Geophysical Research Abstracts
Vol. 16, EGU2014-9393-1, 2014
EGU General Assembly 2014

A nineteenth century avalanche episode reconstruction via historic newspapers: from unstructured information to standardized information

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Several climatic risks studies based on the analysis of data recorded in newspapers have been published to date. These studies deal with both general (Moltó, 2000; García y Martí, 2000; Hernández Varela et al., 2003; Olcina, 2005) and specific risks such as landslides (Domínguez *et al.*, 1999; Devoli *et al.*, 2007; Polemio y Petrucci, 2010) seastorms (Yanes y Marzol, 2009) and snowstorms (Olcina y Moltó, 2002) among others.

The purpose of this paper is to report on the methodology and results of the study of an extreme historical event happened in the Asturian Massif (Northern Spain) in 1888. Special attention has been paid to methodological aspects and to the difficulties found in the goal of devising a method that would enable the reconstruction of this kind of phenomena on the basis of nivometheorogical conditions, geographical location and socio-economic impact. To a great deal we focused our efforts on designing a logical database structure and a set of tables that would allow us to store and cross the information for statistical analysis. This includes outlier detection in order to ensure the quality of the results.

The information sources used in our study have been the issues of the daily newspaper "El Carbayón" and the weekly newspaper "El Oriente de Asturias" published in Oviedo and Llanes (Asturias) between the 20th of January and 30th of May 1888. A total of 92 issues have been collected via the hard copy microfilm housed in the Central Library of Asturias. We reviewed 70 reports relating to avalanche events happened in the aforementioned period of time. We grouped the consequences of the events into 3 main categories (personal injuries, material damages and absence of both) and 5 child categories (deaths, wounded, house and attached building damage, livestock injuries, damage to infrastructures and communications). We gathered data about the thickness of snow-cover, the number of consecutive snowstorms and, in order to facilitate a territorial analysis of this episode, we also gathered data about the event locations.

The primary difficulties we found were lack of information about some details (dates, geographic locations and frequently inaccurate quantification of damage), fuzzy terms or sentences (such as "heavy snow", "we have never seen a snowfall like this", "huge snowslide", etc.) difficult to turn into crisp data, and difficulties in defining categories and allocating every incident into one of the categories. Many of these problems are limitations inherent to work with an information source whose purpose is to describe events for general public and not to write about them for scientific purposes. Others are due to the nature of the climate phenomenon associated to these events. These difficulties are increased, on the other hand, by the lack of development existing at the time which often resulted in villages being isolated by the storms with the ensuing, delays in communication, transportation, etc.

The results of our study show the importance of the 1888 avalanche events, caused by three linked and consecutive snowstorms that took place between the 14th of February 1888 and the 22th of March 1888, creating snow covers with a depth ranging between 5 and 7 meters. Sixty six avalanches were documented, 60 of them causing material damage. The number of dead and wounded reached 37 and 23 respectively. The consequences of the event were felt throughout the Asturian Massif; 14 high- and mid-elevation mountain municipalities, were affected by avalanches, some of which displaced 40.000 m3 of snow.

In this research, historical media has turned out to be a particularly valuable source of information for the study of this kind of episodes, because it enables us to understand the scope of events that occurred in the distant past in remote locations whose socio-economic impact cannot be directly inferred from instrumental data. On the other hand, we consider studies like the present one as preliminary steps for avalanche episodes modelling. Indeed, the information gathered with this kind of methods has to be supplemented with that obtained from other techniques and field geomorphological evidence.