FUTURE ASPECTS OF METEOROLOGICAL SUPPORT FOR COMPETITION FLIGHTS

by Rene' Heise

Presented at XXV OSTIV Congress, St. Auban, France

Summary

The possibilities of weather forecasting with a team meteorologist changed rapidly during the last years due to progresses in numerical weather forecast and communication technology. The access of regional meteorological data and their online evaluation by satellite, mailbox or the internet are presented. For pilots, it's easier to take complex meteorological processes by visualizing them (f.e. 5D) and then modify competition tactics. A view of present opportunities in synoptic meteorology and the use of topographical data as well as an outlook on new trends is also covered.

1. Introduction

The team-meteorologist was often damned to be an extra during the last World Championships. The individual care of the teams was difficult due to a lack of current synoptical data and available material for the weather forecast. Additionally, some countries restricted their data in an unacceptable way. The weather forecaster reached his limit by following the pilot's demand for prediction of the local weather (i.e. mesoscale processes). It was therefore impossible to use the meteorological parameters, which determine the tactics of flight optimally.

However, that situation has been changed fundamentally during the last two years. A team meteorologist is now able to take current synoptical data and numerical products from several national weather services. You have the choice of data access* by using the mailboxes of a certain weather service (i.e. PC met; DWD), through the internet (look at Homepage-WGC http://wwwperso.hol.fr/~wgc/meteo.html) or from telecommunication satellites, depending only on your technical equipment. The available products range from the corresponding SYNOP-, METAR-, TAF- and upper sounding reports to computer-edited satellite and radar pictures. Requested procedures of regional weather forecasts can be produced individually and can be adapted to the region by use of corresponding software for data evaluation under UNIX/WINDOWS or DOS environments. In this way it is possible to prepare highly resolved weather maps as well as to estimate thermals by using upper air soundings along with l-dimensional boundary layer models and their corresponding parametric statements (e.g. BLMODL, BLACKADAR 1989) or empirical statements (e.g. ALPTHERM, LIECHTI 1993) within a short amount of time. This gives the team-meteorologist the permission to react immediately too heavy weather (hazards) and is a contribution to flight safety, too.

2. Basic Synoptical Data

As heretofore mentioned the delivering of meteorological data and information was traditionally in the hands of the national weather services due to technical reasons. That's why the quick availability to and graphical presentation of basic data were problems. New methods of data transmission developed through satellite-supported technologies and progress in telecommunication systems.

As a result, the UNIDATA-Project, sponsored by the National Science Foundation (NSF), was developed in the USA (http://www.unidata.ucar.edu). It aids in the rapidly growing amount of data transfer. The Internet Data Distribution System (IDD) was created and developed. Not only current data from weather observation and forecast models, but also the published research results of certain universities and pictures of Doppler radar and lightning soundings published by private institutes are available.

Some of the products can be taken from the WORLD WIDE WEB. In the United States the legal norms for free data access were set forth by the Freedom of Information Act in 1966. Existing international rules had to be revised due to the free availability of global meteorological data and the development of private servers and the rearrangemant of certain national weather centers (NWC's).

Consequently, the resolution 40 (Cg-XII) was passed by the 12th Congress of the World Meteorological Organization (WMO) in 1995. This resolution rules the worldwide exchange of meteorological and related data.

For example, data from the Regional Basic Networks (RBSNs) is available without a fee or any other restrictions. This includes such data as SYNOP, updated every 6 hours, TEMP/PILOT and AIREPS messages and data of the World Meteorological Centers (WMCs) and the Regional Meteorological Centers (RMCs). It is written that there has to be a free access for education and research in noncommercial cases.

The work of a team-meteorologist is to be seen under this prospect in connection with activities of the OSTIV.

According to the precedents mentioned above, the team-meteorologist can take the basic synoptical data and weather charts to work his way into the current weather situation. He takes the synoptical raw material from the World Wide Net and evaluates it with known software. As a result, the representation of data becomes cornfortable and zoom functions allow an optimal supervision of weather.

