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A Linear Feedback for the Amplification of the Meridional Overturning Circulation Variability on Interdecadal Timescales

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Within the present climate, the Mediterranean Sea produces dense, warm and salty water that outflows through the Gibraltar Strait into the North Atlantic. The outflow amounts to about 1 Sv of water that can be over 1 psu saltier than any other water mass in the North Atlantic at the same latitude and depth. However, due to the large errors on the measures of the freshwater budget both in the North Atlantic and in the Mediterranean Sea, the uncertainties concerning the contribution of MOW to the net freshwater budget of the North Atlantic is also quite large. Moreover, there is substantial uncertainty concerning the path of MOW in the North Atlantic and its impact deep water formation occurring in the North Atlantic. Here, a simple box-model is used to investigate different scenarios of the spreading of MOW in the North Atlantic. We identify an internal advective feedback affecting the amplitude of the thermohaline oscillations. When a salinity gradient is maintained in the ocean interior the oscillations are amplified. Instead, if the intermediate level fluxes are spread in the ocean deep layers, the model variability is reduced. We suggest that this mechanism may be relevant for climate variability on interdecadal time scales.