Past dynamics of Atlantic Ocean overturning: A multi-proxy view on three key intervals

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Changes in deep convection in the North Atlantic are often considered a major driver of past global climate variability. Based on marine proxy evidence of carbonate ion saturation- and bottom water [O_2] changes in the South Atlantic, we provide insights into important aspects of the Atlantic meridional overturning circulation (AMOC) from three key intervals: First, we provide evidence for persistent perturbations of the AMOC strength and/or -geometry during almost every Dansgaard-Oeschger (D-O) event of the last glacial period, highlighting the existence of fast oceanic teleconnection mechanisms and a close link between rapid overturning changes and past millennial-scale climate variability. Second, we show evidence for similar AMOC changes during the penultimate glacial period that also show a systematic relationship to variations in bottom water [O_2] at our study site. Our data do not only highlight the persistence of instabilities of Atlantic overturning during older glacial periods, but also point to a connection between Atlantic-/ Southern Ocean overturning and deep South Atlantic respired carbon storage, with possible implications for atmospheric CO_2 changes. Lastly, although interglacial climate conditions are generally considered as more 'stable' than during glacials, we show evidence for recurrent and significant reductions in bottom water ventilation in the South Atlantic at times of higher-than present local sea surface temperatures during the last interglacial. This may indicate possible feedback mechanisms between instabilities of the cryosphere and the strength of deep water formation in the Atlantic Sector of the Southern Ocean in a warmer-than-present climate.