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Interactive comment on "Multi-decadal climate variability in southern Iberia during the mid- to late-Holocene" *by* Julien Schirrmacher et al.

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We have read this interesting paper about the mid-late Holocene climatic evolution in the western Mediterranean. However, we have observed that some previously published data have been taken/interpreted in a wrong way, more specifically the geochemical data from southern Spain. Authors took these data from a data repository / data descriptor paper (García-Alix et al., 2018; Pangaea), but they did not take into account the source paper where the specific explanation/interpretation of the data for this local area was provided (Garcia-Alix et al., 2017).

In the manuscript authors explained that (Page 6: lines 20-23):"The Norm33 ratio or the proportion of the C33 n-alkane homologue, respectively, is a function of a change

in C4 plant distribution according to air temperature and/ or precipitation change (Bush and McInerney, 2013; Herrmann et al., 2016; Leider et al., 2013; Rommerskirchen et al., 2006; Vogts et al., 2009; Vogts et al., 2012).". Afterwards they stated that (Page 9: lines 15-18): "Notably, in our records all observed drought episodes are paralleled by Norm33 maxima (Figure 4). These maxima indicate a shift towards a higher abundance of C4 plants, which are much more adapted to drier (and warmer) conditions (e.g. Bush and McInerney, 2013). Moreover, our data gains support from Sierra Nevada bog sediments Borreguil de la Virgen and Borreguil de la Caldera (Figure 4; García-Alix et al., 2018), which also indicate an increase in C4 plant abundance during the droughts".

This interpretation of the relationship between C4 and the Norm33 index (C33 vs C29 alkanes) is an overgeneralization, and more information about the local environments is needed to understand the meaning of n-alkanes in the different regions/areas, in particular in the Sierra Nevada (S Iberia). This information is available in a recent plant survey conducted in Sierra Nevada alpine wetlands (including Borreguil de la Virgen and Borreguil de la Caldera sites that authors mentioned). This survey was performed to understand the n-alkane (Garcia-Alix et al., 2017) and the organic δ13C meaning in local paleorecords (Jiménez-Moreno et al., 2013). Firstly, no native C4 plants are found in that area: "Vegetation of the catchment basin primarily consists of members of the Poaceae and Cyperaceae. The mean measured δ13C value of Poaceae and Cyperaceae is -29.3 ± 1.4‰ and -26.7 ± 0.7‰ respectively. By comparison, the carbon isotopic composition of the 16 plant samples (including Poaceae, Cyperaceae, Artemisia, Asteraceae, Fabaceae, Lamiaceae, Plantago, Ranunculaceae and an unidentified bryophyte) taken from near the lake ranges from -30.3‰ to -25.8‰ with a mean value of -27.0 ± 1.4‰" (Jiménez-Moreno et al., 2013). The n-alkane signature of recent plants (C3 plants) is the same as the one of the paleorecords in these alpine areas: "Our modern plant and soil survey in the extreme Sierra Nevada environments (Fig. 1c) shows that the distance plants occur from a water source, such as wetlands, controls the length of n-alkanes carbon chains. In particular, plants that are in or near the water pools show a stronger predominance of the shorter carbon chains." (Garcia-Alix et al., 2017). There is further information in the supplementary material of that paper. Therefore, the relationship between C33 and C29 alkanes, the Norm33 in Schirrmacher's draft, cannot be used as a C4 plant proxy in these sites (Borreguil de la Virgen and Borreguil de la Caldera): 1) because C4 plants do not occur in the area, and 2) because the alkane chain length is related to the plant water availability in these specific sites.

Anyway, the reason why these data seem to agree with authors' C4 reconstrcution is because the Norm33 index in the Sierra Nevada alpine sites (Borreguil de la Virgen and Borreguil de la Caldera) is higher in dry periods, but not related to a higher C4 input. Therefore, Sierra Nevada data make sense for this paper, but their meaning should be related to the alternation of dry-wet periods, instead of C3-C4 plant fluctuations in these alpine sites.

Although we found evidence of north-Africa aeolian inputs in these alpine sites from southern Iberia based on inorganic geochemistry i.e: Zr/Al Zr/Th or Ca/Al proxies (Garcia-Alix et al., 2017; Jiménez-Espejo et al., 2014; Mesa-Fernández et al., 2018), we have not been able to identify a true evidence of C4 organic matter input in these alpine sites so far. The best way to identify C3-C4 plants is by using carbon isotopes, and as it was mentioned before, carbon isotopes in Holocene bulk sediments from these alpine sites show no clear signature of C4 plants (Garcia-Alix et al., 2017; García-Alix, Jiménez-Moreno, Anderson, Jiménez Espejo, & Delgado Huertas, 2012; Jiménez-Espejo et al., 2014; Jiménez-Moreno et al., 2013). The only potential C4 input in Sierra Nevada alpine wetlands may be at the YD-Holocene boundary (in Laguna de Río Seco), when the δ13C values of the organic matter from bulk sediments reached -18‰.This might be related to the release of the sediment stored in the YD glaciers during their melting (Jiménez-Espejo et al., 2014). Carbon isotopes in the n-alkanes from these sites are needed to get an accurate answer to this question.

A similar comment can be applied to (Page 9: lines 18-19): "In addition, pollen data

from Elx and Padul record an increase in C4 grasses (Poaceae) at ca. 5.4, 5.0, 4.8, 4.4 and, 3.7 ka BP (Burjachs pers. comm., 2018; Ramos-Román et al., 2018b". Ramos Roman's paper did not mention that Poaceae species from Padul were C4-Poaceae: actually C4-Poaceae have not been identified in this record so far.

In summary, n-alkanes from Borreguil de la Virgen, and Borreguil de la Caldera, along with Poaceae from Padul might be used for comparison as humidity/drought proxies, but not as C4-plant proxies in the mentioned sites from southern Spain.

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