

Dual-comb spectroscopy over 100km open-air path

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Satellite-based greenhouse gases (GHG) sensing technologies play a critical role in the study of global carbon emissions and climate change. However, none of the existing satellite-based GHG sensing technologies can achieve the measurement of broad bandwidth, high temporal-spatial resolution, and high sensitivity at the same time. Recently, dual-comb spectroscopy (DCS) has been proposed as a superior candidate technology for GHG sensing because it can measure broadband spectra with high temporal-spatial resolution and high sensitivity. Prior research has not been able to implement DCS over 20 km of open-air path. Here, by developing a bistatic setup using time-frequency dissemination and high-power optical frequency combs, we have implemented DCS over a 113 km turbulent horizontal open-air path. Our experiment successfully measured GHG with 7 nm spectral bandwidth and a 10 kHz frequency accuracy. Our results represent a significant step towards advancing the implementation of DCS as a satellite-based technology and improving technologies for GHG monitoring.