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Turbulent transitions in the stable boundary layer: Couette and Poiseuille flow[1] AMBER M. HOLDSWORTH, ADAM H. MONAHAN, University of Victoria — The stable boundary layer (SBL) 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 (MSHF), or shear capacity, is exceeded. The collapse of turbulence in the SBL is investigated using a one dimensional model of Couette flow with a constant heat flux. We show that the MSHF framework for predicting turbulent collapse is qualitatively robust to the choice of turbulence parameterization and extend these earlier stability analyses by numerically determining the unstable modes along the unstable branch. To explore transitions between the VSBL and the WSBL we extend the model to include a horizontal pressure gradient and a surface radiation scheme. Analysis of the Poiseuille flow demonstrates how the idealized energy/momentum budget model with parameterized turbulence can reproduce the regime transitions present in atmospheric data.

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