**We would like to thank Dr. Curt J. Stager and the anonymous reviewer for their insightful and constructive comments and suggestions.  Below, we address the reviewers' suggestions, comments, and concerns. The original reviewers' comments are highlighted in italic and followed by our responses highlighted in bold letters.**

**Comments by Anonymous Referee #2**

*The article of Weldeab et al. proposes what is considered to be a new suite of records reflecting conditions in southern Africa's winter rainfall zone. This is certainly a under- studied region, but it is not clear that the records reflect, in fact, conditions in the winter rainfall zone, derived as they are from Orange River sediments, whose catchment is in the summer rainfall zone.*
*The record and questions are highly challenging, and will require a substantial amount of calibration work to determine sediment source. Until this work is done, and appropriate analyses are undertaken, the record presented will remain of ambiguous values.*
*With substantially more work, the data presented could be a valuable contribution, but as it stands I do not see the submitted paper to be a useful addition to the literature.*

*As the underlying data do not appear to be fundamentally flawed, major revisions, including significant calibration work on the Orange and coastal river sediment sources, could provide a context for a reliable treatment of the data. Until this work is done, I would not consider any interpretation reliable.*
*Detailed comments below.*

**In the revised version of the manuscript, we include and discuss the patterns of K and Ti distribution analyzed in core-top samples from the mudbelt (Govin et al., 2012). The K and Ti analyses along with the distribution pattern of ilmenite, a Ti-bearing mineral, within the mudbelt provide a useful tool to interpret the down core variation of K/Al and Ti/Al. In page 10-11 (line 16-3) we provide detail discussion regarding the source and transport mechanism of terrigenous sediment. Based on published paper, we also show that modern dust input of 7-10 g/m2/year from the Namaqualand constitutes a significant source of coarse grain sediment (page 9, line 5-26). Our radiogenic isotopes of river-bed sediment combined with the K and Ti results of core-top analyses as well as grain size distribution of the core-top sample provide the basis for a interpretation of the multiproxy record.**

**Below we address the reviewer's comment and concerns:**

*p.2284, line 21-22; It is not a surface current per se that carries the coarse sediments northward, but rather littoral drift.*

**We modified our statement accordingly.**

*p.2285, line 5-6; Not clear what reference is cited for southern BUS upwelling be stronger in winter, but based on a range of works by Jury and other, this is not an accurate statement. In fact, maximum upwelling in this region occurs during the summer. It is the northern BUS that is most intense in winter.*

**SST and concentration of chlorophyll-a clearly show that upwelling in the southern BUS is stronger during the austral winter relative to that of austral summer. This pattern is evident in the climatological SST (Locarnini et al., 2010) and an 18-year long satellite**

**observation (see Figures 4 and 6 in Hardmann-Mountford et al. (2003), v. 59, Progress in Oceanography p. 181-221). See also page 3, line 15-21.**

*p.2285, line 13; small relative to what? Certainly not to any of the other rivers being discussed.*

**We clarify this point.**

*p.2285, line 26-29; What is meant by "a significant amount" of sediment? Work by Gavin Birch and others has been made to quantify Orange River vs. western coastal drainage sediment. As a critical element of this study, this needs to be more accurately understood and expressed. Quantification of discharge of the 'rivers' being discussed is also required. One might get the impression that the perennial Orange (975,000 km2 catchment, 11.4 km3 annual runoff) and the ephemeral Holgat (1500 km2 catchment, fails to reach ocean for 50+ years) and Buffels (9000 km2 catchment, reaches ocean every 3-5 years) were in any way comparable.*

**In the revised version, we emphasize the contrast between the catchment size and runoff of Orange and local rivers. We note, however, that no quantitative data is available pertaining the amount of sediment delivered by ephermeral rivers (Holgat and Buffels rivers). The work that the reviewer is referring to is not accessible. See page 4, line 1-31**

*Prospero et al show decidedly insignificant amounts of dust originating from the region and being deposited at/near the core site. These vagueries are cause for concern, considering the extreme complexity of the region and the proxies being employed.*

