The optical frequency comb provided in the output of a femtosecond, mode-locked laser has been employed for many applications, including broadband spectroscopic measurements of trace gases using a variety of detection techniques. One environmentally significant trace gas is CO$_2$, which has characteristic absorption bands near 1.6 $\mu$m and 2.0 $\mu$m. Continuous wave (cw) lasers have typically been used to measure CO$_2$ at atmospheric-level concentrations. However, a broadband frequency comb source can provide rapid, simultaneous and accurate measurements of multiple transitions without the need for mechanical scanning or frequency tuning. Previously, precision broadband spectroscopy was performed on CO$_2$ bands near 1.6 $\mu$m. However, the CO$_2$ absorption bands near 2 $\mu$m have nearly a ten-fold increase in line strength compared to the bands near 1.6 $\mu$m, making the 2 $\mu$m bands attractive candidates for precision measurements of CO$_2$ with improved signal-to-noise and reduced uncertainty.

Here, broadband quantitative spectroscopy of CO$_2$ bands near 2 $\mu$m is pursued. The source that was developed consists of an Er:fiber oscillator, Er:doped fiber amplifier, and highly nonlinear optical fiber, which generates a broadband spectrum spanning from 1 to 2.2 $\mu$m with an average power of 270 mW. Over 70 mW of the optical power is contained in the 1.8-2.2 $\mu$m region relevant to the CO$_2$ measurement. After generation, the laser light is passed through laboratory gas cells or open air where the absorption features from the sample gas are imprinted onto the laser light. Initial detection efforts involve a virtually imaged phased array- (VIPA-) based spectrometer whose output is subsequently imaged on an InSb array detector. The bandwidth of the measured spectrum is 50 nm, limited by the size of the detector array. The characteristics of the spectrometer, including the detection limits and temporal resolution, will be presented. In addition, the progress towards the use of the present spectrometer and related frequency comb technology for quantitative measurement of CO$_2$ on a 2 km open-air path on the NIST-Boulder campus will be discussed.