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Comparison of two identical eddy correlation systems in various configurations

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1 Introduction

Two identical eddy correlation systems have been run in various configurations for almost two years. The configurations included side-by-side, vertically aligned, on opposite sides of the tower, and in adjacent plots separated by about 100 m. Further configurations are planned for the spring of 2002. In this extended abstract we report on the agreement of the units when run side-by-side as a baseline for further analyses of the other arrangements.

2 Methodology

This work was carried out at the Elora Research Station in Elora, Ontario, beginning in August, 2000, on a plot planted to maize in the spring of 2000. The units have been running almost continuously since then. The side-by-side configuration reported here was run from 21 August 2000 to 22 September 2000 at about 1 m above the 2.2 m corn canopy. The units were placed approximately 40 cm apart both facing westerly into the predominant wind direction.

The eddy correlation units were mounted on one tower in the centre of a 100 by 150 m plot within a larger field. The plot used was under a no-till, best management practices treatment. Each unit consisted of one 10 cm Campbell Scientific (CSI) C-SAT3 three dimensional sonic anemometer mounted alongside one LICOR-7500 open path CO_2/H_2O analyzer, separated by about 10 cm. The sensors were controlled at 20 Hz by a CSI CR23X datalogger using the SDM protocol and the data sent to a remote computer for permanent storage. Data files were zipped every ten minutes, and recorded to CD-ROM weekly.

Half hour averages were calculated later from the CDs. Data were filtered for 1/2 h periods with less than 21 min of data, readings of negative concentration or dew point temperatures in excess of 35°C, and readings with relative humidity greater than 1.05. Coordinate rotations to remove the $\overline{v}$ and $\overline{w}$ components were applied, and Webb-Pearman-Leuning corrections performed. Sonic temperature, corrected for vapour density, was used for the sensible energy flux. Spectral corrections were not performed on the data reported here, but should have been nearly the same for both units, and therefore not affect this analysis.

For the results shown here, we have further filtered for when the sonic reported questionable data (diagnostic word -6999) and when the mean wind was outside $\pm 45°$ of both sonic axes. The criteria in the data processing and data selection were intended to ensure that events such as dew formation were excluded, but still retain as many points as possible. The final selection based on wind direction is to edit out shadowing effects due to the wind passing the tower or one system, which other experiments have shown has a significant effect on measured fluxes.

Variable	Slope	r^2
u_*	1.009	0.9943
H	1.038	0.9932
λE	0.9762	0.9466

Table 1: Results of linear regressions comparing the measured u_*, H and λE from the two eddy correlation units.

3 Results

Comparisons of measured friction velocity u_*, sensible energy flux H and latent energy flux λE are shown in Figures 1–3, respectively. Table 1 reports values from linear regressions of the two units for each variable. The slopes are 1.009, 1.038 and 0.9762 for u_*, H and λE, respectively. The r^2 values, also shown in Table 1, further confirm the small variation in measured flux between the two units. This shows that the two units report nearly identical fluxes when exposed to the same conditions. All the measured fluxes tend to agree to within less than 5%, so that in further studies of these systems we expect any differences greater than this to be due to either poor exposure (e.g. tower shadow) or a different actual flux at the measurement points.

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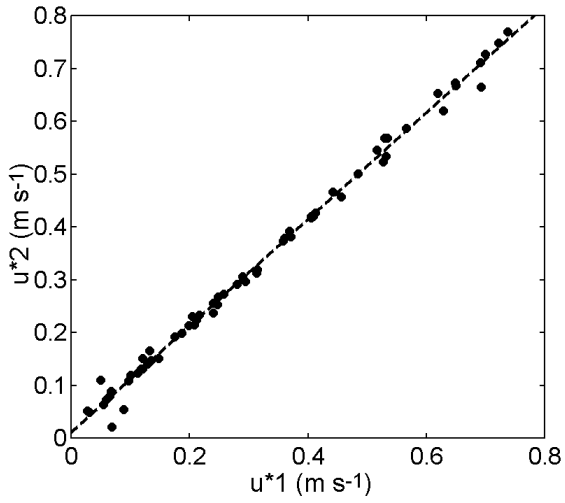

Figure 1: Comparison of friction velocity as measured by the two eddy correlation units. Linear regression shown by the dashed line.

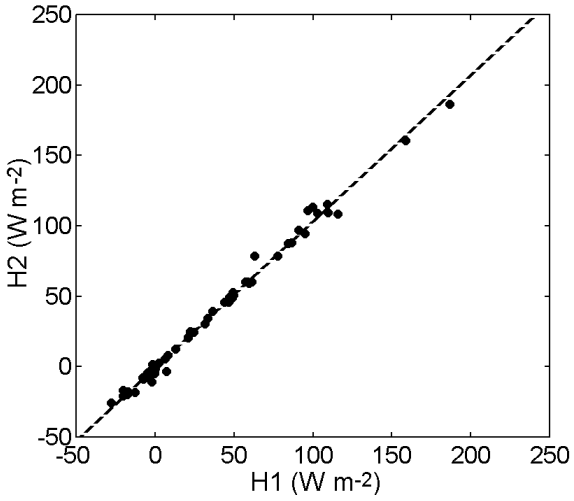

Figure 2: Comparison of sensible energy flux as measured by the two eddy correlation units. Linear regression shown by the dashed line.

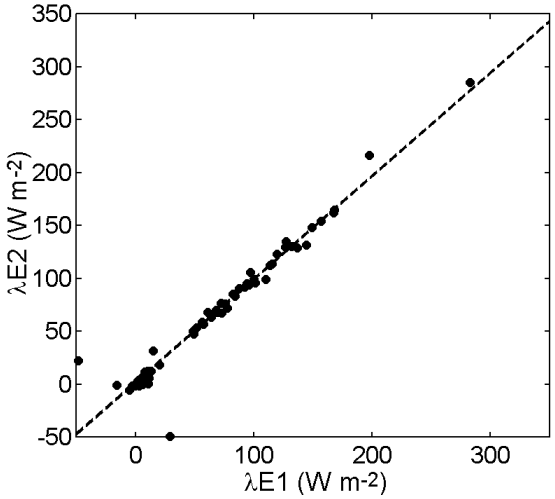

Figure 3: Comparison of latent energy flux as measured by the two eddy correlation units. Linear regression shown by the dashed line.