

Interactive comment on “Abrupt shifts of the Sahara-Sahel boundary during Heinrich Stadials” by J. A. Collins et al.

Anonymous Referee #1

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This is an interesting paper that provides new paleoceanographic data from the eastern Atlantic concerning the development of the boundary between the Sahara desert and the Sahel since around 60,000 years ago. I think this is a useful contribution which will be of wide interest to the community trying to understand the development of climate around the North Atlantic, as well as controls on desertification and its links to other climate events most notably variations in solar insolation and in the degree of glaciation at high latitudes. The authors attempt to quantify the dust component in cores taken along the West African margin and attempt to show that times of enhanced dust sedimentation correlate with Heinrich stadials. They also indicate that there is a latitudinal shift with time that suggests a major equatorward motion of the boundary again mostly during Heinrich stadials. The authors do a relatively convincing job in demonstrating links between modern desertification and the marine records and there is clearly

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something coherent in the history that they present which requires the community to think carefully about the patterns. If I had any significant concerns about the study it might be that the effects of bottom currents are not fully understood. Although they have attempted to account for the longshore currents the effect of transport across the margin is less well constrained. It is interesting to note the relatively high proportion of river sediment versus dust sediment in these cores is partly inexplicable as a result of current activity. However such a solution does leave the reader wondering that if this is such an important process could this not also be governing the large-scale excursions that paper focuses on. Nonetheless, on balance I believe that the story is probably essentially correct and so I support publication.

Specific comments

Page 125 line 4 - late Holocene section of the sediment cores - Can you tell us exactly how old the late Holocene samples would be? How did you select and from what depth? What is the purpose of the late Holocene samples compared the surface samples? Can you explain the rationale?

Page 124 line 10 - uncertainty is represented as non-parametric 68 % confidence intervals - Can you explain why this particular interval was used? Is this a common convention?

Page 126 line 6 - The low dust% values are hence thought to be due to lateral ocean advection - if the concentration of dust in the sediments can be changed very strongly as a result of ocean currents then is it not possible that the variations we see in the cores are driven by changes in ocean currents rather than in the intensity of aridity in the adjacent continent?

Page 126 line 23 - Finally, increased turbidite activity during HS - I have already forgotten what HS means, highstand? Heinrich stadial? In any case perhaps some of the variation we see in the sediments is caused by preferential transport not along the coast but perpendicular and into the deep water. Could the downslope transport be in

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the form of more gradual currents rather than as more catastrophic turbidites?

Page 128 line 5 - because of the latitudinal position of the continental dunes - If the location of the continental dunes is so well known then why is it important to have the marine record at all? Can't we constrain the SSB just using these as indicators of the boundary?

Page 129 line 15 - the coarser fraction is normally only be transported by wind - But sand can also be transported in rivers and then reworked across the shelf by current activity. The sand could even originally have been eroded from dunes on shore via the rivers.

Page 130 line 10 - Our data thus suggest a gradual response to insolation forcing - Is it possible that any of this increased dust since the middle Holocene is generated by human settlement and agricultural development in the Sahel?

Technical corrections

Page 120 Line 13 - during Heinrich Stadials - I think it would be helpful if the authors provided numerical ages as well as just saying "stadials". Likewise I think for the "Last Glacial Maximum".

Page 120 Line 14 - SSB position – I recommend against using abbreviations but if you really must do this then you need to define them before using them.

Page 121 line 2 - Sahara desert during was extended - you need to delete the word "during".

Page 121 line 5 - ~ 14.5 N - I don't think there should be a space between ~ and the number. Please try and fix this throughout the whole paper. Likewise for < and >

Page 121 line 13 - cal ka BP - ka typically means thousands of years ago. I think that the BP is redundant here and inconsistent with what you were doing earlier in the paper.

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Page 121 line 27 - Heinrich Stadials; HS - this paper has far too many abbreviations in it. They make the whole paper unreadable for anyone who is not already an expert.

Page 122 line 16 - Mali-Mauritania region (Fig. 1b) - this region is not marked on the map.

Page 122 line 16 - North-East - I think this should be northeast.

Page 123 line 6 - We use 4 sediment cores - whole numbers up to 10 should be spelt out. Is there some way that we can find out the precise location of these cores?

Page 123 line 24 - analysis using - I think you need to delete the word "using".

Page 125 line 13 - during the Bølling-Allerød - this is not shown on figure 2. You need to label that.

Page 127 line 20 - Senegal and Chad - if you're going to mention countries by name I think you need to mark them on the map.

Page 128 line 22 - the Early phase - I think you need to call out the figure at this point.

Page 128 line 26 - formed during HS4 and HS5 - can you provide numerical ages as well?

Page 129 line 20 - reduction in JAS cross-equatorial insolation - what does JAS mean?

Page 130 line 16 - slowdown of the AMOC – What does AMOC mean?

Page 131 line 8 - greater by up to 4°C during HS – is this because the water is hot in the Gulf of Guinea or because the water is colder offshore Iberia?

Interactive comment on Clim. Past Discuss., 9, 119, 2013.

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