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Meridional migration of the Antarctic Circumpolar Current over the last glacial cycle

XUYUAN ELLEN AI[1,2], LENA M THÖLE[3,4], ALEXANDRA AUDERSET[1], MAREIKE SCHMITT[1], SIMONE MORETTI[1], ANJA S STUDER[5], ELISABETH MICHEL[6], MARTIN WEGMANN[3], ALAIN MAZAUD[7], PETER K BIJL[4], DANIEL M. SIGMAN[2], ALFREDO MARTINEZ-GARCIA[1] AND SAMUEL L JACCARD[3]

[1]Max Planck Institute for Chemistry
[2]Princeton University
[3]University of Bern
[4]Utrecht University
[5]University of Basel
[6]Laboratoire des Sciences du Climat et de l'Environnement (LSCE/IPSL)
[7]Laboratoire des Sciences du Climat et de l'Environnement

Presenting Author: Xuyuan.ai@mpic.de

The Southern Westerly Winds (SWW) drive upwelling south of the Antarctic Polar Front that vents CO_2 to the atmosphere. During the ice ages, a northward (equatorward) shift of the Antarctic Circumpolar Current (ACC) fronts may have reduced this CO_2 venting, helping to explain the lower atmospheric CO_2 concentration of those times. However, direct evidence of frontal migration is scarce. In this study, we report biomarker-based surface layer temperature reconstructions from marine sediment cores at different latitudes in the Southern Indian Ocean across the last glacial cycle. Using a quantitative framework for the effect of the ACC fronts on meridional SST gradient, we show that the ACC was ~2° equatorward relative to its modern position during the ice ages and ~4-6° poleward than its modern position at the end of the last two glacial terminations, consistent with ACC migration playing a role in glacial-interglacial CO_2 change. Further comparison of the temporal evolution of ACC latitude with other observations posits a role for Earth's axial tilt in the strength and latitude range of SWW-driven upwelling. This has implications for past and future atmospheric CO2 concentrations and may explain previously noted deviations in atmospheric CO2 from a simple correlation with Antarctic climate.