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Climate of the Past Discussions
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Interactive comment on "Late Pliocene Cordilleran Ice Sheet development with warm Northeast Pacific sea surface temperatures" *by* Maria Luisa Sánchez-Montes et al.

Anders Carlson (Referee)

acarlson@coas.oregonstate.edu

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Sánchez-Montes et al. present new and exciting SST and IRD data from IODP Site U1417 in the Gulf of Alaska spanning 4 to 1.7 Ma. This occurs during the Pliocene to Pleistocene transition when the world shifted into the modern ice age period. By measuring IRD and SST records in the same core, the authors can provide a one-to-one comparison between local temperature and the behavior of tidewater glaciers.

While this data is exciting, the paper needs some substantial revisions and consideration of other data not referenced. I'll leave my comments at a more general level at present to guide revision prior to more specific comments.

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First, don't call it the mid-Pliocene warm period. The MPWP is actually the mid-Piacenzian warm period. The Piacenzian used to be in the mid Pliocene but as of 2009, it is now the late Pliocene. See Gibbards et al.'s revision of the Cenozoic timescale.

Second, the authors should skip this comparison with modern SST in their discussion and rather focus on comparing with the alkenone record of Praetorius et al. (2015 Nature) that is from 17 ka-0 ka at what is now Site U1419 (core is EW0408-85JC taken on the site survey cruise for the IODP leg). The core top temp is the same as at U1417, supporting the comparison. And more importantly, the glacial interglacial absolute and relative change at U1419 from 17 to 0 ka is the same as the Pliocene and early Pleistocene range and absolute temps at U1417. I think this rules out a major change in CO_2 average composition as a driver of a Pliocene to Pleistocene to last deglaciation SST pattern.

Third, quit saying this is the Cordilleran ice sheet. IRD only means you have a marine terminating ice margin. There is no Cordilleran ice sheet today and the Gulf of Alaska has a lot of marine terminating ice margins and icebergs floating around. For instance, both Bering and Malaspina glaciers could quickly become marine terminating if a big storm came through and blew away their morainal banks that happen to right now be above sea level. Both glaciers have beds below sea level except for that little bank. The evidence for an ice sheet comes from the dated proglacial gravels to the northeast in Hidy et al. (QSR 2013) that date the first Cordilleran ice sheet to about ~2.6 Ma. This paper should be discussed. Likewise, the authors should use the proximal mag sus. record from ODP Site 887 rather than the far removed to western Pacific records of 882 that Haug et al. produced. I would also include comparison of the U1419 mag sun record to 887 to support the authors suggestions/conclusions. The mag sus record could also help in improving the IRD resolution/interpretation. Surprised it isn't included. In summary, the authors should just refer to tidewater glaciation of the mountains, leaving out the word ice sheet or Cordilleran ice sheet. As far as the record they have in U1419, the conclusion is that some icebergs survived to U1419 once at ~2.7

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Ma and then again after ∼2.6 Ma. This is important findings but by no means says anything about an ice sheet or its size. The authors could compare IRD abundance to the IRD record from Addison et al. (2012 Paleoc) on 85JC. Now, 85JC is much closer to the ice margin and coast but could provide some kind of context.

Fourth, I would greatly reduce to just cut the discussion of the PDO or analogues to modern SST patterns from the paper. The whole section is very confusing and hard to follow. Likewise, this depends highly on the age models of all the cores and these are not discussed. To make such comparisons/conclusions, common age models and uncertainties need to be applied which I think is beyond the scope of this paper. Rather, the authors should smooth down to ∼0.1 Ma their records in Fig. 3 and support the idea that the North Pacific warmed over the Plio-Pleisto transition while the North Atlantic cooled. At the multi-0.1 Ma timescale, such a conclusion should be robust without delving into age models too far.

In general, the paper needs some heavy editing on the writing side for clarity and grammar. For instance, conjunctions, such as “aren’t”, are used at points.

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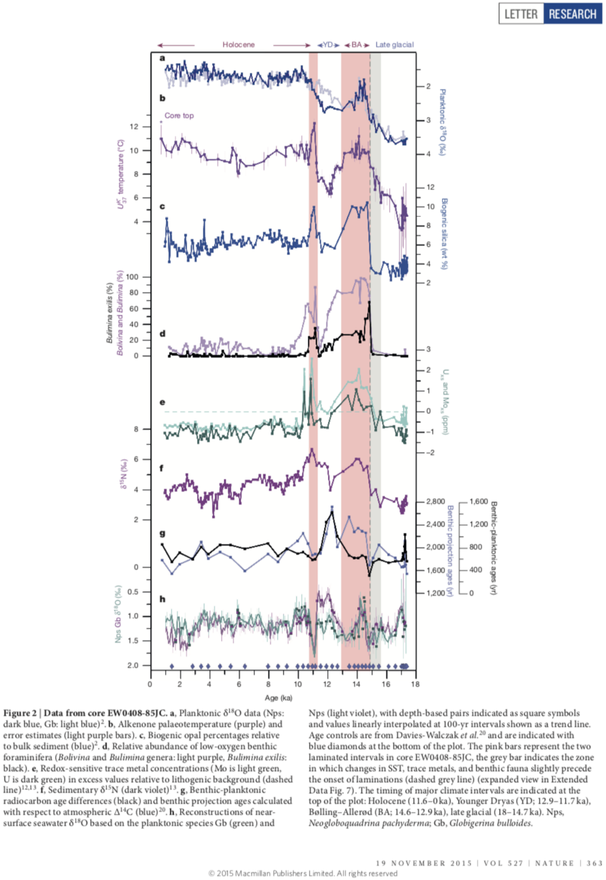
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Figure 2 | Data from core EW0408-85JC. a, Planktonic $\delta^{18}O$ data (Nps: dark blue, Gb: light blue)[2]. **b**, Alkenone palaeotemperature (purple) and error estimates (light purple bars). **c**, Biogenic opal percentages relative to bulk sediment (blue)[2]. **d**, Relative abundance of low-oxygen benthic foraminifera (*Bolivina* and *Bulimina* genera: light purple, *Bulimina exilis*: black). **e**, Redox-sensitive trace metal concentrations (Mo is light green, U is dark green) in excess values relative to lithogenic background (dashed line)[12,13]. **f**, Sedimentary $\delta^{15}N$ (dark violet)[13]. **g**, Benthic-planktonic radiocarbon age differences (black) and benthic projection ages calculated with respect to atmospheric $\Delta^{14}C$ (blue)[20]. **h**, Reconstructions of near-surface seawater $\delta^{18}O$ based on the planktonic species Gb (green) and Nps (light violet), with depth-based pairs indicated as square symbols and values linearly interpolated at 100-yr intervals shown as a trend line. Age controls are from Davies-Walczak *et al.*[20] and are indicated with blue diamonds at the bottom of the plot. The pink bars represent the two laminated intervals in core EW0408-85JC, the grey bar indicates the zone in which changes in SST, trace metals, and benthic fauna slightly precede the onset of laminations (dashed grey line) (expanded view in Extended Data Fig. 7). The timing of major climate intervals are indicated at the top of the plot: Holocene (11.6–0 ka), Younger Dryas (YD; 12.9–11.7 ka), Bølling–Allerød (BA; 14.6–12.9 ka), late glacial (18–14.7 ka). Nps, *Neogloboquadrina pachyderma*; Gb, *Globigerina bulloides*.

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Fig. 1. Figure from Praetorius et al. 2015