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Quantification of the spatial variability of CO_2/H_2O fluxes in dryland ecosystems using low-cost EC systems

Fabio Boschetti (1), Andrew Cunliffe (1), Robert Clement (1), Stephen Sitch (1), Karen Anderson (2), Marcy Litvak (3), Richard Brazier (1), and Timothy Hill (1)

(1) University of Exeter, College of Life and Environmental Sciences, Geography, United Kingdom (f.boschetti@exeter.ac.uk), (2) University of Exeter, ESI, Penryn, Cornwall, United Kingdom, (3) University of New Mexico, Biology, Albuquerque, New Mexico, USA

Drylands cover approximately 30% of the global land area, and the extent of water-limited ecosystems is predicted to increase due to climate change. Although other ecosystems account for a higher percentage of the global mean net ecosystem exchange (NEE), modelling studies suggest that inter-annual variability in global NEE is dominated by semi-arid ecosystems. Dryland ecosystems are extremely sensitive to precipitation. Consequently, high spatial and temporal variability in CO_2 fluxes is common in these biomes, driven by precipitation distribution. This high spatiotemporal variability, coupled with an under-sampling of biogenic flux measurements in these biomes relative to more mesic ecosystems, contributes to greater uncertainty in knowledge of dryland carbon fluxes.
As part of a new project investigating how Dryland Regions control Interannual Variability In Global Carbon flux (DRIVING-C), we are quantifying the variability in carbon fluxes around two existing semiarid EC sites. These sites are US-SEG, a Bouteloua-dominated grassland and US-Ses, a Larrea tridentata shrubland, both of which have been running continuously since 2007. At each site, a cluster of four low-cost eddy covariance systems were deployed in October 2018 around the existing flux tower, one located ca. 7 m from the existing tower to replicate its measurements, while the remaining three low cost systems were placed ca. 80 m away at equal intervals around a circle. Each low-cost system is composed by a Gill sonic anemometer placed at 6m height, a Vaisala closed path gas analyser for CO_2 fluxes and a relative humidity sensor for H_2O fluxes. To our knowledge, this deployment of eight low-cost EC in the south west of US (New Mexico, Sevilleta National Wildlife Refuge) represents the first attempt at investigating biogenic fluxes in semi-arid ecosystems over this short length scales (ca. 100's of m).
This presentation will describe the low cost system, and share preliminary results from the first six months of intercomparisons between the ten EC systems. The low-cost towers are operating with satisfactory reliability, with all sensors returning reasonable and consistent values. Over the 3.5 year project, our comparisons with higher cost conventional towers will allow us to evaluate the ability of these low-cost systems to quantify spatial variability of biogenic fluxes and hence to validate the representativeness of conventional single towers at this observation scale. Should the low-cost EC demonstrate to be a reliable complement for the traditional system, this low cost technology could be deployed more widely to help address the issue of undersampling in dryland biomes.