Nat. Hazards Earth Syst. Sci. Discuss., 3, C2918–C2930, 2016
www.nat-hazards-earth-syst-sci-discuss.net/3/C2918/2016/

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Spatial impact and triggering conditions of the exceptional hydro-geomorphological event of December 1909 in Iberia" *by* S. Pereira et al.

S. Pereira et al.

susana-pereira@campus.ul.pt

Received and published: 11 January 2016

reply to Anonymous Referee #1

Received and published: 14 November 2015 General Comments

1 - The article deals with the analysis of a specific historical flood event that affected the Western part of the Iberian Peninsula. It offers the reconstruction of the event from information provided by different regional and local newspapers, long hydrometeorological series and data from the 20 Century Reanalysis. To compile and to analyse this kind of information are a hard work and I would like to congratulate the authors for it.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

However, in its present form, the paper is mainly a technical note with so much detailed information that includes the name of the major part of little villages affected by floods and landslides. Paragraphs like those included in pages 5815 and 5816 constitute a simple list of localities, but do not provide any interesting information.

We acknowledge the remarks of the reviewer and the pertinent comments and suggestions he/she made along the work, which will allow increasing the quality of the final manuscript. We agree with the reviewer on the necessity to avoid the use of exaggerated detail about the little villages affected by floods and landslides, without a deep analysis on the damage results. In the new version of the manuscript we will delete the details about the affected villages, introducing instead more pertinent analysis at the hydrographic basin level about the percentage of Disaster cases and Disaster cases density per hydrographic basin. Also, the percentage of Disaster cases per hydrographic basin will be explored according to the location on the hydrographic basin section (headwater section, middle section and terminal sector). A new figure (shown below) about these topics will be introduced in the Results section and the information related to the figure is further explored.

2 - The authors could analyse the circumstances of the death of the victims (at home, in the street), any possible early warning or emergence measures, justify the distribution of the most affected places, or another exercise that could provide any interesting novelty to the societal impact analysis.

We acknowledge the necessity to tackle the topic raised by the reviewer's suggestion. In this particular event we have detailed information to analyze the surrounding circumstances of fatalities (e.g. if it took place inside a building in a rural area; inside a building in an urban area; outdoors in a rural area; outdoors in an urban area) per gender (male, female, gender not reported). A new figure of the circumstances surrounding the Disaster fatalities per gender will be introduced (see below) and the results further explored.

NHESSD

3, C2918–C2930, 2016

Additionally, with the aim of providing some additional novelty in the work we have computed 3 damage indexes (fatalities index, homeless index and total affected index) , taking into account the resident population per region obtained from the Census data in Portugal (1911) and Spain (1910). These indices are also provided below:

Fatalities index=(Number of Fatalities)/(Resident Population) .100000

Homeless index=(Number of Homeless people)/(Resident Population) .100000

Total affected index=(Number of total affected people)/(Resident Population) .100000

Damage indexes will be mapped and classified in 5 classes (low, moderate, high, very high, extreme) according to according to natural breaks of Index distribution. Natural breaks classes are based on natural groupings inherent in the data. Class breaks are identified that best group similar values and that maximize the differences between classes. The features are divided into classes whose boundaries are set where there are relatively big differences in the data values distribution. With this methodology each affected region will be classified according to the fatalities index, homeless index and total affected index. The use of these indexes is important to compare the societal impacts of floods and landslides between different regions or other administrative units in this assessment, and additionally, provides an approach that can be applied to other historical events in other study areas. This new data analysis will be explored in the results section.

3 - From the meteorological point of view the authors tell that during this event NAO<0, but they do not relate this value with the meteorological pattern. They mention on different occasions the presence of a frontal system associated with the low pressure, but the maps from 20th Century Reanalysis usually do not provide fronts. Then it would be necessary that they justify the existence of this frontal system as well as its position and evolution.

We agree with the reviewer that the information regarding NAO was not sufficient to

NHESSD

3, C2918–C2930, 2016

explain the above mean precipitation in the domain. Therefore the new version of the manuscript text will be improved in page 5818, lines 23-26.

