**INTRODUCTION**

- New fast CO₂/H₂O analyzer, the LI-7200, is made for low power operation. It can use short intake tube of <1 m or less [1].
- Two fast air temperatures and one air pressure are measured in the cell synchronously with CO₂/H₂O.
- This provides the ability to compute fast mixing ratio (MR), or dry mole fraction, on-the-fly [2].
- MR can be used for Eddy Covariance flux calculations without the need for Webb-Pearman-Leuning density terms [3, 4, 5, 6].

**FIELD EXPERIMENTS**

Comparison of MR-based to density-based flux calculations was made in 9 field experiments covering wide range of conditions [1]:

- 6 experiments from AmeriFlux Roving Experiment using LI-7200 experiment from USDA site in Arizona (AZ-2)
- 1 experiment from LI-COR field test facility in Nebraska (NE)
- 2 experiments from LI-COR biostation, Lincoln, NE

**MIXING RATIO-BASED FLUXES**

- Mixing ratio-based fluxes without WPL are plotted below vs. traditional density-based fluxes of Fc and LE for all 9 field deployments.
- Mixing ratio-based CO₂ flux was within 0%-4% of the density based flux at all sites.
- The site with largest difference of 4%, CA-2, had measurement height ~2× times taller than the any other site, highest LE flux affecting WPL terms, and least number of available data hours.
- Water vapor fluxes were within 1% at all sites, with 3% of LE leading to 2-5% of improvement in the energy budget closure.

**CONCEPT OF MR & WPL**

Fundamentally, fluxes can be computed from a covariance between vertical wind speed and mixing ratio after [3, 4, 5, 6]:

\[ F_c = \frac{\rho_a}{\rho_d} \left( \frac{\partial P}{\partial z} \right) \]

\[ F_c = \frac{q_c}{\rho_d} \left( \frac{\partial \rho}{\partial z} \right) \]

However, traditional flux calculations usually use density measurements which are native to the gas analyzers:

\[ F_{cw} = \frac{q_w}{\rho} \left( \frac{\partial \rho}{\partial z} \right) \]

and then apply density corrections after Webb et al. [3]:

\[ S = \frac{q_w}{\rho} \]

\[ S = \frac{\rho_d}{\rho_a} \left( \frac{\partial \rho}{\partial z} \right) \]

MR can be computed in LI-7200 on-the-fly from density, using instantaneous water mole fraction (Fo). Two temperatures (T) and a pressure (P) measured in the cell, and a gas constant (R):

\[ S = \frac{q_w}{\rho} \]

So, fluxes from LI-7200 could be computed both in traditional manner from density (Eq. 3), and from mixing ratio (Eq. 1).

Fast MR has been used before with conventional closed-path analyzers, without fast and P, because the atmosphere is attenuated in the intake tube. However, in the enclosed LI-7200, when used with short tube, most not all of the fast fluctuations in T are attenuated, so calculating fluxes using MR from such instrument requires validation.

**REFERENCES**


**SUMMARY**

- New enclosed gas analyzer LI-7200 can use short intake tube, because fast T and P are measured in the cell with CO₂ and H₂O.
- LI-7200 outputs fast gas density and MR at the same time.
- This provides opportunity to compare MR-based fluxes without WPL correction with traditional density-based fluxes with WPL.
- Traditional density-based fluxes from LI-7200, on-the-fly MR calculations, and resulting MR-based fluxes were examined:
  - (I) The density-based fluxes from LI-7200 compared well with open-path and closed-path standards
  - (II) MR-based fluxes and density-based fluxes matched well in all 9 experiments over wide range of conditions
  - The ability to compute MR-based fluxes is important for gas flux measurements, because elimination of density corrections can increase flux data quality and temporal resolution, and may help to reduce the magnitude of minimum detectable flux.