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Climate of the Past Discussions

Interactive comment on "Precipitation changes in the South American Altiplano since 1300 AD reconstructed by tree-rings" *by* M. S. Morales et al.

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Reviewer 1

Reviewer: - The paper could benefit from a carefully proof-reading of a native English speaker. It contains a large amount of grammatical errors.

Authors: Following the reviewer suggestion, the new version of the paper was proof-read by a native English speaker. Grammatical and English language errors in the original manuscript were corrected.

R: - Page 4299, lines 25-26: Be careful with sweeping generalizations. The statement that 60% of all camelids on the Altiplano died in 1998 due to drought is exaggerated. This number, while maybe correct in certain locales, was much lower when averaged

over the entire Altiplano region.

A: As the reviewer mentioned, the consequences of the 1998 drought were reported for local areas such as the rural Altiplano in the Jujuy province, Argentine, not for the entire Altiplano. We assume that this severe drought also affected the central-south Altiplano regions from Bolivia and Chile. However, we do not have information for these regions. Consistent with the reviewer's comment, we changed this statement (Page 4299, lines 22-27) to reflect the lack of information for the whole Altiplano. The sentence: "For instance, the severe drought of 1998 provided a comprehensive view of the adverse impacts of dry events on the socio-economical activities in the rural Altiplano when 60% of the local camelid livestock "Llamas" and other domestic animals died. ", was rephrased to "For instance, the severe drought of 1998 provided a comprehensive view of the adverse impacts of dry events on local socio-economical activities, when 60% of the camelid livestock "Llamas" and other domestic animals died in the Puna of Jujuy (Argentinean Altiplano)."

R: - Page 4300, line 6: you mean an 'increase in the elevation of the 0C isotherm'.

A: Corrected, the sentence was rephrased according to the reviewer's comment.

R: - Page 4301, line 18-19: The statement that this record provides the first annually resolved rainfall record for the Altiplano is not quite correct. The accumulation record from Quelccaya in the northernmost Altiplano is also annually resolved (albeit strictly speaking it is snowfall and not rainfall). In fact it would have been nice to see a graphical comparison of the two records.

A: As the reviewer pointed-out, the Quelccaya record is not a rainfall record; it is a snow accumulation record. Net snow accumulation depends on numerous parameters such as wind and snow sublimation, among others. Thus, the interpretation is complex and site dependent. Net accumulation is the result of total accumulation controlled by precipitation and wind drift, minus the ablation (sublimation, evaporation, wind erosion). According to Vimeux et al. (2009), The accuracy of using net- accumulation

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as a proxy for 'precipitation amount'... depends also on the respective seasonality of total accumulation and ablation. For sites like Cerro Tapado (30°08'S, 69°55'W, 5550 m.a.s.l.), combining both low net-accumulation and strong sublimation over a long dry season, the calculated net accumulation cannot be interpreted as representative of the 'amount of precipitation'. Based on these statements, our claiming of providing the "first annually-resolved rainfall record for the Altiplano" is still valid. Presently, we are working in the comparison between annual or quasi-annual records from the Altiplano for the past millennium, including Quelccaya records, and the results from these comparisons will be submitted for publication in the near future.

R: - Page 4306/4307: I don't quite understand why the correlation between the tree ring chronology and SST was done using annual mean (Nov.-Oct.) data. Clearly precipitation in the region is highly seasonal and hence tree ring growth only records climate during a few months per year. I would therefore expect that only SST during the austral summer wet seasons (or maybe the months immediately preceding) show a clear relationship with tree growth. One would think that using data averaged over an entire year would only help to weaken the statistics of this relationship.

A: We agree with the reviewer's comment. However, we calculated all possible correlations between seasonal SST and the annual (Nov-Oct) reconstructed precipitation, and found higher correlation coefficients when the reconstruction was compared with annual instead of seasonal or monthly SSTs. For a summer precipitation reconstruction, it is very likely that the use of SSTs during the same interval could result in more significant correlations. However, in our study, tree-rings were best correlated with annual than seasonal precipitation. Despite the lack of significant relationships between tree growth and precipitation in autumn, winter and spring, it is probably that the scarce precipitation events during these seasons recharge the soil water marginally influencing the radial growth and increasing the level of correlations at annual time scale.

