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Centennial time scale synchronization of the ocean's thermohaline circulation to solar variability

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Motivation for this study are recent results from an intermediate-complexity climate model. In this model, significant century-scale climate variability was found when solar irradiance forcing with a weak century-scale periodicity (as reconstructed from tree ring C14 data) was imposed. In this study, we investigate the hypothesis that this variability arises due to synchronization of the ocean's thermohaline circulation and the solar forcing. We use a 4-box model of the ocean circulation in a parameter regime for which it possesses a damped centennial oscillation under mixed boundary conditions for temperature and salinity. The addition of white noise to the temperature forcing does not excite any statistically significant oscillation, but when a weak periodic component with a 200-yr period is added to the forcing, relatively strong century time-scale variability occurs. The mechanism of this centennial variability is investigated in the box model and quantitative relations between forcing amplitude, noise levels and internal damping are computed. A qualitative comparison between the box model results and those of the climate model shows encouraging similarities and provides support to the synchronization hypothesis.