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A large fraction of soil respiration is not exchanged with the atmosphere through the CO_2 effluxes

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Vertical soil CO_2 efflux from soil (F_{soil}) is often considered equal to soil CO_2 production (R_{soil}), and the two terms are used interchangeably. However, a considerable fraction of the CO_2 produced can be lost due to a host of different processes, including dissolution in water and soil chemical reactions. The ratio between CO_2 efflux / O_2 influx, known as the apparent respiratory quotient (ARQ), allows one to estimate these CO_2 losses from R_{soil}. Here we present the first study using continuous ARQ estimates to evaluate annual CO_2 losses of carbon produced from R_{soil}.

The field site is a semi-arid conifer forest located at 2573 m a.s.l. in the Santa Catalina Mountains, Tucson, Arizona. Three instrumented soil pedons were installed to measure O_2 and CO_2 molar fraction, temperature and humidity at 10, 30 and 60 cm depths. We found that 1/3 of R_{soil} was emitted directly to the atmosphere and 2/3 of R_{soil} was removed by non-biological processes. These losses could be mainly explained by chemical reactions involving carbonic acid, and to a lesser extent by simple CO_2 dissolution in water. Therefore, having better estimates of R_{soil} is key to understanding the true influence of aboveground production on R_{soil} and other connected processes within the critical zone.