Solving the Speed Run

How we broke through the 200kph barrier

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Preface

Just before Christmas 2014, I was preparing for our gliding trip to Kiripotib Flying Lodge in Namibia. I was updating the list of Belgian, Continental and World records with the newest record claims.

My eye had up till then been set on the “Koninginnenummer”: the Open Class 3TP distance. My brother Bert and I had already broken this African record in 2012 in Morocco, but our claim was not ratified due to a silly bureaucratic reason. Because of our story, this bureaucratic process has since then been adjusted by the IGC/FAI, so our experience could not happen again.

However, in the last email of the IGC-mailing list, a new record claim for the free 3TP was just announced, with an impressive distance of 1349.4km, flown by Bostjan Pristavec and Klaus Seemann. This record would be hard to beat. The good news for us though, is that we would be allowed to fly their glider in Namibia: the beautiful EB28 Edition “7”.

In this IGC-email, the last claim caught my attention. Laszlo Hegedus had one day before broken Makoto Ichikawa’s standing African record on the Speed over a triangular course of 100km. He had improved the record from 171.83km/h to 192.69km/h.

I wondered: “What would be the theoretical maximum for this speed run?”

Tijl

100km FAI triangle

The 100km FAI triangle is the sprint discipline of the gliding athletics. It is very different from all other record categories: it is so simple, that you can optimize it so much that it can be completed almost perfectly according to the MacCready rules. Gliding tactics to deal with risk management are unimportant.

Additionally, all record categories allow for a max difference between start and finish altitude of 1000m. This bonus results in a significant boost in the average speed, as it can be used for a final glide which doesn’t have to be “earned” by thermaling. In the 100km triangle, this represents a relatively large part of the flight, and thus has a much larger impact than on the larger triangles and out-and-return categories.

So, the 100km FAI triangle record can be defined as: One Perfect Climb, One Perfect Final Glide.

Its pureness makes it a very interesting theoretical and practical exercise.

However, it has to be said that a significant part of what constitutes gliding is excluded, and, as pilot’s decision making skills play a minor role, you don’t have to be a world champ to break this record. Much more important is planning, weather forecasting and task setting. And concentration during the execution, off course.

Above all, it’s a lot of thrilling fun. The task only takes about half an hour, but this is time is very intense: you are incredibly focused, flying close to VNE, constantly looking at the clock and altimeter, and looking for the best line to get to the finishline as rapidly as possible. To me, it was almost as exciting as the final race of the World Gliding Championships in Rayskala last year.

The rules

The task has to be a triangle with a startpoint, 2 turnpoints and a finishpoint. Since it has to be a closed course, the start and finishpoint have to be the same.

The startline and finishline both are lines of 1km width (500m radius), and the TP sectors are 90 degree sectors with 3km radius.

Each leg has to be at least 28% of the total distance. This means that the largest leg is max 44% of the total distance.

And, finally, as mentioned above, the finish altitude cannot be lower than 1000m under the start altitude.

100km Speed records

Some pilots, amongst whom Hans-Werner Grosse, have lobbied in the past to split up all record categories between thermal and dynamic lift records. It is indeed true that you can't fly as fast, far or high in thermal conditions as in wave. Both are pretty much incomparable, so it's useless to point at the fantastic World Record of 289.4km/h flown in the lee wave of the Andes by Klaus Ohlmann. This is far above the limit possible with thermals.

Luckily for us in this case, there hasn't yet been found a good wave playground in Africa. The 100km speed triangle performance lies thus still within the realm of the thermal flights. And in the last few years, there has been a bit of a rush to knock off seconds of this task.

Overview of African Continental 100km Triangle Progress (Open Class Category):

Speed (km/h)	Time	Date	Pilot	Glider	Location
156.6	38:19	2012/05/31	Laszlo Hegedus	Nimbus 4T	Bitterwasser,NAM
169.8	35:20	2013/03/14	Uys Joncker	JS1C-21m	Tswalu, SA
171.83	34:55	2013/12/11	Makoto Ichikawa	Ventus 2cxm	Bitterwasser,NAM
175.58*	34:10	2014/12/12	Mauro Brunazzo	Quintus M	Bitterwasser,NAM
192.95*	31:08	2014/12/21	Laszlo Hegedus	EB28	Bitterwasser,NAM
205.89*	29:09	2014/01/06	Tijl & Bert Sen. Schmelzer	EB28 Edition	Kiripotib, NAM
***Claims – Not yet ratified**					*(Times are recalculated to 100km)*

The 200kph barrier

A barrier as artificial as the 1000km mark. However, not a single gliding record in thermal conditions has been completed beyond this boundary, and most likely not a single set task neither. And thus, to me, it made this challenge even more exciting. This would entail finishing within 30 minutes of crossing the startline.

But first, we had to analyze if it was even possible to break this barrier.

Some definitions

Before we start with the analysis, I would like to present you with a few definitions, which are common knowledge for pilots who are used to fly in areas with high cloudbases.

Indicated Air Speed (IAS): is the airspeed you read on your airspeed indicator.

True Air Speed (TAS): Since the air density and pressure decrease with altitude, less air molecules push on the membrane of the airspeed indicator. You are thus flying faster through the air, than airspeed indicates. True Air Speed compensates for this measurement error.

Groundspeed: True Air Speed + Windspeed

In higher altitudes the altitude effect becomes noticeable quickly: the difference between IAS and TAS increases with the square root of the air density.

$$IAS = TAS\sqrt{\frac{\rho}{\rho 0}}$$

With ρ being the density of the air in which the glider is flying, and $\rho 0$ the air density in the International Standard Atmosphere (15°C, 1013.25hPa = 1.225kg/m3).

Since temperature in Namibia is not very cold at cloudbase (mostly above freezing temperature), it is also reasonable to ignore temperature effects in our calculations. The above formula can thus be changed to a, for us easier to use, formula:

$$IAS = TAS\sqrt{\frac{Air\ Pressure}{Std.Pressure}}$$

With Std. Pressure being 1013.25 hPa

It is also reasonable to use the ICAO standard atmosphere (a standardized scale of how pressure changes with altitude) for calculations. An approximation for the ICAO standard atmosphere is given by the following formula:

$$Air\ Pressure = (1/100)\left(\frac{(Altitude(m) - 44330.8)}{4946.54}\right)^{1/0.1902632} hPa$$

For example, using these formula's, an IAS of 200km/h at 5000m (540hPa), would be equal to a TAS of 273.96km/h.

The importance of these definitions will be shown later on.

Quick analysis of Laszlo Hegedus' Record Claim flight

So, this analysis started with taking a closer look at the best performance up till then. Laszlo Hegedus is a member of the Hungarian National team, and has competed in many WGC's. He holds the World Record of the Speed over triangular course of 1250km at 151.1km/h. (Bitterwasser, NAM on Nimbus 4t) This is currently one of only two open class world record NOT flown in wave!

During his 100km record flight, he made two attempts, and in the final one he flew a speed of 192.95km/h.

The vital statistics on this run, with my short comments:

Statistic	Value	Unit	Comment
Task Length	119.3	km	Why longer than 100km?
Legs	32.0%-37.6%-30.4%		Doesn't look optimal.
Cloudbase	5073	m	
Start Alt.	4875	m	
Finish Alt.	4078	m	
Alt. Difference	797	m	203 meter left over.
# of Climbs	1		Good
Climb Rate	4.8	m/s	Very powerful!
Alt. Gain	600	m	Low
Time In Climb	02:06		Very low
Total Distance	125.1	km	
Detours	5.8	km	
Detours	4.86%		Low for normal flight, rather average high for 100km speed
Mean L/D	88		Very high
Total Avg. Groundspeed	215	km/h	Too low
Total Avg. IAS	172	km/h	Too low
Rising Avg. GS	184	km/h	About right
Rising Avg. IAS	151	km/h	About right
Sinking Avg. GS	232	km/h	Way too low
Sinking Avg. IAS	183	km/h	Way too low

My main conclusions from this flight, is that it is very good, but not perfect. The climb rate and mean glide ratio are extremely high. However, the glidespeed in sinking air is too low speed (as I will show in the MacCready calculations). Furthermore, the finish was too high.

So there is still room for improvement.

Optimization

The EB28 Edition

All gliding optimization calculations start with the polar of the glider at hand.

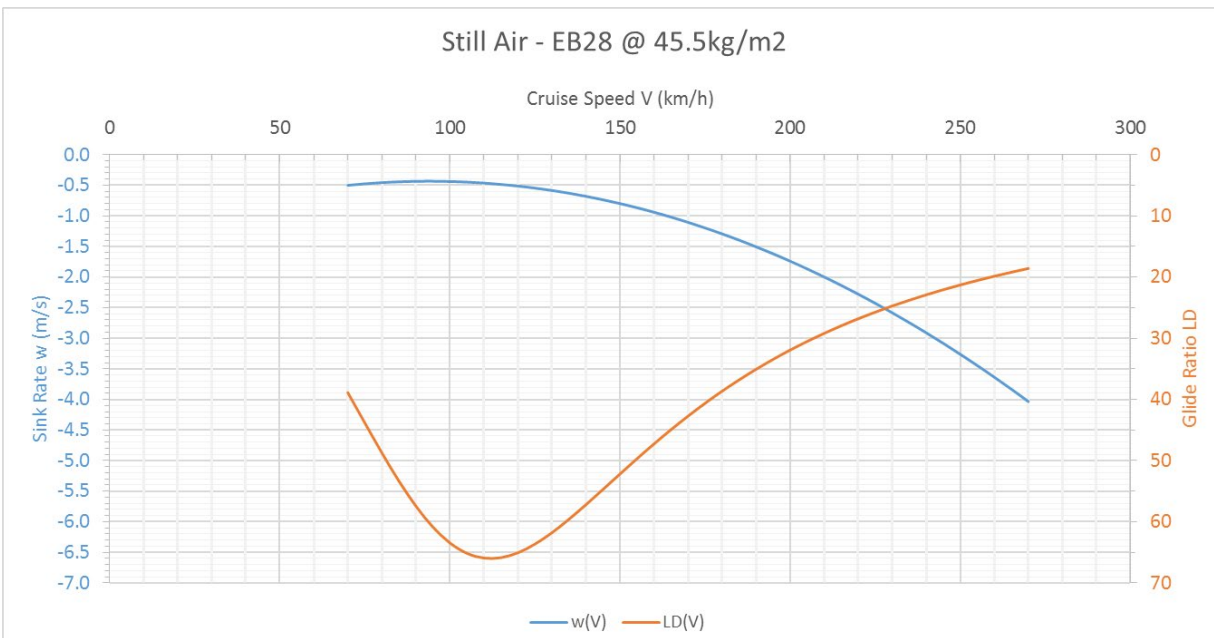
The quadratic approximated sink polar is defined as:

$$w = a\,V^2 + b\,V + c$$

With V the airspeed (km/h), and w the corresponding sinkspeed (m/s). By dividing airspeed V by sinkspeed w, we get the glide (LD) polar.

The a, b and c coefficients are inherent to each glider and wingloading, and the one used for the EB28 edition at min. weight are a = -0.00011616 , b = 0.02182417 , c = -1.4585725

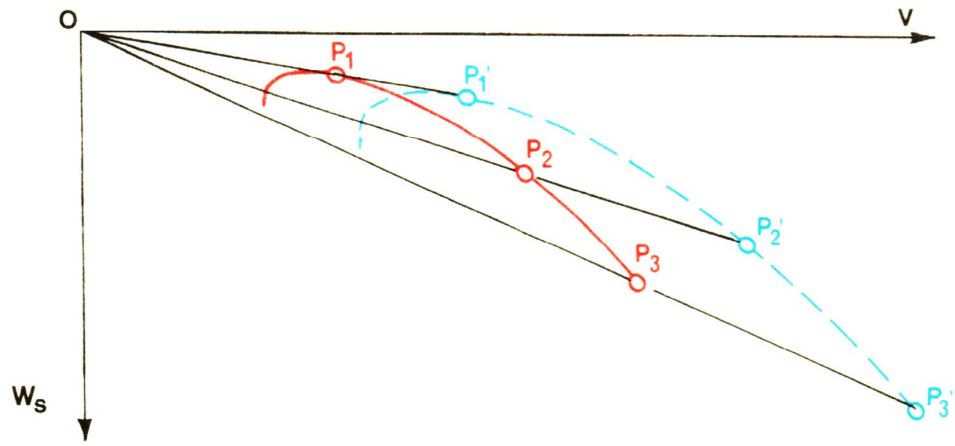
Note that a, b and c values are different from your flight computer or analysis software values, because of different units used in these formulas. They still represent the same polar.



