WEATHER CONDITIONS IN SOUTHERN AFRICA FOR LONG DISTANCE AND HIGH SPEED SOARING FLIGHTS

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Presented at XXV OSTIV Congress, St. Auban, France

Introduction

Extraordinary soaring flights, such as Klaus Holighaus' world record over a 1400 km triangular course and Helmuth Fischer's speed world record over a 1000 km triangular course of 169.7 km/h, have put the spotlight on South Africa as one of the prime "hunting grounds" for world records.

Due to the lack of understanding of Southern Africa's weather mechanism, the potential of this area has not been fully explored. Record attempts were mainly undertaken during relatively short periods and launch points were not systematically chosen. This is not surprising as to date no in-depth analysis exists of the South African weather conditions in respect of soaring flights.

With this paper the author attempts to shed some light on the subject.

The Weather Pattern of the South African Summer

Most of the interior of South Africa is situated at an elevation of between 3,000 and 5,000 ft MSL. Therefore only atmospheric conditions above 950 - 850 mb are of interest for the soaring areas under discussion. During the summer months the interior is screened off from the effect of frontal systems by coastal mountain ranges, in particular to the South of the country.

The "Southern Cape" of Africa is surrounded by two oceans. The Atlantic Ocean to the West and the Indian Ocean to the East and South East. Two currents determine the temperature of the two oceans. Originating from the Antarctic region, the cold Benguela current brushes the Western coast of the country. In contrast a warm current emanating from an area South of Madagascar affects the Indian Ocean to the East and the South East of the country.

The major weather engine for the Southern African region is a strong high pressure system over the Atlantic Ocean, which periodically sweeps around the country to link up with a high pressure system over the Indian Ocean. The outstanding and, for soaring, most important feature in this "concert of airmasses" is the formation of a heat low over the interior of Southern Africa during the summer months. Due to its elongated shape this is frequently referred to as the "trough line."

Figures 1 and 2 show the typical summer weather pattern of Southern Africa at the 850 mb level and at 13,000 ft respectively. The corresponding weather pattern is as follows:

Warm moist air is moving in from the East. Dew points in the area around Johannesburg would be typically in the region of 15 - 17 degrees Celsius. The inversion East of the trough line is largely weak or non-existent, which frequently leads to the development of thunderstorms. Therefore the interior of South Africa is also referred to as the summer rainfall region.

Figure 3 shows the lightning density, which supports the above-mentioned statement. For example Johannesburg has one of the highest lightning densities in the world.

Having lost most of its moisture, the subsiding air to the West of the trough line, together with a strong high pressure system in the upper air, produces cumulus clouds with the characteristically high cloud base for which South Africa and Namibia are well known in gliding circles.

Figure 4 shows the average rainfall in Southern Africa. It can be seen how the trough line separates arid regions to the West from prosperous agricultural land in the East. Maize and cattle farming characterize the area East of the trough line whereas sheep farming dominates the area West of the trough line.

The Significance of the Trough Line for Soaring.

The influx of cool unstable air, which in Central Europe during spring can lead to extraordinary soaring conditions, is unknown in South Africa. Only convective processes as a result of high temperatures play a role. Cool Antarctic air pushed into the interior from the South or South-West by the Atlantic High, is an absolute "killer" for soaring conditions.

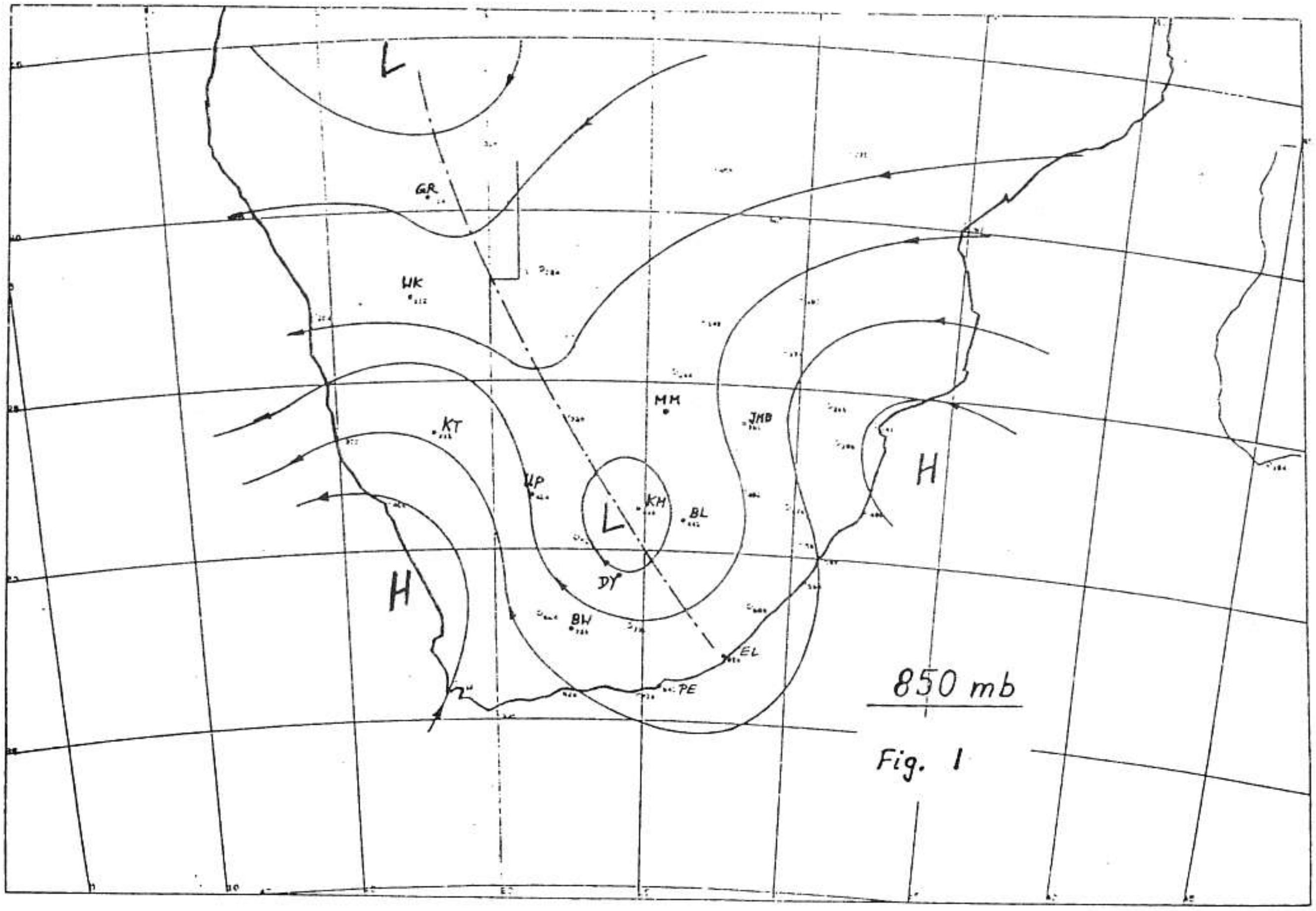
The high moisture content of the soil East of the trough line is due to regular thunderstorms, a similar detrimental effect to good soaring conditions. This, together with the high dew points, leads to a low cloud base (4,000 to 5,000 ft AGL) and weak thermal conditions in the East, e.g. Johannesburg area.

