OUTCROP: Brief project description

Ocean heat uptake (OHU) is one of the most important factors controlling the rate of climate change. Unfortunately, the physical processes controlling OHU remain poorly constrained, for being associated with poorly understood turbulent mixing processes and difficult to observe surface fluxes of heat and freshwater, thus resulting in large uncertainties in climate change projections. To make progress, a firm theoretical understanding of vertical heat transfer is essential. Unfortunately, the validity and usefulness of the standard vertical/advection diffusion model --- the primary theoretical tool to think about the issue --- has been repeatedly questioned over the years owing to its failure to account for a varying topography, isopycnal mixing and the existence of density-compensated temperature anomalies. To resolve the above difficulties, our group recently developed a new process-based vertical advection/diffusion model for the heat balance that exploits advances from the theory of ocean water masses accumulated over the past 50 years or so, and which naturally addresses all the shortcomings of the old model. This project aims to: 1) demonstrate the usefulness of this new process-based model to interpret and rationalise the simulated OHU for a wide range of climate change scenarios including increasing CO2, stabilisation, radiative forcing overshoot, and a collapse of the Atlantic meridional overturning circulation; 2) translate our new process-based understanding of OHU into a major improvement in the accuracy of climate change projections using Simple Climate Models, with a particular application to the MAGICC model, and one developed by the Met Office Hadley Centre. Simple climate models (SCMs) mimic the climate response seen in AOGCMs at much reduced computational cost. SCMs represent a key tool in the study of climate change. They are used for policy advice and play a central role in the science forming the basis for Working groups 2 and 3 of the latest International Panel on Climate Change report, which underlies the recent Paris agreement aimed at limiting the overall global warming below 2C.

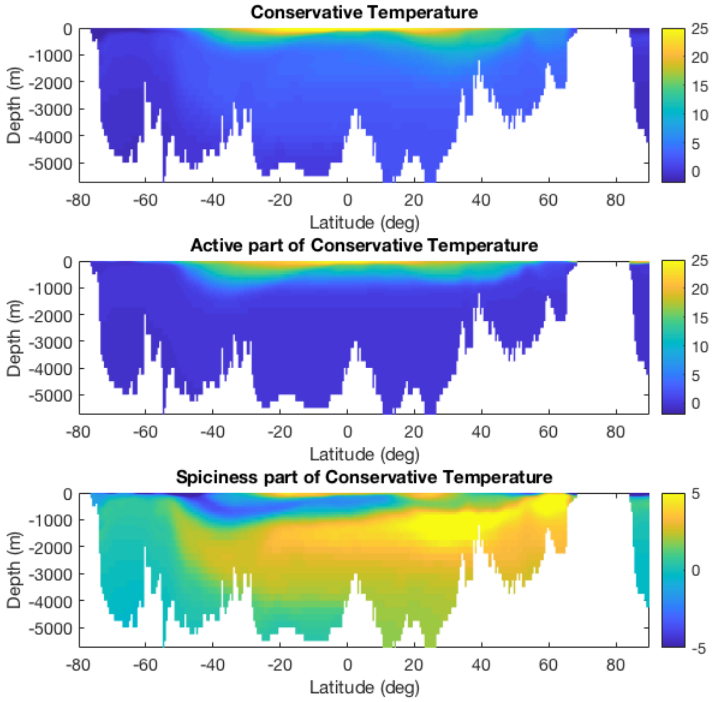

Figure 1: *Decomposition of Conservative Temperature (CT) for a latitude/depth section of the Atlantic (top panel) into an active isopycnal component (middle panel) and passive density-compensated (spiciness) component (bottom panel). The active component of CT is mostly diffused by diapycnal diffusion, whereas the passive component of CT is mostly diffused by isopycnal diffusion. This kind of decomposition plays a key role in the new process-based study of ocean heat uptake that forms the central aim of the OUTCROP project*.

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