Quantifying autotrophic and heterotrophic sources of soil respiration in a California desert ecosystem

M.S. Carbone, S.E. Trumbore, G.C. Winston, C.I. Czimczik, E. Read
Department of Earth System Science, University of California, Irvine

INTRODUCTION

We studied desert soil respiration at the University of California's Burns Piñon Ridge Reserve as part of a cooperative, multi-institutional effort to study soil respiration and its sources across multiple ecosystems and seasonal climates. We sampled isotopic signatures of CO_2 emitted from the soil surface, CO_2 within the soil profile, CO_2 evolved in incubations of soil, and measurements of the amount of C isotope (^{13}C and ^{14}C) in soil organic matter and litter. Additionally, we made automated field measurements of soil respiration, and profiles of pore space CO_2, temperature and moisture. This combination of measurements will allow us to 1) determine C storage and residence time in these desert soils, 2) quantify total soil respiration and how it is partitioned into autotrophic and heterotrophic components, and 3) determine how these factors vary seasonally and with proximity to vegetation.

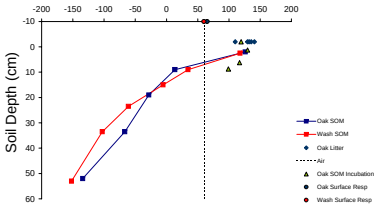
Study site at Burns Piñon Ridge Reserve

Automated CO_2 flux chamber

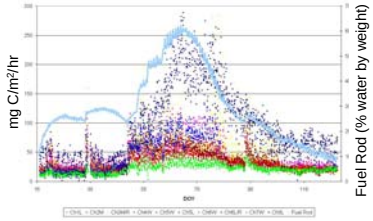
PRELIMINARY RESULTS

- Spring time soil surface respiration reflects atmospheric $\Delta^{14}C$ values, hence soil respiration is dominated by current photosynthetic products (root respiration). ~91% autotrophic, ~9% heterotrophic.
- CO_2 isotopic signatures from incubations of SOM, litter, and soil CO_2 collected beneath the oak tree show older carbon is being decomposed, but contributes little to surface flux.
- There is large seasonal and spatial variation in soil respiration with differences in vegetative cover between the soil beneath the oak tree and the wash.
- Soil and litter moisture and phenology exhibit strong and complex control on respiration fluxes.

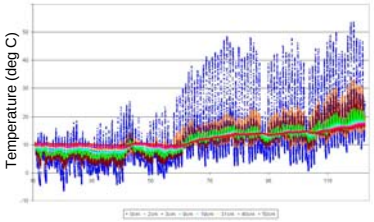
$\Delta^{14}C$ (per mil)



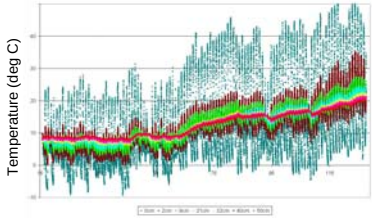
SOIL RESPIRATION



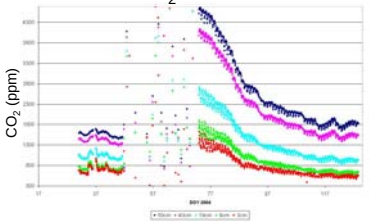
OAK SOIL TEMPERATURE



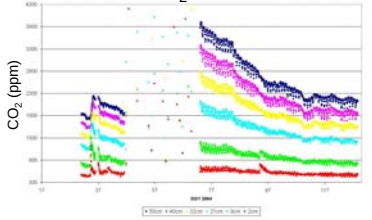
WASH SOIL TEMPERATURE



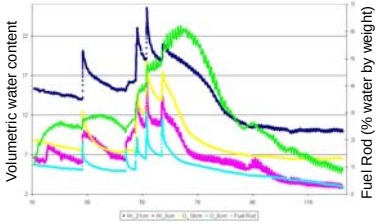
OAK SOIL CO_2 CONCENTRATION



WASH SOIL CO_2 CONCENTRATION



SOIL MOISTURE



ACKNOWLEDGEMENTS

We would like to thank Maddy Luttgen, Kelsey McDuffee, and Xiaomei Xu for their help in sample preparation and analyses; Brad Berger at the Burns Pinon Ridge Reserve; and the Kearney Foundation for graduate student funding.