This situation is vastly improved closer to the trough line where due to moisture loss of the air the cloud base is lifting. However, dew points are still high enough and together with a weak inversion, thunderstorm development prevails. Subsiding air just West of the trough line forms an inversion - so vitally important for successful soaring flights. This subdues the thunderstorm activity and together with the now significantly dryer air (dew points near De Aar between 3 and 7 degrees Celsius), leads to the formation of flat cumulus clouds with a cloud base of between 14,000 and 18,000 ft MSL as well as strong thermal activity - a glider pilot's dream.

Figures 5 and 6 show typical summer tephigrams of the Johannesburg area and just West of the trough line (De Aar) respectively which illustrate the above effects.

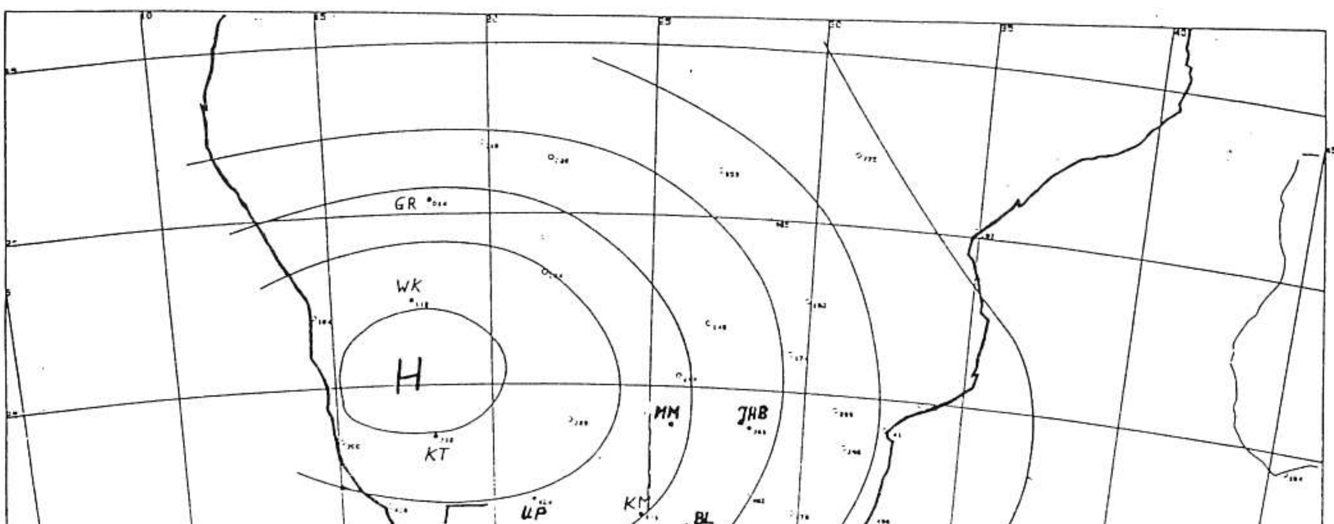
Even further West conditions for soaring deteriorate with the Atlantic High now coming into effect with more stable air and a drop in the inversion level.

Therefore, the position of the Atlantic High, but more importantly, the position and the vertical extension of the heat low (trough line) and their movements during the course of the day, become the critical planning parameters not only for the setting of the task, but also for the selection of the launch point.



