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Southern Ocean Circumpolar Deep Water warming: isopycnal mixing vs overturning as drivers of change

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Using an adiabatic as possible coordinate system we examine temperature and salinity trends in the three primary repeat hydrography sections that cross the Antarctic Circumpolar Current (ACC). These are the SR1b south of South America, Good Hope south of South Africa, and SR3 south of Australia. A similar pattern of change over the last ∼20 years is seen in all three, with cooling and freshening in the Subantarctic Mode Water (SAMW) and Antarctic Intermediate Water (AAIW) layers and warming and salinification in the upper Circumpolar Deep Water (CDW). We compare this fingerprint of change with the results from an eddy permitting general circulation model perturbation experiment forced by a near doubling in zonal wind stress with a corresponding increase of around 15% in the residual overturning circulation. A disparate fingerprint in temperature and salinity in the model to that observed suggests that the observed increase in zonal winds over the last 20 years has not driven a change in the residual overturning circulation. Instead we present analysis based on the observed climatic trend and background property gradients to argue that increased winter water temperatures in the outcropping zones are driving CDW warming via isopycnal mixing.