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Intrinsic low-frequency variability in a low-order model of the wind-driven ocean circulation

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A spectral quasigeostrophic model of the wind-driven ocean circulation with four degrees of freedom is derived with the aim of analyzing the low-order character of the intrinsic low-frequency variability of the midlatitude double-gyre ocean circulation, and of the related coherence resonance phenomena. In this communication the model characteristics and the low-frequency variability are presented and discussed. The model includes an exponential in the basis functions that allows for westward intensification, has two components in both horizontal directions, allows for a rectangular domain and is forced by a steady double-gyre wind field. The dynamical systems analysis of the numerical solution, with the wind amplitude taken as the control parameter, shows several transitions that connect steady states to periodic and chaotic oscillations. A homoclinic bifurcation, in particular, leads to intrinsic decadal relaxation oscillations similar in several respects to those obtained with primitive equation models. This result supports the hypothesis of the low-order character of the intrinsic low-frequency variability that is well known to arise in the double-gyre problem.