



Examining the Mechanisms of Four Decades of Atlantic Warming with an Eddy-Permitting Model

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The warming of the Atlantic Ocean is investigated using an eddy-permitting global ocean model (NEMO) forced with historical atmospheric conditions from 1958-2001. The evolution of the volume averaged temperature and the vertical structure of the zonally averaged temperature trends have been diagnosed from the model run and compared with those from the ENACT gridded observational data set. For those regions and times with a large number of observations in the data set, the model simulation and ENACT are in good agreement. The temperature evolution of the top 3000m within the North Atlantic sub-polar gyre (NASPG), the North Atlantic sub-tropical gyre (NASTG) and the South Atlantic sub-tropical gyre (SASTG) are shown to have distinctive patterns and causes. The NASPG cooled 0.25°C in 2 phases between 1970-1985, and 1988-1995. The first cooling phase was associated with anomalously weak ocean heat transport convergence and the second phase with stronger than normal surface heat loss. The marked NASPG warming after 1995 was primarily due to the strong meridional ocean heat transport into the region from the south. In the NASTG region, surface flux and heat transport anomalies cancel one another for most of the period. However, during the 1970s sustained positive anomalies of heat transport convergence combined with near average surface fluxes to lead to a decade of substantial (0.08°C) warming. The NASTG region contrasts with that of the SASTG, where there was a more persistent temperature increase of 0.13°C between 1958 and 1988 that was followed by a slight cooling