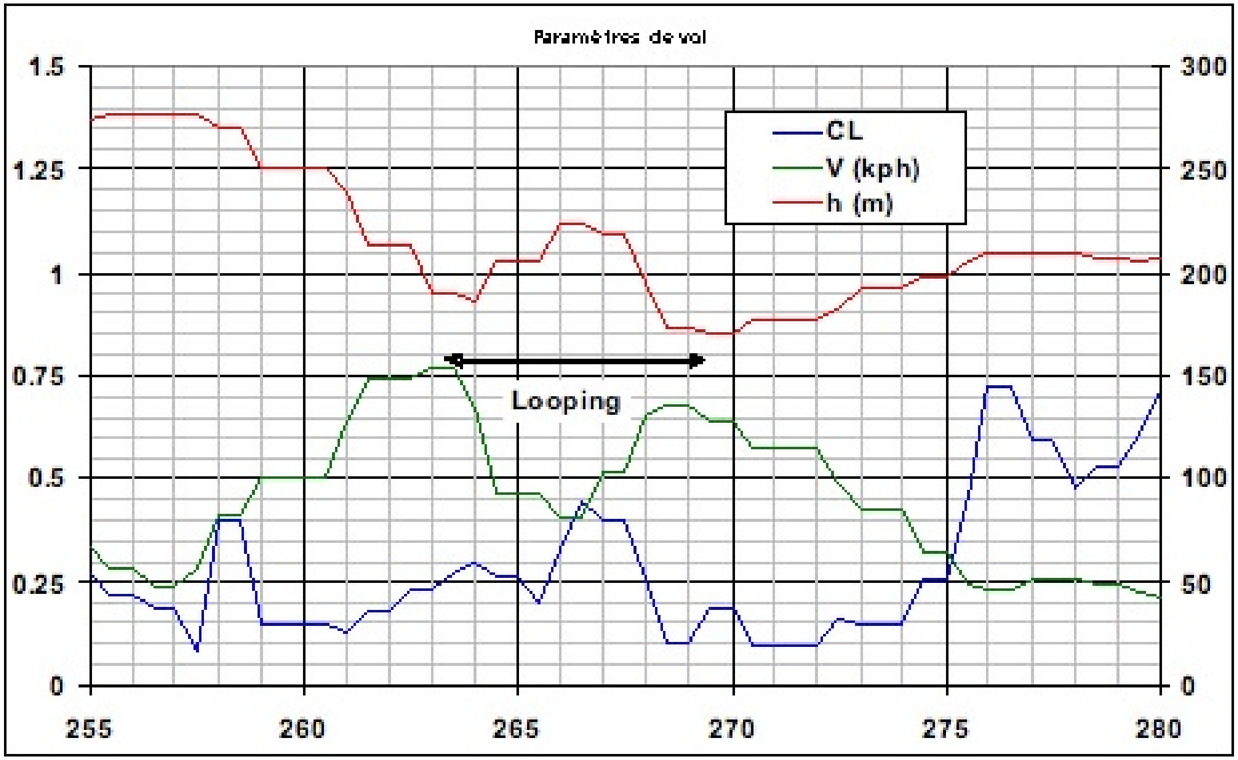
From Eagle Tree software, you can visualize any of the parameters recorded during the flight, and also the flight path in Google Earth: this helps in sorting the different flight phases.

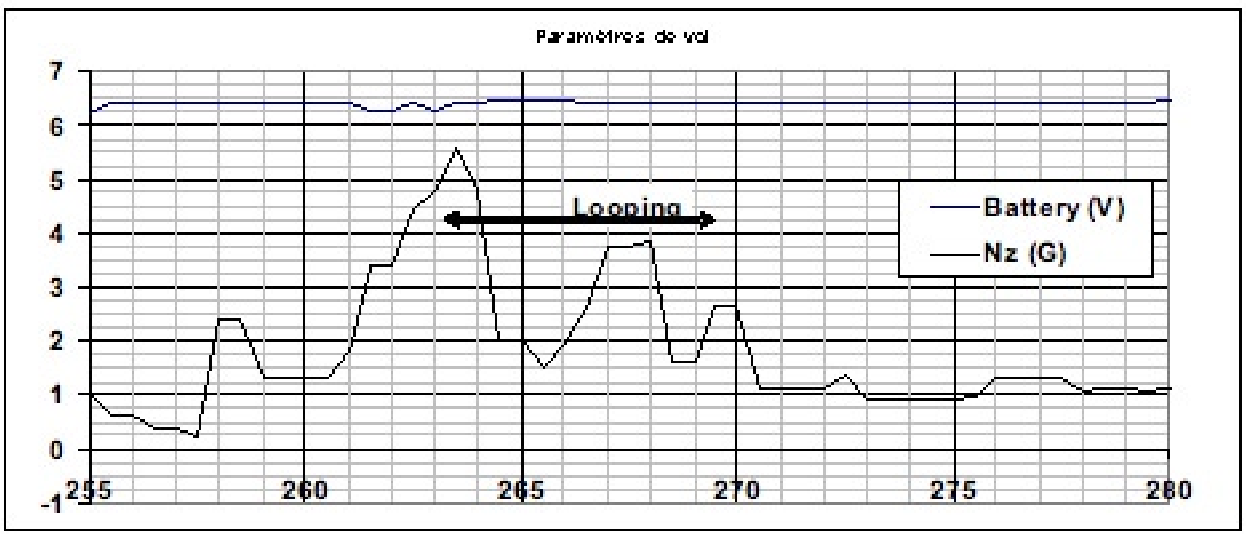
Recording can also be exported to Excel or Matlab in order to generate new parameters as a combination of several recorded parameters. This is done for computing C_L.

Here are some interesting recordings from flights on the Jade sailplane.

First is displayed the full sequence for an aerotowed flight. The altitude is displayed in red, airspeed in green (and orange for GPS speed) and estimated lift coefficient C_L is in blue.

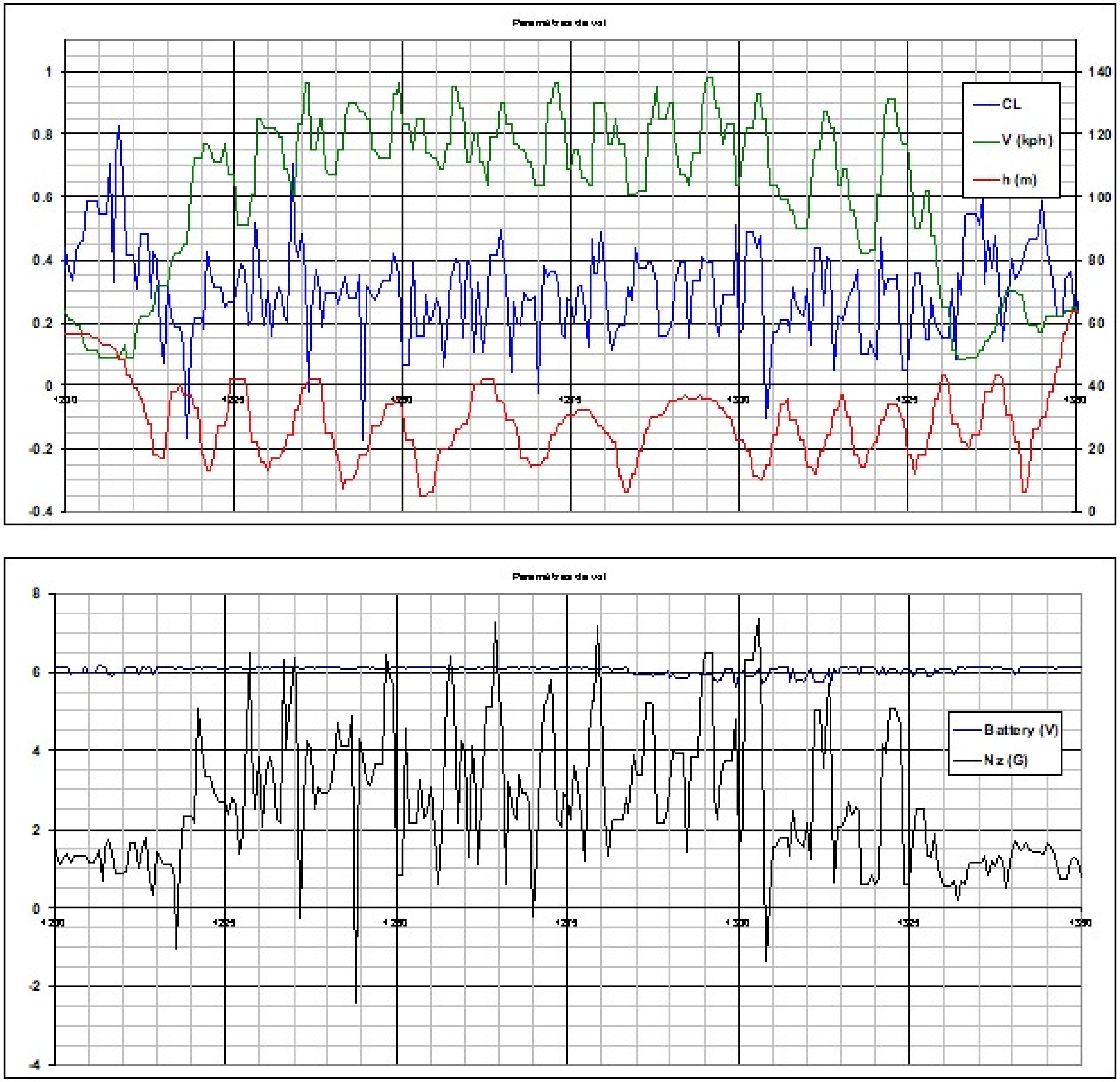
At the very beginning of the sequence, steep climbing corresponds to the aero towing (the mean vertical speed is approximately +6.5m/s). Then some time after release a weak thermal was caught, giving a 75m height gain. This made a 25 minute flight.





