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Interactive comment on "Extreme flood events reconstruction during the last century in the El Bibane lagoon (Southeast of Tunisia): A Multi-proxy Approach" *by* A. Affouri et al.

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Responses to Reviewer Comments

We thank the reviewer for his thoughtful comments and suggestions. His comments have improved the manuscript considerably. We have included almost all of the raised suggestions and below we present a point-by-point response to the comments.

 Interactive comment on "Extreme flood events reconstruction during the last century in the El Bibane lagoon (Southeast of Tunisia): a Multi-proxy Approach " by A. Affouri et al.

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Discussion paper

Anonymous Referee #2

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General Comments The paper shows that this site has the potential for developing reconstructions of past flood events, as demonstrated by the correspondence between silt layers and twentieth century flood/precipitation events. It is really showing the potential for future reconstructions, rather than giving new data at the moment. I think the paper could do more to emphasise the importance of the work. At the moment the abstract finishes with a statement that hydrological events can be reconstructed using sedimentary archives, which has already been shown elsewhere. Instead I would like to see more emphasis in the introduction, discussion and conclusion about what the wider implications are and why this site in particular may be important. For example: saying whether there are other reconstructions from this region that have reconstructed hydrological changes – and if not, highlighting that the paper shows that this site has the potential to provide this, which could answer questions on the recurrence intervals, magnitude changes etc... The manuscript organization needs improving, as there is some mixing of results, interpretation and discussion, which make it quite confusing at times. In addition I feel the English needs better proof reading before publication to ensure it reads well. I have made some changes to this but not throughout. Finally there are too many figures and some seem unnecessary so should be combined or removed. Specific comments

Page 3, line 1-3 – this should not be a paragraph on its own, so either remove or merge with previous paragraph

A paragraph has been included in the introduction accordingly:

“Few studies have been undertaken to reconstruct past flood events from lagoon sediments (Raji, 2014). Most of the studies were interested to flooding associated with both hurricanes and tsunamis where overwash deposits preserved within backbarrier lagoons and salt ponds can provide a means for documenting previous flooding ac-

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tivity. Heavy rain flooding events recorded within these environments are still poorly documented. Moreover we show in this study the importance of lagoon sediment series for reconstructing the flood activity in arid and semi-arid environment in an area where no other significant (and continuous) sediment series can be easily retrieved in fluvial valleys.

Page 3, line 17 – maybe use the word 'partially' before 'separated from the med...', as it looks on the map to not be completely separate.

We agree with the reviewer remark. We added in the revised version the word "partially".

Page 3, line 18 – are peninsulas 12 km, make it clear if this is the combined length or not

"The Eastern periphery of the EBL is partially separated from the Mediterranean Sea (Gulf of Gabes) by two peninsulas, each of about twelve kilometers long, namely Slob El Gharbi and Slob Ech Chargui (Medhioub, 1979)".

Page 4 – there is an extensive geological description here which I am not sure is necessary. I think cut this down and make it more clear which parts are likely to influence the watershed of the lagoon, and the area on which it is situated.

The Fessi river watershed covers all these geological formations outcropping in south-eastern Tunisia. It is necessarily to describe all of these geological formations however we have reduced this part of the manuscript.

Page 5, line 14-15 – this says that figure 3 shows that the precipitation events caused the flood events, however it only shows the precipitation records with no link to flooding. Remove the final part 'causing the flood events' or give more evidence.

We fully agree with the reviewer's suggestion.

Figure 2 shows that the watershed from Fessi River was affected by period of heavy

precipitation events causing floods. Five major precipitation events were recorded from these two stations (i.e. A.D 1932, A.D 1969, A.D 1979, A.D 1984 and A.D 1995). These events have induced large flood events on the Fessi River watershed (Poncet, 1970; Bonvallot, 1979; Ousslati, 1999; Boujarra et Ktita 2009; Fehri, 2014).

Page 7, paragraph 1 – make this paragraph about the dating into a sub section on its own because it doesn't fit in this one about the proxies used. I am not familiar with what 210Pbex is and I think it might be better to refer to it as simply Pb210, as you do in the rest of the paper. If it is necessary it should maybe be defined when it is first mentioned.

Conventionally we used 210Pbex as 210Pbex=210Pb measured- 226Ra. In the revised version, a newly extended sub-section (see section 4.2.2) has been dedicated to the dating. All over the text we have changed 210Pb as 210Pbex.

