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The role of Gaussian noise in local uncertainty for mid-latitude Rossby waves

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The presence of Gaussian white noise can lead to uncertainties in fine-scale structures in numerical representations of atmospheric variables at various spatio-temporal scales. This can cause forecast uncertainty when forecasting events sensitive to small changes in the real field. A two-dimensional nonlinear wavelet transform in space is used to separate model dynamic and thermodynamic variables into coherent and incoherent components, which are then used to analyze the contribution of the noisy component to the full variable's distribution. It is shown that the incoherent field does not significantly contribute to the variance of temperature, geometric height, zonal or meridional wind component, or vorticity on isentropic surfaces at the synoptic scale. The issue of the contribution of the incoherent component to changes in variable distribution locally is then raised. For momentum and potential vorticity, analysis of model output suggests that an interaction between coherent and incoherent components at sub-synoptic scales contribute locally to influence distributions in a way that the coherent component alone cannot. Relevance of local influence is also tested to determine how large-scale signals are influenced by local changes in momentum and potential vorticity distributions. Comparisons between cyclonic and anticyclonic wave breaking are included.