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Impact of eddies and internal waves on the meridional overturning circulation

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The advent of satellite observations have shown that internal waves and eddies are ubiquitous in the ocean. However, despite the increasing wealth of ocean observations the impact of both eddies and internal waves on the variability of the ocean circulation is far from fully understood. Here we analyse output from an eddy-permitting 1/4° global ocean model forced with realistic surface fluxes for the 1958 to 2001 period. The model run consists of two passes through the 1958 to 2001 forcing. After an initial model adjustment with strong drifts in the beginning of the first pass the model reaches a quasi steady-state. The 1976 to 2001 period of each pass is used to extract the imprint of internal waves and eddies on the meridional overturning circulation (MOC). The surface forcing being identical the main difference between both passes is the state of the eddy and internal wave field. The exact formation time of eddies and to a lesser extent also of internal waves is determined by the initial conditions which are different in the two passes of the model run. Therefore, the instantaneous differences between passes 1 and 2 are largely due to different eddy and internal wave fields. These project onto the MOC and lead to differences of several Sv between the subannual to interannual variability in the passes 1 and 2. With standard deviations of more than 5 Sv the largest differences between the two passes are found at the equator but even at mid-latitudes the standard deviation can be as high as 1.5 - 2Sv. This corresponds to about one third of the total MOC variability. Despite the differences due to the internal wave and eddy fields the correlation between the MOC values of the two passes is high suggesting that on subannual to interannual timescales the MOC variability is largely constrained by the atmospheric forcing.