

«Forecasting during Gliding Contests»

Dr. Sepp Froeschl, Dorval P.Q., Canada

Presented at the 12th OSTIV Congress, Alpine, USA (1970)

It is my pleasure and a great honour to be given the opportunity in addressing a group of scientists from all over the world and on a subject so dear to me. I dare to say that it was not a mere coincidence when Dr. Kuettner put me on the agenda of the 12th OSTIV-Meeting scheduled for Alpine/Texas June 27–July 4, 1970.

My curriculum vitae includes just over 30 years of experience as pilot with quite a number of hours spent in sailplanes including competitive flying as well as instructor's time, together with a Doctorate in Meteorology from the University in Vienna/Austria. As for Canada, the country I am representing and where I am working at the main meteorological office in Montreal since April 1966, I hasten to say that the Soaring Association of Canada (SAC) has excellent relations with the Canadian Meteorological Service. Ever since the July 1963 Canadian National Soaring Championships held at Hawkesbury/Ontario, when, at the request of SAC, Met. Headquarters in Toronto authorized the Montreal Weather Office to provide special service for the event, forecasters and assisting staff as well as instrumentation have been made available during all major competitions throughout Canada. The Canadian Met. Service is also delegating lecturers to the annual Glider Instructor Schools, and as a direct result from cooperation a «Soaring and Gliding Forecast Form» was introduced in 1969 thus facilitating communication between the pilot and/or the club on the one hand and the respective Weather Office on the other hand. I would like to thank our Met. Service for all that has been done for the benefit of soaring in Canada.

Introduction

When I started to prepare this paper I thought, that the title might have to be altered in order to suit my intentions, i.e. to give a comprehensive description of the role of the meteorologist in association with gliding contests. But after realising the effect of the time factor I decided to stick to the original title, and to mention those aspects I think absolutely essential, for the sake of clarity, in concise form within the introduction. The more so as the

scope of the whole subject is quite wide considering the subtitle. Another important question was whether the problem should be tackled in a sophisticated way, throwing in all kinds of complex formulae, or in a straightforward and relatively simple form. In view of the fact that the expected audience due to their academic standing and/or wide experience would not be impressed by mathematics, which in a way is nothing else than «the modern natural scientists' short hand» or even a kind of bridge to overcome the language gap, and hoping through the published paper to address a great number of gliding and soaring enthusiasts coming from all walks of life, I decided to use a sort of «layman's» approach.

The intentions of this paper, which from the professional point of view is supposed to be a kind of an overture or prelude, are to stress the importance of meteorological assistance and support for gliding and soaring in general and during competitions in particular. No attempt is made to propagate any particular method or approach in forecasting for two reasons: By following a rather noncommittal-fashion in sketching the needs as far as the competitor is concerned from the meteorologist's standpoint, this paper does not seem to be a lecture, but rather an invitation to an interested audience for participation and dialogue. Secondly it should be avoided to form fronts and by doing so the range of cooperation can be stretched almost to infinity, whilst on the other hand any kind of only pseudo dogmatic approach constitutes the dangerous effect of a «mental block», thus eliminating any number of potential collaborators. Last but not least this paper should if possible rouse interest to form and set up working groups irrespective of language, country or continent, so justifying the subtitle at the same time. It is worth mentioning here that meteorology is one of the fields where cooperation on an international basis in the widest sense of the term is practised, and we within our own organization, namely OSTIV, can be proud of adhering to the same policy of coexistence and cooperation.

It should be mentioned here that, apart from the forecasting, it is an absolute

«must», for any contest to be a success, to plan ahead and do a thorough study of the site; climatological and statistical records must be gathered in order to choose the best place as well as time for the contest in mind. Proper evaluation of the field and its vicinity, taking into account all relevant factors including those outside meteorology, will be of the utmost importance and help at the same time. I shall not dig any further into this matter as the importance seems to be selfevident and by elaborating on general topics I would only waste your as well as my own.

