"Extreme Weather Phenomena" bulletin verification

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Abstract

This paper aims to verify the "Extreme Weather Phenomena" bulletin issued by the Hellenic National Meteorological Service (HNMS) on the 7th of January 2013, concerning heavy snowfall and low temperatures that were expected to occur on the following two days.

All relevant data were collected in order to assess any differences with regards to the content of the bulletin. Each region was then compared to the METEOALARM thresholds and the corresponding colour was used in order then to be categorized.

The comparison results were further analyzed according to the study "Verification Method of Meteorological Bulletins" carried out by HNMS on September 1995; which is used by the National Meteorological Centre to verify the forecasting bulletins issued.

Finally the conclusions referring to each day of the episode for both meteorological elements are presented.

Introduction

The HNMS's National Meteorological Center (NMC) issues specific "Extreme Weather Phenomena" bulletins when hazardous weather conditions are expected to occur or sudden change in weather is forecast.

The network of public European weather services have developed an alert system called METEOALARM which uses a colour scale to indicate the degree of danger of weather phenomena, as follows:

The Bulletin

On 7/1/2013 the following 'Extreme Weather Phenomena' bulletin was issued:

«The weather will gradually change in the country. The main characteristics will be the heavy snowfalls, even in lowland areas, mostly in the north and east of the country, and the significant temperature fall. More specifically:

1. For Monday the 7/1/2013, snowfalls are forecast in the afternoon in Macedonia (mainly in the eastern part), Thrace, and the islands of northern and eastern Aegean Sea as well as in the eastern Thessaly (Magnesia). As of that evening and during Tuesday the 8/1/2013 snowfalls, potentially severe, are expected to occur in the eastern mainland (including Attica), Evia and Sporades, and in mountainous and hilly areas of eastern Peloponnese, Cyclades and Crete.

2. The temperature will reach low levels with severe frost on Tuesday and Wednesday, particularly in Northern Greece where temperatures will remain below zero by day in places».

Data and Methodology

On 7th and 8th January 2013 heavy snowfalls did occur in Eastern Greece and extremely low temperatures were recorded all over the country and especially in Northern Greece.

All available sources - i.e. the network of HNMS stations, the amateur meteorologists' station network

No particular awareness is required.	**The weather is potentially dangerous. The weather phenomena forecast are not unusual.**	**The weather is dangerous. Unusual meteorological phenomena have been forecast.**	**The weather is very dangerous. Exceptionally severe meteorological phenomena have been forecast.**

Meteoalarm's colour scale.

and the press - were used in order to collect the information needed for the bulletin verification. Data gathered from HNMS meteorological stations gave maximum and minimum surface temperatures values. Precipitation data were gathered by amateurs' meteorological stations and the media, as snowfall height cannot be recorded in the HNMS's stations.

These data, depicting the real weather conditions, were then categorized using Meteoalarm's colour scale and thresholds for Greece which are shown in the following table:

The methodology for temperature scoring is similar to the previous one and the criterion used in this case is

Extreme Low Temperature	North Greece-Epirus-Thessalia	$T_{min} > -5$ °C	-5 °C ≥ $T_{min} > -8$ °C	-8 °C ≥ $T_{min} > -15$ °C	$T_{min} \leq -15$ °C
	North Greece-Epirus-Thessalia	$T_{min} > -1$ °C	-5 °C ≥ $T_{min} > -4$ °C	-8 °C ≥ $T_{min} > -8$ °C	$T_{min} \leq -8$ °C
	North Greece-Epirus-Thessalia	$T_{min} > 0$ °C	-5 °C ≥ $T_{min} > -2$ °C	-8 °C ≥ $T_{min} > -5$ °C	$T_{min} \leq -5$ °C
Snow		No Snow Cover	rural areas: height≤ 5cm urban areas: height≤ 2cm	rural areas: 5cm<height≤25cm urban areas: 2cm<height≤10cm	rural areas: height>25cm urban areas: height>10cIt is noted that temperature thresholds vary from region to region while the same does not stand for the snow case.

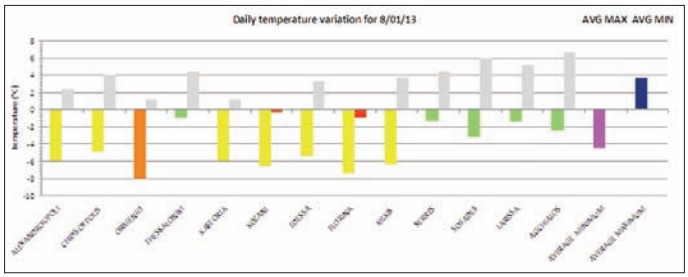
In order for the categorization to be effected, data collected were compared to the forecast ones. Furthermore, according to the methodology used by NMC to verify the forecasts, a certain score in percentage is appointed to each forecast depicting the degree of success each one of them has. More specifically, in case of the snow forecast the score should be 100% when it did snow. It is actually an on/off criterion. When sleet or a snow/rain mix occurs the score is also 100%, while in case of other precipitation phenomena the score is 50%. In case of no precipitation the score is 20% as data collected in meteorological stations refer only to a specific region and there is always the possibility of phenomena occurred in the vicinity of the station. The above is given in the following Table.m

Meteoalarm's thresholds concerning snow and extreme low temperatures in Greece.

