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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Sea extreme events during the last millennium in north-east of Morocco" *by* O. Raji et al.

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The authors would like to thank you for your valuable comments and suggestions, which will undoubtedly improve our submitted manuscript. All the comments are considered seriously and the corresponding corrections will be made in the new version of the manuscript. In the following parts you can ïňĄnd our reply to your comments:

Abstract

The abstract is almost exhaustive, but the number and type of events (Tsunami or storm) should be provided.

Re: Thank you very much for your advice, we have added it.

Introduction

The introduction should be improved. In particular the description of the main events that have affected the study area during the past. Should be also increased bibliographic citations of papers discussing similar approaches to the study of these processes. Why do you chose to make these analyses and not to use another dataset? Are these the most useful proxy to obtain the information on the paleo-extreme events?

Re: thanks for your advice, we will check this section. We agree that other proxy can be used to obtain the information on the paleo-extreme events. However, our study is pioneering in the Nador lagoon and the used proxies represent the best available data at the moment. Indeed, the selected proxy have been tested in several studies and given the good results (Woodruff, 2007; Dezileau, 2011, Sabatier, 2011, Das et al., 2013).

Study area

Could be helpful discuss some questions in order to clarify the chosen of the sampling site: are there some information about on the sediment accumulation rate variability in the lagoon? What are the main sources of the material?

Re: Thanks, we will check this section. The sediment accumulation rate of 0.15mm/an calculated by Mahjoubi, 2001 represent the only available data about the accumulation rate, but this rate was obtained from a single carbon dating without reservoir correction. Our results are the firsts using an age–depth model of high resolution combining radiocarbone multi-dates with 210Pb/137Cs datings.

There are indications about the seabed bathymetry. Could be useful to have sismobathymetric information about the seabed morphology, for example through chirp sonar or multibeam data. Could you check if is possible to find some of these information in literature?

Re: the average depth of the Nador lagoon is 4.8 m, with a maximum depth of 8 m

(Figure 1); these data are produced as part of the project MarchicaMed. A seismic study was carried out under the Mistrals/PaleoMex project in the lagoon at 2013 and the results will shortly be published.

Methods Please specify what kind of shell have you use to date the sediments.

Re: the lagoonal shells selected at different depths for 14C age determination belong to Cerastoderma sp and Abra Ovata.

Results and discussion Lithostratigraphy A briefly discussion about the different types of the contacts between the levels could help the reader to understand the formation processes of the deposits, for example the boundary between levels 2 and 3 is very sharp on the contrary among levels 1 and 2 the transition seems to be much more gradual.

Re: We agree with the reviewer and we will check this section and improve it by taking account of the reviewer's comments.

Geochemistry

In fig 3 the metals concentration in cps depth profiles are reported, I think that could be more constructive, use (and discuss) normalized profiles (i.e., vs. Aluminum), in order to discriminate the different source particles areas. Re: In this figure we preferred plot the XRF elements as a raw data. In the figure 8 inter-elements ratios are used to discriminate marine deposits.

Age-depth models and sedimentation rate

210Pbex profile showed in fig 4 reach the natural values (o for excess Pb) exactly at cm 30, the depth of the last sample. Some others deeper samples should be done. The short lives isotopes profiles are usually affected by mixing processes of the sediment (i.e. physical or biological mixing), but no information from x-Ray description are reported. The presence of bioturbation could influence 210Pb or 137Cs decay profiles, providing an over-estimate value the accumulation rate. This error should create an

inaccuracy in the radiocarbon Reservoir correction.

Re: We agree that the post-depositional mixing by biologic activity (bioturbation) can also affect 210Pb or 137Cs data interpretation. However, during the split of sediment core, any signal of sediment reworking by organisms has been observed (eg. tube-building polychaete). In addition, x-Ray images confirm the absence of physical mixing. In the other hand, the agreement between average sedimentation rates derived from 210Pb , 137Cs and 14C suggests that the various disturbing processes like bioturbation did not play a major role in the studied parts of the cores.

Sediments source

About the distribution of the materials in surficial sediments the authors reports that the concentration of the different metals are "in agreement with previous studies in the area" Please report these references. Authors suggests the use of Inter-elements ratio to trace marine sediments. Should be interesting a briefly discussion of the data (please add the citation of fig.8).

Re: This section has been checked by taking into account the reviewer's comments.

Storm or tsunami events?

As previous suggested the stable isotopes profiles (or other proxies) could help Authors to discriminate events from storm or tsunami.

Re: To date, distinguishing between tsunami- and storm wave-generated deposits is still challenging and an extremely difficult task. While there is a suite of criteria available (stratigraphy, geochemistry, grain size, characteristics)the origin of a deposit still be ambiguous, because some of the characteristics can be extremely similar for both processes. For Nador sediment core, no research has been carried out using stable isotopes but like a chemical signatures a similar signature is expected because of marine origin.

References

Several papers cited in the text have not been reported in the references list, on the contrary, the following reference is given in the bibliography but is not mentioned in the text:

Re: Thank you very much for your advice, we have checked it.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 2079, 2014.