FLOODS IN EASTERN ROMANIA DURING JUNE AND JULY, 2010

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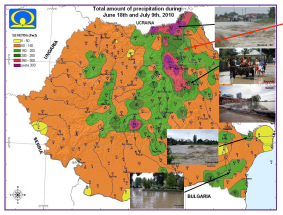
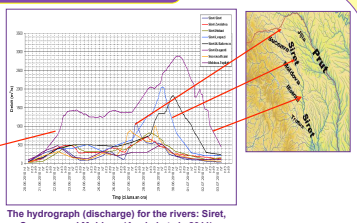
INTRODUCTION

During June and July, 2010, Romania has experienced a period of strong atmospheric instability. The number of days with heavy rain was high and especially in the eastern regions produced historic growth of the rivers debit and levels.

The floods have led to significant economic losses and casualties. During 18th June and 9th July the water amount exceeded the multiannual monthly average (in the eastern regions locally exceeded 200 mm and isolated 300 mm).



Accumulated rainfall during June 18th and July 9th , 2010



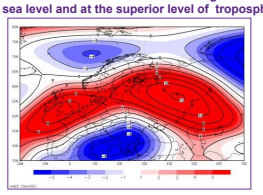
The hydrograph (discharge) for the rivers: Siret, Suceava and Moldova (Anghel et al., 2011)

This situation was caused by the persistent action of two atmospheric blocking structures - one of them acting above the Western Europe and the other over the eastern part of the continent. In these circumstances the south and the south-eastern part of the continent were under the influence of a cyclonic field which also influenced Romanian territory. This situation facilitated the development of the Mesoscale Convective Systems (MCS).

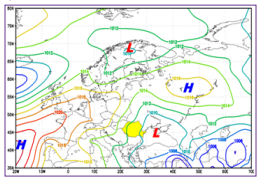
The paper's aim is to illustrate the links between atmospheric blocking within the European area and the severe weather phenomena that occurred in eastern Romania, and to analyze the convective system responsible for the storms occurred in 28th and 29th June and caused disastrous floods in the northern part of Moldavia.

GENERAL CONTEXT

This particular situation has been determined by a synoptic situation wich has involved a blocking circulation. In fact, during the above mentioned period, the blocking anticyclone activity was present in both main areas (Western and Eastern Europe). The continental blocking has a great extension and intensity, and an extended nucleus of positive geopotential anomaly can be observed in image below. In these circumstances, Southern Europe was under the influence of a cyclonic field which continuously enriched this area with moisture from Mediterranean Sea and Black Sea. The synoptic structures have been maintained throughout the whole tropospheric column, being present both at the sea level and at the superior level of troposphere.



Geopotential anomaly (500 hPa) during June 18th and July 9th , 2010



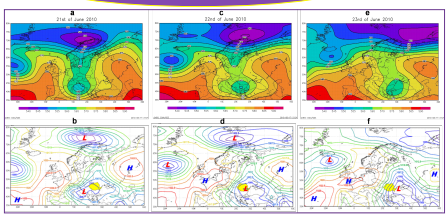
Average mean sea level pressure during June 18th and July 9th , 2010

The continuous warm air advection from the Middle East toward Russia has led to the strengthening and persistence of eastern blocking during the most part of the range of interest. As a result the trajectory of cyclonic nucleus had several cases of retrograde path over the western basin of the Black Sea. Following this trajectory, the air mass was enriched with a considerable amount of water vapour and became unstable, this situation being favourable four MCS.

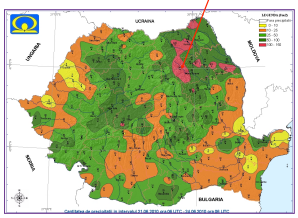
CASE STUDY: FLOODS BETWEEN 18th of JUNE to 9th of JULY

Alongside the 20°E – 30°E longitudinal band, the positive anomaly has a higher persistence, but its position is north of Romanian territory. Therefore, over our country there is a negative geopotential height anomaly, which corresponds to the mediterranean low. The cyclone has been particularly active, on the one hand because of the support of cold nucleus from upper troposphere, and on the other hand because of the eastern European ridge that determined several cases of retrograde situations over the western basin of the Black Sea. The instability has affected eastern Romania, Republic of Moldavia and Ukraine. Of the entire examined range the most relevant episodes of heavy precipitation were: June 21st to 23rd, June 25th to 26th and June 28th to 30th.

