Clim. Past Discuss.,
doi:10.5194/cp-2016-40-AC4, 2016

Climate of the Past Discussions
Open Access
EGU

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.

A. Affouri et al.

aidaemna@yahoo.fr

Received and published: 8 September 2016

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.

Clim. Past Discuss., doi:10.5194/cp-2016-40-RC4, 2016 © Author(s) 2016. CC-BY 3.0 License. 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. Anonymous Referee #4 Received and published: 2 July 2016 General

Printer-friendly version

Discussion paper

comments

The paper focuses on the study of historical paleofloods from a high-resolution geochemical and sedimentological analysis of a sediment core from El Bibane Lagoon (Southern Tunisia). The paper deals with two main objectives: to identify the main sediment sources within the Tataouine and Mednine watershed areas and to decipher El Bibane lagoon sediment record in order to evidence some historical flood events. The first part -concerning the sedimentological and geochemical characterization of potential sediment sources from the lagoon watershed -is rather convincing even if the approach remain very classical and not innovative. The second part - related to the analyse of the sediment core from El Bibane Lagoon - successfully evidences that some fine-grained and Fe and Ti-enriched layers are likely related to historical major flood episodes according to the absolute dating of the core. Once again, the approach is fine even if rather classical, since it demonstrates the potential use of the proposed multi-proxy approach in order to identify paleoflood events in sedimentary sequences. In general, the objectives mentioned above are somehow reached by the proposed work, but the relationship between these two objectives is not clearly demonstrated in the paper as it is written. Furthermore, these objectives are not clearly stated in the manuscript. Finally, the relationship between these two parts is not further discussed in the manuscript. The main results from the first part need to be thoughtfully used when discussing the sediment record. These particular points need to be improved before publication. The proposed multi-proxy approach (sedimentology, elemental chemistry, statistical analysis) is adequate. Nevertheless, some major points need to be improved since the interpretations are not fully demonstrated nor convincing as they are presented: for instance, the complete description of the methods should be addressed carefully, the significance of results, including error and limit should be discussed thoughtfully.

Specific comments

Some re-organisation/modifications are recommended in order to improve the manuscript: - Section 2, p4 lines 4-25, these paragraphs may be moved to p3 line 13

We are fully agree with the reviewer's proposal. In the revised version we take into account this suggestion and these paragraphs have been moved.

- Section 4, move the sentence p5 lines 22-24 to the end of the paragraph p6 line 8

This sentence has been moved in the revised version.

- Section 4, p6 lines 3-4: I guess that the samples from the watershed area were selected before sampling in order to characterize the main potential sediment suppliers to the lagoon. As it is written, it seems that the samples were chosen arbitrarily. I suggest to replace the sentence: "In order to characterize main sources, these surface sediments were subdivided into four regions as:" by " The main potential sediment sources were sampled in order to characterize their sedimentological and chemical signatures as follow: - three samples from the beach area (S1, S2 and S3) representing the marine source, ten samples (S7 to S16) from Fessi Oued catchment representing the fluvial/river sources, two dune samples (S17 and S18) representing the eolian component. Moreover, three surface samples (S4 to S6) from El Bibane lagoon have been selected to represent present-day sedimentation.

In the revised version this part has been replaced.

- Section 4, Analytical Methods are not properly described. Some important information are missing: o The sediment core lithological description should be detailed, organic-rich clay (mentioned p10 line 2) are mentioned but not shown;

In the revised version, we describe the analytical methods in detail (see section 4.2)

o The XRF method should be detailed (apparatus, sample size for discrete surface sediment, error, standard deviation, etc.); Calibration of XRF data and conversion as percentages;

We agree the reviewer and we take into account this suggestion in the revised version:

“For elemental analyses of the bulk sediment a portable energy dispersive X-Ray fluorescence NITON XL3t was used. This technique delivers fast and accurate elemental analysis results, from a few ppm to percentage. XRF-scanning analyses are done directly on the sediments of the BL12-10 split-core section. The split-core surfaces were first flattened and covered with a thin (4 μm) Ultralene film to avoid contamination of the measurement prism of the core scanner (Richter et al., 2006). All surface samples were prepared for XRF-bead analysis by powdering and homogenizing of the dried samples using an agate mortar. The resulting powder was dried for 2 h at 105°C and kept in a desiccator at room temperature. Ca. 4 g of the powdered samples were placed in plastic cups and sealed with Mylar foil (0.4 μm). The prepared sample cups were placed on the XRF and measured for 120 sec with different filters for the detection of specific elements. Two filters were used with the following adjustments: main measuring 90 s at 10 kV tube voltage with 40 μA for Al, Si, S, Cl, K, Ca, Ti, Mn, Fe and 30 kV tube voltage for Zn, Br, Sr, Rb, Zr with 40 μA. The portable XRF scanner (NITON XL3t) has been calibrated and checked on all NITON XRF calibration standards and is certified as “Passed” by Thermo Scientific Portable Analytical inst. Lnc. In our study, the XRF-scan data will be presented as processed intensities expressed in ppm or in percentage. The elemental analyses from XRF measurement were performed each 2 cm step in mining type ModCF prolene mode. These data show directly concentrations in ppm or percentage values. This is a semi-quantitative measurement. International powder standards (NIST2702 and NIST2781) were used to assess the analytical error and accuracy of measurement, which are lower than 5% for Ti, Cr, Fe, Zn, Pb, between 5 and 15% for Ca, Mn, As, Rb, Sr, and between ca. 15 and 25% for K and Co”.

o Grain-size analysis: size/volume of analysed samples, main parameters of the measurements, duration of the measure, reproducibility, error, effect of ultrasound on carbonate shells, etc.

We agree the reviewer and this part have been modified:

“Laser grain-size analyses were achieved with a Beckmann- Coulter LS13320 Particle Size Analyser (Geosciences Montpellier). Grain-size analyses were performed on the BL12-10 sequence with an average interval of 1 cm. For each sample, a small homogeneous amount of sediment was mixed in deionized water then sieved at 1.5 mm diameters before pouring in the Fluid Module of the Particle Sizer until to obtain an optimal obscuration rate between 7 and 12% in the Fraunhofer optical cell. The time of background and sample measurement was set to 90 s and sonication was applied during the measurement of the sample in order to improve the dispersion of fine particles in the fluid. Each sample was measured twice and the good repeatability of measurement was verified according to the statistics from the international standard ISO 13320-1. GRADISTAT program version 4.0 (Blott, 2000) was used for grain size statistical analysis. Sample statistics are calculated using the Method of Moments in Microsoft Visual Basic programming language: mean, mode(s), sorting (standard deviation), skewness, kurtosis, D10, D50, D90, D90/D10, D90-D10, D75/D25 and D75-D25. Grain size parameters are calculated arithmetically and geometrically (in microns) and logarithmically (using the phi scale) (Krumbein and Pettijohn, 1938). Linear interpolation is also used to calculate statistical parameters by the Folk and Ward (1957) graphical method and derive physical descriptions (such as “very coarse sand” and “moderately sorted”.

- Section 4, Statistical analyses:

o The whole method should be discussed, including input and output parameters, pretreatment of data, etc.

The whole method has been concisely and suitably described in the section 4.2.3 in order to shorten the manuscript.

We are fully agree with the reviewer’s suggestion. See paragraph below which has been added in the statistical analyses section:

“Statistical methods were applied to complete and refine the analysis. Principal Component Analysis (PCA) is widely used statistical techniques in environmental geochemistry. This multivariate approaches is used to reduce the large number of variable that result from XRF analysis. Principal Component Analysis (PCA) was applied to chemical elements in order to distinguish the different sediment sources of surface sediments and link them to the geochemical processes or proprieties. In the present work, the dataset contains 18 samples, each of which includes concentration of 8 elements (Ca, Sr, Fe, K, Al, Ti, Si and Zr). Data are presented in the form of elemental concentration (8 variables). In this study, a statistical analysis was performed using the STATITCF (1987) which is based on variables and it is suitable for identifying the associations of variables with a set of observations. A representation quality of the parameters (positions in the factorial plane) was then performed".

o Explain why the grain-size parameters were not included in the dataset for PCA?

The grain size parameters were not been included in the dataset for PCA because we think that the granulometric profiles were sufficient to discriminate the different sediment sources (aeolien, fluvial and marine). Furthermore the PCA application to grain size is redundant.

- Section 5, Results,

5.1.1 sediment description.