**We note that the amount of dust originating from the coastal region is estimate to be 7-10 g/m2/years (Mahowald et al., 2005). This is a significant eolian contribution to the total amount of terrigenous sediment over the core sites. In revised version, we provide detailed discussion about dust contribution, as showed by Mahowald et al. (2005) and other studies from mudbelt (see below).**

**In the following paragraphs, we would like to collectively address the role of the Orange River, local rivers, and dust in supplying sediment to our site. Our reply focuses not only on the above comment but also relates to several and repetitive comments the reviewer made below.**

**EOLIAN CONTRIBUTION TO THE SEDIMENT AT CORE SITE**

**It is well established that eolian sediments, particularly those mobilized by the katabatic "Berg winds" (Foehn wind), contributes to the mudbelt sediments as indicated by several studies (Mahowald et al., 2005; Shannon and Anderson, 1982; Mabote et al., 1997; Rogers and Rau, 2006). Quantitative estimate of dust deposition over the area of investigation accounts for 7-10 g/m2/yr (Mahowald et al., 2005). Due to the proximity of dust source to the core site, it is most likely that the grain size of dust input is dominated by coarse fraction. During the mid Holocene, grain size increase concomitant with Nd isotope shift toward the isotope signature of coastal area supports the assumption that coarse sediment (> 20 µm) originates from the Namaqualand by wind-induced sediment mobilization.**

**We also interpret the variation Ti/Al as indicator of changes in dust input. This interpretation is based on modern distribution of Ti concentration and ilmenite, Ti-bearing heavy mineral, in the mudbelt sediment (Roger and Rau, 2006; Govin et al., 2012). Roger**

**and Rau (2006) showed relatively high abundance of ilmenite off the Holgat and Buffels rivers. Furthermore, Roger and Rau (2006) show that moving from off the Holgar River toward the Orange River, the relative abundance of ilmenite and other heavy minerals decline dramatically. Similarly, Govin et al (2012) show higher Ti abundances in the central and southern mudbelt relative to samples off the Orange River This shows that these heavy minerals originate from the coastal area and the contribution of ilmenite by the Orange River is relatively low. Decrease of eNd values (shift toward the value of coastal sediment), increase of Ti/Al, and increase of sediment fraction with grain median value of 20 µm suggest consistent line of evidence of increased wind-induced increased sediment mobilization in the coastal area. Our interpretation findings of the middle Holocene aridification is with sand dune mobilization along the coastal area (Chase and Thomas, 2006).**

## GRAIN SIZE OF ORANGE RIVER SEDIMENT AT OUR SITE

**The reviewer claims that all grain size end- members are well within the range of the primary [Orange} river's suspended load. This claim is in strong contrast to results of grain size analysis.**

**Detailed studies by Mabote et al. (1997), Rogers and Rau (2006), and Herbert and Compton (2007) show that the grain size of Orange River sediment rapidly decline toward the southwest. Consistent with the findings of the above cited works, the grain size distribution of our core top sediment (100-200 yr BP) shows a median size of 4 µm that explains ~90 % percent of the total terrigenous sediments. The core-top data show that Orange River sediment with grain size of ≥ 20 µm does not present a significant fraction of terrigenous sediment off the Holgat River. The main explanation for this observation is that northeasterly bottom water current is too weak to transport coarse material from subaqueous Orange River delta to our core site. We note that our core site 57 km away from the outflow of the Orange. Therefore significant increase of grain size in the time series indicates changes in the source or transport of sediment.**

## THE CONTRIBUTION OF EPHEMERAL RIVERS

**While the dominant sediment source is the Orange River, due its proximity to our core site the Holgat River contributes sediments to our site. The influence of perennial and ephemeral rivers of the Namaqualand to the mudbelt is clearly documented by Mabote et al. (1970) and Rogers and Rau (2006). In sediment off the Holgat River, Rogers and Rau (2006) show a clear imprint of the Holgat River.**

**Nd isotope analysis from Holgat and Buffels river sediments shows that sediments from Namaqualand have a distinct isotope signature that clearly differs from these of the Orange River. In down core time series, we interpreted Nd isotope shift toward Namaqualand's Nd signature to indicate relatively enhanced contribution coastal area. The shift in Nd isotope is small but not inconsequential. We argue that given the overwhelming contribution of Orange River throughout the investigated episode a shift of the Nd isotope signature by up -1.2 eNd from the average value of the Orange River signature is significant and indicative for changes in sediment source (Figure 4C). More importantly, our argument for changes in**

