ON THE OCEANIC RESPONSE TO WIND STRESS VARIATIONS ASSOCIATED WITH THE ANTARCTIC OSCILLATION

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We assess the ocean's response to idealised latitudinal shifts in the zonal wind field over the Southern Ocean in a global ocean model. The form of the north-south wind shift is chosen to resemble that associated with the Antarctic Oscillation (AAO). We examine both long-term trend and quasi-decadal periodic shifts in the AAO winds. In the long-term trend case, we find that a 5.4° poleward shift of the zonal winds over a 100-year simulation causes the poleward heat transport to increase by an average of 25% between 50°S and the Equator. We find that this change is primarily due to greater northward Ekman transport of cold water and its associated cooling of Sub-antarctic Mode Water (SAMW) by up to 0.5°C in the Central-South Pacific. We also find that the rate of formation of Antarctic Intermediate Water increases as the AAO winds shift polewards, resulting in cooling and freshening at intermediate depths. In the periodic experiment, where the AAO wind axis has a range of 5.4° latitude, the poleward heat transport, North Atlantic Deep Water outflow and the overturning of Antarctic Bottom Water are all modulated by 20-30%. We find significant cooling at intermediate and upper- level water depths in the trend experiment, and temperature fluctuations with a range of up to 0.4°C in the periodic experiment. These changes are of the same magnitude and form as that recently observed at intermediate depths in the Southern Ocean. We conclude that latitudinal shifts associated with the AAO may play a significant role in generating observed temperature fluctuations at intermediate water depths.