The results should be given properly:

o The grain-size parameters should include the mode, median, sorting (when unimodal);

We are agree with reviewer and we take into account this suggestion in the revised version Grain size parameters have been calculated using the GRADISTAT program (see tables 1 and 3)

o The main sediment class should be mentioned (clay, cohesive silt, sortable silt, sand);

In the revised version, please see tables 1 and 3 below which added.

o The photos and observations from figure 5 should be described in much more detailed since they could serve as discriminant (for instance the S17 and S18 observations are rather different, explain why?; the eolian particles as quartz are known to have peculiar morphology);

We think that the difference between S17 and S18 could be explained by a different mechanism of eolian abrasion/transport. There is probably a short transport of aeolian material from the source into S17 dune fields and a long transport of aeolian material from the source into the S18 dune fields. This interpretation is supported by the sorting character of the dune sands from each of these two sites (very well sorted to well sorted sands respectively). Moreover, sources are in the proximity of alluvial deposits of the River Fessi and Matmata loess in the Southeast of Tunisia. This could also explain a part of these differences.

o The significance of variations range should be discussed. The clay fraction varies between 1 and 2% (Figure 9). What about the significance of such a variation?

The BL12-10 core was retrieved in the El Bibane Lagoon from the nearest part of the Fessi River delta. Surface sediments samples show that the finer fraction <2μm (clay) vary between 1 and 2%. This low content could be explained by the redistribution of this finer material by hydrodynamic waves and bottom currents in the lagoon. The fine fraction is redistributed by bottom currents and transported into the middle part of the Lagoon and/or toward the sea. Medhioub (1979) showed that the clay fraction do not exceed 2% in the surface sediment of El Bibane Lagoon around Fessi river delta. Our results corroborate this observation.

o The results from samples S4 to S6 shown in figure 6 are not discussed within the main text?

We agree the reviewer. In the revised version, a paragraph has been added:

“The El Bibane Lagoon surface sediments samples S4, S5 and S6 are characterized by multimodal grain size distribution (Fig. 5). The grain size distributions of sample S4 show polymodal very poorly sorted sandy mud named very fine sandy very coarse silt with trimodal distribution at 154μm, 31μm and 96μm. The sample S5 is unimodal, with mode in 116μm, moderately sorted type named very coarse silty fine sand sediment with a muddy sand texture (Folk, 1954; Folk and Ward, 1957). The sample S6 is very coarse silty very fine sand sediment, with a bimodal distribution in 106μm and 429μm, poorly sorted muddy sand”.

o The differences between samples S7 and S10 should be emphasized (4 modes for S7 on figure 6 and the coarsest mode for S10 being smaller than 100 μm according to figure 6, the fine fraction seems over-represented for sample S18, etc.);

We added a new paragraph as well as a new figure in the text:

"In order to obtain the best resolution in the identification of the fluvial source, we choose to use the sediment samples which were collected only along the River Fessi: S9, S10, S12 and S13. These surface sediment samples show a decrease in the mean grain size from upstream to downstream of the River Fessi watershed (Fig .6). The decrease in the mean grain size could be explained by a strong change of the topographic slope around Tataouine. Here, the coarser material is deposited and the finer material is transported away by the river. These finer sediments are deposited in the low plain of the river and in the El Bibane lagoon. Therefore, we suggest that S9 and S10 (collected between Tataouine and the lagoon) characterize our fluvial component in the lagoon. The grain size distribution for S9 is unimodal with a mean grain size around 96 μm and moderately sorted muddy sand named very coarse silty very fine sand and sample S10 is fine silt with trimodal distribution in 7μm, 26μm and 73μm, and poorly sorted mud sediment type. These characteristics will serve to identify the fluvial source into the lagoon”.

o The sorting of samples S17 and S18 should be calculated since it appears to be discriminant in term of eolian source.

In the revised version we take into account this suggestion:

"Unimodal distributions in 116μm characterize the aeolien samples S17 and S18. These samples are very well sorted (S17) and well sorted (S18) very fine sand".