**sediment source or transport mechanism is not based only on eNd but also grain size and trace elements.**

**SUMMARY**

**Reiterating that fine sediment input from the Orange River presents the most dominant source for the mudbelt, we argue that, based on several lines of evidence provided above, it is undeniable that fluvial and eolian sediment from the Namaqualand also contribute to the mudbelt. The variation of the sediment components from coastal area allows to inferring past climate changes of this region.**

*p.2286; Prior to methods, it is necessary to better describe in the introduction the complexities posed by the setting (reconstructing winter rainfall with what are in very large part sediments from a summer rainfall river) and how each of the proxies will be applied.*

**In the revised version, we described the complexity of the depositional setting and explained how the proxies are used to decipher changes in the source and transport of sediments through the investigated episode (page 4-5, line 1-8).**

*I commend the authors on undertaking such a complex record, but much more care and detail needs to be taken to explain the situation and how they believe they have adequately resolved the inherent questions.*

*p.2287, line 1; Considering this very unfortunate hiatus, why did the authors not analyze sediment from nearby GeoB8331, which has very high sedimentation rates across the middle Holocene? Would certainly make for a more complete study of the question. Indeed, looking at Figure 3, it seems an incredible coincidence that pre- and post- hiatus samples should have such similar values, but the ages as presented do indicate such a break in the record.*

**We believe that the datings and age model are very robust and the hiatus is real! We do not speculate as to why some values are similar in the pre- and post- hiatus samples. We accept them as they are. In fact, the sedimentation rate (Figure 3B) shows a large increase in the post hiatus section, indicating a significant change in sediment mobilizations occurred between the pre- and post- hiatus.**

*p.2290, line 8; While this may be a reasonable assumption for the Stuut et al., 2002 record, it seems rather odd in the context of this core; and the subsequent sentence, which states that EM1 (modal grain size 20?) and EM2 (modal grain size 10?) comprise the bulk of the Orange River suspended fluvial sediments*

*Considering that the core site is located on a subaqueous delta, and that all end- members are well within the range of the primary river's suspended load, it is not at all clear how the indicies of Stuut et al., 2002, which were applied to a site 350 km off a coast with extremely limited fluvial activity, are at all appropriate.*

*Can the authors explain how EM1 and 2 can, in this context, be reliably identified as being non-fluvial?*

**First, the correct statement in page 2290, line 8-9 is "…we suggest that the variability of EM1 and EM2 indicates changes in eolian input from distal and proximal sources."**

**Second, the core top (120-200 yr BP) of our record shows that the terrigenous component of the modern sediment is dominated by sediments with median grain size of 4 µm that explains up to 95 % of total terrigenous sediment. Therefore EM1 and EM2 are not within the range of the primary river's suspended load that arrived at our site. Consistent with our core-top finding, Herbert and Compton (2007) showed also that the silt fraction at our site is less than 1 %. Similarly, Mabote et al. (1997) made the same observation and indicate that the polarward bottom water current is too weak to carry coarse fraction from the subaqueous delta of the Orange River to our core site that is 57 km away from the former. Therefore the reviewer's statement that "all end-members are well within the range of the primary river's suspended load" does not apply to the sediment over core site.**
**Following the reviewer's advise, we proved a more detail discussion pertaining the most likely source and transport of end-members (page 8: line 22-32 and page 9: 1-26)**

**The interpretation of EM1 as dust input is based on several proxy and modern data observation. For instance, during the middle Holocene we note an increase of sediment fraction with a median grain size of 20 µm which is very similar to that of the dust collected over the Walvis Ridge (Stuut et al. 2002). Theoretically, there are three possible explanations for this observation.**
**First, the increase of grain size could be related to strengthening of polarward bottom water current that would carry coarse sediments of the Orange River to our core site. The Nd isotope and Ti/Al records do not support this scenario.**
**Second, the increase of grain size could be due to an increase of fluvial input from local rivers. This is not supported by sedimentation rate (see Figure 3B) and existing climate record suggests dry conditions over the middle Holocene (for instance: Chase and Thomas, 2006). Dust from the coastal area is the most likely source.**

