Impacts of land use change on carbon storage and emissions from semiarid grassland ecosystems of Central Mexico

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Grassland ecosystems are underrepresented in the flux measurement communities (*i.e.*, AmeriFlux, Fluxnet, Carbo-Europe, Fluxnet-Canada). Not only do these cover types occupy >25% of the continental land mass; they represent a critical end member of the precipitation and productivity gradient. We collectively do not know the extent biotic and abiotic factors that control their exchange of CO_2 and energy. They can act as carbon sources or sinks but it is uncertain if global environmental change forces these ecosystems outside their natural range of variation. Moreover, we do not know the combined effects of land use, grazing, and invasive species have on these exchange rates. Addressing these scientific questions are key to enhancing our knowledge of *how* climate change affects carbon and energy balance at broader spatial and temporal scales, and holds large importance for researchers and policymakers, alike. For example, Mexico is losing high rates of soil carbon from agricultural and grazing practices, whereas limited data suggest that US and Canada are near neutral in this respect (SOCCER report, 2007).

The arid and semiarid grassland ecosystems include grazing lands in Mexico, extends1300 km from the Southern USA to Central Mexico. Overall, they are the 5th largest land type spatially,~10^{-4} km^2, and important for biological diversity and in the ecosystem services they provide (*i.e.* soil and water quality, watersheds, etc.). Currently, overgrazing and land conversion is responsible for ~80% of these grasslands exhibiting some degree of deterioration, with lost plant cover/species and soil erosion are the predominant indices.

Our study is among 5 different, representative, managed semiarid grasslands in the subprovince Los Llanos de Ojuelos, and include *i*) a fallow grassland, *ii*) overgrazed and *iii*) un-grazed native grass pastureland (25 year old exclosure), *iv*) an invasive African lovegrass, and *v*) a historical pre-Columbian grassland. We will place an eddy covariance (EC) system to measure real-time exchanges of carbon and energy from the native grass semiarid pastureland (*i.e.*, Net Ecosystem Exchange , NEE), and apply a new, tested, novel approach to measure carbon and energy exchanges from the other ecosystem types (a measure of Net Ecosystem Productivity, NEP*). Questions include: 1) *what* are the spatiotemporal patterns of NEP and NEE of these ecosystems, and *what* are the biotic and abiotic factors that control these rates?, 2) To *what* degree do different land use types access water and other resources differently?, 3) To *what* degree do invasive species allocate carbon differently than naturally occurring grasslands? 4) Are these relationships among biotic and abiotic factors similar to those found in similar ecosystems, *i.e,* Santa Rita NM, Jornada-LTER, Sevillta-LTER, Wilton NM, and Valles Caldera NM? 5) Do differences in energy partitioning and evapotranspiration rates among grassland types translate to different abiotic feedbacks such as ground water depletion, cloud formation, precipitation and lighting strikes?, and 6) Can we improve

upon the current crude models for arid grassland NEE, which are often lumped in with other land surface schemes? and *how* may they change under future climate scenarios?

Our seed grant is from SEMARNAT (ref 23421), which will also include the first high-precision CO_2 lab in Mexico that can be used to make CO_2 standards for other carbon research studies. This study will be carried out at the ILTER site GRACILIS, one of the 10 proposed ILTER sites in Mexico. Expertise in- and calibrations of EC will be leveraged by the AmeriFlux QA/QC lab. Our grant also has provision for technological transfer and for graduate level education. We would encourage the opportunity to foster additional educational program development along the model of ESA-SEEDS.

We also were awarded a second grant for this project from CONACyT basic science 2006 program, but CONACyT internal policy leaves us out of receiving the support due to the appearance of funding similar projects from multiple sources. We acknowledge that this is an ambitious and costly project, new to the funding paradigms in Mexico. We would encourage any communication in our support that may foster any future CONACyT support.

Please let us know if there is anything lese we can to foster intergovernmental agreements for carbon research, and please keep us informed to the progress of Mexico-US-Canada NACP activities. Please consider the project as a model to move this type of research forward between our two countries, and as part of NACP