This sink and glide ratio polar seem to be a bit optimistic at low speeds (max LD 65.5), however, I think it is realistic in the speed range that matters for this flight (150km/h – 250km/h IAS).

The effect of waterballast

Off course, weight of the glider affects the polar. If we increase or decrease the weight, for instance by adding water ballast, the polar will change. Because of the underlying aerodynamical physics, this change can be very well approximated by scaling the original sink polar around the origin.



The scaling factor W is:

$$W = \sqrt{\frac{Weight\ New}{Weight\ Original}}$$

For the a, b and c coefficients of the sinkpolar the effect is:

$$a' = \frac{a}{W}$$

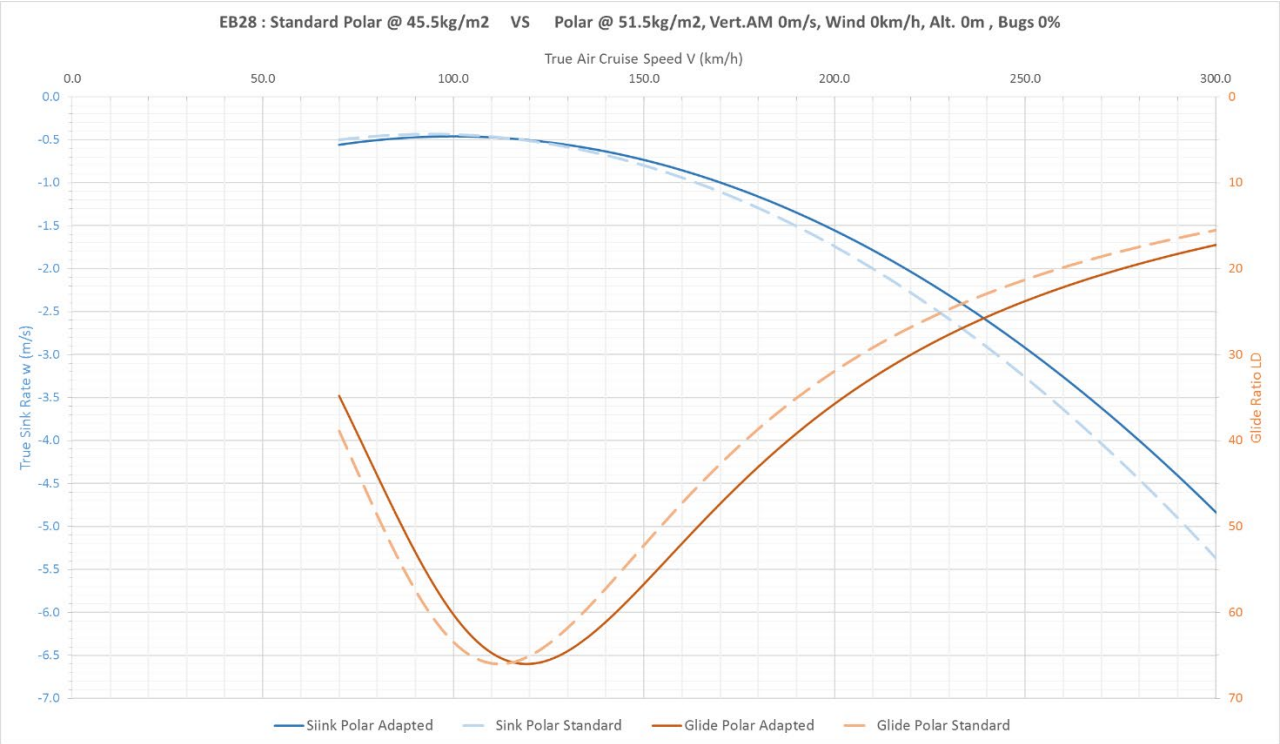
$$b' = b$$

$$c' = Wc$$

If you inquire the effects of this formula, you find that a weight increase does not affect the glide ratio of a glider, it just increases the airspeed at which the best glide ratio can be found. In reality, a weight increase does in fact increase the glide ratio slightly due to flying at higher Reynolds numbers. This, rather small, effect is thus neglected in all glide computers and optimization programs.

Off course, since minimum sink will be higher (and at a higher speed), climbrates in thermals will suffer a bit.

For the 100km speed run, which can only be flown in fantastic conditions, a glider cannot be heavy enough. We will thus need to fly the EB28 at 850kg, with a wingloading of 51.5kg/m2. The resulting polar can be found in the following figure.



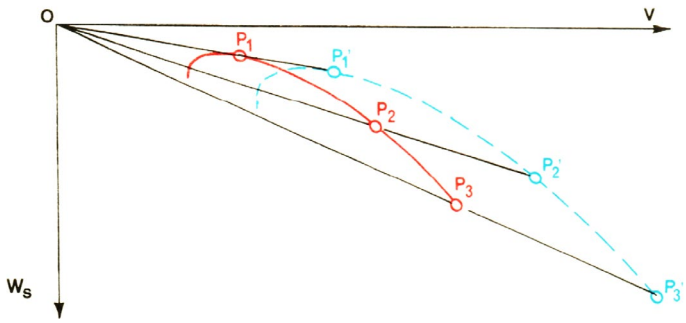
The altitude effect

Altitude not only has a tremendous effect on the IAS measurement, but also on the real sinkpolar and glide polar.

At higher altitude, less air molecules are available to carry the plane. This means the sink speed of the glider will increase with altitude.

But also, there are less air molecules to hold the glider back. Drag is thus reduced as well, making it easier to fly faster.

The net impact of both sink and forward speed can be expressed exactly in the same way as adding waterballast to the glider: it is a scaling of the sink polar around the origin.

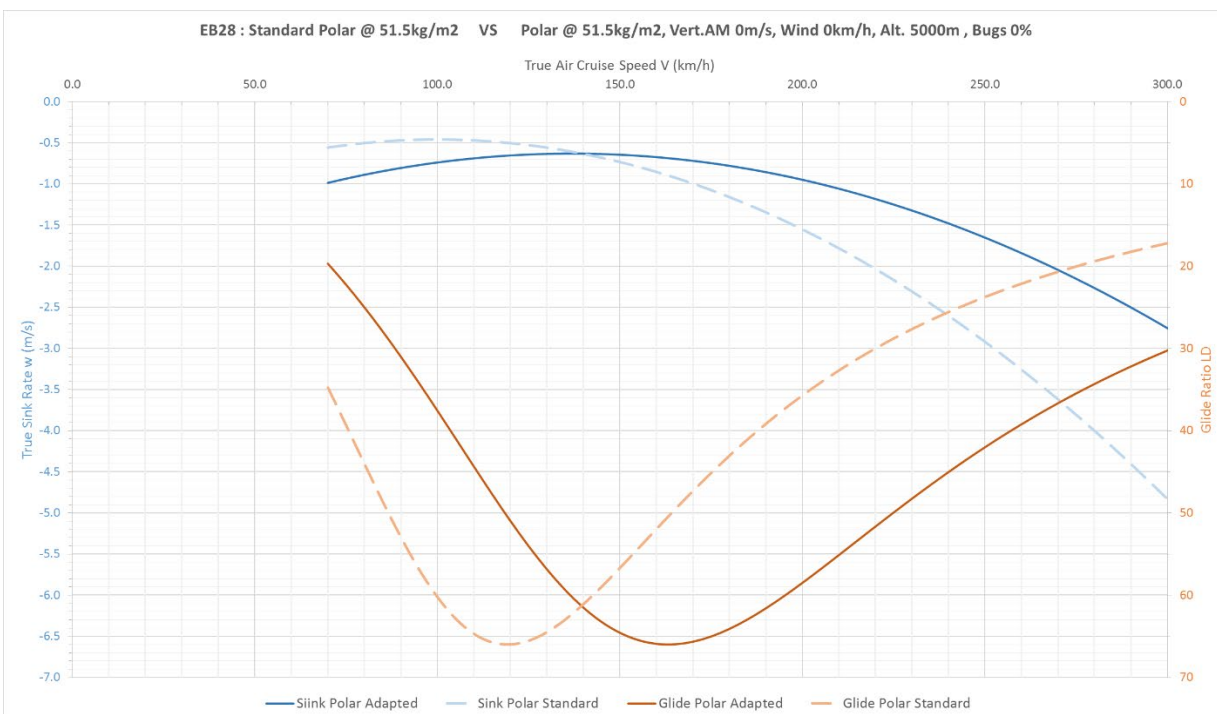


The scaling factor P you are already familiar with:

$$P = \sqrt{\frac{Air\ Pressure}{Std.\ Pressure}}$$

This again ignores secondary temperature effects. And the formula also ignores the small increase in glide ratio in altitude due to the higher Reynolds numbers.

So this altitude effect, a part from the great climb rates, is one of the main reasons people fly so fast in Namibia. As a comparison: the polar of an EB28 at 5000m at 51.5kg/m2 (850kg) corresponds to an EB28 at sea level at 97kg/m2 (1600kg)!



Something else that is important related to the altitude effect: How does the redline change with altitude?

This is an engineering question, which is much more difficult to answer in general. It has to do with the damping effects on flutter of the airmass and many other factors. Normally, the manufacturer of the glider includes a table with the change of max IAS with altitude. For the EB28 Edition, the max IAS decreases from 285km/h at sea level to 245km/h at 5000m. This corresponds with an increase of TAS to 335.6km/h!

For the yellow line, such a table is not commonly available, so common sense prevails. I would not fly at IAS 245km/h in 5000m trough a 5m/s thermal.

So, the question becomes: How does the altitude effect affect MacCready rules and Speed To Fly?

You know that, when you increase waterballast, your Speed To Fly for a certain MacCready Value increases as well. That's why you have to always put in the right wingloading into your flightcomputer.

Since the altitude effect on the polar is similar to the addition of waterballast, you might deduce that you should also fly faster in higher altitude for the same MC setting. And in fact, such is the case. However, we are talking in terms TAS, not IAS!

A following explanation can be often heard or even found in textbooks: "Quite neatly, the altitude effect on Speed To Fly, and the altitude effect on the difference between IAS and TAS cancel each other out. So we can use the IAS measurement for the Speed To Fly as calculated for sea level. This makes it easy, so we just can keep our STF steady looking at the airspeed indicator, while descending during a glide."

However, this is not true! The following tables shows the optimal speed to fly in IAS and TAS in 4 altitudes (0m, 3000m, 4000m, 5000m) for a MacCready Value of 4.5m/s, in still air, and with vertical airmass movement (+3m/s, +2m/s, +1m/s, +0.5m/s, 0m/s, -0.5m/s, -1m/s, -2m/s, -3m/s):

Optimal Speed To Fly EB28Edition@51.5kg/m2

IAS MC4.5

	0m	3000m	4000m	5000m
3.0	167	160	158	156
2.0	193	182	179	176
1.0	215	202	198	194
0.5	225	211	207	202
Still Air	235	220	215	210
-0.5	245	229	223	218
-1.0	254	237	231	226
-2.0	272	252	246	240
-3.0	288	267	260	254

TAS MC4.5

	0m	3000m	4000m	5000m
3.0	167	192	202	213
2.0	193	219	230	241
1.0	215	243	254	266
0.5	225	254	265	277
Still Air	235	265	276	288
-0.5	245	275	286	299
-1.0	254	285	297	309
-2.0	272	303	316	329
-3.0	288	321	334	347

Although modern flight computers could in theory incorporate this, most if not all currently still ignore this secondary effect, as it is not really that important for the vast majority of our performances. In the case of the perfect 100km speed run, it is.

From the table you can see, that STF based on IAS decreases with altitude. Based on TAS it, off course, increases with altitude.

Interestingly, in 5000m with MC4.5, even if you fly through a decent thermal of 2.0m/s during your glide, while your IAS should not go below 176km/h, your TAS should not go below 241km/h! This means that you have to keep your speed up, even while crossing decent climbs. In reality, this is even more pronounced, since dynamic transition losses are not accounted for in these formulas. Thus: don't pull too much while crossing climbs.

