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Climate of the Past Discussions

Interactive comment on "A new age model for the Pliocene of the Southern North Sea Basin: evidence for asynchronous shifts of marine and terrestrial climate" *by* Emily Dearing Crampton-Flood et al.

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A comment to MIS M2 in the southern North Sea Basin:

A hiatus in sedimentation during MIS M2 was already suggested in papers that deal with the stratigraphy of the southern North Sea Basin. Studies by Head (1998), De Schepper et al. (2009, Geological Magazine) and Louwye et al. (2004, 2010, Geological Magazine) place the Belgian (Kattendijk, Lillo, Poederlee Fm) and English (Coralline Crag, Red Crag) Pliocene formations into one coherent stratigraphy. In De

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Schepper et al. (2009) and Louwye et al. (2010), MIS M2 is identified as a sequence boundary, de facto a hiatus, in the southern North Sea Basin. These papers have not been taken into account, but would mostly support the conclusions here. See also the stratigraphic summary of De Schepper and Mangerud (2018, Norwegian Journal of Geology, Figure 7), which compares the northern North Sea Utsira Formation with Pliocene deposits in Iceland, England and Belgium. For L440: Rather than comparing with the Norwegian Sea record, it would be more relevant to compare here with records from the southern North Sea Basin (England, Belgium).

A comment to the mPWP in the southern North Sea Basin:

The Poederlee and Lillo Formation correspond to the interval 3.2–2.7 Ma. The paleoenvironmental information from those formations (De Schepper et al. 2009; Louwye et al. (2010) would be a valuable addition to the interpretations from the Hank core and be a major step forward towards a comprehensive summary of the climate and environmental evolution of the North Sea Basin during the mPWP and Late Pliocene.

A comment to the influence of the NAC in the North Sea:

The influence of the NAC in the Hank record is not convincing. Observing comparable SST variability is no proof for a causal relation (L40, L655 onwards). The common factor between the North Atlantic and the North Sea may be via the atmosphere (i.e. NAO). Note that while the SST variability in the eastern North Atlantic and Norwegian Sea correspond to the NAC (Naafs, Bachem, Lawrence), the cited SST variability in the Iceland Sea is related to the EGC (Clotten et al. 2018) (L655–659). Furthermore, most water from the North Atlantic flows into the North Sea Basin from the north. But in the manuscript, it is claimed that the NAC has a direct influence on the southern North Sea Basin through the shallow connection in the south (Channel/Dover) (L622-624). While an open connection after MIS M2 is possible, it remains speculative. Certainly because the presence of O. centrocarpum (sensu Wall and Dale 1966) in the Hank core is considered as evidence for the NAC influence in the North Sea. This does not

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have to be the case, and most likely it is not - this is a cosmopolitan species. It is true that in the modern North Atlantic, O centrocarpum sensu Wall and Dale (1966) (aka. cysts of Protoceratium reticulatum) can be considered as good indicator for the NAC (e.g. Harland et al. 2016 in Helyon and refs therein). It has been used as an indicator for the NAC in the Pliocene eastern North Atlantic, in the region where the NAC flows (e.g. De Schepper et al. 2009 Paleoceanography, 2013 PLoS One, Hennissen et al. 2014 Paleoceanography). But today, when the Channel is open, it is not a common species in the North Sea (Marret et al. 2003 RPP, Zonneveld et al. 2013 RPP). Given that O centrocarpum (sensu Wall and Dale 1966) is foremost a cosmopolitan species, tolerant to wide range of SST, SSS, nutrients, etc., its occurrence in the North Sea may not be a simple function of North Atlantic water inflow.

Minor comments

L127, L621: It is not impossible, but it remains speculation whether a connection was established after MIS M2. The connection was likely only temporarily opened during the Pliocene when SL was high (e.g. see more recent papers by Van Vliet-Lanoë et al. 2002; Gibbard and Lewin 2016, Geologica Belgica). L317–318: Barssidinium is not the best example for a (sub)tropical taxon, as it occurs in Iceland in the Pleistocene (e.g. Verhoeven et al. 2011, Paleo-3). L625–630: O. centrocarpum (sensu Wall and Dale 1966) is foremost a cosmopolitan species recorded from different environments and tolerant to wide range of SST, SSS, nutrients, etc. Its occurrence in the North Sea shelf environment is thus not necessarily evidence for NAC influence. L629: Boessenkool et al. (2001) studied surface sediments offshore SE Greenland. The study does not provide evidence for a relationship between O. centrocarpum and the NAC. Please use more appropriate references.

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