

# THE INFLUENCE OF MEDITERRANEAN CYCLONES ON THE WEATHER IN OLTENIA DURING THE FIRST MONTH OF SUMMER

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**ABSTRACT.** The influence of Mediterranean cyclones on the weather in Oltenia during the first month of summer. Defining the Mediterranean cyclones as “semi-permanent centers” active only in the cold half of the year would suggest that they are not active in summer, and their influence on the weather of southern Europe and Romania is insignificant during this season. The statistical-climatological study presented in this paper shows that the daily frequency of occurrence of the Mediterranean cyclones during the month of June in the period 1981-2010, which influenced the weather in Oltenia, is 8%. Thus, they can be active all year round and can cause episodes of severe weather, depending on the position of other baric centers (the Azores High, The Icelandic Depression). Climatological aspects were investigated using meteorological data for June in the period 1981-2010, available from the quality check database of National Meteorological Administration, Bucharest. For describing the general context, climatological data was used to provide a global overview. Reanalysis data of sea-level pressure and geopotential height at 500 hPa, available from NOAA-NCEP/NCAR, were also used.

**Keywords:** Mediterranean cyclones, cyclonic trajectories, severe weather, Oltenia

## 1. INTRODUCTION

The Mediterranean cyclones play a very important role in the geographical space of Southern and South-Eastern Europe, not only in the appearance and evolution of the weather and but also in determining the climatic features.

The Mediterranean region is one of the most important cyclogenetic regions for Europe. Due to the social impact of the meteorological phenomena associated with cyclones, accurate forecast of cyclone trajectories and associated weather is of significant socio-economical importance. In this context, in-depth knowledge of cyclone genesis and evolution, as well as on their climatology may help in mitigation of the inherent difficulties in forecasting.

June, the first month of summer, is characterized by the alternation of sunny and warm days with cold and cloudy days, when in an interval of just few hours the amount of precipitation may approach or exceed the multiannual monthly

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mean values for this month. During June, the highest amount of precipitation throughout the year is recorded on almost the whole Romanian territory (Clima României, 2008). In the subcarpathian region of Oltenia the multiannual monthly mean for June is in the range 80-100 mm.

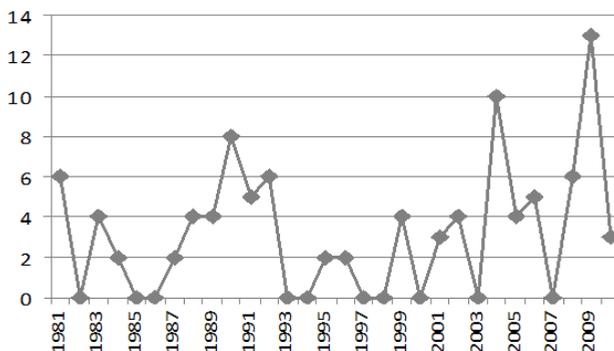
The production of high amounts of precipitation can be either the result of weather fronts (or their periphery) crossing over the region of Oltenia or the result of local factors that may cause vertical development of clouds thus generating significant amounts of rain.

As an example, the month of June 2014 can be characterized from a thermal point of view as being chilly and from a pluviometrical point of view as being excessive, in most of the region. At approximately 64% of the stations considered, the average monthly amounts were exceeded only due the Mediterranean cyclonic activity manifested during 15-26 June.

## 2. STATISTICAL AND CLIMATOLOGICAL STUDY

For this part of the study, the evolution of Mediterranean cyclones along trajectories passing over Oltenia was investigated for the month of June in the period 1981-2010. Synoptic maps describing near-surface (ground level) conditions at 00 UTC for the period of interest were analyzed, aiming to identify the appearance of the first closed isobar with values lower than 1015 hPa, over the Mediterranean Sea. Both cyclones formed “in situ” and those occurring as secondary vortexes on the cold fronts of the Icelandic Depression were considered.

During the period under study, a number of 26 cases when the Mediterranean cyclones influenced the weather in Oltenia during the month of June were identified. The number of day in which they were active during those 30 years is presented in Figure 1.



