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A millennial multi-proxy reconstruction of summer PDSI for Southern South America

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We present the first highly resolved millennial reconstruction of the summer (DJF) Palmer Drought Severity Index (PDSI) for the Southern Hemisphere. Our multi-proxy reconstruction focuses on Southern South-America (SSA, south of 20°S) and is based on a novel spectral analogue method that aims at reconstructing the low frequencies of PDSI series independently from higher frequencies. The analysis of past regimes and long-term fluctuations in the PDSI reveals considerable geographical and temporal variations over the last millennia in SSA. Hence, recent changes, although some were very significant, were rarely exceptional over the last thousand years. However, from the point of view of extremes, recent PDSI values associated to extreme droughts (e.g. in the Andes) or wet spells (e.g. in the Pampas) were unequalled over the last thousand years. A major feature of our reconstruction is that it highlights that low frequency water availability fluctuations in Patagonia were generally in antiphase with those found on the rest of the sub-continent. We show that such antiphases within SSA's hydroclimate could be attributed the Antarctic Oscillation (AAO). The AAO was an important climatic driver during the calibration period (1930-1993) in SSA, and possibly over the last millennia as well. ENSO and PDO signals are also embedded, to a lesser extent, within the PDSI series, but the influence of these forcings has considerably varied through time and space over the last thousand years. Our results therefore highlight the complexity of water-availability fluctuations in SSA and their important dependence on external ocean-atmospheric forcings. On this latter subject, we conclude by confronting our reconstruction to the simulations (precipitation) of a climate model (IPSLCM4_V4) run for the last millennium over SSA. The agreement between the two series is fairly good, so we highlight the potential for future data-model comparison studies