Figure 1 shows the use of the presentation program SYNOP (BRUNS u. RICHTER, 1995) with the weather situation above Germany on April 21st 1997 in 1000km scale (1000km triangle flights). SYNOP represents elements of WMO-code as well as problem-oriented quantities and combination=s of single parameters (e.g. the pseudo-potential temperature for the classification of airmass or the lifting condensation level).

The TLOGP program can be used (Bruns & Richter, 1995) in the same way for the evaluation of radio-sonde data. Figure 2 shows the calculation of thermals with the use of a modified GOLD-analysis and a derived mixing layer as a base for calculation of the rate of ascent.

The possibility to modify the radio-sonde data depending upon temperature-advection and vertical motion should

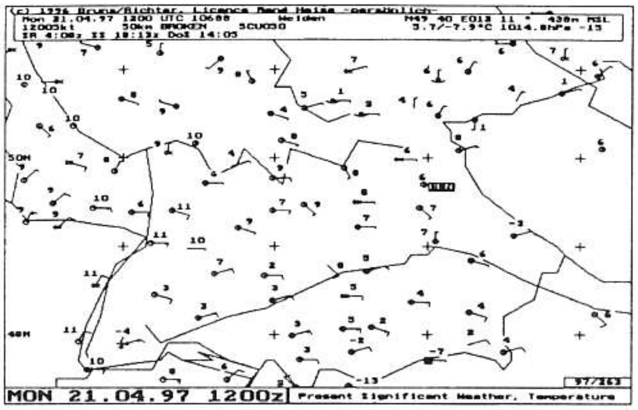

FIGURE 1. SYNOP-Program. WX, temperature and wind from 21.04.1997 (1000km trigangle flights).

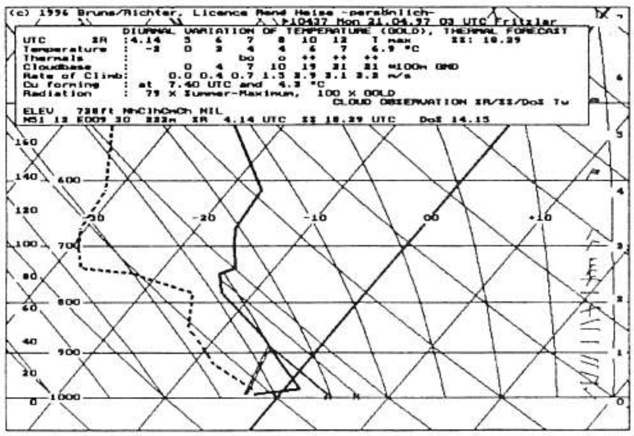

FIGURE 2. TLOGP-Program. Calculation of thermals Station Fritzlar/Hesse 12 Z/21.04.1997.

be pointed out.

If the team-meteorologist is a member of a National Meteorological Service, he can take his data from modem/ mailbox (e.g. pc met/DWD) or from news satellites (EUTELSAT). The transmission by satellite is preferred, because, due to the independence of local communication facilities, more topical data can be taken. A SPECI-report (e.g. Thunderstorm) from the area of competition, for example, is shown within a few seconds on the screen, and the meteorologist can give useful advice for routing. Satellite images can be used at any time, and the WWW offers quick looks as well as special prepared pictures. Figure 3 shows a prepared NOAA-Picture put out from DLR.

Radar pictures serve as additional information to evaluate the weather situation. As of recently, one can use lightning detection systems to locate thunderstorms. Most of them are based on the system LPATS of the firm Atmospheric Research, Inc. (Florida). This system locates every bolt of lightning with highest precision - parts of lightning are spotted, and cloud-to-earth lightning is distinguished from cloud-to- cloud lightning. These regionally distributed receivers (distance about 300 km) receive both a signal of the electro-magnetic wave of the lightning and a time signal of highest precision (GPS). The central analyzer

