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Deep CO_2 soil inhalation/exhalation in a carbonated semiarid steppe induced by atmospheric pressure fluctuations

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Knowledge of mechanisms and processes underlying in CO_2 emissions soil-atmosphere is essential to improve the understanding of the global carbon cycle. The main abiotic driver in the CO_2 exchange is soil ventilation. This advective transport through porous media has been correlated with quasi-static pressure (p) gradients and turbulent winds. Here we examine the variations in the subterranean CO_2 molar fraction (χ_c) over two years within a vertical profile (1.5 m), as influenced by changes in synoptic pressure in a semiarid ecosystem. We show why the increases-decreases registered in χ_c are not due to biological factors.

This study reveals that variations in the deep χ_c (1.5 m depth) are due predominantly to static pressure variations and not to wind or biological influences. Within a few hours, deep χ_c can be increased or decreased fivefold showing a pattern with two maxima-minima per day, due to pressure oscillations caused by atmospheric tides. By contrast, shallow χ_c (0.15 m depth) has only a one maximum-minimum per day influenced by biological factors as soil water content and soil temperature but also affected by winds. Future studies focused on determining the net ecosystem carbon balance should not rely exclusively on Fick's law to calculate soil CO_2 effluxes from profile data.