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# THE CAUSES AND ENVIRONMENTAL CONSEQUENCES OF THE DANGEROUS METEOROLOGICAL PHENOMENA WHICH OCCURRED IN THE INTERVAL 18TH-20TH MAY 2008, IN THE WESTERN ROMANIAN PLAIN

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**Key words**: dangerous meteorological phenomenon, thunderstorm, hail, shower, squall, effect.

**Abstract.** This paper provides a case study of the dangerous meteorological phenomena which took place in the interval 18 - 20 May 2008, in the Western part of Romania. During this period, the Southern and South-Eastern regions of Europe entered the influence of a very hot air mass of tropical origin. By contrast, a cold, humid and unstable air mass pressed on from the North-West of Europe, carried along by the dorsal of the Greenland Anticyclone. Upon the contact of these two air masses characterised by significant thermobaric differences, in the unstable conditions created, a number of dangerous meteorological phenomena took place, manifested in the West of the country in the form of intense lightning, torrential showers, hail and squall. The effects of these dangerous phenomena were numerous: hundreds of hectares of crops compromised; houses, bridges and roads destroyed by floods, hail and wind; trees brought down by squall; localities suffered shortages in electricity or drinking water; buildings caught fire; livestock and domestic animals perished etc. In the following days the dangerous meteorological phenomena caused massive destruction almost everywhere else in the country.

## Introduction

Thunderstorms, hailstorms, torrential showers and squalls are dangerous meteorological phenomena that are either generated by Cumulonimbus clouds with ample vertical extension or associated with them. They are characteristic for the warmer half of the year and are considered to be meteo-climatic hazards, since they can cause damage to property and even casualties in a short time. In addition, these phenomena can have negative consequences on the environment, by destroying the leaves of plants, breaking the branches of trees, setting the vegetation on fire,

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eroding the soil, increasing the liquid and solid flow of waters (which later contributes to eroding riverbeds and flooding), etc.

In the western part of Romania, the dangerous meteorological phenomena are generally caused by the great thermal differences (10-20°C) between the air masses covering the country and the colder and more humid ones replacing them, which lead to significant instability (Bălescu, Militaru, 1967). Due to the fact that the humid air masses of Atlantic origin (i.e. maritime polar air) can more easily penetrate the western part of the country, such phenomena are more frequent in this region than elsewhere.

## 1. Data and methods

The present study relies on meteorological data regarding air temperature, atmospheric precipitation, air pressure and wind speed within the interval comprised between 18 and 22 May 2008, as provided by the weather stations in the western part of the country and taken from the archives of the National Administration of Meteorology (N.A.M.).

The methods used consisted in analysing and interpreting synoptic maps, satellite images and radar maps, taken from the websites of specialised institutions (The Meteorological Centre of Karlsruhe, N.A.M., Eumetsat) and later used for characterising the synoptic situations that contributed to the occurrence of many dangerous meteorological phenomena. Furthermore, the methodology relied on the statistical processing of the hourly meteorological data within the aforementioned interval, on assessing weather forecasts issued over the period at national and European scale, as well as on sourcing information from the media regarding the socio-economic and environmental effects of the dangerous meteorological phenomena.

## 2. Results and discussions

***Synoptic situation.*** Within the interval 18-19 May 2008, the synoptic situation in Europe was characterised by the following: a very hot air mass, originating from North Africa moved toward Southern Europe, later settling in the South-East of the continent and making its way to Romania as well. Between 19 and 20 May, this tropical air mass was stationary over the south-eastern parts of Europe and then it moved eastward. By contrast, a cold, humid and unstable air mass pressed on from North-Western Europe, carried along by the dorsal of the Greenland Anticyclone. The pressure in the centre of the anticyclone was very high, of 1038 hPa (fig. 1-2), while in the western part of Romania it reached a meagre 1008-1010 hPa.

