

SEMINAIRE CNRM

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CONTROLS OF TRANSIENT VENTILATION RATES AND PATHWAYS IN A GLOBAL OCEAN GENERAL CIRCULATION MODEL

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Lien visio : <https://visio.numerique.gouv.fr/ukk-hnvl-dkj>

Résumé:

Understanding the mechanisms controlling transient oceanic ventilation is critical in the context of global warming, as the ocean absorbs over 90% of anthropogenic excess energy. We investigate these mechanisms through dye tracer simulations in a global ocean general circulation model with one-degree resolution and steady stratification. Simulations include seven dye tracers: six released across distinct surface regions spanning the global ocean, and one over the entire ocean surface. This framework reproduces data-constrained transit time distributions at both global and regional scales. Sensitivity experiments are then conducted by disabling one of the following contributions to dye tracer transport: advection, isopycnal diffusion, diapycnal diffusion within the mixed layer, and diapycnal diffusion below the mixed layer. In these experiments, the global ventilated volume after 300 years is reduced by 39%, 11%, 19%, or 7%, respectively. The dominant sensitivity to advection reflects the importance of the global overturning circulation in controlling ocean ventilation. Beyond this global view, we find that transport processes interact in markedly different ways depending on latitude and depth. While transport processes often relay each other to promote ventilation, they can have different effects between different regions. For example, removing isopycnal diffusion reduces ventilation from high southern latitudes (45-65°S) by 52% after 300 years but increases ventilation from mid-southern latitudes (30-45°S) by 45%. Such compensating effects of isopycnal mixing explain why its contribution to global ventilated volume remains limited,



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and illustrate the inherent complexity of oceanic ventilation. Our results shed light on controlling factors of ventilation while simultaneously offering insights for calibrating ocean models toward more realistic ventilation.