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# Response of carbon fluxes to rain pulse in a typical steppified desert ecosystem

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Precipitation is a major driver of biological processes in arid ecosystems. Precipitation pulses play an important role in regulating ecosystem carbon exchange and balance of desert ecosystems, and identifying the role of precipitation-induced changes has been an ongoing challenge. To address this challenge we investigated carbon fluxes for almost two years in different rainfall events (by a manipulative experiment with 20% and 40% droughting and 20% and 40% water supplementation treatments) in a typical steppified desert. Our results showed that net ecosystem exchange (NEE), ecosystem respiration (RE), soil respiration and gross ecosystem productivity (GEP) responded rapidly (within 24 h) to rainfall events, and the responses of RS showed a trend of monotonic decline after rainfall event, while the NEE, RE and GEP varied in a similar way that greatly increased with the days and reached maximum values, thereafter, decreased gradually. The distinct responses of carbon fluxes to different pulse sizes led to a threshold in rain pulse size that larger than about 4 mm in NEE, RE and GEP, and about 2 mm in RS. The magnitude of carbon fluxes response to rain pulses, the times of peak value, and the duration were depended on rainfall size, however, the time of peak GEP was 1–3 days later than that of other carbon fluxes, and the duration is longer. Above which post wetting responses not only favored carbon sequestration in individual rainfall events, but also in seasonal rainfall fluctuations basing on two years observations. There were significant relationships between soil moisture and carbon fluxes, and distinctly different relationships between carbon fluxes and soil temperature under high vs. low soil moisture, which indicated that both soil moisture and soil temperature co-regulated the responses of carbon fluxes to rainfall pulse in desert ecosystem. The quantitative theory presented provides an approach for understanding desert ecosystem carbon balance and helps characterized the dependence of desert ecosystem metabolism on both temperature and water availability induced by precipitation.

*Keyword*: climate change, rain pulse, steppified desert, carbon fluxes, soil moisture, soil temperature.