After referring at length to one side namely the «costumer» and adding up all their advantages it is only just to turn also on the other side and see what benefits might result from this activity. And here we have to say, that forecasting for gliding and soaring and more so during competitions brings the forecaster concerned into closer contact with the weather as well as the «users» of the products of the respective meteorological service than is ever achieved in any other application of meteorology.

Gliding and Meteorology

Ever since gliding passed the stage of occasional «hops» being made by a handful of enthusiasts, and became quite a sport between the two great wars, the relationship between those enjoying this new and most exciting and challenging pastime on the one hand and the meteorological profession on the other has been rather close. This was not only because of the atmospheric conditions being the source of energy, keeping the sailplane airborne, but equally because there were quite a number of people from the meteorological profession very active within the gliding movement. Partly as result of this close relationship between gliding and meteorology, and partly because the experience with gliders helped to explain phenomena hitherto rather mysterious, gliding became an interesting sphere for scientists engaged in atmospheric studies and meteorology in particular. To name only a few of the more outstanding areas in this respect: Convection, Mountain Waves and Clear Air Turbulence CAT, the latter resulting from mountain wave research carried out from Bishop.

After World War II gliding became more and more popular and the role of meteorology changed from merely participatory into a more active one. There are still a great number of professionals associated with meteorology taking part in gliding activity at all levels, and it is certainly not sheer chance when some of the World

Champions have been meteorologists, or people at least connected with meteorology; in any case, pilots at or near the top level always did a considerable amount of meteorological training and study prior to getting there. But as for the change, the gliding people with their ever increasing ambitions became keen and eager customers at weather offices all over the world. With formerly undreamt of goals, like hundreds of miles «out and return flights», «speed triangles» and record breaking free distance ventures, professional advice in the form of «tailored forecasts» became a «must» rather than a mere routine. Despite all our spectacular technological progress the sailplane is in many cases still the best and in almost all instances the least expensive «instrument platform» for atmospheric research within the troposphere and, more than likely, the lower stratosphere. Therefore gliding will be a field of interest and activity for the meteorologist for quite some time to come.

Forecasting during Gliding Contests

After this long but seemingly justified introduction we finally come to the topic proper. As mentioned in the introduction, and I do not hesitate to repeat myself, a thorough investigation in the form of climatology, geography and statistics related to the site and area of the planned competition is an essential prerequisite. As promised earlier, I shall not confine myself to any particular contest; so I shall show now the variety of problems facing the forecaster. Fundamentally we may differentiate between these three: psychological, professional and organizational. In the following paragraphs I shall be going into details starting with problem number one and taking the last mentioned one next; this sequence being only the result of formal considerations and not being meant a qualifying issue.

As for the psychological problem I dare to say, that we should make no mistake in assessing this point properly. Being a pilot myself I am in the lucky position of knowing the game from both sides of the fence. Speaking as a meteorologist one should not overlook the point of view of the majority of pilots. There is a credibility gap which is deeply rooted and originates from many, often very unimportant, things. In order to render satisfactory service to the competitor we have to bridge this gap, and the best way to do this is to convince him that we are interested in his practical problems. Far too often meteorologists are trying to fly the gliders whilst on the other hand the pilots do the forecast-

