First, we would like to express our sincere thanks to Marie-Pierre Ledru, whose critical suggestions gave us good hints to improve the original manuscript!

"…The quality of the data, wich consists in crossing informations from organic, inorganic, micro and macro fossils allows a fine reconstruction of the climate in the area. However their presentation is fuzzy and needs improvement in order to make this paper understandable by a broad community. This study would benefit also to be incorporated within a regional context of climate changes. The references cited in the paper are sometimes inappropriate, too sparse and lack discussion. I would recommend to entirely re write this paper, present clearly the data and resubmit the paper to Climate of The Past."

It was our aim to preferably use references and records from close to the study area. We did not intend to make an overview of all available paleorecords throughout the central Andes. Many of these records lack resolution and/or time control, and therefore, do not fulfil the criteria required by PAGES-2k (PAGES-2k Consortium 2013). Furthermore, such overviews were presented by other authors recently (eg. Engel et al. 2014; Flantua et al. 2015). A more detailed discussion by including more references seems ineffective to us, as many older publications from the area do not cover the past 2000 years with sufficient resolution. An extended discussion of records from Peru, Bolivia and Chile was already presented in the frame of Cerro Llamoca peatland dataset (Schittek et al. 2015). We did not want to repeat discussion topics of this work. We therefore think that the selection of cited literature in our paper is appropriate. However, we added Kuentz et al. (2012) and Ledru et al. (2013) to the discussion of the revised version of our paper.

"Title In its actual state the paper is presenting the responses of a peatland hydrosystem to climatic changes and the title proposed by Schittek et al does not cover the content of the paper."

As the presented research does not include hydrological methods, we do not fully agree to the opinion of the referee in this case. We think, that the expression "environmental history" covers better what we intended to find out by applying the described methods. However, an alternative title could be: "Hydrologic variations of a high-altitude peatland in the NW Argentine Andes (24°) and paleoenvironmental implications over the last 2100 years"

"A map with the location of the other records that are discussed in the paper -A figure that shows the reverse pattern at 37 S with climate diagrams and the position of the arid diagonal."

We generated an additional map, which shows the location of the other records discussed in the paper (excluding the Northern Hemisphere). This can be added to the supplementary material or can be included to the new version of the paper. A figure showing the position of the Arid Diagonal, to our opinion, is not necessary, as this is not the focus of the paper.

"-An additional synthetic figure with an indicator curve for each analysis is needed. For the pollen results I suggest to build a pollen index, see for instance the Poaceae / Asteraceae index in Kuentz et al The Holocene 2012."

We do not think that additional figures for all the curves support achieving our objectives. For the new version of the paper, we included the Poaceae/Asteraceae index, according to Kuentz et al. (2012), to Fig. 5.

"-The final conclusions are not clear as they do not mention what was the final story of the last 2K in NW Argentina as announced in the title and how it fits or not the regional pattern of changes observed in other published records. To help, I tried to pick up some time intervals and dates mentioned in the paper to see if eventually the analyses agree one to another. For this purpose, I built a table (see below). It seems that the authors mixed up climate episods and climate intervals and that a lot of details are provided without any explanations."

We thank the referee for these observations and the compilation of the table. To address this deficit, we added colored bars to Fig. 3 to highlight changes. Further, we rewrote the discussion, especially chapter 5.2, to include further paleoclimatic patterns observed in other published records.

"To improve the understanding and the reading of the paper I suggest to organize the results with the modern samples and the sediment core presented separately, and the discussion in function of the different messages given by this paper. 1) changes in water table 2) changes in climate 3) human occupation. The relation between peatland's surface wetness and climate is not obvious and needs to be better explained."

The discussion already shows the recommended order. As mentioned above, we reworked chapter 5.2 to better explain the relationship between the peatland´s surface wetness and climate. Please note that, as stated in the paper, there is still a significant lack of knowledge concerning the ecological functioning of high-Andean peatland ecosystems, especially in hydrology-related specific fields.

"About@C13 in the High Andes, see also Ledru et al 2013 The Holocene, where modern vegetation is between -27.8 and -25.6 ‰ Wetter conditions are observed when values decrease and drier conditions when they increase. Values at CTP

range between -26.4 and -24.5 ‰. How do you explain such a narrow interval of changes when you have such differences in the pollen content for instance ?"