*Section 4.2; This set of proxies needs to be more clearly discussed/explained/calibrated. How does increased K equate to more humid conditions. How can this be distinguished from a shift in source area? Compton and Maake do not discuss Ti, as suggested by the authors. Why is this a proxy for aridity and/or aeolian transport?*
*Many questions regarding this section, and much to be more clearly discussed explained.*

**In the revised version, based on element and mineralogical analyses of core top samples from the Atlantic and mudbelt, we discussed in detail the dominant source of K/Al and Ti/Al (page 10-11, line 16-3)**

*Section 4.3; This is a critical section. The paper, based on the title, proposes a reconstruction of the winter rainfall regime, but examines sediment that is primarily derived from a summer rainfall zone river. It is very important that it be able to distinguish between winter and summer rainfall sediments/records.*
*The authors recognize that a more comprehensive calibration is required, but it appears quite clear that none of the samples (based on these data) come from winter rainfall zone rivers. The question then is, how are these records thought to reflect changes in the winter rainfall zone? If they are Orange River sediments, as suggested here, they reflect conditions in the summer rainfall zone, and the title of this article is inaccurate/misleading.*

**We have addressed this issue in the above paragraph entitled "THE CONTRIBUTION OF EPHEMERAL RIVERS". We disagree with the review's assessment that the sediments exclusively come from Orange River. We provide(d) a comprehensive discussion and**

**several lines of evidence that the increase of coarse sediment (>20µm) during the mid Holocene and the increase of fine sediment during the "Little Ice Age" are related to sediment mobilization in response to climate changes in the coastal area of the western South Africa (see chapter 5.1 and 5.2).**

*p.2293, line 14-17; Considering the nature of the site and the fluvial sediments of the Orange River, why is this not an increase in river discharge? Considering atmospheric circulation patterns in the region, it would be expected that increased aeolian activity during mid-Holocene (which has been indicated by Chase and Thomas) would bring more material from the winter rainfall zone. However, this is not reflected at all in changes in the radiogenic isotopes. The change in Nd and 87Sr/86Sr values is very slight indeed, remaining soundly within the range of an Orange River 'signature', and clearly distinct from the values obtained from winter rainfall zone rivers. There may be an increase in sediment input from local rivers, but based on these data it is inconsequential.*

**We discussed this issue in the above paragraph entitled "EOLIAN CONTRIBUTION TO THE SEDIMENT AT CORE SITE". The increase of dust from the coastal area during the middle Holocene is clearly indicated by the Nd isotope shifts toward the values of the Namaqualand (see Figure 4C and 4D). This is also true for the increase of fine sediment (~4 µm) during the "LIA" (see Figure 4C and 4D). The shift in eNd values is relatively small because sediments from the Orange River remain the most dominant component. The influence of increased dust input is also indicated by changes in grain size and Ti/Al values.**

*p.2293, line 16-22; As mentioned above, the grain size end-members are all included in the dominant fractions of the Orange River fluvial sediments, and the argument that they reflect aeolian vs. fluvial inputs is unconvincing.*

**As shown in our core top data, and as explained above, the polarward bottom water current is considered too weak to carry coarse fraction from the subaqueous delta of the Orange River to our core site that is 57 km away from the former. Therefore the reviewer's statement that "the grain size end-members are all included in the dominant fractions of the Orange River fluvial sediments" is not supported by our and several published field data. The reviewer' s statement is certainly valid in the subaqueous delta of the Orange River, but not off the Holgat River.**

*Section 5.1 p.2295, line 18; Low dust accumulation? Based on what evidence precisely? I assume we are talking about the grain-size analysis, and the attribution of different size classes to different depositional mechanisms, but again the argument for this interpretation needs to be made much more clearly and strongly considering the nature of the Orange River sediments.*

**The reviewer is correct. The term "accumulation" is not accurate in the context of our discussion. We revised this paragraph (page 14, line: 24-26).**

**As we stated several times, the characterization of eolian sediments based on the several parameters. While the dust component is primarily defined by the coarse sediments, we pay attention that this interpretation is supported by Nd isotope and Ti/Al.**

