

Comments to specific items of text are referened as Pxxx Lyyy for Page xxx
Line yyy

1 General Comments

Zhang et al. “A new method of resolving annual precipitation for the past millennia from Tibetan ice cores” presents a detailed study on the average accumulation rate for 3 epochs in the last 2500 years for an ice core site on the Chongce ice cap, northwestern Tibetan Plateau. The paper combines annual layer thickness data (from ultra-high resolution ice core elemental chemistry) with a flow thinning model (constrained by water-insoluble organic carbon ^{14}C ages) to determine local net accumulation over 3 disjoint epochs. The paper is well written and structured and generally presents sufficient supporting evidence. I recommend minor alterations and corrections detailed below.

2 Specific Comments

2.1 Major Specific Comment

The most significant problem with the manuscript as it stands is the data fit to the flow model presented in Figure 2 and associated text on P8 L228–229. In particular, it appears that all of the ^{14}C ages are above the nonlinear least squares data fit. This raises questions about the validity of the data fit and if the solution has converged. I would have expected at least some of the ^{14}C ages to be below the data fit. Specifically, the data fit line can be moved upward and this would reduce the error at every observational data point, and hence the overall error of the fit. The authors need to verify that the data fit presented is indeed a (near) optimal fit, and redo the accumulation analysis if the data fit needs to be revised and improved.

2.2 Minor Specific Comments

P2 L40 Is Christiansen and Ljungqvist (2017) the correct citation? This paper is about temperature reconstruction, and only mentions precipitation because of it’s influence on temperature reconstructions.

P2 2nd paragraph. This needs a restructure, at the moment, the sentence topics are annual layers, thinning, annual layers then thinning again. Suggest you move the sentence staring “In addition, the nonlinear” to after the sentence staring “The most common approach”. Then change “The thinning parameter” → “This thinning parameter”.

P3 L80 I think the location map (Fig S1) should be moved into the main manuscript, as this is key information.

P5 Section 2.3 You do not give the vertical size of the samples required to give the 1kg sample, this is key information for the depth uncertainty estimate of the β -activity dating.

P5 L130 Was the Argon gas flow purged or was the system purged using Argon gas? If the later, suggest changing “whilst the Argon (Ar) gas flow was purged for two minutes” → “whilst the system was purged with Argon (Ar) gas for two minutes”.

P5 Section 2.4 you do not give the vertical size of the samples used for the ^{14}C extraction, this is key information for the uncertainty estimate of the ^{14}C dating, as there is uncertainty in both the age and depth.

P6 L188–189 These grouped peaks could also be from independent snow events with dry wind blown dust deposition between these snow events.

P9 L241–242 Make it clear that you are using the values of “b” and “p” that you found in Section 3.2.

P10 L257 Change “can be securely stored” → “is preserved”. In fact your density profiles (Fig S6) suggest this for Core 2 and 3, which both lack the lower densities near the surface indicative of snow. I suggest you add a sentence at Line 258 making this point.

P10 L265 You have presented all other accumulation rates as mm w.e./yr, suggest that you do the same for the Thompson et al (2006) results, to allow for easy comparison.

P10 L284–286 This statement is not correct. For example, an error in either the ^{14}C dating, or the flow model fit (see main points above) will introduce an error in the flow thinning model, which due to its non-linear nature will result in different relative average accumulations over various epochs.

P11 L295–299 In fact you already have 9 such markers from the ^{14}C age ties, which allow you to calculate the average accumulation rate over the 8 epochs these 9 makers define.

Supp info, Figure 1b Give details of where the remote sensing data is from, what is the instrument (e.g. optical, SAR) and give a data citation.

Supp info, Figure S8 Give details of which core (or cores) are being compared here.

Supp info, Table S1 is the depth in meters water equivalent? Explain the difference between “ ^{14}C age” and “cal age”.

3 Technical corrections

P2 L34 Kidd and Hoffman 2011 do not say “most important” only “variable parameter associated with atmospheric circulation”. Delete “most important”.

P2 L45 “glacier” → “glaciers”.

P2 L45–47 It is possible to obtain accumulation rates at time-scales other than annual from ice-cores. Suggest changing “obtain reliable annual-layer thickness information” → “obtain reliable layer thickness information for the relevant times-scales (typically annual, but may be centennial for low temporal resolution sites or studies)”.

P2 L48 You are not constraining the thinning, you are compensating for it, suggest changing “constrained” → “compensated for”.

P2 L57 There are many more ice core records than just the citations you list, suggest changing “(Alley” → “(e.g., Alley”

P3 L62 Change “methods. e.g., the” → “methods, for example the”.

P3 L64 Remove the full stop after “technology”.

P3 L65 Maybe change “reveal” to “resolve”.

P3 L69 Change “parameters” → “parameterisations”.

P3 L77 Delete the word “parameter”.

P3 L78 Change “record” → “records”.

P4 L93 See comment above about moving Fig S1 into the main manuscript.

P4 L96 Is there a citation for the statement that the local climate is “largely controlled by the mid-tropospheric westerlies”?

P4 L100 Given you have listed the summer (28%) and winter/spring (59%) precipitation percentages, also include for autumn (13%) rather than leave the reader to calculate this. Suggest changing “lowest amount of precipitation.” → “lowest amount (13%) of precipitation.”

P5 L145 There is some ambiguity about what you are removing the 3mm outer layer from, and while the reader can work it out, it is much better to make it easier for the reader to understand. Therefore, suggest changing “decontaminated the ¹⁴C samples” → “decontaminated the ice for the ¹⁴C samples”.

P5 L147 The more common term is laminar flow “hood” rather than “box”.

P6 L149 Delete “were”.

P6 L153 Change “found in the previous studies (Uglietti et al., 2016).” → “found in Uglietti et al. (2016).”

P6 S2.5 You talk about verifying your annual-layer identification using Strati-Counter, but at this point in the manuscript you haven’t described how you did your annual-layer identification. As this description comes later, suggest changing “To verify our annual-layer identifications” → “To verify our annual-layer identifications (see Section 3.1)”.

P6 L166 While CCSM3 might have been “state-of-the-art” when this research was conducted (2006), this is no longer the case, with CCSM3 being replaced by CCSM4 in 2010. Suggest deleting “state-of-the-art”.

P8 L208-209 Until this point your references have been in alphabetic order, so suggest you swap order of Rapp 2012 and Nye 1963.

P8 L225 Change “overweigh” → “over emphasise”.

P9 L236 Change “of the Holocene” → “over the Holocene”.

P9 L245 Change “The initial” → “The estimated original (pre-thinning)”.

P13 L344 Change “Bronk Ramsey, C.,” → “Ramsey, C.B.”.

P13 L350 Delete second, repeated “for large-scale temperature”.

P15 L412 I don’t think Parrenin et al 2004 is cited anywhere in the manuscript.

P16 L443 I don’t think Tang et al 2015 is cited anywhere in the manuscript.

P17 L475 Change “sine” → “since”

Supp info, Figure S4 Change “The seasonal precipitation” → “Monthly precipitation”.