THE BLIZZARD PHENOMENON IN SOUTHWESTERN ROMANIA

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ABSTRACT. The blizzard phenomenon in southwestern Romania. The most common situation when blizzard occurs in this region is when the East-European anticyclon's ridge and a mediterranean low pressure field are coupled. Very rarrely the blizzard occures due to the atmospheric coupling between Azores anticyclone with a low pressure field. In this paper these posibillities of blizzard's occurrence are studied. Their specific elements were compared in order to help operational activity of weather forecasters. For establishing the synoptic and mesoscale contexts that had generated the severe weather events listed below, global numerical model output -ECMWF (European Centre for Mediumum-Range Weather Forecast) and short-range numerical model output - ALADIN, EUMETSAT satellite imagies, maps using data from ESTOFEX site and observational data from meteorological stations, validated and administrated by National Meteorological Administration were used.

Keyword: blizzard, snowfall, wind gust, anticyclone, cyclone

1. INTRODUCTION

Blizzard is an atmospheric winter phenomenon specific to temperate and cold climates, with severe consequences, having a great calamity potential and being in the same time the most representative mesoscale phenomenon for Romania in the lower troposphere. It is manifested by snowfall (sometimes heavy) and sustained wind gust that blows the snow and could be form drifts. The visibility drops to almost 0 m and it is hard to appreciate if it's still snowing or not.

Damages and disruption of economic and social activities, amplified sometimes by the preexisting conditions (already existed snow layer settled during previous blizzard episodes), roads position to the wind blowing direction, or even worse, loss of human lives justify the following comparative analysis.

In blizzard producing an undeniable role has both the orographic blockage imposed by the Carpathians to the cold air advection from the Russian Plain, and the heat blockage imposed by the presence of the Black Sea, which favors a strong cold air channeling to the Romanian Plain. Knowing that blizzards occurs at the brutal interaction of two type of air masses with different physical characteristics, who are confronting only in lower layers of the troposphere (up to 600-800 m altitude), the role of orographic barrier appears more obvious.

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The smallest number of days with blizzard is found in sheltered areas of northeast and east cold air advection, i.e.: Transylvanian Plateau and Western Plain (1…2 days). The highest number of days with blizzard (3-5 days) is recorded in extra-Carpathians regions such as Central Moldavian Plateau, Inferior Siret Plain and the most part of Romanian Plain. In central area of Baragan and North Dobrogea Plateau the blizzard frequency is bigger than 5 days (*Clima României* 2008). In Oltenia the average annual of blizzard days increases from north (1 day) to south (2-3 days) of the region.

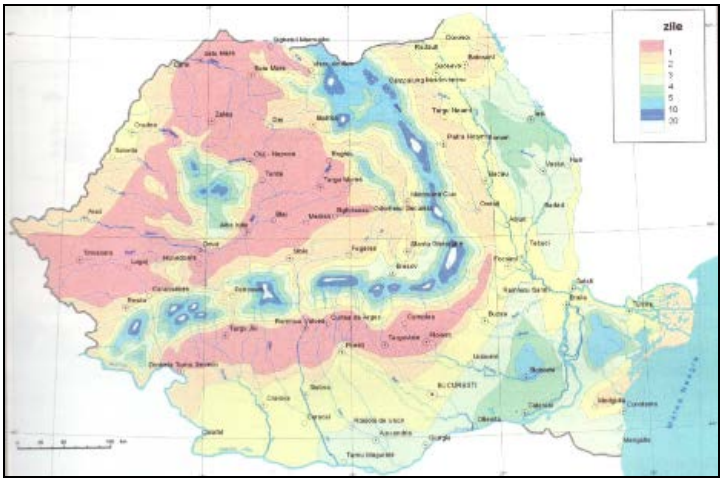


Fig. 1. The territorial distribution of the average annual number of days with blizzard
(Clima României, 2008)

On Romanian territory, wind speed during blizzards varies on average between 11-17 m/sec (41-60 km/h), but often exceeds these conventional limits. Depending on wind speed, conventionally, blizzards are grouped into three categories: *violent blizzards* (v > 17 m/sec), *strong blizzards* (v= 11-17 m/sec) and *moderate blizzards* (v= 6-10 m/sec).