Additionally, there is also the issue that the same IAS-TAS difference because of altitude can also be found in certain variometer types. Some vario's show not the real climb and sink rates. And this has an effect on correct MC Value setting. I'd like to refer to Reichmann's Streckensegelflug for more information on that. Most modern common electric vario's do measure true climb and sink rates.

How does this all translate into cross country average speeds?

If we look at the case where there is no vertical airmass movement, the following tables give the summation for Sea level and 4000m:

Sea level	**Climbrate**	**3**	**3.5**	**4**	**4.5**	**5**	**5.5**	**6**	**m/s**
	STF TAS = IAS	204	215	225	235	245	254	263	**km/h**
	Sinkspeed True	-1.65	-1.91	-2.18	-2.47	-2.76	-3.06	-3.36	**m/s**
	LD	34.4	31.3	28.7	26.5	24.7	23.1	21.7	
True XC	**Alt.Loss**	-2905	-3195	-3484	-3770	-4053	-4331	-4605	**m**
	TimeToClimb	16.1	15.2	14.5	14.0	13.5	13.1	12.8	**min**
	TimeToCruise	29.4	27.9	26.6	25.5	24.5	23.6	22.8	**min**
	TotalTime	45.5	43.1	41.1	39.5	38.0	36.7	35.6	**min**
	XCSpeed	131.8	139.2	145.9	152.1	157.9	163.3	168.5	**km/h**
With 1000m diff.	**Alt.Loss**	-1905	-2195	-2484	-2770	-3053	-3331	-3605	**m**
Start-Finish	**TimeToClimb**	10.6	10.5	10.4	10.3	10.2	10.1	10.0	**min**
	TotalTime	40.0	38.4	37.0	35.7	34.7	33.7	32.8	**min**
	Avg. Speed	150.1	156.5	162.3	167.8	173.1	178.0	182.8	**km/h**

4000m	**Climbrate**	**3**	**3.5**	**4**	**4.5**	**5**	**5.5**	**6**	**m/s**
	STF TAS	242	254	265	276	286	297	306	**km/h**
	STF IAS	189	198	207	215	223	231	239	**km/h**
	Sinkspeed True	-1.70	-1.94	-2.19	-2.45	-2.73	-3.01	-3.29	**m/s**
	LD	39.6	36.4	33.6	31.2	29.2	27.4	25.8	
True XC	**Alt.Loss**	-2523	-2748	-2975	-3201	-3427	-3650	-3872	**m**
	TimeToClimb	14.0	13.1	12.4	11.9	11.4	11.1	10.8	**min**
	TimeToCruise	24.8	23.6	22.6	21.7	20.9	20.2	19.6	**min**
	TotalTime	38.8	36.7	35.0	33.6	32.4	31.3	30.3	**min**
	XCSpeed	154.6	163.4	171.3	178.6	185.4	191.7	197.7	**km/h**
With 1000m diff.	**Alt.Loss**	-1523	-1748	-1975	-2201	-2427	-2650	-2872	**m**
Start-Finish	**TimeToClimb**	8.5	8.3	8.2	8.2	8.1	8.0	8.0	**min**
	TotalTime	33.3	32.0	30.9	29.9	29.0	28.3	27.6	**min**
	Avg. Speed	180.4	187.7	194.5	200.7	206.7	212.3	217.6	**km/h**

Now this is uplifting news! According to this, with a realistic 4.5m/s climb rate, and an average altitude of 4000m during the flight, an average speed of 200.7 km/h should be possible. Even without cloudstreeting and energy lines!

Also, notice that the average speed bonus of the 1000m altitude difference between start and finish is about 20km/h. So, people thinking the 100km triangle is just a simple final glide, and nothing to it, are wrong. Beating the 200km/h barrier, still means flying above 180km/h true average XC speed, albeit over a relatively short distance!

Unfortunately, some things are not taken into account:

- Detours: in a normal flight, you fly 5-10% more km than the task distance because the optimal line is very rarely straight on course. In the 100km speed run, each % detour, results in a bit more than a 2km/h speed loss. A realistic value lies between 2.5-5%, so 5-10km/h speed loss.

- You lose speed while cornering around the turning points. First you have to slow down and speed up again, which results in dynamic losses as well as deviating from optimal STF. And, secondly, you have to fly a bit (about 250m) beyond the turnpoint. To be certain to have a log fix within the turnpoint sector. I estimate the losses to be ca 1.5km/h per turnpoint, so 3km/h in total. This part can be included in the detours.

- The pilot, nor the glider is perfect. At these high speeds, small imperfections (deviations from optimal STF, time to center climb, slipping, not using total 1000m buffer,…), cause significant losses in average speed. It is hard to estimate exactly how much, but I think it should be in the range of 5-10km/h.

Adding these three losses together we come to a realistic max speed on the 100km triangle of 13-25km/h.

This reduces the attainable record speed to 175-188km/h with a realistic 4.5m/s climb, and 187-199km/h with a fantastic 5.5m/s climb.

Luckily, there are some pieces of the puzzle left in the bag.

Dynamic pull

There is no max limit to the startspeed, and no min limit to the finishspeed. You could thus start at VNE, and finish with stall speed. In a normal flight, this is quite unimportant, but, in the 100km task, it can be vital!

In a real situation, you would start at 4500m with IAS 235km/h (TAS 311km/h), and finish in 3500m with IAS 110km/h (TAS 137km/h). You would off course pull up a bit from IAS 235km/h to ca IAS 215km/h just after the start, and from IAS 215km/h to IAS 100km/h just before the finish. But for simplicity, it is easier to see it as one pull-up.

How does speed convert to altitude? Ignoring second order air resistance effects, the physics are quite simple by equating kinetic and potential energy:

$$E\ \frac{m\,V^2}{2} = mgh$$

With m mass, V True Air Speed in m/s, dimensionless E dynamic transition efficiency, g gravitational constant 9.8m3/(kg.s2) , and h altitude in m.

Since the efficiency of a single transition in a glider is rather efficient, we can arbitrarily put this at 90%. This value is likely a bit too conservative.

Since the mass can be scrapped from both sides, this becomes:

$$\Delta h = \ E\frac{V0^2 - V^2}{2g}$$

with V0 the original speed in m/s, and Δh the change in altitude.

Filling in the above speeds of 311km/h and 137km/h, gives us a Δh of 300m.

Off course, it is impossible to do and time this maneuver perfectly, so let's round it down to 200m. The following table shows the effect on the average speed:

4000m	**Climbrate**	**3**	**3.5**	**4**	**4.5**	**5**	**5.5**	**6**	**m/s**
	STF TAS	242	254	265	276	286	297	306	**km/h**
	STF IAS	189	198	207	215	223	231	239	**km/h**
	Sinkspeed True	-1.70	-1.94	-2.19	-2.45	-2.73	-3.01	-3.29	**m/s**
	LD	39.6	36.4	33.6	31.2	29.2	27.4	25.8	
True XC	**Alt.Loss**	-2523	-2748	-2975	-3201	-3427	-3650	-3872	**m**
	TimeToClimb	14.0	13.1	12.4	11.9	11.4	11.1	10.8	**min**
	TimeToCruise	24.8	23.6	22.6	21.7	20.9	20.2	19.6	**min**
	TotalTime	38.8	36.7	35.0	33.6	32.4	31.3	30.3	**min**
	XCSpeed	154.6	163.4	171.3	178.6	185.4	191.7	197.7	**km/h**
With 1000m diff.	**Alt.Loss**	-1523	-1748	-1975	-2201	-2427	-2650	-2872	**m**
Start-Finish	**TimeToClimb**	8.5	8.3	8.2	8.2	8.1	8.0	8.0	**min**
	TotalTime	33.3	32.0	30.9	29.9	29.0	28.3	27.6	**min**
	Avg. Speed	180.4	187.7	194.5	200.7	206.7	212.3	217.6	**km/h**
With 1000m diff.	**Alt.Loss**	-1323	-1548	-1775	-2001	-2227	-2450	-2672	**m**
Start-Finish	**TimeToClimb**	7.4	7.4	7.4	7.4	7.4	7.4	7.4	**min**
and Pull-Up	**TotalTime**	32.1	31.0	30.0	29.1	28.4	27.7	27.0	**min**
	Avg. Speed	186.7	193.5	199.9	205.8	211.5	216.9	222.1	**km/h**

The Pull-up gives us thus an additional 5km/h bonus. We are now nearing the possibility of the 200km/h barrier, but only with a 5.5m/s climb.

Cloudstreeting

Luckily, there are cloudstreets and energylines. This will be the final piece of the puzzle to the 100km record. But also the hardest to put into a model.

Energylines shift the sink polar upwards, with its upward velocity. This means that your glide ratio will improve tremendously. The longer, and the better the patches of rising air, the more we can boost our average speed. So, what does a realistic Cloudstreet look like?

For this we would need a general distribution of vertical airmass movement along the track. My preferred method for this, would be using actual flight data of a good flight. However, to extract the airmass movement from an IGC-file, a dynamic model would be needed, and I am not aware of such software currently existing.

Generally, I would split up the data in rising and sinking parts, and regard both of these parts as two separate homogenous blocks. The parameters could then be extracted from SeeYou.

However, SeeYou's paramaters are not derived from a dynamic model, and as such, netto climb and sink rates are exaggerated due to "Knuppeltermik". In moderate European circumstances on a 300km+ flight, this is not a big issue. For the purposes presented here, the skew in the data becomes very large.

In this case, I thus prefer to see the whole airmass as one homogenous entity. The vertical movement is then derived from comparing the actual average sinkrate during the total glide, to the sinkrate connected to the actual average glidespeed as derived from the theoretical EB28 polar in the average altitude.

In this way, the effect of dynamic transitions is eliminated. The model thus becomes a bit less accurate, but more robust. In reality, one would fly slower than the model STF in rising parts, and faster than the STF in sinking parts. In reality, the glide angle, and the final average task speed would both be a bit (a few km/h) higher. This is important keep in mind looking at the following pages.

To find realistic values, we can use the values of Laszlo Hegedus' record flight:

Alt. Loss in Glide	-1414	m
Time Glide	1982	sec
Average Sinkrate	-0.71	m/s
Average Glidespeed TAS	215	km/h
Polar Sinkrate for that TAS	-1.17	m/s
Netto Avg. Airmass movement	**0.46**	m/s

Analysis and optimization of the 192.95km Record Claim

The actual performance

Putting all data in the simple model delivers a resulting time (37:20) and speed of 191.7km/h very close to the actual record claim (37:05) and 192.95km/h.

From previous experience with using this simple model, this accuracy is not uncommon, since it is fitted to the polar.

Also the glide ratio from the model (84) and reality (88) are very close, as well as the climb height in thermals (691m vs 600m).

So, now that the model works, and since we have a real life scenario, we can start optimizing.

Taskparameters			
	Taskdistance	119.3	km
	Total Distance	125.1	km
	De-tours	4.86%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	803	m
	Climbrate	4.76	m/s
	Netto cloud streeting climb	0.46	m/s

Calculations			
Thermalling	Average netto climb	5.56	m/s
Glide	GlideSpeed TAS	215	km/h
	GlideSpeed IAS	162	km/h
	Sinkspeed True	-0.71	m/s
	Time Glide	34.9	min
	Altitude loss	-1494	m
	Time Climb	5.2	min
Finalglide	Time not climb	-2.8	min

Output			
	timeclimb	2.4	min
	Altclimb	691	m
	timeglide	34.9	min
	LD	84	
	Total time	**37:20**	**min:sec**
	Average Speed	**191.7**	**km/h**

Flying the perfect MacCready Speed To Fly

The first, and most important part is the perfection of STF. The main improvement would be changing the average glidespeed from 215km/h TAS to the optimal STF of 278km/h TAS (210 km/h IAS). The result of doing only this, would lead to an average speed of 204.8km/h!

However, glide ratio decreases to 41, and required altitude to climb to 2264m, which could not be done using a single thermal (see discussion between 1 and multiple thermals later on)!

Keep in mind, that this a hindsight optimization. And hindsight is 20/20.

