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# Sensitivity to the vertical diffusivity in a fully coupled atmosphere-ocean model

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The meridional overturning circulation (MOC) is often presented as being controlled by the vertical diffusivity ($\kappa_v$), which sets the rate at which dense bottom water can be mixed up through the stratified water column. Previous studies, based on simple analytical approaches and single-basin ocean general circulation models (GCMs) suggested that the strength of both the MOC and the meridional ocean heat transport increase with the average vertical diffusivity following simple power laws.

Here, we investigate the dependence of the MOC strength to the vertical diffusivity in a low resolution, fully coupled ocean-atmosphere GCM with realistic geometry, FORTE (developed at Southampton Oceanography Centre), with values ranging from $\kappa_v = 0.1\ cm^2/s$ to an unrealistic high value of $5\ cm^2/s$ over all ocean basins. At cyclostationary state, the MOC strength increases as expected with vertical diffusivity, but the different basins show different power laws, such as 0.47 for the North Atlantic and 0.8 for the North Pacific. The Pacific behaves as two single ocean basins with two vigorous cells and no cross equatorial flow. The heat transport does not follow a power law, and shows particularly high sensitivity in the Southern Ocean. The atmospheric energy transport decreases with $\kappa_v$ in the tropical region, which can be associated with a swallower equator-pole sea temperature surface gradient. The Ekman transport shows very small sensitivity in the Atlantic and decreases with $\kappa_v$ at all latitudes in the Pacific.