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Augmenting Restricted Nonlinear Turbulence to Capture Scale Separation[1] BENJAMIN MINNICK, DENNICE GAYME, Johns Hopkins University — The restricted nonlinear (RNL) dynamics comprises a streamwise constant mean flow interacting with a dynamically restricted perturbation field. This model aims to capture key features of wall-bounded turbulence with reduced computational expense. Constraining the nonlinear interactions leads to a reduced representation in which the RNL dynamics are supported by a small number of streamwise varying modes (non-zero streamwise Fourier coefficients) interacting with the streamwise mean, which captures statistical features of low Reynolds turbulence. To correctly capture momentum transfer at moderate Reynolds numbers where scale separation emerges, the streamwise varying modes must correspond to the small wave lengths associated with the outer-layer peak of the surrogate dissipation spectra. At higher Reynolds numbers where there is a clear separation of scales, we expect the model to require additional large scales consistent with triadic interactions of the small scales. Here, we simulate these interactions by including a large scale streamwise varying mode which is permitted to interact nonlinearly with small scale modes. We demonstrate that this augmented RNL (ARNL) model reproduces key flow statistics for Reynolds numbers as high as $Re_\tau \approx 5200$.

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Benjamin Minnick
Johns Hopkins University

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