Taskparameters			
	Taskdistance	119.3	km
	Total Distance	125.1	km
	De-tours	4.86%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	803	m
	Climbrate	4.76	m/s
	Netto cloud streeting climb	0.46	m/s

Calculations			
Thermalling	Average netto climb	5.56	m/s
Glide	GlideSpeed TAS	278	km/h
	GlideSpeed IAS	210	km/h
	Sinkspeed True	-1.89	m/s
	Time Glide	27.0	min
	Altitude loss	-3067	m
	Time Climb	10.7	min
Finalglide	Time not climb	-2.8	min

Output			
	timeclimb	7.9	min
	Altclimb	2264	m
	timeglide	27.0	min
	LD	41	
	Total time	**34:57**	**min:sec**
	Average Speed	**204.8**	**km/h**

Watching the red line

If we use a bit more conservative glidespeed of TAS 260km/h (IAS 196 km/h), and glidespeed), the average speed would still have been 203.9km/h, but Glide ratio would be a healthy 48, and required altitude to climb in the thermal 1738m.

Taskparameters			
	Taskdistance	119.3	km
	Total Distance	125.1	km
	De-tours	4.86%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	803	m
	Climbrate	4.76	m/s
	Netto cloud streeting climb	0.46	m/s

Calculations			
Thermalling	Average netto climb	5.56	m/s
Glide	GlideSpeed TAS	260	km/h
	GlideSpeed IAS	196	km/h
	Sinkspeed True	-1.49	m/s
	Time Glide	28.9	min
	Altitude loss	-2586	m
	Time Climb	9.1	min
Finalglide	Time not climb	-2.8	min

Output			
	timeclimb	6.2	min
	Altclimb	1783	m
	timeglide	28.9	min
	LD	48	
	Total time	**35:07**	**min:sec**
	Average Speed	**203.9**	**km/h**

Using the whole 1000m buffer and Pulling-Up before the finishline

Now, if we optimize this further, by using up 950m of the 1000m altitude difference, instead of the 803m used, and additionally adding the 200m of the pull-up before the finishline, we can increase the average speed further to 211.2km/h.

Taskparameters			
	Taskdistance	119.3	km
	Total Distance	125.1	km
	De-tours	4.86%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	1150	m
	Climbrate	4.76	m/s
	Netto cloud streeting climb	0.46	m/s

Calculations			
Thermalling	Average netto climb	5.56	m/s
Glide	GlideSpeed TAS	260	km/h
	GlideSpeed IAS	196	km/h
	Sinkspeed True	-1.49	m/s
	Time Glide	28.9	min
	Altitude loss	-2586	m
	Time Climb	9.1	min
Finalglide	Time not climb	-4.0	min

Output			
	timeclimb	5.0	min
	Altclimb	1436	m
	timeglide	28.9	min
	LD	48	
	Total time	**33:54**	**min:sec**
	Average Speed	**211.2**	**km/h**

Why fly more than necessary?

A next step, is reducing the task distance from 119.3km to 101km. This improves the average speed already to 215.9km/h!

And now, the altitude needed to climb is reduced to a very manageable 1038m, possible to do in a single climb!

This flight would thus have been possible in these circumstances (however, we would have needed to start 300 meter lower, but, this discussion will follow later).

Taskparameters			
	Taskdistance	101	km
	Total Distance	105.9	km
	De-tours	4.83%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	1150	m
	Climbrate	4.76	m/s
	Netto cloud streeting climb	0.46	m/s

Calculations			
Thermalling	Average netto climb	5.56	m/s
Glide	GlideSpeed TAS	260	km/h
	GlideSpeed IAS	196	km/h
	Sinkspeed True	-1.49	m/s
	Time Glide	24.4	min
	Altitude loss	-2188	m
	Time Climb	7.7	min
Finalglide	Time not climb	-4.0	min

Output			
	timeclimb	3.6	min
	Altclimb	1038	m
	timeglide	24.4	min
	LD	48	
	Total time	**28:04**	**min:sec**
	Average Speed	**215.9**	**km/h**

Perfect weather

The 192.95km/h record claim was flown in very good, but not perfect weather. What would be the ultimate weather for the 100km speed triangle?

This question is off course impossible to answer 100% correctly, but we can make a good realistic guess, by increasing the Climbrate from 4.76m/s to a fantastic but possible climb of 5.5m/s, and additionally increasing the Netto cloud streeting climb rate from 0.46 to 0.75m/s.

At the same time, we decrease the detours to 3.5%.

In this case, the max attainable average speed increases to 236.3km/h, and I think this should be pretty close to the theoretical max record speed in thermal conditions on the EB28 Edition.

However, this would be extremely difficult to do in reality!

Taskparameters			
	Taskdistance	101	km
	Total Distance	104.5	km
	De-tours	3.50%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	1150	m
	Climbrate	5.50	m/s
	Netto cloud streeting climb	0.75	m/s

Calculations			
Thermalling	Average netto climb	6.30	m/s
Glide	GlideSpeed TAS	287	km/h
	GlideSpeed IAS	217	km/h
	Sinkspeed True	-1.84	m/s
	Time Glide	21.8	min
	Altitude loss	-2410	m
	Time Climb	7.3	min
Finalglide	Time not climb	-3.5	min

Output			
	timeclimb	3.8	min
	Altclimb	1260	m
	timeglide	21.8	min
	LD	43	
	Total time	**25:38**	**min:sec**
	Average Speed	**236.3**	**km/h**

Flying an EB29 with 25.3m span @ 61.7kg/m2

What if we would switch gliders to the single seater EB29, with short wingspan at the higher max take-off weight of 900kg?

With a roughly estimated decrease in climb rate of 0.1m/s compared to the lighter EB28 edition, the max average speed in perfect weather would increase to an incredible 258.5km/h!

To reach this speed, however, one would need to fly beyond the red line in sink.

Taskparameters			
	Taskdistance	101	km
	Total Distance	104.5	km
	De-tours	3.50%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	1150	m
	Climbrate	5.40	m/s
	Netto cloud streeting climb	0.75	m/s

Calculations			
Thermalling	Average netto climb	6.30	m/s
Glide	GlideSpeed TAS	318	km/h
	GlideSpeed IAS	240	km/h
	Sinkspeed True	-1.98	m/s
	Time Glide	19.8	min
	Altitude loss	-2347	m
	Time Climb	7.2	min
Finalglide	Time not climb	-3.5	min

Output			
	timeclimb	3.7	min
	Altclimb	1197	m
	timeglide	19.8	min
	LD	45	
	Total time	**23:27**	**min:sec**
	Average Speed	**258.5**	**km/h**

Flying an ASG29-18m @ 57.1kg/m2

Since the glide polars 18m and open class ships cross at high speeds, the question is often asked: when would a 18m glider become better than the open class ships? Would an 18m glider be more suited for this 100km speed triangle? According to this model, the answer is: no.

Even if we force the climb rate in the thermal to be the same as for the EB28 edition (5.50m/s), the ASG29-18m at max. weight would be 10km/h slower. In reality, the 18meter glider would climb a bit worse.

On the other hand, these speed polars are not perfect in this very high speed range. So an exact conclusion is not possible. I have no doubt, however, that an EB29-25.3m at 900kg will always be faster than any current 18m glider.

Taskparameters			
	Taskdistance	101	km
	Total Distance	104.5	km
	De-tours	3.50%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	1150	m
	Climbrate	5.50	m/s
	Netto cloud streeting climb	0.75	m/s

Calculations			
Thermalling	Average netto climb	6.74	m/s
Glide	GlideSpeed TAS	276	km/h
	GlideSpeed IAS	209	km/h
	Sinkspeed True	-1.82	m/s
	Time Glide	22.7	min
	Altitude loss	-2480	m
	Time Climb	7.5	min
Finalglide	Time not climb	-3.5	min

Output			
	timeclimb	4.0	min
	Altclimb	1330	m
	timeglide	22.7	min
	LD	42	
	Total time	**26:43**	**min:sec**
	Average Speed	**226.8**	**km/h**

The perfect flight in practice

Task setting

You have to plan your task, taking the weather into account. Very often we are too lazy to make new waypoints for a single flight.

For the 100km triangle, this is not a good way to go. As shown previously, making a task exactly 101km long with 2 new turnpoints, instead of using 2 existing TPs with, for example, a 112km task length, makes a 5kph difference, without having to fly better.

If you know that cloudstreets are forecasted in one direction, you should make a one leg as long as possible parallel to that direction!

Within the limit of the rules, the longest leg can be max. 44% of the total task length. The other two legs, which will cross the cloudstreets under an angle, will both be 28km long.

Wind

To keep things simple, I ignore windspeeds for all these calculations. I don't think this record can be flown in very high windspeeds anyway. However, one important remark: set your task so, that your thermaling is all done on a tailwind leg.

1 or several thermals?

There are several arguments for using only 1 thermal:

- You only need to center the thermal once, and stay in that thermal for a long climb. The centering part will thus be relatively lower, thus increasing the average climb rate.

- It is pretty much impossible to find 2 equally good perfect thermals in one 100km flight. One will always be better, and you should thus climb your needed altitude in that thermal.

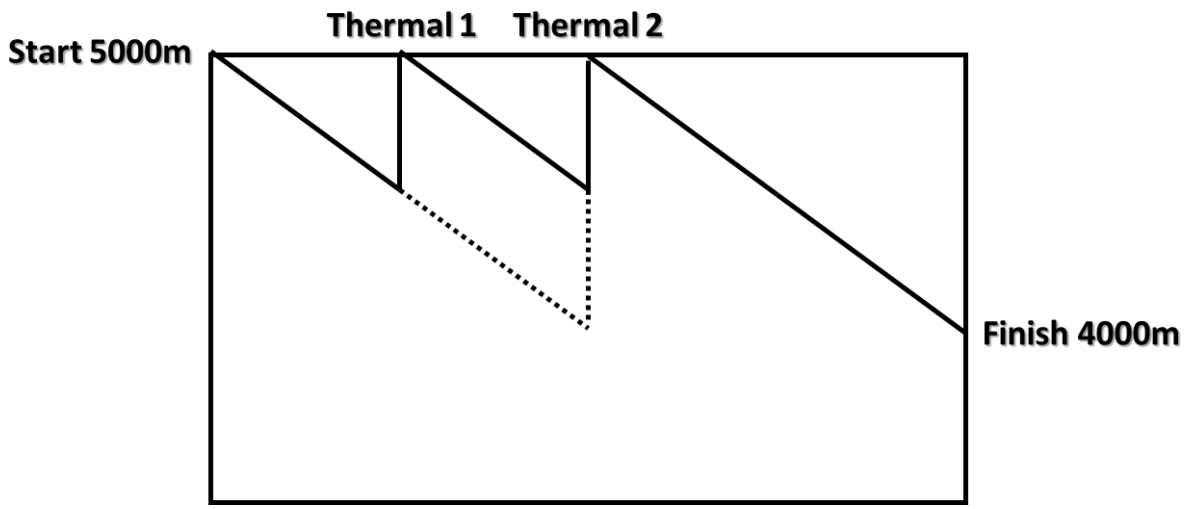
- Using only 1 thermal, you reduce the amount of dynamic transitions (pulling and pushing), resulting in less losses.

However, there is one good argument for using 2 (and perhaps 3 thermals): using multiple thermals, you will fly on average higher than using only one thermal, thus profiting more from the altitude effect.

The following figure shows the schematic barographs of pilot A, who uses two thermals, and stays on average during his flight at 4625m. Pilot B only uses only the second thermal, and flies on average in 4500m.

The net effect of this would be an increase from 214.9km/h average speed for Pilot B to 216km/h for Pilot B.

The positive effect of using multiple thermals is thus rather small (ca 1km/h), and I think the net effect of disadvantages of using multiple thermals is larger than the advantage.



Thermal at begin or end of the course?

So, now that we decided to use only one thermal, where should that thermal be taken?

This can be done at the beginning, middle, or end.

If one would take the thermal right at the end, you would be able to very precisely climb up till the 1000m altitude difference limit, and thus avoid any waste. This is optimal, and cannot be done when thermaling in the beginning of the course, as you don't know yet which netto climbs and sinks you will encounter during your glide, and thus not know your glide ratio.

Additionally, when you take the thermal at the beginning, you need to start much lower than the cloudbase to leave room for your climb, and thus your flight will be on average flown lower with the same

amount, and thus reduces the altitude effect. This disadvantage is very significant. In the case of starting 500m lower, the max record speed is lowered from 214.9km/h to 210.8km/h. You thus give 4km/h away!

