

## ***Interactive comment on “Multi-decadal climate variability in southern Iberia during the mid- to late-Holocene” by Julien Schirrmacher et al.***

### **Anonymous Referee #3**

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This paper presents two re-analysed cores from off the south coast of Iberia, one from the Gulf of Cadiz and the other from the Alboran Sea covering the mid-late Holocene. The authors suggest that, whilst close within a spatial context these two marine environments are influenced by quite different climate forcings. The paper is well laid out and nicely written, with detailed presentation of the identified wet-dry phases in the mid to late Holocene. Before recommending publication however, some significant areas of clarification are still required. My major concerns / points for consideration are listed first, followed by more minor typo style points and suggested any small changes to the Figures. I hope these comments prove useful to the authors. 1) The introduction seems to focus mainly on the 4.2ka event where the data set and the remainder of the paper is much broader than that one event. I would like to see an extension of

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the introduction to cover more of the mid-late Holocene “events” in detail. The introduction could also include more background on the major forcing mechanisms in play here and discussed later in the paper. The NAO bit is in the study area section, but there is no info on the Bond events, and how these may influence ocean circulation and SST’s in this region. 2) Figure 1 needs improvement. A scale, north arrow and labelling of the different oceans, countries etc is needed for a non local expert reader. 3) It would be nice to see the sedimentation rates through time plotted in your figures (Figure 3 for example) this would help get a feeling of how the different cores were deposited over time and will help inform the reader with regards to sample density vs time and therefore resolution of the data set. This is critical when interpreting changes at the multi-decadal level. 4) You state that two dates were removed (page 4 line 17) as they gave the same value as another date at 120cm. Can you explain why they were removed? Does this not just suggest a rapid accumulation rate over this period of the core and that all dates are valid? 5) I have some concerns about the use of the n-alkane data as the primary proxy for wetter or dryer conditions; I fear this proxy has been over extended in the interpretation. The areas I would like clarification are: a) it would be nice to see a couple of example chromatograms from the n-alkane work, especially during the extreme wet and dry periods (supplementary info is appropriate). This would help clarify if the material is originating from the same/similar source locations throughout the record. My concern is that over such a large catchment and long time period, changes in rainfall may be geographically heterogeneous, leading to the removal of organic matter from different parts of the catchment at different rates over time. b) Linked to this, more explanation of the physical mechanism of n-alkane removal by runoff is required (at least in your response to these comments). I’m concerned that under dry conditions, C3 dominated environments (forests for example) are less susceptible to water and sediment loss than C4 dominated environments, due to the physical make-up and bonding of their soils by root systems. If this is the case then the co-variation between n-alkane concentration reduction and “C4 proxy increase” is actually not showing an increase in C4 vegetation abundance within the catchment, but

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a change in the relative loss of n-alkanes from each environment within the catchment. c) I would also direct the authors to the following paper, which suggests that identifying between C3 and C4 vegetation using n-alkanes is not straightforward, this needs consideration and clarification. Bush and McInerney (2013) Leaf wax n-alkane distributions in and across modern plants: Implications for paleoecology and chemotaxonomy. *Geochimica et Cosmochimica Acta* 117 (2013) 161–179. d) How can you be sure that reductions in the n-alkane concentration in the core are not just a dilution effect from marine sediment deposition? Showing sediment accumulation rate on the same graph would clarify this (see comment above). 6) There are a few places in the text where you suggest this are “well correlated” or that events are well replicated in both cores (page 7 line 11, page 8 line 11, page 10 line 7). I think the paper would benefit greatly from some stats to back up these statements, which are currently based on a visual assessment of the data. Being able to demonstrate a relationship between the cores will greatly enhance the robustness of the conclusions drawn. 7) I would also suggest that you investigate the periodicity of the wet-dry events shown in the record. NAO and bond events have well documented “frequencies”, if you can demonstrate that these events in your record have a similar frequency this would again add weight to the argument that these major climate modes maybe the dominant mechanism controlling changes seen in your record. 8) If you are confident that the Norm33 does represent changes in C3-C4 vegetation distribution within the catchment (see comments above), I direct you to page 9 where you suggest that changes in vegetation community composition may change on very rapid time scales and that this can be accurately recorded within the ocean records. Under modern conditions, is there evidence of changes between C3 and C4 vegetation makeup over the time scales you see in the sediments? And, could you use these proxies to quantify the extent of vegetation change that would have been seen to get such a change in Norm33. What I’m asking I guess is, does the extent of Norm33 change seen in the record make sense, in terms of both rate of change from C3-C4 and the extent (%) of vegetation cover that would have to have changed, if contextualised by our understanding of the catchment under modern conditions? 9) The

SST data resolved from alkenone data is interesting but it must be clear within the text (when interpreting) and within the figures when this data falls within the 1°C error that you state in the methods (I suggest adding error bands in the figures). For example, in Figure 3 most of the peaks and troughs in your seasonal SST data are within error. This data is best interpreted in terms of differences between season temperatures (which you do well). Don't over interpret unless the max/min temps fall outside your (+/-?) 1°C error. 10) I think that more detail on the significance of not seeing Bond event 2 should be added. You suggest this is the first time higher seasonality in SST in relation to mid Holocene Bond events is described this far south. More mechanistic detail of how this N Atlantic process effects the Gulf of Cadiz would be helpful in understanding why there are difference between the mid and late Holocene Bond events and how it shows up at your sites. More minor comments: a) Page 3 line 14, "during winter" repeated. b) Page 6 line 1, "cm" not "ccm" c) Page 7 lines 1 and 2, use "in high resolution" not "on high resolution". d) Page 10 line 8, Figure 6 is introduced into the text before Figure 5, re-order figures. e) Figure 1 needs changes listed above

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