STUDY OF THE FRECUENCY OF HEAVY SNOWFALL ON THE COAST OF CATALONIA (WESTERN MEDITERRANEAN) USING AN EXPONENTIAL MODEL

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INTRODUCTION

Although the northeastern coast of the Iberian Peninsula has recorded a few days of snow, when a snowfall occurs, it tends to be intense because of the large precipitable water content.
Since the last century has been officially documented on snowy days and snowy days with coverage, but do not have a sufficient database to study in detail the frequency of heavy snowfall. It is therefore necessary to use data that often are not official, and therefore should be considered validation errors

Objetive of study:

To **analyze the frequency** of heavy snowfall of 3 observatories in Catalonia, and estimate the associated return periods.

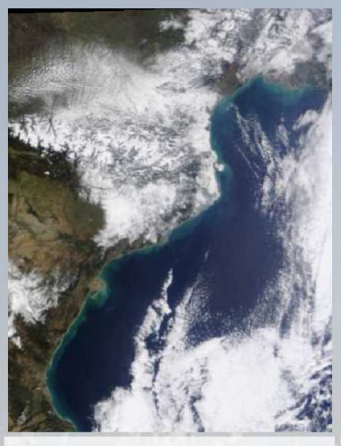


FIG. 1. Visual channel of MSG, on 9th March, 2010. See the result of an intense snowfall in Catalonia

METHODOLOGY

The frequency with which produces a snow's thickness n less than N can be adjusted to a 2-parameter exponential distribution (Weibull distribution), as:

$$\pi\left(n \geq N\right) = \exp\left(-kN^{m}\right)$$

where k and m are two adjustable parameters. This distribution can be adjusted by least squares regression, i.e. minimizing the sum of squared errors. So then, taking two times the logarithm to equation 1 we obtain:

$$\underbrace{\ln\left(-\ln\pi\left(n \geq N\right)\right)}_{y} = \underbrace{\ln(k)}_{n} + \underbrace{m}_{m} \cdot \underbrace{\ln(N)}_{x}$$

The goodness of fit was measured from the Pearson correlation (R^2) of the predicted values of snow depth compared to those observed. We also measured the normalized mean absolute error (NMAE).

DATA

Table 1. Thickness of most important snowfall (cm)

Fabra (415 m) 1950-1970		Badalona (100 m) 1975-2006		L'Estartit (100 m) 1947-2010	
Date	N (cm)	Date	N (cm)	Date	N (cm)
13/02/1953	10	14/01/1978	2	25/01/1947	50
06/02/1954	8	19/02/1981	1	24/12/1962	23
06/03/1955	12	10/02/1983	2	14/12/1963	10
20/02/1956	6	12/02/1983	10	07/03/1964	25
11/01/1960	7	05/01/1985	10	10/01/1967	3.2
25/12/1962	80	11/01/1985	12	18/03/1975	1.3
07/03/1964	18	18/02/1987	20	12/02/1983	4
18/02/1965	10	14/02/1991	2	12/01/1985	18
10/01/1967	3	01/03/1993	15	12/01/1987	0.5
30/11/1969	2	28/02/2005	25	14/01/1987	5
28/12/1970	8			16/01/1987	1.1
				22/01/1992	1.5
				20/02/1996	1
				14/12/2001	0.8
				28/02/2005	0.1
				08/03/2010	3

Three samples were taken on significant accumulations of snow over the Catalan littoral, according to the "Bulletin of the meteorological and seismic section" of the Fabra Observatory (Barcelona, Martin Vide 1984a), and from weather observers in Badalona (Barcelona) and L'Estartit (Girona).

FIG. 2. Localization of observatories

RESULTS

The results showed that the model fits well to the frequency of the thickness of the snow, as it obtained a normalized mean absolute error (NMAE) equal to 12% (**Fig. 3**). For longest series, the NMAE is reduced to 10% or less.

The model predicts that a snowfall of 50 cm in one day has a return period of 24 ± 8 years for Badalona (6 m), 28 ± 8 years Fabra (415 m), and 46 ± 5 years for L'Estartit, Girona (sea level). The probability curves intersect to high return periods; i. e., the higher extremes of snowfall are more likely on the coast. (**Fig. 4**).

This study may serve to quantify the risk of heavy snow on the west Catalan coast, and thus can be updated snow risk maps with greater accuracy return periods.

FIG. 3. Cumulative probability

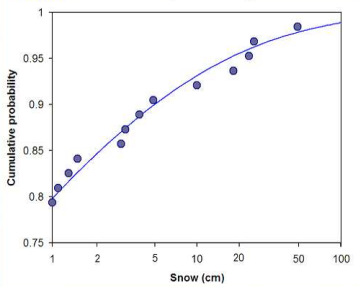
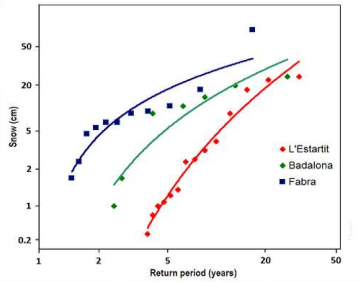


FIG. 4. Return period



CONCLUSIONS

- Weibull exponential model has good fits for the snow at least in the study area. Both snowfalls weak to intense it obtained a normalized mean absolute error (NMAE) around 12%. The probability curves show the higher extremes of snowfall are more likely on the coast.
- As explained, despite the occasional occurrence of snow at sea level in the Occidental Mediterranean , the contribution made by the Mediterranean wet to cold European air masses provide many examples of severe snowfall with important thickness, exceeding half a meter on the Mediterranean coast.
- It is therefore necessary to upgrade and improve forecasting and statistical models to predict such phenomena that can seriously affect the daily lives of citizens and this study can be extrapolated to other parts of the Mediterranean coast.

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