However, there is a still a very good reason to take the thermal in the beginning. If you would take the thermal in the end, you first need to fly the whole course. The chance of finding an excellent climb at the end of your flight, precisely where you need it to be, are very slim. Conversely, if you would wait near the startline until you can easily wait until you have the perfect thermal just in the right location after the startline.

Additionally, a failed attempt with a thermal at the end of the course, will take you 45min to 1 hour. A failed attempt while taking the thermal in the beginning of the course, might take you only 15min to 0.5hour. You could thus make many more attempts in one day when taking your thermal in the beginning.

Conclusion: in theory, taking the climb at the end is much better. In practice, taking the climb in the beginning makes it easier to succeed.

Final strategy

0. Wait in front of startline until the perfect climb is on track, close to the startpoint.
1. Dive to the startline at VNE, ca900m below cloudbase, and Pull back gently to STF IAS 210-215km/h in still air.
2. After ca 3-10km, take climb, and climb ca 1000m.
3. Fly the rest of the course with MC4 following the energylines, and slowing down to IAS170km/h for taking the 2 turnpoints.
4. Just before crossing the finishline, pull-up to IAS 110km/h, and cross 950m below start altitude, ca 1850m below cloudbase.

Simple, isn't it? ☺

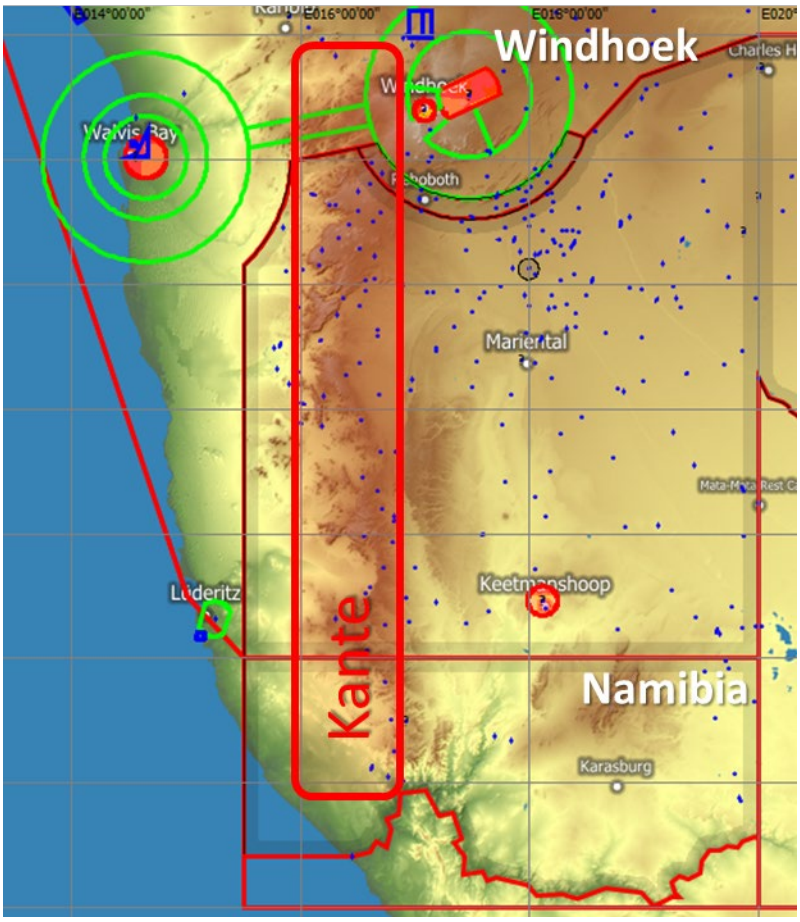
Note: Off course, as explained before, the optimal strategy is to start at cloudbase, and take your single thermal just before crossing the finish line. However, the chance of success is much lower.

Flight preparation

The “Kante”

The Kante is the Namibian ancient and eroded mountain range, which forms the natural barrier between the Namib Desert and the Kalahari Savannnah. Overhead and along this range, the dry Southern Polar airmass, and the wet Upper Tropical airmass will sometimes collide. When this happens, a fantastic convergence line is formed, with the good climbrates on the Eastern side towards the Kalaharo. This phenomenon is then used by happy glider pilots to fly tremendous distances at astonishing speeds.

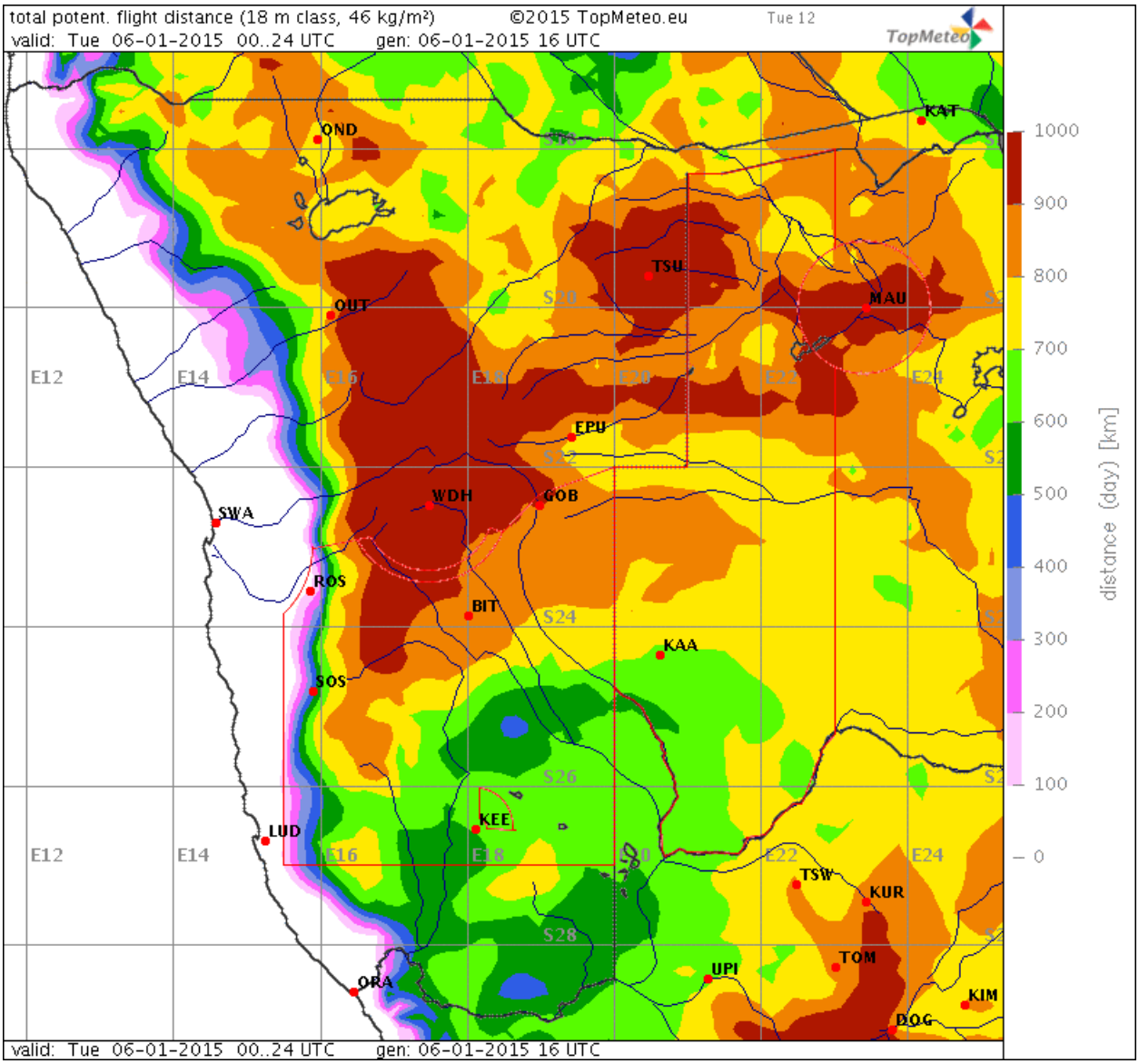
The ideal location for the 100km triangle speed run.

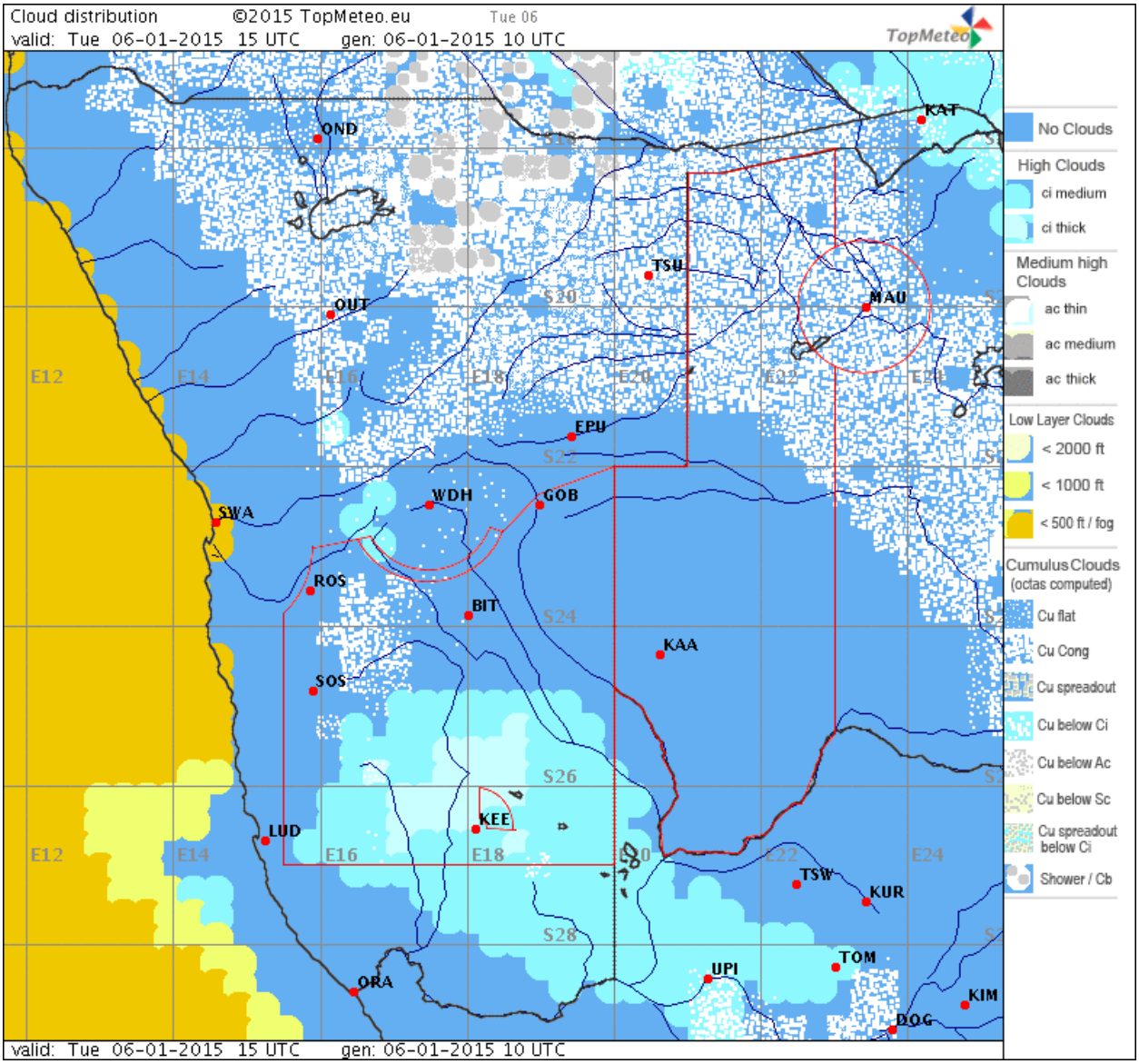


Weather forecast

After one week in Namibia, the topmeteo forecast seemed to us very accurate in that region. For 6 januari 2015, fantastic weather was forecasted in the Windhoek CTR and north of that. Unfortunately the northern half of Namibia is off limits for glider pilots. So only the smallish area from Gollschau to Sosus Valley was predicted to be good.

