Supporting Information for "Scaling Laws for the Length Scale of Energy-Containing Eddies in a Sheared and Thermally Stratified Atmospheric Surface Layer"

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Introduction

The Supporting Information provides the expressions for the data used in the main text.

Text S1

The MOST dimensionless functions as well as several estimates of the spectral peaks as a function of atmospheric stability are listed. From the Kansas experiment, Kaimal and Finnigan (1994) give the following MOST dimensionless functions

$$\phi_m(\zeta) = \begin{cases} 1 + 4.7\zeta, & \zeta \geq 0 \\ (1 - 15\zeta)^{-1/4}, & \zeta < 0 \end{cases}, \quad \phi_w(\zeta) = \begin{cases} 1.56, & \zeta \geq 0 \\ 1.56(1 - 3\zeta)^{2/3}, & \zeta < 0 \end{cases} \qquad (1a, b)$$

and values of the spectral peak

$$zk_p^K(\zeta) = \begin{cases} 2\pi\zeta, & \zeta > 2 \\ 2\pi(1.1 + 0.45\zeta), & 1 < \zeta \leq 2 \\ 2\pi(0.55 + \zeta), & 0 \leq \zeta \leq 1 \\ 2\pi(0.55 + 0.38\zeta), & -1 \leq \zeta < 0 \\ 2\pi 0.17, & \zeta < -1 \end{cases}. \qquad (2)$$

From the AHATS experiment data, Salesky et al. (2013) provided an estimate of the streamwise integral length scale of the vertical velocity

$$\Lambda(z) = \int \frac{\overline{w'(0,z)w'(x,z)}}{\sigma_w^2(z)} dx \qquad (3)$$

which is inversely proportional to the transition wavenumber. The resulting relative variations of k_p are

$$\frac{k_p^s(\zeta)}{k_p^s(0)} = \begin{cases} (1 + 4.01\zeta)^{0.586}, & \zeta \geq 0 \\ 1 - 0.462(1 - e^{4.82\zeta}), & \zeta < 0 \end{cases} \qquad (4)$$

Li et al. (2016) presents the following expression for the Ozmidov length scale in accordance with the AHATS experiment and lake data

$$zL_{oz} = (1/0.4)[\zeta\phi_m(\zeta)]^{3/4}[\phi_m(\zeta) - \zeta]^{-1/2}, \quad \zeta > 0.2. \qquad (5)$$

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