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The influence of time-varying external forcings on turbulent transitions in the stable boundary layer

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The stable boundary layer can be classified into two distinct regimes. The weakly stable regime (WSBL) which occurs in the presence of moderate to strong pressure gradients or cloudy skies and is characterized by continuous turbulent mixing, and the very stable regime (VSBL) which occurs in the presence of weak pressure gradients or clear skies and turbulence weakens to the point of collapse. Modelling and observational results indicate that transitions from the WSBL to the VSBL occur when the maximum sustainable heat flux (or shear capacity) is exceeded. However, transitions from the VSBL to the WSBL are still not well understood. In this study we use an idealized model to explore transitions between the VSBL and the WSBL. By introducing a stochastic pressure gradient, we show that large scale weather can inhibit or facilitate turbulent transitions and explore the stability properties of the psuedo-steady state in which turbulence has collapsed. This analysis demonstrates how the idealized energy/momentum budget model with parameterized turbulence can reproduce the regime transitions present in atmospheric data.