South of the line Sosus Valley – Mariental, heavy Cirrus clouds would block thermal development. And East of the Kante, only blue thermals were forecasted.



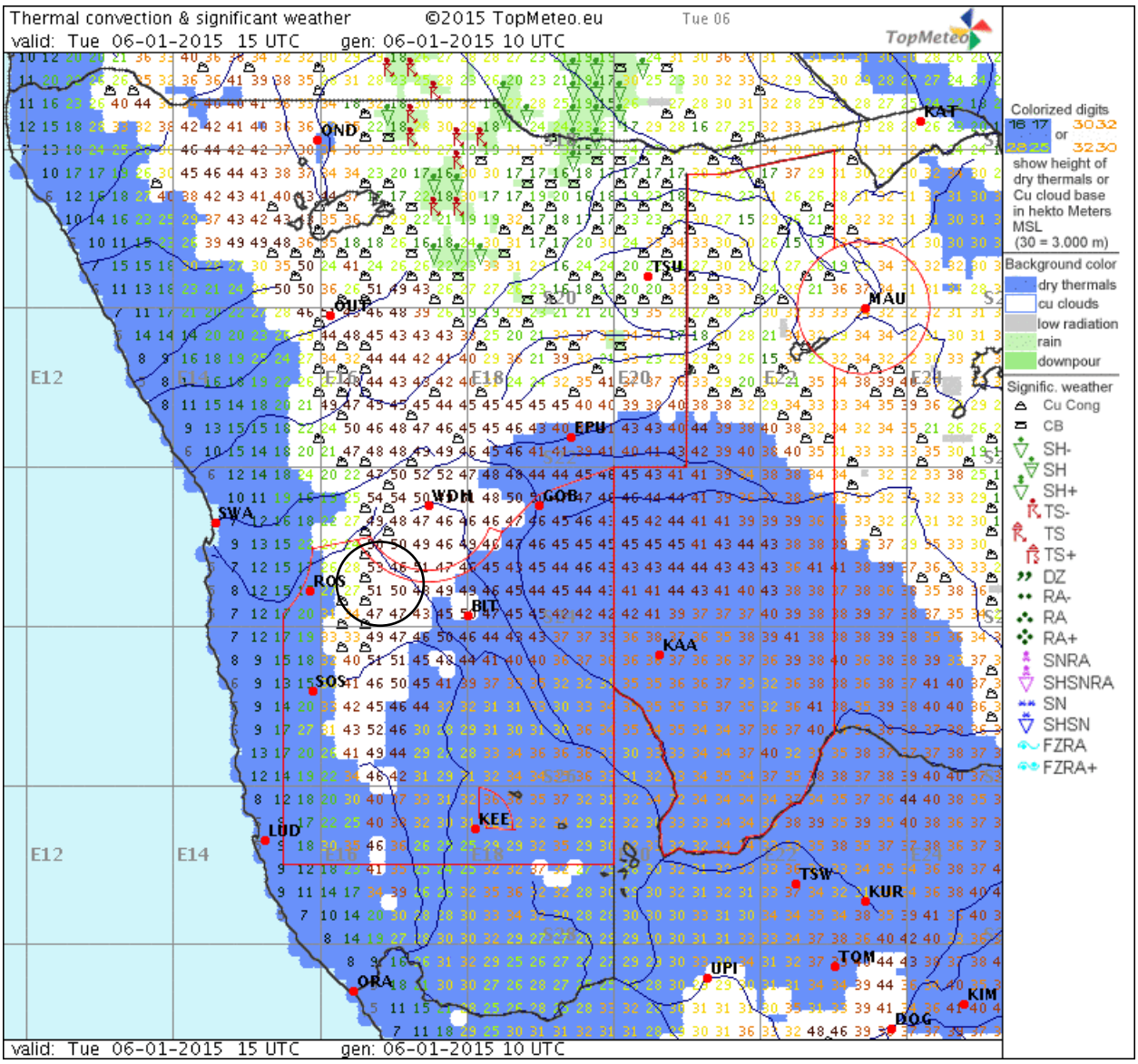

Cloud distribution
©2015 TopMeteo.eu
Tue 06
valid: Tue 06-01-2015 15 UTC
gen: 06-01-2015 10 UTC
TopMeteo
OND
KAT
TSU
MAU
OUT
EPU
WDH
GOB
SWA
ROS
BIT
KAA
SOS
KEE
LUD
TSW
KUR
TOM
UPI
ORA
KIM
DOG
S20
S22
S24
S26
S28
E12
E14
E16
E18
E20
E22
E24
No Clouds
High Clouds
ci medium
ci thick
Medium high Clouds
ac thin
ac medium
ac thick
Low Layer Clouds
< 2000 ft
< 1000 ft
< 500 ft / fog
Cumulus Clouds (octas computed)
Cu flat
Cu Cong
Cu spreadout
Cu below Ci
Cu below Ac
Cu below Sc
Cu spreadout below Ci
Shower / Cb

However, in the small area around Gollschau, a prediction of a convergence line was clear from the charts, with a cloudbase up till 5300meter MSL.

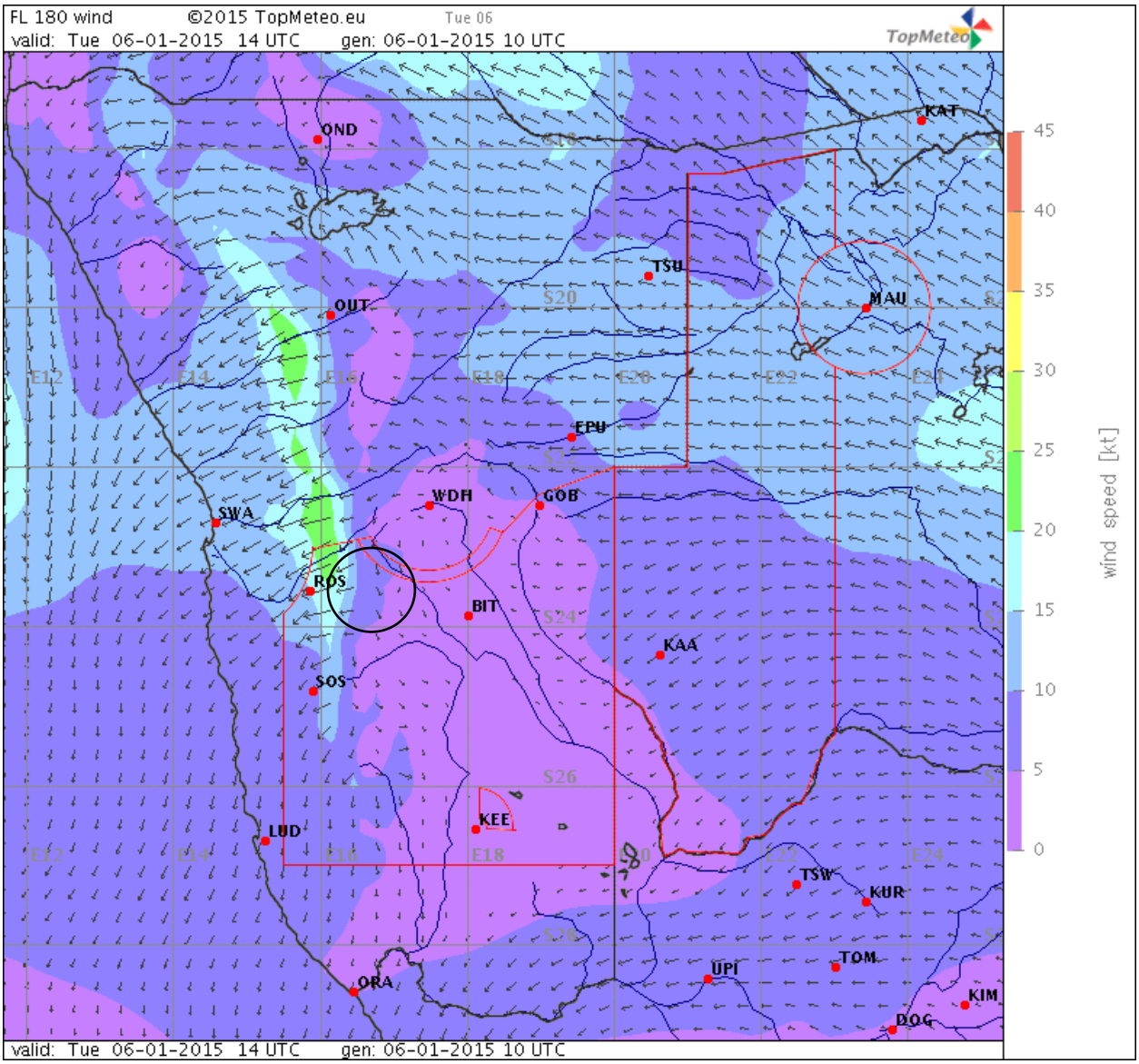
As very large flights would be difficult that day, to us, this seemed to be the perfect day to try the 100km speed triangle.

The optimal time window for the record would be 15.00 to 17.30 local time.

The area of interest is shown with the black circle in the map.



Also windspeeds at altitude were negligible, and mostly coming from the north. In the west of the task area, the wind would turn to the east perpendicular to the convergence line, and speeds would pick up.



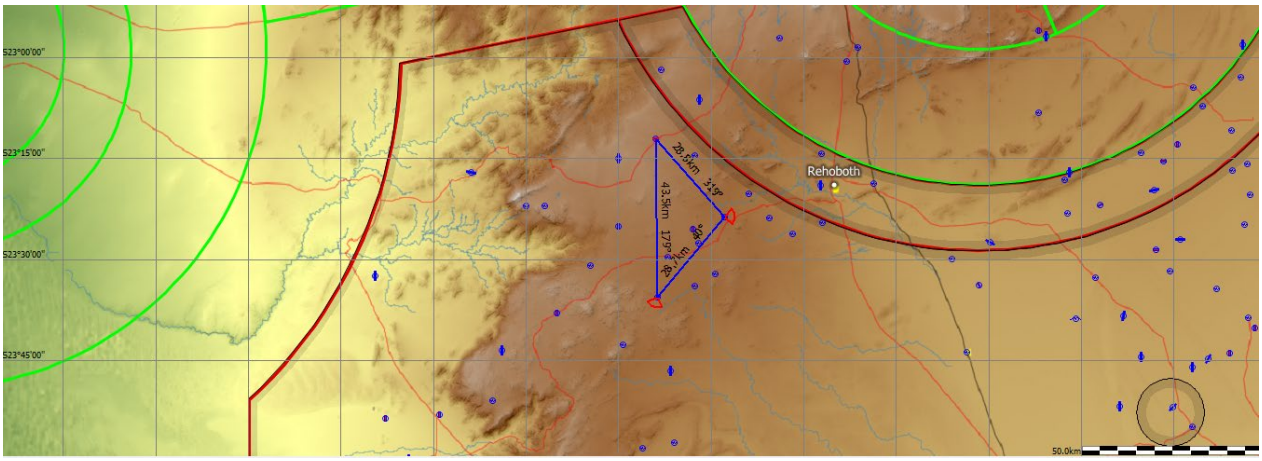
Task setting

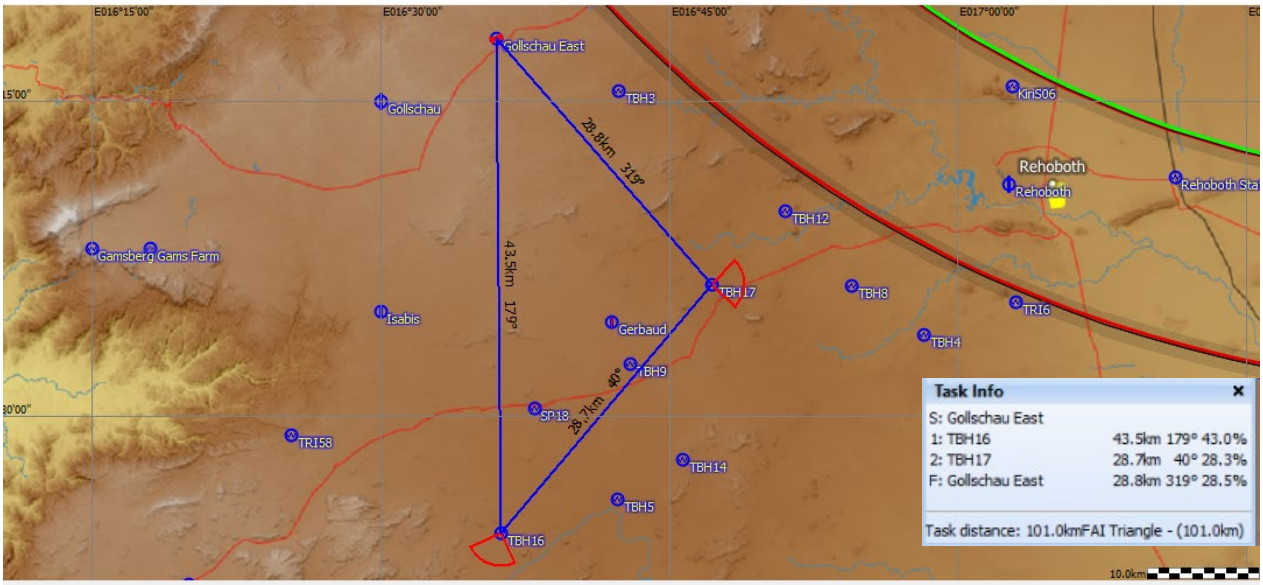
The task was chosen to be a bit away from the “Kante”, to avoid the usual overdevelopments.

