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Stochastic Modeling of Decadal Variability in Ocean Gyres

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Decadal large-scale low-frequency variability of the ocean circulation due to its nonlinear dynamics remains a big challenge for theoretical understanding and practical ocean modeling. This paper presents a novel fully data-driven approach that addresses this challenge. We propose non-Markovian low-order methodology with stochastic closure and data-adaptive mode decomposition. The multilayer stochastic linear model is obtained from the coarse-grained eddy-resolving ocean model solution, and it reproduces with high accuracy the main statistical properties of the decadal variability. The proposed methodology does not depend on the governing fluid dynamics equations and geometry of the problem, and it can be extended to other ocean models and ultimately to the real data.