**Fig. 1.** *The number of days with cyclonic activity in the month of June, 1981-2010.*

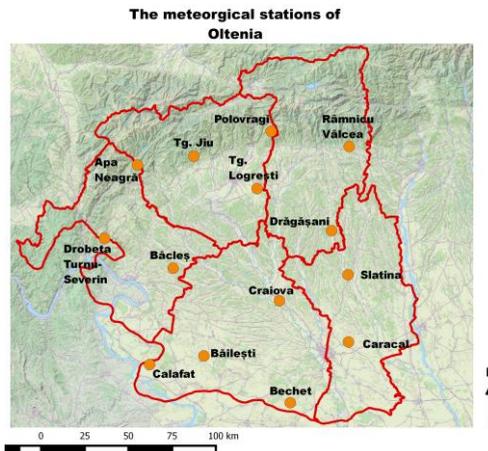
A first classification of cases of active Mediterranean cyclones in June identified with in the period 1981-2010 was based on their origin. Thus, a number of 12 cases, representing about 46% from the total number, were formed “in place”, in the Mediterranean Sea basin, while 14 of them were descendants of an

Icelandic depression, when it extended towards Southern Europe, reactivating in the Mediterranean Sea, and following one of the classical trajectories or a deviation from these.

Another classification was based on the trajectories of the cyclones identified. The cyclones with a classical trajectory T1 (or a deviation from that) represented 50%, 31% had the 4a trans-Balkan trajectory, 12% had a double trajectory (T1 and 4a trans-Balkan) and in only two cases the 2b trans-Balkan trajectories were present.

### 3. CLIMATE ASPECTS IN JUNE, IN OLTENIA

The physical-geographical factors are involved in a different way in shaping the climate profile of a region. The topography of the region can influence the general circulation of the atmosphere, leading to the apparition, development and intensification of certain phenomena affecting the main meteorological parameters which define the weather at a certain moment.



**Fig. 2.** *The meteorological stations of Oltenia*

Oltenia is situated in southwestern part of Romania and presents all forms of relief. The position of the Carpathians and Subcarpathians in the Oltenia region, relative to the direction of penetration of air masses driven by the main barometric centers, modulates the spatial distribution of rainfall in this area. For example, the mean amounts of precipitation in June 1981-2010 increases from south to north (55.6 mm at Bechet, 101.3 mm at Polovragi) and from east to west (67.1 mm at Slatina, 70.6 mm at Dr. Tr. Severin). Data from 14 weather stations, that have a full range of meteorological data, was used for this study (Fig. 2).

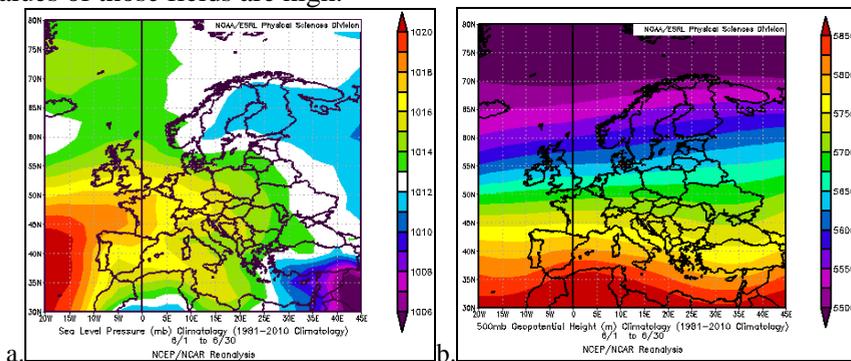
The first month of summer is characterized by an alternation of warm and sunny days, when the temperature values often reaches more than 30 °C during midday hours, and cold and cloudy days, when in a few hours interval the amount

of rainfall can exceed the average monthly quantities. Without having the thermal values of the other two summer months, June is pretty warm, especially in the lowlands of southern Oltenia, where monthly average temperatures exceed 21°C. In the other regions, average monthly values are in the range between 18 and 21°C (Burada et al, 2011, a).

June is the richest month in precipitation from all the months of the year, the distribution of the average quantities based on the geography highlighting this aspect: the average monthly quantities increases from 51.7 mm at Calafat (in the southern plain) to 101.5 mm at Polovragi (in the subcarpathian region) (Burada et al, 2011, b).

From a hydrological point of view, June marks the end of the high waters of Oltenia rivers found in spring and caused by snow melting and rains, as shown by the lower rates of water flow in this month, compared with previous months. However, sometimes high flow rates may be found on small rivers, which can cause serious damage.

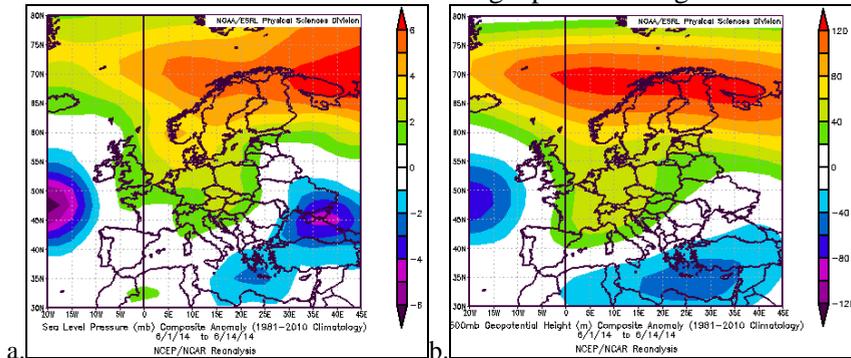
Reanalysis data available from NCEP/NCAR (<http://www.esrl.noaa.gov>) was employed to describe the spatial distribution of multiannual monthly mean sea-level pressure (Fig. 3a) and geopotential height at 500 hPa (Figure 3b) for June 1981 - 2010. From a climatological point of view, during June Europe is under the influence of the Azores High Ridge and the Arab baric depression; the first baric center can bring moist oceanic air which in contact with the tropical air determines the occurrence of rainfall, while the latter can cause excessive heating (Fig. 3a). In altitude, a low geopotential field is located over the northern half of Europe, while the southern half of Europe is located in a high geopotential field, the air circulation being western, zonal. According to the standard configuration for this time of the year, both at the ground level and in mid-troposphere, above Romania the values of those fields are high.



**Fig. 3. Multiannual monthly mean of: a) Sea Level Pressure; b) Geopotential Height at 500 hPa, for June, 1981-201** (<http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/comp.day.pl>)

In the following we present the characterization of June 2014, by dividing it into 3 periods.

During the first period, from the 1<sup>st</sup> to the 14<sup>th</sup> of June, over the most of Europe acted, at the ground level, a belt formed between the Azores High and the Greenland Anticyclone. The Arabic Depression was felt in the south-east of the continent. In mid-troposphere, at 500 hPa level, the southern part of the continent was in a high geopotential field, with a ridge extended up to Poland. Romania was situated, at the ground level at the contact between the two fields of pressure, and at the 500 hPa level under the influence of the geopotential ridge.



**Fig. 4. a) Sea Level Pressure Composite Anomaly, 1-14 June 2014; b) 500 hPa Geopotential Height Composite Anomaly, 1-14 June 2014**  
[\(<http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/comp.day.pl>\)](http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/comp.day.pl)

On the maps presenting the pressure fields anomalies at the ground level (Figure 4a), respectively the geopotential field anomalies at 500 hPa level (Figure 4b), based on NCEP/NCAR reanalysis data for the period between the 1<sup>st</sup> and the 14<sup>th</sup> of June, it may be seen that a positive anomaly was predominant over most of Europe, except the western and the southeastern extremity.

In this synoptic context, in Oltenia the weather got warmer, becoming hot, in the period between the 8<sup>th</sup> and 14<sup>th</sup> of June and positive deviations of temperature up to 3-5 °C were present. Phenomena associated with atmospheric instability occurred locally, in particular in the hilly and mountainous areas, especially in the afternoon and early in the night, caused by convective cloud systems. There were rains with a torrential character (39.2 mm in Drăgășani – 04.06.2014), the wind presented short-term intensifications, taking the aspect of a storm (72 km/h at Tg. Logrești - 08.06.2014) and there were isolated cases of small-sized hail.

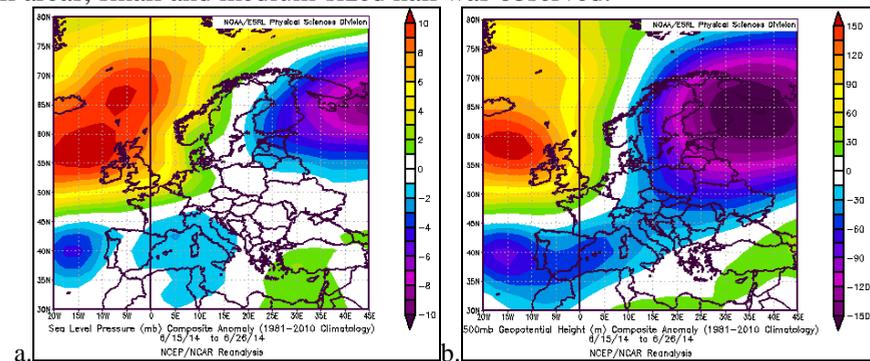
The maximum temperatures of this period of time were generally comprised between 26 °C and 33 °C; the temperatures were lower for the first two days, when the weather was cool, down to 19 °C at Polovragi; high values, up to 35°C were also registered at Dr. Tr. Severin and Calafat on 11.06.2014, a day when the temperature-humidity index exceeded the critical threshold of 80 units on small areas in Oltenia. Minimum temperatures varied between 10 °C and 18 °C, locally lower, down to 6 °C at Apa Neagră in the period between 03.06 - 04.06, but also higher, up to 20 °C at Calafat, between 13.06 - 14.06.

The second period, from 15<sup>th</sup> to 26<sup>th</sup> June, was characterized by an intense Mediterranean cyclonic activity. There were 3 episodes in which the weather in Oltenia was determined by the frontal systems related to that.

At the ground level, the western part of the continent maintained itself in an anticyclonic field which went westward, above Germany, the rest of Europe being in a depression field. It was noted a low pressure field in central-western basin of the Mediterranean, sustained in mid troposphere, by the configuration at 500 hPa level; here a vast geopotential trough was present, flanked on its west side by a ridge which facilitated in its latter part the cold air advection up to the northern part of the Adriatic Sea, favoring cyclogenesis.

Analysing the anomalies of the pressure fields (Fig. 5a) and those of the geopotential fields respectively (Fig. 5b) obtained from the NCEP/NCAR reanalysis, it is noted that in this period the north-western part of the continent was situated in a pressure field with higher values than the climatological norms. Negative deviations can be observed mainly in the northeastern half of the continent and in the central-western basin of the Mediterranean, peripheral affecting Romania, thus influencing the degree of instability.

In this synoptic context, in Oltenia, the weather was cool and unstable. This was due to the pronounced nebulosity and to the precipitation caused by the intense activity of Mediterranean cyclones acting over Oltenia in this period. There were rains over extended areas, lightning, brief wind intensifications and, over small areas, small and medium-sized hail was observed.

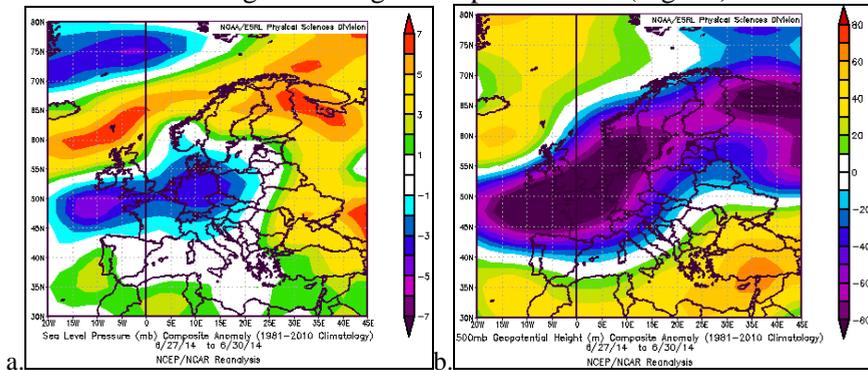


**Fig. 5. a) Sea Level Pressure Composite Anomaly, 15-26 June 2014; b) 500 hPa Geopotential Height Composite Anomaly, 15-26 June 2014**  
[\(<http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/comp.day.pl>\)](http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/comp.day.pl)

The amount of recorded rainfall was comprised between 31.2 mm at Bechet and 103.8 mm at Apa Neagră. The maximum temperatures were comprised between 15 °C at Bâcleș (on 19.06) and 25 °C at Tg. Jiu (on 21.06) in this week (16.06-21.06); in the following days, temperatures increased reaching 33 °C in the day of 24.06 at Bechet and Calafat.

In the third period, between the 27<sup>th</sup> and the 30<sup>th</sup> of June, at the ground level it may be seen that central-western and western Europe pressure values were below the climatological norms of the period, while in the rest of the continent

there were positive deviations. In the mid troposphere we can observe positive anomalies of geopotential values in southern, south-eastern and north-western Europe, while in most of the European continent the geopotential with lower values than the climatological averages was predominant (Fig. 6b).



**Fig. 6. a) Sea Level Pressure Composite Anomaly, 27-30 June 2014; b) 500 hPa Geopotential Height Composite Anomaly, 27-30 June 2014**  
[\(<http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/comp.day.pl>\)](http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/comp.day.pl)

As a result, the weather was defined by an increase in temperature from one day to another, becoming in general nice and warm, with maximum temperatures reaching as far as 31°C at Bechet and Calafat (29 and 30.06). In terms of precipitation there were isolated reports of weak showers, but only in the first day of the period.

The month of June, as mentioned before, is the rainiest month of the year. In June 2014, the amount of rainfall recorded had values between 48.4 mm at Bechet (Dolj County) and 169.4 mm at Tg. Logrești (Gorj County); at the pluviometric stations the largest amount of rainfall was recorded in Vâlcea County, at Șirineasa (181.2 mm). The amount of rainfall recorded between the 16<sup>th</sup> and the 26<sup>th</sup> of June, from Mediterranean cyclones were comprised between 31.2 mm at Bechet (Dolj) and 103.8 mm at Apa Neagră (Gorj).

From the 14 stations analyzed, at 9 of them, representing approximately 64%, average monthly precipitation amounts were exceeded only due to the Mediterranean cyclonic activity. Thus the amount of rainfall recorded in the period between the 15<sup>th</sup> and 26<sup>th</sup> of June exceeded the multiannual averages by approximately 4% at Băilești to about 45% at Drăgășani; the multiannual value was exceeded at Craiova by 40%.

Regarding the temperatures of the month of June 2014 in Oltenia, we can observe an alternation between periods of time when the weather was cool, with temperatures under the climatological norms with those in which the weather was warm, hot and the temperature – humidity index exceeded the critical threshold of 80 units, but only on small areas.

Average temperatures were comprised between 17.6 °C at Polovragi (Gorj) and 21.1 °C at Calafat (Dolj). The average temperature anomaly was negative in all

meteorological stations, ranging between 0.1 °C at Tg. Logrești (Gorj) and 1.5 °C at Slatina (Ilt).

In terms of rainfall and precipitation, June 2014 was an exceedingly rainy month, from a thermal point of view, was close to the climatological norms of that period.

## CONCLUSIONS

Although Mediterranean cyclones are named “semi-permanent”, those can be active all year long, depending on the position of other baric centers (the Azores High, the Icelandic Depression).

From the classification made here, depending on the origin of Mediterranean cyclones, which influenced the weather in Oltenia, in the period 1981-2010, in June, we found that approximately 46% from the total number, were formed “in place” in the Mediterranean Sea basin, while approximately 54% were the descendents of an Icelandic Depression.

From a pluviometrical point of view, the month of June 2014 was exceedant because of the intense activity of Mediterranean Cyclones, the number of days in which those influenced the weather in Oltenia had a frequency of over 30%.

The recorded amounts of rainfall had high values from 16<sup>th</sup> to the 26<sup>th</sup> of June, when the weather in Oltenia was influenced by the Mediterranean depression, such that the climatological norms were exceeded at 64% of the studied stations, with deviation ranging from 4% at Băilești up to 45% at Drăgășani.

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