Recording of a looping of Jade

Next session is the recording of a simple looping manoeuvre during another aero towed flight. This gives an idea of the conditions encountered by the sailplane in such a manoeuvre. The entry speed was roughly 155 kph and a gentle pull up ($C_L \approx 0.3$) created 5.5g (black curve on the lower part of the graphic). The diameter was approximately 45m. At the end of the manoeuvre, the speed was around 135kph, and altitude was 20m lower than at the beginning.



Recording of 13 laps while DSing the Jade

Last but not least, here is a DS sequence flown on a calm day (15kph wind). This gives some information about aerodynamic parameters while DSing. The flight did look very gentle, as needed for a big lady as Jade sailplane. Already the condition encountered in such calm DS session may seem tough!

Some facts:

- From the altitude variation the mean radius of the path was around 45m (path considered as a 45 degree tilted circle), and airspeed oscillates about +/-20kph around a mean value of 120kph.
- On each lap, the acceleration reaches round 6g, with some peak around 7g.
- The airspeed increase when crossing the shear layer can be observed twice per lap, as “in the book”: in the downwind leg and in the upwind leg.
- Negative g, hence negative values for C_L, are encountered while crossing the shear layer.

This sequence closes the first part about raw experimental material.

Statistical study of a flight: the "flight template"

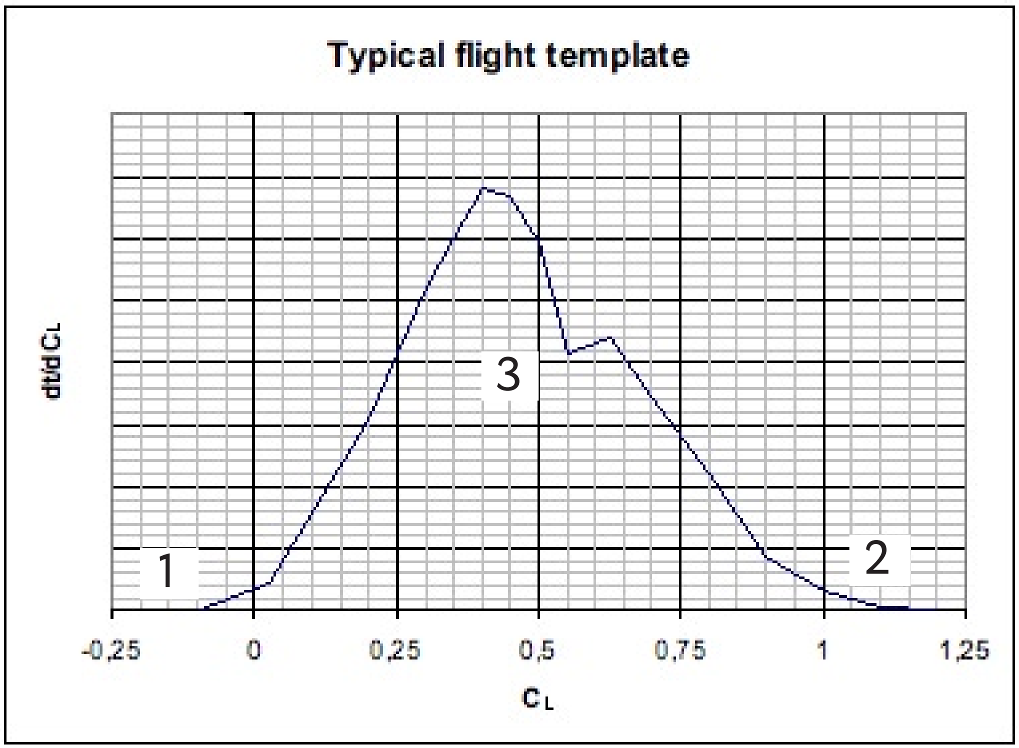
There is a lot of information to treat within a flight recording. In order to be focused on the most important results, a post-treatment of time C_L history was performed. The objective is to have a statistical representation of the flight.

The following plots give an image of how much time was spent for each value of C_L during the flight.

I have called this a "flight template." It represents the relative density of each C_L. Such a curve can be used for summarizing the flight at first sight, in order to give a qualitative and quantitative content of the flight you have performed. Here is given a typical example of a flight template:

Horizontal axis represents value of lift coefficient C_L. **On the vertical axis, the higher the value for one C_L, the more time was spent for this C_L.** Note that vertical axis values have no direct physical meaning.

From this figure, several points can be addressed:



- The minimum value of lift coefficient reached during this flight is approximately $C_L = 0.1$ (1)
- The maximum lift coefficient value reached is approximately $C_L = 1.1$ (2)
- Most of the time during this flight was spent flying the lift coefficient around the main peak of the curve, meaning between $C_L \approx 0.30$ and $C_L \approx 0.55$ (3)

Such a curve can be used for summarizing the flight at first sight, for it gives a qualitative and quantitative content of the flight you have performed.

Note that such a curve can *a priori* be different for each flight, dependant upon several parameters, such as wing loading, etc... But surprisingly, general rules do appear independently from the kind of sailplane flown.

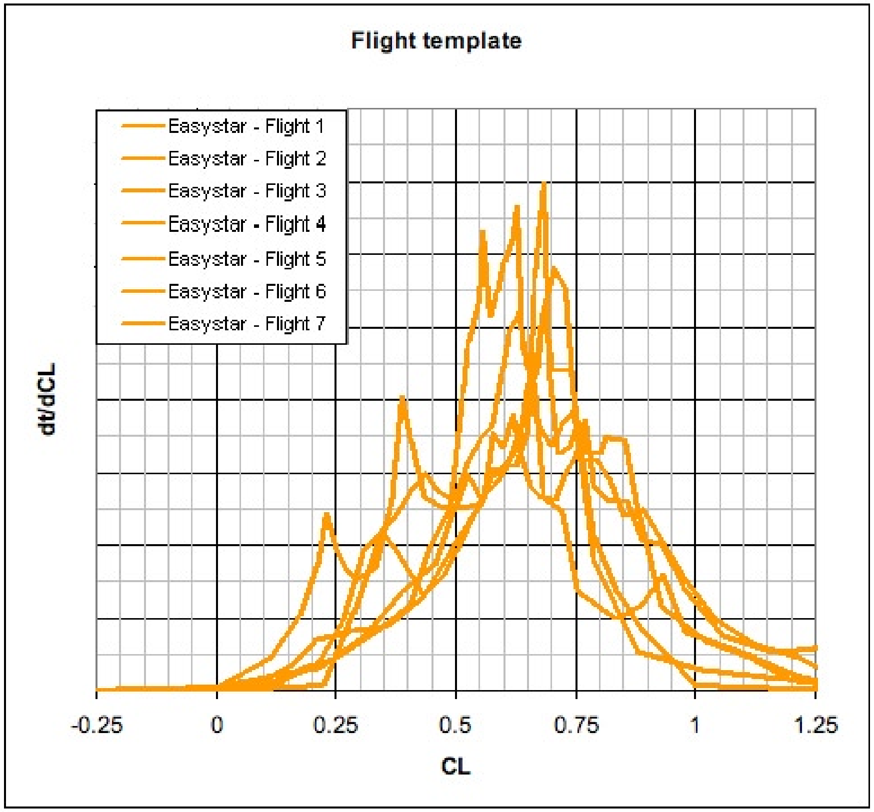
This means some aerodynamic paramount does exist for models, leading to design rules.

