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Interactive comment on "Multidisciplinary Approach to Rainfall-Triggered Rockfalls: the Case Study of the Disaster of the Ancient Hydrothermal Sclafani Spa (Madonie Mts., Northern-Central Sicily, Italy) in 1851" *by* Antonio Contino et al.

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Dear Referee #2,

Our paper underlines the crucial importance of documentary data analysis to reconstruct the circumstances of landslide events that occurred in historical times, providing a significant methodological and scientific contribution of a pioneering nature.

We acknowledge your effort to identify the correct target of our paper. However, in our opinion, your attempt has failed. Indeed, your comments lack an objective assessment of the fundamental role that historical datasets (documentary data, ancient maps, ancient engravings, etc.) play in the study of past landslide events. Your comments oversimplify and underestimate our archival contribution, reducing it to a mere “summary of the historical documents that describe the event". Our meticulous archival research work, with three documentary appendices (see Supplementary Information) including plenty of selected historical data, most of which unpublished (e.g. those from manuscript sources), was intended to offer a comprehensive analysis of historical sources in support of our assumptions and not just a list of collected data.

An example that can help clarify the mutual interaction between historical and geological data is the mapping of the landslide deposits from the Sclafani event. Geological and geomorphological evidence collected during field surveys, analysis of ancient maps, aerial and/or satellite images and historical data fit perfectly together, providing a detailed mapping of the area covered by the landslide deposits. We believe that there is no dichotomy between the data recorded in natural archives and those reported in historical archives: both are fundamental to the study of natural disasters. Our research rests upon the assumption: History for Earth Sciences, not History vs. Earth Sciences.

In recent times, Hungr (2004) stressed the importance of historical evidence, "potentially more accurate" than geological evidence (proxy data), even if “limited to the length of the historical period, often little more 100 years in much of the world”. The catastrophic event of Sclafani, happened over 150 years ago, constitutes an interesting and emblematic case study.

Our historical reconstruction of the severe rainstorm of March 1851, and of the related Sclafani catastrophe, is supported by three different types of evidence. The first type is the direct description of the area of the thermal springs prior to the disaster by contemporary sources. These memories hold precious information about the landscape near the ancient thermal baths prior to the extreme event. The second type of documentary source is represented by the records of local and regional authorities concerning measures taken to respond to the terrible disaster (destruction of thermal baths, water mills, roads etc.). A third source is the weather data kept by the Astronomic Observatory of the Palermo University (official) and by the Nautical Institute of Palermo (not official). We used these records to confirm the exact day of the disaster (previously incorrectly reported), as well as the impact and magnitude of the rainstorm, i.e. the main triggering factor. We consider that the manifold pieces of the Sclafani event puzzle, provided by documentary and geological evidence, fit entirely together, yielding a consistent picture of the impact of the disaster. The case study of Sclafani is an emblematic example that revives a catastrophic event ignored by the Italian inventories of landslide events (e.g. databases of ISPRA IFFI, AVI etc.).

The word “multidisciplinary” (in the title) was intended to highlight the dual contribution of different academic disciplines (Earth Sciences and History) to our research approach.

The “results of the aerial photointerpretation and satellite images” that, in your opinion, "are not included", are given in the map of Fig. 5, which outlines geological and geomorphological features (e.g. landslides) with a high degree of accuracy. The map is the synthesis of a detailed field survey, which was fine-tuned through a careful interpretation of topographical and cadastral maps, aerial photographs and satellite images.

For general assessments of geomorphological mapping in geohazards, Lee (2001) recommends 1:10,000 as a suitable scale. The map scale of 1:10,000 is the one of the Regional Technical Map of the Sicily Region. This is the scale chosen to build Italian official geological, geomorphological and hydrogeological maps (see ISPRA site, CARG Project). The area shown in the map is the minimum one that is required to describe the natural section outcropping in the environs of Sclafani.

Historical record collections do not include estimations of volume. A reliable estimation of volume and thickness is not possible, as no pre-event maps are available. With regard to the area of the deposit, see P10L338. The exceptional rainfall event of March 1851, which devastated this north-western area of the Madonie mountains, must have certainly changed the lower talus slope (documentary sources report that the event caused an increase in ravines). As a result, any attempt to obtain a model of the possible trajectories related to the landslide would be unreliable. In addition, the soft rocks (radiolarites and siliceous shales), which form the lower talus slope, are prone to erosion; in 150 years, they certainly experienced denudation and modelling processes (above all during extreme rainfall events: 1886, 1890, 1895, 1919, 1925, 1929, 1931, 1954, 1964, 1976-77; 1985, see Aureli et al. 2008) making any model useless. Finally, the synchronous engraving (see Fig. 09), which represents the site of the ancient thermal spa, shows the vegetation cover of the talus; this vegetation is supposed to have had an impact on the trajectories of fall of the material. Unfortunately, Italian maps prior to the 20th century lack indications on vegetation covers.

The main triggering factor was the exceptional rainfall event of 12-13 March 1851. There is a cause-effect relationship between the exceptional rainstorm and the landslide, as substantiated by the numerous historical data that we retrieved. The area of Sclafani, typically mountainous, is subject to freeze-thaw conditions (see P9L286-289). The earthquake events that produced macroseismic effects in the study area in the first halves of the 19th century took place in 1818-19 and 1823 (Billi et al., 2010). Predisposing factors are many; some are intrinsic (related to the stratigraphic and tectonic setting), while other ones include selective erosion (hard-on-soft landforms, see P6L193-194; 199-200, 202-203). The anthropogenic impact changed the landscape near the source area (e.g. the road built in 1930, whose excavation required the use of explosives).

