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A parameterisation of shear-driven turbulence for ocean climate models

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We present a new parameterisation for stratified, shear-driven mixing which is relevant to climate models, in particular the shear-driven mixing in overflows and the Equatorial Undercurrent (EUC). Critically for climate applications this parameterisation is simple enough to be implemented implicitly which allows the parameterisation to be used with timesteps that are long compared to the time on which the turbulence evolves. It also allows the parameterisation to be used with isopycnal coordinate, where the layer thickness can be small, as well as with z-coordinates.

The mixing is expressed in terms of a turbulent diffusivity which is dependent on the shear Richardson number, the shear forcing and the buoyancy length scale (the length scale over which the turbulence is affected by the stratification). The balance is non-local which allows a decay of turbulence vertically away from the low Richardson number region: a process our results show is important for mixing across a jet.

We conduct high resolution, nonhydrostatic simulations of 3D shear-driven, stratified mixing in both a shear layer and jet. These are compared to existing parameterisations and used to constrain parameters for our new parameterisation. We also demonstrate the results of our parameterisation on mixing in the overflows and EUC in a global climate model.