SYNOPTIC CONDITIONS FOR AVALANCHE CASES IN ROMANIA

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ABSTRACT. – The paper presents the synoptic conditions for triggering avalanches reported in our country, that caused victims or extensive damage to the forest. Thirty-three cases of the most representative avalanches regarding damages and injuries have been selected for the analyse. NCEP reanalysis ground level pressure maps, absolute topography and temperature maps at 500 hPa were used, from http://www.wetter3.de
The aim of that study is to highlight the importance of avalanche monitoring and snow studies in the mountainous areas affected by avalanches, in order to provide a daily estimation of avalanche risk.

Keywords: avalanche, ground pressure, bsolute topography, temperature

1. INTRODUCTION

In order to protect the tourists, since february 2004 the National Meteorological Administration started a program for snow and avalanche monitoring in Bucegi and Făgăraş Mountains.

Using informations from Mountain Rescue Services, papers or articles (www.dinumititeanu.blogopedia.biz), literature (Voiculescu, 2002), and from the National Administration of Meteorology database, we have made a database about the avalanche cases with victims and fatalities, important forest or roads damages.

One of the first mentions about avalanches in the Romanian Carpathians is from april 1704 in the Ceahlău massif; the avalanche stroke the Sihăstria monastery and killed twenty monks (Bălan, 2001). But first studies about avalanches have been made in 1963 and 1964, when more than 150 avalanches occured all over the Carpathians and blocked railways and highways.

The study includes several cases of known avalanche casualty or significant damages (in the forest or blocking roads), the majority after 2002. Synoptic conditions from the days when avalanche happened are presented comparatively. NCEP reanalysis ground level pressure maps, absolute topography and temperature maps at 500 hPa were used, from http://www.wetter3.de.

2. SYNOPTIC CONDITIONS

We have selected 33 cases of the most representative avalanches for the analyse, from the Annual Reports (***, Bilanţul nivologic). Of these, 14 occurred

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in the high pressure conditions (ground pressure above 1020 mb), from wich 2 on more than 1030 mb. The Azores High Ridge acted in 9 of the cases, the East European Anticyclone in one case, and in 5 cases an anticyclone zone formed by the two Highs.

Tabel. 1. ***Avalanche cases, damages and fatalities in the Carpathians***

Nr	DATA	DAMAGES	PLACE
1	1977.04.17	fatalities	Bâlea, Făgăraş
2	2002.12.28	fatalities	Capra, Făgăraş
3	2004.01.20	fatalities	Valea Morarului, Bucegi
4	2004.02.20	fatalities	Gutâi
5	2004.03.01	broken lake	Căldarea Bâlii, , Făgăraş
6	2004.03.03-07	blocked roads	Valea Capra şi Bâlea, Făgăraş
7	2004.04.14	Salvamont refuge	Bâlea, Făgăraş
8	2005.01.26	blocked roads	Capra, Făgăraş
9	2005.03.05	forest damages	Capra, Făgăraş
11	2005.03.05-10	forest damages, injured	Vlăduşca-Piatra Craiului, Cozia
10	2005.03.07	injured, blocked roads	Capra, Făgăraş
12	2005.03.07-08	blocked roads	Paltinu, Făgăraş
13	2005.03.09	fatalities	Capra, Făgăraş
14	2005.03.17	blocked roads	Lipitoarea, , Făgăraş sud
15	2005.03.21-23	forest damages, Coştila refuge	abruptul Prahovean al Bucegilor
16	2005.04.08	blocked roads, forest damages	Valea Argeşului, DN 7C
17	2006.01.29	fatalities	Valea Cerbului, Bucegi
18	2006.02.12-13	forest damages	Valea Urlătoarea Mică, Bucegi
19	2007.03.07	injured	Strunga Dracului, Făgăraş
20	2007.03.08-11	blocked roads	Valea Bâlii, Bucegi
21	2007.03.22-25	forest damages, injured	Valea Bâlii şi Capra - Făgăraş, Bucegi
22	2008.03.08	injured	Valea Bâlii
23	2009.02.21	fatalities	Drumul de vară, Bucegi
24	2009.03.08	fatalities	Vâlcan
25	2010.02.06	fatalities	Munţii Baiului
26	2010.02.08	injured	Făgăraş
27	2010.02.09	injured	Bucegi, între Cota 2000 şi 1400
30	2010.02.20	fatalities	Valea Bâlii
28	2012.02.13	blocked roads	DN6, Drobeta Turnu Severin-Orşova
29	2012.02.13	blocked roads	DN7, Valea Oltului
31	2012.02.16	blocked roads	DN 67D, Valea Cernei - Tismana
32	2012.02.21	blocked roads	DN 18, Vişeu de Jos - Sighetu Marmaţiei
33	2012.02.23	blocked roads	DN 750, Gârda de Sus - Gheţari