The TP Gollschau-East was chosen as the starting point and finish point.

As the convergence line in that area is mostly north-south, the large leg was laid along that axis and maximized to 43.5km/h. The two other legs would be crossing the convergence line main axis, and thus be the shortest of 28.7km, for a combined total of 101.0km. To create this task, two new turnpoints had to be created (which were named TBH16 and TBH17).

The triangle could still be chosen to be flown clockwise or counterclockwise. Since we planned to take the single thermal on the first leg, and since slight northerly wind was predicted. We chose to fly counterclockwise.





The record flight

Flying to the startline

The startpoint is 140km from Kiripotib Flying Lodge. Since there was no use in arriving there before 14.00, we chose to take it easy with a late launch at 12.14 local time.

When we arrived in Gollschau Area around 14.00, the convergence line was still building up in the west. Over the start point the situation was reasonable, but in the southern part of the first leg, and on leg2 and leg3, conditions were still blue, with sometimes a small cumulus cloud. It was still too early. In the north (outside of the Namibian glider zone) the conditions looked fantastic.

1st Test: Flying through the start gate

Since we were early, but there, we decided to do an initial run through the startgate to practice the pull up maneuver with the EB28, and check the instruments and Nav box information on the LX9000.

2nd attempt: A Belgian record, and encouraging results on the first trial

It was still way too blue and early, but now we wanted to try a full lap, to check every aspect of the flight.

We started with a groundspeed of 305km/h in 4599m, and pulled under the first cumulus which we believed to have a good thermal after 17km.

Nothing.

1 useless circle, we pushed on ahead again.

After yet another 11km, we found a poor 3.3m/s climb. Since this was just a trial we decided to climb in it for 719m.

After leaving, and flying another 10km, we found another thermal. 4.5m/s this time. We climbed for 236m up till cloudbase, which was only 4930m under that cloud.

After taking the turnpoint, it became clear that without a decent energyline, we were again sinking under glide path. We thus turned into the third thermal on the second leg. 4.3m/s over 415m.

This was more than sufficient to complete the rest of the lap, and we crossed the finish line in 3748m, 851m below the start, and thus no pull-up needed.

Because of the blueish conditions, the cloudstreeting was bad (only 0.21m/s compared to Laszlo's 0.46m/s), and the glide ratio was thus bad. Because of that, we needed to take 3 thermals. Average climb rate was with 3.78m/s also not good at all (although perhaps it could have been improved climbing more in the 2nd and 3rd thermal instead of the 1st).

We also thermaled ca 300m too much.

To top it off, we made a useless circle…

With all this, we still managed to fly 190.03km/h.

This was just 2.6km/h below the current record claim, and 20km/h above the standing Belgian record.

Very encouraging indeed.

Alt. Loss in Glide	-2223	m
Time Glide	1550	sec
Average Sinkrate	-1.43	m/s
Average Glidespeed TAS	242	km/h
Polar Sinkrate for that TAS	-1.65	m/s
Netto Avg. Airmass movement	**0.21**	m/s

The actual flight statistics of attempt 2 in the model

Taskparameters			
	Taskdistance	101	km
	Total Distance	104.4	km
	De-tours	3.37%	
	Average Altitude	4250	m
	Altitude Effect Factor	1.30	
	Start-Finish Alt Difference	851	m
	Climbrate	3.78	m/s
	Netto cloud streeting climb	0.21	m/s

Output			
	timeclimb	6.1	min
	Altclimb	1376	m
	timeglide	25.9	min
	LD	47	
	Total time	**31:57**	**min:sec**
	Average Speed	**189.6**	**km/h**

Calculations			
Thermalling	Average netto climb	4.55	m/s
Glide	GlideSpeed TAS	242	km/h
	GlideSpeed IAS	186	km/h
	Sinkspeed True	-1.43	m/s
	Time Glide	25.9	min
	Altitude loss	-2227	m
	Time Climb	9.8	min
Finalglide	Time not climb	-3.8	min

In hindsight, if we would have used up the whole 1150m altitude bonus, skipped the useless turn, thermaled less in the 1st, and a bit more in the 2nd or 3rd climb (resulting in a 4.00m/s average climbrate), and fly a bit faster (250km/h TAS) we would have been able to break the 200km/h barrier already.

Taskparameters			
	Taskdistance	101	km
	Total Distance	104.4	km
	De-tours	3.37%	
	Average Altitude	4250	m
	Altitude Effect Factor	1.30	
	Start-Finish Alt Difference	1150	m
	Climbrate	4.00	m/s
	Netto cloud streeting climb	0.21	m/s

Output			
	timeclimb	5.2	min
	Altclimb	1239	m
	timeglide	25.1	min
	LD	44	
	Total time	**30:13**	**min:sec**
	Average Speed	**200.5**	**km/h**

Calculations			
Thermalling	Average netto climb	4.77	m/s
Glide	GlideSpeed TAS	250	km/h
	GlideSpeed IAS	192	km/h
	Sinkspeed True	-1.59	m/s
	Time Glide	25.1	min
	Altitude loss	-2389	m
	Time Climb	10.0	min
Finalglide	Time not climb	-4.8	min

Attempts 3&4

We did a couple of other runs and attempts, but each failed and was thus abandoned for its own reason (low LD, bad centering, no good climb …).

5th attempt: Success!!!

After two hours of playing around, the topmeteo forecast we hoped for started to come true. The convergence line was now really getting strong, but a bit more in the West than we had hoped for. We would need to fly a detour to reach it. The second and third leg were still with separate cumulus clouds, but also these had grown much stronger.

The wind had turned a bit to the west (as forecasted), but we would still tailwind on the first leg.

So, at 16:15 we crossed the startline in 4161m. We immediately turned to the right, to the convergence line in the west, and we reached it after 15km. Not far under the massive cloudstreet, an authorative push under the left wing signaled a thermal. This would turn out to be a 4.36m/s thermal. Not the best ever, but quite good nonetheless. We climbed for 1069 meters, and left a bit below cloudbase.

The powerful convergence line was outlined a few degrees off our track, but the airmass moved us clearly upward underneath it.

A few km before the first turnpoint (TBH16), we said goodbye to the convergence line, and focused on taking the corner.

The second leg was like in the second attempt of the day. But with the tremendous amount of altitude left, we could push on to the third turnpoint.

While taking the last corner of the day, we knew this should suffice. 900m left for 28km, and speed to pull up another 200m. On top of that, a large and promising cumulus was just building up, a bit southwest of track, just a few kilometer before the finish line.

After the final dash we stopped the clock:

29:26

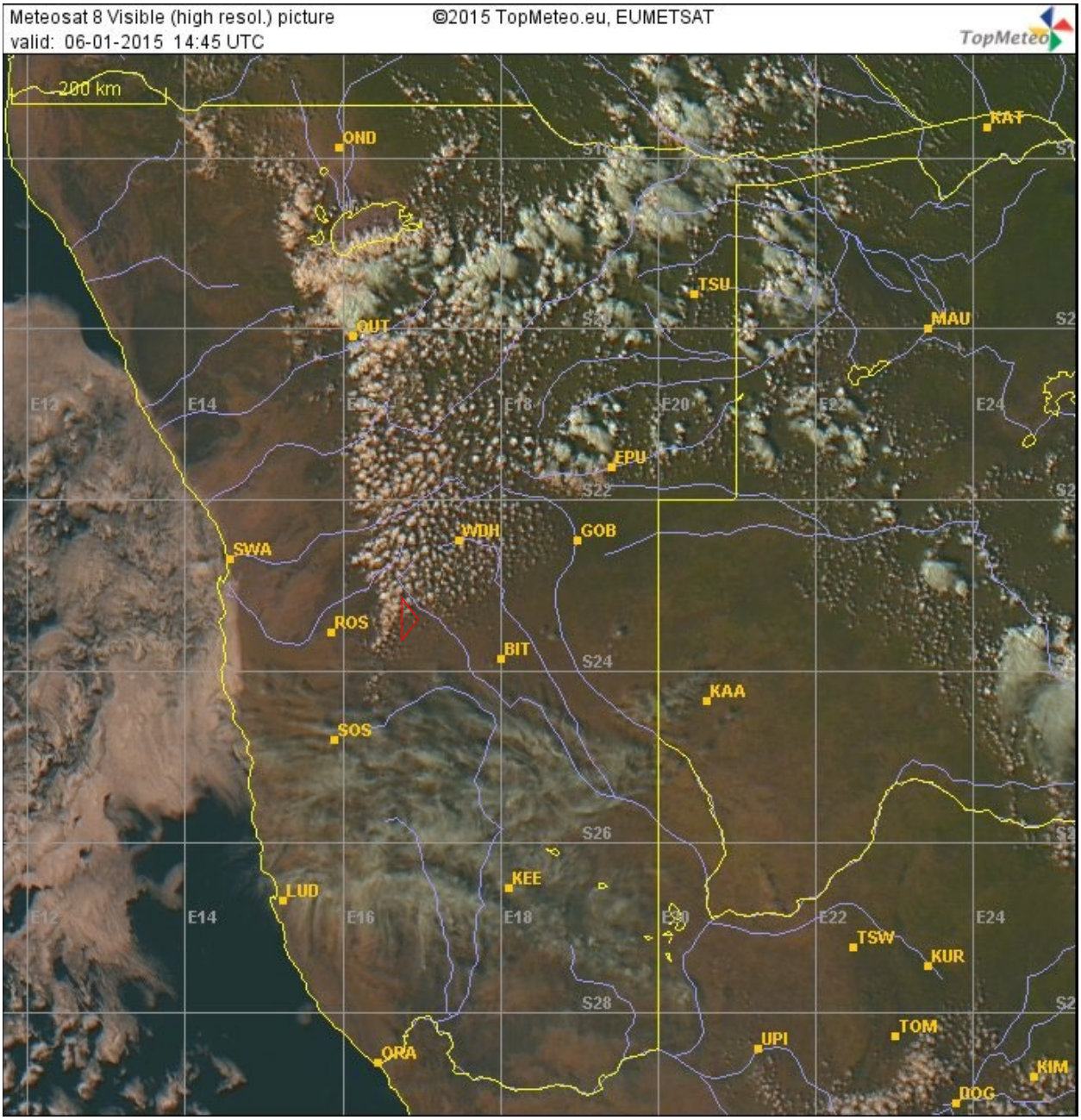
205.89km/h over the 101km task.

Adrenaline still pumping, and a battle cry of joy. This speed run truly is fun!