The thermal differences between the two air masses exceeded 10°C (fig. 3), and the isotherms were very close, facilitating the occurrence of extreme weather

phenomena. As a result, upon the contact of the two air masses with great thermobaric differences, in the subsequent increased instability, some dangerous meteorological phenomena took place, including torrential showers, intense lighting, hail and an increase in wind force, which led to squalls. Over the following days, the occurrence of these phenomena was further facilitated by the evolution, along the Eastern ridge of the Greenland Anticyclone, of cyclones originating from the Barents Sea region. Thus, there was a continuous afflux of humidity toward the eastern and south-eastern parts of Europe.

For 18 May 2008, the forecast of N.A.M. in Bucharest predicted warm weather in the entire country, with maximum temperatures between 21-29°C (25°C in Oradea, 26°C in Arad and 27°C in Timişoara), as well as increased nebulosity, thunderstorm, conditions for hail formation, showers, intensified wind speeds and precipitation that were to reach 25 l/m$^2$ in isolated areas. For 19 May, the same dangerous phenomena were predicted, with very hot weather in the entire country, maximum temperatures between 28-29°C in the western part of the country (28°C in Arad, 29°C in Timişoara and Oradea), and local precipitation exceeding 20 l/m$^2$, expected to fall in the second part of the day and during the night.

Between 9:00 AM, 18 May 2008 – 6:00 AM, 19 May 2008, competent authorities issued 12 code yellow warnings regarding imminent dangerous meteorological phenomena, as follows: Oradea – 2 radar warnings, Timişoara Regional Service for Weather Forecast (RSWF) – 2 warnings, Cluj RSWF – 3 warnings, Craiova RSWF – 1 warning, Sibiu RSWF – 1 warning and Bacău RSWF – 3 warnings (fig. 4). Within the next interval, 9:00 AM, 19 May 2008 – 6:00 AM, 20 May 2008, 8 code yellow warnings were issued regarding imminent dangerous meteorological phenomena, as follows: Oradea Radar Observatory – 3 warnings, Cluj RSWF – 3 warnings and Timişoara RSWF – 2 warnings (fig. 5). Between 9:00 AM, 20 May and 6:00 AM, 21 May, 11 code yellow warnings about imminent dangerous phenomena were issued: 3 by the Oradea Radar Observatory, 4 by Timişoara RSWF and 4 by Cluj RSWF (according to N.A.M.).

Between 18–20 May, the meteorological situation was characterised by the following (according to N.A.M.):

♦ On Sunday, 18 May, the weather was warm in most of the country. The sky was temporarily cloudy in the afternoon and during the first part of the night in the West, North and centre of the country, as well as in the mountains. Showers were observed (frequently accompanied by lightning) in Crişana, Maramureş, relatively large areas of Banat, locally in Transylvania and in the mountains, as well as over small areas of Moldavia and Oltenia. The rainfalls had a torrential character, reaching 72 l/m$^2$ in Banat (Băile Herculane), and 42 l/m$^2$ in the mountains (Parâng). In the West of the country, in the counties of Arad, Timiş and Caraş-Severin (but also in other counties) hail was recorded. The wind force was

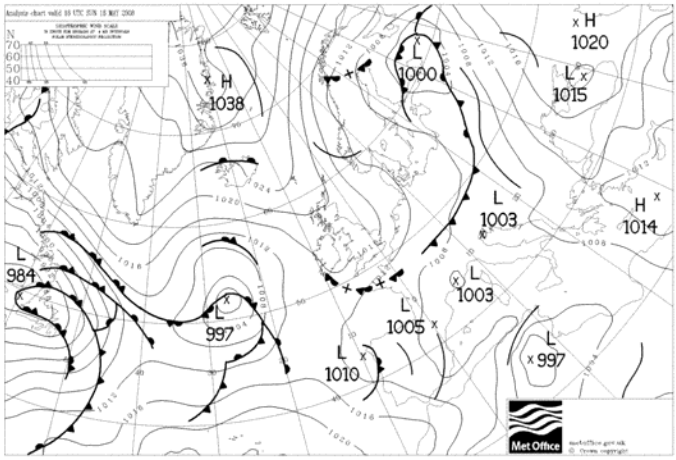


Fig. 1 - The field of atmospheric pressure above Europe at ground level, on 18 May 2008, 18:00 hrs. UTC (according to www.wetterzentrale.de).

