Modelling multidecadal variability in the North Atlantic and Arctic oceans

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Abstract. The Atlantic Multidecadal Oscillation (AMO) is a pattern of variability observed in the North Atlantic ocean which has an effect on the climate of the surrounding land masses. If the North Atlantic ocean is described using a simple 3D primitive equation ocean model then variability arises through a normal mode which destabilises the background state through a Hopf bifurcation. This internal ocean mode has a multidecadal time scale and is characterised by westward propagating temperature anomalies and a spatial pattern at the surface which resembles observations of the Atlantic Multidecadal Oscillation. This variability, although damped when using realistic surface boundary conditions in the ocean model, can be excited by noisy forcing. It is found that spatial and temporal patterns in the noise can be effective at exciting the mode of variability. Anomalies associated with this variability also propagate from the North Atlantic into the Arctic and can be tracked, in a model, around the Arctic as the water mass transforms. The particle tracking model implements a novel stochastic mixed layer parametrisation to simulate the behaviour of water in the upper layer of the ocean.