*p.2295, line 19-20; None of the Nd values are positive. Do you mean more positive /less negative?*
**Yes, we mean more positive Nd. We corrected it.**

*Also, the wording of this is slightly misleading. The Nd values are soundly within the range of the Orange River sediments, and nowhere near the values of the coastal rivers. There is the (again, slight) implication that coastal rivers played some role, and this is not indicated.*
*More importantly, these data do not clearly indicate more humid conditions in SW Africa. Even if the attribution of the end-members is correct (which I do not accept based on the data presented and that from other sources), low dust does not necessarily indicate humidity and the increased fluvial input is identified as coming from the Orange River, whose catchment is not primarily in SW Africa, but which is primarily fed by summer precipitation in the east of the subcontinent. Comparison with the Kristen et al records is complex, as those records are themselves quite intricate. This comparison should be shown more clearly in a figure, explaining precisely which proxies are seen to shown similarities.*

**We clarified and rephrased our statement (page 14, line 23-31 and page 15, line1-3)**
**Regarding the Nd isotope changes, we disagree with the reviewer. Figure 4C shows a shift of Nd isotope toward the signature of the Namaqualand. We argue that due the dominant influence of Orange River sediment, one can not expect a large-scale changes in eNd. Between 11,000 and 9,500 years BP, eNd values slightly shift toward the value of the coastal area (Figure 4C) and the fraction of fine sediment remained, probably indicating wet climate in the coastal area.**
**Followin the reiewer's suggestion, figures 6J and 6K show climate records from the Wonderkrater (Scott et. al., 2012) and Tswaing Crater (Kristen et al., 2010) that are thought to reflect eastern South Africa climate.**

*Considering that the 'dust' and the 'fluvial' sediments have different sources (dust=coastal/winter rainfall zone, and fluvial=Orange River-summer rainfall zone), how is the general coeval inverse relationship described by Cockcroft et al., 1987 expressed? Drier winter rainfall zone would be predicted to result in increased dust at the same time that there is increased fluvial input from increased precipitation n the summer rainfall zone. Similar changes in climate in both regions may produce the signal that the authors focus on, with more dust at times of reduced fluvial input, and vice-versa, but this is not what is generally understood to have occurred during the late Quaternary.*

**At time when (7500-5500 years BP) the records from eastern South Africa suggest relative wet conditions, our record suggests relatively dry conditions (eNd shift toward and coastal values, low fraction of fine sediment, and high fraction of coarse sediment). Conversely, during the "LIA" our record and those of Stager et al. (2012) and Benito et al. (2011) records indicate wet conditions in the western coastal area of South Africa, whereas record from eastern South Africa indicate relative dry conditions (page 19, line 21-32 and page 20, line 1-7). The results of the east-west comparison are consistent with conceptual model described by Cockraft et al. (1997).**

*p.2296, line 1-2; In this region, decreases in precipitation are more likely to be associated with increases in southeasterly winds, as the South Atlantic Anticyclone gains dominance.*
*p.2296, line 2-3; Two issues here: 1) the authors report an increase in wind strength at the same time that there is a decrease in upwelling, which is not consistent with regional circulation systems and the factors that increase upwelling (increases in the same winds that dominate in the*

*region, and would be capable of bring dust from aeolian sediment from Namaqualand); and 2) the record of upwelling presented here is inconsistent with other from the region (e.g. Farmer et al., 2005), which have been validated by comparison with records such as the hyrax midden record the authors cite from Spitzkoppe (Chase et al., 2009).*

**We agree that a clarification is due here.**
**During the mid Holocene, our record indicates relatively dry conditions in the coastal area and a weakened southern Benguela Upwelling System (BUS). The weakening of the southern BUS coincides with an increase of warm Indian Ocean water leakages into South Atlantic (Peteers et al. 2004). Modern observation indicates that increase in warm Indian Ocean water leakages modify the density of surface water and weaken the southern upwelling BUS (Hardman-Mountford et al., 2003). The increase of dust inputs from Namaqualand is related to strengthening or increased frequency of the Bergwinds (easterly wind). Therefore, we do not see inconsistency between increase of dust and weakening of upwelling.**