But let's talk first about practical examples of the so called "flight template."

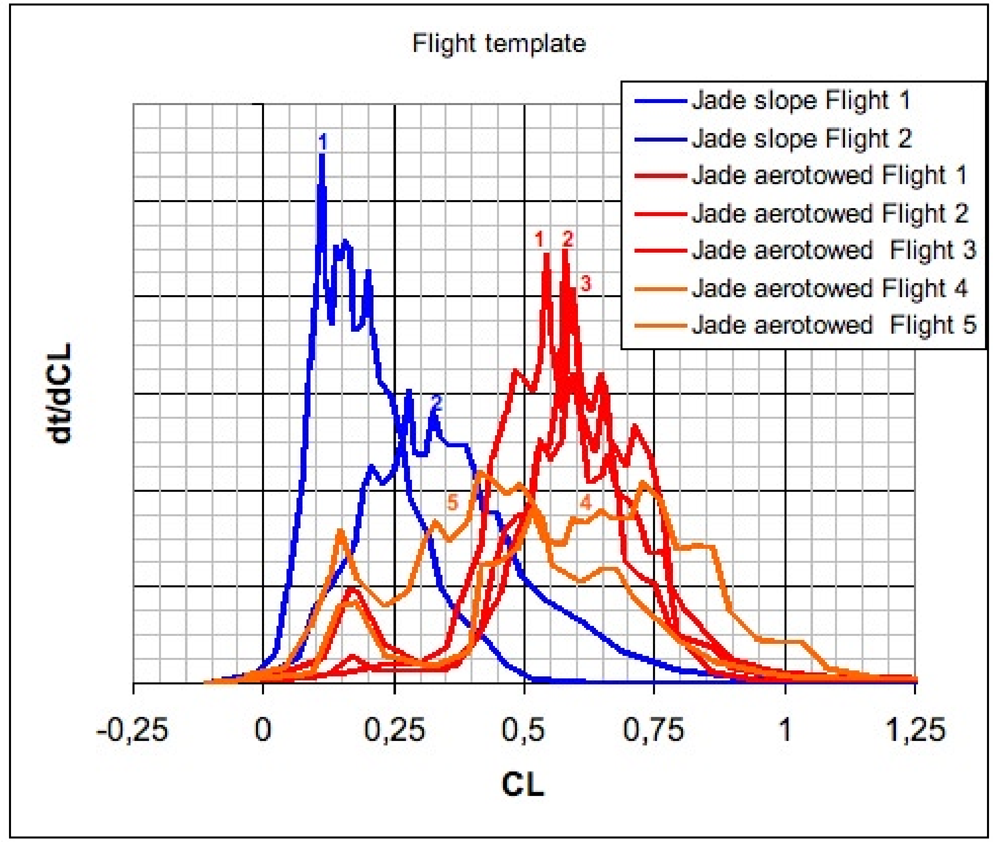
Practical example of a flight template

Easystar

I have been flying the Easystar electric glider quite extensively with Eagle Tree system onboard, without specific objective in flight: to put it in a nutshell, just flying for fun.



Flight template obtained flying the Easystar



Flight template obtained flying the Jade

I have picked up seven flights and generated corresponding "flight templates" representing approximately three hours of typical flight for this model: climbing in thermal when possible, playing at low altitude, etc.

At the end we have here a summary of a typical flight condition for "everyday flight" with a small sailplane.

Several conclusions can be drawn from those curves:

- Evidence is converging to the fact that most of the time is spent flying in the 0.5-0.75 C_L range. This remains true over a wide range of "flight style."
- The upper limit of C_L experienced flying the Easystar is over 1.25. The airfoil being able to generate such a lift, it is used, but not that often.
- The more active the flight, the lower the main peak and the wider its base ("flatter" curve).

Jade sailplane

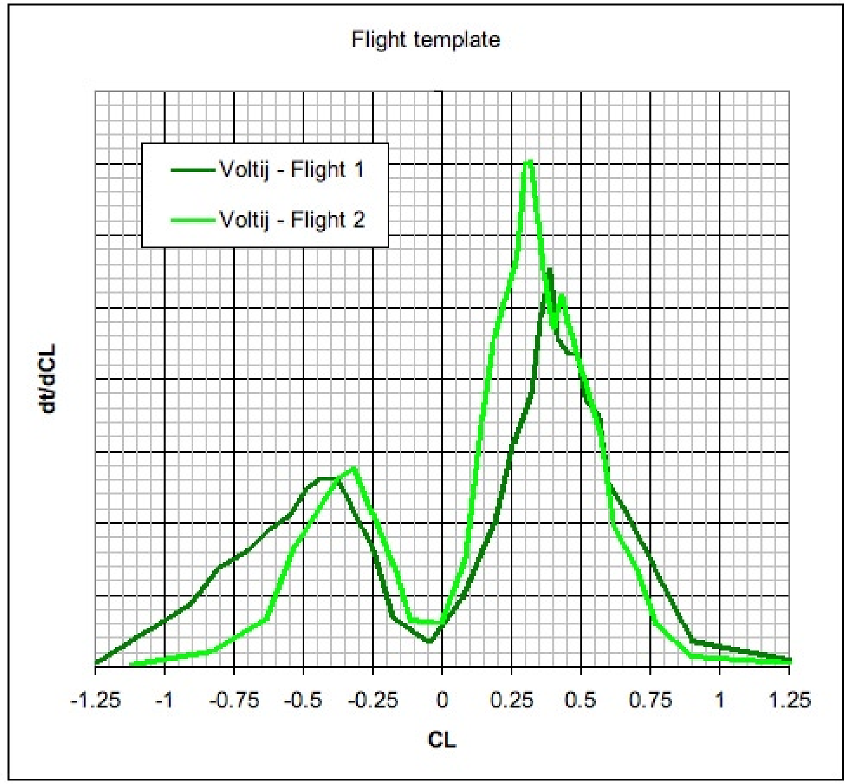
Here are now described flight templates for seven flights performed over three flight sessions. This summarizes nearly 2h30 of effective flight time in different conditions.

In blue, two flights performed at a slope, in altitude (1700m, Port de Bales in French Pyrenees).
In red three flights performed over flat land with aero towed start, on a fair day with broad but weak thermals.

In orange flights from the same place, on a calm day with so to speak no lift.

Several conclusions can be drawn from those data:

- At the slope with very windy conditions (blue line nb1) the need for lift coefficient is very reduced (C_L = 0.5 maximum). Most of the time is spent flying C_L within 0.07 - 0.25 range.
NB: this is probably a good indication of the fact that the wing loading was too low for this windy day…
- At the slope with good conditions but with less wind (blue line nb2), it can be observed that most of the time is speed flying with C_L around 0.15 - 0.5 which is quite low again. But this time, maximum value reached is around C_L = 0.9 - 1.0.
- Over flat land with low wind conditions (red and orange curve), it seems most of the time is spent around C_L = 0.6, whatever the condition. This is in line with results from the Easystar, even if the design is really different.
- Slightly negative values for C_L are encountered, even without performing aerobatics.
- The longer the flight while seeking thermal (red curves, weak thermal available), the more the flight template is focused around the mean value of the typical C_L. And the lower the curves at the extremity of the C_L range.
- The shorter the flight and/or the more “activity” in the flight (orange curves, no thermal available: short flights and aerobatics), the flatter and wider the flight template is, as the whole flight domain is more equally flown.



