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Millennial-scale variability in Antarctic Circumpolar Current and its impacts during the last glacial cycle

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The Antarctic Circumpolar Current (ACC) is the largest current system in the world, linking the Pacific, Atlantic and Indian Ocean basins. However, the variability of the ACC, which plays a fundamental role on global ocean circulation and climate variability, is still poorly constrained. This information is crucial for understanding the role of the ACC on global ocean circulation in response to global warming. Here, we reconstruct changes in the ACC over the past 155,000 years based on sediment grain size variations recorded in a highly-resolved marine sedimentary record from the central Drake Passage near the Polar Front. Our results show significant changes in the ACC during the last glacial cycle and a remarkable boundary between the glacial and interglacial periods. Substantial decreases (~33% to ~47%) in the ACC flow speed from interglacial to glacial period, which corroborates and extends results of previous studies along the subantarctic northern limit of the ACC into the central Drake Passage. This strong variation of ACC likely plays a significant role in regulating Pacific-Atlantic water mass exchange via the “cold water route” and could significantly affect the Atlantic Meridional Overturning Circulation. Superimposed on these glacial-interglacial changes, we found strong millennial-scale variations in ACC current speed, increasing in amplitude close to full glacial conditions. We hypothesise that the central ACC increases its sensitivity to Southern Hemisphere millennial-scale climates oscillations, likely associated with westerlies’ wind stress and Antarctic sea ice extent once glacial conditions fully formed.