"It is important to mention that in November and December 1909 strong negative values of NAO (-1.9 and -2.5, respectively) were registered. The NAO plays an important role in shaping European precipitation variability (Trigo et al., 2008) and especially in the Iberian Peninsula, where negative values of NAO are associated with above-normal precipitation in the region. This significant impact results from the displacement of the storm track further south of its normal position during months with negative NAO index, leading to a higher frequency of Atlantic low pressure systems (mid-latitude cyclones) that travel into the region (Trigo et al., 2004, Trigo et al., 2008). The impacts of the negative values of the NAO help to put into context the above average precipitation that occurred in November and December."

Regarding the presence of a frontal system, we acknowledge that the 20th Century Reanalysis (as all Reanalyses datasets) do not provide explicit front analysis. However, the authors (and many other colleagues from Portugal and Spain) have contributed in the last 15 years with studies dealing with the precipitation mechanisms in the Iberian Peninsula, either by means of Weather type's classification (e.g. Ramos et al., 2014) or to the role of Atlantic storm tracks (e.g. Trigo et al., 2004; 2008). In both approaches it has always become evident the role played by frontal systems in strong precipitation events. The SLP pattern shown in old Figure 10 of the manuscript is similar to the one presented in Figure 2 of Ramos et al (2014), i.e. a typical SW type. In fact the objective Weather type classification for these two days corresponds to a SW type. Ramos et al., 2014 showed that the SW and W weather types have a higher precipitation contribution than the Cyclonic type in the winter months and are clearly linked with frontal systems. Moreover, the SLP pattern combined with the precipitation pattern (old Figure 10), allows us to depict that the precipitation band it's typical of a conceptual model of an extratropical cyclone (Shapiro–Keyser conceptual model). (Comparison between several cyclone models including the old Bergen school and Shapiro-Keyser models

NHESSD

3, C2918–C2930, 2016

can been seen here: (http://www.eumetrain.org/data/2/292/292.pdf) This information will be included now in section 4.2 when we first refer the frontal system. “In addition, the frontal system associated with this low pressure struck western Iberian Peninsula from a SW-NE direction. It was this relatively stationary frontal system that continually affected the Iberian Peninsula with high 6h precipitation rates inducing heavy daily precipitation in some regions of the Iberian Peninsula as shown in Fig. 8. Despite the 20th Century Reanalysis do not provide fronts analysis, the precipitation pattern around the cyclone center corresponds clearly to a frontal system when compared with a conceptual model of an extratropical cyclone (Shapiro–Keyser, 1990)”. In fact we must emphasize that the vast majority of the Atlantic mid-latitude cyclones that struck Iberia are characterized by the presence of frontal systems (sometimes already in the occlusion phase), that extend the precipitation impacts considerably to the south of the low pressure system center (Trigo et al., 2004).”

Shapiro, M. A. and Keyser, D.: Fronts, jet streams and the tropopause, in Extratropical Cyclones: The Erik Palmen Memorial Volume, edited by C. W. Newton and E. O. Holopainen, pp. 167–191., 1990. Trigo, R. M., Pozo-Vázquez, D., Osborn, T. J., Castro-Díez, Y., Gámiz-Fortis, S. and Esteban-Parra, M. J.: North Atlantic oscillation influence on precipitation, river flow and water resources in the Iberian Peninsula, Int. J. Climatol., 24(8), 925–944, doi:10.1002/joc.1048, 2004. Trigo, R. M., Valente, M. A, Trigo, I. F., Miranda, P. M. A, Ramos, A. M., Paredes, D. and García-Herrera, R.: The impact of North Atlantic wind and cyclone trends on European precipitation and significant wave height in the Atlantic, Ann. N. Y. Acad. Sci., 1146, 212–34, doi:10.1196/annals.1446.014, 2008.

4 - The discussion about the precipitation event is hard and confusing, merging it with other events without following a clear methodology and objective. This fact is particularly relevant in page 5817.