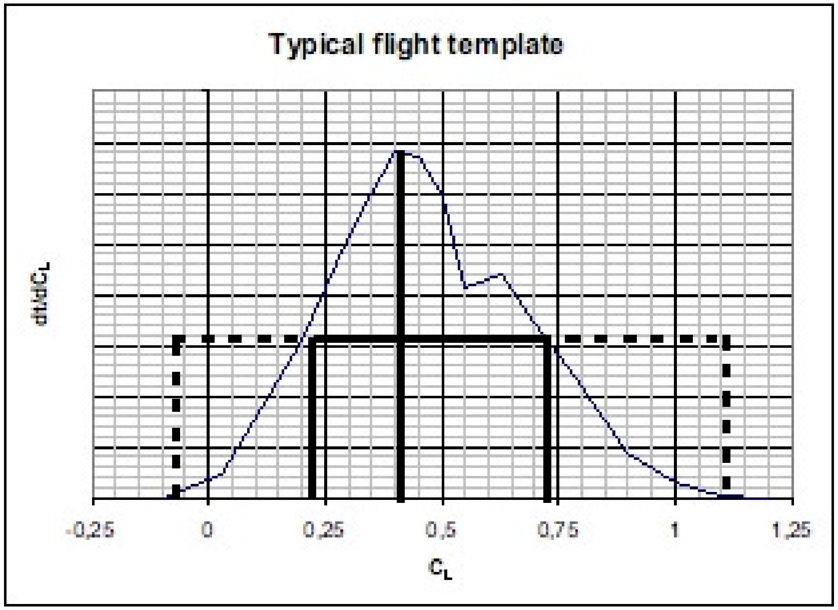
Flight template obtained flying the Voltij

Voltij sailplane

Here are flight templates for two flights performed at a slope in fair lift conditions. This represents approximately. 0h40 of effective flight time while performing various aerobatics manoeuvres. These were quite “active” flights.

Several conclusions can be drawn from those data:

- The positive C_L part is quite consistent with results obtained from Jade sailplane flown at slope.
- Once again the need for high C_L is not often verified. Nevertheless in the detail, it seems more (negative) lift is used in inverted flight than in positive.
- A symmetrical sailplane as Voltij can be used symmetrically, as mean peaks for positive and negative C_L are symmetrically shared.
- The relative heights of the peaks for positive and negative C_L mean how much time was spent in normal flight versus in inverted flight (here roughly 2/3 in positive, 1/3 in negative).



Airfoil analysis and design rules using lessons learned from flight templates

Use of flight template in airfoil and sailplane design

A flight template gives basically the image of which part of the C_L is flown more often. Then the following statement quite logically comes to mind:

We should optimize the aerodynamic characteristics for the C_L conditions that are the most flown.

To put it in a nutshell, the higher the flight template for one C_L condition, the higher attention should be paid to the aerodynamic characteristics, and the more effort should be dedicated to reducing drag for this C_L.

The two typical flight templates defined for slope flight and flight over flat land can now be used for helping the design of an all around sailplane.

Based on a given flight template, two main strategies for optimizing aerodynamic characteristics can be adopted:

- **Maximise performance within the most flown area at any cost elsewhere**

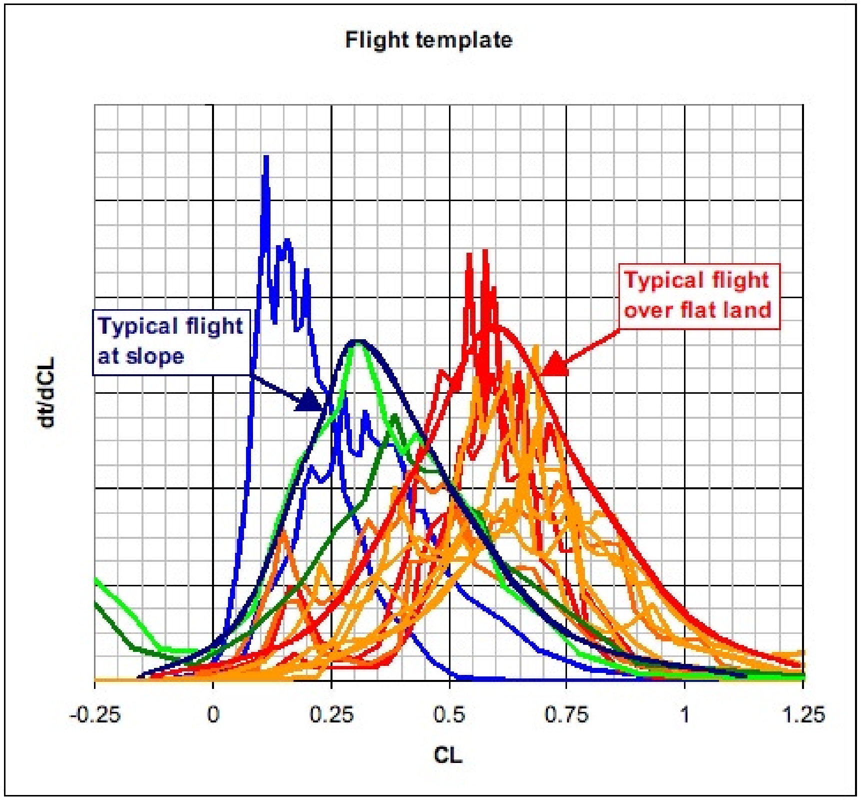
This means optimizing only the most flown part of the domain (bold lines on chart) according to the "flight program" depicted by the flight template.

This is a risky strategy, as high C_L are not flown very often, but nevertheless might be needed over a short period of time. This can be considered for hot competition sailplanes, designing the best for the task represented by the flight template, but probably exhibiting a narrow flight domain, restricted to the completion of the task.

- **Maximise drag performance with attention paid to highest lift coefficients**

This means optimizing the most flown part of the domain (bold lines on chart) but also considering reaching the limit of the flown domain (dotted lines).

This is a less risky strategy, as some efforts are dedicated to fulfilling the



Typical flight template to consider for "everyday flights"

upper end of the C_L range. The sailplane will for sure be less slippery, as it will accept higher lift situation. Nevertheless, it is not possible anymore to optimize as much the "peaky C_L" range of the flight template.

NB: optimizing according to flight template is related to minimizing energy absorbed by drag. Strategy for automated numerical optimization can be derived, for more information see:

<http://perso.orange.fr/scherrer/matthieu/aero/papers/Flight%20template_OSTIV.pdf>

<http://perso.orange.fr/scherrer/matthieu/aero/papers/Ostiv%20presentation%20V2.ppt>

Typical "everyday flights"

We have compiled all the data obtained through flight-testing on different sailplanes in different conditions. Common conditions that can be encountered when flying sailplane models have been covered. It is now possible to define two "statistical flight templates," representing two main C_L range of conditions for flights either at a slope or over flat land, whatever the sailplane:

Typical flight performed at slope (in dark blue):

- The airfoil is the most often used around $C_L = 0.3$
- Typical C_L range of most use is 0.15 to 0.6
- Nevertheless, C_L over 1.0 is flown, but not over a long period of time

NB: conclusion drawn here would be different when considering an F3F run, as the flight is much shorter and the proportion of tight turn much higher.

Typical flight performed over flat land (in red):

- The airfoil is most often used around $C_L = 0.6$
- Typical C_L range of most use is 0.3 to 0.8
- Nevertheless, C_L up to 1.1 - 1.2 is flown, but not over a long period of time.

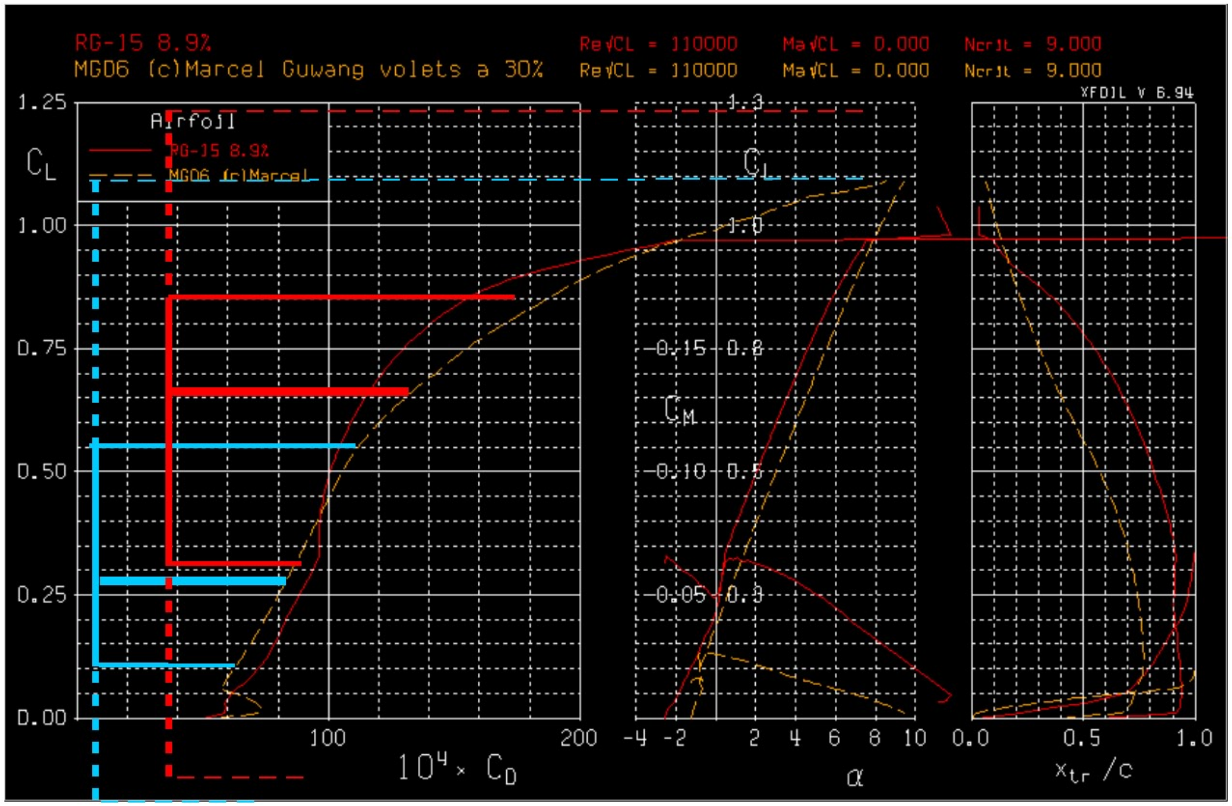
NB : conclusion drawn here might probably stand for duration tasks in competitions.

