Progress toward developing a novel mini tunable diode laser for measuring CO_2 fluxes in situ

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We introduce a novel mini tunable diode laser (TDL) that is being developed at Lawrence Livermore National Laboratory (LLNL). This sensor has the potential to measure a multitude of trace gases and their isotopologues by choosing a laser tuned to the appropriate wavelengths. Additionally, multiple sample cells could be deployed as an array for improved spatial sampling of fluxes and isotopologues using a single laser source. This decreases the cost and maintenance normally associated with increasing spatial sampling at a site. The sensor is compact and requires low amounts of power through the use of data acquisition units (DAQs) meaning it is ideal for remote in situ deployment or airborne sampling.

We present preliminary tests of the LLNL mini-TDL using a vertical cavity surface-emitting laser (VCSEL) tuned to a narrow spectral range targeting CO_2 absorption lines at 2012 nm. The sample cell is a multi-pass Fraunhofer White cell measuring 5cm x 4cm x 1cm with a total path length of 2.5m. The VCSEL was calibrated in the lab using a Bristol wavelength meter to match CO_2 absorption peaks against the HITRAN 2012 database. We characterize sensor performance in the lab at a range of [CO_2] from 0 ppm to 1000 ppm. Additionally, we show sensor stability under a range of temperature and humidity in an environmental chamber.

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