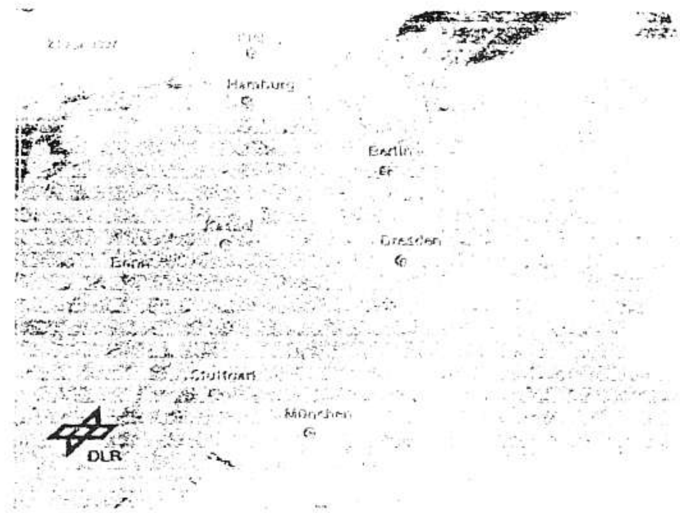

FIGURE 3. NOAA-Picture from the DLR/Oberpfaffenhofen

calculates the location of the lightning with a precision of 0.2 to 1.5 km. This way, the meteorologist has the chance to locate thunderstorms during the competition, independent of the given density of weather observations.

The data transfer is possible from the central transmission unit by modem. In the U.S. you can take the data from Intemet Data Distribution (IDD). The creation of a network of these systems and transmission by satellite is planned in Europe.

3. Weather Forecasting Products

Now that the process of data accumulation has been explained, I will describe several methods and products for weather forecast. The progress in weather forecasting in the last years due to the application of numerical models is indisputable. Information from the models of the meso-α-scale are suitable to predict the local weather for one day. The routing is adapted to certain "windows," and a forecast for the next day is derived. Additional methods of evaluation are recommended to resolve subscalic processes which determine the local weather and, consequently, the tactics of the competition. Here it is useful to work with KALMAN-filtered parameters (wind, temperature, cloud cover, . . .) of the Direct Model Output (DMO). The representation of relevant gridpoints in a meteogramm is recommended to get a better overview. Additionally, model profiles of wind and temperature for a chosen time and region can be displayed. The Model Output Statistics (MOS) should also be used for known gridpoints to get help by forecasting ceiling and cloud cover. However, weather forecasts are useless without every pilot's knowledge of the complex behavior of atmospheric processes. One can use the software of Vis5D to visualize the numerical fields of a weather forecasting model. This software was developed by the Space Science and Engineering Center, University of Wisconsin with NASA support. The visualized presentation of certain parameters of a hydrostatic model in meso - α - or meso β scale serves to train pilots to understand the three-dimensional processes better.

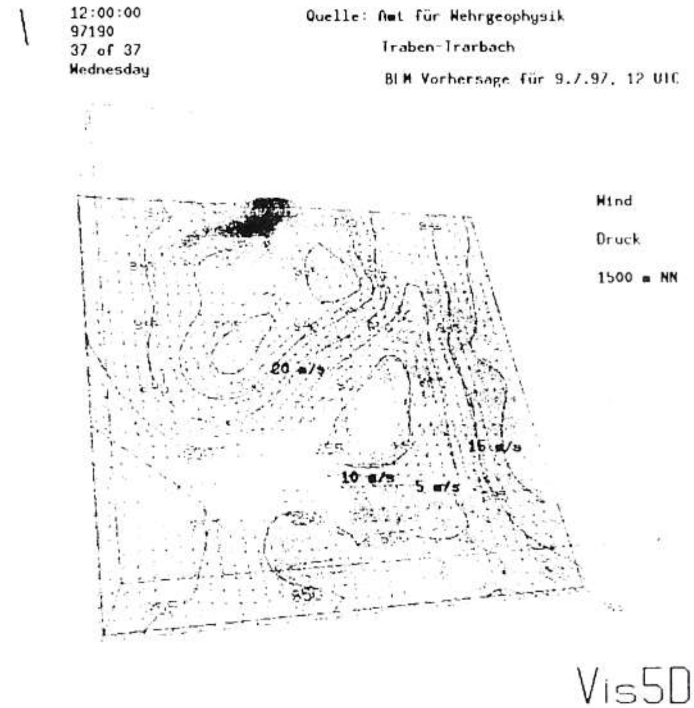

FIGURE 4. Wind-/Pressure-Forecast from the Boundary Layer Mode3l (PRENOSIL, 1990)

