Comparing Atmospheric CO_2 Measurements from Two Instruments at Baring Head, New Zealand

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Measurements of atmospheric carbon dioxide (CO_2) began at Baring Head (41.41° S, 174.87° E) in 1972. From 1986 to December 2016 these measurements were made with a non-dispersive infra-red analyser: the Siemens Ultramat 3. The CO_2 measurements are now made with a Picarro cavity ring down spectrometer. The Picarro ran in parallel with the Siemens from 2011. The Picarro has some advantages over the Siemens: it measures over a wider concentration range, uses less gas, is more stable, is more linear, and also measures CH_4 and H_2O. This paper compares CO_2 measurements made at Baring Head with the Siemens and the Picarro from 2014 to 2016. Eight CCL calibration gases are used in the measuring system as long-term transfer standards to provide a link to the WMO mole fraction scale. The offsets between the Picarro average measured value and the assigned value for each CCL tank lies in the range 0.02 to 0.07 ppm (Figure 1), which is close to the GAW compatibility goal of 0.05 ppm for southern hemisphere stations. The Siemens offsets for six of the CCL tanks (381 to 401 ppm) range from 0.02 to 0.07 ppm, but the values for the 372 ppm and 410 ppm tanks are well outside this range (Figure 1). During steady period events the air arriving at Baring Head has very low CO_2 variability, making these events ideal for comparing the final processed air values from each instrument. A steady interval occurs when the standard deviation of measured values from a single inlet line over a six-hour interval is 0.1 ppm or less. Overlapping "intervals" of steady data are then combined to form steady "periods". Between 2014 and 2016 the Siemens and the Picarro both measured a steady period at the same time on 82 occasions. For these steady periods, which vary in length from 6 hours to 3 days, the average difference between the two instruments is 0.045 ppm (Figure 2).

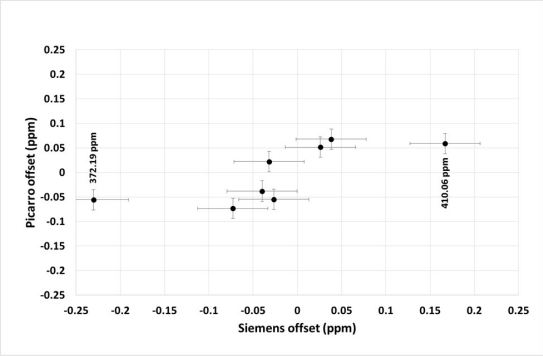

Figure 1. Differences between the average measured values for the CCL tanks and the CCL assigned value. The error bars are the standard deviation.

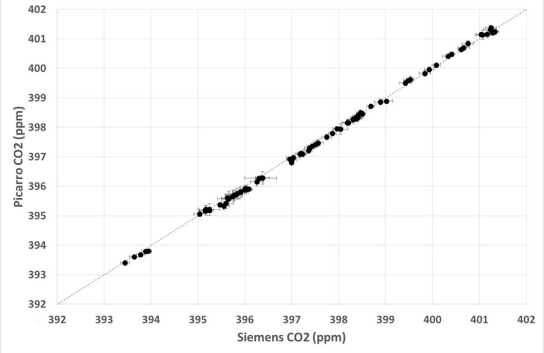

Figure 2. Siemens and Picarro measured CO_2 values for steady period air.