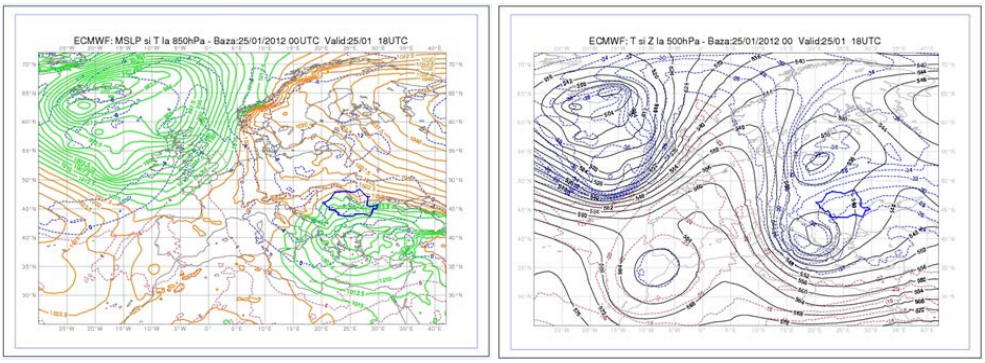
2. FIRST CASE: THE EAST BLIZZARD

For the Southwestern Romania this synoptic context determines the most severe episodes of blizzard.

The first blizzard of 2011-2012 winter occurred between 24-26 January and came after a long period poor in precipitation, mainly due to a low cyclonic activity in Mediterranean Sea basin.

For southwestern Romania blizzard's peak was during 25-26 night, when the Mediterranean Low moved to Black Sea through a trans-Balkan trajectory. Synoptic configuration - surface level map (Fig. 2) - shows that the largest part of Europe was under the influence of an anticyclonic belt formed between Azores and

East-European High. Only northwestern and southeastern of the continent were in a low pressure fields (Fig. 2a).

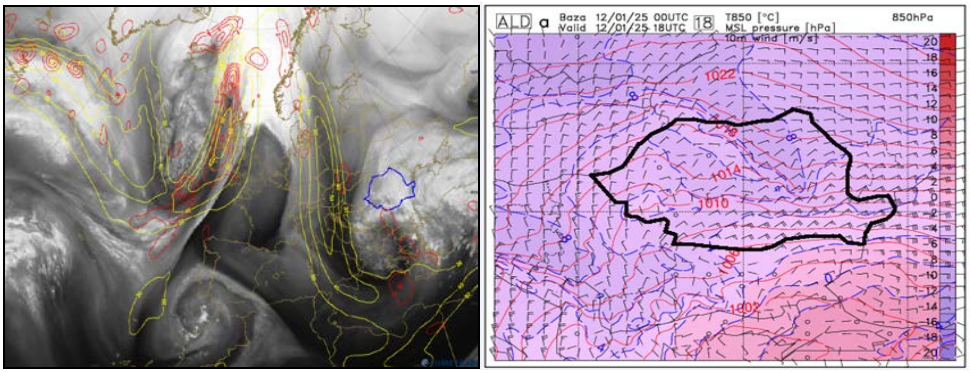


a) *b)*

Fig. 2. a) Sea Level Pressure(SLP) and 850 hPa Temperature; b) 500 hPa Geopotential Height and Temperature;– 25.01.2012 18 UTC ECMWF model

At 500 hPa level, the anterior flak of geopotential's ridge, extended up over Scandinavian Peninsula, facilitates the cold air descending to central basin of Mediterranean Sea. It can be seen the "cut-off" structure that actionated above Romania, structure who influenced the amounts of precipitation (Fig. 2b).

The satellite images (Fig. 3a) shows that at the left exit from the Jet Strem it is a nucleus of Positive Vorticity Advection (PVA), supporting the development of the cyclone, suggested also by the dry air of stratospheric origin -dark zones. Overlapping the SLP (Sea Level Pressure) with the altitude we can see that the nucleus axis is oriented NW-SE, suggesting that the cyclone is still in development.



a) *b)*

Fig. 3. 25.01. 2012, 18UTC a) WV 6.2 Satellite Image(red PVA, yellow isotachs, at 300hPa) *(www.eumetrain.org)* ***; b) SLP, 850 hPa Temp., 10 m Wind ALADIN model***

Short-range weather forecast model ALADIN (Fig. 3b), highlights better the East-European anticyclone's influence and its contact area with Mediterranean Low. The contact between them creates in horizontal plane great thermal and pressure gradients. From north to south the pressure gradient is 14 hPa and the thermal one is almost 6°C. It can be observed that, for South and East of Romania, the wind direction is from north-east; its intensity is higher in the Carpathians curvature and decreases as we go towards southwest.