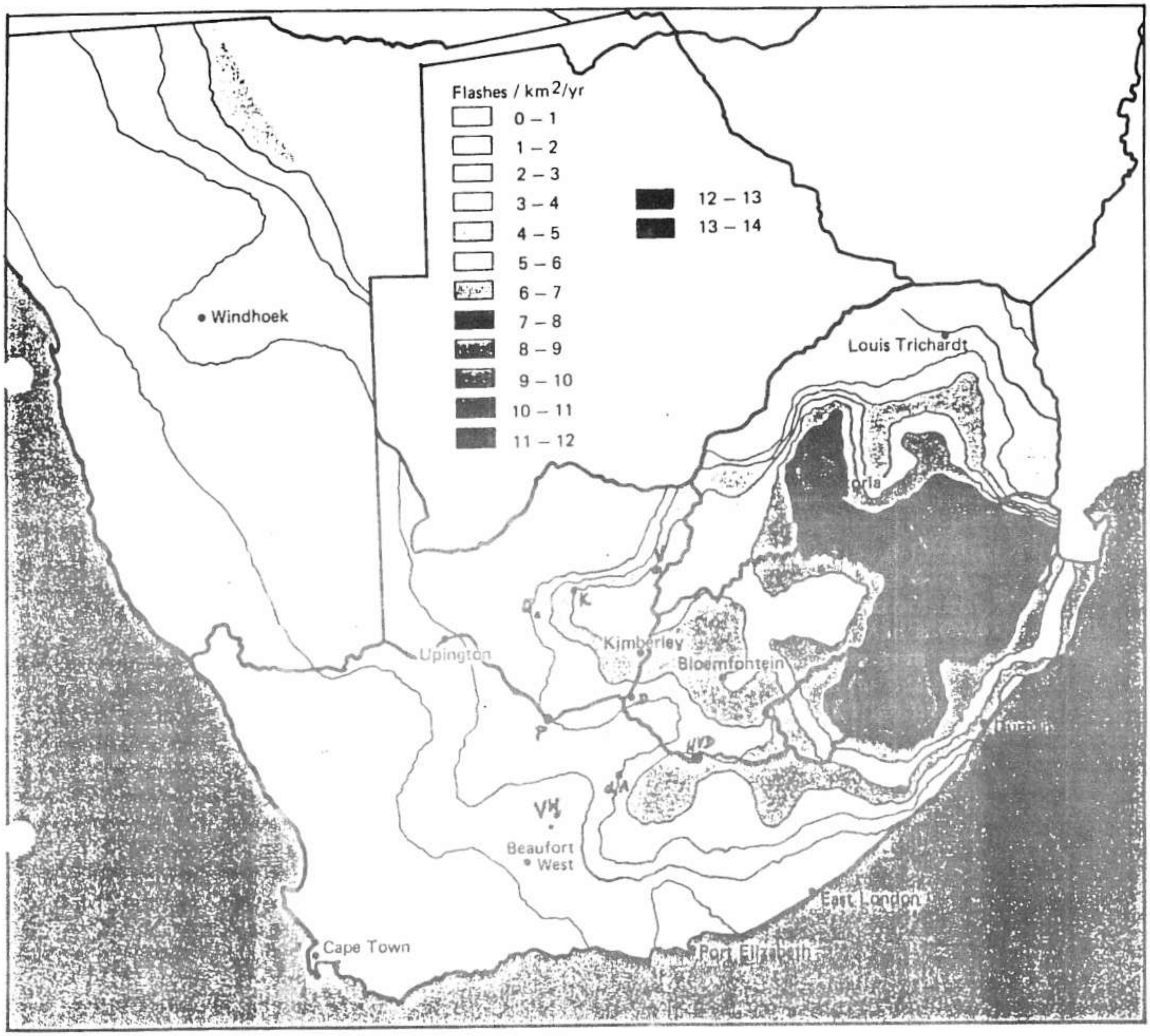
850 mb

Fig. 1



13.000 ft

Fig. 2



LIGHTNING GROUND FLASH DENSITY (1975 – 1986) GRONDWEERLIGDIGTHEID

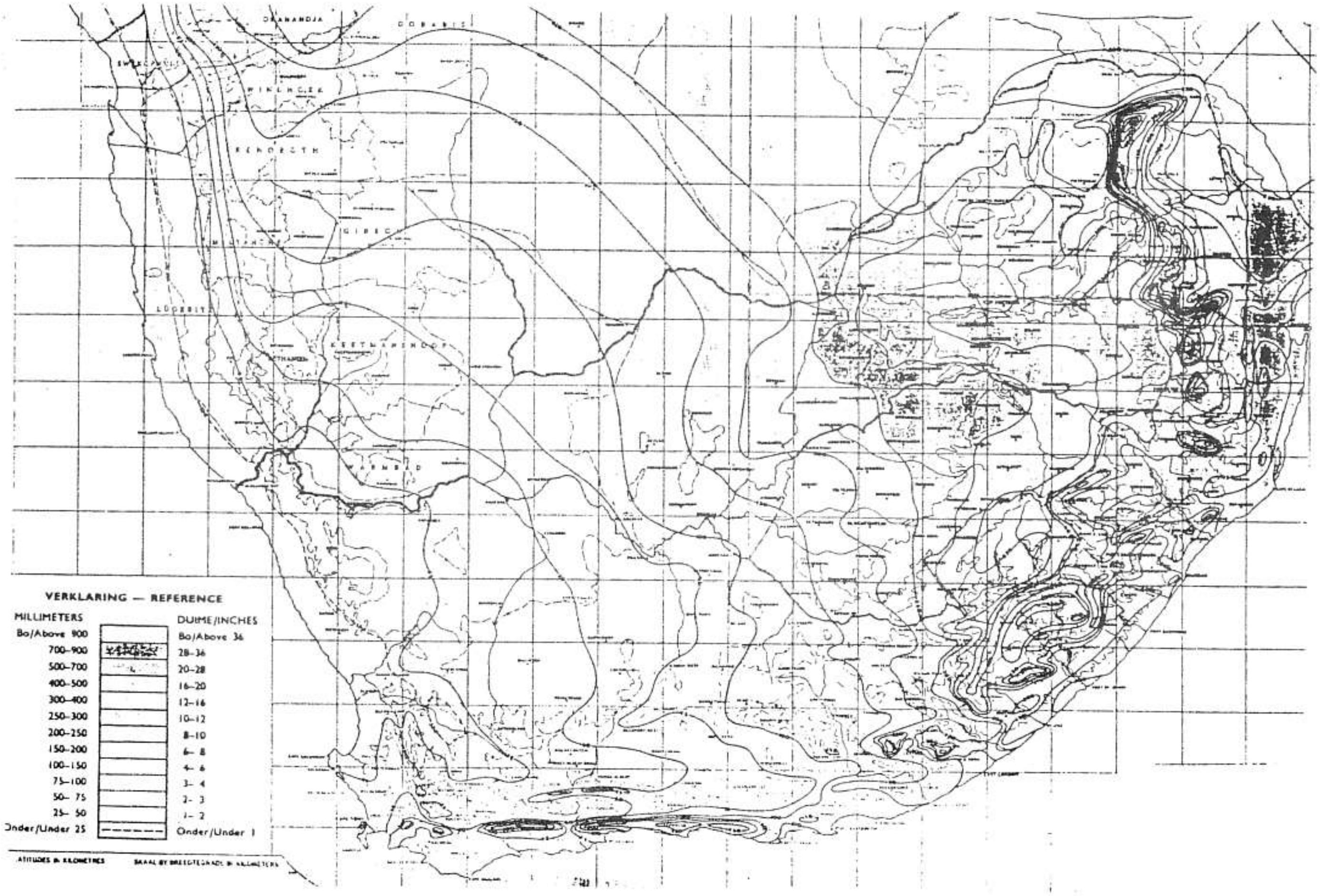
The cyclical movement of the Atlantic High around the country linked to the passage of cold fronts South of the Cape Peninsula determine the position of the trough line, which oscillates around a clearly defined mean. This is a line stretching from Grootfontein in Namibia to about East London in South Africa. It is illustrated in Figures 7 to 10. Soaring conditions are thus becoming predictable and, depending on the choice of the launch point, a high flexibility of task setting can be obtained.

Given a location, e.g. De Aar, which most of the time is situated just West of the trough line, Figure 11 shows the effect of the approaching trough or the deepening of the heat low. The latter two days of this sequence provided conditions in which two outstanding world records were flown. The Figures 12 to 14 show the related tephigrams of De Aar (DY), Upington (UP) and Bloemfontein (BL) one of the days, the 5, January 1995.

The author used this day to fly a speed world record over a 1,000 km triangular course with an average speed of 169.7 km/h. Judging from the general conditions in the task area, it was estimated that a speed of approximately 155 km/h could have been achieved over a triangular course of 1,250 km. In Figure 15 the above is put in relationship to the world records existing at that time. The comparison points to the tremendous potential available in South Africa. The high altitude at which flights are performed definitely leads to high speeds.

