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On the low-order character of coherence resonance in the midlatitude wind-driven ocean circulation

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A spectral quasigeostrophic model with four degrees of freedom is derived, and used to investigate the low-order character of the coherence resonance phenomenon in the wind-driven double-gyre ocean circulation. The model, forced by a climatological wind, is found to produce vigorous relaxation oscillations (ROs) past a homoclinic bifurcation. If, on the other hand, suitable red noise winds are added to the forcing in a parameter range preceding that bifurcation, ROs can be excited in a coherence resonance scenario that is very similar to the one obtained with a primitive equation model of the Kuroshio Extension. The low-order character of such a phenomenon is thus established. The next step to get a deeper understanding of the phenomenon is to investigate the RO excitation mechanism. To this respect, a method denoted here as phase selection is proposed: the system is forced with additive fictitious periodic winds that produce an emergence of ROs yielding strong phase dependence with the periodic forcing. A subsequent analysis reveals the character of the wind that is most likely to excite a RO. The results are discussed also in the general framework of climate dynamics.