B12A-05 - Linking carbon exchanges to watershed dynamics in a mixed shrubland of the Chihuahuan Desert

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Moscone West - 3007, L3

Abstract

Water availability plays a fundamental role in the ecosystem responses in the North American monsoon (NAM) region. Summer precipitation pulses trigger a variety of biophysical processes that impact land surface-atmosphere interactions and the net carbon balance in ecosystems. In this study, we analyze the event, seasonal and interannual variability of water-energy-carbon fluxes in a mixed shrubland of the Chihuahuan Desert and their relationship to precipitation and runoff pulses in a first-order, instrumented watershed on an arid piedmont slope. Long-term flux records from an eddy covariance system during the period 2010 to 2018 are analyzed in light of the vertical and horizontal water fluxes occurring during storm and interstorm events measured from a distributed network of soil moisture and runoff sensors. A wide variability in the flux behavior was found due the presence of different precipitation regimes, including individual storm intensity and duration and their temporal sequencing during the NAM. Overall, the mixed shrubland acted as a net carbon sink at the annual scale for all years (-25 to -380 g CO_2 m^{-2} y^{-1}), which had annual ET ranging between 150 and 300 mm y^{-1} and annual precipitation from 175 to 481 mm y^{-1}. On average, precipitation pulses initially promote the release of CO_2 and H_2O to the atmosphere, with a gradual decrease in these fluxes after the storm event. We found that large precipitation pulses in the summer growing season promote hillslope and channel runoff which decrease soil water availability in deeper soil layers and ultimately reduce plant water uptake and vertical carbon exchanges. In contrast, small precipitation pulses lead to a higher plant water use efficiency and limited hydrologic connectivity in the landscape. We identify a monthly rainfall threshold that predicts well the decoupling of carbon exchanges from excess water available for horizontal transport. These results shed new light on how horizontal and vertical water fluxes are related to carbon fluxes in arid and semiarid ecosystems.

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