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Climate of the Past Discussions

Interactive comment on "A multi-proxy perspective on millennium-long climate variability in the Southern Pyrenees" *by* M. Morellón et al.

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We acknowledge criticism and constructive comments for the discussion of this paper made by Lourdes Lopez-Merino.

The authors have provided detailed explanations about the interpretation and temporal resolution of the proxies analyzed in the paleoclimatic records reviewed in this paper. As suggested by Reviewer 1, a specific section including a critical assessment of how each of these proxies responds to climate variability will be included.

We also agree on the high scientific interest of including data from the northern slopes of the Pyrenees in order to provide a more regional perspective for our review, however, we finally decided to focus only on the southern side for the following reasons:

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Interactive Discussion

Discussion Paper

i) There are important landscape differences between the two slopes of the mountain range, which are characterized by different climatic conditions (strong Mediterranean influence in the South, almost absent in the north)

ii) The lack of multi-proxy sequences for the last millennium in the French side. In fact, most of published studies are only pollen sequences and focused on human activities

iii) The lack of access to these pollen databases for an adequate re-interpretation of these sequences from a paleoclimatic point of view

Concerning the interest of Portlligat Bay sequence for this research, we disagree with Dr Lopez-Merino. In spite of its location, in the Mediterranean shoreline, this record provides a good record of both local (Mediterranean area) and regional (Pyrenean region) changes in landscape, forced by both climate variability and human activities. The double provenance of pollen (aeolian and fluvial) is a common feature of all the palynological records (marine-littoral, lacustrine and marine pollen sequences), and not only of this particular sequence. The authors have used the chronology of the sequence published by López-Sáez et al., (2009) that was revised later by Serrano et al. (2011) in a different article focused on historical pollution in this site. As Dr Lopez-Merino, co-author of first paper reviewed here, knows, this age model is valid and offers an adequate chronology for our review, previously discussed and published. In fact, the same radiocarbon ages were used in both age models, with different marine reservoir effect corrections. Lopez-Saez vegetation reconstruction is also consistent with historical changes reported by other authors and we consider this model as the most adequate because it was the one used for vegetation reconstruction in Portlligat.

As Lopez-Merino advised we will replace the citation Van Geel (1978) by Mighall et al. (2006), more adequate for Type 18. This NPP type has been used as a proxy for humidity not only in ombrotrophic peatbogs but also in other contexts and Lopez-Merino does not provide any valid argument against the use of this proxy.

We support the role of pollen as a proxy for climate variability during the last millennia,

CPD

7, C1872–C1876, 2011

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as stated in the response to referee 1 and demonstrated by numerous records published in the Iberian Peninsula and outlined in this previous comment (see response to Referee 1). The discussion of the reviewed pollen sequences is not based on Pinus content because as Lopez-Merino states, the pine's types are very different in each record and, here, it would not be a good indicator. Despite the pine content has been frequently used in marine pollen records to identify climatic changes, this is not so evident in continental areas. One of the authors, in González-Sampériz et al. (2006), has demonstrated that Juniperus, mesophytes and some heliophytes (steppe herbs), but not pines, were really good indicators of abrupt climatic changes in the Pyrenees during the Lateglacial and the Holocene. Thus, the same author and palynological collaborators of this paper have decided to employ the same taxa (junipers, mesophytes and heliophytes, next to some hydro-hygrophytic component) and not pines such as climatic and hydrological indicators to test their validity in recent times and to compare between the selected sequences.

In Arreo record juniper's pollen content was not significant because of the vegetation composition of the area and thus, Pinus has been plotted to provide four pollen curves in each site. In this sense, we will consider the elimination of this taxon in Arreo. In Basa de la Mora, Pinus is the dominant taxa in the whole sequence, and no important changes have been recorded. Thus, we haven't plotted the Pinus curve because it doesn't provide significant paleoclimatic information.

The chronological framework of the Basa de la Mora Lake has been published in the journal ZUBÍA Pérez Sanz et al., (in press) and preliminary results were already published in Moreno et al., (in press). The chronology for this part of the sequence has been obtained by dating 2 terrestrial plant macroremains and the 1963 AD 137Cs peak. These three points and their calibrated ages will be plotted in figure 2.

As Lopez-Merino states, humid conditions prevailed in the Iberian Peninsula during the LIA, with the exception of the NW region. In fact, this spatial variability has been discussed in Moreno et al., (in press) and we will rephrase this part of the text accordingly.

CPD

7, C1872–C1876, 2011

In any case, all the reconstructions carried out in this part of Spain are consistent and they have recorded more humid conditions during this period. The lack of an annual resolution in most of the reviewed sequences limits the accuracy of our discussion about the footprint of sunspot variability during the last millennia, as we state at the beginning of section 5.1. For this reason, changes in Lake Montcortes diatoms C:P ratio has not been used here as a proxy of humidity/aridity. Only changes in sublayering are discussed here. Particular inconsistencies between the sequences can be expected and they have been sufficiently discussed in this section. Differences in water salinity reconstruction and arid/humid phases are not contradictory because they refer to different environmental conditions: water salinity refers exclusively to precipitation/evaporation ratios, reconstructed from high-resolution geochemical changes in the sediment core; whereas arid and humid stages have been defined as a summary of the high number of proxies evaluated in (Morellón et al., 2011), comprising: i) sedimentology, ii) elemental and isotopic geochemistry, and iii) biological proxies (pollen, diatoms and chironomids). The description of these stages and the interpretation of each of these proxies can be found in this article. Minor corrections suggested by Lopez-Merino will be also taken into account for the revision of the manuscript.

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CPD

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