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Total and Kinetic Energy Conservation in Governing Turbulent Energy Transfers in the Stratified Atmospheric Boundary Layer

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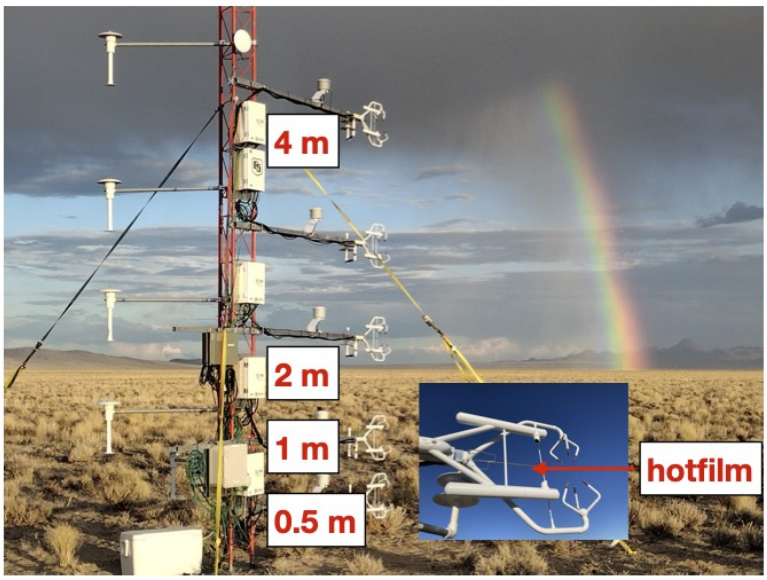
LMFL Fluid Mechanics Webinar Link

Abstract

Puzzled by a number of observed disagreements between field observations in the atmospheric boundary layer and theoretical expectations based on the 1st law of thermodynamics, I have investigated a generalized thermal energy balance in the stratified atmosphere based on total and kinetic energy conservation. Because the 1st law is a special case of total energy conservation, the widely used thermal energy balance based on the 1st law is a special case of the generalized formulation under neutral conditions. I will explain important interconnections among kinetic, thermal, and potential energy variations in the stratified atmosphere, whether stable or unstable, as well as interconnections between viscous stress work and thermal energy changes in air-land interactions following their underlying physical generation mechanisms. I will demonstrate these important interconnections in explaining the well observed systematic, diurnally varying surface thermal energy imbalance using field observations including hot-film measurements collected in a recent field campaign. Potentially, the interconnections between different forms of energy variation can provide explanations for other observed conundrums and challenging issues in the atmosphere boundary layer.

Suggested paper as support material: https://doi.org/10.1002/qj.5005



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