We agree with the statement that 'wetter conditions are observed when values decrease and drier conditions when they increase' (see Page 2053 line 12). These changes between drier and wetter conditions seem to be responsible for the $\delta^{13}C$-values ranging between -26.4 and -24.5 ‰. Please take into account that our data do not represent an overview for a given vegetation assembly but represent isotopic variations within (mainly) *Oxychloe andina.* Pronounced changes in the pollen content could be the result of anthropogenic intervention like increased grazing activity, which reduces the abundance of Poaceae (see Schittek 2014). To give further consideration on pollen and plant macroremains, we added a chapter to the discussion in the new manuscript.

Did the authors consider the C3 plants ? the pCO2 under these high elevations ?

Ruthsatz and Hoffmann (1984) presented a detailed description of the vegetation cover in the subtropical-semiarid high Andes of NW Argentina and the altitudinal distributions of the C3 and C4 plant species. The percentage of C4 plant species diminishes with altitude. "Their upper limit corresponds more or less with a mean annual temperature of 7 °C and a mean temperature of the hottest month of 9.5 °C, the mean maximum temperature of which amounts to 18 °C and the mean minimum to 5 °C." (Ruthsatz and Hoffmann, 1984). At higher altitudes, we would not expect to find many C4 plants. *Oxychloe* and *Zameioscirpus* are C3 plants and, thus, our "isotopic signal" represents a "C3 plant signal". Since the atmospheric CO_2 concentration does not significantly change with increasing altitude, the issue of higher elevations plays no role in C3/C4 competition (see Boom 2004). Variations of CO_2 concentration during the Holocene (excluding the past 200 years) were very low (Leuenberger, 2007).

Does Oxychloe andina explain everything? Separate the plant discussion from the sediment core discussion of the results and show how the first one contributes to the second one (also for TOC and @15N)."

Indeed, *Oxychloe andina* is by far the most dominant peat-accumulating species at our site. High-altitude cushion-plant peatlands at these latitudes in the central Puna mountain ranges are usually dominated by *Oxychloe* (see Ruthsatz, 2008 and literature cited there). *Oxychloe* constitutes the main component of an azonal vegetation unit and has been the dominant peat-accumulator at CTP throughout the sequence. As mentioned above, we added further explanation on these topics to the discussion chapter.

"Polen diagram : what are the criteria used for the zonations ?"

We used a binary splitting technique with hierarchical clustering producing a dendrogram. This will be added to the supplementary material.

"What shows the principal component analysis performed on the geochemical data ? Iwould suggest to erase that part."

This is described on page 2052 line 16-21. Alternatively, the PCA part could be moved to the supplement.

"Page 2049 L23 Ân very low Âz how much ?"

We added the sentence: "In total, 26 different pollen types were observed."

"Page 2047 L6 Án ..is highest.. Âz How much ?"

Well, in the same sentence it is stated that sample resolution varies between 7-18 years per cm. So, the highest resolution of a sample is 7 years per cm.

"P2059 L2-4 Is it the main result of this study ?"

This sentence is a concluding remark. The main results are concluded afterwards in the same chapter.

"P2059L9-18 Was it a methodology paper ?"

We do not consider our paper as a methodology paper. As research on high-altitude cushion-plant peatlands in South America is still very scarce, we offer experiences with some methods we applied to conduct paleoenvironmental research based on Andean peat archives. To our opinion, this might be interesting for people reading the conclusions.

"P2060 L2-3 are these phases or events ?"

A dry (humid) phase should be understood as a period with an increased number of dry (humid) events. In fact, our listing of dry and humid phases in chapter 6 is irritating. For example, "AD 1500" should be understood as "around AD 1500". We changed this for the revised version.

"L4 What were these volcanic forcings ?"

This is explained on page 2057 line 23-27. For the new manuscript, we extended this paragraph and added citations.

"L7-14 this was also showed in Schittek 2015 and should not come as a conclusion for this paper."

For the new manuscript, we shortened the original paragraph.

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