BEGINNING TO INTEGRATE MEASURES OF SOIL RESPIRATION ACROSS SPATIAL AND TEMPORAL SCALES
ALONG A WOODY PLANT ENCROACHMENT GRADIENT USING TRADITIONAL AND INNOVATIVE TECHNIQUES

ABSTRACT: The phytodiversity shift in ecosystem structure from a grassland to a woodland may alter the sensitivity of CO$_2$ exchange of entire ecosystems to variations in growing-season temperatures and precipitation inputs.

Understanding ecosystem carbon flux dynamics and identifying whether landscapes are sources or sinks for atmospheric carbon is especially important in light of climatic and vegetative cover change. This source/sink status may change greatly as vegetation cover shifts from a grassland to a woodland.

Soil respiration (R$_{soil}$) has been greatest under the mesic component of ecosystem in the herbaceous community. This primary component of net carbon exchange in forests, R$_{soil}$, is a function of both biotic (vegetation cover type, litter quality, rooting depths) and abiotic (resource availability, climate, temperature) factors. The relative importance of each drivers has not been fully quantified. Such investigations are particularly of interest within the semi-arid southwestern region where the major environmental drivers (temperature and available moisture) vary and covary throughout a year and vegetation cover change is rapid.

We have been integrating multiple datasets and methodologies to build a spatially and temporally extensive estimation of soil respiration within a grassland and mesquite shrubland.

RESULTS: Soil temperature varied greatly throughout the year, peaking between DOY 190-280, when the mesquite began to bloom (Fig 1A). Daily temperature fluctuations were greatest under the grasses and in the open spaces as opposed to under mesquite. As expected, soil temperatures were greatest in the open spaces and greater under the grasses than the mesquite (Fig 1B).

RESULTS: Soil moisture increased in response to monsoonal and winter rain events, remaining highest between DOY 190-280 after the monsoon began (Fig 1C). Soil moisture was highest under the grasses and lowest in the open bare spaces (Fig 1D). The mesquite was the driest of all the ecosystems over the winter season (Fig 1E).

RESULTS: R$_{soil}$ varied significantly throughout the growing season. Rates peaked in the early monsoon, but remained high throughout the end of the monsoon (Fig 1F). Average R$_{soil}$ was greatest under the mesquite throughout the year (when R$_{soil}$ = 0). R$_{soil}$ was greatest under grasses than in the open areas. During the wet season, the grasses became the most productive (Fig 2A). Total soil CO$_2$ efflux under the mesquite was 1792±6 mm (under grasses = 1127±6 mm) and in open spaces = 853±6 mm.

RESULTS: The temperature dependence of R$_{soil}$ was greatest in the peak monsoon. The greatest the mesquite, there was little influence of temperature. A second pulse of R$_{soil}$ activity was detected during the wet winter, and temperature again became a driving factor of R$_{soil}$ rates.

CONCLUSIONS: R$_{soil}$ rates and the temperature dependence of R$_{soil}$ varied significantly throughout the year, suggesting a single modelling parameter would be insufficient for such a precipitation-pulse driven ecosystem. R$_{soil}$ rates were greatest under mesquite (59%) on an annual scale) than under grasses, suggesting that as vegetation cover transitions to more woody plants, R$_{soil}$ will become a larger component of the ecosystem carbon flux. This significantly greater efflux of carbon may cause these woodland systems to be net carbon sources on an annual scale.

* Developing a better understanding of when respiration rates are temperature sensitive and when they are not will help in predicting carbon status of these ecosystems as they experience predicted climatic change.