BRASOV AIRFIELD
INTRODUCTION IN TEMPERATURE ANALYSIS

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***Abstract**: The particularity of the geographical location of Brasov airfield can mark out meteo-climatic elements and typologies that could help improve the aeronautical forecast. The temperature evolution from the last 38 years emphasized the dropping tendences of extreme characteristic tempereatures for the winter season as well as the increasing temperatures for the summer season in paralel with the pronounced variability of the extreme absolute temperatures and the differences from one month to another regarding the monthly and daily extreme average. This fact maintained the multiannual average temperature at 7.6˚C according to the climatological norm. With a number of 325 days of temperatures ≥30ºC registered during the period of study there were distingueshed 8 specifical typologies for the medium range of atmosferic circulation. These results could have an essential aport in the prognostic analysis for Brasov airfield.*

***Keywords**: climatological norm, atmosferic sounding, absolut topographic baric maps, cyclone, thalweg, anticyclone, dorsal.*

1. INTRODUCTION

The topoclimat of Brasov depression along with the specific atmospheric circulation from medium altitude are the main sources used in the making of a reliable forecast.

Being in tight relations with the heat balance and with the succession of the main baric centers, temperature represents the prime element that stands at the basis of all physical processes. Thus, a climatological analysis regarding temperature evolution has the purpose of understanding the topoclimat of Brasov airfield. Once accustomed with the topoclimat through an aerological analysis concerning the circulation on the medium layers of the atmosphere one can also give explanations regarding the evolution of extreme temperatures, temperatures with a high importance in the aeronautical forecast.

2. CLIMATOLOGICAL ANALYSIS

During the years 1896-1965 the multiannual average temperature for Brasov airfield was 7.6˚C [5], value maintained also for the analysis period, 1971-2008. However, referring to a mountain climate that is permanently situated under the influence of air masses with different thermal characteristics, the variability of the thermal range can point out another image regarding the evolution of the multiannual monthly average temperature or the number of tropical days frequency, to the absolute maximum or minimum temperature registered.

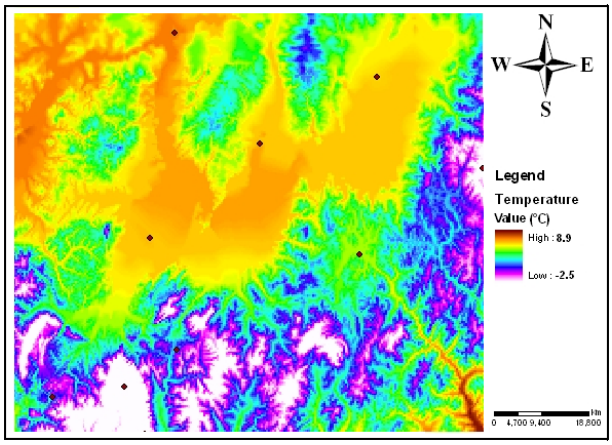

Fig. 1 Brasov Depression – teritorial repartition of the multiannual average temeperature (1971-2000)

If in the winter months the average multiannual temperature was -3.3˚C, as climatological norm, for the study period the temperature raised to -2.9˚C, increase given by the positive difference of 1.3˚C of the multiannual average temperature for January, from -5.1°C to -3.8°C. Otherwise, the elevated temperatures during winter drove to the rising of the annual medium temperature. A conclusive example is the year 2007 when there was registered the highest average annual temperature of 9˚C, monthly means for January and February being positive, in January being registered the highest average in daily temperature, of 7.8°C. The pronounced increase in temperature as well as its decrease, are tightly connected with the specificity of the atmospheric circulation from the season in question. During the 2006-2007 winter there were registered the highest temperatures since the beginning of meteorological observations in Romania (over 100 years), in January being recorded the highest positive deviation (with aprox 6°C), thus becoming the hottest month compared with the normal registered.

Cold air advections and the frequent thermal inversions specific for depressions in the winter season caused a strange variability between the highest and the lowest multiannual monthly average (Fig. 2).