Timing and Location for Record Flights in South Africa

Being entirely dependent on the weather there is never



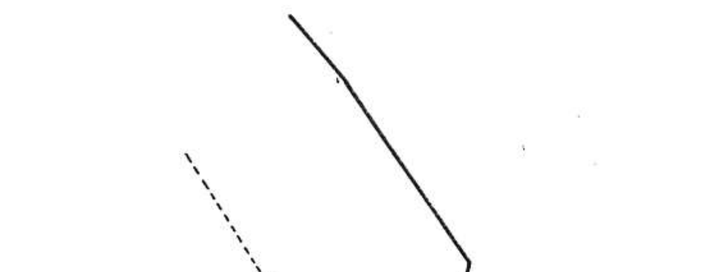
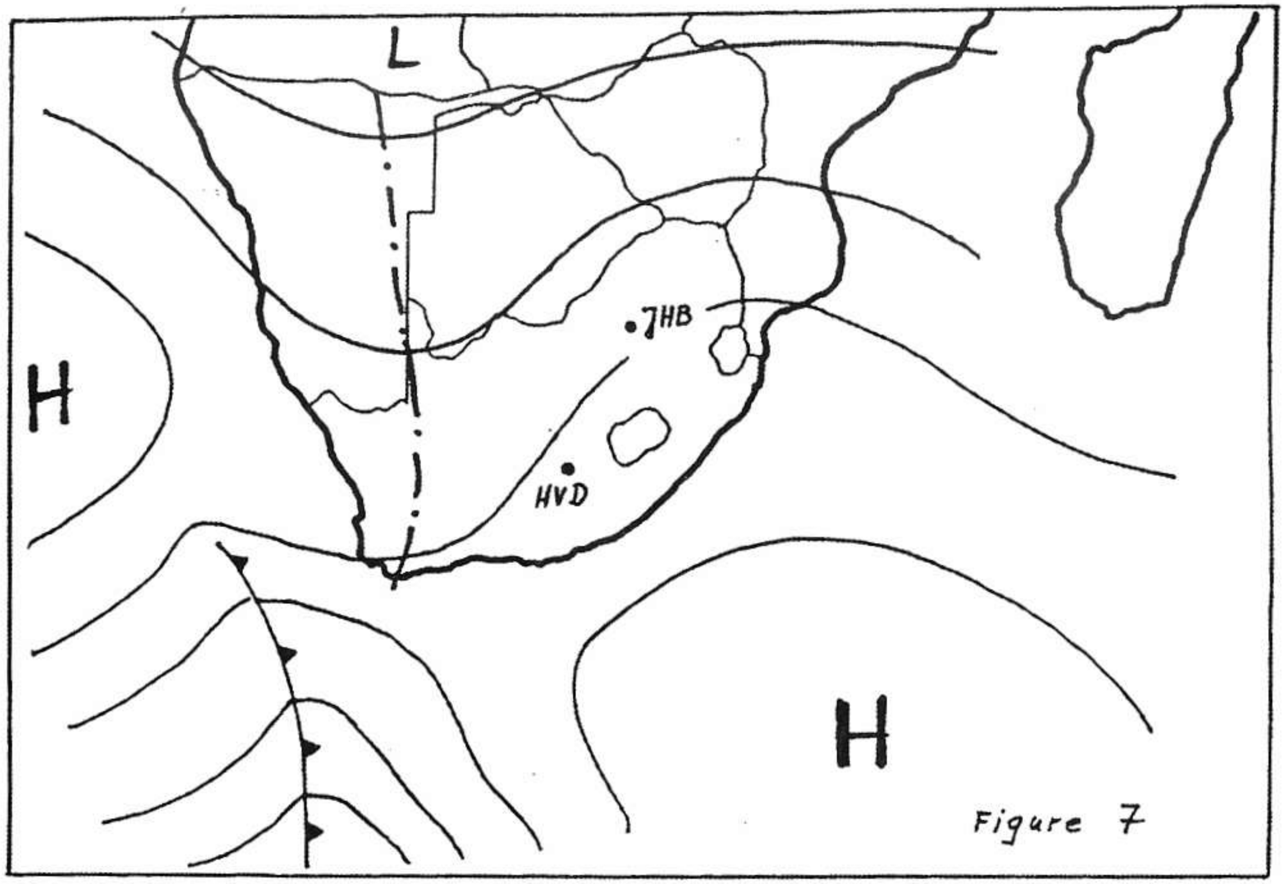
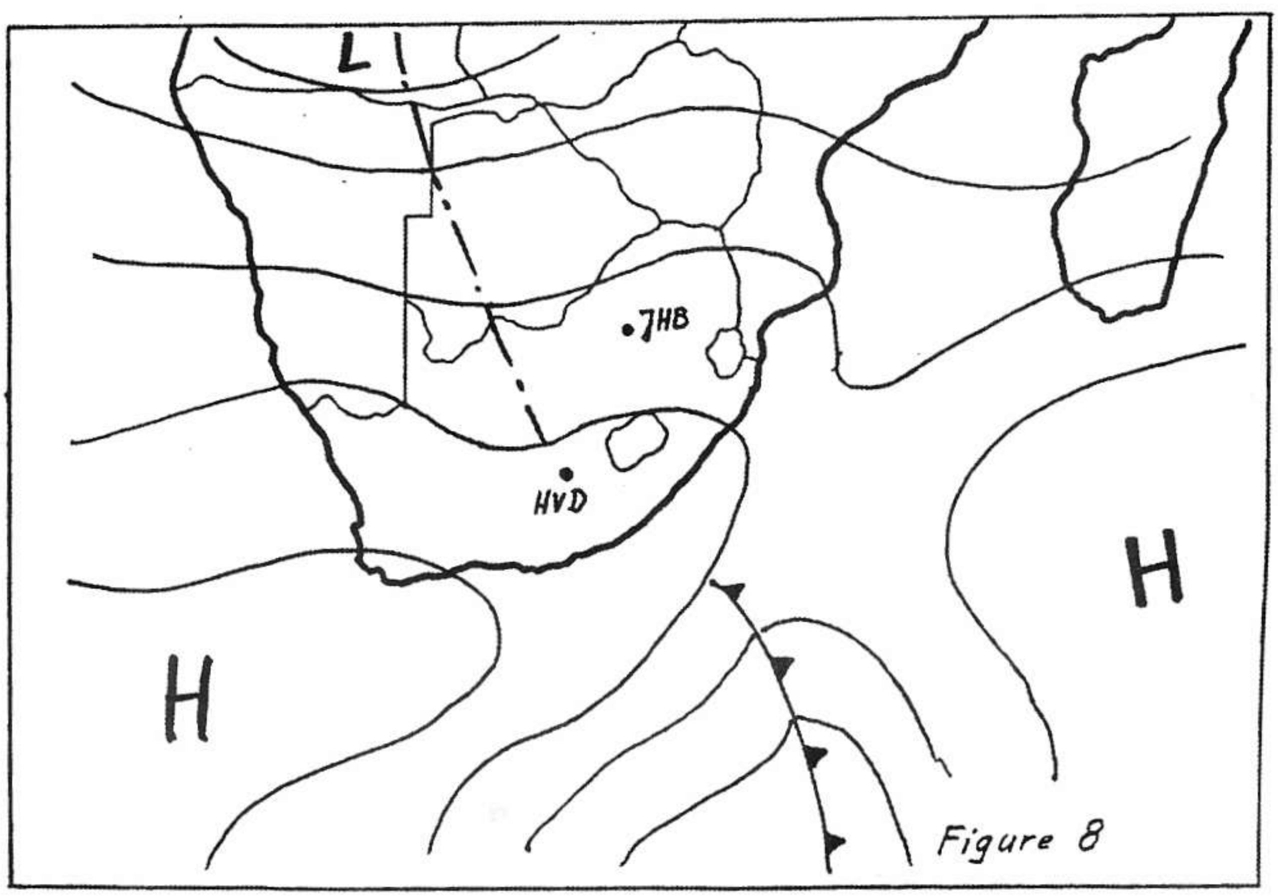


Figure 5 De Aar (DY)

Figure 6 Johannesburg (JHB)


