

# DIRECT COMPARISON OF EDDY COVARIANCE AND BOWEN RATIO/ENERGY BALANCE MEASUREMENTS OF CO<sub>2</sub> FLUXES IN GRAZING AGROECOSYSTEMS

G.L. Doyle<sup>1</sup>, W.A. Dugas<sup>2</sup>, and H. Mayeux<sup>1</sup>

<sup>1</sup>USDA-ARS, Grazinglands Research Laboratory, El Reno, OK (USA)

<sup>2</sup>Texas Agricultural Research Station, Temple TX (USA)

## ABSTRACT

The objectives of this study were to (1) compare annual mass and energy fluxes of sensible carbon dioxide (CO<sub>2</sub>), heat flux density (H), and latent heat flux density (LE) from Campbell Scientific, Inc. (CSI) manufactured eddy covariance (EC) and Bowen Ratio/energy balance (BREB) instrumentation in a tallgrass prairie site and (2) make similar short term (5-14 d) comparison in other grazing ecosystems throughout the western United States. The long-term tallgrass prairie site was located in central Oklahoma with measurements being made from August 2001- October 2004, while the short-term sites were located in Oregon, Colorado, Idaho, North Dakota, and Arizona during the summers of 2003 and 2005. Results from the long-term (< 36-month) co-located EC and BREB units indicated that both systems demonstrated similar seasonal patterns, yet the EC consistently failed to close the energy balance by 25-35% when compared to the BREB. A timing error between the LI-COR 7500 infrared gas analyzer and the CSI CR23X data logger was discovered and repaired in 2003, which did not affect the measurement of H, while there was a marked difference in LE measured by the two systems before and after the correction. Little difference was seen in the relationship of daily NEE (net ecosystem CO<sub>2</sub> exchange) from the two methods before and after the timing correction, with the EC measuring ~ 70% of the BREB daily NEE. On days with NEE > 0, BREB NEE was slightly more positive (more loss) when compared to the EC. Months with CO<sub>2</sub> uptake (NEE < 0, typically May - August) can be 2 - 5 times greater than months with an average loss of CO<sub>2</sub> (NEE > 0). Average daily NEE for entire period was approximately -0.4 g CO<sub>2</sub> m<sup>-2</sup> d<sup>-1</sup> and is therefore a CO<sub>2</sub> sink (223 kg ha<sup>-1</sup> y<sup>-1</sup>). Monthly and annual NEE compares even more favorably between systems. Similar daily results were observed at the short term sites, suggesting that use of BREB measured NEE in these ecosystems can be successfully compared to those made using EC systems.