FORECASTS	FORECASTS	SCORE (%)
SNOW	SNOW	100
		50
		20

Scale	Difference in degrees between real time – prognostics forecast values	Score (%)
1	T≤3	100
2	1<T≤3	80
3	3<T≤5	50
4	5≤T	10

▶ *Diagram 1: Temperature extremes in Thrace, Macedonia and Thessaly on 08/01/13, (green, yellow, orange and red colors according to the Meteoalarm color scale).*



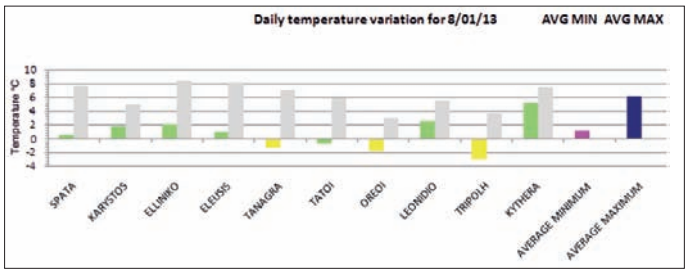
the difference (in degrees Celsius) between the real time data and the forecast values. When the difference is less or equal to one degree, the score is 100%. When the difference lies between one and three degrees is 80% while when it lies between three and five degrees is 50%. In case of more than five degrees the score given is 10%.

Analysis

a. Precipitation phenomena

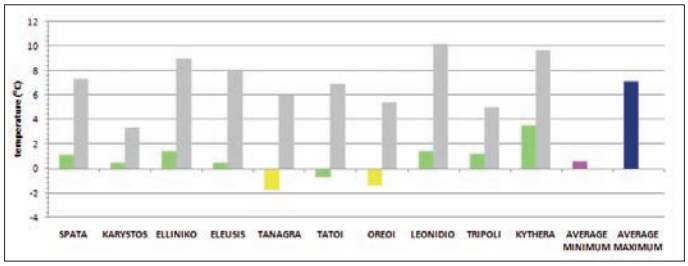
On the 7th January of 2013 snowfall and sleet were observed only in East Macedonia and in eastern and northern Aegean Sea islands. In the rest of Macedonia, as well as in Thrace and Thessaly no precipitation phenomena were observed. The above are shown in the following map in which the Meteoalarm colour scale and thresholds are used.

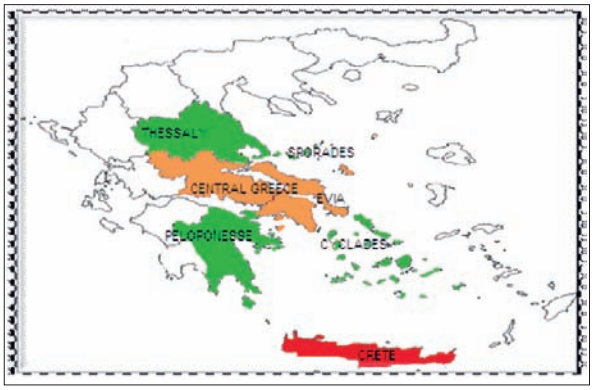
On the 8th January of 2013, snowfall was observed in Attica, Skyros and in the mountainous and hilly areas of Crete and Evia. It should be mentioned that on the 9th of January 2013, sleet was observed in Karystos (Evia).



▲ *Diagram 2: temperature extremes in Eastern, Central Greece and Peloponnese on 08/01/13 (green and yellow colours according to the Meteoalarm colour scale).*

▼ *Diagram 3: temperature extremes in Eastern, Central Greece and Peloponnese on 09/01/13 (green and yellow colours according to the Meteoalarm colour scale).*





A. Temperature

1) Northern Greece and Thessaly

On 8th January 2013, low temperatures were recorded in northern Greece and eastern Thessaly, and maximum temperatures below zero were observed in Kozani and Florina stations.

2) Central Greece and Peloponnese

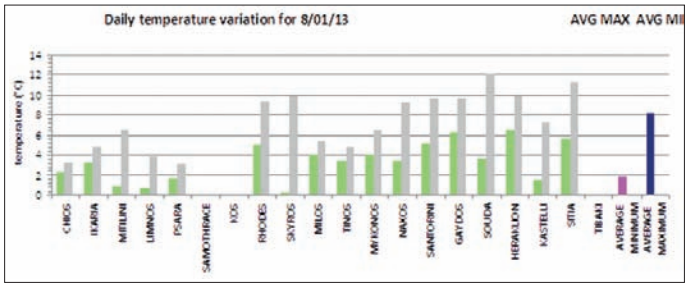
Frost was observed in Tanagra, Tatoi ,Oreoi and Tripoli stations on 8th January 2013 and in Tanagra, Oreoi ant Tatoi on 9th January 2013 .