ing; for heaven's sake let's stick to our respective duties and thus cut out one source of distrust right from the beginning! Let's refrain from a language over sophisticated, and let's communicate in a way that is easy to understand. Another problem within the same sphere results from the fact, that, subconsciously the competition pilot expects a certain kind of weather, namely good soaring conditions; and this is understandable, because this is what he is here for, to compete in a soaring competition. Therefore, however good or professionally correct and exact the forecast may be, if it predicts poor conditions or no flying weather at all the forecast is no good! And to add to it instead of helping to smooth the situation, there is always such a wide range in meteorological knowledge of the assembled pilots, that it is extremely difficult to find a «common denominator» in reaching all of them during the briefing time. As far as the organization is concerned, this is primarily a question of the interrelationship between the organizer, be it a local club or a national association, and the respective meteorological authorities. Depending on the scope of the contest, it might be sufficient to have one forecaster delegated to the site, who will keep in touch with the nearest Forecast Office; in the case of a national event and in particular if it happens to be the World Championships the Meteorological Service has quite a problem at hand. Unless the site is identical with an airport with a fully fledged Met. Office, and this is in most cases not so, a temporary Forecast Office has to be installed with at least a certain minimum of equipment and personnel so that an adequate forecast service can be provided. A bare minimum would be: (1) duty forecaster who in the case of an international event will be assisted by at least one other meteorologist from another country; 2 met. technicians, and at least one teletype circuit over which a special selection of material can be received on a regular basis including «hourlies», Radar reports, Airmets and Sigmet, FA's and FT's, «specials», and all other relevant reports and messages for the area of interest. In addition a facsimile receiver for Surface, Sig Wx. and 700 Mb Prognostications, 850, 700, 500 and 300 Mb Analyses and if at all possible satellite pictures. Furthermore the following equipment must be supplied: balloons and gas, theodolite and all the necessary forms and tables to perform wind measurements and cloud-base checks; dry and wet bulb thermometers, barometer or better still barograph, anemometer, and a rain gauge. Reliable telephone communication – if at all possible a «hot line»

between the site and the closest forecast office in order to get all the latest information without delay, as there are radiosonde data and all the latest developments covering the area of the contest.

The professional part of the subject will now be treated in such a manner, that I am starting out with some general aspects within forecasting together with a few theoretical ideas and afterwards I shall refer to practical forecasting for gliding with special emphasis on contest forecasting.

It is a well known fact that we are living in a rapidly changing world; this applies in particular to science, and meteorology is certainly no exception in this respect. Forecasting and the functional position of the forecaster – and I am referring to the academically qualified and experienced meteorologist in this respect – is in a state of transition. Ever since the end of World War II there is a worldwide trend towards objectivity. This movement away from subjectivity is gaining momentum and ground. Modern technology is at hand with all its gear; automatic weather reporting stations, high speed teleprinters, radar, weather satellites and last but not least computers constitute important tools within everyday meteorology. The continual improvement in communication systems and increasing cooperation throughout the civilized world, together with remarkable progress within the field of collection and distribution of reports and data in code form or on facsimile circuits, are another step forward in the same direction.

Despite the progress in developing quantitative techniques, the conventional forecaster will have an important part to play. This is particularly so in case of special, or as I like to call them «tailor made» forecasts; and the forecasts for gliding in general and during contests in particular are such special forecasts, and as such textbook cases of a «tailor made» forecast. The forecaster's wide experience of local and regional conditions, orographic and topographic influences, moisture and pollution sources and so on, will be invaluable in supplementing the machine-made forecasts. While the machine provides the answers that can be computed routinely, the forecaster will have the opportunity to concentrate on the problems which can be solved only by resort to scientific insight and experience. Furthermore, since the machine-made forecasts are derived, at least in part from idealized models, there will always be an unexplained residual which invites and necessitates study. It is important, therefore, that the forecaster be fully conversant with the underlying theories, assumptions and models. In par-

ticular it is important, that he be able to identify the «abnormal situations» when the idealized models (be they dynamical, statistical or a mixture of both) are more than likely to be inadequate.

Meteorology or the science of weather is the study of the atmosphere and the elements of weather namely temperature, pressure and moisture, and their general distribution over the earth's surface. It combines physics and geography; not only does it apply the principles of physics (and in many instances by extensive use of mathematics) to the behaviour of the air as a mixture of gases, but also it takes into consideration the whole atmosphere and the relationship between its phenomena and land and water bodies, topography, and latitude. It is an applied science since its chief purpose in the past and present as well as immediate future is to aid in forecasting developments of the weather, and by now already partly to start to modify it. From what has been said so far it is quite obvious that forecasting for gliding contests, being a typical example of a so called «tailor made» forecast, can only be the result of the closest possible cooperation between man and machine. The actual forecast, or the final product remains to be the synthesis of the computer output and its proper interpretation and application by man. The numerical predictions are unfortunately only of restricted value to the forecaster during gliding contests. With due respect for the high quality and accuracy of the 6-layer PE Progs issued for periods of 24, 36 and 48 hours by the US Weather Bureau, their actual use for the short range, local and detailed contest forecast is not more than a guideline. As a matter of fact these machine products with all their smoothing, their numerous assumptions and the so called meteorological noise being filtered out, are of only little help in our case. The glider pilot is more or less living on all these elements, which become a victim of the computer processing of data.

