LCLUC Abstract

Regional NPP and Carbon Stocks in Southwestern USA Rangelands: Land-Use Impacts on the Grassland-Woodland Balance

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Tree/grass ratios profoundly impact the biogeochemistry of grasslands and savannas by affecting: (i) decomposition of above- and belowground biomass, (ii) vertical distribution, mass, and size of roots in the soil , and (iii) microclimatic influences on soil microbial biomass and rates of organic matter turnover. Because dryland ecosystems comprise half the terrestrial surface, changes in tree/grass ratios likely influence global biogeochemical cycles and climate. Our existing LCLUC project, "Quantifying grassland-to-woodland transitions and the implication for carbon and nitrogen dynamics in the Southwest United States" investigates spatial and temporal changes in woody –herbaceous mixtures associated with contrasting land management practices. We have focused on quantifying how changes in tree/grass ratios affect storage of carbon (C) and nitrogen (N) across topoedaphically diverse landscapes. This proposal at once acts as a renewal to expand our LCLUC work to the greater Southwest, and to initiate new objectives addressing the Carbon Cycle Science Initiative. We propose to extrapolate our high-resolution, validated studies to assess land-use impacts on NPP and C-storage in rangeland ecosystems throughout the Southwest. We will integrate aircraft, Landsat, and MODIS data to retrieve, with increasing spatial coarseness, biogeophysical information relevant to biogeochemistry, vegetation dynamics, and land management. Sequenced validation of land cover fractions from plot-to-Landsat -to-MODIS scales using spectral mixture analysis will enable us to determine scaling properties of key biophysical variables (e.g. live vs. dead vegetation) from landscapes to regions in contrasting bioclimatic zones. These variables will constrain the ecosystem process model TerraFlux, and thereby estimate regional productivity and C-storage in vegetation and soil. $\delta^{13}C$ of soil organic carbon (SOC), , a biogeochemical tracer of woody-herbaceous inputs, will be obtained for our temperate savanna site and used to test model performance and, hence, the adequacy of the remote sensing inputs. $\delta^{13}C$ of SOC will also enable us to document long-term vegetation history, estimate SOC turnover, and the relative contribution of grasses vs. woody plants to ecosystem productivity and C-storage. This $\delta^{13}C$ database will be comparable to that completed at our subtropical savanna site; therefore, we will compare and contrast effects of woody plant encroachment on ecosystem C-storage in contrasting bioclimatic regions.

We will also develop a spatially explicit land-use history within our Texas study region to distinguish among land-use practices influencing tree/grass ratios (e.g., grazing, fire, brush clearing, cropland abandonment) Because human management plays a dominant role in this region, , we will test scenarios encompassing the range of impacts that might result from contrasting land-use policies. We cannot predict what state/federal policies might be enacted to affect range management practices. Nor can we predict what economic incentives pertaining to 'carbon credits' might arise. However, we can use our linked remote sensing-modeling approach to predict regional C budgets in response to potential policies or incentives that may emerge. Land-use scenarios that define different policy environments (e.g., government subsidies to support woody plant control, or carbon credit incentives that promote woody plant proliferation) will be developed and played out through a simple GIS approach. Consequent prescribed

changes in vegetation structure, when coupled Terraflux, will enable us to estimate the influence that policy changes might have on trajectories in C-sequestration and liberation at the scale of the Southwest region.