Geophysical Research Abstracts
Vol. 21, EGU2019-11174, 2019
EGU General Assembly 2019

Tracing net diapycnal mixing in ocean circulation models with Argon saturation

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Oceanic diapycnal mixing is the linchpin of the conveyor belt and controls heat transport and the oceanic storage of (anthropogen) carbon. Despite its pivotal role in the earth system its (global) quantification is still work in progress. This does also apply to the current generation of earth system models where numerical artefacts act diffusive or dispersive and thereby effectively (and spuriously) mix or even un-mix properties such as temperature, salt, nutrients and carbon.
In this study we investigate the potential of the saturation state of the noble gases dissolved in the ocean to constrain effective diapycnal mixing in earth system models. Specifically, we simulate dissolved argon with a suite of model configurations: depending on the underlying advection scheme and the vertical diffusion coefficient we find severe differences in the 3D pattern of the net mixing. Locally, even configurations sharing the same meridional overturning circulation feature differences in excess of 2% with largest discrepancies in the tropical oceans. Our results suggest that a global climatology of dissolved noble gases would be instrumental in constraining diapycnal mixing in models.