Measuring Differences in Carbon Storage in Pasture and Vineyard at Two Sites in Napa County

Status and Progress

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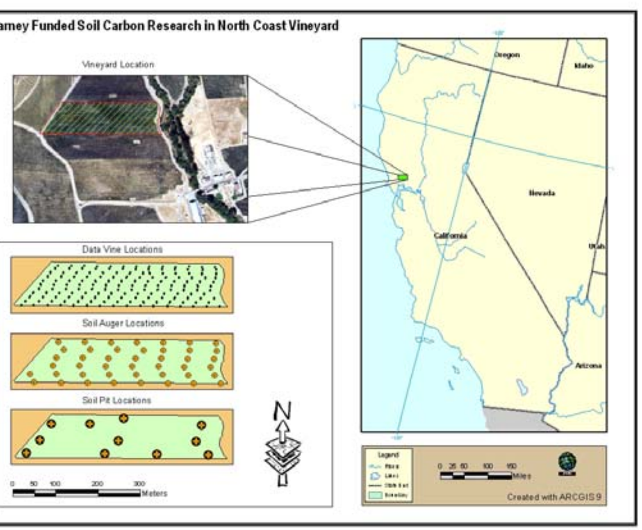
Introduction

Terrestrial ecosystems represent the largest pool of carbon in the biosphere. They are a dynamic part the carbon cycle that serve as both a sink and source through exchanges with the atmosphere. Terrestrial bon sequestration is a strategy identified by the U.S. Department of Energy (DOE) Office of Science as portant in the removal of CO_2 from the atmosphere (http://cdiac2.esd.ornl.gov/). This concerns the ential for the terrestrial biosphere to serve as a long-term carbon sink to offset the increases in atmospheric O_2 attributed to the use of fossil fuels to generate energy. The removal of CO_2 by vegetation and its bsequent storage in biomass and soil is an important process in the carbon cycle that can be used to manage ure carbon distribution.

The nature of how disturbance alters the C-cycle in North American ecosystems is poorly understood. is is particularly true for California where an extreme mosaic of land use patterns and kinds of conversion st (Salas and Los Huertos 2003). California hosts an agriculture industry that rivals nations in its oductivity. Since these are human manipulated systems, the potential for putting this attribute to use for ximizing the sequestration of carbon is high. One agricultural resource that has shown tremendous pansion onto non-agricultural lands in California is vineyard. California has seen conversion of forest, sture and other lands to vineyards in the last decade that has increased viticultural plantings by 20% ween 1994 and 2001 with 2003 acreage estimated at over 800,000 acres (USDA 2003). Grapevines are a ennial crop with annual buildup of woody biomass that can store carbon for decades. It is uncertain ether current vineyard management techniques can provide for maximizing the retention of soil organic bon (SOC) through deep rooting behavior (Smart et al. 2005) and cover cropping. In general, what this ange in land use means for the carbon budget is not clear and warrants comparison with pasture (or odland) land use.

Location

California's Mayacamas Mountains extend 20 miles north-northwest from the north end of San Pablo y along the Napa and Sonoma county border. The flanks of the mountains are a patchwork of state-owned kland, cattle ranches, agricultural land and residential areas. These foothill areas have been in use for cattle ching and agricultural activities for decades and in more recent times have been increasingly converted to eyard.



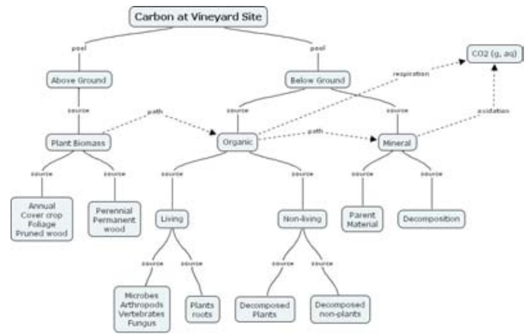


Figure 2: Carbon pools, sources and pathways at the North Coast vineyard site

Approach

Research is focused on building a framework for effectively comparing the carbon sequestration regimes between two land-use types, viticulture and pasture. This approach will then be used to parameterize a landscape model for estimation of carbon sequestration oriented around inputs from classified multi/hyper-spectral satellite image data and USGS DEM data.

Initial analysis will confirm the accuracy of existing data collected and processed during the last calendar year for a vineyard site. Data processing and organization will then commence on pasture sites. These data are to be collected during the spring and fall of 2005 with sampling technique and sample analysis to match that of the vineyard site.

Tripod LiDAR is being tested as a fast and accurate means to measure above ground live plant tissue with preliminary acquisition of data initiated on 3/9/05. Pending the results of this test, full-scale acquisition is scheduled for the Winter 2006 vine dormancy season. These data combined with data characterizing carbon content of vine woody tissue will be used to measure the above ground carbon reserves with a high degree of accuracy.

Comparison of ground and remote sensing data will be used to improve the relationship between biomass and remote sensing parameters. Imagery derived biomass will be compared and integrated with LiDAR estimates of woody biomass and both compared to assays of plant biomass collected at the two sites. These data will be combined with soil carbon data to yield carbon density maps for the vineyard and pasture sites for 3 distinct stages of the vine annual phenological cycle.

Figure 3: Two vines imaged using tripod LiDAR. A preliminary test to determine utility in computing permanent wood biomass for larger scale implementation. This data capture represents two 'view' angles (see shadows) and data points numbering in the thousands. Time required to capture these data was approximately 20 minutes.

Progress

Work during late 2004 and early 2005 has focused on building a geodatabase (GIS) as a comprehensive resource for all data collected for this project. It is anticipated that all analysis will take place in this framework to control error, manage statistical analyses with special attention paid to spatial parameters and to enable use of robust data processing techniques. Soil sample processing continues with DANR lab analysis of carbon and nitrogen anticipated by June of 2005. Planning of summer and fall data campaigns is underway. Preliminary analysis of soil pit data reveals soil carbon is depleted especially at depths to 30 cm (Figure 4). These findings will be better demonstrated pending soil pit carbon profiles.

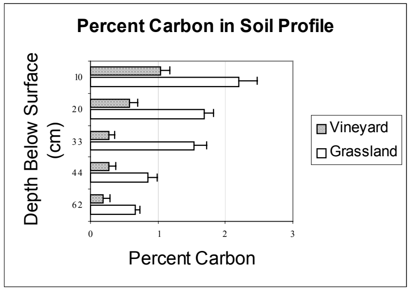


Figure 4: Percent soil carbon for two sites in California. The sites have similar topography and slope aspect, but are located in different areas of the state with different soil types (Keightley, Ustin and Smart unpublished data, and Gessler 2000)

Figure 5: Ongoing soil processing in lab facilities

References

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