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Climate of the Past Discussions

Interactive comment on "Seemingly divergent sea surface temperature proxy records in the central Mediterranean during the last deglacial" *by* M.-A. Sicre et al.

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GENERAL COMMENTS

In this manuscript (Text, 3 Figures), authors compile their previously published work [Siani et al., 2001, Sci.; 2004, QSR; 2010, JQS; 2013, CP–this issue; Genty et al., 2006, QSR; Essallami et al., 2007, G3; Rouis-Zargouni et al., 2010, PPP; 2012, CR GEOSCI.; Bout-Roumazeilles et al., 2013, CPD–this issue; Desprat et al., 2013, CP–this issue] with some new results published here for the first time, and with records already worked and published by others [GISP2 record... Cuffey Clow, 1997, JGR?]. Hence, authors are familiar with the study area.

The two datasets chosen (sites MD04-2797 and MD90-917) are well suited for the special issue *Holocene changes in environment and climate in the central Mediterranean as reflected by lake and marine records* by **M. Magny, N. Combourieu-Nebout, D.-D. Rousseau, and M.-F. Loutre'**.

A number of aspects of the manuscript are of particular interest:

- The connection between the Siculo-Tunisian Straits, the Ionian basin and the Adriatic shelf, that is, climate sensitive areas where western-eastern water exchange takes place (including eastern Mediterranean deep water formation) and the tropical (monsoonal) climatic system of Northern Africa interacts with the North Atlantic climatic system.

- The dating control for the deglaciation and mid-Holocene is remarkable, consisting of 13 14C for MD04-2797 and 21 14C dates for MD90-917, together with a previous in-depth evaluation of radiocarbon reservoir age changes and ash layers. Thus, in general the age control is enough for the discussion (exception: H2; see below for constructive comments). The dating of late Holocene (ca. from 5k to present) is less well constrained, though the authors do not attempt to explain this section.

- The multiproxy approach enriches the description of events: $\delta^{18}O_{G.bulloides}$, sea surface temperature reconstructions using alkenones, and planktonic foraminifera assemblages for comparison purposes with $\delta^{18}O_{speleo}$, $\delta^{13}C_{speleo}$, $\delta^{18}O_{ice}$

The results presented in the paper generally support the interpretations and conclusions. They provide reference patterns for the central Mediterranean during the interval studied and this should certainly be of interest to the reader. In this regard, the paper merits publication in Climate of the Past. In order to make the manuscript more suitable for publication, my only advice is that the authors attempt to add complexity to their discussion and achieve slightly better clarity on the figures. Below are specific and technical constructive comments intended to improve the manuscript.

SPECIFIC COMMENTS

References are made to the text by giving [page number, line number: "text quote"]. I group the specific comments around three main aspects:

ONE **Clarify FIG. 2 and FIG. 3; uncertainties; NEW TABLE 1, NEW TABLE 2**
TWO **Deglaciation disimilarities: seasonality only? proxy and location?**
THREE **Holocene Hypsithermal/ Holocene thermal maximum missing?**

ONE **Clarify FIG. 2 and FIG. 3; uncertainties; NEW TABLE 1, NEW TABLE 2**

Please indicate clearly the original publication of every profile (i.e. the references which the data shown in the figures belong to) and the new contribution/proxies presented in this study. If not, as the manuscript is currently written, it is hard to distinguish who has done what, what the authors are actually contributing in this study and what improvements are made to previously published profiles. Below some suggestions; please confirm they are correct.

MD90-917 (South Adriatic Sea, 41N 17E, -1010.0 m) - $\delta^{18}O_{calcite}$ determined in G. bulloides calcite (‰; [Siani et al., 2004, QSR; 2010, JQS] - SSTs derived from planktonic foraminifera assemblages; April–May and October–November (AM-SSTforam and ON-SSTforam respectively, °C); [Siani et al., 2004, QSR; 2010, JQS] - alkenones (SSTalk, °C) [this study?]

MD04-2797 (Siculo–Tunisian Straits, 36N, 11E, -771 m) - $\delta^{18}O_{calcite}$ determined in G. bulloides calcite (‰; [Rouis-Zargouni et al., 2010, PPP? if so, please include this reference] - SSTs derived from planktonic foraminifera assemblages; April–May and October–November (AM-SSTforam and ON-SSTforam respectively, °C); [Rouis-Zargouni et al., 2010, PPP? if so, please include this reference] - alkenones (SSTalk, °C) [Essallami et al., 2007, G3; this study?]

The reader always appreciates it if authors point out precisely in which part of the figures one can find whatever is being discussed (as far as possible, a figure must be self-explanatory). If figures are clearly worked, the reader will be able to recognize at first glance what is going to be discussed in the text; thus, I earnestly request that authors include in FIG. 2 and FIG. 3 the name of the core and the proxy used; this information must be clear either in the title axis and/or above every profile. This will have the added benefit of simplifying legends and the text of figure captions, without losing information (e.g. the original publication of every profile). In addition, if I'm not mistaken, labels for the alkenone profiles in FIG. 3 are mixed up, i.e. label 'Siculo-Tunisian Strait' must read 'Adriatic Sea' and viceversa.

[689,13-16: "The higher resolution SSTalk signal also reveals imprint of millennial-scale Heinrich event coolings, i.e. H1a (15.5kyr)... H2a off the Iberian margin (Bard et al., 2000)"] [700,6: " Shaded areas in grey indicate the Younger Dryas (YD), the Heinrich stadials H1a, H1b and H2a. "]

Is it H2a or H2b? or simply H2? the label in FIG 2 does not agree with the figure caption. In any case, I'm afraid around the H2 interval, the dating is not precise enough to comment on it; please delete the sentences accordingly. Apart from that, it must be emphasised that Heinrich events cannot be recognized in the SST profiles or $\delta^{18}O_{calcite}$ record of different species. I'm aware that everybody does it, but technically speaking, this is not correct. We assume that the events are synchronous, but it is no more than an assumption. It is necessary to honour originally published designations wherever possible [Rousseau et al., 2006, QSR]; that is, Heinrich events" [Broecker et al, 1992. CD] were described solely as marine sediment layers containing a large concentration of ice-rafted debris and a scarcity of foraminifera or high N. pachyderma sinistral (Nps) percentages at particular northeast Atlantic mid-latitudes. Nps percentages for core MD04-2797are shown in [Rouis-Zargouni et al., 2010, PPP – Fig. 6]; are Nps percentages available for core MD90-917?; Can Nps percentages be added in FIG. 2 and FIG. 3 and name "Heinrich events" only to them?

- NEW TABLE 1 horizontal uncertainties; this is of particular importance, even when it is clear that extensive research has been performed with these cores. A TABLE with the dates, raw, errors, calibrated ages, together with changes concerning the newest calibrations available if applicable, etc would be very much appreciated in order to avoid digging too much in dispersed literature [Combourieu-Nebout et al., 1998, QSR; Rouis-Zargouni et al., 2010, PPP; Desprat et al., 2013, CP; Siani et al., 2013, CP]. Authors must always keep in mind the specific purpose of their manuscript: divergent sea surface temperature proxy records in the central Mediterranean during the last deglacial. In this respect, the comparison between sites MD04-2797 and MD90-917 must be transparent, taking into account chronological uncertainties. Additionally, please justify why the GISP2 chronology is used in the paper as a reference; why not the NGRIP ice core stratigraphy - GICC05 chronology? or authors use the synchronised version? [Lowe et al., 2008, QSR; Rasmussen et al., 2008, QSR; Davies et al., 2008, JQC; Austin et al., 2012, QSR]; please smooth the $\delta^{18}O_{ice}$, in order to make it comparable with the resolution in the marine sediments.

- NEW TABLE 2 vertical uncertainties. A question of possible interest for the reader: comparison between the paleo-records and the instrumental data? ... not because the paleo-records cover the most recent interval but for comments on seasonality. A thoroughly review of methodological mean error of each site and proxy would be very useful; something like AM-SSTforam and ON-SSTforam: methodological error ca. $\pm$0.7-1.4°C ?? SSTalk: methodological error ca. $\pm$0.5°C ??

... together with inclusion of the seasonality at present at core locations [Fichaut, M., M. J. Garcia, A. Giorgetti, A. Iona, A. Kuznetsov, M. Rixen, and M. Group (2003), MEDAR/MEDATLAS 2002: A Mediterranean and Black Sea database for operational oceanography, in Elsevier Oceanography Series, edited by N. C. F. K. N. H. Dahlin and S. E. Petersson, pp. 645-648, Elsevier] Below some information from SSTs in °C MEDATLAS 2002; please confirm it is correct and discuss results in the context of the methods used (Ternois? Conte? for the SSTalk; modern analogue technique-MAT for

SSTforams? Calibration errors?).

MD90-917 (South Adriatic Sea, 41N 17E, -1010.0 m)

January 14.0 February 13.5 March 13.7 April 14.8 May 17.2 June 21.1 July 23.4 August 25.2 September 23.3 October 19.8 November 17.2 December 15.6 annual mean: 18.2 $\pm$ 4.2 °C

MD04-2797 (Siculo–Tunisian Straits, 36N, 11E, -771 m)

January 15.4 February 14.9 March 14.9 April 15.6 May 17.1 June 20.6 July 23.4 August 25.4 September 24.4 October 22.8 November 19.7 December 17.3 annual mean: 19.3 $\pm$ 3.9 °C

TWO **Deglaciation disimilarities: seasonality only? proxy and location?**

[689, 1: "SSTforam indicate a 2.5°C cooling... in the SSTalk record"] [689, 13-16: "The most remarkable discrepancy... South Adriatic Sea at 16.5 kyr"] [691,11-15: "Higher than ON-SSTforam values between 19 and 16 kyr (and the YD) point to preferential summer alkenone production at both sites of the central Mediterranean Sea. In contrast, under milder BA and Holocene climates, SSTalk are close to AM-SSTforam except for the Holocene in the Siculo–Tunisian Strait region where they are similar to ON-SSTforam underlining seasonal production changes during the deglacial."] [694,5-11: "final warming to the Holocene occurs seemingly earlier in the SSTalk than SSTforam leading to an apparent shorter duration YD,... We suggest that this bias result from alkenone production shifting from spring during the BA, to summer during theYD and back to spring during the Holocene, except for the Siculo–Tunisian Strait region were Holocene SSTalk are close to ON-SSTforam.]

The uncertainties mentioned above (essentially NEW TABLE 1 and NEW TABLE 2, as yet to be included in FIG. 2 and FIG. 3) are crucial to discussion of the dissimilarities observed between both paleothermometers, in particular around the H1with its

two phases, H1a and H1b (please use the N. pachyderma (s) percentages to locate these events as per point one) or the BA and the YD. For the later, the hypothesis of seasonal shift from spring to summer and then to spring again in the case of the alkenones could sound interesting but I'm afraid it is hard to prove with the tools the authors have in hand. Please include the uncertainties in the figures to help with the discussion. In any case, wouldn't be easier to invoke changes due to the different location/proxies studied? What about the comparison between SSTalk and SSTforams? The alkenone view is not expected to be exactly the same view as forams, even when they are measured in the same strata, because a marine plant (coccolithophores) could react differently from an animal (foraminifera); what could be lethal to plants may not be so to animals, and viceversa. Additionally, climate changes in the South Adriatic Sea are not expected to be exactly the same as events described by other proxies in relatively closer regions such as the Sicily Straits, either in intensity or rates of change. The reader would appreciate clearer discussion on that.

THREE **Holocene Hypsithermal/ Holocene thermal maximum missing?**

Why is the Holocene hypsithermal not evident in the SST records? Or at least why is this feature not discussed? I very much like the approach of the authors when they try to connect land and marine environments by means of speleothems; they use La Mine [Genty et al., 2006, QSR]; that's fine; what about the Grotta di Carburangeli [Frisia et al., 2006; QR] or others from the eastern Med? In terms of humidity, changes are observed from early to late Holocene at Lake Accesa in north-central Mediterranean [Magny et al., 2007] and Lake Preola in Sicily [Magny et al., 2011]. Hence, why no changes are evident/discussed in the alkenone profiles or the foram records? What about marine cores in the area? in [Emeis Dawson, 2003, The Holocene?] the SSTalk shows approximately -4°C decrease from the 8.2k event down to the core-top sample, from 21°C to 17°C. Concerning SSTforams, do they show a warming trend for the same time span? Do the authors have any comment on the role of the increased melting of

the Laurentide Ice Sheet during the early Holocene and its influence of the central Med climate? Please consider further references for the discussion of the seasonality-forcings and the Med specific case [Renssen et al., 2012, QSR] at least to explain the long-term trends. Perhaps the authors would be kind enough to provide the reader with their hypotheses/observations on the apparently missing Holocene Hypsithermal/ Holocene thermal maximum.

Some references

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499-515, doi:10.5194/cp-9-499-2013 (2013).

TECHNICAL COMMENTS

[692, 13: “at the onset of G1S in the Greenland isotope record”]
change G1S to GS-1 and apply it to the GISP2 record only

In general, please check the references: e.g.

[684, 17: “Lionello et al., 2008; Luterbacher et al., 2006”; 696, 16: “Lionello, P., Planton”]
Consider Luterbacher, J. et al. in The Climate of the Mediterranean Region (ed P. Lionello) 87-185 (Elsevier, 2012).

[684, 17: “Siani et al., 2012) ”]
Siani et al., 2013?

[696, 10: “Huston, W. H.: The Aghulas”]
Please correct Hutson, W. H. The Agulhas Current During the Late Pleistocene: Analysis of Modern Faunal Analogs. Science 207, 64-66, doi:10.1126/science.207.4426.64 (1980).

Sincerely,

Belen Martrat

Interactive comment on Clim. Past Discuss., 9, 683, 2013.