The forecaster's most important job at a championship is to advise on the suitability of the weather for flying tasks which are set, if possible, on each day. The overall success of a competition depends very much on the right task being set, and the meteorological advice given to the task-setters each morning is crucial to this. In view of the fact that the vast majority of important contests are held at sites where «thermal soaring» is the main issue this paper will stress this type of activity with only some hints on «wave soaring» at the end of this chapter. High on the list of his special considerations comes the forecaster's as-

essment of the likely convection activity throughout the day. As well as predicting the height to which convection will penetrate, and the time that usable thermals will start and finish, the forecaster must try to assess the possibility of any mesoscale patterns in the organization of the convection. Systems of cloudstreets; patterns produced by lee-wave effects; convergence lines and sea breeze cloud formations – any of these may form important irregularities in the basic field of convection and should be forecast. In order to get the best possible results the competition forecaster has to concentrate his efforts on mesoscale analysis every day. Normal routine observations and all the material produced and distributed by the Met. Service responsible for the respective area are not enough for such analyses, so reconnaissance and temperature sounding flights have to be carried out, and frequent pilot-balloon checks are another important tool.

Once the day's task has been decided, the briefing has to be prepared. Whenever the atmospheric conditions are classified as «marginal», and this is not a rare occasion at all, the duties of the forecaster are greatly increased. Depending on the local arrangements fairly elaborate plans ought to be put into effect, because the timing becomes most critical. Additional reconnaissance flights, if possible in a glider and flights in light aeroplanes upwind for checking cloud and turbulence should be made. During this operation close contact between all those engaged in the whole operation is most important. Although this procedure may appear elaborate, without such a provision several contest days could be mismanaged or lost completely. The overall success of a competition depends very much on the right task being set for each day, and the meteorological advice given to the organizers each morning is crucial in this respect. Overestimating the general vigour of the «thermals» or underestimating the cloud cover (resulting in the so called «overdevelopment») may lead to setting an impossible task whilst the reverse might result in not making the most of a really good day. As mentioned earlier no attempt is made within the scope of this paper either to introduce or propagate any particular method for gliding forecasting. However the author feels obliged just to mention a few particular elements and features which might be used in future research by professionals for the benefit of the pilot as well as in the interest of advancement in forecasting.

Irrespective of the kind of «lift» being utilized the wind field and profile covering the area of the competition from

ground level up to operational maximum, which in case of mountain waves being utilized may be up to near the tropopause, plays a very important role. The same is true for the stratification with respect to stability. As a matter of fact, the variability of the vertical wind is a function of stability to some degree, as well as of the horizontal windspeed. The magnitude of the vertical wind component is apparently controlled to a large degree by the stability of the atmosphere. In unstable air the vertical winds are much stronger and the sign (up or down) persists through much deeper layers than within stable air. Under stable conditions, vertical wind components are of the order of 10–25 cm/sec whilst in unstable air they are of the order of 55–100 cm/sec. This agrees well with accepted theory since convective turbulence has a much longer wavelength than mechanical turbulence.

As for stability (or instability), we have to bear in mind that stability as such exerts a controlling influence on vertical motion, but it does not initiate it. It would mean stretching matters beyond the scope of this paper if I would go any further in discussing these parameters; the more so as stability, lapse rate, vertical motion and inversions are dealt with at length in many books. Before referring to some aspects on wave activity it should be stated here that it seems likely that a new type of «lift» could greatly influence gliding and soaring in the not too distant future; or I should say the utilization of specific atmospheric conditions producing «lift», that were unknown or at least not used to any appreciable extent in the past and at present, namely the so called «thermal waves» or as our Italian friends call them in their melodique language «termo onda». So far experience is rather sporadic and as for theory Dr. Kuettner, Dr. Jaekisch and a group of Italian experts are investigating the problem. I am not only mentioning this new and upcoming field for the sake of curiosity; I am doing some research of my own within this field. I am thinking in terms of shear being the main source of lift; if this proves to be right a tremendous new technique in soaring and gliding should result, changing the whole concept even more than «thermal soaring» did in the past.

