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Long-path atmospheric measurements using dual frequency comb measurements

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The dual frequency comb spectrometer is a new tool for performing atmospheric trace gas measurements. This instrument is capable of measuring carbon dioxide, methane, and water with extremely high resolution in the region between 1.5 and 2.1 microns in the near-IR. It combines the high resolution of a laboratory-based FTIR instrument with the portability of a long-path DOAS system. We operate this instrument at path lengths of a few kilometers, thus bridging the spatial resolution of in-situ point sensors and the tens of square kilometer footprints of satellites. This spatial resolution is ideal for measuring greenhouse gas emissions from cities.

Here we present initial long-path integrated column measurements of the greenhouse gases water, carbon dioxide, and methane in an urban environment. We present a time series with 5 minute time resolution over a 2 kilometer path in Boulder, Colorado at the urban-rural interface. We validate this data via a comparison with an in-situ greenhouse gas monitor co-located along the measurement path and show that we agree well on the baseline concentration but that we are significantly less sensitive to local point source emission that have high temporal variability, making this instrument ideal for measurements of average city-wide emissions. We additionally present progress towards measurements over an 11 kilometer path over downtown Boulder to measure the diurnal flux of greenhouse gases across the city.