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Effect of Southern Hemisphere Westerlies on hydroclimate and seasonality from the Last Glacial Maximum: Using the fossil charcoal and pollen records from Elands Bay Cave and Boomplaas Cave, South Africa

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Palaeoproxy records during the Last Glacial Maximum (LGM) in Southern Africa have not offered consistent results regarding hydroclimate of the region. Similarly, models from the Palaeoclimate/Coupled Modelling Intercomparison Project (PMIP/CMIP) show varying results with regards to the movement of the Southern Hemisphere (SH) Westerlies. An equator-wards shift in the SH Westerlies has long been used to account for increased precipitation in Southern Africa during the LGM. Palynological studies have supported this narrative citing the presence of higher precipitation species during the LGM as evidence of increased precipitation. This project uses the fossil charcoal and pollen assemblages from Elands Bay Cave (EBC) and Boomplaas Cave (BPC) to quantify the change in Mean Annual Temperature (MAT) and Total Annual Precipitation (TAP) using the recalibrated age models at both sites to understand the change in hydroclimate of the region. These sites are both spatially and temporally ideal to track changes in the SH Westerlies with both sites recording floral assemblages from the Last Glacial Period, the LGM, and deglaciation at EBC in the Winter Rainfall Zone (WRZ) and BPC in the Year-round Rainfall Zone (YRZ). Both rainfall zones receive precipitation from mid-latitude frontal systems associated with the SH Westerlies. The YRZ is associated with both the mid-latitude frontal systems and tropical disturbances. A database of the modern-day distribution of the taxa identified in the stratigraphy at EBC and BPC was created using the Global Biodiversity Information Facility and paired with modern climate data from WorldClim to perform a Weighted Average – Partial Least Squares (WA-PLS) regression to predict MAT and TAP. Most of the WA-PLS regression models predict temperatures around 7°C at the LGM, consistent with regional records. The predicted TAP at the LGM is mostly lower than that of the Last Glacial Period. In the case of EBC in the WRZ, decreased precipitation is consistent with a decrease in intensity of the frontal system and/or a polewards shift in the SH Westerlies at the LGM. Similarly, decreased precipitation in BPC in the YRZ implies decrease in intensity of frontal systems and/or a polewards shift in the SH Westerlies. This poleward shift in the SH Westerlies has been demonstrated in some climate models, the parameters of which need further interrogation.