Important note

This memo reports accuracy results for a previous model of the Indoor Carbon Dioxide Monitor. These results showed that, for the previous model, the unaccounted effects of atmospheric pressure was the major source of error in the carbon dioxide observations.

The results of this report motivated the new model of the Indoor Carbon Dioxide Monitor. The new monitor properly accounts for atmospheric pressure and is currently the only model being sold. The atmospheric compensated values reported in Table 1 accurately represent the performance of the current model.

Carbon dioxide measurement accuracy

This report describes an experiment to verify the accuracy, repeatability, and drift of carbon dioxide measurements from Weblink Sensors Indoor Carbon Dioxide Monitors.

Weblink Sensors' Indoor Carbon Dioxide Monitors incorporate an NDIR (non-dispersive infrared) carbon dioxide module. Values for carbon dioxide accuracy and repeatability quoted in the specification brochure reflect values given by module vendor. To verify the accuracy, repeatability, and drift of carbon dioxide measurements from these modules, carbon dioxide measurements from three monitors were compared over a one month period.

Experimental Method

At the beginning of the experiment, each monitor was calibrated with a 1000 ppm carbon dioxide gas standard. Then all monitors were observed CO_2 for one month. During the month, data from all 3 sensors were recorded in 15 second intervals. At the end of the month, each monitor was compared against two calibration gas standards—one at 1000 ppm and another at 0 ppm. During the experimental period, temperature was allowed to vary between 20.5 and 25.5 ºC. However, both the initial calibration and the final calibration gas comparison were performed at 23.3 ºC.

Results

Table 1 shows the accuracy of the 3 monitors at the end of the experiment. Columns 2 and 3 show the CO_2 readings given by the monitor for both 1000 ppm and 0 ppm carbon dioxide calibration gases.

Investigation of the data shows that atmospheric pressure differences between the beginning and the end of the experiment were the dominate error sources. For this model, carbon dioxide values are calculated with the assumption of constant pressure. They do not compensate for variations due to natural pressure variability. Since atmospheric pressure varies (typically by ±2%), some error is generated by the false assumption of constant pressure. In this experiment, the atmospheric pressure during calibration at the beginning of the experiment was 852 mb, while the pressure during calibration checks at the end of the experiment was 839 mb. Columns 3 and 4 show the predicted values that the

carbon dioxide sensors would observe in the hypothetical case that the sensors were pressure compensated. As shown, the accuracy of the sensor is much better with the pressure compensation.

	Sensor measurements		***With atmospheric pressure compensation***	
	Calibration gas concentration			
Sensor	1000 ppm	0 ppm	1000 ppm	0 ppm
#1	985	19	1000	19
#2	978	27	993	27
#3	970	11	985	12

Table 1. Comparison of 3 sensors with calibration gas standards after 1 month.

This data shows that the carbon dioxide sensors do not drift outside of the quoted accuracy range over a period of one month. Figure 1 shows the comparison of Sensors #1 and #2, and the comparison of Sensors #1 and #3. Figure 3 shows the total histogram of errors for each these cases. These figures together show that the repeatability of the sensors is within ± 20 ppm for the vast majority of cases.

