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On the mechanism of centennial thermohaline oscillations

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Centennial oscillations of the ocean thermohaline circulation are studied in a two-dimensional latitude-depth model. Both nonlinear time integration and linear stability analysis around a steady state of this model in a single hemisphere configuration reveal centennial oscillations, where anomalies seem to be purely advected by the mean flow.
The existence of these oscillations is strongly related to the type of surface boundary conditions applied to temperature and salinity, namely the restoring surface temperature and prescribed freshwater (or salt) flux, known as mixed boundary condition.
Its fundamental mechanism is investigated through a density variance budget, that points out the surface temperature relaxation as the main source of variance counterbalancing eddy-diffusion effects on the anomalies: A good correlation between temperature and salinity anomalies is thus crucial to this positive feedback.
A minimal model tractable analytically, the Howard-Malkus loop oscillator, is derived to understand physically the oscillatory and growth mechanisms: We suggest that the oscillation and the so-called salinity feedback are based, in a different parameters regime, on the same physical mechanism.
Finally the robustness of these oscillations is analyzed in more realistic bihemispheric configurations including an idealized Antartic Circumpolar Current and results are tentatively interpreted.