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The impact of stochastic mesoscale weather systems on the Atlantic Ocean

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The ocean is forced by the atmosphere on a range of spatial and temporal scales. In numerical models the atmospheric resolution sets a limit on these scales and for typical climate models mesoscale (<500 km) atmospheric forcing is absent or misrepresented. Here we use a novel stochastic parameterization – based on a cellular automaton algorithm – to represent spatially coherent weather systems realistically over a range of scales, including down to the ocean grid-scale. We show that the addition of mesoscale atmospheric forcing leads to coherent and robust patterns of change: a cooler sea surface in the tropical and subtropical Atlantic, deeper mixed layers in the subpolar North Atlantic, and enhanced volume transport of the North Atlantic Subpolar Gyre and the Atlantic Meridional Overturning Circulation. Convection-permitting atmospheric models predict changes in mesoscale weather systems due to climate change, so representing them in climate models would bring higher fidelity to climate projections.