We agree with the reviewer that section 4.2 was not clear mainly due to the inclusion of information related with other events in the middle of this section. Nevertheless, we

NHESSD

3, C2918–C2930, 2016

still consider that it is essential to put the December 1909 event into a wider context by comparing this with two other important events that caused high social-economic impacts. Therefore the paragraph with references to other events will be maintained but replaced at the end of section 4.2 and the objective of that inclusion will be (hopefully) better described. “The relevance of above average precipitation before the major event depends on the temporal and spatial scales of the phenomena being analyzed. The December 1909 event along with the 1876 event (Trigo et al., 2014) highlights the key role played by previous accumulated precipitation in the occurrence of floods during events lasting several days in the major rivers basins of western Iberian Peninsula, particularly for the period prior to the construction of major Dams (Trigo et al., 2014). On the contrary, floods occurring after intense bursts of precipitation over relatively confined areas of western Iberia can induce flash floods independently of the precipitation that occurred in previous weeks or months. That was the case of the sub-daily 1967 event occurred during the night between 25 and 26 November 1967 which was confined to the Lisbon metropolitan area, i.e. without affecting large river basins. The 1967 event was the deadliest storm affecting Portugal at least since early 19th century with several flash floods in heavily constructed suburban areas around Lisbon causing more than 500 fatalities. In this case, the accumulated precipitation prior to the 25 and 26 November 1967 was not relevant (being below average) and the flash floods occurred mainly as a result of very intense hourly precipitations, ranging in duration from 4 to 9 h, compatible with return periods of 100 years or more (Trigo et al., 2015)”.

5 - In conclusion, the authors have enough information to prepare a paper that could give interesting results for the scientific community. But it means to do some new work. Nowadays, a notable bibliography on the analysis of historical flood events exists. The own team from the University of Lisbon has published in the past relevant papers on this kind of topic. I would recommend the authors to read other papers focused on historical events like the most recent from Boudou et al (Hydrol. Earth Syst. Sci. Discuss., 12, 6151–6177, 2015), Lumbroso and Vinet (Nat. Hazards Earth Syst. Sci., 11, 2321–2333, 2011) or Petrucci (Nat. Hazards Earth Syst. Sci., 13, 755–761, 2013)

NHESSD

3, C2918–C2930, 2016

We acknowledge the reviewer comments and suggestions. We read the suggested papers that were very helpful to propose new contributions related with damage impact analysis. We are confident that the new version of the manuscript will be more interesting and relevant to the scientific community interested in flood events, namely as we intend to incorporate all the novel analyses and figures mentioned above when answering to the reviewer's major comments.

Specific comments P. 5807 l. 8: Flash floods are not typically of winter in the Iberian Peninsula, although exceptionally they can occur. We acknowledge the reviewer comments. This sentence will be rephrased to: "In the Iberian Peninsula, extreme precipitation events that occurred during winter (December-January-February-March) have been historically associated with progressive flooding events in the major rivers (Salgueiro et al., 2013), and exceptionally with flash floods. . .".

P. 5810 l. 24: Substitute "vs.precipitation" by "hail or rainfall". We will follow the reviewer suggestion: "(snow vs. hail or rainfall)"

P. 5812 and following ones: Please, write the names in Spanish language or Portuguese language in cursive or between quotes. We will follow the reviewer suggestion.

P. 5813 l. 7: Table 3 The number of the table will be corrected.

P. 5813 l. 22-27. Could you integrate this paragraph with the previous one? It is not clear if these long-term precipitation data are from ERA-CLIIM or EMULATE projects. We agree with the reviewer's suggestion. Therefore the text will be changed accordingly. "According to Fig. 1, seven meteorological stations were located in Portugal (Beja, Campo Maior, Coimbra, Évora, Guarda, Lisbon and Porto) and were digitized by the Geophysical Institute Infante Dom Luiz (IDL) within the ERA-CLIIM project (Stickler et al., 2014). In addition, 20 meteorological stations were used in Spain (Albacete, Alicante, Badajoz, Barcelona, Burgos, Cádiz, Ciudad Real, Granada, Huelva, Huesca, La Coruña, Madrid, Málaga, Murcia, Salamanca, Sevilla, Soria, Valencia, Valladolid and

NHESSD
3, C2918–C2930, 2016

Zaragoza) and were digitized in the framework of the project EMULATE which are the most complete and reliable daily precipitation records extending back to the mid-19th century (Brunet et al., 2007). A large fraction of these stations were used in a long-term assessment of tendencies in the frequency of days characterised by low, medium and intense precipitation (Gallego et al., 2011)."