In result, the following recommendations for the weather discussion during the World Championship 1997 in St.Auban, South France are:

1. Use of a numerical weather forecast model which resolves processes in the meso β scale (e.g. orographical winds, land-sea breeze, areas of convergence) (DM, ARPEGE T95 C=3.5, ALADDIN)
2. Comparison of the model analysis with the current observations (SYNOP, TEMP, SAT, RADAR) and the individual manual analysis
3. Graphical presentation of predicted DMO-gridpoints and model profiles for the region. The gridpoints can be chosen individually according to arrangements with each NWC. The predicted parameters should contain wind, temperature and humidity as well as parameters of convection (e.g. forecast of convection in the Alps region obtained from DM/DWD)
4. MOS-forecast for St. Auban and Embrun with regard to wind direction and speed, because a set of synoptical observations of these stations exists, and a view in local breeze systems is possible
5. Use of methods for regional modifying of temperature- and humidity profiles (e.g. ALPTERM, BLACKADAR)
6. Visualizing of the ruling meteorological processes of each day of competition (e.g. Vis5D) in order to find out the best tactics.

New, higher resolving models for weather forecasting are being developed at present. These models resolve the meso - γ - scale, which is of interest for sailplanes (e.g. Local Model/DWD, MMS-NCAR Mesoscale Model). The Local Model (LM) of DWD is a non-hydrostatic model with a resolution of 2. 5 x 2. 5 km. A starting version of this model will be run at the end of 1998 with a resolution of 8 x 8 km and in an area of 2000 x 2000 km. Pilots of sailplanes can make a valuable contribution to verification and determination of approaches for parameterization of these models.

4. Use Of Topographical Models

Topographical data banks and their representation can be used for training and tactical investigations with the help of the appropriate software. The flights can be displayed exactly in their relief by using the GPS logger data and can be discussed, dependent upon the weather situation, with an additional display of observations.

The German Military Weather Service is using a topographical model - TOPOGRAF (KAMPE 1997) with the following parameters:

- Resolution of elevation data: 90 x 60 m horizontal, with a precision of height of about ±35m in the mountains
- Topographical data:
  - resolution 150X100m
  - 2 densities of settlement
  - 2 kinds of soil
  - 3 kinds of forest
  - bush-, heathland- and water areas

The highest resolution for displaying the data is 100 x 100 m.

What possibilities does the team-meteorologist have for displaying ?

- Display and planning of the route by assigning appropriate convection areas which are determined empirical or statistical, or by the kind of soil and the topographical position (for Germany see MULLER&KOTTMEIER 1986).
- Cross-sections along the flight route with appropriate weather information (weather conditions, upper wind, ceiling are interpolated from observation reports and gridpoint data of the numerical models). With regard to the World Championship 1997 in St. Auban, one can see exactly if a pilot flew in the relief, which means in the breeze system or mostly by use of thermals. Display of the terrain as a relief and additional display of the temperature-inversion shows you which slopes above the inversion can already be used for the flight. Alternated routings can be chosen during the competition with the use of the ceiling-display.
- Radiation and short-wave net radiation considering the time, the slope and its orientation and the nature of the ground. The best slopes can be advised to the pilots in cases of large shielding by clouds and the additional input of the cloud species and their degree of sky cover.
- Display and discussion of hot spots from thermals-data banks (these data banks are special filtered GPS-logger evaluations).

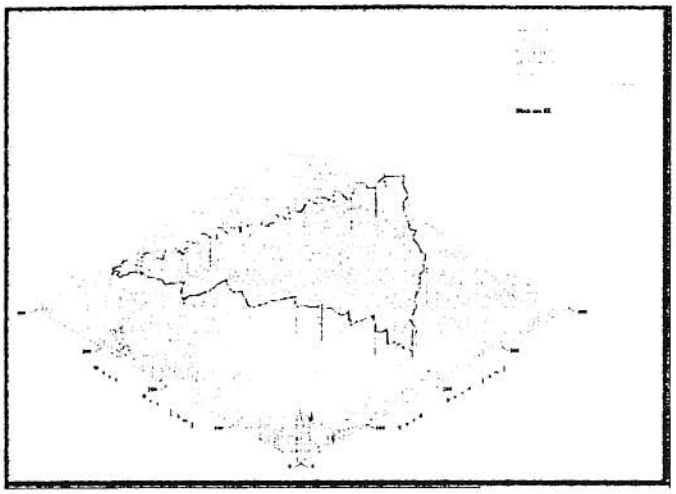

FIGURE 5.

