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Climate of the Past Discussions

Interactive comment on "Significant recent warming over the northern Tibetan Plateau from ice core δ^{18}O records" *by* W. An et al.

Anonymous Referee #3

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GENERAL COMMENTS In 'Significant recent warming over the northern Tibetan Plateau from ice core d18O records', An et al. introduce a new delta-18-oxygen isotope record from the northern Tibetan Plateau glacier, the Mt Zangser Kangri. They correlate their isotope record with nearby ice core records of the northern Tibetan Plateau, and then use the delta-18-oxygen records of the northern Tibetan Plateau to reconstruction regional temperature history for 1951-2008. In doing so, they find pronounced decadal regional warming trends over the northern Tibetan Plateau, rates of 1.12-1.31 degrees per decade since 1970. These decadal warming rates are compared with the much lower values for both the instrumental record from the northern Tibetan Plateau and the global mean (0.45 and 0.28 degrees per decade). This is an outstanding contribution of a new proxy record from a remote Tibetan Plateau location. The authors rightly attempt to reconcile the new isotope records with others from

the region and to place the record in a global and warming context which is appropriate. The temperature reconstructions from the delta-18-oxygen isotope record would benefit from a more quantitative selection of the isotope sensitivity and assessment of results to choice of this isotope sensitivity. I would recommend publication of the manuscript following revision based on the provided comments.

SPECIFIC COMMENTS It would be great to see a figure that presents the sensitivity of their results for decadal rates of warming to choice of isotope sensitivity (delta value per mil per degrees Celsius). The first paragraph of page 2708 outlines some bases for their choice of isotope sensitivity but it would be great to see a more quantitive reason for the selection of 0.6-0.7 per mil per degrees Celsius. The outcome of this paper as it is presented depends largely on this selection and so this is a critical part of the paper and I would like to see more about it. Since the use of 0.6-0.7 represents a 'low end of the range' of estimate (p. 2708, line 18), what would use of lower and higher values of isotope sensitivity indicate about decadal warming rates for the northern Tibetan Plateau? What does a figure of warming rate (degrees per decade for 1970s-2008) versus isotope sensitivity (delta-per mil per degrees Celsius) look like? Then, how does the uncertainty associated with the delta-18-oxygen values influence that figure? Finally, what if isotope sensitivity is time-variable?

TECHNICAL COMMENTS p. 2703, line 16: ice core d18O is not 'unique' to the TP, nor is ice core d18O the only paleoclimate proxy of the TP, remove 'unique'

p. 2704, line 12: Indicate the organization affiliated with the State Key Laboratory of Cryospheric Science?

p. 2705, first paragraph: It seems hasty to dismiss the precipitation signal from the delta-18-oxygen isotope ratio simply because there are not statistically signfiicant long-term trends in the seasonal precipitation time-series. The words in lines 4-6 to describe this analysis 'time series for the proportions of both summer and winter precip' do not clearly describe what is shown in Fig. S1. Be more clear both in the text and the

caption of Fig. S1 what is shown in this figure. What are the percentages on the y-axes? Is it the percent of the annual total precipitation? It would be nice to see the climatological precipitation cycle, or at least describe the regional seasonal cycle. Given the emphasis on Spring temperatures elsewhere in the paper, what might be the influence from non-solstice season precipitation?

Rather than, or in conjunction with, temperature, how may the northern TP d18O record relate to upstream convection (see He et al 2015, JGR-Atmospheres doi:10.1002/2014JD022180) either over India or to westerly synoptic systems over the mid-latitudes? Basically, where does the vapor come from and what is its history?

Likewise, in addition to temperature, how may the northern TP d18O records relate to changes in the large-scale circulation and the transport or mixing of water vapor by those circulations?

p. 2706, line 8-10: The low correlation coefficients between d18O and instrumental temperature suggest that d18O variability is not wholly temperature dependent.

Do the high rates of reconstructed decadal warming correspond with observed changes in mass balance for northern TP glaciers? or, do mass balance changes in the glaciers more closely agree with TP instrumental temperature observations?

Further discuss the snow-albedo feedback and how it may influence warming rates. Can we quantify or estimate (back-of-the-envelope) how much of the 1.12-1.31 degrees per decade may be attributed to the snow-albedo feedback?

p. 2711, line 11-14: Rewrite this sentence, it is a bit unclear.

Section 3.2: What is the basis of the per mil per degrees relationship used to calculate the degrees per decade values? Can the authors somehow constrain an estimate of the isotope sensitivity on the time-scale of decades? What is the change in isotope ratio per degrees Celsius per decade?

p. 2711, line 18: Be clear on what is meant by southwest monsoon, particularly in the

context of the Asian monsoon system that is referenced in the previous sentence.

Discussion: Reduce the speculative discussion of how the the distance between the TP and equatorial ocean circulations dilute the warming hiatus signal.

Further discuss the significance of the stronger relationship between the isotope records and spring temperatures? What would be a physical explanation for this relationship?

TABLES AND FIGURES Table 3. There are no 'a' notes ($p<0.05$) is this right? Its listed below the table but I see no instances of its use?

Fig. 1. The black rectangle (study region) boundary shown in the inset does not correspond to the area shown in the larger map, make the inset black rectange match the area shown in the larger map.

Fig. 1. The red arrows seem to be for near surface and lower troposphere boreal summer winds, whereas the blue arrows appear to be for mid to upper troposphere boreal winter winds and this needs to be clear in the caption that you are showing horizontal winds for different pressure levels in the atmosphere. Also, the different lengths of the red and blue arrows may erroneously suggest relative wind speeds that are more nearly opposite to what is shown, so I would suggest common arrow lengths to avoid confusion. Mid to upper troposphere winds (those above the plateau, assuming that is what you are showing) are not so dramatically wrapped around the plateau.

Fig. 2. Ca2+ (and Mg2+)concentrations appear to decrease while d18O increases over the past few decades? Could these reflect changes in circulation from a dustier/colder source to a less dusty/warmer source, or from a dustier extratropical source to a less dusty tropical source?

Figs. 2 and 4. Not a major problem but you flipped the direction of the time/x axes between figs. 2 and 4. Make consistent.

Fig. 4. Supplemental Figure indicates slopes and p-values for those slopes. The

poor p-values of the seasonal precipitation trends are used to dismiss precipitation as important. Please also provide slopes and p-values to the trend lines shown in Fig. 4. The slopes of these lines determine (along with the isotope sensitivity) the decadal warming rates that are so central to this manuscript. It would be important to see the significance of the trend lines for the ice core isotope records.

Interactive comment on Clim. Past Discuss., 11, 2701, 2015.