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The Atlantic Subpolar Gyre as a stochastically forced oscillator

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Internal variability of the Atlantic subpolar gyre is investigated in a 600 year control simulation of a comprehensive coupled climate model. The subpolar gyre shows irregular oscillations of decadal time scale with most spectral power around 20 years. A positive feedback mechanism destabilizes the gyre circulation and leads to an internal ocean oscillation. This involves periodically enhanced deep convection in the subpolar gyre center and intermittently enhanced air-sea thermal coupling. As a result, anomalies of the large-scale atmospheric circulation are transferred to the ocean on the ocean's intrinsic time scale, triggering the destabilizing feedbacks and exciting the oscillator stochastically. A detailed understanding of oscillatory mechanisms of the ocean and their sensitivity to atmospheric forcing holds considerable potential for decadal predictions as well as for the interpretation of proxy data records.