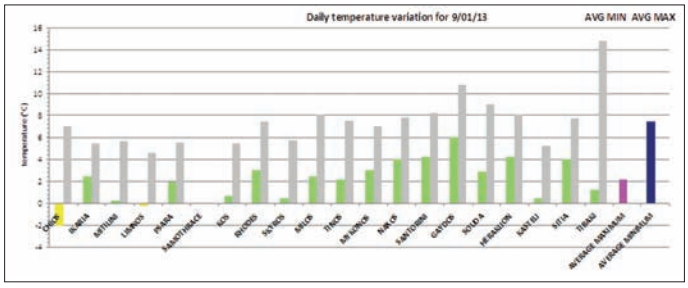
3) Islands

On 8th January 2013, no low temperature extremes were recorded but on the next day frost was observed in the islands of northeastern Aegean Sea (Chios and Lemnos stations.

◀ *Map 1 (at the top): Precipitation (orange) and no precipitation (green) on 07/01/13.*

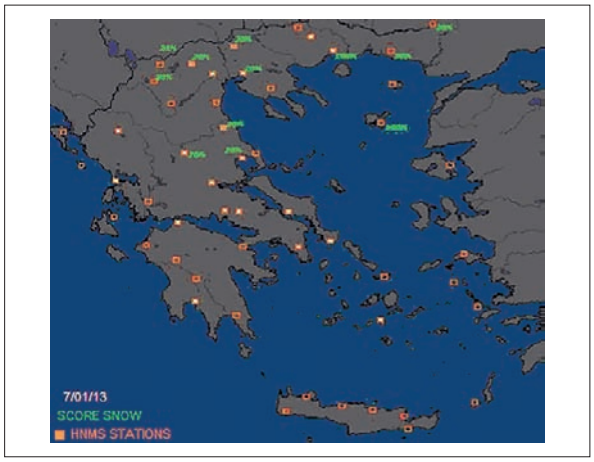
◀ *Map 2 (below): Heavy snowfall (red), precipitation (orange) and no precipitation (green) on 08/01/13.*



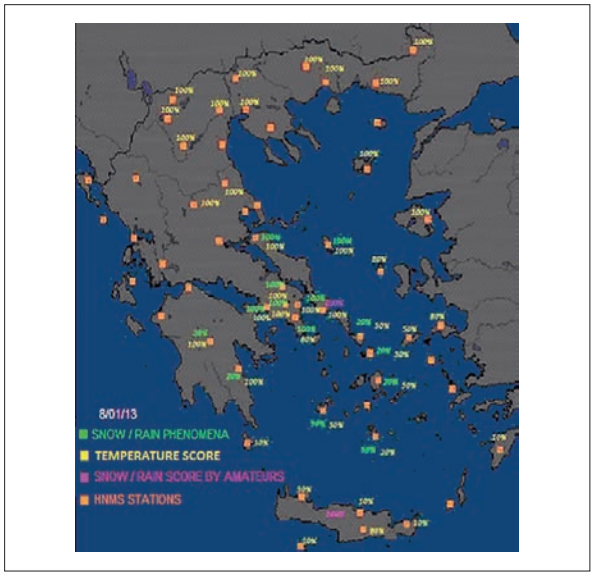


▲ *Diagram 4 (at the top): temperature extremes in islands 08/01/13 (green coluor according to the Meteoalarm colour scale).*

▲ *Diagram 5 (below): temperature extremes in islands on 09/01/13 (green and yellow colours according to the Meteoalarm colour scale).*



▲ *Map 1: snow scores on 07/01/2013.*



▲ *Map 2: snow and frost scores on 8/01/13.*

Results

In the following maps snow and temperature scores are shown for all three days.

Conclusions

The forecast may be characterized as relatively successful for 7th January 2013 as precipitation fell in **Eastern Macedonia** and the **islands of the northeastern Aegean**, but snowfall did not occur in **Thrace** and the **Eastern Thessaly**. The mean score was 33.3%.

On January the 8th the forecast can be considered as successful as there was snowfall in **Eastern Central Greece (Attica, Beotia, Evia, Sporades** and **Crete)**. The mean score was 100%. In **Eastern Peloponnese** and **Cyclades**, only rain fell. Consequently the forecast was moderately successful (score 50%).

Finally, the temperature fall during the three days i.e. 7th, 8th and 9th January 2013 was noticeable throughout the country. There was **frost** on the mainland which most intense in northern parts. The mean score is 100%. **Maximum temperatures below zero were** observed in northern Greece (Florina, Kozani) and it was successfully forecast. It should be pointed that temperatures near 00 C were recorded even in the islands such as Kos and Mytilini. The mean score is 100%.

References:

• Bassiakos, I. and Frangouli, P. , "Verification Method of Meteorological Bulletins", Athens September 1995

• http://meteoalarm.eu/

▲ *Map 3: temperature scores on 9/01/13.*