Atmospheric sounding from Bucharest, 26 January 00 UTC (Fig. 4), shows that in the low troposphere (first 1500 m), three layers with different flows are found, which demonstrates the existence of the Low Level Jet (according to the specialized literature, Drăghici, 1988):

-*a stormy layer* (***s***), with an intense horizontal circulation, situated under the 925 hPa level. In this layer the maximum intensity of the flow (about 25 m/s) is reached in the 969 hPa level vecinity, meaning at about 360 m above ground level;

-*a relaxation layer* (***r***), located in the vecinity of 874 hPa level, where there is a significant decrease in the flow's intensity;

-*a quietly layer* (***q***), localted at about 850 hPa level, where the wind intensity reaches a minimum of 19…20 m/s.

15420 LRBS Bucuresti Inmh-Banesa Observations at 00Z 26 Jan 2012

PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
1003.0	91	-4.1	-4.7	96	2.70	45	25	268.8	276.2	269.3
1000.0	120	-4.9	-7.1	85	2.25	45	29	268.2	274.5	268.6
982.0	262	-6.3	-8.0	88	2.15	40	52	268.2	274.2	268.6
969.0 s	367	-7.3	-8.6	90	2.07	46	52	268.2	274.0	268.6
940.0	604	-7.5	-8.6	92	2.13	58	50	270.4	276.4	270.7
926.0	722	-6.1	-6.4	98	2.57	65	49	273.0	280.2	273.4
925.0	730	-5.7	-5.9	98	2.67	65	49	273.5	281.0	273.9
912.0 r	842	-1.7	-1.7	100	3.72	70	47	278.7	289.2	279.3
874.0	1179	-3.3	-3.3	100	3.44	85	41	280.5	290.3	281.1
850.0 q	1400	-4.3	-4.4	99	3.26	85	41	281.6	291.0	282.2
798.0	1895	-7.4	-7.9	96	2.65	85	43	283.4	291.2	283.9
790.0	1974	-7.9	-8.5	95	2.56	89	42	283.7	291.2	284.2
748.0	2397	-9.3	-10.2	94	2.37	110	35	286.6	293.7	287.0
700.0	2911	-11.1	-12.2	92	2.15	115	31	290.2	296.7	290.5
691.0	3010	-11.3	-12.5	90	2.12	115	29	291.0	297.5	291.4
671.0	3236	-11.7	-13.3	88	2.05	126	23	293.0	299.4	293.4
631.0	3704	-14.5	-16.8	83	1.64	150	12	295.0	300.2	295.3
601.0	4074	-16.7	-19.5	79	1.37	138	11	296.6	301.0	296.9
559.0	4600	-20.9	-24.2	75	0.97	120	10	297.9	301.1	298.0
512.0	5256	-26.0	-30.0	69	0.62	150	16	299.3	301.4	299.4
504.0	5372	-26.9	-31.0	68	0.57	150	17	299.5	301.5	299.6
500.0	5430	-27.3	-31.5	67	0.55	150	17	299.7	301.6	299.8
400.0	6990	-40.7	-43.0	78	0.22	150	29	302.0	302.8	302.1
397.0	7041	-41.1	-43.3	79	0.21	150	29	302.1	302.9	302.2
389.0	7179	-42.1	-45.2	72	0.17	152	29	302.6	303.2	302.6
340.0	8056	-50.6	-53.7	70	0.08	160	31	302.9	303.2	302.9
311.0	8638	-56.2	-59.3	69	0.04	165	31	302.8	303.0	302.8
303.0	8807	-57.9	-60.9	68	0.03	172	31	302.8	302.9	302.8
300.0	8870	-58.3	-61.3	68	0.03	175	31	303.1	303.2	303.1
263.0	9694	-62.1	-65.5	64	0.02	200	25	309.1	309.2	309.1
250.0	10010	-60.1	-64.4	57	0.03	205	23	316.6	316.7	316.6