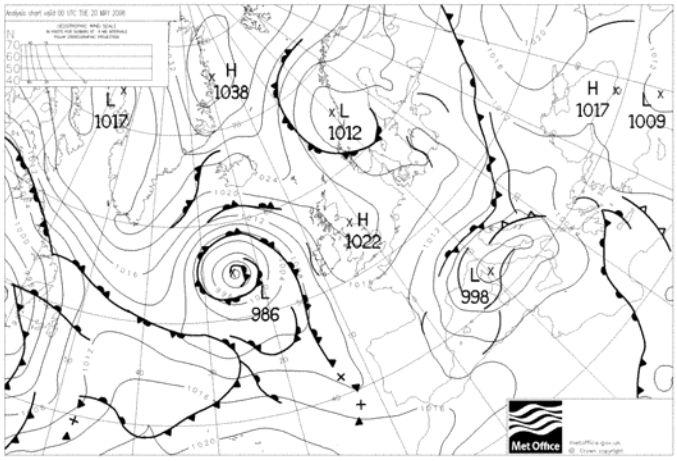


Fig. 2 - The field of atmospheric pressure above Europe at ground level, on 20 May 2008, 00:00 hrs. UTC (according to www.wetterzentrale.de).

light to moderate, becoming more intense during the rains, reaching the level of a squall in Baia Mare and 14 m/s in Oradea (at 10:00 PM). The maximum

temperature peaked at 31°C in the West of the country (Chişineu-Criş, Jimbolia, Lugoj, Deva), but also at some stations in the South of Romania.

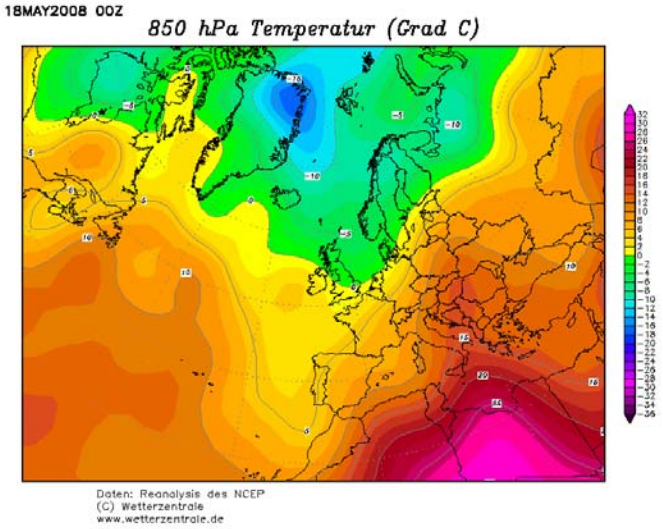


Fig. 3 - The distribution of air temperature over Europe at the 850 hPa isobaric surface, on 18 May 2008, 00:00 hrs. UTC (according to www.wetterzentrale.de).

♦ On Monday, 19 May, the weather continued to be warm in most of the country. In the western and north-western regions of Romania, atmospheric instability prevailed in the evening and during the night. Frequent lightning and showers were recorded in Crişana, Maramureş, North-Western Transylvania and locally in Banat, as well as on an entirely isolated scale in other parts of the country. Torrential rainfalls amounted to 43 l/m$^2$ at Chişineu-Criş and 32 l/m$^2$ at Banloc. Hail was observed in small areas of Arad County. The wind force was light to moderate and became more intense during showers in the southern part of Banat (but also in other regions of the country). The maximum temperature reached 31°C (a value recorded at some stations in the South of the country).

On the evening of 19 May (21:00 hrs.), air temperature in the Western Plain was comprised between 11.6°C at Chişineu-Criş and 23.0°C at Săcueni, the warmest area being that of the Someş Plain. Here, a temperature of 22-23°C was recorded, as opposed to 17-21°C in the Banat-Crişana Plain (and 11.6°C at Chişineu-Criş). The wind speed exceeded 2-4 m/s over the entire plain area, reaching higher levels at Oradea (6 m/s) and Holod (5 m/s). Atmospheric pressure was comprised between 991-995 hPa.

