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Variability of the ocean heat content during the last millennium. An assessment with the ECHO-g Model

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This work analyses the ocean heat content (OHC) described by two forced simulations of the last millennium, performed with the ECHO-G atmosphere-ocean General Circulation Model (AOGCM). The results are evaluated by comparing with observations and results from other models of different complexity. A 1000-yr long control ECHO-G simulation is also used to determine the main features of natural (unforced) OHC variability.
Comparison with observations during the period 1955-2000 shows that the model does not reproduce properly the interannual OHC variability. At lower-frequencies the agreement between simulations and observations is relatively good, and the contribution from volcanic aerosols seems to be well captured. However, the long-term OHC trends are overestimated in the simulations. These trends are specially large in the Pacific ocean, which is also found to produce most of the intradecadal OHC variability.
In the context of the last millennium, both forced simulations exhibit similar variability in the upper ocean (0-300m) since year 1500, showing also a good agreement with results from other models. Before year 1500 the agreement between the forced runs is no longer observed, and is mainly a consequence of their different initial conditions. The discrepancies between the simulations are more important in the deeper ocean, and become maximum around 3000m. At this depth, none of the simulations is in good agreement with results from other models and proxy reconstructions.
Finally, most of high-frequency OHC variability is found near the Equator, where the OHC seems to be dominated by El Niño-Southern Oscillation (ENSO) variability. Largest interdecadal to secular OHC variability takes place in the tropics, with maximum values near 30ºN and 30ºS. The dynamical (wind-driven) and radiative contribution to these OHC variations is explored.