

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

Anonymous Referee #1

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This paper provides a clear and comprehensive review of palaeoclimatic evidence from the Spanish side of the Pyrenees mountains during Medieval and Little Ice Age times. Its overall conclusions are not new (LIA=cool, wet; MCA=warmer, dry), but this is the first paper to bring together a full range of different proxies, and it will make a useful addition to the published literature. The paper could, however, be improved by being less descriptive and more analytical. Some suggestions about how this could be done follow below. . .

1. The paper uses four different types of proxy data, but makes no critical assessment of how each of them responds to climate change (see NRC 2006 for a useful review). In essence

a. Tree-rings provide excellent, well-dated climate data on seasonal, inter-annual and
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decadal timescales, but are less reliable for centennial trends (“segment length curse” etc) and suffer from a reduction in data back in time (fewer data are available for Medieval times than for the LIA)

b. Glaciers are also climate-sensitive, but with a very different response time to tree rings; typically decadal to centennial. They also suffer from a reduction in data back in time and for warm periods (hence, almost no information for Medieval times)

c. Lakes are most useful for identifying decadal or longer climate trends, and records normally cover the whole of the MCA/LIA period. The main uncertainties are 1) chronological imprecision and sampling resolution 2) the role of human impact

d. Pollen is the least reliable of the four climate proxies for the last 1 ka, mainly because it can be difficult or impossible to separate climatic from anthropogenic effects. However, climate changes in mountain regions, especially near the tree line, may be detectable in pollen records. For this reason, I would exclude the Porlligat Bay site from this synthesis, since it is based only on pollen data (with no other proxy for validation) and is at sea level, not in the Pyrenees mountains. I would also put figure 2 after figure 3, and discuss pollen evidence after the other three lines of evidence, since it is least dependable as a climate signal.

In consequence, climate changes in the Pyrenees may not have been recorded in exactly the same way by each of the four different proxy archives. It would be good to see some critical evaluation of this issue in the paper, rather than an implicit assumption that they all respond in the same way. For example, as can be seen in figure 3, the only data source for Medieval climate in the Pyrenees comes from lake sediments (tree ring and glacial evidence only begins after AD1300).

2. The authors provide no rationale for defining their study region, namely the southern Pyrenees. In climatic terms would it not be more logical to take the whole of the Pyrenees mountains as a unit for study, both French and Spanish? Most studies of climate change in the Alps, for instance, do not restrict themselves to country boundaries! In

fact, the glacial data shown in figure 1B cover both French and Spanish sides of the Pyrenees. Inclusion of the whole mountain chain would then allow an evaluation of any differences between the two sides (e.g. north vs south facing). At the very least, some reference should be made to palaeoclimatic evidence from the French Pyrenees – it is more directly relevant than the Jura or Appennines, which are mentioned!

3. Although the figures are useful, the data could also be synthesised in other additional ways, which the authors might wish to consider; for example, as mapped summaries for selected time slices (e.g. 1000-1100 AD vs 1600-1700 AD), or some of the proxy time series could be transformed and homogenised into Z scores, which would allow direct comparison between them. . .

4. The English text is generally good, but a few corrections follow below.

National Research Council STR Committee 2006 Surface temperature reconstructions for the past 2,000 years. National Academies Press, Washington DC, 145 pp

Minor corrections p. 3052, line 11: “on European societies. . .” line 27: “warming it is necessary” p. 3053; line 18: Bay of Biscay in the west and Cape Creus to the east p.3054, line 1: “towards the Aquitaine (France).” p.3055; lines 9-14: re-write this sentence. It is currently not clear. p. 3055, 3062, 3065, and elsewhere: “varve counting”; “evidence” not “evidences”; precipitation not precipitations p. 3057; line 19: “during the warmer. . .” p. 3058; line 18: IP needs defining in full when first used. p.3060; line 1: “is located at a high altitude in. . .” line 16-17; “temperatures decreased sharply. According to the Redon record. . .” p. 3061; line 19; delete “robustly” lines 22-24: as written there is a 50 year overlap between the two time periods, please correct this. (1300-1450, 1500-1850) p. 3062, line 27: “Ten massifs with glaciers. . .” p. 3063, line 1: “development of cirque glaciers with reduced. . .” p. 3069; line 1: “short-lived climate”

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