In the remaining 19 cases, the pressure at ground level was lowered under 1015 mb, due to the Icelandic Low, with his through extended to southern Europe (6 cases), or due to cyclones formed in the Mediterranean (11 cases) or coming from northern Europe (2 cases).

At the level of 500 hPa, geopotential values ranged from 518 to 570 dmgp. Of these, in 9 cases the values were lower than 532 dmgp, 14 between 532 and 552 dmgp and 10 over 552 dmgp, with the highest value of 570 dmgp.

The most common height structure was the trough associated to the Icelandic Low. In 13 cases we were on the ascendent part of the through (with a the southwestern circulation), in 6 cases on the downlink, and in 5 cases cyclonic nuclei crossed the country. The associated Azores High ridge was present in 7 cases.

The values of the 500 hPa level isotherm were of -20 degrees in 4 cases, between -21 and -25 degrees in 10 cases, -25 to -30 degrees in 14 cases, -31 to -35 degrees in 3, and -40 degrees in 2 cases.

The values of the 850 hPa level isotherm were less than -10 degrees in 4 cases, between -10 and -5 degrees in 11 cases, between -5 and 0 degree in 10 cases, 0 to 5 degrees in 3 cases, 5 to 10 degrees in 2 cases, more than 10 degrees in one case and in two other cases the values ranged within 2-3 days (with important avalanche activity) up or down between -10 to -2 degrees.

Regarding the damages of the 33 studied cases, in 14 cases there were involved tourists, skiers or snowboarders, and of these, 10 were fatalities, with a total of 42 deaths. Massive forest damage occurred after 6 avalanches, of which 4 were of wet snow, that occurred at high temperature (the 850 hPa level temperature was positive, and the one from 500 hPa was high) and one occurred after heavy snowfall in 24 hours (about 1 meter new snow).

In other 10 cases national or local roads were blocked, some of which associated with important forest damages - trees brought by avalanche into the road: DN 67D (Cerna Valley to Tismana) DN6 (Drobeta Turnu Severin - Orşova), DN7 (Olt Valley), DN 7C (Transfăgărăşan), DN18 (Vişeu de Jos - Sighetul Marmaţiei), DN750 (Gârda de Sus and Gheţari).

The studied avalanches occurred between December to April, as follows: 14 in march, 12 in february, 4 in january, 3 in april and 1 in december

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3. PARTICULAR AVALANCHE CASES

3.1. february 13 – 23, 2012

The period between 13 and 23 february 2012 was particularly active in terms of avalanches, registering at least 5 cases in several areas of the country. It is a typical case, when the Icelandic through was active over the country, with a low core and correspondent structure in altitude (fig.1).