Illustrated use of flight template for airfoil selection

Let's have a look at the following test case. Hereafter are displayed Xfoil polars for the MG06 (very successful in the 60 inch class) and RG15, at rather low Re condition.

According to those results:

- If we consider a typical flight over flat land, we see that in the most often flown C_L range (red, bold line on the left) RG15 does exhibit lower drag than MG06.
- For typical slope conditions, this time MG06 has a lower drag than RG15 in the most often flown C_L range (blue, bold line on the left).



Airfoil polars & range of use as described by flight template

In the end, RG15 seems a better all around airfoil than MG06, whereas MG06 is better adapted than RG15 to slope flying. Additionally, the fact that MG06 is able to generate high lift at low Reynolds numbers should make a sailplane equipped with it easy to fly. This fits rather well with the in-flight observation for a 60 inch glider equipped with those airfoils.
NB: for completing the full view, the effect of flaps should be studied, as the MG06 range of use does improve much with dynamic use of flaps.

Conclusion

I hope you now have a better idea of the aerodynamic conditions as encountered by our sailplane models, and accordingly what needs to be done for better-optimized gliders.

It was at first not an easy task to define a process that allows proper estimates of lift coefficients we are actually flying, as we are not in the sailplane.

Based on recordings, I have built the concept of "flight templates" that are curves describing the content of the flight in terms of lift coefficient C_L.

For "everyday flying," typical templates for flying at a slope and over flat land have been extracted. It has been shown that some parts of the C_L range are more often used than other. Surprisingly, the most often flown lift coefficients values, around $C_L \approx$ 0.5-0.6, may seem rather low. Nevertheless, higher C_L are experienced, over shorter periods of time.

For competition, a task flight template can be as well derived for defining very precise aerodynamic specification for the optimization process. The ideas developed in this paper have been adapted to F3B competition, and are being used for a sailplane project in collaboration with P. Kolb & B. Rodax.

With the knowledge of those statistical studies of flights, new optimization strategies can now be adopted in order to design sailplanes that fit with the use we make of them.

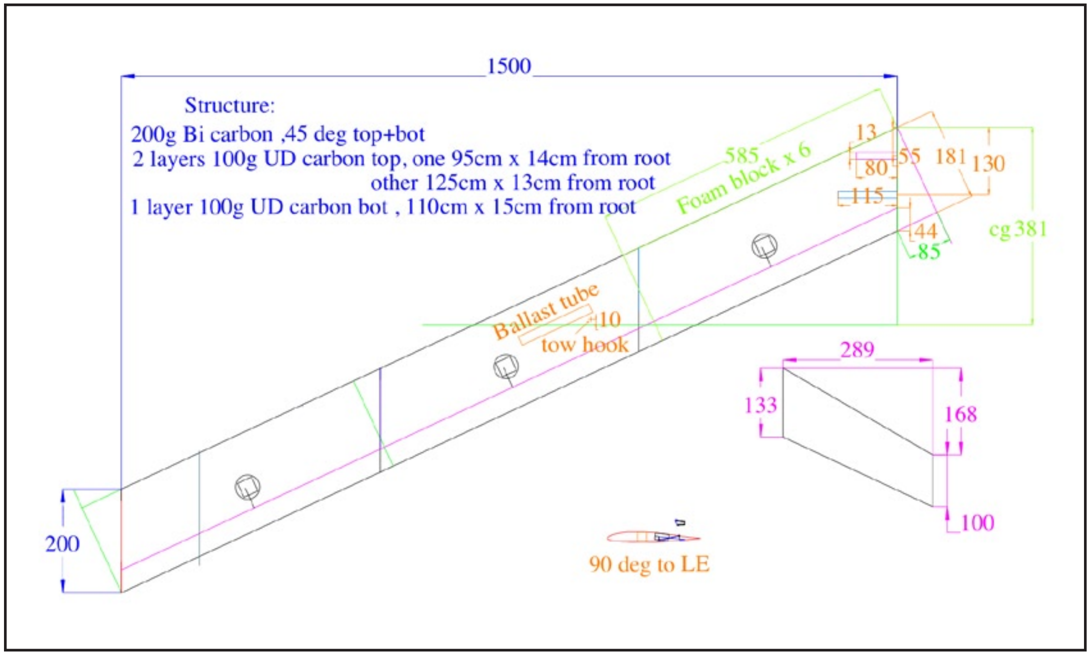
I now wish you happy designing and flying with the benefit of all this information!!

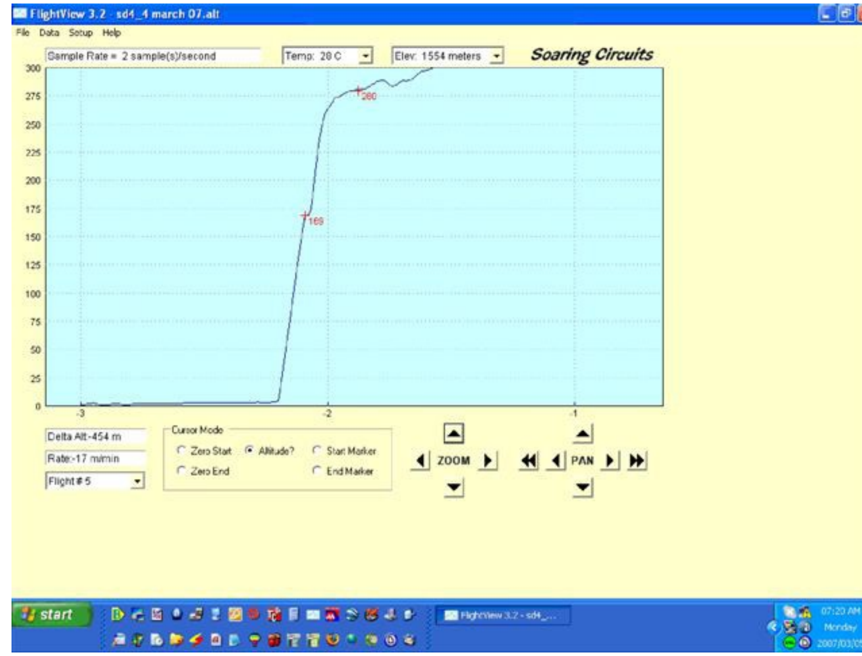
SD4

an F3B capable 'wing

by Stephane De La Haye Duponsel
<theduponsels@yebo.co.za>

I have built a flying wing as an experiment to see if it could be competitive in F3B. I have built many of my own conventional designs and I compete regularly in the thermal events and in F3B in South Africa.I am not too concerned about winning events, so I am quite happy to partake and see what the wing can achieve. Being obsessed with launch height and speed, I have designed the wing so that it can launch with camber (hence the sweep for stability) and for speed, zero wash out with zero pitch airfoil. I modified an HQ airfoil to have a higher camber and thickness. The idea was to have the same max lift as the popular MH45 but with less drag at the high angle of attack.





The SD4 is a simple design based on the CO (Hans-Hürgen Unvereferth) planforms:
span: 3m
sweep: 25 degrees
constant chord: 20cm , no wash out
airfoil: modified a Quabeck HQS 1.5/9
wing area: 60dm
weight: 1600g plus 1000g ballast

I am very pleased with the launch heights achieved. This is at the high altitude that I live (5500ft). It uses up a lot less line than my other conventional designs before the zoom, and the total launch height depends on the conditions and how much line tension can be achieved. Ranges from 200m with crosswind and no lift, to my best at 280m with both headwind and lift.