- Section 5, Results,

5.1.2 Distribution of major and trace elements:

o The matrix effect (carbonate vs. quartz) should be major: are there any CaCO3 measurements? It would help to evaluate this matrix effect;

The results could be affected by matrix effect, sediment humidity, etc. Even though these effects exist, they have not major influence on the results. We have performed numerous XRF measurements on different standards. Please, see paragraph added in the revised version:

"The elemental analyses from XRF measurement were performed in mining type ModCF prolene mode. These data show directly concentrations in ppm or percentage values. This is a semi-quantitative measurement. International powder standards (NIST2702 and NIST2781) were used to assess the analytical error and accuracy of measurement, which are lower than 5% for Ti, Cr, Fe, Zn, Pb, between 5 and 15% for Ca, Mn, As, Rb, Sr, and between ca. 15 and 25% for K and Co".

o p8 lines 17 to 20, the authors described the behaviour of iron: "The iron displays its highest percentages in the Fessi River samples. Lower values characterize the eolian dunes whereas this element is totally absent in marine sediments. This same distribution is also observed for Ti, K and Al: : :". According to figure 7, I do not agree with this sentence: Fe is indeed maximum in samples from the Fessi River but more generally Fe content is highest in samples from the Mednine and Tataouine catchment areas and from Fessi River. Ti is also highest in samples from Mednine and Tataouine watershed areas, but not in samples from the Fessi River itself (figure 7), whereas K

and Al are only higher in samples from the continent compared with marine samples.
o p9 lines 4 and 5: Sr concentrations are obviously lower than Ca concentrations! This is not new!

We are fully agree with the reviewer's remark. In the revised version this part has been modified

o p9 lines 9 to 12, the authors write "these results corroborate the marine origin: : :" but this is not correct. The samples are marine samples, and the fact that Ca content is high is only consistent with that fact that samples are marine samples with a dominant biogenic component.

In the revised version this part has been modified:

"Ca in the marine samples is high. The high percentage of Ca in these samples is related to both the significant presence of biogenic material, but also probably the precipitation of authigenic carbonate."

o p9 lines 13 to 15, this sentence appears to be rather obvious: Si is a major component of alumina-silicate (obviously as silicate) and of quartz (which is pure SiO2); only the eolian samples are characterized by high values, so Si enrichment could be used as a diagnostic for eolian provenance;

- Section 5:

o 5.2 core description (p9 and 10), this section should rather appear in the material section 4.1;

We change this section in the revised version (See section 4.2).

o The description of the grain-size variations is absolutely not sufficient. A complete description (including mode, median, sorting, clay fraction, silt fraction, sand fraction, etc.) should appear (with a dedicated paragraph), as this is absolutely essential for identifying potential paleoflood events! I do not understand why these results do not appear in this section;

We added a complete description of the grain-size variations for the core BL12-10:

"The sediment sequence from El Bibane lagoon presented in this study come from the core BL12-10 retrieved from the nearest part of the delta of Fessi River in May 2012 (Fig. 3). The lithotological description of the first 30 cm core showed coarse-grained layers of siliciclastic sand and shell fragments inter-bedded with organic rich dark grey fine grained sediment (mud) of clay and silt. Three mud layers were identified from 6 to 10 cm, 14 to 18 cm and finally from 26 to 30 cm core depth. The high-resolution grain-size analysis of BL12-10 core showed several thin, fine grained and sand sediments layers (Fig. 8). The more prominent mud layers are typically composed of clay and silt sediments. Grain size parameters are calculated by Statistical analysis (GRADISTAT program version 4.0; Blott, 2000) and the nomenclature of grain size classifications follows Folk and Ward (1975). Analysis of BL12-10 samples for sediment grain size demonstrated that sediments were composed of muddy sand as a mixture of fine and medium grains (e.g. very coarse silty very fine sand). The BL12-10 core is dominated by the bimodal and trimodal grain size distributions. These distributions were labeled as very coarse silty to very fine sand, poorly to very poorly sorted, fine skewed with leptokurtic distribution (Table 3)"

o The chronological aspect should be discussed before the sedimentological and geochemical results (§5.3 should appear as §5.2.1) :

For the coherence of the manuscript we prefer to discuss the core description before the chronological data because these latter were studied on the sedimentary sequences. For this reason the section "core description" must appear before.

o 5.3 dating: I would like the authors to discuss the impact of major flood events on the sedimentation rate;

The examination of the 210Pbex profile shows that the FL2 was characterized, more or less, by constant 210Pbex values. This suggests that FL2 represents a succession of extreme flood events close in time. However, the low measurement resolution as well as the bioturbation could smooth the signal. That is why it is difficult to discuss accurately in this paper the effect of major flood events on the sedimentation rate. This could be a perspective for a future work at high resolution.

o I suggest some modification as follow: âĔŸA ′c §5.2.1 Pb and Cs dating âĔŸA ′c §5.2.2 grain size/sedimentological results âĔŸA′c §5.2.3 XRF results

In the revised version, this section has been modified:

"5.2 Core BL12-10

5.2.1. Core description and grain size analysis

5.2.2. 210Pb and 137Cs dating"

o The complete description of XRF data (with a dedicated paragraph) should also be included!

