Institute for the Development of Commercial Remote Sensing Technologies
University of Missouri-Columbia

Missouri AgriMart: Multi-scale modeling of soybean productivity in the Midwest
(*http://www.geog.missouri.edu/synergy/agri_mart/)*
Status Report
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Project Status:
There are a number of concurrent activities under way in ICREST's *Multi-scale modeling of soybean productivity in the Midwest* project. These tasks include 1) data processing, 2) model development, 3) business plan development, and 4) field trials.

Data Processing
All of the remotely sensed data (Landsat 5 & 7) from 1999 has been processed and is presently being analyzed. Tasseled Cap coefficients, NDVI, mSAVI, and other vegetation indices have been computed and integrated into the database containing the field data provided by J-Mar Agri Group for close to 20,000 acres of crop land in the Bootheel Region of Missouri. Data were obtained from Dr. Bill Wiebold and Kenneth Sudduth for several of the Belmont fields of J-Mar Agri Group. The data set includes soil electroconductivity, protein content and oil content obtained through NIR methods, and fatty acid profiles obtained through wet chemistry for 1999's soybean crop. The soil electroconductivity measures were collected in April 1999 and the protein, oil and fatty acid profiles were obtained from insitu measurements in late September 1999. The electroconductivity dataset consisted of around 7517 data points while the soybean protein data consisted of approximately 50 data points. All of the data points from both datasets have been complemented with tasseled cap (greenness, brightness, third components), normalized difference of vegetation, and modified soil adjusted vegetation index values throughout the 1999 growing season associated with them to aid in geostatistical analysis of the points. Other components, such as crop yield and soil type have also been integrated into this database. Our data analysis is primarily for soybean crops, but data sets include yield/productivity measures for other crops, including millet, wheat and corn.

We are presently preparing for field work in the fields concurrent with planned Landsat 7 overflights for the 2000 growing season. Additional soil electroconductivity, protein content and oil content obtained through NIR methods, and fatty acid profiles for the 2000 soybean crop are to be obtained, as well as additional GPS and field spectrometry data.

Model Development

Datasets created from the electroconductivity, protein, yield, soil, and vegetation index data are currently being statistically analyzed. Models are being created to establish how well various vegetation indicies collected throughout the season perform in predicting electroconductivity, soybean oil and protein content, soybean yield, and soil type. Thus far, linear stepwise regression techniques have been applied to the datasets to aide in determining which vegetation indicies from particular dates are the largest contributors to the model's predictive value. Also, electroconductivity and soil type are being investigated as to better understand how they may affect soybean yield and soybean oil and protein content levels. We are looking at data mining (knowledge discovery in databases, or KDD) methods for analyzing the immense amount of data.

Business Plan Development

Part of the Synergy concept is to examine the needs of the user community for the determination of whether an effective delivery system for satellite data & derived information can be developed. The first of these tasks is to understand the spatial distribution of key crops in the United States. Our goal is to develop the strategy, or business plan, for an InfoMART (which we call the Missouri AgriMart). The AgriMart would be an interface to EOSDIS where farmers or growers could subscribe, or register their 'parcel' of land, and, throughout the growing season they could receive information products derived from NASA EOS satellite imagery. The interface to the information would be web-based and the information available in a format that could be viewed on screen, or downloaded and imported into a variety of commercial-off-the-shelf (COTS) crop management software systems.

One of the first steps in the business plan development is to determine the economic feasibility of acquiring satellite imagery for regions of the country growing the following agricultural commodities: soybean, corn, wheat, millet, and sorghum. Data were extracted by county from the 1997 USDA NAAS Census of Agriculture and include bushels harvested, number of farms, and land under cultivation. Criteria are presently being set up to determine the minimum data needs to deliver the AgriMart Landsat 7 derived information products to farmers at monthly or bi-mothly intervals nationwide for each of these commodities. Cost structures are being determined for the number of scenes needed and likelihood of at least one cloud free scene per month over a given area.

Preliminary estimates are as follows:

Commodity	# of Scenes	# of Acquisitions	Cost per scene	Total Cost
Soybean	154	~12	$600	$1,108,800
Corn	194	~12	$600	$1,396,800
Sorghum	73	~12	$600	$525,600
Wheat	301	~12	$600	$2,167,200
Millet	26	~12	$600	$187,200

Preliminary estimates for imagery needed are on a crop-by-crop basis and do not include overlap between the crops (i.e., overlapping geographic ranges between corn & soybean) and potential resale value of the acquired imagery as a VAR (Landsat 7 is public domain data once 'purchased', among other issues.

Field Trials

A series of field trials were set up at the University of Missouri's agricultural experiment farm known as Bradford Farm. The field was planted with approximately six rows of soybeans in late

May. Each row contained six varieties of soybeans and rows alternated between Roundup Ready (a Genetically Modified Organism or GMO) and non-Roundup Ready varieties. The varieties were randomized over six rows. Field spectroscopy work begins the week of June 12. Field work includes the collection of spectral signature of the 12 varieties (6 Roundup Ready and 6 non-Roundup Ready) on a weekly basis. Leaf collection will alternate every two weeks, where samples will be collected and analyzed under full illumination in order to minimize effects of atmospheric absorption.

Issues:

A heads up: We will be inquiring every 16 days, or so, to get the most current Landsat 7 image of our Bootheel study area. As noted in previous emails and the proposal we will be acquiring approximately 8 images through this year's growing season.