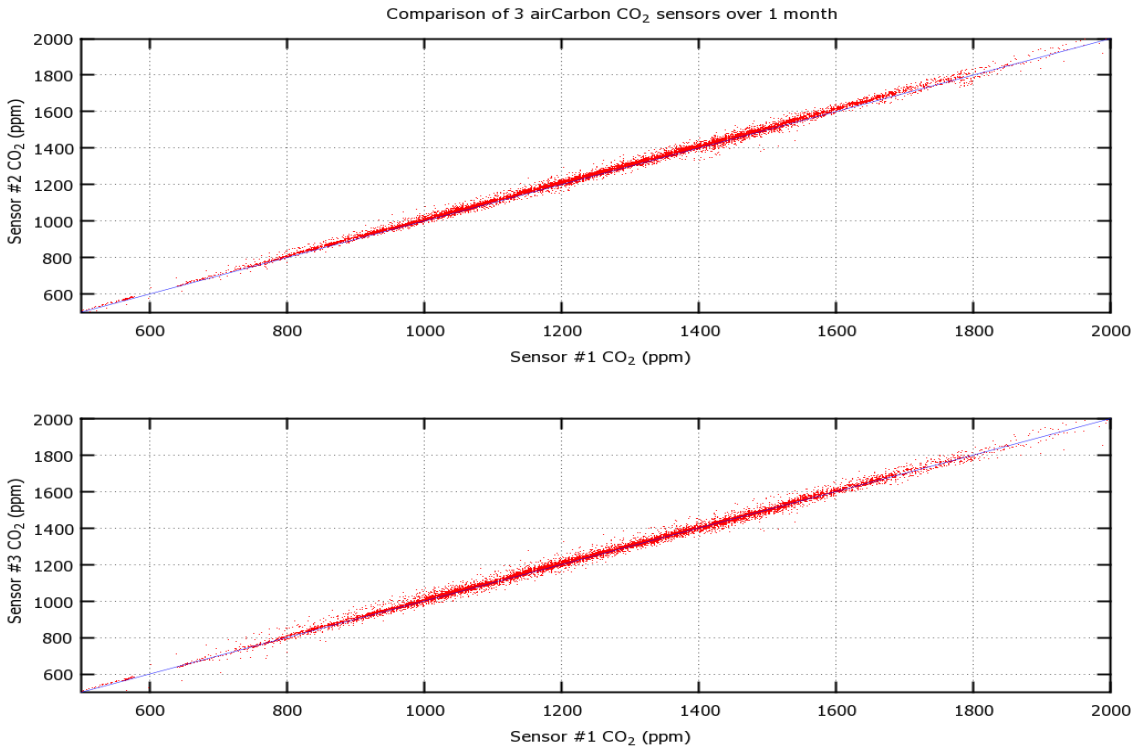

Figure 2. Comparisons of pairs of sensors observations during a 1 month period

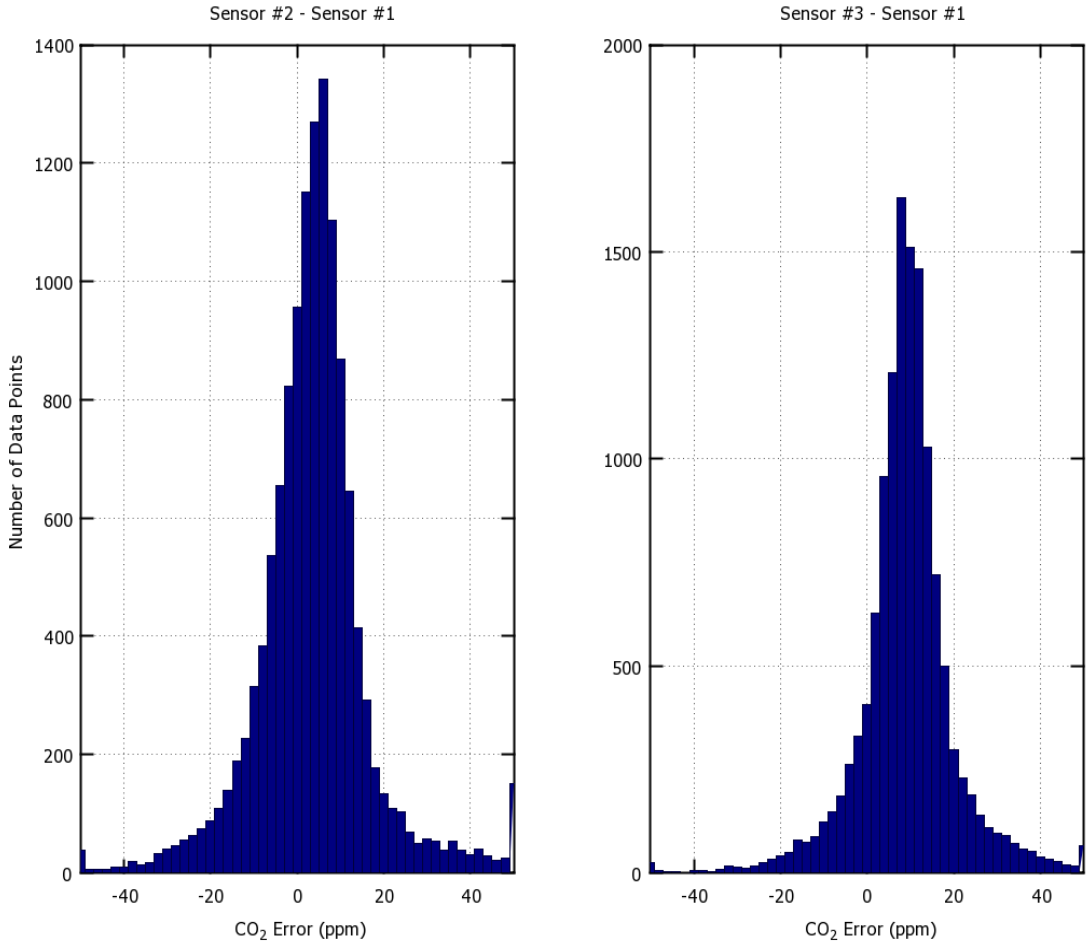

Figure 3. Histograms of error for pairs of sensors over period

For this example, the values reported are within the error limits specified in the sensor documentation (even including atmospheric pressure errors). Since this design is not pressure compensated, much of this error is directly related to nature atmospheric pressure fluctuations. The performance of the newly designed Indoor Carbon Dioxide Monitor (see below) will have significantly lower standard deviation than the results reported in Figure 3.