P. 5815 l. 4: It is difficult to assess from historical sources the number of injured people. Probably the number of injured people was considerably highest that 4 people, or that the figures showed in table 2. We agree with the reviewer's comment. In fact newspapers did not report more injuries caused by floods. This reduced number of injuries reports does not mean that there were not more injured people and can be justified by the prevalence that newspapers have given to the report of fatalities and homeless people.

P. 5815 l. 13-14: Please, indicate in which basin is Orense and why the small village of Bolo was the most affected The small village of Bolo is located in the "Minho" basin and was severely affected by a debris flow that occurred in this place.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 5805, 2015.

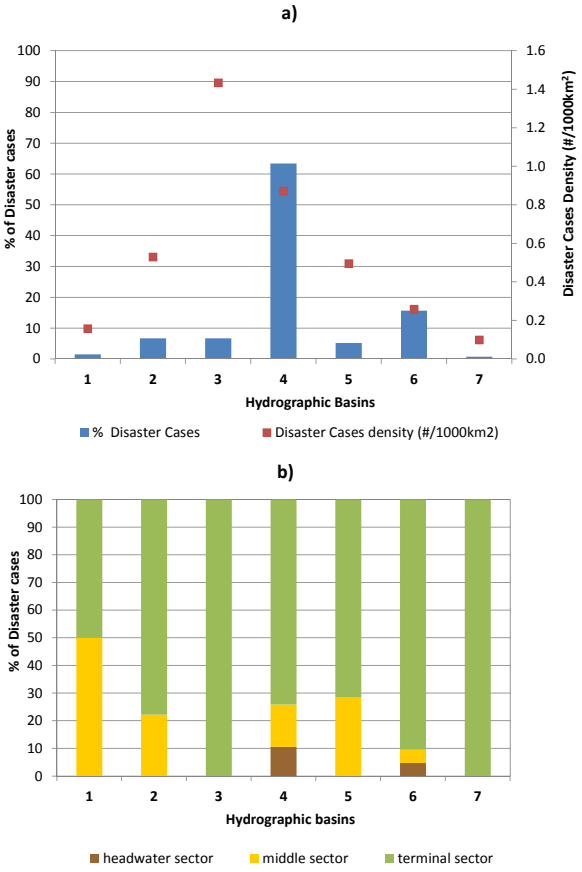

Fig. 1. Percentage of Disaster cases and Disaster cases density per hydrographic basin (a) and percentage of Disaster cases per hydrographic basin according to the location on the hydrographic basin sector. H

NHESSD
3, C2918–C2930, 2016

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

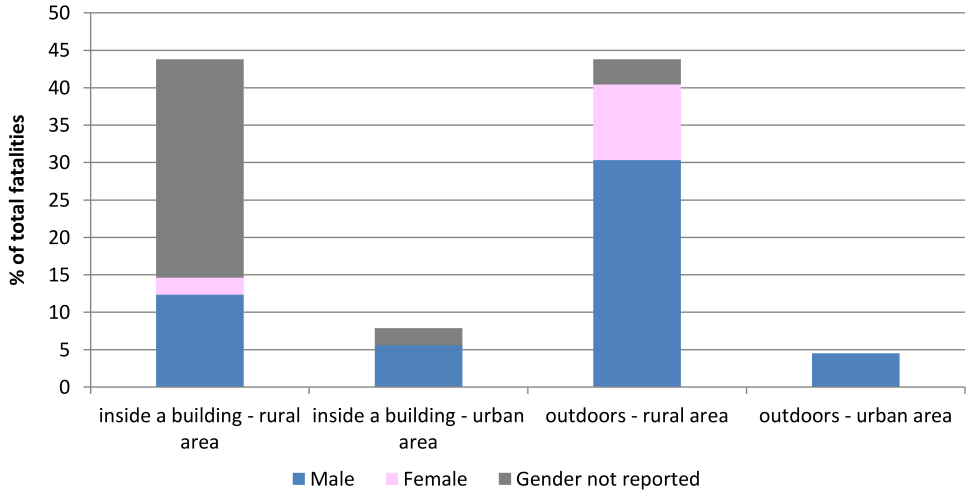

Fig. 2. Circumstances surrounding the fatalities by gender of the December 1909 event in Iberia

