

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.

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reply to Anonymous Referee #2

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The paper by S. Pereira et al. describes an event occurring between 20 and 28 December 1909, which caused a great number of floods and landslides in the western part of the Iberian Peninsula. The event is ranked as the one with highest number of flood and landslide cases in Portugal in the period 1865–2010. In the paper, it is described by means of observed impacts, precipitation distribution and atmospheric distribution.

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General Comments The topic of the paper is interesting and I think that detailed reconstructions as the one presented in the paper are very useful to improve our knowledge on events that may have an high impact on the territory. I also think that local and national newspaper are a good source on information, together with in-situ data and reanalysis data, to give a detailed characterization of such events.

1 - In its present form, the paper has however some deficits that should be addressed before publication. The main one is that the real focus of the paper is not always clear: after reading the paper, it is not clear whether the main aim of the paper is the description of the impacts of the event or the characterization of the associated meteorological conditions. In my opinion, it is important that the authors clarify this point. After clarifying this point, the authors should then clearly explain the impact of the paper in terms of new knowledge. In other words, if the main goal of the paper is to characterize the spatial distribution and social impacts of the event, they should explain what is the new information with respect to the already available DISASTER database (in suppose the information concerning Spain). On the other hand, if the main objective is the meteorological characterization, they should try to study more in detail the spatial distribution of precipitation (e.g. by modelling a local relation between precipitation and elevation) and give more information than just the one concerning December, 22th.

We acknowledge the reviewer comments that the real focus of the paper was not sufficiently clear in the 1st version of the manuscript. In fact, this paper has a dual purpose in order to give a detailed (but multidisciplinary) characterization of this extreme event, namely: (i) to analyze the social impacts of the December 1909 hydro-geomorphologic DISASTER event and its corresponding spatial distribution; and (ii) to analyze the meteorological conditions that triggered the event and the spatial distribution of the precipitation anomalies.

In this context, we aim to characterize the meteorological synoptic forcing of one of the most important hydro-geomorphologic events presented in the DISASTER database in the last 150 years. However, besides this meteorological/climatological assessment we

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are equally interested in obtaining a full characterization of the associated human cost and the spatial extent of associated social impacts, as such evaluation has never been done before. Overall, we expect a better understanding of the climatic driving forces of hydro-geomorphologic disaster events and corresponding societal impacts over Iberia. These clarifications will be introduced in the end of the Introduction section and also in the abstract.

Also, in the discussion section it will be clarified the use of new information about this Disaster event in Spain that was not provided by the DISASTER database. Meteorological characterization of the event will be enlarged and more detailed to the event period (15 November - 28 December).

2 - Finally, I think the paper has to be subjected to a revision to improve the language. We acknowledge the reviewer's suggestion. This manuscript will be revised by a native English speaker to improve the language.

Specific comments

Page 5809, line 19: please check "has". "Has" was checked and will be corrected to "as".

Page 5811, line 3: please check "of". "Of" will be checked.

Pages 5814-5818: section 4.1 is really too long and gives too much details. We agree with the reviewer on the use of unnecessary and exaggerated detail in section 4.1. In the new version of the manuscript we will delete the details on the affected villages and damages description, introducing a more pertinent analysis at the hydrographic basin level taking in account the percentage of Disaster cases and the 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 showing these topics will be introduced in the Results section (see below) and the results will be also explored in a

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reorganized Results section to better separate impact analysis, precipitation event and hydrological context and the atmospheric circulation assessment.

4. Results

4.1. Societal impacts of the December 1909 event

4.1.1. Spatial distribution of the impacts

4.1.2. Temporal distribution of the impacts

4.1.3. Surrounding circumstances of fatalities

4.2. Precipitation event and hydrologic context

4.3. Assessing atmospheric circulation

Page 5818: the relation of the mid November precipitation with the event investigated in the paper is not clear for me. The authors should explain the mechanisms that make it relevant for the paper.