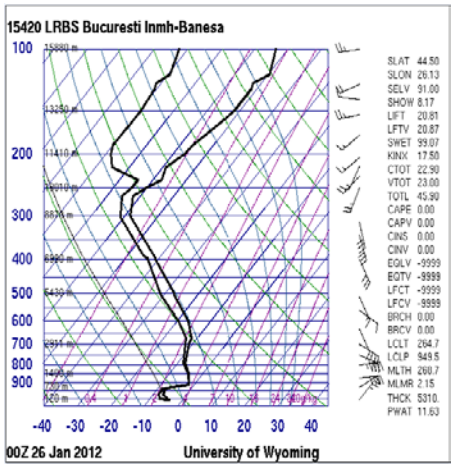
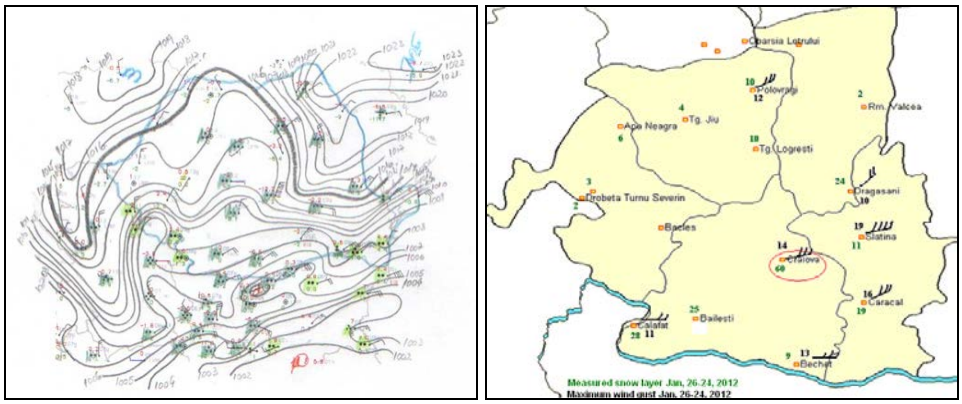


Fig. 4. Bucharest Atmospheric Sounding from 26.01.2012 at 00 UTC
(www.weather.uwyo.edu/upperair/sounding)

On 24th to 26th January, the weather in Oltenia was cloudy. All over the region were recorded precipitation, in general moderate. On the first day it was raining all over Oltenia but during the night, rain turned into snow (Fig. 5a).

Thus on 26th of January, 06 UTC the measured snow layer in Oltenia was between 2 cm at Rm. Valcea weather station, and 60 cm at Craiova weather station (which was the highest layer in Romania at that time, except for mountain areas). Also the greatest precipitation amount of this severe episode was recorded at Craiova too – **90,1 mm**. Wind blew weak to moderate with local intensification

from eastern sector in south and east of the region, the maximum wind gust being 68 km/h at Slatina meteorological weather station (Fig. 5b).



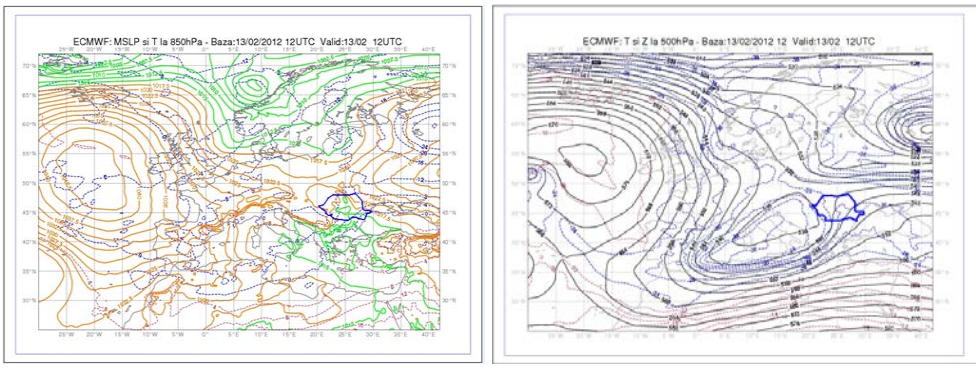
a) *b)*

Fig. 5. a) Bjerknes Scheme (original map *www.estofex.org)* ***24.01. 2012, 18 UTC; b) Oltenia-snow layer (green) and maximum wind gust (black) 24-26.01.2012***

3. SECOND CASE: THE WEST BLIZZARD

This blizzard episode occurred after several cases of severe weather, blizzards and low temperatures (-25°C), recorded in Oltenia. The duration of this episode was smaller than the previously analyzed, up to 18 hours and affected the southwestern Oltenia. Maximum intensity of the phenomenon was between 13.02. 2012, 12 UTC – 14.02. 2012, 00 UTC.

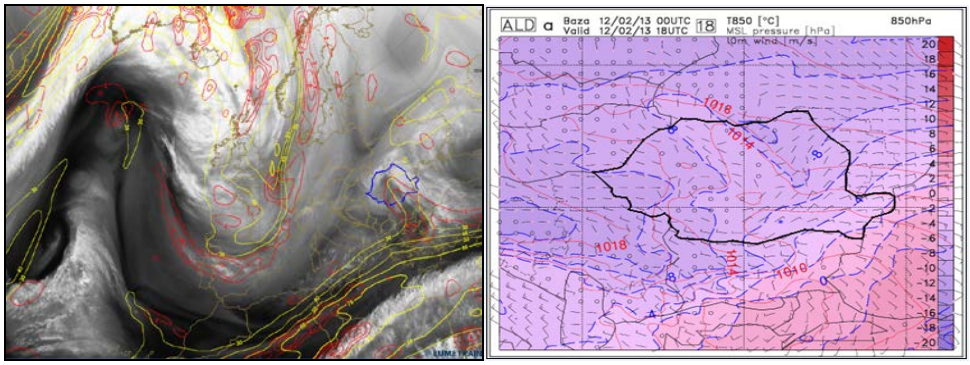
Thus, on ground level on 13.02.2012, 12 UTC, the anticyclonic belt starts to break, the East-European High's ridge retreats eastward allowing the advancement of Mediterranean Low to the Black Sea. At 850 hPa level temperature field, over our country we can observe an accentuated horizontal gradient (0.02°C/km). In Oltenia it point out the atmospheric coupling made between Azores anticlyclone and the Mediterranean Low (Fig. 6a).



a) *b)*

Fig. 6. a) Sea Level Pressure and 850 hPa Temperature; b) 500 hPa Geopotential Height and Temperature;– 13.02. 2012 12 UTC ECMWF model

At 500 hPa level, the biggest part of continent was under the influence of a wide thalweg of geopotential extended till the western basin of Mediterranean Sea (Fig. 6b). The extreme Southeast and West Europe were situated in a high geopotential field. Water vapor satellite image (Fig. 7a) helps us to identify the location and orientation of jet axis; it can be seen that trough South Romania there is a nucleus of PVA. The dry areas (dark) are a sign of cyclogenesis as stratospheric air is protruding down; in this case it sustaines the cyclone nearby the Black Sea.

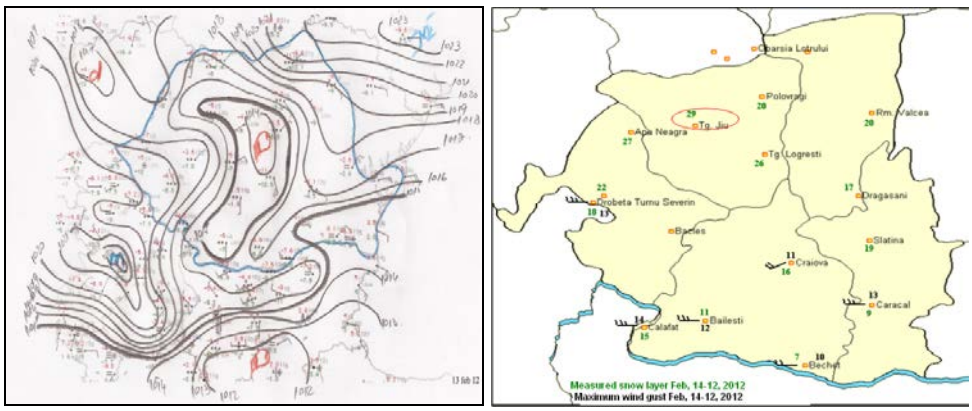


a) *b)*

Fig. 7. 13.02. 2012 18UTC a) WV 6.2 Satellite Image (red PVA, yellow isotachs, at 300hPa) *(www.eumetrain.org)****; b) SLP, 850 hPa Temp., 10 m Wind ALADIN model***

Analyzing the output of numerical model ALADIN (Fig. 7b), can be observed that in southwestern Romania the wind direction was from west (Azores High influence), while in southeastern it was from northeast (East-European High influence). The temperature of 850 hPa level was smaller then -8°C.

From 12th to 14th February 2012 (fig. 9) the weather in Oltenia region was cloudy. Widely it was snowing moderate. The maximum precipitation amount was 39 mm to Apa Neagră weather station.



a) *b)*

Fig. 9. a) Bjerknes Scheme (original map *www.estofex.org* ***) 13.02. 2012, 12 UTC; b) Oltenia-snow layer (green) and maximum wind gust (black) 12-14.02. 2012***

Wind speed had intensification in south and west of the region mainly from western sector, blowing the snow, maximum wind gust being 47 km/h at Calafat weather station.The snow layer measured in these two days was from 7 cm at Bechet up to 29 cm at Tg. Jiu weather station.

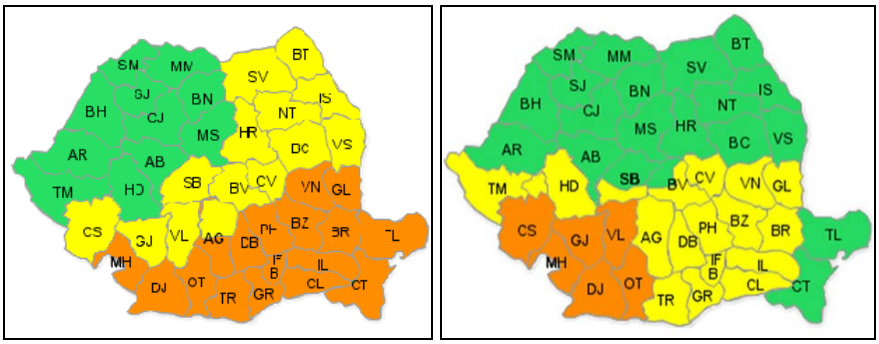
4. CONCLUSIONS

The effects of the first blizzard event (24th -26th January 2012) were more severe in Olt county, where because of wind gust several localities remained without electricity. The road traffic has been hampered all over the region mainly due to heavy and moderate amounts of precipitation. The main characteristics of this blizzard episode are:

- the atmospheric coupling was between ***East-European High and Mediterranean Low***;
- the precipitation amounts were moderate and scattered heavy: the biggest amount recorded was ***90,1 mm*** at Craiova meteorological weather station;
- episode's measured snow layer: ***2 cm - 60 cm***; blizzard duration: 36 hours;
- ***strong*** and ***violent*** blizzard (19 m/s); affected areas: ***south and east*** of the region;
- National Meteorological Administration issued an ORANGE/YELLOW CODE warning (Fig. 10a) for Oltenia region.

After the second blizzard event (12th -14th February 2012) the schools in Mehedinţi, Gorj, Dolj and Olt counties were closed. The main characteristics of this blizzard episode are:

- the atmospheric coupling was between ***Azores High- Mediterranean Low***;
- the precipitation amounts were moderate: the biggest amount recorded was ***39,1 mm*** at Apa Neagra meteorological weather station;
- episode's measured snow layer: ***7cm - 29 cm***; blizzard duration: 24 hours;
- ***moderate*** and ***strong*** blizzard (14 m/s); affected areas: ***southwestern half*** of the region;
- National Meteorological Administration issued first an ORANGE CODE warning (Fig. 10b) for Oltenia region.



a) *b)*

Fig. 10. The warnings issued by National Meteorological Administration for a) 24-26.01. 2012; b)12-14.02.2012

REFERENCES

1. Administraţia Naţională de Meteorologie (2008), *Clima României*, Editura Academiei Române, Bucureşti, pg 339.
2. Drăghici. I. (1988), *Dinamica Atmosferei*, Editura Tehnică.
3. www.eumetrain.org (accessed in 01.22.2014)
4. www.estofex.org (accessed in 11.15.2012 and 01.27.2014)
5. www.weather.uwyo.edu/upperair/sounding (accessed in 01.22.2014)
6. www.mediafax.ro
7. www.realitatea.net
8. www.evenimentdeolt.ro