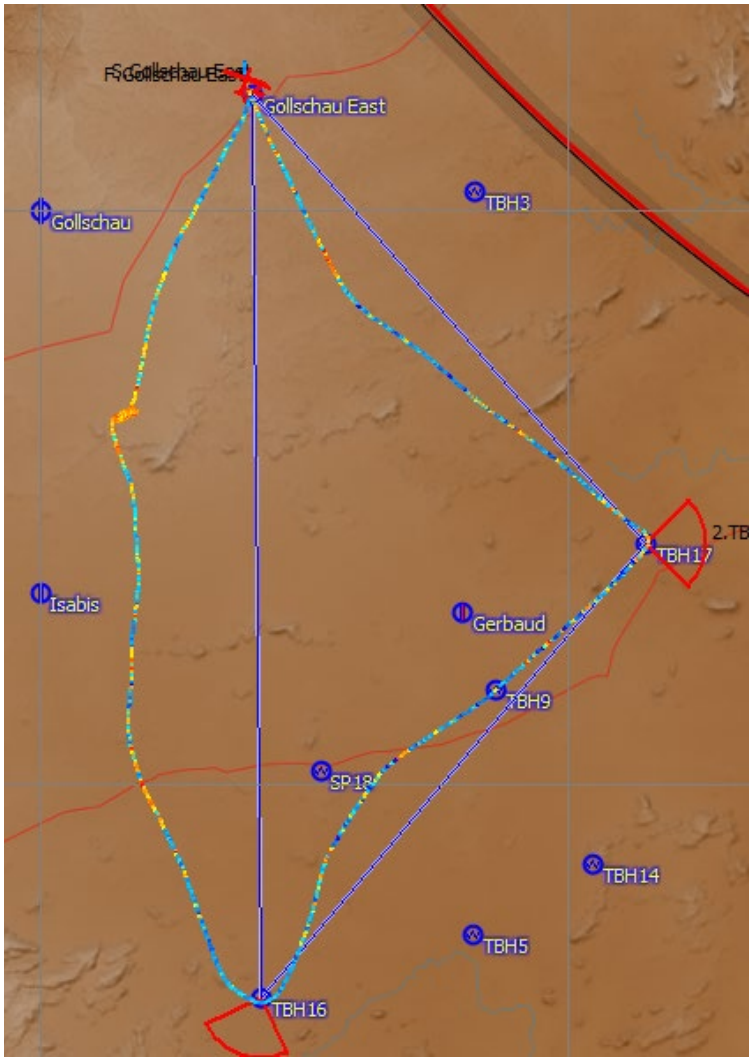
A few moments after crossing the finish line, we enter yet another great thermal (even better than the one we had on the record lap). I take a picture of the LX9000 and post it on facebook.

We decide that we worked enough for today, and unhurriedly fly back to Kiripotib.

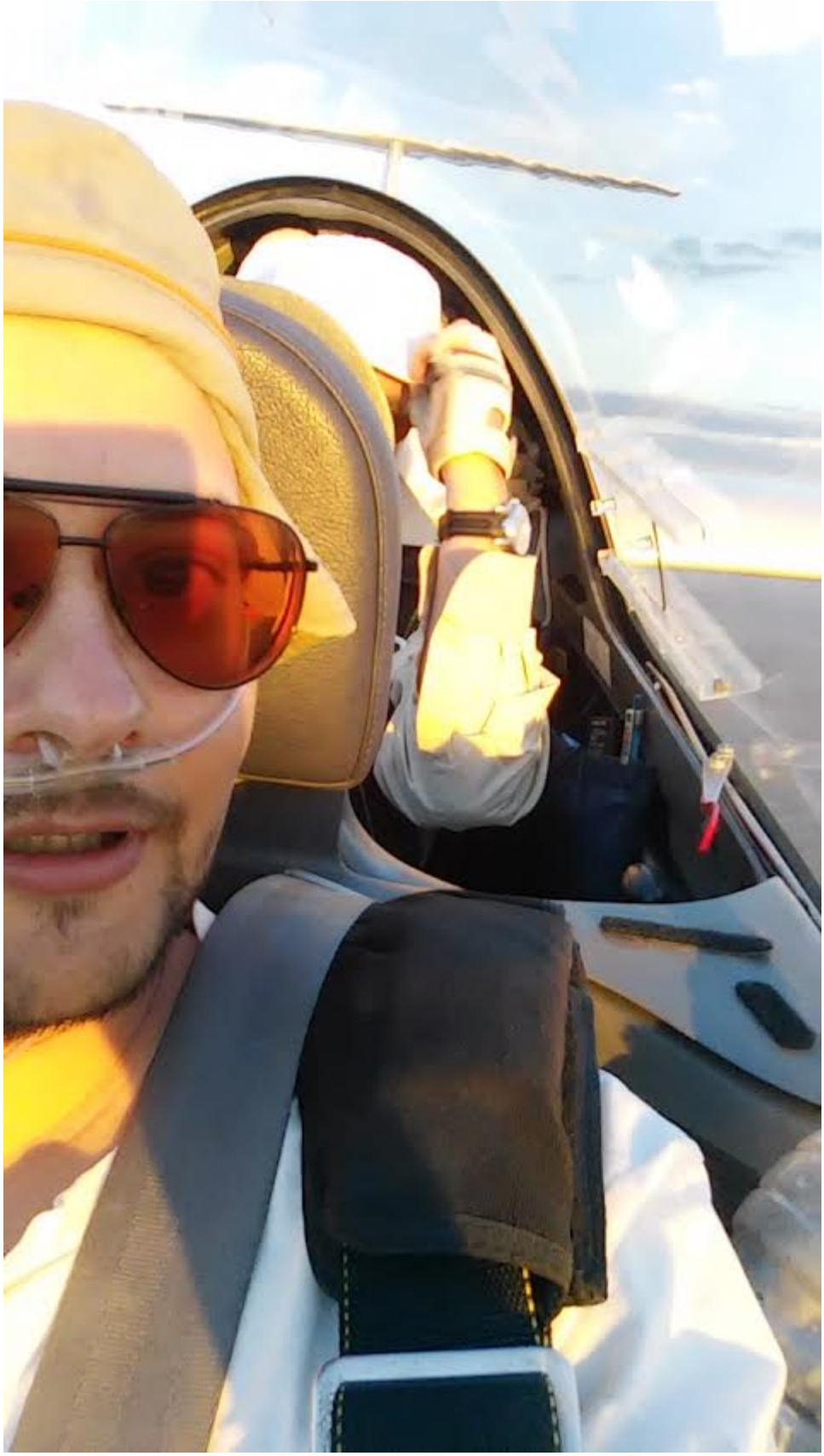
Sattelite image of the clouds during the successful speed run



Our Diamond shaped trackline




Front
Trim
Rear
6.6m/s
4716m
winter
Statistics
+4.6%
+4.3%
+2.8%
Last 60 minutes statistics (On Task)
Avg.vario: 4.2m/s
Avg.speed: 206.4km/h
XC speed: 187.0km/h
Dis.flown: 101km
Circling: 14%
Duration: 00:29:25
THERMALS
Solar
Oudie
On
Speaker
Front
Middle
Fuelpump
Wingfuel
Waterpump
Refuepump
Generator



Post Flight Analysis

We can see that the Netto Avg. Airmass movement is quite good thanks to the massive convergence line. It is ca 0.1m/s better than during Laszlo's record attempt. Climbrate in the thermal is however worse (4.36m/s).

Detours where average, but could be smaller.

This was definitely good weather, but not exceptional.

Alt. Loss in Glide	-1819	m
Time Glide	1521	sec
Average Sinkrate	-1.20	m/s
Average Glidespeed TAS	250	km/h
Polar Sinkrate for that TAS	-1.75	m/s
Netto Avg. Airmass movement	**0.55**	m/s

Taskparameters			
	Taskdistance	101	km
	Total Distance	105.6	km
	De-tours	4.55%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	749	m
	Climbrate	4.36	m/s
	Netto cloud streeting climb	0.55	m/s

Calculations			
Thermalling	Average netto climb	5.16	m/s
Glide	GlideSpeed TAS	250	km/h
	GlideSpeed IAS	189	km/h
	Sinkspeed True	-1.20	m/s
	Time Glide	25.3	min
	Altitude loss	-1826	m
	Time Climb	7.0	min
Finalglide	Time not climb	-2.9	min

Output		
timeclimb	4.1	min
Altclimb	1077	m
timeglide	25.3	min
LD	58	
Total time	**29:27**	**min:sec**
Average Speed	**205.7**	**km/h**

Our glidespeed was only 12km/h IAS under the optimal STF 267km/h TAS. The resulting effect of doing it perfectly would only have been 1km/h more on the average speed.

Taskparameters			
	Taskdistance	101	km
	Total Distance	105.6	km
	De-tours	4.55%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	749	m
	Climbrate	4.36	m/s
	Netto cloud streeting climb	0.55	m/s

Calculations			
Thermalling	Average netto climb	5.16	m/s
Glide	GlideSpeed TAS	267	km/h
	GlideSpeed IAS	201	km/h
	Sinkspeed True	-1.55	m/s
	Time Glide	23.7	min
	Altitude loss	-2209	m
	Time Climb	8.4	min
Finalglide	Time not climb	-2.9	min

Output		
timeclimb	5.6	min
Altclimb	1460	m
timeglide	23.7	min
LD	48	
Total time	**29:19**	**min:sec**
Average Speed	**206.7**	**km/h**

However, we only used up 749m of our 1150m bonus. We could have thermaled 390m less, and then 218.1km/h would have been reached! However, again, this is hindsight knowledge. The glide ratio could have been much worse.

Taskparameters			
	Taskdistance	101	km
	Total Distance	105.6	km
	De-tours	4.55%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	1150	m
	Climbrate	4.36	m/s
	Netto cloud streeting climb	0.55	m/s

Output			
	timeclimb	4.0	min
	Altclimb	1059	m
	timeglide	23.7	min
	LD	48	
	Total time	**27:47**	**min:sec**
	Average Speed	**218.1**	**km/h**

Calculations			
Thermalling	Average netto climb	5.16	m/s
Glide	GlideSpeed TAS	267	km/h
	GlideSpeed IAS	201	km/h
	Sinkspeed True	-1.55	m/s
	Time Glide	23.7	min
	Altitude loss	-2209	m
	Time Climb	8.4	min
Finalglide	Time not climb	-4.4	min

An interesting thought experiment again: what would have been our average speed, if there would not have been allowed a difference between start and finish altitude. It would thus negate the “bonus”. This is called the XC speed in the LX9000 and Seeyou software.

For this record lap, the XC speed is 187.5km/h. This is very high for a set task, and something you would rarely see in a normal flight!

Taskparameters			
	Taskdistance	101	km
	Total Distance	105.6	km
	De-tours	4.55%	
	Average Altitude	4500	m
	Altitude Effect Factor	1.32	
	Start-Finish Alt Difference	0	m
	Climbrate	4.36	m/s
	Netto cloud streeting climb	0.55	m/s

Output			
	timeclimb	7.0	min
	Altclimb	1826	m
	timeglide	25.3	min
	LD	58	
	Total time	**32:19**	**min:sec**
	Average Speed	**187.5**	**km/h**

Calculations			
Thermalling	Average netto climb	5.16	m/s
Glide	GlideSpeed TAS	250	km/h
	GlideSpeed IAS	189	km/h
	Sinkspeed True	-1.20	m/s
	Time Glide	25.3	min
	Altitude loss	-1826	m
	Time Climb	7.0	min
Finalglide	Time not climb	0.0	min

205.89km/h is not the end

As with previous projects, I always enjoy thinking something up behind the desk, and then testing it out in the real world. I am glad we succeeded, and also glad to be able to contribute to the theoretical understanding of gliding, in this case of the 100km speed run.

The record we set was decent, but definitely not the end. I predict that before the end of the 2015/2016 season of Namibia, the record speed on the 100km FAI triangle will be close to 220kph.

It just takes one man in the right spot with a good glider, and with half an hour time to spare.

Thanks

We would like to thank:

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http://www.dolba.de/kiripotib_flying/index.html

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Topmeteo for again a perfect forecast
http://de.africa.topmeteo.eu/go/home

Sponsor Brillen Kueppers for the superb new sunglasses
http://www.brillen-kueppers.de/de

Naviter/Seeyou for making flight planning a lot easier
http://www.naviter.com/

LXNav for making flying a lot easier
http://www.lxnav.com/

Previous reports

Keiheuvel – Viersen – Spanish border: 1000km straight distance
http://www.scribd.com/doc/90226458/16042012-Keiheuvel-Viersen-SpanishBorder

The Cloud Making Machines: 1000km from Flanders
http://www.scribd.com/doc/97134912/Cloud-Making-Machines

Solving the Speed Run

How we broke through the 200kph barrier

Tijl Schmelzer & Bert Sen. Schmelzer