The handling is very docile using the wing fences. I am too scared to try without.

Minimum sink is OK.

I have not tried an F3B speed run yet, but will let you know what can be achieved. I have dived from speck height without ballast and no flutter as yet (holding thumbs).

The turns at speed are impressive using “snap flap” (elevator up, root flaps down). This mode is nice and has sensitive pitch control, but has to be switched off at landing or else you might find the nose embedded in the ground if you overreact.

I use my throttle stick to adjust camber along the wing as I feel. I don’t like using preset modes. No throttle, zero wash out to full throttle for launch/thermal giving 10 degrees at root, three degrees at tip.

The wing is stable for the full range of airspeed, with just a touch of reflex, one degree, at the tip elevon when there is no wash out.

At launch I use a preset switch to give reflex at the tips to help rotate. Just before the wing is about to rotate onto it's back I flick the switch to remove the reflex. It then keeps the line tension and correct angle.

For landing I deflect the root flap 30 degrees, middle 80 degrees, and the tip stays the same. The root flap has enough lift to counteract the negative pitch of the middle flap.

The idea was to have the stiff control surfaces at the root and the tip, the middle flap has in my opinion less impact than the root on flutter and twisting the wing structure if it is a little floppy.

The wing with this set up lands very slowly , but you have to make sure that the elevons have a lot of travel to keep directional control authority at slow speeds.

I wanted to keep things simple from a construction point of view .

All you need is :
- two sets of templates of HQs_1,64_9,8
- six blocks of pink foam 181mm x 585mm x 50mm thick

All six panels are identical in shape and then three are glued together to make up each wing. The wings are bagged as large rectangles 181mm x 1755mm. The tips are then cut at the right angles to make up the sweep. The wing joiner boxes are made from 10mm ID alluminium tubing. The foam is drilled out from the root to make space for the joiners which are glued in place using a mixture of microballoons and resin .

(People are welcome to email me for info on a technique how to get the angles and alignments correct or any other info.)

The structure is simply a stressed skin layup of carbon over pink foam. I used 100g UD carbon for everything. Two layers at 45 degrees over whole area. A couple of layers parallel to the LE for bending strength. Two 10mm carbon rod wing joiners go through the fuselage. Alluminium joiner tubes simply glued in place with microballoon filler to tie the skins together. The wing has one degree anhedral - raised 26mm at the root when installing wing joiners.

The structure is light and stiff, and quick to build. It was designed to take loads from the middle flap where the tow hooks are for the bridle. I also modified the templates for foam cutting to have the same thickness but narrower chord to be able to cut at 90 degrees to the leading edge. The wing is bagged as a big rectangle and then the ends are cut off to make the sweep.

Ballast is also held in the middle flap area, I am hoping that because I will only use ballast at speed that the roll rate will still be OK.

I will keep you updated as the results come in.

The SD4 airfoil, used along the entire span and without washout:

```
1.00000  0.00000
0.99114  0.00055
0.97553  0.00153
0.95241  0.00319
0.92216  0.00568
0.89508  0.00820
0.85355  0.01256
0.80645  0.01817
0.75452  0.02480
0.69857  0.03205
0.65451  0.03753
0.60907  0.04281
0.54705  0.04918
0.50000  0.05309
0.45295  0.05605
0.40631  0.05822
0.34549  0.05975
0.30143  0.05980
0.24548  0.05864
0.19355  0.05662
0.14645  0.05130
0.10492  0.04526
0.07784  0.03955
0.05450  0.03324
0.02447  0.02189
0.01204  0.01487
0.00616  0.01022
0.00222  0.00573
0.00099  0.00378
0.00025  0.00187
0.00000  0.00000
0.00025  -0.00175
```

0.00099	-0.00330
0.00222	-0.00467
0.00616	-0.00699
0.01204	-0.00949
0.02447	-0.01287
0.05450	-0.01777
0.07784	-0.02047
0.10492	-0.02286
0.14645	-0.02557
0.19355	-0.02758
0.24548	-0.02892
0.30143	-0.02983
0.34549	-0.03009
0.40631	-0.03021
0.45295	-0.03003
0.50000	-0.02941
0.54705	-0.02831
0.60907	-0.02606
0.65451	-0.02386
0.69857	-0.02158
0.75452	-0.01844
0.80645	-0.01533
0.85355	-0.01203
0.89508	-0.00879
0.92216	-0.00660
0.95241	-0.00407
0.97553	-0.00211
0.99114	-0.00077
1.00000	0.00000

Template coordinates, for use during construction as outlined in the article:

1.00000	0.00000		
0.99726	0.00021	0.00273	-0.00614
0.98907	0.00082	0.01091	-0.01091
0.97553	0.00185	0.02446	-0.01551
0.95677	0.00346	0.04321	-0.01948
0.93301	0.00574	0.06697	-0.02329
0.90451	0.00882	0.09547	-0.02667
0.87157	0.01281	0.12841	-0.02958
0.83456	0.01783	0.16542	-0.03199
0.79389	0.02387	0.20610	-0.03376
0.75000	0.03071	0.24999	-0.03503
0.70337	0.03802	0.29662	-0.03593
0.65451	0.04539	0.34549	-0.03633
0.60395	0.05247	0.39604	-0.03648
0.55226	0.05889	0.44774	-0.03631
0.50000	0.06420	0.50000	-0.03552
0.44774	0.06814	0.55227	-0.03401
0.39605	0.07087	0.60396	-0.03172
0.34550	0.07227	0.65451	-0.02883
0.29664	0.07223	0.70337	-0.02575
0.25001	0.07116	0.75000	-0.02260
0.20612	0.06931	0.79390	-0.01947
0.16545	0.06502	0.83457	-0.01621
0.12845	0.05918	0.87157	-0.01287
0.09551	0.05256	0.90451	-0.00971
0.06701	0.04452	0.93301	-0.00689
0.04325	0.03585	0.95677	-0.00448
0.02449	0.02652	0.97553	-0.00255
0.01094	0.01711	0.98907	-0.00115
0.00275	0.00777	0.99726	-0.00029
0.00000	0.00000	1.00000	0.00000

a slope soaring weekend

BLACK EAGLE

March 10 - 11th 2007

Mike May, Bartlett Eggs Radio Gliders (BERG) North/West of Johannesburg, South Africa
Photography by Martie Du Toit and Piet L. Rheeders

This weekend event occurs once a year and is an opportunity for a group of South African model glider pilots to all come and share some "big air" on the slope together.

The venue of choice at present is Tamatie Berg (Afrikaans for tomato mountain) no-one has yet explained its name and no, it is not red in colour. When one flies in the south easterly wind here, the sleepy town of Volksrust is spread out before you with the majestic Majuba mountain in the distance, site of a famous Boer war battle.

This mountain stands alone and has a fair road as access to the top to service a large communication mast. Most wind directions generate flying conditions on its many faces and wind is normally not a problem, as this area acts as a funnel between the highveld and lowveld with the Balele mountain escarpment nearby.

The background all nicely explained, onto the flying.

The aircraft include a range of foam type flying wings and simple conventional layout gliders up to large scale composite gliders, often fitted with onboard variometer telemetry.

What makes this weekend special is the comradeship between pilots from different parts of the country, and cities as far apart as Durban , Bloemfontein and Johannesburg/Pretoria . For the city slickers, staying on a working farm also adds to the experience as we overnight and chat about the days events.

This year marginal conditions at times meant pilots needed to go out and search for thermals to gain height, and this was often done under duress while a group of backseat drivers gave advice. Almost without exception these aircraft regained height, thus saving their owners from what is known locally as the "big walk of shame."

The event was attended by +/- 30 slope flyers from mainly Gauteng, Kzn and Freestate provinces. The range of models ranged from a 15 cm twin pusher electric model, park flyers, foamies, moldies and "Go Big or Go Home" large scale gliders of fve to six meters wing span.

The pictures tell their own story, but the visit into the mix of gliders by a local and very territorial Black Eagle (see opposite page) was a highlight.

This was captured by Martie Du Toit on a Panasonic DVC-F250. These raptors specialize in hunting the Dassie (rock hyrax), abundant in these mountains. This bird really seemed to enjoy checking out these new shiny multi-coloured space invaders.

Black Eagle slope weekend, where did it get its name? Pretty apparent - we fly where Eagles dare.

Until next time when we soar to new heights.