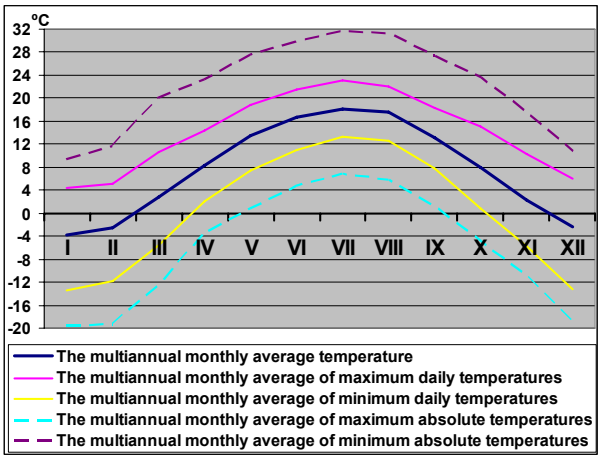

Fig. 2 The variability of the multiannual monthly average temperature

These differences became reduced during the summer season due to the lower contrast between the air masses, from 10.9-12°C in the winter season to 4.7- 6.5°C in the summer season. The most pronounced difference from one month to another for the multiannual monthly average regarding the daily maximum temperature is between February and March with 5.56°C and for the minimal daily temperature 7.62°C is between months March and April. The smallest differences are found, in both cases, between the months December-January and July-August. The concave shape of the relief delimited by mountain heights determines the formation and the frequency of freezing and of very low minimal temperatures due to the stasis of cold air for long periods. Thus, during the cold season the minimal temperature constantly decreases below 0°C representing 48.4-68.4% of the total number of days characterized by freezing. If until the year 2000 only in the years 1971, 1989 were registered less than 130 freezing days, starting with the year 2001 the frequency has dropped; there were recorded only in 2003 and 2006 a number of over 130 days with the minimal temperature below 0°C (Fig. 3). The same tendency can also be noticed for the days with frosty nights.

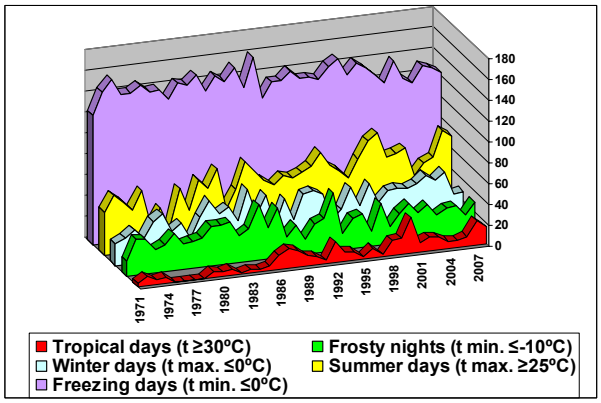

Fig. 3 Evolution of the days with extreme characteristic temperatures

In the first 16 years of analysis there were recorded 10 years with over 30 days that had the minimal temperature below -10°C, while in the next 22 years there were registered only 7 days with frosty nights. The analysis of the pressure gradient for the cold period of the year shows that this evolution was determined by the blocking regime for the 2000-2001, 2002-2003 winter, the zonal flow regime in North of Romania for the winter from 1999-2000, 2001-2002, 2003-2004, 2004-2005 and the anticyclone regime from 2005-2006

winter, 2006-2007, 2007-2008 (The weather regimes for winter seasons are explained by Vautard [8]).

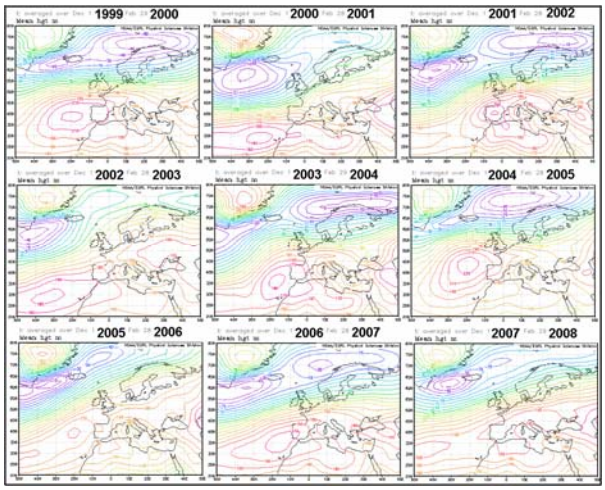

Fig.4 The weather regims for the winter season from 1999-2000 to 2007-2008 (data processing with NOAA)