♦ On Tuesday, 20 May, the weather was warm. In the West and North-West of the country atmospheric instability became more severe in the evening and during the night, as had been the case the day before. Frequent lightning and


Fig. 4 - The radar map of Romania, 18 May 2008, at 21:30 hrs. (according to N.A.M.).

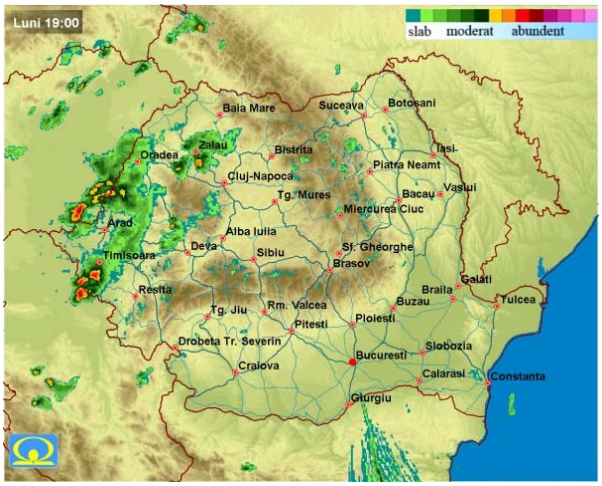


Fig. 5 - The radar map of Romania, 19 May 2008, at 19:00 hrs. (according to N.A.M.).

showers were recorded in Maramureş, Crişana, Banat, as well as the West and North of Transylvania. Torrential rainfalls were also the case, reaching levels of 42.5 l/m$^2$ at Nuşfalău (Sălaj County), 20 l/m$^2$ at Sălard (Bihor County) or 17 l/m$^2$ at Banloc (Timiş County). Hail was recorded in isolated areas of Bihor, Sălaj and Maramureş counties. The wind force was weak toward moderate, being more intense during the showers. Air temperature reached a maximum of 31°C, in the South of the country.

This instability continued over the following days, being less pronounced in the West of the country and more prominent in the other regions. Thus, on the 21$^{st}$ of May, hail was observed in isolated areas of Bihor County. Starting with the 22 May, the weather became colder (the maximum temperatures being between 15°C at Şiria and 29°C at Slobozia). At Petriş (Arad County) the precipitation level was 43 l/m$^2$. The highest amount of precipitation on that day was 95 l/m$^2$, recorded at Petreni (Hunedoara County). On 23 May, the dangerous meteorological phenomena continued in most regions of the country, also manifesting themselves in isolated areas of Crişana (according to N.A.M.).

With respect to the ***effects*** of these, we should note that they were significant. Thus, on the evening of ***18 May,*** thunderstorms were numerous and violent in Oradea. In consequence, around 21:30 – 22:00 hrs, television broadcasts were interrupted due to power failures. Lightning and wind caused 10,500 RON fire damage to two buildings, destroying roofs, electrical equipment, windows and doors. In the city centre, the wind toppled the Red Cross tent into the Crişul Repede River (firemen were forced to use their hooks to retrieve it from the water). The same evening, the fire department was mobilised on the national roads DN 19 and DN 79 (at Hidişelul de Jos), as well as on the European road E 771 (at Valea lui Mihai), in order to remove the trees felled by the wind which were blocking the traffic (fig. 6). Fortunately, there were no casualties (sources: *Jurnal bihorean,* 20 May 2008; www.contrastonline.ro/stiri). In addition, due to lightning, 13 localities in Arad County were left without electricity on that evening. At Rădeşti (Gurahonţ), a haystack was struck by lightning and caught fire (source: *Observator Arădean*, Arad Online, www.stirilocale.ro/arad).

