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A centennial-scale Arctic - North Atlantic recharge oscillator in a coupled climate model

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In global climate models, low-frequency natural variability related to the Atlantic Ocean overturning circulation is a common behaviour. Such intrinsic climate variability is a potential source of decadal climate predictability. However, over longer term scenario simulations, this natural variability becomes a major source of uncertainty. In this study, we document a large and sustained centennial variability in the 3500-year pre-industrial control run of the CNRM-CM6 coupled climate model which is driven by the North Atlantic ocean, and more specifically its meridional overturning circulation (AMOC). We propose a new AMOC dynamical decomposition highlighting the dominant role of mid-depth density anomalies at the western boundary as the driver of this centennial variability. We relate such density variability to deep convection and overflows in the western subpolar gyre, themselves controlled by and intense salinity variability of the upper layers. Finally, we show that such salinity variability is the result of periodic freshwater recharge and descharge events from the Arctic Ocean, themselves triggered by stochastic atmospheric forcing.