Mike May

P.S. The Black Eagle slope weekend is organized once a year by the BERG club. You are welcome to visit our Web Log at <http://berg-gliders.blogspot.com/>.

Martie Du Toit took this stunning picture of a real Black Eagle formatting on Ryan Nelson's Zagi on Sunday. Working with the Zagi wing span and presuming that the eagle and the Zagi are at the same altitude, the bird's span calculates out at about 850mm.

Mike May and his two meter bagged Zagi, Charl Viviers launching for it's maiden flight. South slope with Volksrust mountains in the distance. Photos by Piet L. Rheeders

Above: “No, we are not fishing!”

Right: Pilots’ pit area. The wind is up and every one is having a ball.

Photos by Piet L. Rheeders


B
2
ZS-MGM

Left: Assembling the Big One - Mike May's 5.1 meter Ventus 2ax in the car park - North slope Volksrust.

Below: Izak Theron recovering his JW - South slope Volksrust.

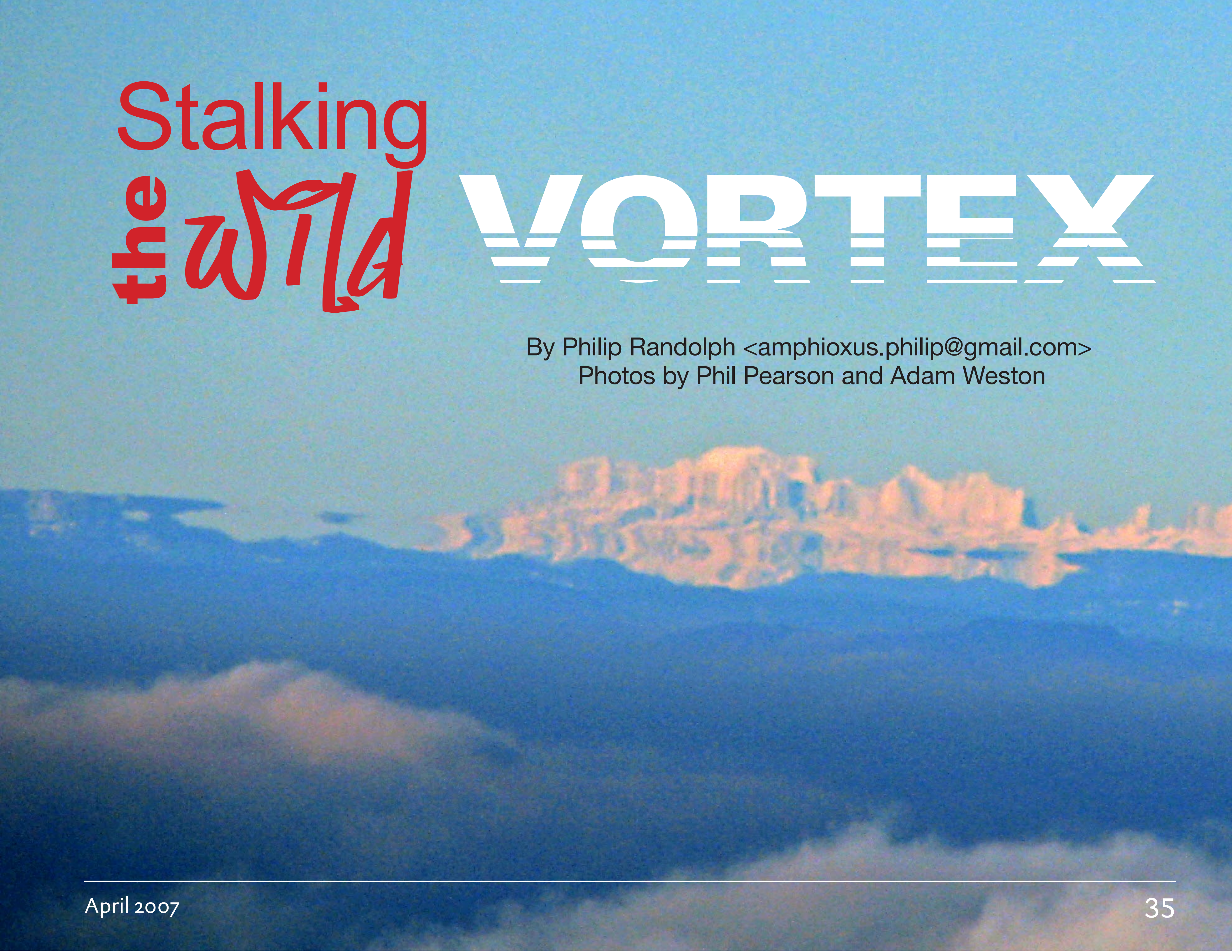
Photos by Piet L. Rheeders

Opposite page:
Mike May's 1/3 scale
Ventus 2ax spans
5.1 meters and
weighs 8 kg.
Photo by Piet L. Rheeders

John Phillips launching a competitor's Aris at the Welsh Open F3F event, South Wales, 19 August 2006. Photo by Michael Shellim.

Stalking the Wild VORTEX

By Philip Randolph <amphioxus.philip@gmail.com>
Photos by Phil Pearson and Adam Weston



A wheelbarrow up a tree. A paraglider up a tree. A discus-launch glider up a tree. (And your author? Perhaps you'll decide he also is up a tree.) Performance enhancing drugs. Mirages (not from the drugs). What guys talk about (equals: why women stay at home, rather than hike with us). Winter hikes up Tiger Mountain.

(Humor, but only if you find it humorous. Members of the Society for the Protection of Wild Vortices will not.)

Tiger Mountain is that mostly wooded, 3000' bump just SE of Issaquah, Washington. If you Google Earth, 47° 29'59.07"N 122° 00'25.47"W, you'll see a paraglider taking off from an indoor-outdoor carpet ramp, near the West summit. The ramp is at one of Tiger's two spots where paragliders and a few of us RC glider guys stalk wild vortices. It's at a side-hill 1800' elevation bump called, "Poo Poo Point." (Gawd. Why?) There is also a cleared southern face.

Paraglider personages get to drive up. Even in these days when politicians are so closely aligned with special interests they have to pick the pocket lint out of their beards, this probably isn't the result of some shady, back-room deal. It's more likely related to the minor fact that the paragliders selfishly did all the site work—clearing, seeding, and watering. There's a big, stainless steel tank back in the trees, salvaged from a local creamery, that they used to water the new grass, some years ago, to keep it going through our fairly dry summers. They even put up a wind monitoring station.

But everyone else has to hike. Everyone else, for the purposes of this airudite literary endeavor, means Phil Pearson, Adam Weston, Steven Allmaras, James Hohensee, and what's-his-name (your author). So on any of five early Fridays in January and February, if you were in the wrong place, you might have observed some subset of us lugging Encores and Red Herrings and transmitters and lunches up the trail from the paraglider landing site.

For those of you who want to make a pilgrimage to the wheelbarrow, the landing site trailhead is by Issaquah-Hobart Rd. SE and SE 113th St.

Rule number one:

Stalk little wild vortices.
Run from the big ones.

A quarter of the way up the trail there's a spot where a fully-grown wild vortex must have touched down, in last December's windstorm. It's a couple hundred yards across. Half the trees are down, and some of the rocks are ripped out of the ground. When you are stalking a wild vortex, stalk a smaller one.

Unfortunately, wild vortices, unlike their dust-devil cousins, are usually invisible. That makes it hard to film the stalking of them. The closest example I can offer is of Mickey Rooney stalking the wild Rainiers. (To view, Google: YouTube, Mickey Rooney Safari, Rainier.)

Intrepid Slope Explorer Chris Ericson saw some wild vortices one time, dust-devils wandering up Quartz Mountain, South of Cle Elum. He launched his Red Herring into several, against their rotation.

A moment of truth: More commonly, we catch the cousin of the wild vortex, the wild thermal updraft. These are also usually invisible. I saw one, once, from the top of Granite Mountain. It was sucking fog out of a fog bank 4000' below, in slowly twining ribbons. I was too new to the sport to launch my Chinook at it.

Wild thermal updrafts and even dust devils are so large that they are not significantly injured by toy airplanes. I wish I could also say that no wild vortices were injured during the making of this article.

Title page photo: Canadian Cascades and foothills in mirage! Photo by Adam Weston

Adam Weston, Philip, and Steven Allmaras at south launch site. Photo by Phil Pearson.

Hike number one, January 26, 2007. Fog. Mirages.