The more pronounced influence of the hot air masses advections is given by the tendency of growth in the summer days as well as the number of tropical days. During the analyzed period there were years in which the number of summer days surpassed the number of 70 (1986, 1994, 1999, 2000, 2007, 2008), whilst the minimal annual number varyed between 19-40 days. As for the number of tropical days, starting with the year 1986 there were registered years with over 10 days with temperatures ≥30ºC, in 2001 reaching a maximum of 34 tropical days. The highest absolute maximum temperature was of 37.3°C in July 2000 and 37.2°C in July 2007, the multiannual mean being of 32.6°C (Fig. 5).

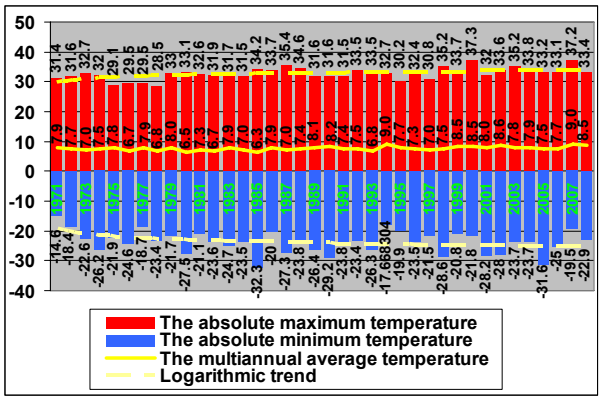

Fig. 5 The annual evolution of absolute extreme temperatures

Secondly, the lowest absolute minimal temperature was of -32.3ºC in January 1985 and -31.6°C in Ferbuary 2005, the multiannual average being of -23,7°C.

3. AEROLOGICAL ANALYSIS

For the precise interpretation of an airfield forecast it is necessary the analysis of synoptic and baric (aerologic) topography. The most representative maps of absolute baric topography through which the general circulation in the atmosphere can be characterized are the TA 500mb maps [4]. For the understanding of the baric situations that led to temperatures ≥30ºC at Brasov aerodrome, with a number of 325 cases between 1971-2008, I had in mind the analysis of the baric field and the analysis of the wind at 500mb. For this analysis, I used height maps from the electronic German archive and soundings from Bucharest-Baneasa and Cluj-Napoca. Thus, eight typologies referring to the tropical days registered at Brasov airfield were highlighted:

a) **Typology 1** is particular for the south-west advection. In Europe the configuration of the baric system at the level of 500mb is characteristic to the Icelandic cyclone with broadened thalweg to Central and Western Europe and the presence of a baric dorsal over Romania (Fig. 6).

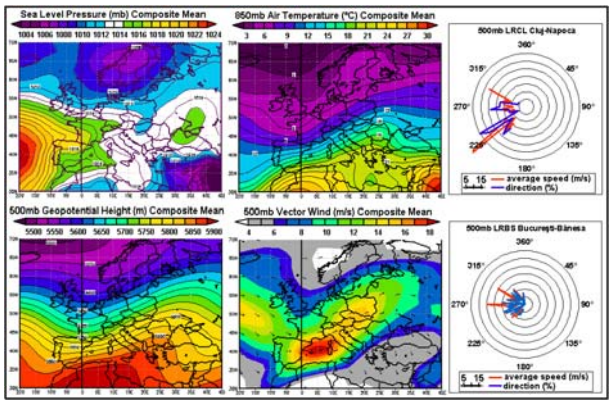

Fig. 6 Typology 1 Mediate pressure data, temperature and wind (data processing with NOAA and the University of Wyoming)