Page 7, paragraph 2 – as you just used PCA it might be better to start the paragraph with 'Principle Component Analysis was used to understand the relationship....' because this makes the link with what you say in the next sentence. I would also merge the last two sentences in this paragraph.

In the revised version we take into account the reviewer's suggestion: Principal component analysis (PCA)

Page 7, paragraph 3 – the first sentence suggests that you have made the measurements and then grouped them into 3 source areas, whereas I think you have actually taken samples from three different types of location and then present the characteristics of these. Change this first sentence to make it clear that this is what you did.

This part has been changed in the revised version accordingly:

"The collected surface sediment samples have been taken from three different types of location and the characteristics of these samples are then presented".

Page 9, paragraph 1 – in the first two sentences you have used 'sediment' in each

and then described three different origins – make it clear which sediment you are describing. I think in the first sentence you mean the lagoon sediment and in the second sentence perhaps terrestrial sediment, but I am not sure. So make this clear and also reference each sentence. Is the third sentence about ionic radius important to know for understanding the results? I think it needs removing. Finally, the last sentence repeats the results from section 5.1.1., so I think that you could delete lines 11 and 12 (ending the sentence with 'observations') and in brackets put 'see 5.1.1'.

In the revised version we take into account this suggestion.

Page 9, paragraph 2 – the sentence about detrital quartz (line 18-19) does not fit in here and should be removed. The end of the paragraph from line 18-22 is also more of an interpretation and doesn't belong here in the results. Also would need to reference line 20.

We agree with the reviewer comment. We modified the text accordingly.

Page 10, paragraph 1 – first sentence should be in the materials section, as it is about collecting the core – or delete this if it is already described in the methods. The final sentence in this paragraph is an interpretation, and I think would go better in an interpretation section.

We agree with the reviewer comment. We modified the text accordingly.

Page 10, paragraph 2 – I don't think you should chose a Pb210 model based on the downcore distribution of Pb activity (and Pb210 activity often has exponential curve), I think it should be based on understanding of the deposition at the site, for example I think the CF:CS model assumes constant sedimentation, whereas the CRS model does not. Look at the assumptions of this model and then justify it in the methods section, and also make sure that this is referenced as it is not here. In line 10 you say the range is down to 0.1, but in table 3 the lowest is 1.058. Also the Pb210 profile in figure 10 shows a big gap between 21 and 40 cm with no samples dated – would it

be possible to date between these? Without these depths you are not able to show where the equilibrium depth is (where Pb210 activity is around 0). I know that having this depth is important for the CRS model – I am not familiar with the CF:CS model so it may be different, but if possible further dates would help constrain the timing of the lowest flood layer.

The CF:CS model (Golberg, 1963; Krishnaswami et al., 1971) supposes a constant 210Pb flux and a constant sedimentation rate. Although the sedimentation rate in the lagoon is clearly variable, the CF:CS model can still be applied when typical lagoonal conditions prevail (Sabatier et al., 2008). It is the case for BL12-10 all along the core. In a logarithmic diagram, 210Pbex data define a straight regression line which allows us to calculate an average sedimentation rate. It is not necessarily to have intermediate points and to find the 210Pbex activity around 0 with this method. Indeed, this method differs from CRS method which must be performed with continuous measurements all along the sediment core. Furthermore, the accumulation rate estimated by 210Pbex (CFCS model) and 137Cs in this dynamic environment is not too bad (0, 37 cm/y with 137Cs and 0, 48 cm/y with 210Pbex).

Page 11, paragraph 1 – I would remove this section completely and move most of it (line 4-17) to the results (put it in section 5.1.2). The order of the figures would then also change.

We agree with the reviewer. In the revised version this part has been displaced accordingly. In the revised version, a newly extended sub-section (see section 5.1.3) has been dedicated to the PCA.

Page 12, lines 1-9 – the term ‘continental source’ appears here and it is unclear what this describes, as previously only marine, fluvial and aeolian sources are described. Either change it or explain what is meant. Also what is meant by ‘continental pole’ and ‘marine pole’ is unclear, maybe use the ‘sediments’ or ‘sources’ instead of ‘pole’.

In the revised version we take into account the suggestion of the reviewer.

Page 12, section 6.3 – I think it would help to have a paragraph or a few sentences at the start of this section clarifying the link between the sediment source characteristics and the sediment changes in the lake sediments. For example say that as the sediment from fluvial source was high in X,X,X then these characteristics in the core sediment will be used as a basis for interpreting flood events.

