Improved Understanding of Land-Atmosphere Interactions Using Profiling and Surface Flux Observations

Dave Turner*†[1], Ryann Wakefield[2], Tim Wagner[3], Thijs Heus[4], Tessa Rosenberger[4], and Tilden Meyers[5]

[1]NOAA Global Systems Laboratory – 325 Broadway, Boulder, CO 80301, United States
[2]University of Oklahoma – Norman, OK, United States
[3]University of Wisconsin - Madison – Madison, WI, United States
[4]Cleveland State University – Cleveland, OH, United States
[5]NOAA Air Resources Laboratory – Boulder, CO, United States

Abstract

Land-atmosphere interactions play a critical role in both the atmospheric water and energy cycles. Mixing diagrams provide insight into the evolution of the heat and moisture budget within the convective boundary layer (CBL). Mixing diagrams enable us to quantify the contributions from surface fluxes, advection, radiative heating, encroachment, and entrainment to the evolution of the CBL moisture and energy budgets as a function of the time-of-day. We demonstrate that observations from the ARM Southern Great Plains (SGP) site provide all of the inputs needed for the mixing diagram framework. In particular, the high temporal resolution profiles of temperature and humidity retrieved from the Atmospheric Emitted Radiance Interferometer (AERI) are a critical component in this analysis, as they provide a unique opportunity to quantify encroachment, advection, and mixed-layer quantities *from observations*. We demonstrate that the mixed-layer mean values of temperature and humidity are optimal for understanding the evolution of the CBL; past work using 2 m above ground in-situ observations in mixing diagrams results in biases. We also demonstrate that encroachment is a critical term for understanding the CBL evolution; past work had convolved this term with entrainment. We use this framework to evaluate both large-eddy simulation (LES) and the High-Resolution Rapid Refresh (HRRR) models using this approach.

Keywords: land, atmosphere interactions, boundary layer

*Speaker
†Corresponding author: Dave.Turner@noaa.gov