L
H
JHB
HVD
H
Figure 7


L
JHB
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H
Figure 8

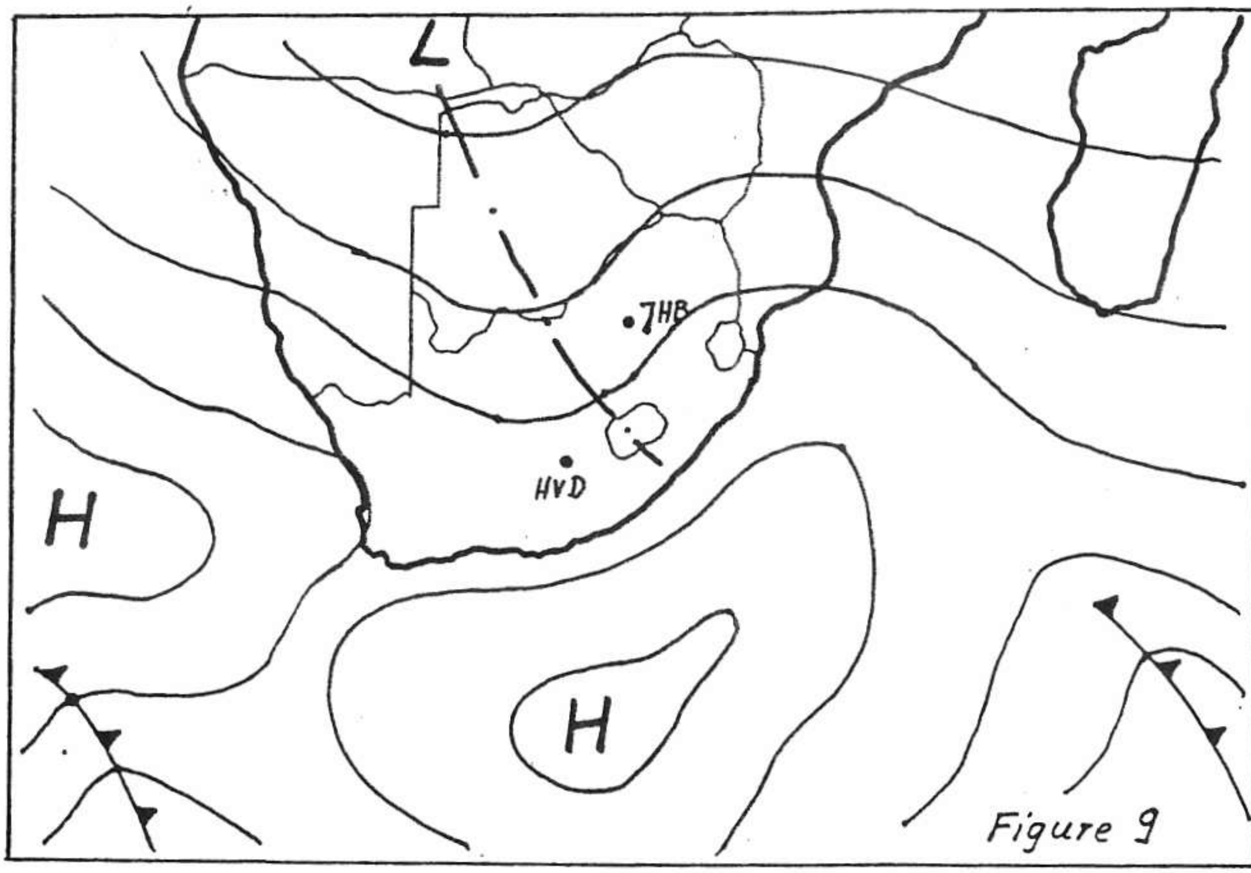

Figure 9

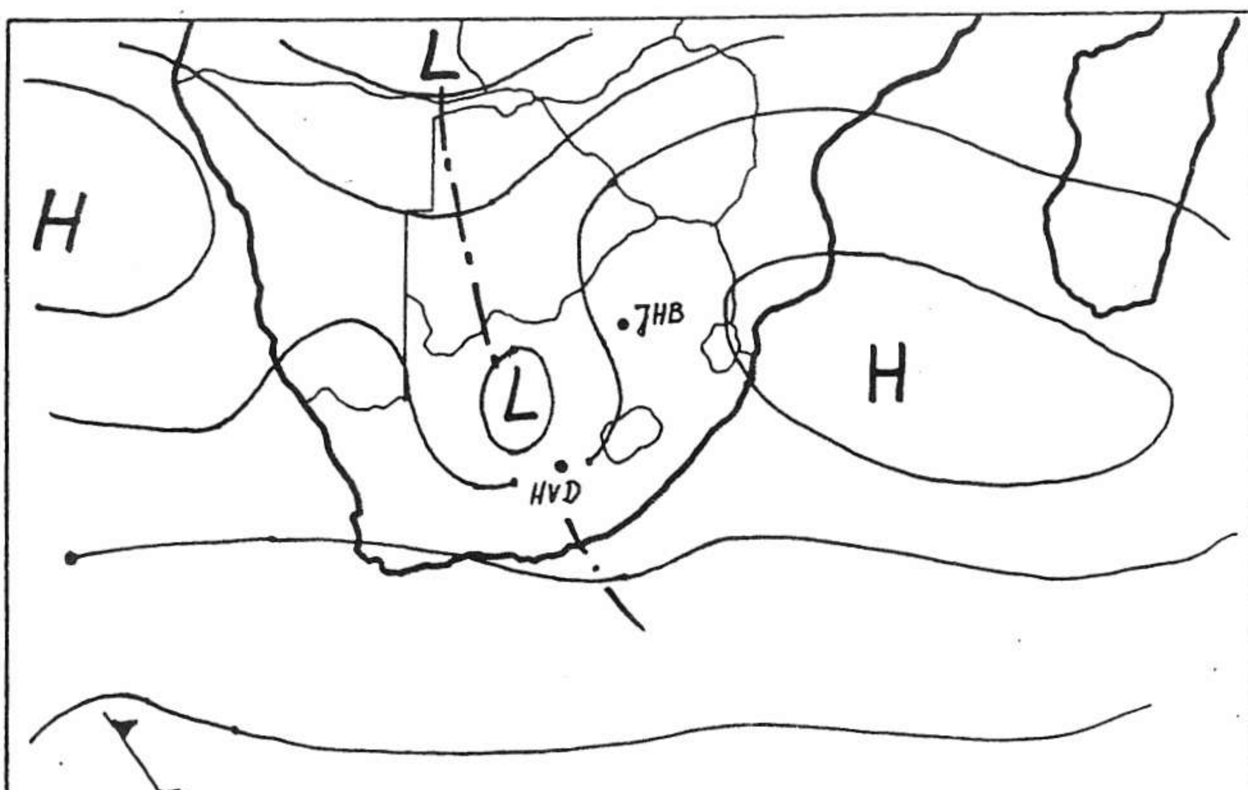

Figure 10

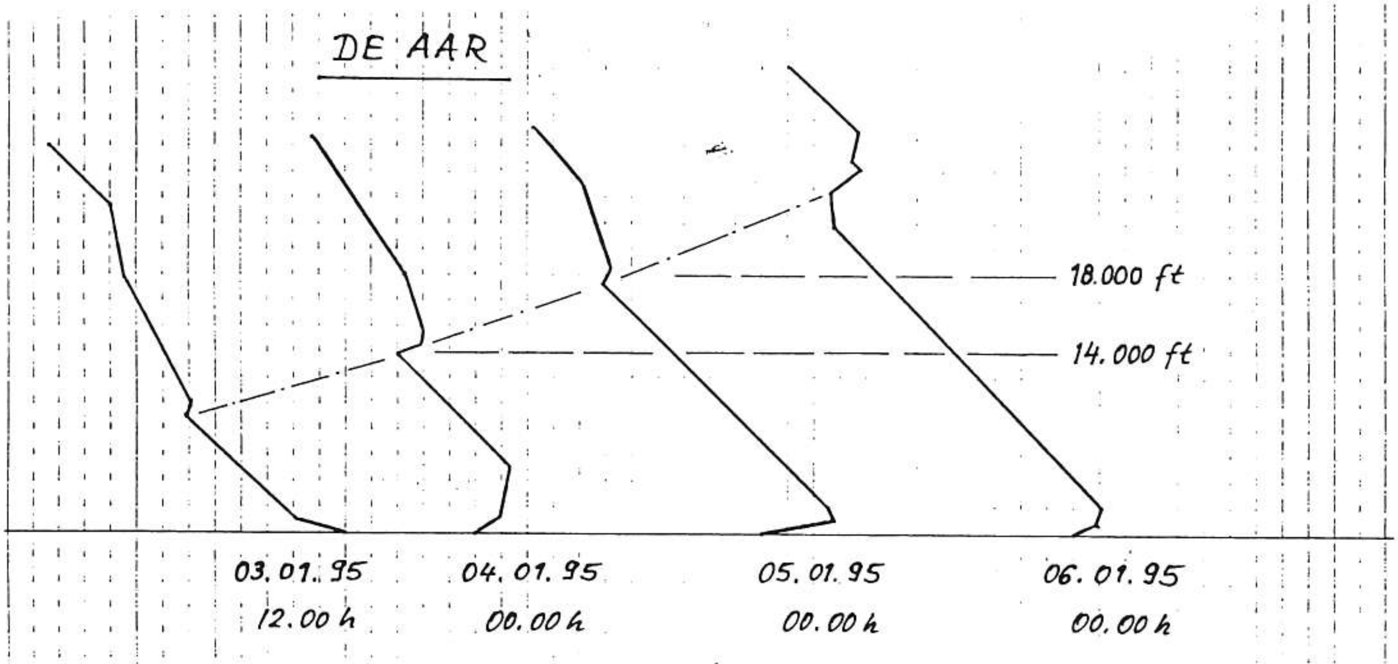

Figure 11

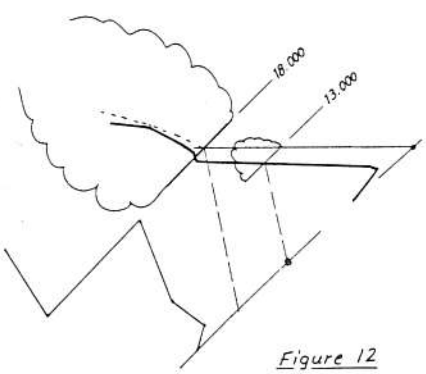

Figure 12
05.01.95
00.00
De Aar

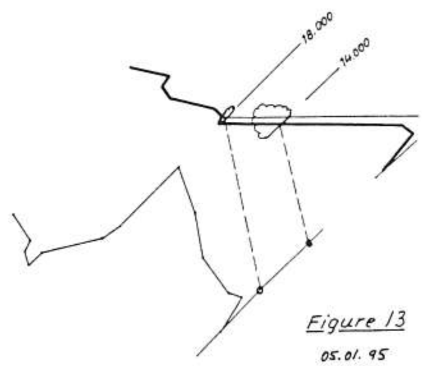

Figure 13
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Upington

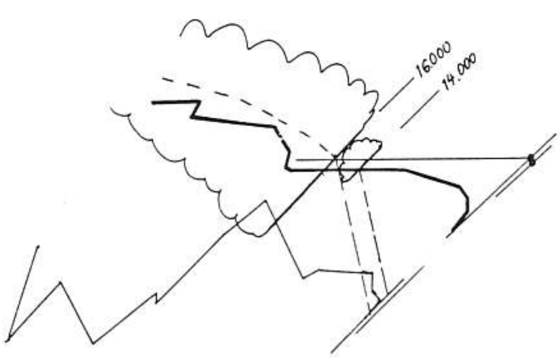

Figure 14
05.01.95
00.00
Bloemfontein

an absolute guarantee linked to a certain place. Therefore the choice is aimed at increasing the probability for success. From the above deliberations it can be gleaned that a location on or just West of the average position of the trough line represents an optimum. Figure 16 depicts the area in question.

No consideration will be given in this paper to other criteria, such as outlanding facilities or luxurious accommodation. These would lead to the choice of suboptimum locations, such as Kimberley, Bloemfontein or Mafikeng (previously Mmabatho), all of which are located East of the trough line.

