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Methods of calculation of the Atlantic meridional transports at 26.5°N from ocean models

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The Atlantic meridional overturning circulation (AMOC) and the associated meridional heat transport (MHT) at 26.5°N are investigated in two global ocean models at different resolutions and setup and compared with observational estimates from the Rapid Climate Change programme (RAPID). Three different methods of calculation are used to compute the modelled meridional transports: the first method (MOC_mod) is based on simulated velocity fields, the second (MOC_endpoint) relies on the same assumptions as for the RAPID calculations, and the third (MOC_ff_baro) is also based on hydrostatic and geostrophic relationships, but relative to the model barotropic circulation. All methods correctly reproduce the time-mean AMOC strength at 26.5°N, although some differences with observations are present at depth.

Despite the higher AMOC simulated by our eddy-rich global model, the corresponding heat transport is significantly lower than the RAPID estimates, as in other model studies. The differences between the deep structure of the simulated and observed AMOC impact the heat transport less than the discrepancies between the MOC_mod and MOC_endpoint AMOC structure in the upper ∼500m layer.

The comparison of the AMOC obtained by the three methods suggests that an inadequate representation of currents near the western boundary by geostrophy leads to underestimate the southward circulation in the upper-mid ocean and largely impact the heat transport calculations. In our analysis, calculation based on RAPID assumptions (applied in MOC_endpoint) result in a higher mean heat transport (>25%) compared to MOC_mod calculation.