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Unmasking the effect of a precipitation pulse on the biological processes composing Net Ecosystem Carbon Exchange

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Drylands occupy 47.2% of the global terrestrial area and are key ecosystems that significantly determine the inter-annual variability of the global carbon balance. However, it is still necessary to delve into the functional behavior of arid and semiarid ecosystems due to the complexity of drivers and interactions between underpinning processes (whether biological or abiotic) that modulate net ecosystem CO_2 exchange (NEE). In this context, water inputs are crucial to biological organisms survival in arid ecosystems and frequently arrive via rain events that are commonly stochastic and unpredictable (i.e. precipitation pulses) and strongly control arid land ecosystem structure and function. The eddy covariance technique can be used to investigate the effect of precipitation pulses on NEE, but provide limited understanding of what exactly happens after a rain event. The chief reasons are that, firstly, we cannot measure separately autotrophic and heterotrophic components, and secondly, the partitioning techniques widely utilized to separate Gross Primary Production and Total Ecosystem Respiration, do not work properly in these water-limited ecosystems, resulting in biased estimations of plant and soil processes. Consequently, it is essential to combine eddy covariance measurements with other techniques to disentangle the different biological processes composing NEE that are activated by a precipitation pulse. Accordingly, the main objectives of this work were: (i) to quantify the contribution of precipitation pulse events to annual NEE using the eddy covariance technique in a semiarid steppe located in Almería (Spain), and (ii) to simulate a realistic precipitation pulse in order to understand its effect on the ecosystem, soil and plant CO_2 exchanges by using a transitory-state closed canopy chamber, soil respiration chambers and continuous monitoring CO_2 sensors inserted in the subsoil. Preliminary results showed, as expected, a delay between soil and plant responses after the rain event, since soil respiration immediately peaked, and CO_2 assimilation did not occur until the third day after the simulated precipitation event. Furthermore, for NEE there was a masking effect between offsetting processes of soil respiration and plant photosynthesis. In short, this study affirms the need to monitor other variables, apart from NEE, to precisely understand the link between ecosystem carbon balance, together with its components, and precipitation pulses in arid and semiarid regions.