When I am now briefly referring to wave soaring, the fact that I left this topic to the end does not mean that I am underestimating it – not at all. Only the circumstances made me do this: gliding and soaring championships in the past have not been held under prevailing «wave conditions» and do not look likely to be in the future. Another reason for singling this

topic out was, that for this type of activity and the associated forecasting duties, the forecaster can very much rely on material being issued, prepared and distributed by the regional forecast offices. We can always find a Radiosond station representative for the area of interest and the forecast wind speed and direction are also available. Therefore the forecast problem is relatively simple and it should be mentioned that the accuracy in the upper wind forecasts on a numerical (machine produced) basis is very high and the reliability most convincing.

Summary and Conclusions

As stated earlier on, this paper is not meant to be a lecture but merely an invitation for a dialogue or better still for participation. The more so as the subtitle is more than an invitation to such ideas. In order to keep up with the development on the technical sector, with the improvements in the sailplanes and the performance of the pilots, the forecaster's position becomes more important and effective than ever before. And in order to meet these requirements considerable effort is to be made. Research is unfortunately time and fund consuming; and as we can not expect too much in the way of funds, we have to rely more on time, time being spent by enthusiasts and idealists, for the sake of progress and the benefit of the gliding movement. And due to lack of funds international cooperation is more important than otherwise. And above all the closest possible cooperation between the pilots and the forecasters, on all levels and within the local and national organizations, is another milestone on the

road to the ultimate success.

Gliding and soaring are gaining in popularity all over the world, irrespective of language, race or political structure; and as mentioned before they are not only a widely accepted pastime, but their role in atmospheric research and as an instrument platform is gaining momentum after a recess in the recent past, when powered aircraft were favoured, because it is a proven fact that the sailplane is not only better suited for most of the research assignments and at the same time less expensive than the powered aircraft. I should not forget to mention here the tremendous progress that has been made in developing and improving the «motor glider», and its impact on future research operations, as well as its great help in advanced and ab initio training for glider pilots. The so called «field/site evaluation», a program for «mapping» certain preferred routes for all kinds of tasks like triangles, goal flights and out and return flights, might have a lot to gain by the use of the «motor glider».

The close link between gliding and meteorology, which has existed since the early days of gliding, is still unchanged. The active interest and to quite some extent, active participation, of individual meteorologists as well as the assistance provided by meteorological services to their activity, has become even more effective in recent years. The fact that so many national Met. Services are sending official forecasters with their teams to the world championships, and also as representatives to OSTIV Congresses, held in conjunction with these meetings of the world's best glider pilots, is another example of the importance that is as-

sociated with gliding. In order to keep this spirit up and to make the best of it for the benefit of all concerned we, the professionals should make every effort to establish close contact with the «user» of our product, that is the forecast, and to avoid this relationship becoming a «one way traffic». We have to rely on the wide and versatile experience of the activists; we do need their cooperation not only in supplying us with the necessary material for supplementing the routine means and tools in our task, but also to pass on to us all sorts of experienced specialties, rare phenomenae, and odd events for further study and investigation. Before coming to the very end of this paper I hasten to say that it gives great satisfaction that the meeting of meteorologists gathered at Alpine during the closing week of the 1970 World Championships in gliding, called by Dr. J. P. Kuettner, has not only been attended by the vast majority of those at hand (unanimously apart from the few that were with their competing crews all day), but ended in a working paper and the unanimous resolution to establish contact and to work in close cooperation on various research programmes, besides the organisational task of streamlining «forecasting for soaring/gliding in general and during competitions in particular» on a world-wide basis.

It can only be hoped that the enthusiasm shown by all those here at Texas will not die too soon. The spirit should be kept alive and every effort should be made to contribute to the benefit of this great and challenging activity. We should be in a position to come up with some useful results at the next World Contest.