

## ***Interactive comment on “A 250 year periodicity in Southern Hemisphere westerly winds over the last 2600 years” by C. Turney et al.***

### **Anonymous Referee #2**

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This paper uses a pollen/charcoal records from a site in the Falklands to ultimately reconstruct changes in the strength of the westerlies and the possibility of solar variability as a driver. In my opinion, the conclusions overreach the data, and the authors need to provide more context for the interpretation of the records, before jumping to the site's link to climate and solar drivers.

General comments: The record, which spans the last 2600 years, comes from a peat bog, and such sites are notorious for their varied lithology and sedimentation rate. Detailed lithologic information is not presented, but the age model indicates changes in sediment accumulation rate and possibly hiatuses as a result of local hydrologic changes. The fact that the site shifts from a grassland to a heath, ca. 1000 cal yr BP, also suggest a change in sedimentation rate. If the sediment accumulation was

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as steady as the authors suggest, they should base their interpretation on pollen and charcoal accumulation rates, rather than pollen and charcoal concentrations. Use of concentration data suggests that sedimentation rates are constraining the interpretation.

The discussion of the charcoal data is also a concern. The fact that pollen-slide charcoal as opposed to macroscopic charcoal was analyzed suggests that the fires are extralocal, perhaps as far away as the Andes. If that is the case, one would expect that the charcoal data would be highly correlated with the *Nothofagus* pollen record, which is also coming from the Andes. Thus, the co-occurrence of charcoal and *Nothofagus* pollen may be related to westerly strength but tell little about local fire activity or climate on the Falklands.

The source of the extralocal pollen is not well described. What parts of the Patagonia vegetation would deliver *Nothofagus*, *Ephedra*, and *Anacardiaceae* pollen? More information on the biogeography, and additional information on Figure 1 showing the distribution of these taxa would be helpful.

There are other paleoecological records from the Falklands. How do the pollen stratigraphy and interpretation at this airport site compare with them? Are there similar changes at ~1000 years BP or is the shift in vegetation from grassland to heath related to very local hydrologic conditions? Similarly, other papers have described the Holocene history of the westerlies in Patagonia (e.g., Fletcher and Moreno, *Geology*, 2011; Iglesias et al., *QSR*, 2014; Iglesias and Whitlock, *PNAS*, 2014)). It would be good to discuss how these reconstructions are relevant to the general discussion and whether or not they show a shift in vegetation and climate about 1000 years ago?

The assignment of the westerly strength to changes in solar variability without any obvious mechanism makes the paper highly speculative. Even if the depositional setting were not problematic, separating a shift in westerly strength from a shift in the latitudinal position of the westerlies is not possible without a more regional analysis. While I

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appreciate the analysis shown in Fig. 4 relating SAM to Falkland temperature, it is not clear that stronger westerlies would be associated with drier conditions or more fires on the islands. Again, the assumption is that the fires are local, but the pollen is not.

Specific comments:

p. 2162, l. 16: Describe the lithology in more detail, especially to address the likelihood of changes in sedimentation rate or hiatuses. Also, explain the origin of the site. p. 2162, l. 20: Misspelled Iversen (!) p. 2162, l. 26: The term Terrestrial Land Pollen seems redundant—don't you mean terrestrial pollen? Gunnera is a wetland species and shouldn't be in the sum. p. 2164, l. 23-24: A shift from grassland to heath should be associated with a change in lithology, sedimentation rate, and probably charcoal abundance (if the charcoal is a local signal). The Nothofagus and charcoal data should be plotted side by side to facilitate their comparison. p. 2164, l. 25-28: Two charcoal sizes covary through time; why does this suggest “sustained burning”. There is no information on the charcoal type (grass or wood) or whether the fires are local versus extralocal or regional fires. Given that macroscopic charcoal was not discussed, I suspect it wasn't present in the record. Again, its absence suggests that the pollen-slide charcoal is coming from distant sources, not local ones. p. 2165, l. 3: “all originating from South America”. Please provide more geographic specificity by describing the ranges of these genera. p. 2165, l. 9: change the word “frequency” to “percentages” p. 2165, l. 11: “consistent with more distal studies”. Identify them and explain. I suspect the variability in large part arises from local variations in lithology and sedimentation rate. p. 2165, l. 11-16: The charcoal and pollen data are probably not independent. Given the size fraction, I could imagine that most of the charcoal is from Nothofagus and represents fires in the eastern Andes. Increases in Nothofagus pollen and charcoal could simply mean more westerly transport, not more fires or dry conditions. p. 2165, l. 27-29: Please explain the last sentence. The inference is that precipitation is affected, but what is the evidence, aside from the charcoal data? p. 2166, l. 8-11; p. 2167, l. 21-23: Authors should consult papers from Patagonia p. 2167, l. 9-13: It

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is interesting that this shift from stronger to weaker westerlies, also coincides with a change in vegetation and local depositional environment. As noted above, what role does this shift in environment and depositional setting have on the concentration data? The authors should examine nonclimatic reasons when *Nothofagus*/fires are better represented before 1000 cal yr BP than afterwards. p. 2168: last sentence: This paper on its own cannot separate strength of the westerlies from changes in latitudinal position.

Figure 1: Please show the geographic range of the exotic taxa.

Figure 2: Please explain the ecological role of *Gunnera*, which is represented in very high percentages. Should it be included in the pollen sum, given its wetland habitat?

Figure 3: should plot *Nothofagus* data along side charcoal data to better show relationship.

Needed is a high resolution figure of the lithology, along side the age model and pollen record.

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