Irrespective of the above, the availability of adequate accommodation and a suitable airfield nevertheless play an important role when selecting a launch point. Considering all criteria most points are scored by Gariep Dam (previously Hendrik Verwoerd Dam = HVD). This is confirmed by the most spectacular world records flown in South Africa in recent years.

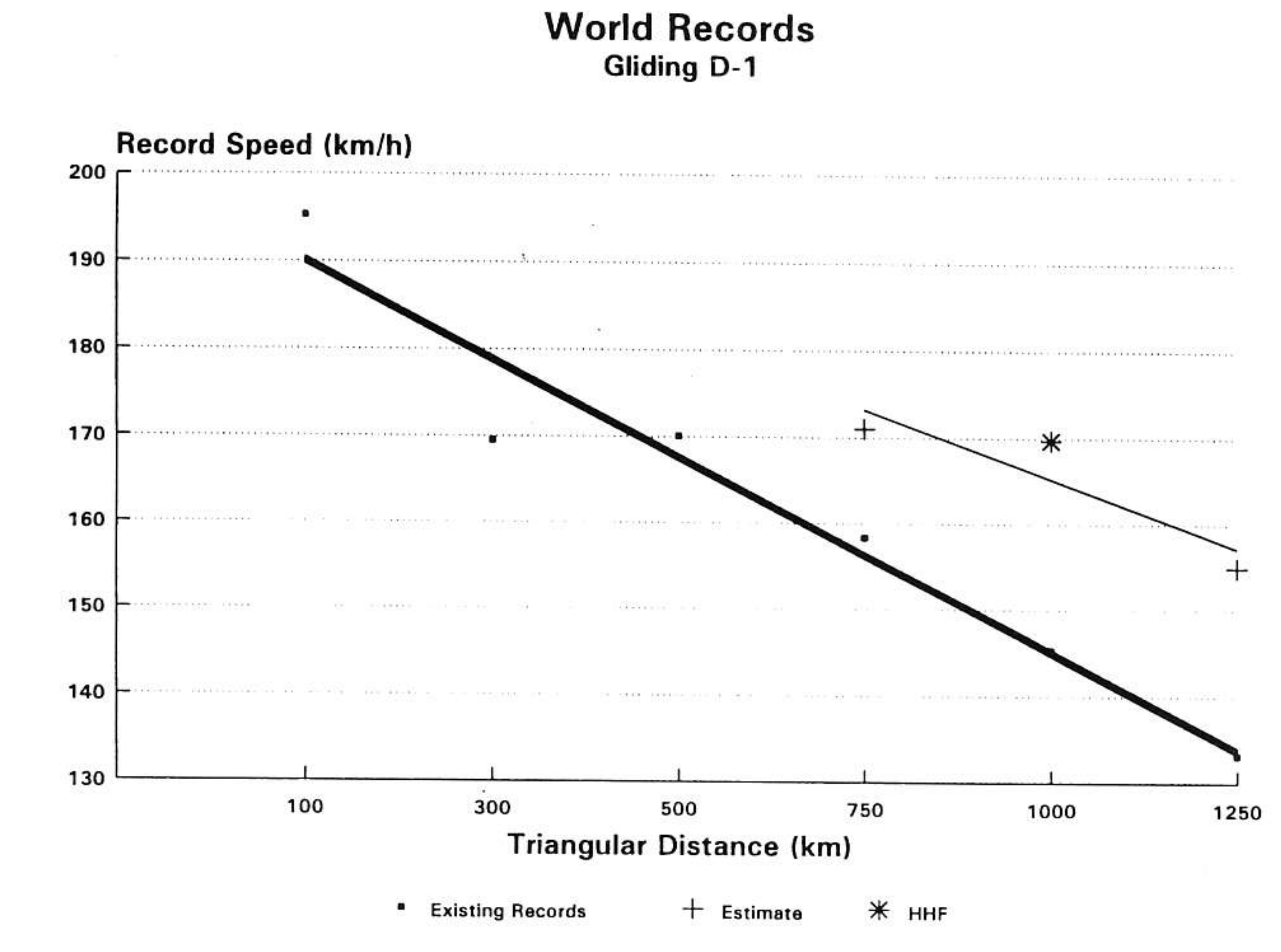

Figure 15

Figure 17 shows what a typical triangular task flown from Gariep Dam would look like. The launch point would be situated on one leg of the triangle. Therefore the first short leg would lead to the East utilizing the prevailing tailwind associated with the high pressure system in the upper air (see Figure 2). On the second leg this would turn into a headwind, which at times can be rather strong, but would reduce further to the North-West as one approaches the center of the upper air High. On the second, and more so on the last leg, one would again benefit from the tailwind. This is particular welcome towards the evening when returning from a long distance task.