We do not discuss in this paper about all XRF elemental data. We believe this is not necessary. It will take a whole page to discuss and the article is already long. We only discuss the geochemical ratios Fe/Ca and Ti/Ca of surface samples. These geochemical ratios have permitted the characterization of the three sediment sources (aeolian, marine and fluvial) and have been applied to the BL12-10 core samples. This approach was used to identify the variation of the sediment source supply to the lagoon and the past flood events in BL12-10 core.

- Section 6, §6.1 PCA

o This paragraph should be included in the result section (§5.1.3 Principal Component Analysis) and should not appear in the discussion

As suggested by the reviewer 4, this section has been moved as §5.1.3 in the result section.

o Explain why the PCA does not include grain-size data?

In this study, the grain size parameters were not included in the dataset for PCA because we think that the granulometric profiles were sufficient to discriminate the different sediment sources (aeolien, fluvial and marine).

o Is this reference adequate? (p11 line 4, Windston et al., 1989)

We agree with the reviewer's remark. This reference has been removed in the revised version

o p11 lines 11-13, "The first component represents therefore the fine fraction of the sediment, which is mainly composed of various types of clay minerals, usually abundant in surface sediments"; this conclusion is not supported by the dataset since the grain-size analyses are not included in the PCA. To my opinion Factor 1 is mainly related to the matrix which is either calcium dominated or alumina-silicate dominated, in other words, Factor 1 depends on nature of the sediment: carbonate (i.e. biogenic component in this particular case) or alumina-silicate (i.e. detrital or terrigenous component); o p11 lines 16-17, the following conclusion "These two factors differentiate hence marines carbonates to continental components" is once again not fully supported by the PCA analyses since grain-size is not taken into account in the PCA. Actually, the fact that Zr (and Si) likely drives Factor 2 suggests that grain-size should be one forcing factor. I suggest the author to check this conclusion by including grain-size analyses in the PCA input;

We agree the reviewer that grain-size is not taken into account in the PCA. Each sample which has been analyzed by XRF and PCA has been analyzed by Laser granulometry. Therefore, we could associate watershed samples to specific granulometric fractions. i.e samples from the watershed which were collected in the River Fessi. These samples are characterized by multi-modal grain size distribution, whereas, those from the Aeolian source show unimodal distribution.

Printer-friendly version

Discussion paper

o I do agree with the conclusion that 1) Ca and Sr may be used to retrace the marine component, 2) Al, Fe, Ti and K may be used to retrace riverine supply and 3) Zr and Si may be used to retrace the eolian contribution, but I am not fully convinced that PCA is useful to demonstrate this commonly accepted statement. - §6 Discussion o The choice of the parameters should be better justified, for instance explain the fact that Zr is not further used?

Statistical analyses of geochemical data have permitted to characterise and to distinguish the different sediment components around El Bibane lagoon. Ca, Ti and Fe elements have been chosen in order to recognize the contribution of these sources to the surface sediments of the Lagoon. Zr is present in the three components. In our region, Zr concentrations are not sufficiently discriminant between these different sources. o p12 lines 3-4, Ti/Ca and Fe/Ca ratio appear to reflect solely the marine component. I suggest to use “supply” or “contribution” or “component” instead of “pole” since the paper is not dealing with end-members;

We agree with the reviewer: we used “contribution” or “component” instead “pole”

o p12 lines 4-9, this part of the discussion is a bit clumsy. It is clear from Figure 12 that these ratios are efficient in discriminating the “continental source” (in this case the eolian source) and “marine source” and the text mentions that “El Bibane lagoon surface sediments are situated between marine and continental sources”. But, according to Figure 12, the sediments from El Bibane are in fact situated between the Marine and Fluvial sources, while the pure “eolian” contribution is likely not significant.

