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Climate of the Past Discussions

Interactive comment on "A two thousand year annual record of snow accumulation rates for Law Dome, East Antarctica" *by* J. Roberts et al.

Anonymous Referee #1

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This paper presents new high resolution records of snow accumulation rates of the last 2000 yr at Law Dome, in East Antarctica. The main tools used in this study are the thinning function to calculate the temporal variability of snow accumulation identified by the seasonally-varying water stable isotope ratios. The paper contributes to ongoing debate concerning the past climate and estimation of the temporal variability in snow accumulation. The manuscript subject is appropriate for the Climate of the Past and data are very important, however there are some issues and the manuscript must be improved.

My main concerns are the following issues: the paper presents data of Law Dome ice core already partially published in previous papers (e.g. Plummer et al., 2012, van Ommen and Morgan 2010, for snow accumulation; Vance et al., 2013 and in press

for correlation with IPO and ENSO) with some difference, but without real discussion between the record and elaboration (e.g. spectral analysis of LDsss and LD snow accumulation). the paper discusses mainly the use of two thinning function, which provide difference up to $\pm$3% of annual snow accumulation, this difference could be negligible at annual layer but not at decadal scale. the paper does not discuss the possibility that variation of snow accumulation could be due to change in spatial variability of snow accumulation and not on ammount of precipitation variability. Law Dome site presents the highest dome gradient in Antarctica with a very strong gradient in spatial variability in snow accumulation (around 25 kg m3/yr per km). A change in the direction of precipitation track or wind scouring could be a strong impact of snow accumulation pattern. the paper pointed out that the DSS ice core record capture broad scale variability across a large region of East Antarctica, well beyond the immediate vicinity of the Law Dome Summit, on the base of atmospheric model, but without any comparison with the analogous snow accumulation records, or comparison with previous snow accumulation reconstruction in east Antarctica (e.g. Somme at al., 2000; Stenni et al., 2001; Ruth et al., 2004) the annual layer has been calculated used seasonally-varying water stable isotope verified by seasonally varying trace ions, but no data are shown or discussed, in particular about difference between signal and uncertainty also respect to nssSO4 record of Plummer et al., 2012 the comparison between snow accumulation record and isotope and chemical species are desirable

Comments:

pag 4470 and elsewhere Line 7 AD -22 = BCE 22

pag 4472 line 22-25, the record of the different snow accumulation record and relatively isotope and chemical species signal must be shown and discussed, to provide information about the significativity of signal and its spatial variability.

pag 4478 line 15-20, what occurs if a vertical strain rate from GPS measurements is applied at the two models?

pag 4479 line 9-10, the strongest anomaly of 1970-2009 on the base of fig. 4 is not so clear, the phrase should be supported by more analysis, also in the general contest of Antarctica (e.g. Monaghan et al., 2006; Frezzotti et al., 2013)

pag 4479-4480 line 23-12 the spectral analysis presents different frequencies with Vance et al., 2013, the text must be improved (eg. the 29.7 yr does not appear in Vance et al., 2013).

pag 4480 line 6-8 sastrugi noise is at annual scale, and could not influence sub-decadal signal, moreover change in spatial snow accumulation pattern draw by change in precipitation or ridistribution process.

pag. 4480 line 10-12 the phrase is not coherent with the recostruction of Vance et al., 2014.

Pag 4481 line 19-20. How much is the % of PC3? and could be significant to show a strong correlation?

Fig. 4c should show the difference between the two records

Reference Frezzotti, M., et al. "A synthesis of the Antarctic surface mass balance during the last 800 yr." Cryosphere 7.1 (2013): 303-319. Monaghan, Andrew J., et al. "Insignificant change in Antarctic snowfall since the International Geophysical Year." Science 313.5788 (2006): 827-831.Ruth et al., 2004 Sommer, S., et al. "GlacioâĂŘchemical study spanning the past 2 kyr on three ice cores from Dronning Maud Land, Antarctica: 2. Seasonally resolved chemical records." Journal of Geophysical Research: Atmospheres (1984–2012) 105.D24 (2000): 29423-29433. Stenni, B., et al. "Eight centuries of volcanic signal and climate change at Talos Dome (East Antarctica)." Journal of Geophysical Research: Atmospheres (1984–2012) 107.D9 (2002): ACL-3.

Interactive comment on Clim. Past Discuss., 10, 4469, 2014.