**With regard the weakening of the southern BUS and its relationship to the northern BUS, we point out to the findings that the northern and southern show an asymmetric response to atmospheric-oceanic events. Lutjeharms et al. (2001) observed that a steady weakening of upwelling off Cape Columbine (southern BUS) from 1980 to 1986 is not matched by weakening of the northern BUS (off Luederitz ). Another modern observation shows that along with atmospheric-oceanic conditions that influence the strength of northern and southern BUS, the intrusion of warm Indian Ocean water into the southeastern Atlantic impacts primarily the southern BUS (Hardman-Mountford et al., 2003).**

**Past change in the intensity of upwelling is best characterized by its thermal and nutrient imprints in the surface water. Our record provides a robust evidence of surface warming and a weakened southern BUS during the mid Holocene. Parallel to the weakening of the southern BUS, a shift in planktonic foraminiferal assemblage indicates an enhanced warm Agulhas leakage into the southeastern Atlantic (Peteers et al., 2004) (Figure 5). Based on modern observations (Hardman-Mountford et al., 2003), we argue that there is a causal linkage between the mid Holocene weakening of the southern BUS and the concomitantly enhanced leakage of warm Indian Ocean water into southeastern Atlantic.**

*p.2296, line 4-6; Is this basis for finding that the data presented here reflect changes in the winter rainfall zone? That it shows the opposite of what is observed in the summer rainfall zone? It should be considered that the data from Tswaing are complex/contentious (see both Kristen and Partridge articles), and that the Cold Air Cave data have been interpreted in different ways (Holmgren articles and Lee-Thorp et al., 2001). This has been synthesized to some extent by Chase et al., 2010, but a fuller treatment of the current debate on Holocene climate change in southern Africa is critical for this paper.*

**Following the reviewer's recommendation, we added a summary of existing interpretation and discussion of the records from the Orange River catchment (Figures 6 J and H and discussion in section 5.1 and 5.2)**

*To summarise, it is the opinion of a growing number of researchers, based on more, improved data, that the early Holocene in the southern African summer rainfall zone was more humid, and that the mid- to late Holocene was characterized by increasingly arid conditions. Evidence from* *the Cederberg Mountains (Meadows, Scott Woodborne, Chase) suggests that a similar pattern existed in at least this portion of the "WRZ".*

**In the original version of the manuscript, we provided a summary and conclusion that is very similar to what the reviewer summerized here!**

*p.2296, line 12; Meadows et al. find very little change across the early to mid-Holocene.*
**We removed the reference to Meadows et al. 2010.**

*Broadly, to this point, considering that the sediments being analysed are shown to be of Orange River, summer rainfall zone origin, it is not clear why comparisons are being drawn with records of the WRZ. How do Orange river sediments record changes in winter rainfall zone climate, particularly if EM1 and 2 cannot be considered as exclusively/predominantly aeolian?*
*Section 5.2 Issues raised previously also exist here: interpretation of grain size, insignificant changes in radioisotopes being interpreted as indicating "significant" contributions of Namaqualand rivers, and a reasonable, but superficial understanding of the regions palaeoenvironmental records.*
*p.2296, line 6-8; it is again unclear how this minor change in radioisotopes reflects a significant contribution of WRZ rivers. (y-axis for Sr should not be clipped to allow for coastal sediment values to be shown. Figure 5 clearer, and this figure should have labels for the samples.*

**See previous replies to similar reviewer's comments**

*p.2296, line 9-10; Which cave deposits? Unnecessarily vague.*

**We specified our statement.**

*The authors should also consider what proxies are used to infer "cold, dry conditions". Tyson et al. are quite liberal with their treatment of the data, and with a wider range of data sets, difficulties and inconsistencies in the d18O records have been revealed.*