1. JUNE 21st to 23rd — DOUBLE BLOCKING

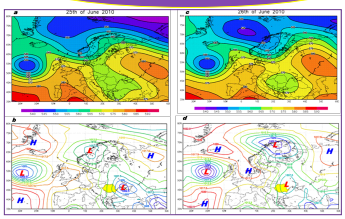


Geopotential hight of 500 hPa for 21.06 (a), 22.06(c) si 23.06 (e) (contour interval 5 damgp) si presiunea medie la nivelul marii pentru 21.06 (b), 22.06(d) si 23.06 (f) (intervalul de contur 2.5 hPa)

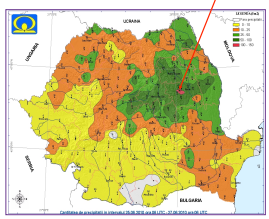


Accumulated rainfall for Romania, June 21 – 23

2. JUNE 25th to 26th — EASTERN BLOCKING



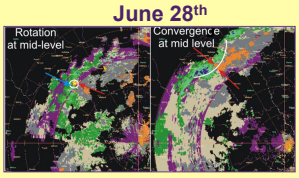
500 hPa geopotential height for June 25 (a) and June 26 (c) (contour interval: 5 damgp) and mean sea level pressure for June 25 (b) and June 26(d) (contour interval: 2.5 hPa)



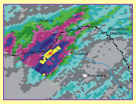
Accumulated rainfall for Romania, June 25 - 26

The most representative event took place between 28th and 30th June. Convective systems responsible for manifestations of severe weather in the north-east of the country were set up in supercells (with very high reflectivity in the radar image and typical satellite images). In this period a decisive role was played by orography. Carpathian orientation facilitated the moisture convergence and forced the ascending motion on the mountain slope. On 29th June favored the development of a mesocyclone.

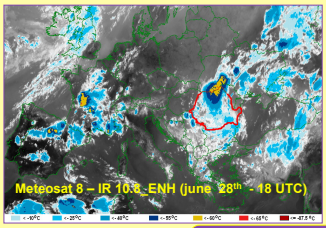
June 28th



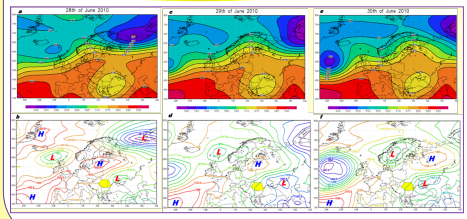
Storm relative velocity – Rotation at mid-level (June 28th 17:46 UTC and Mid Altitude Radial Convergence (June 28th 18:12 UTC



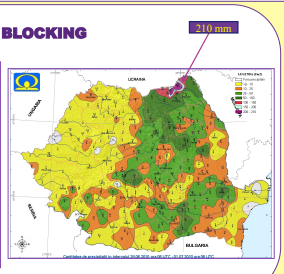
Precipitation estimation with Barnova Radar (more than 200 mm), for June 28th



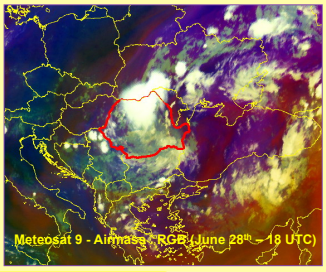
3. JUNE 28th to 30th — DOUBLE BLOCKING

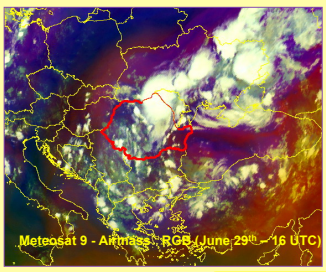


500 hPa geopotential height for June 28 (a), 29 (c) and 30 (e) (contour interval: 5 damgp) and mean sea level pressure for June 28 (b), 29 (d) and 30 (f) (contour interval: 2.5 hPa)

