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Climate of the Past Discussions

Interactive comment on "Variations in mid-latitude North Atlantic surface water properties during the mid-Brunhes: Does Marine Isotope Stage 11 stand out?" *by* A. H. L. Voelker et al.

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Authors' response to review of referee # 1

Referee # 1 is concerned with the point of the paper and the fundamental step forward it makes towards the understanding of past interglacials. While it is true that most of the major new findings, especially in respect to the hydrographic conditions on the western Iberian margin, are not related to the interglacial periods there are a few points we want to make:

1) We did not expect that the mid-latitude records for Interglacials 9 to 13 would show significantly different temperature patterns than those already known from previous

studies in the subtropical and subpolar North Atlantic. However, they come as a confirmation for the mid-latitudes and especially the eastern boundary upwelling system off Iberia, from which no data was available, yet. Such a confirmation and thus additional data points for a potential data – model comparison is essential, if we are going to study interglacial MIS 11c with coupled ocean – atmosphere models. During the meeting of the MIS 11 INQUA working group during the 17th INQUA Congress in Cairns (July 2007), to which this special theme in Climate of the Past is linked, the need of compiling a data base of existing climate indicators for MIS 11c from different climate archives was already raised as a necessary step towards providing paleo-data to the interested modeling community. For such a comparison it is also important to know if water mass transport pathways and regions of mode water formation were different from today. Tracking such paths and regions was one of the major aims of this paper and it was only possible by combining all the different records (meaning a lot of data).

2) Core MD03-2699 is the first high-resolution mid-Brunhes record from the North Atlantic's eastern boundary upwelling system covering the complete MIS 11c interval and MIS 13. Its records reveal that the complex and seasonal variable hydrography with counter-/ poleward currents also existed during the mid-Brunhes interglacials, making them not much different from today. However, they also indicate that subsurface heat transport with the poleward current was stronger during MIS 11c than today and consequently might have affected the productivity in this region, i.e. leading to lower productivity. With an increase in poleward penetration of the nutrient-poorer subtropical subsurface waters rather than the nutrient-rich subpolar variety, which today is sustaining the extremely high productivity on the northern Iberian margin, is likely to have led to lower productivity, an issue for future research (since productivity records were not shown in the paper this aspect was not discussed). So while in the referee's view all this might not be a breakthrough in our scientific knowledge and/ or understanding of the Brunhes period, it certainly is an important finding at the regional-/ hemispheric scale. In addition, hydrographic conditions indicated by the two sediment records off Portugal impacted climate on Iberia and will thus help in the interpretation of existing

and future pollen and terrigenous biomarker records from the Iberian margin.

3) Today North Atlantic and Iberian climate are closely coupled through the North Atlantic Oscillation (NAO). While our mid-Brunhes paleo-records do not have the resolution to resolve NAO-type connections, it is important to reconstruct North Atlantic/ Iberia connections in the past and in this paper we did it based on the surface water currents and related mode (subsurface) waters. Understanding such connections is important because they also impact the Mediterranean Sea and thus Mediterranean climate (we are still missing high-resolution reconstructions of the Mediterranean hydrography during the mid-Brunhes). Any insights into such past connections will be essential for the interpretation of the sites to be drilled along the southern Iberian margin for the IODP GUCADRILL proposal.

Thus we do believe that our manuscript is worth publishing and is advancing the understanding climate patterns at the hemispheric and regional scales. Because some of the points outlined above were apparently not as clearly stated in the manuscript, we intend to modify this in the final manuscript.

Furthermore, if only the breakthrough papers were to be published a lot of the data that provides the basic information necessary for those to be possible, would just not exist! In addition, the pressing need for more and more regional modeling, as well as the need of data from the best past warm climate analogs, such as the interglacials, as indeed requested in the last IPCC report, is a good enough reason to publish these high-resolution records.

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