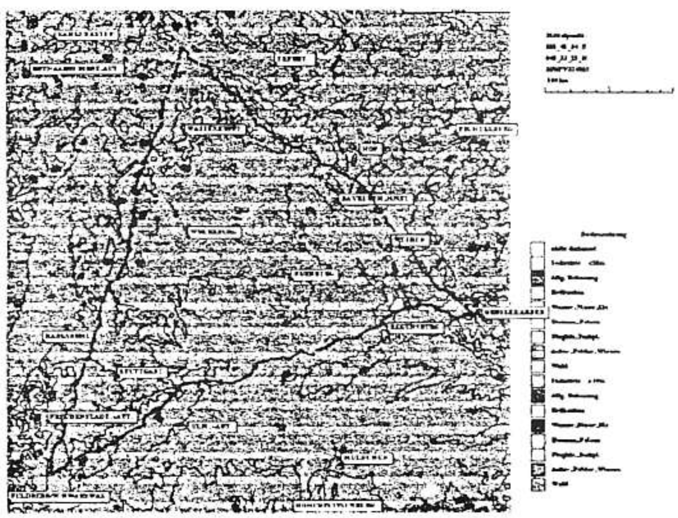

FIGURE 6. Figures 5 and 6 are glight route from Uli Schwenk/ ASW-22 (1000 km Triangle Flight-21.04.1998).

5. Concluding Remarks

I'm quite aware that many of my simulations become quickly dated due to progresses in weather forecasting and new developments in computer and communication techniques. Essentially, the aforementioned opportunities should have shown how to use meteorological data and new methods of weather forecast to support a team or the competition by providing modern methods of data display. This can be a contribution to equalization and transparency concerning the different individual abilities of the team-meteorologists.

Acknowledgments

This work could not have been done without the generous cooperation with the Science Department of the German Military Geophysical Office. The author would like to thank Dr. Th. Prenosil, W. aufm Kampe and H. Weber for the valuable discussions and helpful advice in this work.

References

Blackadar, A.K: Model description BLMODL, Pennsylvania State University.

Bruns, Th. and Richter, B. (1995): SYNOP-Programm zur grapischen Dartsellung von

Bodenwettermeldungen nach WMO-Codes FM12/FMl3/ FMl 5, Programmbeschreibung.

Bruns, Th. and Richter, B. (1995): TLOGP- Programm zur graphischen Darstellung und interaktiven Auswertung von Radiosondenaufstiegen mit thermodynamischen Diagrammen.

Kampe, W.(1997): TOPOGRAF- Programmbeschreibung, Amt fur Wehrgeophysik.

Knupfer, K. (1996): Methodical and Predictability Aspects of MOS Systems, Preprint Volume: 13th Conference on Probalility and Statistics in Atmospheric Science. February 19-23, San Fransisco, California.

Liechti, O. and Neininger, B. (1993): Alptherm- a pc -based model for atmospheric convection over complex topography. Technical Soaring Volume XVIII, No. 3.

Muller, D. and Kottmeier, C. (1986): Meteorologische Aspekte des Streckensegelfluges-Thermik von A bis Z -, Verlag Muller&Kottmeier.

Prenosil, Th. and Becker, M.G. (1990): Das Boundary Layer - Modell des Geophysikalischen Beratungsdienstes der Bundeswehr, Fachliche Mitteilungen.

Resolution 40 (Cg-XII): WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities, WMO-Bulletin Vol. 45, No. 1, Jan. 1996.

Siemens (1993): BLIDS- Blitz Informationsdienstleistung, Systembeschreibung.

Steppeler, J. (1996): The new local model (LM), Quarterly Report No. 4, German Weather Service.