

SPECIFIC SYNOPTIC CONTEXT PRODUCING EXTREME MINIMUM AIR-TEMPERATURES IN ROMANIA. CASE STUDY: 13-14 JANUARY 1985

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Contextes synoptiques caractéristiques pour la production de températures minimales extrêmes sur le territoire de la Roumanie. Étude de cas : 13-14 janvier 1985

Mots-clés : températures minimales de l'air extrêmes, contextes synoptiques, inversions de température, Roumanie

Keywords: extreme minimum air-temperatures, synoptic contexts, temperature inversions, Romania

Introduction

The minimum air-temperatures often go to extremes in Romania (Busuioc *et al.*, 2015; Ilea, Ionac, 2022), thus having a great variability in time and space, accounting for the importance of their analysis (Bartholy and Pongrácz, 2007). The purpose of this study was not only to identify the synoptic context in which the lowest daily minimum air-temperatures were registered at most of the weather stations in Romania, in the 1980-2015 period, but also to show that topography may play an important role in their occurrence, especially by creating favorable conditions for air-temperature inversions. As most minimum air-temperatures extremes usually occur on the bottom of intra-mountainous depressions, during the cold season in Romania, their study may be useful in forecasting and mitigating potential climatic hazards and economic losses related to specific air-circulation patterns and local relief forms.

1. Data and methods

In order to relevantly outline the most extreme minimum air-temperature values recorded in Romania, 43 weather stations operated by the National Meteorological Administration (NMA) were taken into consideration. The period of reference is 1980-2015 and includes homogeneous data series for daily minimum air-temperatures.

A distinct synoptic situation (case study) was analyzed for 13-14 January 1985, a period in which extreme minimum air-temperatures were recorded at very many weather stations out of the 43 selected, at the same time. In this respect, maps of temperature and atmospheric pressure distribution at ground level (2 m), as well as maps of temperature and geopotential at different heights in the troposphere (850 hPa and 500 hPa), extracted from the GFS global area model archive, were mainly used (https://wetter3.de/archiv_gfs_dt.html), alongside with the distribution map of snow depth on Romania's territory, from the ECMWF global model archives (<https://meteologix.com/ro/reanalysis/ecmwf-era5/romania/snow-depth/19850113-0600z.html>).

In order to highlight the presence of an air-temperature inversion over some intra-mountainous depressions in the country, comparative analyses were carried out between two-paired neighboring weather stations (one being located in the high mountain area and the other one, on the bottom of the depression), not only to confirm the temperature inversions, but also to demonstrate that, in certain synoptic contexts and depending on local conditions, lower minimum air temperature values usually occur in depression areas and not on mountain tops.

2. Results

Among the 43 extreme minimum air temperature values recorded in January 1985, most of them occurred between 13 and 14 January (18 values, representing 41.9%) (Figure 1). Most of the respective temperatures occurred in lowland areas: Eastern Transylvanian depressions, on Siret and Mureș river valleys (at Bacău and Deva) and in plain areas, especially in the Bărăgan steppe plain (Eastern part of Muntenia).

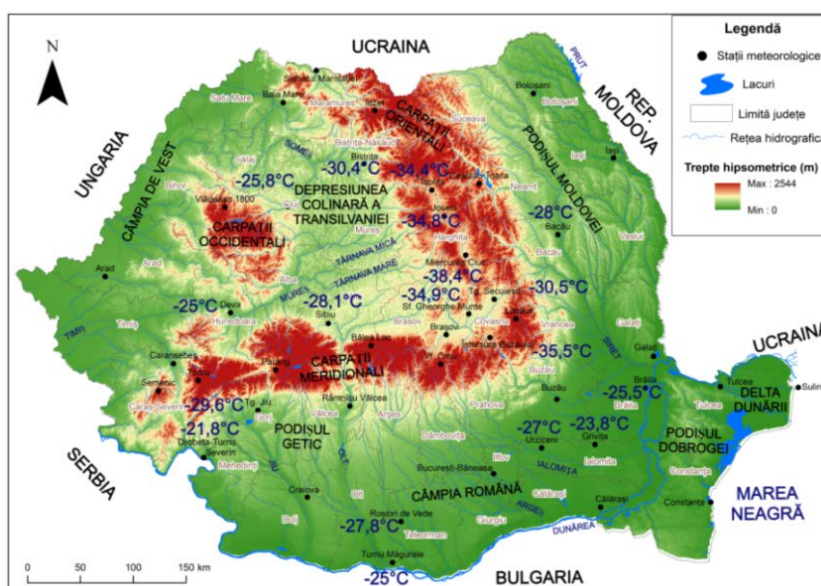


Figure 1. The absolute minimum air-temperatures recorded at 18 weather stations in Romania (13-14 January 1985)

The influence, over the entire country, of an anticyclone accounted for strong atmospheric stability and air-temperature inversions leading to the intense radiative cooling over the night between 13 and 14 January 1985. At the level of 500 hPa, a very cold air mass was lying over the Romanian territory, which has imprinted its characteristics on the largest part of the European continent. Thus, the high-altitude cold advection coupled with the high pressure ridge on the ground level produced extremely low minimum air-temperatures in Romania.

Significant air-temperature differences were noted between Întorsura Buzăului and Lacăuți weather stations (14.5°C), respectively between Toplița and Ceahlău-Toaca weather stations (11.4°C), mainly because of an intense temperature inversion occurring on the morning of 13th of January 1985 in the Eastern and South-Eastern parts of Transylvania (Table 1).

Table 1. Minimum air-temperatures (°C) recorded on 13th of January 1985 at seven pairs of weather stations and the air-temperature inversion highlighted (shade of yellow)

Id	Depression	Altitude (m)	Tmin (°C)	Mountain area	Altitude (m)	Tmin (°C)	Differences (°C)
1	Sighetu Marmatei	275	-21.2	Iezer	1785	-24	2.8
2	Toplița	687	-34.4	Ceahlău-Toaca	1897	-23	-11.4
3	Întorsura Buzăului	707	-35.5	Lacăuți	1776	-21	-14.5
4	Brașov-Ghimbav	534	-31.8	Vf. Omu	2504	-27.8	-4
5	Sibiu	443	-28.1	Bălea-Lac	2070	-24.8	-3.3
6	Caransebeș	241	-20.9	Semenic	1432	-21.5	0.6
7	Cluj-Napoca	410	-25.8	Vlădeasa-1800 m	1836	-19.8	-6

Conclusion

The most frequent synoptic context for producing extreme minimum air-temperatures in Romania is given by the presence of an anticyclone at ground level, combined with a very cold air-mass throughout the entire troposphere, which determines strong atmospheric stability and intense radiative cooling during the night, thus creating favorable conditions for air-temperature inversions, especially in the intra-mountainous depressions of the Eastern Carpathians.

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