The strong advection is given by the elevated baric gradient especially in the Northwestern part of Romania; this fact is also confirmed by the medium speed of the

wind, much higher on the soundings from Cluj-Napoca compared to the diagram from Baneasa. In Romania, the medium value of the isohypse at 500mb is situated between 580-585mgp, whilst the medium pressure value at sea level is between 1013-1015hPa. This typology represents 24.9% from the tropical days cases, the medium temperature being of 31.6°C and the absolute maximum temperature reaching 35.4°C.

b) **Typology 1b** is characteristic for the southern advection. This atmospheric circulation is generated by the presence of the Mediterranean altitude cyclone in the Northern part of Italy through which it distinguishes itself from the first typology that has no ground correspondent, usually being found at the level of 500mb (Fig. 7). It was present in only 5.5% cases, the medium temperature being at 31.3°C and the absolute maximum reaching 33.6°C. The baric field at see level and the medium value of the isohypse at 500mb have a similar representation to typology 1.

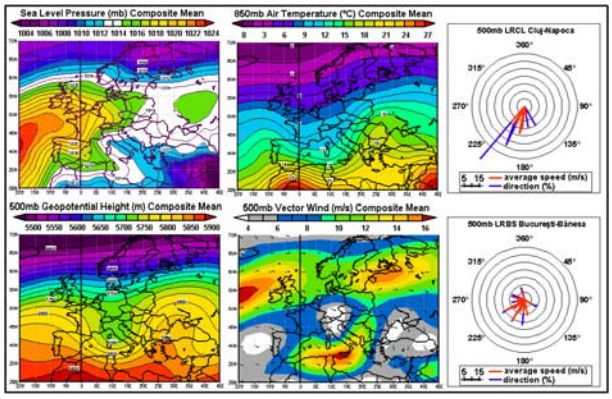

Fig. 7 Typology 1b Mediate pressure data, temperature and wind (data processing with NOAA and the University of Wyoming)

c) **Typology 1c** is characterized, unlike typology 1, through the much more advanced baric dorsal specific over Romania, which determines and maintains to the ground a higher baric regime. In most cases, the anticyclone present over Romania had an anticyclone correspondent with a closed isohypse until the level of 300mb, which determined also a lower wind regime registered at both soundings, but having a predominant direction towards North-East (Fig. 8). Thus, in Romania's area, the medium value of the pressure at see level is rising to 1015-1017hPa, and the medium value of the isohypses is rising to 585-587.5mgp.

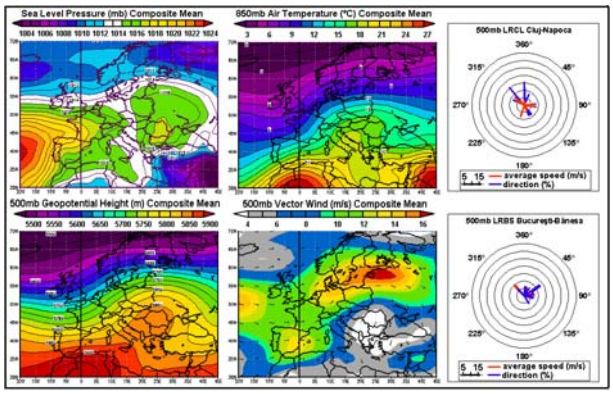

Fig. 8 Typology 1c Mediate pressure data, temperature and wind (data processing with NOAA and the University of Wyoming)

This fact leads to the maintaining of a medium temperature at 31.6°C, distinctive for typology 1, while the maximum absolute temperature is 34°C.

d) **Typology 2** marks out the presence of an altitude anticyclone in the western part of Russia that extends to the North-East of Romania whose correspondent at 500mb is a very advanced dorsal that blocks the western circulation, while the Icelandic cyclone extends to the South-Western part of Europe (Fig. 9). This typology is encountered in 5.8% cases, with the medium temperature at 32.3°C being higher than in other typologies because of the weak circulation in the medium atmosphere for this area and the influences of the warmer continental air masses. The absolute maximum temperature was at 35.5°C.