**see discussion in sections 5.1 and 5.2**

*The relationship between the WRZ proxies and those reported here is unconvincing. The Verlorenvlei record shows no clear similarity with the K/Al record. The variability in the former is also not seen in the grain size record (to be explained by authors). The plot of Buffels River flood events may be confusing the authors, as at first glance it appears to indicate a trend similar to the grain size analysis. It is, however, a cumulative plot and it does not show that it is drier at the beginning of the record, just that there is only one record considered. The authors should familarise themselves with this kind of plot so as to be able to interpret it properly. Key period are when the line is steeper, indicating clusters of flood events. These show broad correspondence with the Verlorenvlei record, but not the GeoB8332 records. Perhaps because the sediment is derived from the Orange River, and does not therefore (primarily, or perhaps at all) reflect the WRZ.*
*In fact, the greatest similarities with the K/Al record are from the summer rainfall zone and tropical Africa, which is not surprising considering position of the Orange River catchment.*

**We respectfully disagree with the reviewer. A look at Figures 7H-K reveals that the reviewer's claims are not supported by the data.**

**Considering age model uncertainties and the nature of the climate archives (lake, river bank, and marine sediments) the climate records from Lake Verlorenvlei (Stager et al., 2012), Buffels River (Benito et al. 2011), and our multi-proxy record indicate a trend of humid climate in the WRZ of South Africa.**

**Our grain size and K/Al records indicates a continuous increase of fluvial sediment (Figure 7H-I). A concomitant shift of Nd isotope values toward the values of Namaqualand signature (Figure 4 C) suggests that the increase in fluvial sediment reflect an increased sediment supply from the local rivers. We interpret this observation as an indicator of humid climate in the coastal area.**

**On centennial-scale, the trends of EM3 and K/Al parallel with the increasing amplitude of freshening pulses in Lake Verlorenvlei throughout the LIA (Stager et al., 2012). Similarly, two of the three steep increases of flooding events in the Buffels River banks correspond with continuous increase of EM3 and K/Al.**
**The reviewer's claim that our K/Al record shares more similarity with record of tropical Africa is not supported by our data and data from eastern South Africa that indicate relatively dry condition during the LIA (see discussion in section 5.2).**
**During the LIA our K/Al, grain size, and eNd records indicate a relatively wet climate in the WRZ of South Africa. In contrast, records from eastern South Africa suggest cold and dry condition (Tyson et al 2001, Vogel et al., 2001, and Neumann et al., 2010) as discussed in section 5.2 of the revised manuscript.**

*p.2299, line 27; "amelioration" is a subjective thing. More humid.*

**We rephrased the wording.**

*p.2300; Considering my reservations with the authors interpretations, I am not convinced that an adequate basis has been established for the comparisons and arguments that the authors develop here.*

**Using our core top data and results of previous works, we showed that only a fine fraction of Orange River sediment arrive to our core site. We provide evidence that the source of the fine sediment during the LIA was the coastal area, and not, as claimed by the reviewer, the Orange River. A shift of Nd isotope values from the average value of Orange River toward the Namaqualand signature supports our interpretation regarding the origin of the fine sediments. The reviewer argues that the shift in Nd isotope is not large enough to infer a contribution of local source. We argue that given the dominant role of the Orange River in supplying sediment to the mudbelt, it is unrealistic to expect large-scale changes in the Nd isotope composition of the mudbelt sediment. Small but robust shift in the eNd signature along with changes in Ti/Al, K/Al, and grain size provide, however, an important tool to infer past climate changes of the coastal area and its link to oceanic conditions. Our results of the mid Holocene and the LIA are good examples as they reveal a clear linkage between the thermal state of the coastal water and climate of the Namaqualand.**

*p.2300, line 20-21; Again, amelioration is an inappropriate term.*

**We rephrased the wording.**

*Further, what is the expectation that the WRZ and SRZ will be in/out of phase or leading/lagging? The authors appear to be suggesting that frontal, winter rainfall systems* *created the more humid conditions at Spitzkoppe in the last 1000 years. This is inconsistent with both conceptual models from the region and the existing data. A more thorough reading and analysis of the existing data from the region should be undertaken, if this is the case.*

**The reviewer is referring to a fragment of a paragraph. Reading that paragraph to the end and the conclusion gives a clear picture that is not in conflict with existing conceptual models. Here is what we wrote:**