We agree with the reviewer's comment. This section has been changed (see section 6.4) and a paragraph was added in the revised version:

Our multi-proxy analysis on the BL12-10 core shows that sediments with high content of clay+silt, as well as high Fe/Ca and Ti/Ca elemental ratios would be the sedimentological signature of the paleoflood levels identified in the lagoon sequence. Dating of the three most recent flood deposits provides ages of AD 1995 $\pm$ 6, AD 1970 $\pm$ 9, and AD 1945 $\pm$ 9. The results show striking temporal correspondence of these layers to heavy precipitation events recorded in the region since the 20th century. Such a good correlation between flood deposits and historical and instrumental heavy rain precipitation events suggests that flood deposit paleohydrology constitutes a valuable tool for flood assessment in the southeastern Tunisia.

Page 13, line 2 - remove this sentence as it repeats the previous one.

This sentence has been removed accordingly.

Page 13, line 5-6 – I also feel this sentence is repetitive and has no reference, so should be removed

In the revised version this sentence has been removed accordingly.

Page 12 and 13 - This is a very long paragraph so I would split it into three, with new paragraphs at page 12 line 23 ('From our age model...'), at page 13 line 6 ('Using the same approach') and page 13 line 14 ('Finally')

In the revised version we take into account this suggestion.

Page 13, line 11-13 – I am unclear what is meant by 'most of the sediments'. Did these studies show that sediment deposits were left by the 1969 event in particular? It is also not clear which event is being referred to as the latter event, so make it clear which it is.

The geochronology of the FL2 flood deposit extends from AD.1965 to AD.1980. Between these dates, two historical extreme flood events are known (AD.1969 and AD.1979) and one flood event of lower magnitude (AD.1972). Only one deposit occurs in the case of the BL12-10 core. Consequently, we assume that this unique flood deposit is linked to these three high precipitation events (i.e. AD.1969, AD.1972 and AD.1979). The sedimentary supply from the different rivers in relationship to these heavy precipitation events has been trapped in the inundation plain, in the Lagoon and probably transported to the Mediterranean Sea through the passes. The sedimentation rate belonging to these events in the lagoon is not very high. Otherwise, these events are sedimentologically and geochemically recorded. Bioturbation and bottom currents in the lagoon have probably smooth the signal. Finally, the three extreme flood events are registered as only one deposit in our sedimentary archive.

Page 13, line 17-19 – I agree with this statement about the constraints on your pb210 dating, but maybe acknowledge this sooner in the results section

We agree with the reviewer remark.

Figure 1 and 2: these could be combined, as the geological map could be put in place of the lower map on figure 1 which spans the same area and doesn't show much additional information.

We agree with the reviewer. These figures 1 and 2 have been combined as figure 1.

Figure 5: This is interesting but I think it may not be important enough to require a figure. There are a lot of figures, so this might be one to remove. Also the figure caption refers to samples which are not shown on the figure (e.g.S4) so these should

not be mentioned.

As suggested by the reviewer 1, the figure has been modified.

Figure 7 and 8: it is clear from the graph that the values are percentages, so remove this from the caption. These two figures could be combined, as they show the same type of data.

In the revised version we take into account this suggestion. These figures have been combined as figure 6.

Figure 11 and 12: these are important for the interpretation so I think these figures should come earlier (before the figure 9 and 10 showing the core results). I think if the PCA section is moved to 5.1.2 as I suggest above then this should come forward, and figure 12 could also be introduced there as well. The paper might read better if there is a clear first part looking at the catchment sources, followed by the results from the core.

We agree with the reviewer. These figures have been reordered accordingly.

Figure 13: this compares the precipitation and sediment cores using both depth and age. I understand that the pb210 model is not perfect but it might be better to have an additional x-axis on the top graph showing the estimated age, or at least ages marked on at the boundaries of the flood periods so that you can see the timings of these just by looking at the figure without needing to read the caption. Also, in black and white the bar for FL1 does not show up well.

This figure has been changed as suggested by the reviewer (see figure 13).

Table 1: this could go in supplementary information. It is clear on figure 4 where they are all located and in the next table you state the type of locality they are.

In the revised version this table has been removed.

Technical corrections

We thank the reviewer for his help in the text editing. All of the technical corrections have been changed accordingly.