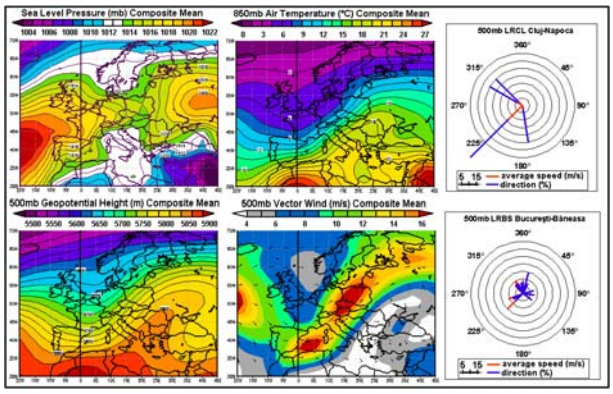

Fig. 9 Typology 2 Mediate pressure data, temperature and wind (data processing with NOAA and the University of Wyoming)

e) **Typology 2b** is characterized through the maintaining of the western advection-blocking situation specifically for typology 2, but the Icelandic cyclone is being much more active in Central Europe, which determines its influence over the circulation across our country as it can be observed in the wind distribution in both soundings (Fig. 10).

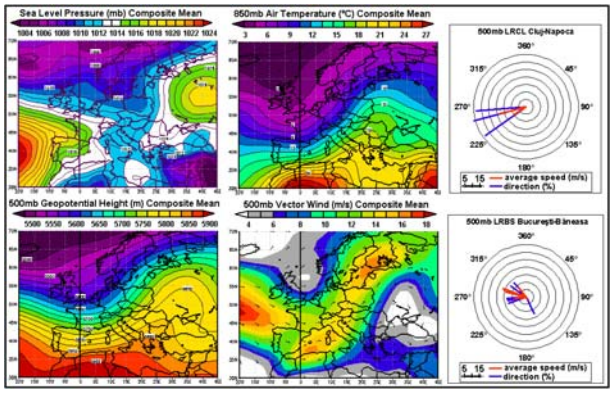

Fig. 10 Typology 2b Mediate pressure data, temperature and wind (data processing with NOAA and the University of Wyoming)

Being in proportion of about 3.7%, this typology is in most cases a passing to typologies 1 and 2, with the medium temperature recorded at 31.8°C and the absolute maximum temperature reaching 33.5°C.

f) **Typology 3** is defined by the presence of the Azores altitude anticyclone extended through Central and Eastern Europe, generating tropical-marine air masses advection, fact that leads to an absolute maximum temperature of 35°C. This typology is in 9.2% from all cases, the medium temperature being at 31.2°C.

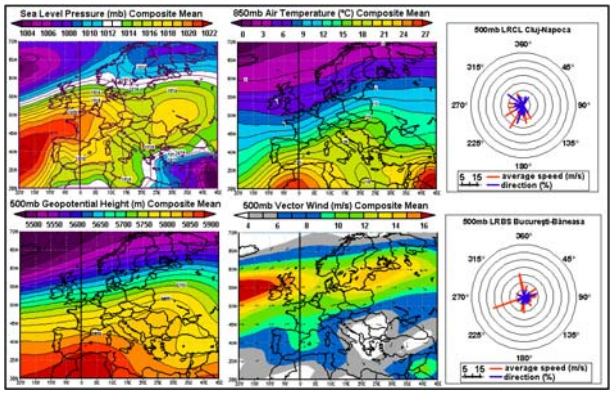

Fig. 11 Typology 3 Mediate pressure data, temperature and wind (data processing with NOAA and the University of Wyoming)

g) **Typology 3b** was found in about 2.5% instances, with the smallest number of cases. What makes this typology individuate, unlike typology 3, is the development and the weak presence of a depression over the Black Sea, the cyclogenesis being favorable due to the temperature differences between the cold air masses that are found over the Black Sea and those found over the continent (Fig. 12).

