

Importance of short-term dynamics in carbon isotope ratios of ecosystem respiration ($\delta^{13}\text{C}_R$) in a Mediterranean oak woodland and linkage to environmental factors

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Summary

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- Temporal dynamics in carbon isotope ratios of ecosystem respiration ($\delta^{13}\text{C}_R$) were evaluated on hourly, daily and annual timescales in a Mediterranean woodland. Emphasis was given to the periods of transition from wet to dry season and vice versa, when the system turns from a net carbon sink to a source. The constancy of nocturnal $\delta^{13}\text{C}_R$ was tested.
- The relationship between $\delta^{13}\text{C}_R$ (determined through Keeling plots) and environmental factors was evaluated through time-lag analysis.
- $\delta^{13}\text{C}_R$ exhibited high annual variation (> 7‰). During the transition periods, $\delta^{13}\text{C}_R$ correlated significantly with factors influencing photosynthetic discrimination, soil respiration, and whole-canopy conductance. Time-lags differed between below- and above-ground variables, and between seasons. A shift in regression parameters with environmental factors indicated seasonal differences in ecosystem responsiveness (e.g. temperature acclimation). $\delta^{13}\text{C}_R$ exhibited substantial nocturnal enrichment (> 4‰) from dusk to dawn.
- These data indicate pronounced short-term dynamics in $\delta^{13}\text{C}_R$ at hourly to daily timescales and a modulated response to environmental drivers. Substantial short-term changes in nocturnal $\delta^{13}\text{C}_R$ may have important implications for the sampling protocols of nocturnal Keeling plots.

Key words: carbon isotope discrimination, carbon isotope ratio ($\delta^{13}\text{C}$), ecosystem respiration, Keeling plot, Mediterranean woodland, stable isotope, time-lag, vapour pressure deficit (VPD).

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