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Identifying wave processes associated with predictability across time scales: An empirical normal mode approach

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The key to better prediction of S2S variability and weather regimes in a changing climate lies with improved understanding of the fundamental nature of S2S phase space structure and associated predictability and dynamical processes. The S2S variability can be partitioned with the Modified Lagrangian Mean (MLM) approach in terms of slow diabatic processes, such as radiative forcing, and adiabatic dynamical processes. The latter can be decomposed into a finite number of relatively large-scale discrete-like Rossby waves with coherent space-time characteristics using Empirical Normal Mode (ENM) analysis. ENM analysis is based on principal component analysis, conservation laws and normal mode theories. These modes evolve in a complex manner through nonlinear interactions with themselves and transient eddies and weak dissipative processes. The foundations and potential value of the ENM approach are presented but novel research is required to understand S2S predictability and dynamical processes like the nonlinear wave-wave and wave-mean flow interactions.