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Climate of the Past Discussions

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

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We thank the anonymous reviewer for their comments. We have undertaken considerably more analyses and revised the text accordingly which we hope satisfy their concerns.

Below we respond to the points raised. 1. Regarding the issue over sedimentation rate, it is quite possible that the radiocarbon and 137Cs ages do not capture all changes; after all, flux analysis assumes a linear relationship exists between each pair of dated points. Importantly, however, we do not have varied lithology. The Falkland Islands record presented here was deliberately selected because it was obtained from a 'uniform dark-brown peat sequence' (p2162, lines 16-17) and was contagiously sampled to capture a continuous record of change. The uniform lithology and absence of abrupt

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Interactive Discussion

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shifts in the vegetation composition (in the pollen stratigraphy) argues against the presence of any significant hiatuses. We have therefore opted for a more conservative approach and focused our interpretation on the concentration data. 2. We completely agree with the anonymous reviewer regarding the fire history. We have summed the charcoal values to <106μm (which dominates the charcoal fraction). As there reviewer quite rightly points out there was negligible charcoal in the large size fraction (we apologise for any confusion). In comparison to the excellent dataset reported by Moreno et al. (2009) we find parallel changes in charcoal that strongly argue for a Patagonian source, as suggested by the reviewer. We discuss the implications of this observation for the interpretation of the charcoal as a measure of westerly wind strength. With regards the relationship between Nothofagus and charcoal, it's important to realise that in spite of the proximity of the Falklands to South America, the input of exotic pollen remains relatively low (<5% TLP). As described below, we argue the charcoal data is aerially-derived from Patagonia and of sufficient concentration to be more robust. 3. The other exotic pollen types, whilst representing Patagonian vegetation, represent <0.5% TLP and can effectively be ignored as a measure of palaeo-wind strength. 4. Whilst there may have been hydrological changes on the bog, it is important to recognise that the source of the charcoal (and Nothofagus) is South America and therefore does not negate the southern hemisphere westerly wind interpretation made here. We have undertaken more analysis to published Patagonian records to test our interpretation (including the recent Moreno et al., 2014) and cited these in the revised manuscript (including several highlighted by the reviewer). 5. Thanks to the reviewer for suggesting we revisit the interpretation of the charcoal. By taking a more regional analysis, we now can demonstrate both are sourced from South America. More comprehensive spectral analysis (including 14C production rates, application of the Lomb-Scargle algorithm, and coherence with the charcoal) our data does indeed suggest there is a relationship between solar variability and westerly wind strength. importantly, the period of inferred stronger winds (2000 to 1000 cal. years BP) coincides with a broadening of the periodicity as seen in the wavelet plot (see attached revised Figure 6) and an increased

CPD

11, C1508–C1511, 2015

amplitude in the extracted coherent charcoal-14C production rate periodicity (centred on 289 years) suggesting a longer periodicity in solar variability may play a modulating role. How a longer solar periodicity may influence the strength of Southern Hemisphere westerly airflow is not exactly known. One possibility is centennial-duration periods of lower solar activity may lead to an equatorward shift in the mean westerly latitude (Varma et al., 2011). Alternatively, recent modelling work suggests insolation changes can lead to increased 'baroclinicity' (Fogwill et al., 2015) or a 'Split Jet' (Chiang et al., 2014), strengthening westerly winds.

Thank you for the specific comments; all have been incorporated in the revised manuscript. The only issue of clarification is whilst some Gunnera can be found in marshes and swamps, it is typically described as a terrestrial vegetation type (i.e. commonly found on dwarf shrub heath, tussock, cliffs and neutral and acid grasslands) and as a result should be included in the total land pollen sum.

Interactive comment on Clim. Past Discuss., 11, 2159, 2015.

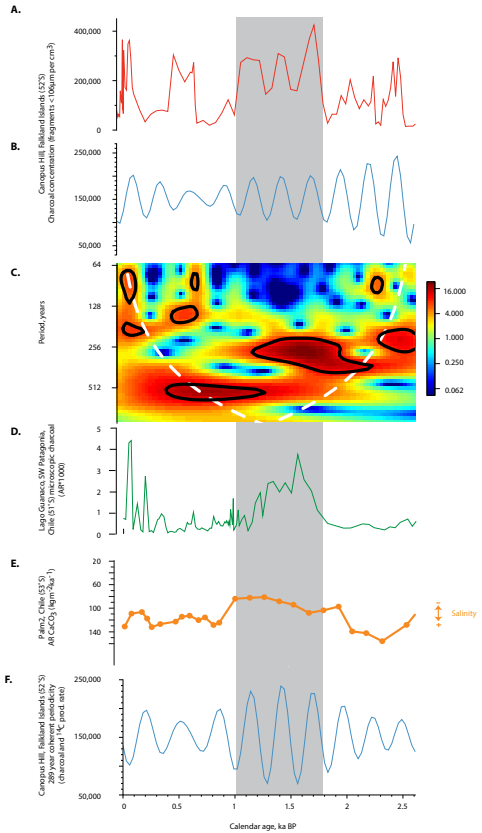

Fig. 1. Revised Fig 6

CPD
11, C1508–C1511, 2015