

## Applications of Cavity Ring-Down Spectroscopy to carbon, nitrogen and water cycling in soil

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Over the past five years, advances in cavity-enhanced absorption spectroscopy have fundamentally changed the way soil scientists study carbon, nitrogen and water cycling between the subsurface, plants and the atmosphere. With the continuous evolution of performance, including high precision, low drift and part-per-billion resolution, along with compact, field-deployable and easy-to-use instruments, scientists are increasingly able to leave their labs and make measurements directly in the field. Here we describe how Picarro's Cavity Ring-Down Spectroscopy technology has been applied to a number of soil applications, including (i) the determination of soil flux measurements by coupling newly developed real-time software with simultaneous measurements of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, NH<sub>3</sub> and H<sub>2</sub>O from closed-loop, recirculated soil chambers; (ii) partitioning water loss from evaporation versus transpiration in arid environments using in-situ measurements of ambient atmospheric water vapor measurements, soil water isotopes and the isotopic signature of local transpiration; and (iii) using in-situ measurements of d<sup>15</sup>N and the site preference of <sup>15</sup>N in N<sub>2</sub>O to constrain N<sub>2</sub>O emissions in agricultural settings.

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