NHESSD
3, C2918–C2930, 2016

Fig. 3. Fatalities index (a) of the December 1909 event affected regions over Iberia.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

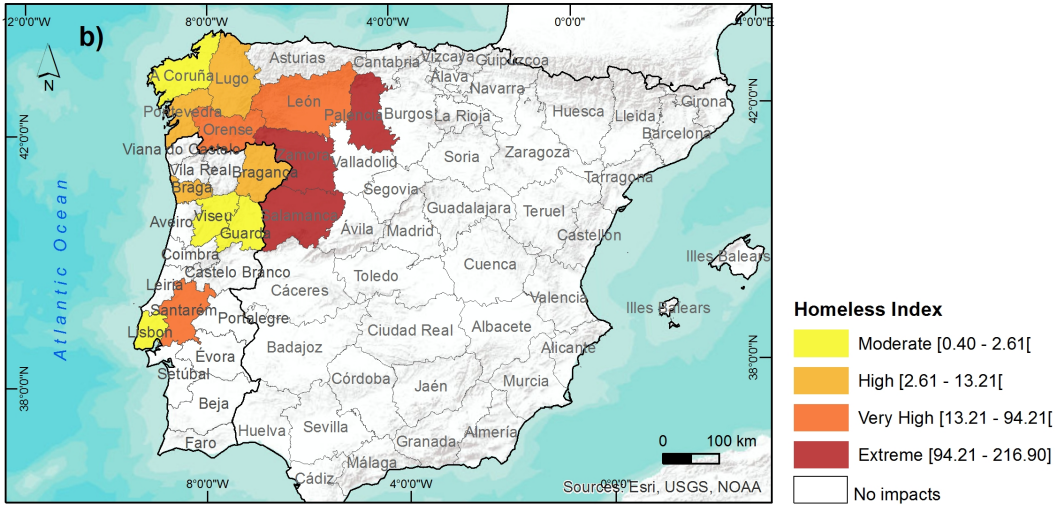

Fig. 4. Homeless index (b) of the December 1909 event affected regions over Iberia.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

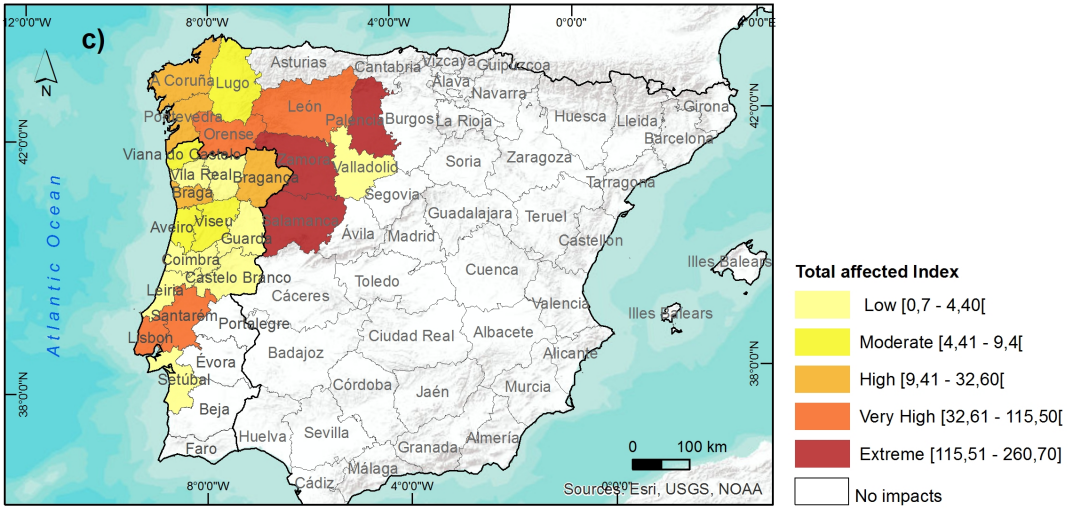

Fig. 5. and total affected index (c) of the December 1909 event affected regions over Iberia.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper