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Climate of the Past Discussions



# *Interactive comment on* "Abrupt climate changes of the last deglaciation detected in a western Mediterranean forest record" *by* W. J. Fletcher et al.

**Anonymous Referee #2**

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This manuscript presents a very high resolution pollen record covering the last deglacial period between 20 to 6 cal ka BP from a sedimentary core recovered at 1841 m water depth in the Alboran Sea. The authors, used pollen data to quantify temperate Mediterranean forest development and estimate annual precipitation (Pann) and coldest and warmest months temperature (MTCO and MTWA) by using the Modern Analogue Technique (MAT). The whole data set is supported by AMS $^{14}$C dating previously published by Cacho et al., 1999. Thanks to the high sedimentation rate of the studied core and the high resolution climatic record obtained by pollen data, the authors attempt to correlate climatic changes in the western Mediterranean region to events of meltwater discharges and perturbation in the North Atlantic circulation.

Results depict a detailed climatic record since the Oldest Dryas event in term of temperature and precipitation changes showing multi-centennial scale variability occurred during this time interval.

Their conclusion suggest as plausible climatic mechanism to explain the recurrence of dry and mild intervals, the influence of an atmospheric forcing related to the dynamic of the jet stream and the relative position of the atmospheric blocking highs. Finally, in the last part of the manuscript the authors suggest by comparing radiocarbon and ice-cores ages during the Late Glacial climatic transition an increase of marine reservoir $^{14}C$ ages in the Alboran Sea by about 200 years.

**In general, the overall presentation of the manuscript is well structured supported by a very interesting and useful set of data. Results are well presented and support the general conclusion even if some interpretations are not always well legitimated.**

**Nevertheless, the manuscript present some questionable points that I will summarize as follow:**

1. In the paragraph “Data and Methods” the authors present the Modern Analogue Technique (MAT) to estimate past temperature and precipitation based on pollen data. Reliability of temperature and precipitation reconstructions are in general assessed using a square chord distance test (dissimilarity coefficient) representing the mean degree of similarity between the sample and the best modern analogues issued from the database. When the dissimilarity coefficient is lower than 0.25, the reconstruction is considered to be of good quality (see Overpeck et al., 1985). The authors did not present the dissimilarity coefficient values neither the geographic origin and the number of modern analogs used in this study. These data should be provided to facilitate the interpretation of results. Finally, how is significant to present Temperature and Precipitation record by MAT instead of TMF record taking into account the error bars on the estimations?



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2. Results from MAT reconstructions and TMF record clearly indicate a good correlation with SSTs alkenone record from Cacho et al. 1999, especially during the main climatic transitions since the last deglaciation. On contrary short term climatic changes are only recorded by TMF record indicating a series of dry intervals characterised by reduced forest development throughout the Late glacial to the Early Holocene. For the events dated at 12.4 ka, 11.4 ka, 11.1 ka, 10.7 ka, 10.1 ka and 6.9 ka, TMF variability is lower than 5-10%. May these events be considered realistic especially when compared to Alkenone SSTs record? Can we consider AC3 AC4 AC5 and AC6 events reliable taking into account the error bars on the alkenone measurement? Finally, how can be explained the absence of the Younger Dryas cold event in the temperature and precipitation record?

3. The Authors suggest an increase of sea surface $^{14}$C reservoir age in the Alboran Sea by about 200 years during the Late glacial/interglacial transition by comparing calibrated radiocarbon and ice core ages. From my point of view this approach is a little bit simplistic as it is not based on a quantitative measure of the offset between the $^{14}$C activity of the atmosphere and that of the contemporaneous oceanic carbon reservoir. This approach was indeed adopted in Mediterranean Sea (Siani et al., 2001) as well in the North Atlantic Ocean (Bard et al., 1994, Austin et al., 1995; Bondevik et al., 2006; Cao et al., 2007 among the others). Concerning the present study, I believe that the best way to give a more realistic estimation of the sea-surface reservoir $^{14}$C age in the Alboran Sea is to compare the SST record in Siani et al., (2001) with TMF record in core MD95-2043 by using for both series the conventional radiocarbon measures as age model. Such correlation displays a good match between the Adriatic and Alboran sea records showing a quite synchronous Glacial-Interglacial transition. Therefore, by taking into account that no changes in the Mediterranean circulation occurred during this time interval, it could be suggested that the reservoir age offset estimated in the Alboran Sea is probably the same than the Adriatic one and consequently



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older than present day global mean age of 400 yrs. Finally, I recommend to add in paragraph 5.3 the following references, Bard et al., (1994), Austin et al., (1995) and Bondevik et al., (2006) when the authors introduce the term reservoir $^{14}C$ ages in North Atlantic Ocean taking into account that their estimations are based on reliable results and not from correlations with ice cores chronologies.

**Further remarks:**

1. paragraph 5.1.1, page 211 line 3-4

The authors state that *HE1 is the equivalent of the Oldest Dryas in southern Europe terrestrial pollen sequences*. It is not clear for the reader which are the definitions of Older Dryas (OD) and Heinrich event (HE). In general, the OD is considered like a cold and dry ***period*** spanning a time interval between 15 ka to 17 ka and corresponding to the GS-2a event following INTIMATE recommendations (Lowe et al., 2008). On contrary, HE is a rapid ***event*** characterised by short surge ***episodes*** associated to iceberg meltings. In conclusion, it is not realistic consider HE 1 as *a climatic period* but rather as one or more short ***events*** occurred during the Oldest Dryas ***period***.

**In conclusion, after careful considerations the manuscript is original and provides an important contribution for a better understanding of the climate variability in the western Mediterranean area. I find the manuscript in its present form acceptable for publication on Climate of the Past. Minor revisions of the manuscript are recommended.**

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Interactive comment on Clim. Past Discuss., 5, 203, 2009.