The synoptic situation which would provide the desired properties prevails during the months of November up to and inclusive of February. In some years even March can provide surprisingly good conditions, albeit with reduced sunshine hours. A cloud base of 16,000 ft with climb rates of between 5 - 6 m/s has been experienced by the author during March.

Soaring Conditions in Countries North of South Africa

The summer circulation also benefits a place such as Bitterwasser in Namibia. This is confirmed by many excellent records flown there over the years.

However some constraints influence soaring conditions around Bitterwasser. As a result of the summer circulation moist subtropical air is moving South in the upper air from the Intertropical Convergence Zone. This process intensifies as the summer moves on and brings extensive rain to Namibia from approximately the middle of January onward through to March. This not only limits the number of months during which records can be flown, but at times limits the task area in the North of Bitterwasser due to substantial Altostratus and Altocumulus development.

The other constraint is the result of the sea breeze. In Southern Africa, particularly in the Western parts the sea breeze can at times move over a distance of up to 300 km inland. Originating from the cold Atlantic Ocean off the West coast of Namibia the effect on soaring conditions can be disastrous. If the stable sea breeze air is not pushed back during the night, thermal development can still be delayed the following morning.

The Northern part of Namibia, Southern Angola, Botswana, Zambia and Zimbabwe are fully affected by the

