During the Regional Approaches to Climate Change (REACCH) project, five eddy covariance flux towers were active over wheat cropping systems with the goal of assessing annual carbon sources and sinks. A systematic error in the measurement of carbon dioxide (CO₂) concentration was recently identified in the infrared gas analyzers (IRGA) utilized by the towers. Low-frequency temperature fluctuations measured by the IRGA were used to calculate CO₂ density, which failed to capture high-frequency temperature fluctuations. This led to a bias in the calculation of the CO₂ fluxes that scales with kinematic heat flux leading to an underestimation of the land-to-atmosphere net carbon exchange. The Long Term Agricultural Research (LTAR) project, which is a continuation of the REACCH project, will continue to operate four flux towers. Software analysis programs have been upgraded and the need to correct the CO₂ bias have resulted in the following goals for this work:

• Comparing EddyPro (REACCH software) with EasyFlux (LTAR) analysis software to determine best practices going forward.
• Assessing, on a per instrument basis, the effect the bias has on cumulative carbon flux calculations.
• Quantifying how the bias affects historic carbon budgets.

### METHODS

**EddyPro and EasyFlux Comparison**

A comparison of the data processing software was performed using the new LTAR data as shown in the flow chart below. The quality check consisted of removing data that does not meet the eddy covariance requirements and thus has a high level of uncertainty. This can include data periods with low friction velocity (stable conditions), winds coming through the tower, and periods during precipitation events which can interfere with the IRGA. The resulting time series was not gap filled.

### CONCLUSIONS

**EddyPro and EasyFlux Comparison**

The analysis showed that EasyFlux returns lower sensible, latent, and carbon dioxide fluxes. The resulting cumulative carbon fluxes calculated using EasyFlux were 12.7%, 10.4%, and 12.9% lower than fluxes calculated from EddyPro for Boyd North, Boyd South, and Cook East, respectively. This magnitude of this uncertainty is comparable to the commonly accepted amount of error in eddy flux covariance systems. Furthermore, it is noteworthy that the data for Cook West was insufficient to complete the total carbon calculation.

**High Frequency and Low Frequency Comparison**

Figure Four shows the different corrections on a per instrument basis that could be used to correct the historical REACCH data. Three of the four sites appear reasonable, however the Cook East site has some outliers that don’t follow the trend line. Future work needs to include longer data sets for all of the sites to incorporate additional seasons. The data period used for this study was approximately May through July (with slight variations across the different sites), which included periods of time when winter wheat was senescing (Boyd sites). Results showed that differences between the high and low frequency CO₂ fluxes were greatest during periods of senescence, or during times of low carbon exchange. This was also some of the highest kinematic heat flux values as shown in Figure Six.

**FUTURE WORK**

Although the differences between EddyPro and EasyFlux were within the overall uncertainty of EC measurements, they were still substantial. Future work will include a more in depth look at the two software codes to evaluate why EddyPro is returning greater flux values. It will also be important to validate the results of the low and high frequency comparison at the Cook sites using multiple growing seasons. The results from all of these tasks will be used to determine if corrections to the historical REACCH data for the IRGA bias are warranted.

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