

CO₂ MEASUREMENTS WITH DUAL-COMB SPECTROSCOPY AT MAUNA LOA OBSERVATORY

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Global measurements of greenhouse gas sources and sinks require accurate molecular absorption models. These absorption models are frequently developed using laboratory gas cells in known concentrated conditions, and applied to satellite measurements over different unknown non-uniform gas conditions. Dual-comb spectroscopy (DCS) can bridge these measurements by measuring the same absorption features in relatively known, uniform atmospheric conditions. To this end, we present open-path DCS measurements at the Mauna Loa Observatory in Hawaii, co-located with the long-standing calibrated point measurements of CO₂, CH₄, and meteorology at the Mauna Loa site. Nocturnal measurements at this alpine site are typically unaffected by local sources and sinks, providing the most controlled conditions for comparison of open-path measurements and molecular absorption models with reference-gas-calibrated point sensors.

We compare laboratory- and ab initio-derived CO₂ absorption models near 1600 nm in the 30012 and 30013 bands. Our fits using HITRAN2020 match the point sensors to 0.4%, although we also observe wavelength-dependence in the retrieved mole fraction.