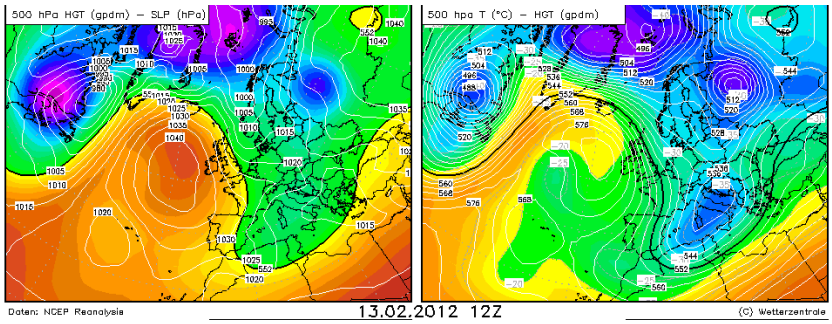

Fig. 1. ***2012.02.13 at 12 UTC – NCEP numerical model - reanalysis.Ground-level pressure (hPa, white lines), absolute topography and temperature at 500hPa***

At the end of this period, the same road blockage happened, this time because of temperature rising. The Azores High ridge was active at the ground, with associated ridge in the altitude (fig.2).

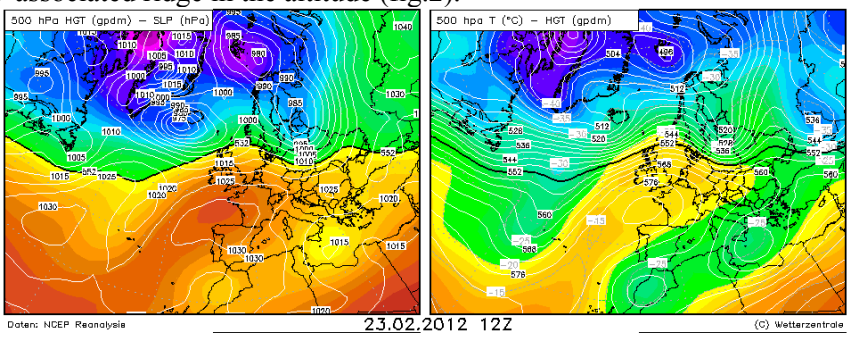

Fig. 2. ***2012.02.23 at 12 UTC – NCEP numerical model - reanalysis.Ground-level pressure (hPa, white lines), absolute topography and temperature at 500hPa***

Fig. 3. ***left: 2012.02.13 - DN6, 15 cars blocked due to an avalanche falling on the road between Drobeta Turnu Severin and Orşova*** (http://www.antena3.ro/romania/o-avalansa-a-blocat-dn6-15-masini-captive-in-zapada-155154.html)
right: 2012.01.23 – DN750 between Gârda de Sus and Gheţari (Alba county) blocked by avalanches (http://www.adevarul.ro/locale/albaăiulia/Drum-blocat-Apuseni-zapadaă0ă632937157.html)

3.2. february 2010

February 2010 had more avalanches casualty, including 2 fatalities. Avalanches occurred in different conditions, from 6 to 9 February in terms of Azores Ridge withdrawal and submission of a Icelandic Low core recharged in the Mediterranean, that followed a transbalcanical path, amid low temperatures (-10 to -8 degrees at 850 hPa) that followed snow episodes, favoring the formation of faceted crystals and plans instability within the snow (fig.4).

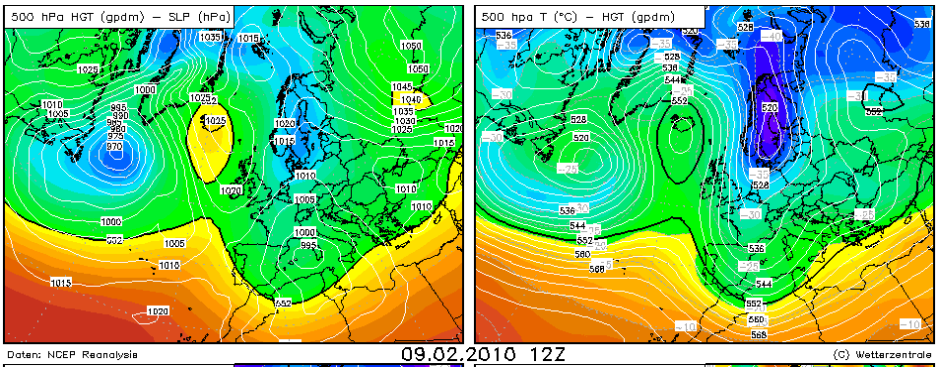

Fig. 4. ***2010.02.09 at 12 UTC – NCEP numerical model - reanalysis.Ground-level pressure (hPa, white lines), absolute topography and temperature at 500hPa***

