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## The impact of thermohaline staircases: estimates from a global analysis of Argo floats

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Thermohaline staircases are stepped structures in the temperature and salinity stratification that result from double diffusive processes. In the open ocean, double diffusive processes enhance the downgradient diapycnal heat transfer compared to turbulent mixing. However, in combination with salinity effects, the resulting buoyancy flux within the thermohaline staircases is counter gradient. This vertical density transport strengthens the stratification and, consequently, affects the density of the water masses above and below the staircase layer. Although 44 percent of the world's oceans is susceptible to double diffusion and thermohaline staircases are ubiquitous in these regions, the impact of double diffusion on diapycnal heat transfer and on water mass transformation has not been quantified yet. Here, we analyse a dataset of Argo float profiles to obtain a global overview of the occurrence of thermohaline staircases and to estimate their impact on diapycnal heat transfer and water mass transformation. Several regions with a high staircase occurrence are identified. Besides the well-known regions in the Caribbean Sea, the Mediterranean Sea and the subtropical Atlantic Ocean, our analysis reveals a new staircase region in the Indian Ocean. Using this global overview, we estimate, for the first time, the contribution of downgradient diapycnal heat transfer by the staircases. It appears that this contribution is very low compared to the dissipation required to maintain the observed temperature stratification. However, each staircase region can potentially impact the global circulation by affecting the density of the water masses above and below. In particular, the staircase region in the Indian Ocean overlies the waters of the Tasman Leakage. These waters flow westward from Australia towards the Agulhas region and affect the properties of waters entering the Atlantic Ocean. This implies that the vertical flux of salt into the Tasman Leakage waters induced by the presence of thermohaline staircases above can impact the salt transport into the Atlantic Ocean, which in turn is expected to impact the Atlantic Meridional Overturning Circulation.