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Stochastic Analysis of Double Gyre and Thermohaline Flows

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We study and analyze the stochastic response of an idealized model of the variability of large-scale wind-driven ocean circulations. Specifically, we consider the two-dimensional barotropic quasi-geostrophic model of double gyre flows and characterize the stochastic response of this model to a wide range of Reynolds numbers and forcing parameters. Also considered are two-dimensional thermohaline circulations and their stability properties. The stochastic analyses, including time-dependent modal decompositions and energy transfers, are completed using new partial differential equations, the Dynamically Orthogonal (DO) field equations, and a new numerical finite-volume stochastic partial differential framework.