The occurrence of intense precipitation in the weeks (even months) prior to the main event can be crucial, as they tend to saturate the soil and therefore, when an extreme precipitation event occurs it will increase surface runoff of all tributaries of river Douro, thus contributing decisively to the flood levels observed. As shown in Figure 6, in mid-November the precipitation surpasses the long term mean for Lisbon, Guarda, Salamanca and Oporto. In addition, from mid-November the precipitation in the domain occurs virtually every day (more intense since 17 December) reaching a climax on the 22th December. Moreover, as stated now at the end of section 4.2, it must be stressed that recent studies have shown that in western Iberian Peninsula major floods have been amplified by the occurrence of significant precipitation during the weeks prior to the main event (e.g. Trigo et al., 2014). On the other hand some localized events lasting only a few hours were also responsible for high mortality rates and socio-economic impacts (e.g. Trigo et al., 2015) but with no role played by antecedent rainfall. Therefore

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we believe that a brief overview regarding the atmospheric conditions and the previous precipitation are important to understand the impacts of the event.

Pages 5821-5823: in my opinion section 4.3 should be, together with section 4.2, the most important section of the paper. In this case, however, the analysis cannot be restricted to December, 22th, but it has to cover the entire period with observed impacts (and high run-off).

We acknowledge the comment of the reviewer. Accordingly, our synoptic analysis will be expanded to the longer period 15 November - 28 December. Also two supplementary videos will be added to the manuscript. Supplementary Video 1 - Sequential 6-hours of SLP and the corresponding accumulated precipitation (both from the 20CR) are represented between 15 November at 0UTC and 28 December at 18UTC; Supplementary Video 2 - Sequential every 6-hours of specific humidity and wind vectors at 900hPa (both from the 20CR) are presented between 15 November at 0UTC to 28 December 18UTC.

Pages 5823-5826: the section discussion and conclusion is mainly a repetition of the other sections of the paper. It has to be revised highlighting the new information provided by the paper and its significance in the context of the management of extreme precipitation events.

We acknowledge the reviewer comment. We will follow the reviewer's suggestion and ensure that the Discussion and Conclusion section will be improved, highlighting the new information provided in this work and its importance to contribute to a better understanding of the climatic driving forces of hydro-geomorphologic disaster events and corresponding impacts over Iberia.

Page 5837: figure 4 is not necessary as the same information is provided in table 2.

In fact, (old) figure 4 does not provide the same information as Table 2. Figure 4 shows the daily evolution of Disaster cases, fatalities and affected people in the Dis-

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aster 1909 event, in the Douro and the Tagus basins. Table 2 summarizes the social consequences in all affected hydrographic basin in Iberia, not providing the daily number of the impacts caused by the 1909 event. Therefore, we believe that it makes sense to maintain both.

Pages 5844-5845: the captions of figure 11 has the caption of figure 12 and figure 12 has the caption of figure 11. We acknowledge the reviewer comment and the Figure captions will be corrected.

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

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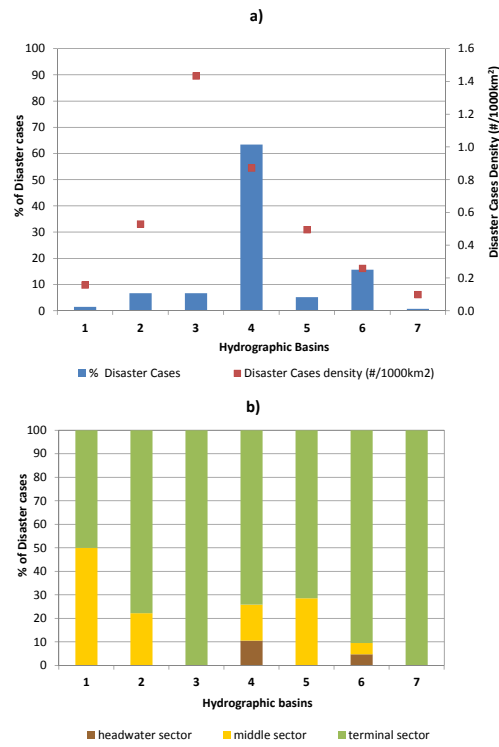


Fig. 1. Percentage of Disaster cases and Disaster cases density per hydrographic basin (a) and percentage of Disaster cases per hydrographic basin according to the location on the hydrographic basin sector. H