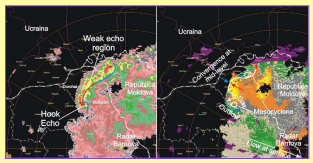


Accumulated rainfall for Romania, June 28 - 30

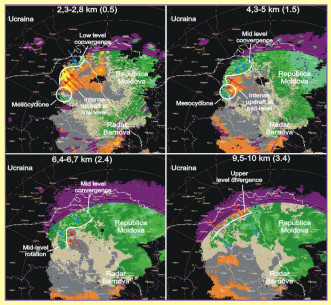




June 29th



Reflectivity and Storm Relative Velocity (mesocyclone June 29th – 15:14 UTC)



Storm Relative Velocity at different elevations (mesocyclone) (June 29th – 15:26 UTC)

CONCLUSIONS

The study concludes that the atmospheric double blocking over the European continent, on both sides of the longitudinal band which Romania is situated, has favored disastrous weather conditions. During this period the most sever episodes were those in which the Eastern European ridge determined a backward trajectory of the Mediterranean cyclones arrived in South-Eastern Europe and their reactivation over the Black Sea basin. The moist air transport from the Mediterranean and Black Sea played an important role in the atmospheric instability amplification. This situation facilitated the development of the Mesoscale Convective Systems (MCS).

In this period were affected Ukraine and Republic of Moldova, too. Heavy rains in these regions influenced also increasing levels of some rivers in Romania. Prior to their onset, all of these rainfall episodes in Eastern Romania, both during June and July, were the subject of meteorological warnings issued by the National Meteorological Administration of Romania with 12, or 24 hours in advance. Also, close to 100 warning messages – coded either Yellow or Orange as per the significance of predicted events – were issued as now-casting forecasts, based on RADAR observations.

REFERENCES

Anghel, E., Frimescu. L., Banciu, O., Smota, M, Gheorghe, C., 2011, Caracterizarea viiturilor excepționale din 2010, *Sesiunea de comunicari stiintifice a INHGA.*
Bordei, Ion, Ecaterina., (2009) : Rolul lanțului Alpino - Carpatic în evoluția ciclonilor mediteraneeni – ediția a II-a., *Editura Printech., București., 107-122.*
Colucci, S.J., 1985: Explosive Cyclogenesis and Large-scale Circulation Changes: Implications for the Atmospheric Blocking, *J.Atmos.Sci.*, 42, 2701-2717.
Dima, Viorica, Pop,a Florinela, Banciu, Doina, 2005: Studiul comparativ al contextului meteorologic în care s-au produs inundațiile din primaverile anilor 1970 si 2005, *Sesiunea de comunicari stiintifice a ANM, Bucuresti.*
Georgescu, M, Andrei, S., Stefanescu, V., 2010, Persistence of atmospheric double blocking action as basis of flooding in eastern Romania during June - July, 2010, *National Physics Conference, 2010*
Hustiu, M., Structuri mezoscalare ce produc inundatii de tip "Flash Flood" in Podisul Moldovei, *Sesiuniea de comunicari stiintifice a ANM.*
Lupo, A.R and L.F. Bosart, 1999: An analysis of a relatively rare case of continental blocking, *Q. J. R. Meteor. Soc.* 125, 107 – 138.
Stefan, Sabina, 2004, Fizica atmosferei, vremea si clima" *Editura Universitatii Bucuresti.*
Tibaldi,S., Molteni,F., 1990: On the Operational Predictability of Blocking, *Tellus, Ser. A*, 42, 343-365.
Wiedenmann, J.M, et al., 2002: The climatology of blocking Anticyclones for the Northern and Southern Hemispheres: Block Intensity as a Diagnostic, *J.Climate*, 15, 3459-3473.

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