On the evening of ***19 May*** and during the night between the ***19$^{th}$ and 20$^{th}$ May,*** in Arad County hundreds of hectares of crops were destroyed as a result of the extremely violent storm, affecting most severely Sintea Mare and Adea, where hail caused irreversible damage to over 100 hectares of wheat crops. In these two localities, private gardens were flooded and the wind destroyed the roofs of over 50 houses. In the commune of Macea a few hundred hectares of watermelon and wheat were also affected by hail. According to eyewitness testimony, here, hailstones were as big as pigeon's eggs and formed a layer over 10 cm thick (fig. 7-8). Several localities in the county, as well as two districts in the city of Arad

suffered electrical power failures. In the commune of Cermei, a tree in front of a house was struck by lightning (sources: *NewsIn*, www.stirilocale.ro/arad/ziare; *Evenimentul zilei*, www.evz.ro; *Antena 1* News, www.antena1.ro).

Fig. 6 - Felled trees in Bihor County after the squall of 18 May 2008 (source: http://www.contrastonline.ro).

Fig. 7 - The quantity of hail recorded inArad County on 19 May 2008 (photo: Alex Negru).

Fig. 8 - The quantity of hail recorded in Arad County on 19 May 2008 (source: http://www.evz.ro).

Fig. 9 - The consequences of the flash-flood of 19-20 May 2008 in Cluj County (source: Mediafax Foto).

During the same night, the effects of the dangerous meteorological phenomena were observed in other parts of the country too. Thus, in Sălaj County, near Şimleul Silvaniei, the hailstorm that lasted approximately 2 minutes caused severe damage to the crops. The strong wind broke power lines, leaving 6 localities in the county in total darkness. In Bistriţa-Năsăud County, 3 stables in Mintiu were burned down, after they had been hit by lightning. Hundreds of houses were left without electricity due to the strong wind (sources: *Antena 1* News, www.antena1.ro; *Evenimentul zilei*, www.evz.ro).

However, it was in Cluj County that the greatest damages were signalled during that night (fig. 9). Here, approximately 210 houses in 6 localities were flooded as a result of a powerful flash-flood around 1 AM in the Sălătruc Valley. The most affected places were Căşeiu, Chiuieşti and Coplean. About 15 kilometres of county and communal roads as well as two bridges were destroyed. The DN 1 national road was blocked for a few hours. In Căşeiu three houses were completely destroyed by the flash-flood and 100 households were isolated because of a fallen bridge. In household yards, water reached a level of 1 m. As a result, many people were isolated and could be rescued only with the help of firemen, the military and the police. Over 1,300 persons were affected by the flash-flood, 420 hectares of crops were inundated, some 2100 animals perished and 75 wells were clogged with mud (sources: *NewsIn*, www.stirilocale.ro/cluj; *Evenimentul zilei*, www.evz.ro; *Antena 1* News, www.antena1.ro; *ProTV* News, www.protv.ro/stiri; *MediaFax*, www.astazi.ro; www.clujeanul.ro; *Adevărul*, www.adevărul.ro).

In many parts of the country, the effects of the dangerous meteorological phenomena were felt over the following days, too (21-24 May). The counties were floods were recorded, causing damage to property, were: Bihor, Arad, Hunedoara, Alba, Cluj, Maramureş, Bistriţa-Năsăud, Suceava, Botoşani, Neamţ, Vrancea, Dâmboviţa.

In Bihor County, over 20 households in a number of localities were flooded in the wake of storms and rains from 22–23 May 2008. In Arad County, during the night of 23–24 May, due to the abundant rains that had fallen over the previous days, flash-floods occurred, affecting over 500 hectares of farmland, 80 hectares of hay, over 3 kilometres of roadway, some 14 households, 10 wells and 2 footbridges (source: *Adevărul*, www.astazi.ro).

**Conclusions**

This case study reveals that intense meteorological phenomena associated with Cumulonimbus clouds, or generated by them – *thunderstorms, hail, showers, squalls* – may cause significant damage to communities. In consequence, it is imperative to monitor these meteorological hazards continuously, including those occurring in the western part of Romania, where the more unstable air masses can easily penetrate. They are almost imperceptibly affected while crossing the territory of the Pannonian Plain, due to the lack of orographic obstacles, but the phenomena associated with them grow in intensity upon the contact with the higher elevations of the Western Carpathians.

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