Geophysical Research Abstracts
Vol. 21, EGU2019-8639-1, 2019
EGU General Assembly 2019

A global network to measure biomass in low-stature ecosystems: Drone photogrammetry for allometric inference

Andrew Cunliffe (1), Karen Anderson (2), Fabio Boschetti (1), Hugh Graham (1), Richard Brazier (1), Michael Cramer (9), Caroline Havrilla (8), Jason Karl (10), Cameron McIntire (5), Simon Power (9), Isla Myers-Smith (3), Katherine Sauer (4), Stephen Sitch (1), Julian Smit (9), Miguel Villarreal (7), and Fleur Visser (6)

(1) University of Exeter, Geography, Exeter, United Kingdom (a.cunliffe@exeter.ac.uk), (2) ESI, University of Exeter, Penryn, Cornwall, United Kingdom, (9) University of Cape Town, Cape Town, South Africa, (8) University of Colorado Boulder, Boulder, Colorado, USA, (10) University of Idaho, Department of Forest, Rangeland, and Fire Sciences, (5) University of New Mexico, Albuquerque, New Mexico, USA, (3) University of Edinburgh, Edinburgh, Scotland, United Kingdom, (4) Sul Ross State University, Alpine, Texas, USA, (7) U.S. Geological Survey, Western Geographic Science Center, California, USA, (6) University of Worcester, Worcester, Worcestershire, UK

Ecosystems dominated by low stature vegetation, including grasslands, shrublands and savannahs occupy ca. 35% of the terrestrial environment. There is growing appreciation of the important role these ecosystems play in the provision of globally important ecosystem services including the sequestration and storage of carbon, the provision of forage for livestock and wildlife, and ecosystems responses to disturbances such as fire. Understanding vegetation dynamics at landscape scales requires knowledge of changes in biomass through time and space. A range of approaches have been developed for measuring aboveground biomass, typically using allometry whereby plant dimensions are related to biomass via a limited number of observations from destructive harvests. However, ground-based allometric approaches are often very labour intensive, limiting the spatiotemporal resolution of observations. Consequently, these methods are prone to undersampling in spatially heterogeneous and/or temporally dynamic low stature ecosystems, such as grasslands and shrublands.

Recent technological advances have enabled the acquisition of new datasets at fine spatial and temporal grains, for example via aerial images collected using lightweight unmanned aerial vehicles and processed with structure-from-motion (SfM) photogrammetry. Several studies have demonstrated strong relationships between aboveground biomass and remotely sensed vegetation attributes (e.g. Cunliffe et al., 2016). The rise in low cost, do-it-yourself remote sensing has seen the development and adoption of workflows that can be appropriate for specific applications, but which yield datasets and findings that are difficult to compare, hindering cross-site syntheses and the development of transferable understanding about the ecosystem properties retrievable from remote sensing observations.

Here we present on a novel global experiment to investigate the transferability of drone-derived allometric relationships through space and time and taxa. Working with an ever-growing global network of drone-equipped scientists and land managers, we have led an experiment that exploits the broad availability of drone technology. Collaborating with diverse groups to collect new data, we have analysed these observations to measure vegetation structure linked with direct biomass observations from accompanying harvest plots. High standards of both quality and comparability are ensured through a standardised and comprehensive sampling protocol (Cunliffe and Anderson, 2019), followed by centralised processing and analysis. As of January 2019, 38 groups are planning data contributions, and eight teams have already collected 16 datasets, consisting of 303 observations (harvest plots) representing 18 different species and/or communities. Our preliminary findings indicating strong coefficients of determination between biomass and remotely sensed canopy attributes (R2 ranging from 0.64 to 0.95), and reveal new insights into the (dis)similarity of these allometric relationships between different taxa. We will share our aspirations of how this new and expanding global network can support further coordinated experiments to advance knowledge of plant trait relationships around our planet and fill the gaps between local and regional scale observations.

References:
Ahlström et al., (2015) Science, doi:10.1126/science.aaa1668. Poulter et al., (2014) Nature, doi:10.1038/nature13376. Cunliffe et al., (2016) Remote Sensing of Environment, doi:10.1016/j.rse.2016.05.019. Cunliffe and Anderson (2019) Protocol Exchange, doi:10.1038/protex.2018.134