

Paired gas measurements: A new biogeochemical tracer?

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Soil respiration is fundamental in terrestrial ecosystems, where plants and microbes dominate the production of carbon dioxide released to the atmosphere. The scientific understanding of the processes underpinning soil respiration remains incomplete, limiting our ability to accurately predict how the global carbon cycle will respond to the changing climate.

To gain more insight into the factors that contribute to [soil respiration](#), scientists have developed a paired gas measurements technique to calculate the ratio of carbon dioxide produced to oxygen consumed. In tree stems and soils, this ratio is called the apparent respiratory quotient (ARQ).

Although this ratio can be a useful biogeochemical tracer, scientists first need to better constrain the sources of its variability. Hilman et al. conducted a 15-month pilot study in a Mediterranean oak forest in Odem, Golan Heights. The team conducted seasonal measurements of bulk-soil respiration and the ARQs of tree stem and root tissues from both deciduous and evergreen species. They also took [air samples](#) from underlying soils.

The ARQ values in the stem and [soil samples](#) were much lower than the researchers expected to find for respiration occurring in carbohydrate substrates. The authors attribute this variability to non-photosynthetic carbon dioxide fixation in the stems and to microbial breakdown of stable soil compounds that require more oxygen.

The team also found that the forest's soil-air ARQ measurements were typically higher than the bulk-soil ARQs and lower than the root ARQs. The researchers argue that these differences demonstrate the potential for this technique to distinguish autotrophic sources of soil respiration (which can synthesize their own food) from heterotrophic sources.

These findings, published in the *Journal of Geophysical Research: Biogeosciences*, demonstrate the strong potential for paired gas measurements to unravel the processes that contribute to soil respiration. An increased understanding of the variability in ARQs should provide information that biogeochemists need to develop this technique and better predict crucial ecosystem processes.

More information: Boaz Hilman et al, The Apparent Respiratory Quotient of Soils and Tree Stems and the Processes That Control It, *Journal of Geophysical Research: Biogeosciences* (2022). [DOI: 10.1029/2021JG006676](https://doi.org/10.1029/2021JG006676)

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