The conclusions show that geological and historical data fit reciprocally, making it possible to reconstruct a coherent picture of the event; a crucial role derives from the analysis of historical data that are the goals of the research carried out (see P11L357-362 and 366-368).

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Discussion paper

The event was a complex one; the type of initial failure evolved into another movement mechanism, when the material moved along the slope and changed its volume, incorporating materials entrained in its path. Indeed, the accumulated material does not reflect the composition of the lithotypes outcropping in the source area (Ellipsactinia breccias), but rather the one of the rocks present in the entire slope (Ellipsactinia breccias, radiolarites, siliceous shales, marls, calcilutites, dolomites etc.).

In the final part of your comments, you stated that: “it is unlikely that the details provided could contribute to the quantification of the susceptibility of the slope to failure”. The data that we provided are propaedeutic. We never claimed that we could contribute “to quantifying” the susceptibility of the slope to failure (see P1L20-22). In P11L361-363, we merely reported the opinions of Authors (Porter and Orombelli, 1980; Wieczorek and Jäger, 1996) without comments. Finally, in the conclusions, with regard to susceptibility, we emphasise the need for conducting further investigations in order to gain more insight into our research findings (see P12L380-384).

As data on discontinuities are not available (see P9L280-283), no stability analysis is feasible.

In over 150 years, the lower talus slope certainly underwent erosion phenomena; therefore, its morphology cannot be regarded as constant in time; furthermore, empirical models are unable to predict the travel distance of future landslides (see Ayala-Carcedo et al., 2003) based on the data obtained for past events (e.g. the Sclafani catastrophe of March 1851).

Finally, in (P11L370-371), we merely quote the opinion of Zellmer (1987) without comments. We know that some researchers studied some possible precursors of rockfalls (mountain deformations: e.g. Bovis, 1990; seismic: Wang et al., 2003; Amitrano et al., 2005), including through monitoring systems (e.g. Schenato et al., 2013), in order to investigate the issue of prediction of these events, which are often catastrophic.

Additional References and Sitography

Amitrano D., Grasso, J.R., Senfaute G.: Seismic precursory patterns before a cliff collapse and critical point phenomena. Geophysical Research Letters 32: L08314, 2005.

Aureli, A., Contino, A., and Cusimano, G.: Aspetti idrogeologici e vulnerabilità all'Inquinamento degli acquiferi delle Madonie (Sicilia centro settentrionale). Note illustrative alla Carta della Vulnerabilità all'Inquinamento degli acquiferi delle Madonie (Sicilia centro settentrionale), Scala 1:50000. Regione Siciliana - Azienda Regionale Foreste Demaniali, Università degli Studi di Palermo, Dipartimento di Geologia e Geodesia, C. N. R.- G. N. D. C. I. - Pubbl. n. 2312, Collana Sicilia Foreste n. 39, Industria grafica Sarcuto, Agrigento, 168 pp., 2008.

AVI project.: avi.gndci.cnr.it/

Ayala-Carcedo, F.J., Cubillo-Nielsen, S., Alvarez, A., DomÄśnguez, M., LaÄśn, L., LaÄśn, R., and Ortiz, G.: Large Scale Rockfall Reach Susceptibility Maps in La Cabrera Sierra (Madrid) performed with GIS and Dynamic Analysis at 1:5000, Nat. Hazards, 30(3), 325–340, 2003.

Billi, A., Presti, D., Orecchio, B. Faccenna C. and Neri G.: Incipient extension along the active convergent margin of Nubia in Sicily, Italy: Cefalù-Etna seismic zone, Tectonics, 29, TC4026, doi:10.1029/2009TC002559, 2010.

Bovis, M.J.: Rock-slope deformation at Affliction Creek, southern Coast Mountains, British Columbia. Canadian Journal of Earth Sciences, 27, 243–254, 1990.

Hungr O.: Rock Avalanche Motion. Process and Modeling: Evans, S. G. and Martino S. (eds.), Massive Rock Slope Failure: New Models for hazard assessment, Celano, Italy, June 16-21, Abstract volume NATO and advanced Research Workshop, 66-69, 2002.

ISPRA CARG: http://www.isprambiente.gov.it/Media/carg/

ISPRA IFFI: http://www.isprambiente.gov.it/en/projects/soil-and-territory/iffi-project/default

Lee, E.M.: Geomorphological mapping, in J.S. Griffiths (ed.), Land Surface Evaluation for Engineering Practice, Geological Society Engineering Geology Special Publication 18, 53–56, 2001.

Schenato, L., Palmieri, L., Autizi, E., Calzavara, F., Vianello, L., Teza, G., Marcato, G., Sassi, R., Pasuto, A., Galgaro, A. and Galtarossa, A.: 'Rockfall precursor detection based on rock fracturing monitoring by means of optical fibre sensors', Int. J. Sustainable Materials and Structural Systems, Vol. 1, No. 2, pp.123–141, 2013.

Wang, W-N., Chigira, M., and Furuya, T.: Geological and geomorphological precursors of the Chiu-fen-erh-shan landslide triggered by the Chi-Chi earthquake in central Taiwan, Eng. Geol., 69, 1-13, 2003.

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