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Dynamics and predictability of extratropical wintertime low-frequency variability examined by a stochastic differential equation in a low-dimensional system

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Dynamics and sub-seasonal predictability of extratropical low-frequency variability (LFV) in Northern Hemisphere winter are examined in the framework of a two-dimensional (2-D) stochastic differential equation (SDE) on the phase space spanned by two leading empirical orthogonal function modes of low-pass-filtered 500-hPa geopotential height variations. The drift vector and diffusion tensor of the 2-D SDE with multiplicative noise are theoretically connected to deterministic and stochastic error growth, respectively, which are statistically estimated from a reanalysis dataset. Projected onto the 2-D phase space is the predictability of LFV estimated by the 10-day forecast spread based on the 1-month ensemble prediction operated by the Japan Meteorological Agency. It is shown that the inhomogeneous distribution of the LFV predictability in the 2-D phase space is explained by the estimated stochastic error growth due to the diffusion tensor rather than the deterministic error growth due to the Jacobian of the drift vector. Hence, the stochastic processes mostly control the operational forecast error growth associated with LFV in the 2-D phase space.