

## ***Interactive comment on “The Last Glacial Termination on the eastern flank of the central Patagonian Andes (47 S)” by W. Henríquez et al.***

### **Anonymous Referee #2**

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The paper presents a new pollen record from a sediment core of Lago Edita located at 570 m elevation on the east-side of the Andes at latitude 47°S and to the east (typical lee side) of the present-day Northern Patagonian Ice Field. The lake is located between two former glacial valleys which have been also partly covered by glacier lobes and partly filled by proglacial lakes during the LGM and the following ice retreat. Besides paleoecological considerations the pollen record was also used to deduce the ice retreat of the Patagonian ice sheet after the LGM until the beginning of the Holocene (Termination 1) as well as shifting of the Southern Hemispheric Westerlies. The general scope is appropriate for the addressed journal. The introduction of the paper is partly focusing on the previous ice retreat reconstructions from the Cordillera Darwin (54°S), the investigated area between 45 to 48°S and the southern region of the Chilean Lake District. Afterwards the authors mention the modelling of the

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thermal and atmospheric impact by the Laurentia ice sheet, probably to suggest that this could be also a scenario for the area to the east of the Northern Patagonian Ice field. However, I am not convinced that this can be easily compared with the situation in the working area. Finally they address several questions they like to address with their record. However, some basic information and/or introduction how the palynology of such an area can be interpreted and what problems could appear with such interpretations are not introduced. How could be the past climate conditions with 1 to  $>6^{\circ}\text{C}$  lower temperatures and with different unknown humidity deduced from the pollen record? Ok., such aspects could be also addressed in the discussion, but I am also missing most of the following aspects in the discussion:  $\hat{\text{U}}\hat{\text{R}}$  What is the possible size and also the altitudinal distribution of the pollen catchments of the investigated site?  $\hat{\text{U}}\hat{\text{R}}$  Does the pollen represent a mixture of one or both associated valleys and its plant vegetation at different elevations? I agree that a far distance transport of from the coastal zone is not likely, since existing records from this area are different.  $\hat{\text{U}}\hat{\text{R}}$  Are such pollen records able to recognize change in the timberline and therefore could give implication for temperature changes?  $\hat{\text{U}}\hat{\text{R}}$  How does the tree growth react with respect to changes in precipitation, evaporation and/or changes in the soil moisture? Such aspects and other climatic and ecological implications from the pollen/paleovegetation spectra have been partly discussed for Holocene scenarios but not as much for the past. What implication have 5 to  $6^{\circ}\text{C}$  lower temperature during the LGM for the evaporation and soil moisture and the amount of plant available water.  $\hat{\text{U}}\hat{\text{R}}$  How fast is the development of a plant succession near the timberline and how fast does the pollen community and the ecosystem react on climate changes. How did the timberline changed during Termination 1 and does the pollen record provide information concerning this question? However, the regional position and extend of the proglacial lake system and changes in the ice margin of the glacier lobes are not well illustrated in Figure 1 for different periods of the glacier retreat. The paper includes many discussion concerning shifting and intensity of the westerlies during T1 which are deduced from the hypothesis that humidity and/or precipitation have been clearly

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westerly-linked. Garreaud et al. (2013) has calculated the present day relationship between precipitation and westerly strength. I could imagine that at the investigated site a R-value of around 0.4 describes the correlation between precipitation and westerly strength based of NCEP/NCAR data of the past 40 years. But is this also valid for T1? Beside this, the effect of lower temperatures as well as weaker or stronger wind has an import effect on the evaporation and thus on the humidity of the soils, in particular on the east side of the Andes. Only one record of Moreno from further north was taken as implication for the paleotemperature development. Siani et al (2013) MD07/3088 record from around 47°, and further north at 41° S the ODP 1233 record and the MD07/3128 record of from 53°S (both shown and compared in Caniupan et al. 2011) provide further SST's which indicate a very strong temperature (around 5°C) increase between 18.0 to 15.5 Kyrs. Afterwards the between 15 and 11 Kyrs the temperature increase may be slightly, more stepwise and less pronounced (2°C). Concerning the near-costal SST development the former records gives a consistent overall picture, but at the investigated site the tree pollen starts to increase strongly first after 13 kyrs. To explain such a comparatively late forest expansion (also later than a record of Lake Stibney from the western side of the Andes indicates) the authors try to explain this "delay in warming" (marked in Fig. 8) by a persisting very long delay in regional warming (which would have also affected the glacier retreat dynamics in this area). However, I cannot believe that there was a delay in warming of about 4500 years at latitude 47° and that there have been such a strong temperature depression between the Westside and East side of glaciated Andes. If this is a realistic scenario it should be quantitatively better justified. The westerly behavior is very complex. Recently, the SWW strength and related precipitation has a summer minimum at latitudes 47°S and northward, whereas from 50 to 55°S it has a summer maximum. How does such seasonal pattern affect the plant communities and the investigated site and what catchment have they sampled in an area with very strong local climate gradients? This concerns also the vegetation changes with altitude. The investigate lake sediment record is situated in an area of steep valleys. What does

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these pollen represent? The average plant community of the valley or above a certain elevation? What role plays the tree timberline or its changes? These questions are not well addressed. I am aware that the interpretation and discussion of these pollen is a very complex topic and obviously I am not a palynologist. But I would like to see the paleoclimate considerations better reviewed. There seems to be a lot of published work concerning the regional relationship between proglacial lake evolutions and ice retreat and glacier margins. How did this change the spatial distribution of plant growing areas and/or pollen catchments? There is something mentioned, but it is not well illustrated by maps. Finally, all the figures are very poorly and sluggish prepared and much information are missing. I made many comments in the text, but think that the coauthors have a lot of experience to review this seriously before resubmission. In conclusion, I suggest that the manuscript needs a major revision with respect to the above addressed topics. There are very experienced coauthors which published many good papers in international journals. I cannot believe that they have seriously revised and/or contributed to this paper. I made many comments in the text, but it will take several days to make a profound review of all things I would like to be improved. I think that the record data are important and should be published and I am willing to review this paper once more, but only after a profound revision of the coauthors.

Please also note the supplement to this comment:

<http://www.clim-past-discuss.net/cp-2016-89/cp-2016-89-RC2-supplement.pdf>

Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2016-89, 2016.

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