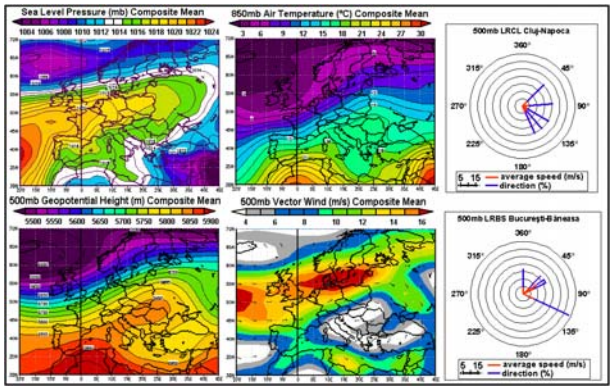

Fig. 12 Typology 3b Mediate pressure data, temperature and wind (data processing with NOAA and the University of Wyoming)

This fact determined the predominant wind direction to be East, the medium temperature maintaining around 31.3°C while the absolute maximum will reach 34°C.

h) **Typology 4** is characteristic to the western circulation at the level of Europe and it represents 39% from the cases with tropical temperatures, having the most encountered presence from all typologies.

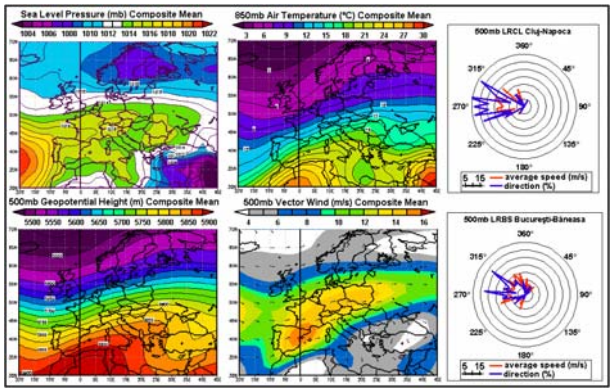

Fig. 13 Typology 4 Mediate pressure data, temperature and wind (data processing with NOAA and the University of Wyoming)

A more powerful influence of the depression regime determines the tropical-maritime air masses advection and a strong

influence of the anticyclone regime determines the tropical-continental air masses advection. Thus, the medium temperature is at 31.8°C, while the absolute maximum reaches 37.3°C.

4. CONCLUSIONS

The temperature analysis from 1971-2008 period marked out the accentuated variability of extreme temperatures and cold air advections, but also the more pronounced influence of the anticyclonic regime. Thus, the high temperatures during winter time have lead to the growth of the annual average temperature, the highest annual medium temperature reaching 9°C in the year 2007.

The interlunar growths for the multiannual lunar averages of maximum daily temperatures are even more pronounced in the months February and March, reaching 5.56°C, and for the daily minimum temperatures reaching 7.62°C between months March and April. On the other hand, the smallest differences are found between December-January and July-August.

The pronounced variability is also given by the absolute maximum temperatures, the highest temperature being of 37.3°C in July 2000, and the lowest temperature being registered in January 1985 of -32.3°C. The dropping or growing tendency on the number of days with characteristically temperatures has restored the importance not only of the topoclimate, but also of the medium circulation in the atmosphere. Thus, for the tropical temperatures I have highlighted 8 typologies regarding the medium regimes of circulation (level 500mb). The typologies 1, 1b and 1c are characteristic mainly to the south-western advection, at 500mb the Icelandic cyclone having the thalweg extended until over Central and Western Europe, sometimes with the presence of the Mediterranean altitude cyclone, over Romania being present a baric dorsal. The absolute maximum temperature registered was 35.4°C. Typologies 2 and 2b have as characteristics the influence of a very advanced dorsal, through the West of Russia that blocks the western circulation, while in the southwestern part of Europe is under the influence of the Iceland cyclone. The tropical-maritime air masses influence determined by the extension to Central and Eastern Europe of the Azores anticyclone is indicated in typologies 3 and 3b. The absolute maximum temperature registered in the last four typologies had the value of 35.5°C. However, the highest temperature of 37.3°C is found in typology number 4, which is characterized by the western circulation referring to Europe, having the most encountered frequency of all typologies.

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