RESEARCH STATEMENT

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As a researcher, I am focused on the analysis of environmental and economic tradeoffs associated with climate change mitigation strategies involving land and natural resource management. I am particularly interested in the development of computational algorithms and modeling approaches to both understand existing conditions and predict future impacts of climate change policy. I am excited by the possibilities and challenges associated with integration of increasingly dense data derived from remote platforms into analysis frameworks for decision making and scenario analysis. Broadly, I am interested in systems analysis that blends the fields of engineering, remote sensing, forestry and geography.

Background and Current Work

My research as a graduate student has resulted in a breadth of expertise with broad range of approaches to understanding the dynamic relation ship between the demand for energy and natural resources for economic growth and impacts on ecological systems. I have been fortunate to work with excellent mentors and fellow student researchers in close collaboration on a range of topics outlined below.

Remote sensing of disturbance and biophysical characteristics of forests

Decreasing cost and increasing fidelity of remotely sensed data from aerial and satellite platforms has challenged scientists to synthesize exponentially larger datasets into useful information.

In 2008 I received funding to acquire aerial LiDAR data and test methods of rapid forest resource assessment on the 2,700 acre van Eck forest in northern California. This analysis is the focus of my dissertation has shown promising results for comprehensive individual tree identification using minimal field data. I am interested in continuing the development of algorithms for identifying other forest ecological parameters such as canopy bulk density, bole volume, and crown base height using low level computational languages (`c++` and Python).

The potential to generate revenue from offsetting greenhouse gas emissions by protecting forests as sequestration tools influenced the van Eck Forest trust in 2001 to reduce timber harvest levels and market the increased carbon storage on their land. The trust conducted an extensive and costly field inventory to assess the impacts of the change in management. This inventory has been used for benchmarking the tree-detection algorithm developed as a part of my dissertation.

The 2008 Northern California Lightening Series of wildfires burned over 800,000 acres. Using Landsat TM data I conducted analysis of burn severity and economic impacts to timberlands in Mendocino and Sonoma counties. Normalized Burn Ratio (NBR) and similar approaches proved useful in detecting tree mortality. Fundamental band relationships in NBR are also relevant to detecting insect and disease mortality. These coastal mixed confier forests have a fire regime of long interval and high intensity blazes primarily due to predominant moist and humid weather. Changing climate may expose large carbon pools in temperate forests to more frequent periods of elevated wildfire risk.

Life-cycle analysis

California has taken on the challenge of significantly reducing greenhouse gas emissions from industrial sources pursuant to the 2006 Assembly Bill 32. A primary component of the strategy is reducing emissions from transportation. Advanced biofuels produced from forest residues may substantially reduce the carbon intensity of the transport sector. Accurate calculations of the aggregate benefits of forest-based biofuels must consider both direct impacts (stand growth changes and disease/wildfire risk) and indirect impacts (land use change; wood, energy, and fiber product market displacement). Further, impacts of forest residue use on ecological function and non-climate forest values must be addressed. I co-authored a framework article outlining a methodology for comprehensive life-cycle impacts analysis of forest based bioenergy in a compendium of peer reviewed articles organized by the Pinchot Institute entitled *"The Future of Wood Bioenergy in the United States: Defining Sustainability, Status, Trends and Outlooks for Regional Development* . I am a eager to continue to investigate the dynamic relationship between sequestration, displacement, and disturbance in the context of forest based bioenergy production.

Bioenergy production systems

Biofuels have received significant attention for their potential to reduce the carbon intensity of transportation. Feedstocks used in biofuel production significantly impact the relative climate benefit of biofuel in relation to fossil energy sources. I worked with a team of researchers at UC Davis, USDA Forest Products Laboratory, National Renewable Energy Laboratory, and others to develop spatially explicit economic models of bioenergy production. The modeling effort assessed the cost and availability of a wide range of biomass feedstocks including municipal solid waste, forest and agricultural residue, energy crops, waste grease and animal fats. The model considers harvesting, transport, conversion and distribution costs and included detailed intermodal network. The resulting system model was then optimized to predict the level of production and feedstock across a range of fuel prices. Results of this research suggest that while great potential exists to produce low carbon energy from biomass, the lack of a coherent policy framework addressing competition between electricity and fuels as well as mitigating undesired impacts including indirect land use change may present more significant barriers to the buildout of a bioenergy production system than the technical and economic aspects of the biofuel supply chain.

Skill set and curent status

I am presently in the final stages of completing my doctoral dissertation at the University of California, Davis in the Geography Graduate Group. My dissertation is titled *"Aerial LiDAR derived forest metrics as a basis for modeling climate impacts of forest growth, management, and products"* and I expect complete by January 1, 2011.

I have acquired a substantial set of geospatial analysis skills both as a Geographic Information Systems consultant and as a graduate student, including pixel based and object based feature extraction from aerial and satellite imagery products, extraction of individual tree metrics and topographic information from LiDAR data, spatial database management (PostGreSQL with PostGIS, SQLite, ESRI™geodatabases), geographic network analysis, 3D data visualization and analysis, and development of interactive map and data tools. I have also conducted field based forest inventory using fixed and variable plot methods as well as field surveys of fire risk.

I have compiled a growing code library of broadly useful functions, classes, and modules for spatial analysis, 3D visualization and spatial data management written in the Python and R programming language and built upon the rapidly growing base of scientific tools contained in the SciPy and NumPy and R code projects. I am passionate about the potential that the growing range of Free and Open Source Software (FOSS) tools have to expand directions of scientific research.

I have 10 years of professional experience as a consultant using a broad range of spatial tools to develop web and print information products for organizations such as the Sacramento River Watershed Program, California Coastal Commission, Sierra Club and others.

My academic and professional experiences have reinforced the value of clear communication, collegiality, and the benefit of cultivating an open and cooperative work environment.