



Vertical Variations of Mixing Lengths During CASES99

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We investigated vertical variations of the mixing lengths for momentum and heat using the data collected from the Cooperative Atmosphere-Surface Exchange Study in 1999 (CASES-99). By comparing the mixing lengths calculated using the observations with κz that is assumed in Monin-Obukhov similarity theory (MOST), where κ is the von Kármán constant, and z is the height above the ground, we identified the vertical layer where MOST is valid during CASES99. We found that on average, MOST is approximately valid between 0.5 m and 10 m. Above it, the observed mixing lengths are smaller than the MOST κz and can be approximately described by the Blackadar mixing length formula, $\kappa z / (1 + \kappa z / l_\infty)$ for up to ~ 20 m for the mixing length for momentum, and up to the highest observation height for the mixing length for heat. We found that $l_\infty = 15$ m fits the observations best. Above ~ 20 m, the mixing length for momentum approaches a constant. Both MOST κz and the Blackadar's formula systematically overestimate the mixing length for momentum above ~ 20 m. Therefore, using either the MOST or Blackadar mixing length in the K theory may overestimate turbulence above ~ 20 m.