

# Asymmetries in heat and carbon uptake by the Southern and northern oceans

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The Southern Ocean provides dominant contributions to global ocean heat and carbon uptake, which is widely interpreted as resulting from its unique upwelling and circulation. Here we show a large asymmetry in these contributions, with the Southern Ocean accounting for  $83\% \pm 33\%$  of global heat uptake versus  $43\% \pm 3\%$  of global ocean carbon uptake over the historical period in state-of-the-art climate models. Using single-radiative forcing experiments, we explore why there is this asymmetry in heat and carbon uptake. In future projections, such as the shared socio-economic pathway SSP2-4.5, the Southern Ocean contributions to global heat and carbon uptake become more comparable,  $52\% \pm 5\%$  and  $47\% \pm 4\%$  respectively. Hence, the past is not a reliable indicator of the future, with the northern oceans becoming important for heat uptake while the Southern Ocean remains important for both heat and carbon uptake.

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