

Verification of Extreme Weather Phenomena in HELLAS

Introduction

Weather warnings for specific extreme weather phenomena are issued by the Hellenic National Meteorological Service. In this work, the phenomena for which the specific warnings are issued, the issuance criteria, and the methodology used for the verification purposes are presented.

Background

Weather warnings for specific extreme weather phenomena as well as early warnings are issued by the Hellenic National Meteorological Service. Early warnings are rarer and issued only for specific reasons.

The phenomena for which the specific warnings are issued are:

- Extreme air temperature values
- Heavy snowfall
- Very heavy rainfall
- Heavy hail fall
- Gales

Specific warnings are issued according to the criteria set in Meteoalarm, when the phenomenon is forecast for an extended area - orange colour - or even in a limited area - red colour. The limits are different for each region but in all cases warnings are always issued when the forecast wind speed is at least 60km/h or wind gusts exceed 80km/h. If the total amount of 12h or 24h rainfall is greater than a specific amount in each area, a warning is issued. Another reason to issue a warning is if snowfall for rural areas is over 5 cm and for urban areas over 2 cm. Another case where a warning is issued is when very strong thunderstorms are forecast with wind gust ≥ 80 km/h, or when there is a significant possibility of flooding or hail of diameter ≥ 1 cm. The criteria for very high and very low temperature warnings are also specified in regions compatible with Meteoalarm.

The recipients of the specific weather warnings are the General Secretariat for Civil Protection, the Ministry of Defence, the Athens News Agency, the Ministry for Mercantile Marine and Island Policy, the Fire Brigade, the Hellenic Police, the Regional Meteorological Centers and all the Meteorological Offices.

Analysis

Quality control is performed by NMC for both routine forecasts and specific warnings with daily checks. Moreover, every month a presentation of the monthly results is made by the verification department of the Meteorological Center emphasizing special cases e.g. extreme weather phenomena or large deviations from normal.

The verification of forecasts is performed as follows:

- The forecast temperature values are compared with the ones observed and acquired through the HNMS station network.

- Rainfall, snowfall and thunderstorm forecast values are also compared with the ones observed and acquired through the HNMS station network, while additional information is collected from other bodies' networks (e.g. NOAA, Ministry of Agriculture, etc.) and media (radio, television).
- Wind speed and direction forecast values are compared with the ones observed and acquired through the HNMS station network while additional information is collected from other bodies' networks (e.g. NOAA, Ministry of Agriculture, etc.), media as well as from the Buoys Network of the Hellenic Centre for Marine Research.

Verification of forecasts is performed with the aid of the *Hellenic Verification Scheme* (HeVeS). The basic definitions of the terms used are:

- **Precision (P)** is the number of successful forecasts for the specific phenomenon out of the total forecasts for the same phenomenon.
- **Recall (R)** is the number of successful forecasts for the specific phenomenon out of the total number of days that the specific phenomenon occurred.
- **Fall-Out** is the number of the unsuccessful forecasts for the specific phenomenon out of the total number of days that this phenomenon did not occur.
- **F-measure** is the weighted harmonic mean of Precision (P) and Recall (R) and is defined as:

The more general formula is:

Two commonly used F measures are :

for $\beta=2$ i.e. Recall weights twice as much as Precision and

for $\beta=0.5$ i.e. Precision weights twice as much as Recall. After years of study HNMS have ended up using the value $\beta=1.2$ for the verification of extreme weather phenomena i.e. to use the $F_{1.2}$ measure.

Administration set as targets:

- The value 0.8 for $F_{1.2}$ for the services provided (Precision 80%)
- The Recall value to =1 in cases where the word “possibility” is used in the forecast text.

Case study

An example of the application of the above methodology is given below:

- 25 cases of extreme weather phenomena were recorded in Greece during the previous year.
- HNMS successfully predicted 23 of them.
- The possibility of occurrence was given to the remaining 2.
- 30 specific warnings were issued.

That gives:

- Precision = 0.83
- Recall = 0.92
- Fall-Out = 0.005. And $F_{1.2} = 0.88$

Thus we can demonstrate a very good percentage of success.

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