**"This comparison reveals that climate amelioration in the Southwestern African SRZ was delayed by ~ 200 yr relative to that of the WRZ. Progressive northward expansion of the relatively wet WRZ into the southwestern margin of the SRZ presents one possible explanation. An alternative explanation arises when the timing of maximum impact of the northern LIA is considered. Intensification of ice-cap growth in the Arctic Canada (Miller et al., 2012), maximal glacier advances in Europe (Holzhauser et al., 2005), and a significantly reduced meridional heat transport to the North Atlantic (Lund and Curry, 2006) commenced between 400 and 450 yr BP. As a consequence, an increased temperature gradient between the northern mid-latitude and the tropics caused a large-scale southward displacement of the ITCZ, as suggested by the Lake Malawi and Cariaco Basin records (Haug et al., 2001; Johnson et al., 2001). Accordingly, the alternative hypothesis could be that at 400–450 yr BP a southward displacement of the intertropical convergence zone (ITCZ) during the austral summer allowed more moisture incursion into the arid SRZ in Southwestern Africa." (page 2300-2301, line: 20-4).**

**"… while a northward expansion of the humid WRZ into the arid SRZ can not be ruled out, a southward shift of the ITCZ may have played a more dominant role in bringing more moisture to the SRZ." (page 2302, line: 24-27)**

*p.2300 It would great to see other upwelling and SSTs proxies from these sediments that were comparable with other records from the region. A high resolution record would be extremely useful. As it stands, strong upwelling at this site is at odds with the records of Farmer et al., 2005 to the north, and the records from Spitzkoppe, which show similarities with the K/Al record, but reflect summer rainfall conditions.*

**The extremely low abundance of planktonic foraminifer in GeoB8332-4 makes difficult to confidently establish a Mg/Ca-derived temperature record. Ice-volume-corrected d18O (d18Oivc) records provide an alternative approach to semi-quantitatively assess calcification temperature. The covariability of d18Oivc with the d13C record presents a robust indicator for temperature changes that was most likely driven by changes in the strength of the southern BUS.**

**With regard to the relationship between the southern and northern BUS, we point out to two observations:**
**First, it has been shown that at decadal- and interannual-scale southern and northern BUSs do not respond always symmetrically (Lutjeharms et al., 2002; Hardman-Mountford et al., 2003). For instance, Lutjeharms et al. (2002) show that a continuous weakening of the southern BUS was not accompanied by systematic changes in the northern BUS. More importantly, the intrusion of warm water from the Indian Ocean (Agulhas leakage) into the Southeastern Atlantic impacts more the southern BUS than the northern BUS (Hardman-Mountford et al., 2003). In analogy to modern conditions, we propose that the weakening of**

**southern BUS and the concomitant increase of water leakage into the southeastern Atlantic are causally linked.**

**Second, if we take SST as a robust indicator of changes in the strength of an upwelling system, the mid Holocene history of the northern BUS is far from being well understood. Alkenone-derived SST (Kim et al, 2002) indicates a continuous surface warming during the mid Holocene, whereas the record Farmer et al (2005) indicates a cooling during same time.**

*Summary and Conclusions Unconvinced by the interpretations of the authors, I do not find the narrative here to have an adequate foundation.*

**While our record, like all other paleo-records from southwest Africa and elsewhere, harbors uncertainties with regard to its interpretation, the multi-proxy nature of record and the combination of terrestrial (grain size and radiogenic isotopes) and marine proxies (d18O an d13C) provide a robust foundation to decipher past climate change in western South Africa and it link to the conditions of the adjacent ocean.**

**One of the notable findings of this paper is that the mid Holocene aridification trend, as inferred from grain size and Nd isotope analysis, was paralleled by a weakening of the southern BUS. By putting this observation into regional and hemispheric context, we show that the mid Holocene arid conditions and the weakened southern BUS coincide with the timing of enhanced warm water leakage from the Indian Ocean into southeastern Atlantic and increased dust accumulation over Antarctica. Therefore, the coherent regional data sets (see Figure 6) argue for a poleward shift of the austral westerlies as the most probable cause for the dry and warm conditions. Though the notion of poleward displacement of the westerlies and its effect on southwestern Africa is not new, it is undeniable that our terrestrial and oceanic proxy record provides for the first time a robust foundation for this narrative that describes the sequence of events (see summery and conclusion). We believe this is a new and important contribution toward a better understanding past climate at regional level and links hemispheric-wide reorganization of atmospheric and oceanic circulation.**