The first hike of the season is by Phil, Adam, and Philip. We're trying to get back in shape after. And a big part of flying things, for me, is that it gets me to gorgeous places. Tiger Mountain is worth hiking even in the summer, when there are more options without much snow.

Tiger is foggy, all the way up. We pass the wheelbarrow, which is hanging in a tree a couple hundred yards from bottom of the south launch clearing. It has no wheel.

Philip observes, "The wheelbarrow has a modified Clark Y (flat bottomed) airfoil, heavily reflexed at the trailing and leading edges. Observe that it has twin tailbooms. To these the operator can attach an inverted vee stabilizer, approximately his arms, for control."

We don't know whether wheelbarrows roost in trees, whether it climbed it, or whether, like a hang-glider you'll meet shortly, it landed there after a failed takeoff.

We switchback up to the south launch site. The wind is coming up the slope. We eat lunch with the trees dripping from the fog. Just as we launch 60 inch Encores, the wind reverses. Negative lift.

Left: Phil Pearson, Encore in sink, just before it disappears. Photo by Adam Weston Right: Phil. Encore. Photo by Adam Weston

We walk another quarter mile, to the west and northwest facing paraglider launch site.

At first we're still in fog. Lift is mostly negative, bending down over the trees from the northeast. That doesn't stop Adam. When he does his discus launch, half the vicarious experience is from the sound. There's a "Pffwapp!" and his Encore is streaking 175 feet, up. See the front cover of this issue.

The cloud layer drops, so we're looking across white to the top of Squak Mountain, with the Olympics beyond.

Lift remains negative, till the cloud rises again, for a few minutes, lifted by a broad thermal. That makes one of two flights with (foggy) lift, all day, between all of us. I'm circling my Encore into the fog. For me it almost disappears, but for the guys standing a ways behind me, it does disappear. Adam asks, "Can you see it?" Then it slowly reappears. Ghostly, with the quiet a fog brings.

The cloud lowers again, to just below our feet. Above the cloud, it's so clear we can see the Canadian Cascades, beyond Mt. Baker, and to its left. They are amplified by a thermocline, a sharp atmospheric temperature and density gradient. They're twice as tall as they

Phil Pearson by launch ramp, Encore. Squak Mountain and Olympics. Photo by Adam Weston

Starting to clear, which means the clouds are sinking. Photo by Adam Weston

should be, and their normally shaped peaks are stretched into jagged spires. Their lower half is a broad, horizontal band with vertical stripes, refractions of the whites and shadows of the peaks above. And the dark of the foothills and lowlands on the horizon, to the left of Baker, is distorted into what looks like plateaus or mesas, gaps between them connected with horizontal sausages, like when you hold your two fingers in front of your eyes.

Philip Randolph's Encore soars above the clouds and fog. Photo by Phil Pearson

Hike number two, February 9. The wheelbarrow in a tree. What guys talk about. Stalking the wild vortex. The paraglider in a tree.

Please understand that I'm hiking with some brilliant guys. Phil Pearson is the Encore manufacturing arm of Maple Leaf Designs. Adam Weston is an acoustic engineer for Boeing, and Steve Allmaras is a Boeing aerodynamicist.

The four of us pant past the wheelbarrow hanging in the tree. Well, I'm panting hardest. Adam says, "At least we have a wheelbarrow, to haul you down with, if you pop a gasket."

Phil says, "It doesn't have a wheel. We could make a wheel. A round of green cedar might be best."

Adam says, "If we had a chainsaw."

Steve says, "You'd need to put a band of iron around it."

Philip says, "Just haul up a forge, and some coal."

Steve says, "You could use big hose clamps."

Adam says, "Then it would go bump, bump, bump, on the trail."

Phil says, "We could cut notches in the cedar round, and turn the hose clamp inside out, so the adjusters were on the inside."

Philip says, "A normal tire is just air in a toroid (smoke ring) vortex shape with some rubber around it. We catch wild vortices all the time. Forget the rubber. We'll just catch one and put a stick through it for an axle."

At the west facing launch site, the wind is blowing gently down the slope. We take advantage of some down-thermals, to shorten our glide times. Paraglider guys occasionally launch in attempt to set new records for who can get to the landing site fastest.

I'm not paying any attention, just standing with Encore in hand, when I hear gasps and yells. I put down my glider. A paraglider guy has gone down in the trees below.

More yells: "Are you okay?" No answers.

A couple paraglider guys and I run down the slope. It gets "grab-tree-branch," nearly-cliff steep.

After a bit, we hear, "I'm okay."

He's fifty yards down. His glider lines are tangled in the top of a vine maple. The gentle upwards pressure of treetops is a form of lift, sometimes preventing hard landings. A couple of us climb up trunks a bit over two inches thick, and stand sideways between them, to push the tops down to where he can clear his lines.

I tell him, "As long as you didn't get hurt, thanks for the entertainment."

Up top, he spends a couple hours untangling sticks from lines. His chute appears okay. He says he's going to go over it, back in town, before flying it again.

Phil Pearson was watching as he launched. Phil says, "One end of his chute turned under." Someone explains that he also stalled.

Hike three, February 9. Entirely uneventful. Performance enhancing drugs. A nap in the rain.

Hikers: Phil, Adam, James, Philip.

A short distance up the trail, on any given trip, Philip (your author) is panting and complaining and whining and maybe whimpering, too. On trip number three, while pausing by the wheelbarrow, Phil Pearson says, "Don't tell anyone my secret. I take Ibuprofen before a hike. It slows the formation of lactic acid in the muscles."

The wind was from the SE. Cloudy. On the south facing launch slope, the wind quarters down over the firs. (Adam calls them, "pines," because he is from Ohio, or to drive botanical expert Phil bonkers, who knows.) There's wild turbulence and little lift at the top of the slope. My plane bounces all over the place. It's tail drops sharply, and it seems to drag its way forwards. Phil says, "When it puts its tail between its legs, that's a downdraft."

We watch rain showers moving toward us, from Tacoma.

Adam and Phil do their "Pffwapp" discus launches, and get up over the trees, to passable lift. James follows. Adam starts ducking down behind the trees and then up the slope, trying to find some dynamic soaring. I fight my way up through the turbulence.

We hear a sharp crack, the sort of sound James' DLG would make if it hit bare alder branches. Rebagging time. (I fibbed abut the lack of events.)

At the west facing paraglider slope, lift is distinctively downwards. Adam and Phil make their incredibly high launches (my back won't let me do that), and have excellent consistency in shortness of flights. The sun threatens to come out, as it starts to lightly rain. I lie down on the paraglider launch carpet, and go to sleep, till the cold in my legs wakes me. My cell phone hasn't worked consistently since.

The author, with a wild vortex impaled on a stick. Photo by Phil Pearson

Hike number four for me, five for Phil Pearson, February 23. Wild vortices don't survive long in captivity.

As we start, there's a cold breeze in the parking lot. But I must be getting in shape, because I huff less.

I know I am going to disappoint readers who wish to know the secrets of stalking a wild vortex. However, on this hike I have had a fit of conscience. I have discovered that wild vortices don't survive long in captivity, especially if you poke a stick through them.

Domesticated vortices also don't survive impalement. Please see the picture of me with a domesticated (wingtip) vortex on my stick. By the time I could lash the stick to the wheelbarrow, the vortex had expired. Perhaps this whole approach was a bad idea, and cruel.

Consequently, and subsequently, we (well, I) consider further about how to re-wheel the barrow.

I say, "Probably the stoutest way is to use native basketry. The pre-gringo locals knew their materials. Cedar roots woven in concentric layers around a stick axle would probably hold up for a while."

Phil looks at me like, "I was ever part of this discussion?"

Up top there's an inch of snow. Heavy cloud cover, and a chilly wind hitting the south launch site. For once, there is great lift, and fairly smooth.

I have my Encore ballasted and up when a corn-snow, hail squall hits, so thick it's like fog. The lift booms and the wind picks up till it's hard to land.

Ten furious minutes later and the squall passes. Perhaps it was an expiring wild vortex. (Sad thought.)

But it gets so cold that Phil and I take turns running up and down the paraglider shuttle-bus road.

Still, we get a couple hours of fine flying in. Phil lands his Encore so neatly it leaves long little sled trails in the fresh snow.

_____

A side note from Phil Pearson: Poo Poo refers to the steam-whistle signals used in the early days to signal the donkey or skidder operators to position the chokers or haul in the turn of logs. The steam-whistle sound resembled a "poo poo," echoing across the ridges from a far away distance.

Back cover: "An Existential Portrait On One Of Those Days." Philip's Encore soars between the clouds. Photo by Phil Pearson