Clim. Past Discuss.,
https://doi.org/10.5194/cp-2017-113-AC3, 2017

Climate of the Past Discussions
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Interactive comment on "Land–sea coupling of Early Pleistocene glacial cycles in the southern North Sea exhibit dominant Northern Hemisphere forcing" *by* Timme Donders et al.

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Received and published: 19 December 2017

Donders, T.H. et al. We thank the reviewers for their constructive and specific comments and will use them to improve the interpretation and data representation. Here we provide a first reply to the comments and indicate where we plan to make adjustments, and provide additional information to support our interpretations. We feel that with extension of the discussion and added detail as indicated below we are able to meet the concerns of all reviewers.

Anonymous Referee #3

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Comment: The arboreal pollen and T/M ratio curve shows large fluctuations and hardly reveal any clear trends. These fluctuations may have resulted from a) the extremely low pollen sum after exclusion of bisaccate pollen, and b) the fact that the pollen results were merged from two different sites.

Reply: as Rev. #3 suggests, the AP curve shows variability. It is however clear that the glacial intervals AP values do not exceed 20%, except for one sample, and are consistently associated with increased Ericaceae. Interglacial AP values are clearly enhanced between 20 and 50 %, so we strongly disagree with the statement that there is no clear trend. The detailed pollen diagram in the supplementary data shows consistent abundance changes for the combined (spliced) dataset for e.g. Ericaceae, ferns, Picea. The variability in the Pinus curve is also visible in the sections that come from a single core, e.g. in MIS 95 and thus not a product of the splice. The splice is based on the high resolution GR record (verified by the dinocyst events), which provides a total of 15 tie points that produced a completely linear well tie (see Fig. 1).

Comment 1:An excellent age control is critical for all high-resolution studies of leads and lags. The authors should therefore provide more information on how the specific section has been dated.

Reply: see validation by Noorbergen et al (2015) study outlined in the reply to S. de Schepper, including tie points and age model construction. In short, the basic age model is outlined in Kuhlmann et al., 2006a, we have only transferred this age dating on an age scale. The leads and lags infer changes between proxies from the same record and in that sense are independent of an exact age model, although obviously desirable. Tie points and a review of the ages used in Kuhlmann et al., 2006a will be provided in the revision and is not expected to alter the outcomes.

Comments 3&4: The multiproxy approach makes the method chapter the longest section of the entire manuscript. Consider moving parts of the methods into the Supplementary Information and focus mainly on describing what the proxies show and

discuss the methodological limitations relevant to this study. The palaeoenvironmental interpretation of the record lacks depth and should be more detailed.

Reply: we do provide the outline of the interpretations for each proxy in the methods section of the original manuscript. We will expand the palaeoenvironmental interpretation, particularly on the pollen data, referring in more detail to the full record in the supplement. Based on this revision we will decide on moving sections to the supplement as is suggested by Rev. #3. and highlight individual results more explicitly where needed.

Comments 2&5: It would be very helpful if the authors could provide a conceptual model describing in detail what they would expect to see in regard to the timing of each proxy, if obliquity forcing were the major driver. The analysis of lead and lags needs to be more detailed in order to provide convincing evidence for the main conclusion. I also struggle to see the parallel initial decrease of cold water dinocysts and Sphagnum biomarkers (first two curves) and the final decrease in T/M ratio and d18O (last two curves), which, according to the authors, followed with a delay of a few thousand years.

Reply: Statistical analysis of the lead-lag relations is desirable but unfortunately not possible due to the limits of the record recovery, hence we choose to focus on the best resolved and completely cored G-IG cycle (MIS 98-97-96). We will improve the description of our specific observations on the leads and lags and link them, as suggested by Rev #3, to our forcing scenario in relation to the expanded discussion on this topic (as was suggested by reviewer D. Naafs). In particular, as questioned by Rev#3; Decreases in cold water dinocysts and Sphagnum biomarkers (first two curves) and the final decrease in T/M ratio and d18O are based on high values of the first two in the early half of MIS 98 (shaded interval), after which the T/M increases only in the second half of MIS98 (and correlated LR04 d18O signal, but this detail depends on uncertainty in the age model). The key curve to assess are the cold water dinocysts and not the coastal signal, which is probably causing the remarks by rev #3.

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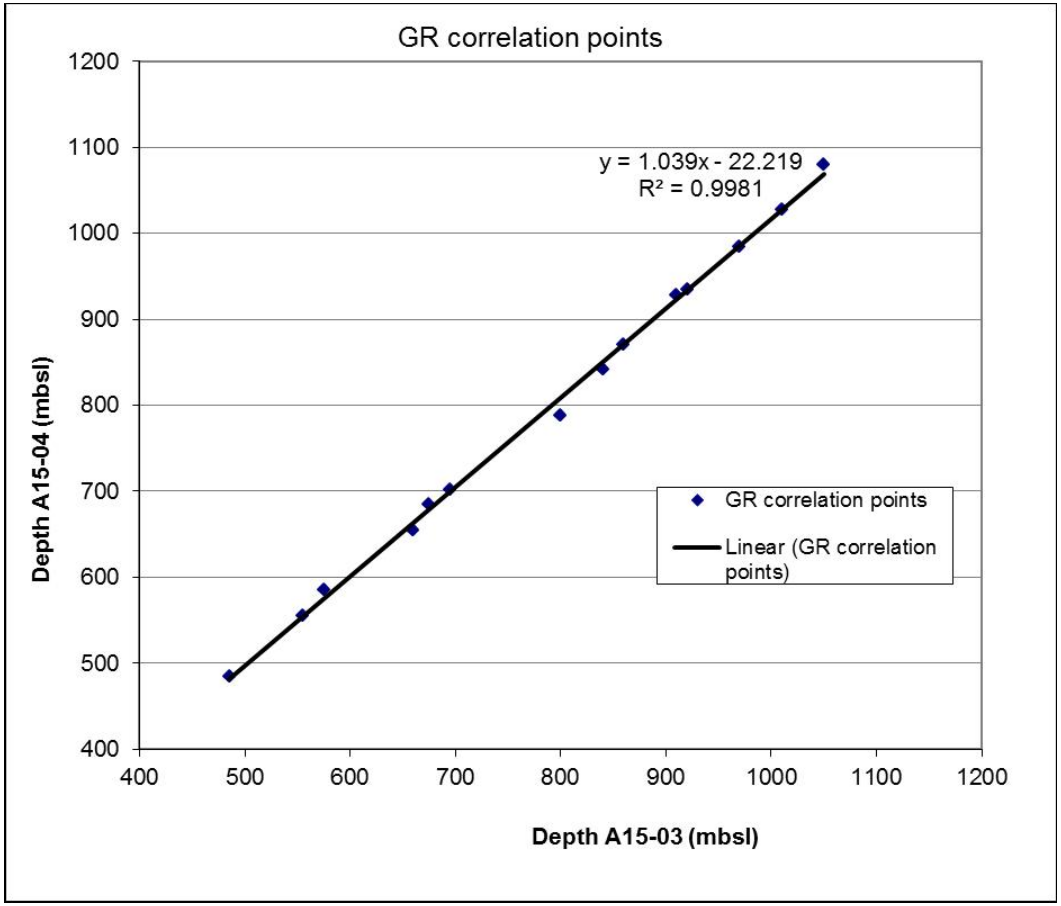

Fig. 1. Figure 1: Well tie correlation points indicate a clear linear relation between the wells A15-3 and A15-4