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Climate of the Past Discussions

Interactive comment on "Environmental and climatic history in the NW Argentine Andes (24 S) over the last 2100 years inferred from a high-altitude peatland record" *by* K. Schittek et al.

Anonymous Referee #1

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Schittek et al. present a multi-proxy record from a peatland in the north-western Argentinian Andes. Organic as well as anorganic geochemical proxies were measured and pollen and macrofossil analyses are presented. The authors mainly interpreted the well-established Mn/Fe proxy as indicative of changes in redox conditions and thereby infer the water table level at Cerro Tuzgle Peat bog (CTP). The water table of the peat bog is interpreted as proxy for precipitation.

The authors did a great job measuring a multitude of proxies and the ecological interpretation of these proxies seems sound. However, the interpretation of the mea-

sured variables as climate proxies needs considerable improvement. Even though the presentation of the results and their discussion in terms of paleo-redox conditions is appealing I will focus this review on the interpretation of the bog record in terms of climate.

As Charman et al. (2006) mention, there is a great challenge when interpreting peatland records: 'Peatlands are subject to a range of long-term developmental changes that can arise as a result of autogenic factors as well as external factors such as climate change.' Hence the question in this study is: are the redox conditions indicative of large scale precipitation changes or are they indicative of local in bog processes. Charman et al. (2006) also suggest how this could be tested: 'replicability between profiles and between sites within the same climate region should be a guide to the reliability of each suggested climate feature.'

The authors try to achieve this task in Fig 6. In Fig. 6, the CTP record is compared to a record from the Cariaco basin (Haug et al. 2001) that is associated with the position of the ITCZ, a Northern Hemisphere temperature reconstruction (Moberg et al. 2005) and an annual (November through October of the following year) precipitation reconstruction from the western flank of the Andes in Bolivia and Chile (Morales et al. 2012).

Fig. 6 could be greatly improved. First, I suggest fitting smoothers such as locally weighted regressions (loess) or splines to all of the data series compared. Currently, it is extremely difficult to determine whether the small spikes in the different time series that are connected by dashed lines are major features of the time-series or if they are noise. As the figure is now, I could add as many lines that show contradictions between the records as the authors draw lines that (apparently) show similarities. It is also difficult to see the general patterns of the records compared.

I also struggle to see similarities in the general patterns of the records compared. In my opinion, page 2055 lines 24 – 27 'The variation of Mn/Fe ratios at CTP clearly

reveals that local moisture availability is strongly coupled to more southward positions of the ITCZ (Haug et al., 2001), which further corresponds to overall cooler conditions in the Northern Hemisphere (Moberg et al., 2005)' is not supported by the data shown in Fig. 6. It would be nice to have some evidence in terms of correlation coefficients (preferably taking into account chronological uncertainties). One method for achieving this goal is the method developed by Rehfeld and Kurths, (2014).

Unfortunately, the choice of the records compared to the CTP record is not sufficiently motivated. For instance why is the Moberg et al. (2005) record used and not one of the other records available (e.g. Mann et al. (2008)). As shown in Fig. 3 of Morales et al. (2012) the precipitation reconstruction by Morales et al. (2012) is not strongly related to the precipitation in North-western Argentina for the period 1961 – 2006. Important reconstructions are omitted form the comparison. Most importantly, a comparison with the work by Neukom et al. (2010) and Boucher et al. (2011) who provided spatially explicit reconstructions of precipitation and palmer drought severity index, respectively is missing. Such a comparison would greatly improve the quality of the manuscript as it would shed some light on the major question: local, bog related signal or precipitation signal. The CTP record is not compared with the author's own record from southern Peru (Schittek et al. 2014, close to the location of the record by Morales et al. (2012)) and the proxy by Rein et al. (2004) shown in Schittek et al. (2014).

Fig 4 and Principal component analysis: The sentence used to describe the PCA methodology is ambiguous: 'standardisation of the data to omit rows with missing values'. I guess the authors meant to say 'standardisation of the data after omitting rows with missing values' i.e. eigenvalue decomposition was computed on the correlation matrix, which is appropriate given the data at hand. Unfortunately, I disagree with one of the interpretations of the PCA-biplot: In my opinion, Mn/Fe is not contributing a lot to PC-axis 2 as suggested page 2049 line 20. Most probably Mn/Fe has a high loading in the third component. I therefore suggest to substitute Figure 4 with a table giving the loadings of each variable in the first three components (given the third component is

also significant). Using standardized data (correlation matrix), the loadings are Pearson's product moment correlation coefficients between the PC-scores of the axis at hand and the variables.

Minor comments: Fig 6.: In Haug et al. (2001) [and also Schittek et al. (2014)], the unit of Titanium is % and not cps,

P 2045 l. 14: I presume this should read $p<0.05$ and not $p>0.05$

P 2055 l 14: I was not sure what 'that period' refers to.

P 2059 l 11 – 14: The proxies mentioned here are not prominently used to get information on past peatland surface wetness and climate.

P2059 l 21: 'this hypothesis can be confirmed by our data' as the data are presented currently, I do not agree with this conclusion.

Additional References:

Boucher et al. 2011. A millennial multi-proxy reconstruction of summer PDSI for Southern South America. Climate of the Past

Charman et al. 2006. Compilation of non-annually resolved Holocene proxy climate records: stacked Holocene peatland palaeo-water table reconstructions from northern Britain. Quaternary Science Reviews

Mann et al. 2008. Proxy-based reconstructions of hemispheric and global surface temperature variations over the past two millennia. PNAS.

Neukom et al. 2010. MultiâĂŘcentennial summer and winter precipitation variability in southern South America. Geophysical Research Letters.

Rehfeld and Kurths, 2014. Similarity estimators for irregular and age-uncertain time series. Climate of the Past.

Interactive comment on Clim. Past Discuss., 11, 2037, 2015.