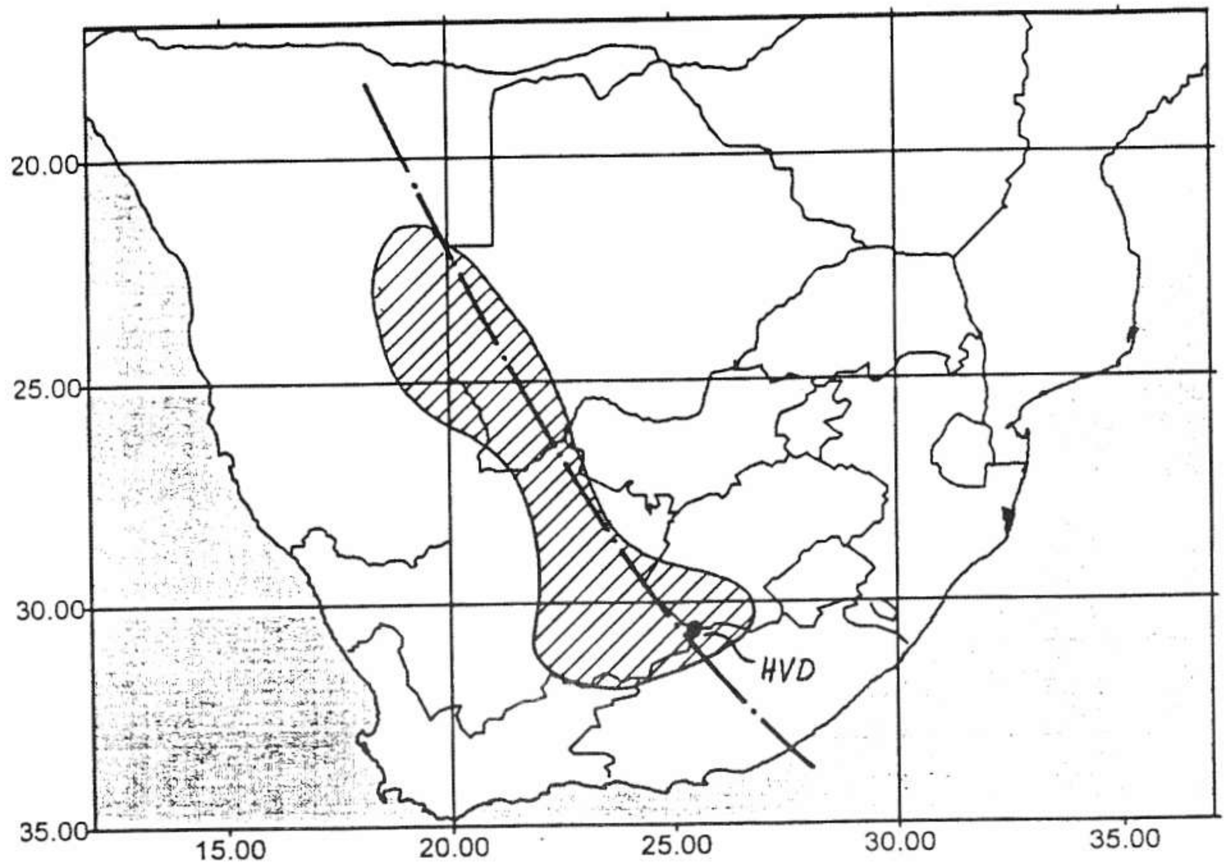

Figure 16

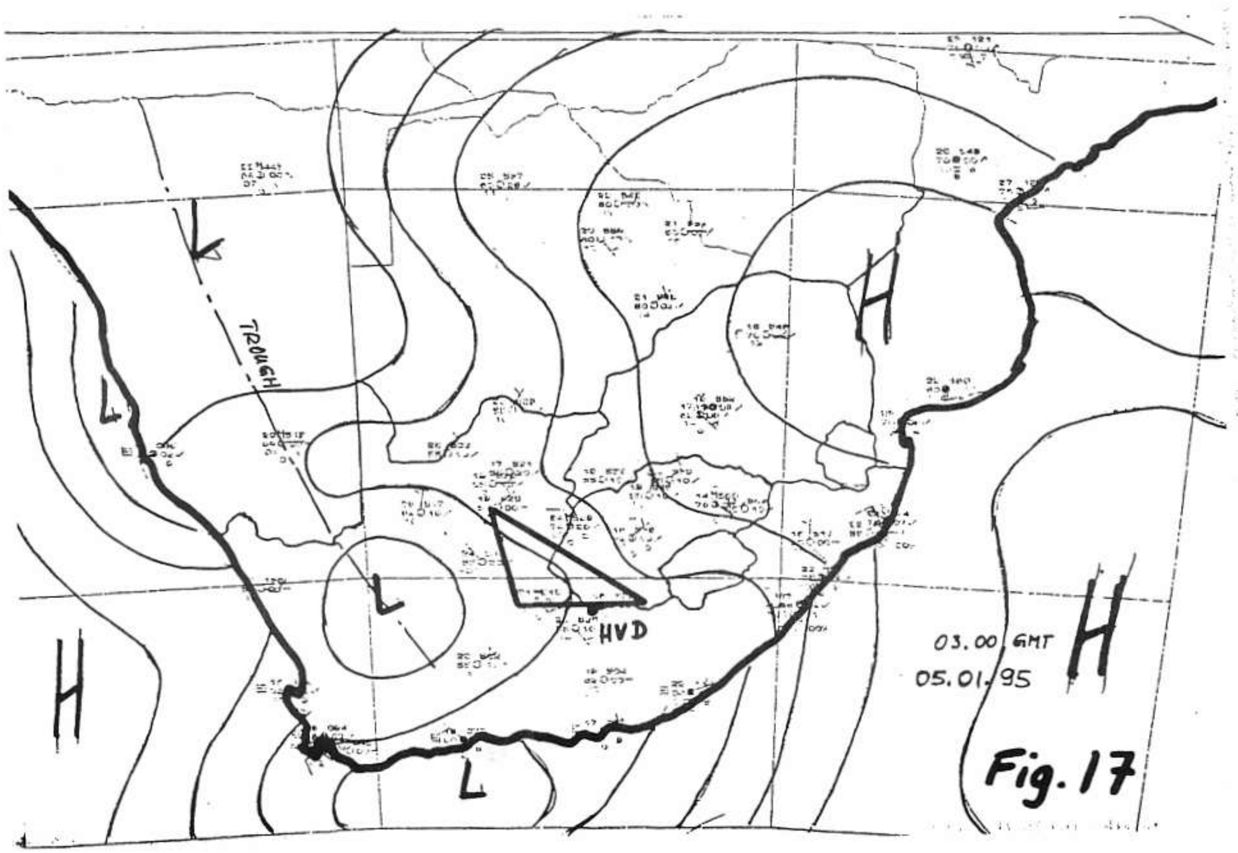

Fig. 17

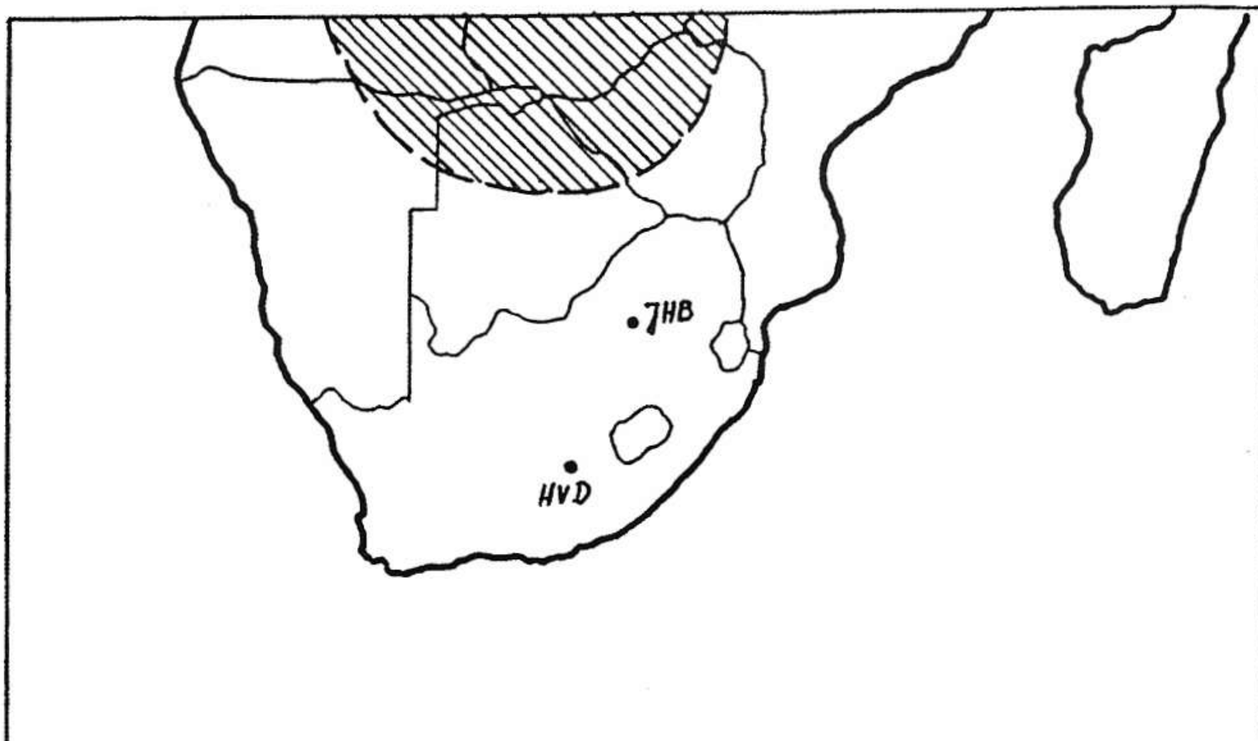

Figure 18 Sept./Oct.

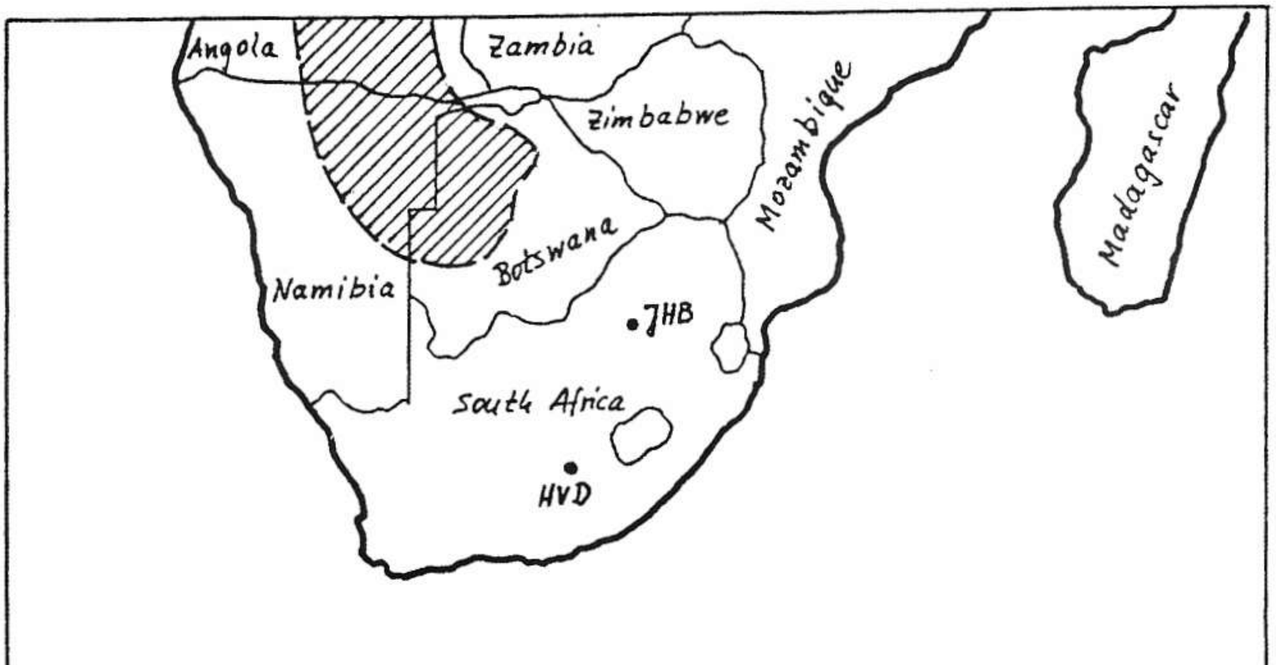

Figure 19 April/May

influx of moist subtropical air during the summer and, therefore undesirable for record attempts during the months November to March. The best months for these countries are September/October and April/May. However these are months with already reduced hours available during the day. Figures 18 and 19 indicate the approximate suitable areas for soaring flights during the months in question. September and October - being more dry - are the better months for record attempts

The constraints for these areas are the accessibility, the limited number of suitable airfields, the very limited number of places with adequate accommodation and, most importantly, the total lack of outlanding facilities. The latter, as well as logistical difficulties necessitate the exclusive use of motorgliders for record attempts. One of the hazards which may be encountered during an outlanding is the fact that parts of the flying area is still inhabited by wild animals, such as lions.

The author has flown in some of the areas further North and did not encounter insurmountable administrative difficulties. This is different in Zimbabwe and may be problematic in Southern Angola, which is still in the process of recovering from a civil war.

In the past a major difficulty has been the lack of accurate map material, as well as the lack of suitable turnpoints. GPS assisted navigation and more recently, documentation using GPS data loggers by which turnpoints can simply be defined by their co-ordinates has basically eliminated those problems.