

Interactive comment on “Ice core precipitation record in central Tibetan plateau since AD 1600” by T. Yao et al.

Anonymous Referee #2

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This manuscript presents a new reconstruction of central Tibetan Plateau precipitation variability over the past 400 years, using a new ice core drilled in the Puruogangri Ice Field. The data are new and should provide an important contribution to the description and understanding of precipitation variability. However, the text and figures must be significantly improved before the manuscript can be considered for publication in Climate of the Past. I therefore suggest major revisions.

The map displayed in Figure 1 does not have a detailed caption. I suggest to show a general map with a legend showing the location of previous and this new ice core, and a more detailed map (or picture) showing the topography near the drilling site and the location of the Tuotuohe meteorological station used for the calibration study.

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I also suggest to show the raw measurements conducted on the ice core. This could be a figure showing, as a function of depth, the variations of density, of water 18O , and dashed vertical lines showing the identification of annual layers based on the visual inspection of the dust horizons in the ice core. I understand that the actual accumulation reconstruction requires a correction for layer thinning, and this figure could help the reader to understand how this thinning is varying with depth. As glaciological effects could have a profound influence on the layer thickness, any information relevant for the ice flow would be useful. Have there been radar echo soundings conducted on the ice field, analyses of ice flow? What is the total estimated ice depth at the site of drilling? What are the topographic properties at the drilling site? Are there inclined layers identified in the core? While I understand how difficult it is to model the flow of such a glacier, it is important to give to the reader the most detailed available information on the ice flow. Also, the authors do not mention melt features, have such features been identified in the cores? This can be potentially important for the identification of past warm periods.

Regarding to the age scale, it is apparently only based on the seasonal visible dust layers. Is there a possibility to use alternative age markers to support the age scale, such as volcanic horizons? It would be extremely useful to back up the counted age scale with an independent information, and to estimate objectively the uncertainty associated with the layer counting.

Figure 3 shows the time variations of the estimated accumulation and a statistical test used to assess if the 31 year running average is significantly different from the long term mean. First, it would be interesting to calculate the spectral properties of this annual accumulation signal. Does the record show frequencies already identified for instance in tropical or temperate rainfall interannual to decadal variability? An analysis of spectral properties would also be very useful to decide what should be the length for calculating long term trends (here, 31 years).

Regarding these long term trends, I would suggest to show the long term running aver-

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age and running standard deviation of the annual accumulation data. It is quite striking that not only does the mean accumulation vary significantly, but also the interannual variability as well (for instance, it seems very low in the 19th century).

When discussing the quality of the accumulation reconstruction, the authors discuss the sources of uncertainty and estimate that the error is less than 10% for annual data and less than 5% on the 10 year mean. The authors must support this statement by evidence. The only evidence given in the manuscript is in the very interesting Figure 2 showing the comparison between Tuotuohe instrumental precipitation data and Puruogangri ice core data. When looking at this comparison, it seems indeed that the quality of the correlation is good, but that a $R=0.45$ suggests more than 10% of uncertainty. It would be nice to show the annual data and the 5 year running average which is said to have a high correlation coefficient. By the way, what is the precipitation seasonality at TMS (a diagram showing the distribution of rainfall in the different months would be useful). Also, the authors should compare the annual accumulation derived from the 3 ice cores drilled on the same location in order to assess the signal to noise ratio and the spatial coherency of the local accumulation counted layer records.

The interpretation of the data is given in terms of temporal long term accumulation changes, and also in terms of spatial differences between temperature and accumulation. It is frustrating for the reader to see a stack of 18O converted to temperature and each record for accumulation. I suggest to change Figure 4 and to show on the left panel, the 3 accumulation records, and on the right panel, the 3 18O records. Data treatment methods such as principal component analyses could be used to highlight the common or specific features of these different records.

This would be useful to see the spatial differences and also the links between 18O and accumulation, as many processes within the atmospheric water cycle can alter 18O such as continental recycling, moisture origin, droplet reevaporation, convective versus stratiform processes, and therefore both local temperature and precipitation amount. I have never seen a detailed analysis of the links between 18O and accumulation for

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different ice core sites, and many recent results even from the Antarctic coast clearly show that you can learn something from the difference between $\delta^{18}\text{O}$ and accumulation (probably linked with changes in air mass trajectories). A solid discussion of the past temperature history and of the potential and limits of $\delta^{18}\text{O}$ to estimate past temperatures is clearly needed.

The text itself must be carefully written again both to give more explanations on some aspects of data interpretation (as suggested above) and to improve the English. I am not the best person to correct the language, but I really think that the language must be improved.

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