



Dynamical threshold may enhance variability of subpolar gyre

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Direct observations, satellite measurements and paleorecords reveal strong variability of the Atlantic subpolar gyre (SPG) on various time scales. We present simulations with a coarse-resolution coupled climate model which includes an oceanic general circulation model but is lacking internal variability due to its statistical-dynamical atmosphere. In equilibrium simulations the Atlantic SPG exhibits a threshold response to anomalous constant surface freshwater flux. When applying time-variable surface forcing the magnitude of SPG variability as seen in observations can only be reproduced when the system is close to this dynamical threshold. Near the threshold multi-decadal to centennial-scale variability is strongly enhanced for both surface freshwater and surface wind stress forcing. Our results thus indicate that previously reported positive baroclinic feedbacks may play a dynamic role in presently observed SPG variability. They further suggest a mechanism for long-term variability of the North Atlantic Oscillation (NAO) where a strong SPG is associated with a positive NAO phase.

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