Page 1: Title – ‘spanning’ might be better word than ‘during’. Also, there is an uneven use of capital letters. Changed

Line 10 – flood not floods Changed

Line 11 – ‘Recent studies of’ not ‘Recently, study of’ Changed

L12 – ‘have enhanced’ not ‘contributed to enhance’ Changed

L14 – I think it should be ‘multi-proxy approach’ not ‘multi-approach’. Also rethink word ‘associating’ and maybe use ‘combining’ Changed

L16 – change to ‘sediment deposits’ Changed

L17 – remove ‘s’ at end of sediments Removed

L22 – ‘flood’ not ‘floods’ Changed

L23 – Chronology should not have a capital letter Changed

L22 and L23 – merge these sentences perhaps ‘...137Cs chronology, and give ages of AD 1995....’ Done

Page 2:

L1 and L2 – remove first half of sentence maybe up until suggests and then merge with previous sentence, as the part starting ‘Such a good correlation...’ is repeating the previous sentence. Removed

L3 – maybe add ‘in this location’ after ‘possible’ because this does not prove that this method would work everywhere. Also, ‘rendered’ is not necessary. Changed L12 – ‘flood events’ Changed

Page 3:

L5 – either south of Tunisia, or Southern Tunisia

Changed

L5 to L11 – description of aims needs rewording. For example, say ‘The first aim of this research was to identify...’ not ‘First aims’. You could also call them ‘stages’ rather than aims. I think the part about the Pb and Cs dating methods is not needed here. Changed L14 – remove word ‘which’ and there is no need for the first ‘km’ Changed

L15 - add ‘and’ after axis and remove word ‘up’. Km should not be capitalised. Add ‘a’ before 6m Changed

L20 – is the word ‘slobs’ the technical word or a local word. If it is local maybe use word peninsula Changed

Page 4: L1 – L3 – merge these two sentences perhaps. Also change to ‘has low demographic pressure’ Changed

Page 5:

L4 and L5 – reference these two weather facts. I also do not understand the term ‘unequally spatiotemporal repartition’ so maybe consider changing Changed

L7 – change to ‘is concentrated within 30 days/yr (...’ Changed

L8 – typo of Mars not March Changed

L8 – change to ‘while in the summer months there are drought conditions’ Changed

L10- L13 – Merge first two sentences of this paragraph. Maybe move ‘obtained from the Directorate Reseach of Water Resource (ref)’ to follow watershed in line 10 and remove rest of the second sentence. Changed

L15 – change to ‘precipitation events’ not ‘precipitations’ Changed

L16-17 – the sentence beginning ‘During flood events...’ needs a reference

References added as (Poncet, 1970; Bonvallot, 1979; Ousslati, 1999; Boujarra et Ktita 2009; Fehri, 2014).

Page 6:

L7 – be careful of the spacing between the sample names

Done

L12 – add ‘a’ before combination Done

L13-15 – It might be better to merge these two sentences that describe the XRF analysis Done

Page 9:

L10 – do you mean microscope rather than binocular?

We mean “Binocular observation”

L17 – remove ‘of the southern Tunisia’ because you are referring to your samples rather than the wider region. Removed

Page 10:

L12 – use ‘Constant Flux: Constant Supply (CF:CS)...’, so capitalize it and add brackets Done

Page 11: L20 – ‘To precise the modern contribution of these...’ doesn’t make sense so reword

This sentence has been modified. Ca, Ti and Fe elements have been chosen in order to recognize the contribution of these sources to the surface sediments of the Lagoon (see section 6.3).

L21 – change ‘Lagoon’ to lagoon Done

L23 – remove ‘South-eastern Tunisia’ as you are considering the sand dunes close to

your site rather than those throughout this part of Tunisia. Done

L24 – instead of ‘cf chapt 5.1.1’ put ‘see section 5.1.1.’ Done

Page 12:

L2 – be consistent in use of either Fe or Iron. Merge sentences on L1 and L2

We agree with the reviewer. In the revised version we take into account this suggestion: “On the other hand, Fe is present as a maximum in the river samples and as a trace element in marine samples”.

Page 13:

L16 – give reference or refer to a figure if it is shown in one.

The 1932 flood event registered in south Tunisian historical archives and data (Fehri, 2014).

L24 – use different term than ‘heavily precipitating events’ e.g. high intensity precipitation events. Done

L 25 – use ‘Furthermore’ rather than ‘on the other hand’, as you are not contradicting yourself but rather making another point. Done

Page 14:

L8 – change to ‘discriminate between the...’ Done

L15 – reconsider phrasing of ‘have permitted to identify’, maybe ‘have allowed us to identify’ Done

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