Fig. 5. ***left: the victime from Baiului Mountains; right: avalanches triggered in the wood***

At the end of the month, a avalanche happened because of warming weather (positive temperatures during the day, up to +3.3 degrees on February 19th at Bâlea-Lac). On the ground acted also a low trough, but on altitude the entering of a warm ridge can be observed, both at 500 hPa, and especially at 850 hPa, where the temperature raised to +10 degrees (fig.6).

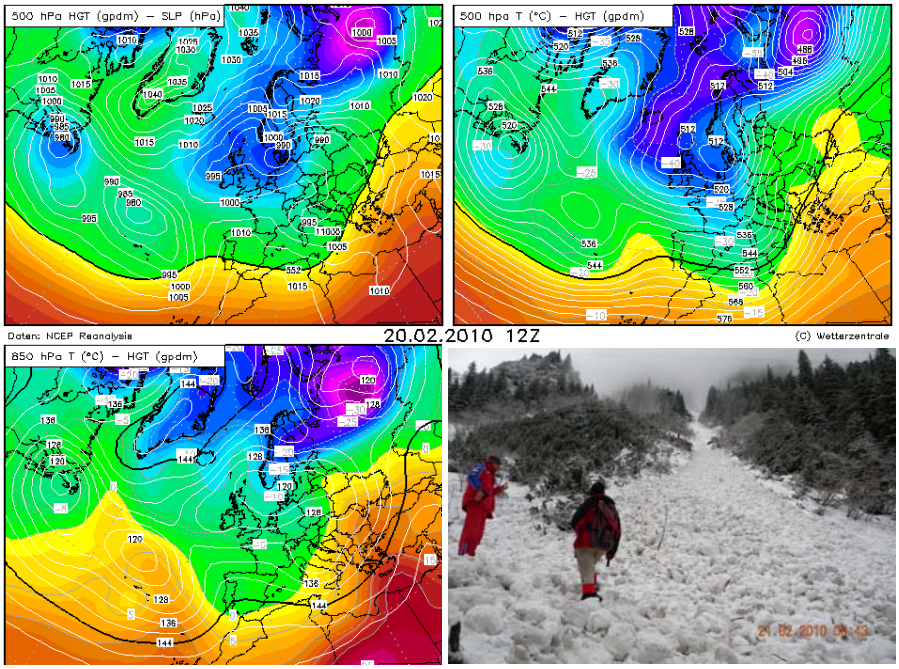

Fig. 6. ***2010.02.20 at 12 UTC – NCEP numerical model - reanalysis.Ground-level pressure (hPa, white lines), absolute topography and temperature at 500 and 850 hPa right down: Bâlea Valley, prone to the waterfall, mountain rescuers searching the victim***

3.3. march 2005

The month of March 2005 was characterized by an intense avalanche activity, culminating in a fatal accident, of a mountain rescuer from Argeş (9th of March). Accumulated snow had considerable thicknesses in the Făgăraş Mountains, and falled down from the slopes in the form of slab avalanche at the beginning of month and of melting avalanches since mid. Between March 5 to 8, several avalanches occures in the Făgăraş and Piatra Craiului Mountains, both on the northern and southern slopes. Between 21 and 23 March, there have been 20 avalanches in the Prahova steep of Bucegi Mountains, producing important damages to the forest and to the Coştila refuge (Source of information: Asociaţia Amicii Bucegilor) (fig.7).

Fig. 7. ***left: Făgăraş Mt: 17.03.2005 melting avalanche in Lipitoarea Valley (2,5 km length Transfăgărăşan road blocked on the permanent open area risk 4); Right: 09.03.2005 – avalanche in Capra Valley, with 1 dead victim (photos by Argeş Mountain Rescue Team)***

If on early march, the Icelandic through could be identified at the ground, having a correspondent in altitude, after 15 March the pressure was high, due to the Azores High or the waist Ridge formed with the East-European High. On the lower troposphere the associated anticyclonic Azores ridge (from 15 to 18 and after 22 March), succeded the Icelandic through (March 18 to 22) (fig.7,8).

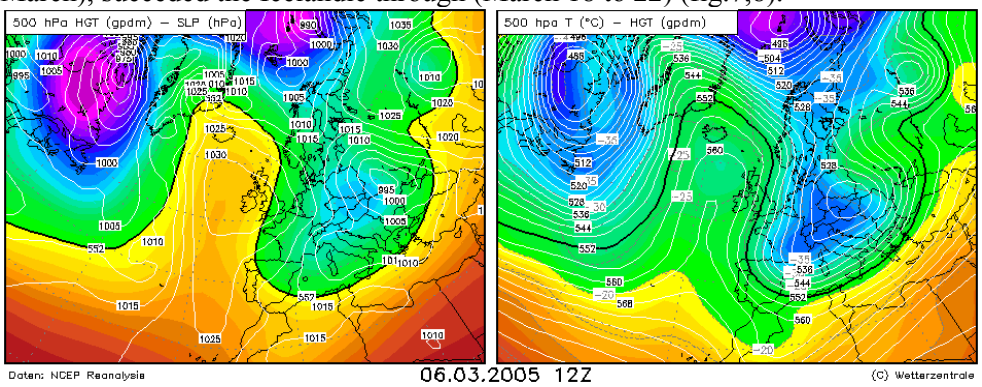

Fig. 7. ***2005.03.06 at 12 UTC – NCEP numerical model - reanalysis.Ground-level pressure (hPa, white lines), absolute topography and temperature at 500hPa***

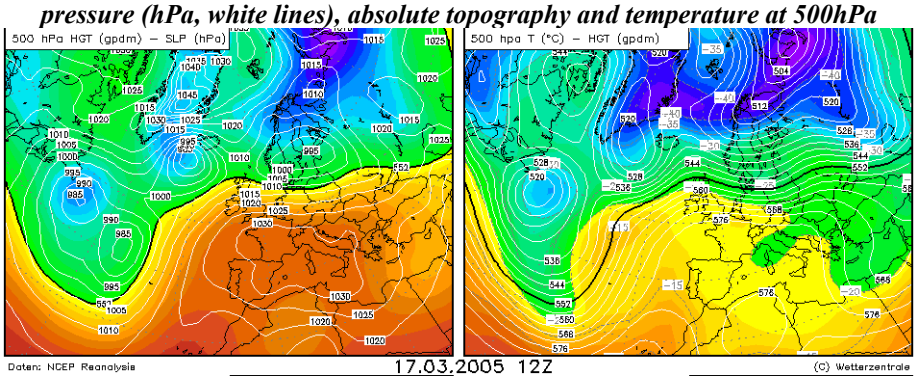

Fig. 8. ***2005.03.17 at 12 UTC – NCEP numerical model - reanalysis.Ground-level pressure (hPa, white lines), absolute topography and temperature at 500hPa***

Deadly avalanche of 9 March 2005 was caused by a bottom slab, due to the disruption of a lower layer composed by faceted crystals (fig.7). There was a deceased victim, Alin Tavă, member of Argeş Mountain Rescue team.

5. CONCLUSIONS

Avalanches are one of the most powerfull and distructive extreme events, causing economic injuries, as well as victims or fatalities.

The presented cases show that avalanches occur under different synoptic conditions and during the whole winter. They are not only under the direct influence of heavy snowfall or increasing temperatures, but also depend on snow crystals transformations within the layer, especially on the formation of faceted, unstable crystals inside.

Because the number of winter hikers and skiers are increasing every year, in order to avoid any human life loss, but also to prevent massive accidents with significant economic damage, permanent snow and avalanche measurements are needed, especially in areas with high tourist potential. Therefore, the daily snow and avalanche bulletin provided by the National Administration of Meteorology is a useful tool for everyone, from skiers to local authorities and Mountain Rescuers.

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