R: Figure 4: The tree ring reconstruction shows a much subdued precipitation anomaly during the LIA when compared to other precipitation reconstructions further north in

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the tropical Andes (Quelccaya, Thompson et al., (2006, PNAS), Pumacocha, Bird et al., (2011, PNAS)), which both indicate a very pronounced wet period during the LIA. Is this lack of centennial-scale departures related to the tree ring standardization or does it represent a real regional difference? This aspect should be discussed in more detail.

A: The standardization process involves a trade-off between keeping the low frequency climate signal and eliminating the variability in the series not related to climate such as tree aging or forest disturbances. It is true that the standardization process could weak and underestimates the low frequency signal; however, our tree-ring based reconstruction was developed using a conservative method of standardization. Our reconstruction indicates that the LIA period was a relatively humid period with high interannual variance. However, it is not as humid and cold as recorded in the Quelccaya ice cores or the Pumacocha sediments. Pronounced wet multidecadal periods around AD 1500 and 1840 are recorded in the tree-ring reconstruction suggesting that our record does register the low frequency variability. It is probable that the humid/cold LIA was weaker in the southern Altiplano than in the northern tropical Andes. To account on these differences, we add the following sentence in page 16; line 18-21 of the new version: "However, it is important to note that cold/wet conditions during this period were not so pronounced as were record in the Quelccaya ice core (Thompson et al. 2006) and the Pumacocha sediments (Birds et al. 2011) from northernmost tropical Andes".

R: -Page 4315, lines 26-30: Note that while Urrutia and Vuille (2009) did indeed use an RCM, the results by Minvielle & Garreaud (2011) are based on an ensemble of GCMs, not an RCM.

A: Following reviewer comment, in the new version we refered both as climate models

Minor errors: R: Page 4316, line 26: 'SENAMHI' is misspelled

A: Corrected "SENHAMI" by "SENAMHI"

R: The reference section is littered with mistakes. Please revise this section very care-

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fully. Page 4317, line 18: ‘journal name is incomplete’

A: Corrected, we added the complete journal name.

R: Page 4318, line 3: ‘journal name is incomplete’

A: Corrected, we added.

R: Page 4318, line 18: ‘Seager’ is misspelled’

A: Corrected.

R: Page 4318, line 22: ‘Hydrol. Sci.’

A: Corrected.

R: Page 4318, line 24: ‘Ann. Rev.’

A: The Journal name is Annual Review of Marine Science and the abbreviation is Annu. Rev. Mar. Sci.

R: Page 4318, line 26-29: The paper by Francou et al. (2004) was published in ‘Journal of Geophysical Research’ and not in ‘Geophysical Research Letters’.

A: Corrected

R: Page 4318, line 24: Journal abbreviation is erroneous.

A: No, journal abbreviation is correct

R: Page 4319, line 6: Error in article title: it should read ‘: : : and mechanisms of past changes’.

A: Corrected

R: Page 4319, line 6: ‘journal name is incomplete’

A: Changed.

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R: Page 4319, line 8: ‘journal name is incomplete’

A: We completed journal name.

R: Page 4320, line 3: ‘journal name is incomplete’

A: We completed journal name.

R: Page 4320, line 10: Journal abbreviation is erroneous.

A: We checked the journal abbreviation and it is correct.

R: Page 4320, line 14: ‘journal name is incomplete’

A: We completed journal name

R: Page 4321, line 32: ‘journal name is incomplete’

A: We completed journal name

R: Page 4321, lines 10-11: Journal abbreviation is erroneous.

A: We checked the journal abbreviation and it is correct

R: Page 4321, line 24: Journal abbreviation is erroneous.

A: We could not found a journal abbreviation in line 24

R: Page 4323, lines 8-9: ‘journal name is incomplete’

A: We completed journal name

Interactive comment on Clim. Past Discuss., 7, 4297, 2011.