We are fully agree with the reviewer’s suggestion. In the revised version this has been modified.

o §6.3: in this paragraph, it is not clear if the paleoflood sequences were first identified thanks to their lithological aspects, or if they were identified using both grain-size and elemental ratio? This point should be clarified;

Printer-friendly version

Discussion paper

We agree with the reviewer. The paleoflood sequences were first identified using both grain-size and elemental ratio. This paragraph has been changed as:

"The BL12-10 core shows different mud layers (clay and silt mixture) preserved in the core which seems to be flood layers, i.e., coming from fluvial incursions during intense flood events. Multiproxy analysis on these mud layers show that they are characterized by high content in clay+silt, as well as high Fe/Ca and Ti/Ca elemental ratios which represent the sedimentological origin of the watershed. Consequently, these layers register past flood activities of the River Fessi".

o p12 lines 13-14: the sentence ": : :high content of the clay and silt and high content of the elemental ratio" should be replaced by ": : :high content in silt and high elemental ratio: : :"

In the revised version we take into account this suggestion and this sentence has been replaced.

o p13 lines 20-25: the hypothesis of multi-phased flooding is not supported by the data (see figure 13);

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.

- Conclusion

o p14 lines 4-6: please add “sedimentological and geochemical characterization”, change “in order to reconstruct” by “in order to identify the specific signature of paleoflood events”;

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

o p14 lines 10-11: change “: : :are situated between marine and continental end members” by “are situated between marine and river sources”.

We agree with the reviewer. The continental end members have been change in the revised version.

o p14 line 12, the term “clay” should be omitted since it only represents <2 % of the sediment.

We prefer to keep this term even if it represents only 2% or less because it defines the contribution of the watershed.

Technical corrections

The English spelling and grammar should be checked carefully. Please check the consistency of some terms, for instance “Mednine” or “Medenine” should be used consistently throughout the text and figures. Done

Some sentences/wording are not correct: - p1 line 18: “high content of the clay and silt” is not correct, replaced by “high content in clay and silt”

As suggested by the reviewer, some sentences/wording has been corrected.

- p1 line 19 (and within the main text): “high content of the elemental ratio” is not appropriate; transform to “high elemental ratio”

In the revised version, this sentence has been transformed.

- p3 line 21: “Tyrrhenian” should be explained (it is explained on page 4, but should be explained on its first appearance)

Done (See section.2)

- p4 line 7: Matmata is missing on figure 2

Matmata has been added in Fig. 2

- p5 line 4: change “the number of sunny days may reach 64,4%” by “the number of sunny days may reach 64%” Done

- p5 lines 4-5 : “The rainfall : : : annual average that does not exceed 200 mm”. This average should be drawn on Figure 3; - etc.: : : Done

Some of the references (from the references list) are not used within the text:

- Prospero et al., 1981 - Raji, 1984 - Torres-Padron et al., 2002 Done

Some references are not correctly used within the main text: Done

- p2 lines 15-16: Becker et al., 1989 should be replaced by Becker, 1989 Done

- p2 line 20: Noren, 2002 should be replaced by Noren et al., 2002 Done.

- p2 lines 22-23: Liu et al., 1993 should be replaced by Liu & Fearn, 1992 Done

- p2 line 23: Donnelly et al., 2007 should be replaced by Donelly and Woodruff, 2007. Done

- p3 line 20: Medhioub, 1981 should be replaced by Medhioub & Perthuist, 1981 Done

- p4 line 3: Pilkey et al., 1989 should be replaced by Pilkey, 1989 Done

- p4 line 2: Bouougri, 2012 should be replaced by Bouougri & Parada, 2012 Done

Figures:

- Figures 2 and 4 could be gathered in a unique figure; the bottom insert in figure 4 could be removed; Done

- Figure 2: the reference Ben Haj Ali et al., 1985 is missing in the references list, check the colour variations between Neogene and Paleogene, and between Permian and Permo-Trias; Done

- Figure 3: I suggest to use only diagram, reference is missing; Done

- Figures 7 and 8, I suggest to use distinct symbols for eolian (diamond), marine (square) and river samples; Done

- Figure 9: add some parameters (mode, median, etc.) and specify the considered grain-size fraction (sortable silt, cohesive silt, fine sand or give the size range <63_m, >63_m, etc.); Done

- Figure 13 could be associated with Figure 9. Explain the difference between Figure 13(b) and figure 3? Figure 3 could thus be removed.

As suggested by the reviewer, figure 13 b has been changed as figure 2.

Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2016-40, 2016.