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CIRIOS

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NASA Coastal Image Applications Project
Progress Report
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The project was begun on the initial receipt of information that in February 1994 NASA had flown a photographic mission over Elkhorn Slough, the target terrain for this project. Within a few days of the photo mission, the Principal Investigators, Gary D. Sharp (CIRIOS); Rikk Kvitek (Moss Landing Marine Labs); and Joe Betit (CSU Fresno), and Jonathan VanKoops of the California Coastal Commission's Geographic Information Services office, San Francisco, visited with Michael Fitzgerald, NASA Ames contact point, to review the photos, and select those to be further processed for the study.

It was well into June before it was announced that the digitized products were made available by NASA.

In preparation for receipt and handling of large digital data files from NASA, several initial steps were taken, at three different State institutions: California State University Fresno, Moss Landing Marine Laboratories, a California State University laboratory consortium that serves six State University campuses, and the California Resources Agency, California Coastal Commission (CCC) Office in Santa Cruz.

The CCC Santa Cruz office, the ultimate users of this project's products, had no modern image handling capable technology. An Apple Macintosh 840AV computer, a second 20" monitor, and basic software were purchased. An array of free image processing applications were installed to provide a standards image handling and display tool set at the California Coastal Commission. The CCC San Francisco office purchased a new 486 DOS GIS capable platform in an effort to update their capabilities from obsolescent WANG technologies from the early 1980s. Our project challenge was to devise means for moving digital data sets at NASA Ames Overflight Facility, out into State institutions, within the domains of commonly available contemporary platforms for GIS activities at the office and/or laboratory levels. This has met with mixed success.

To date, we have been unable to coordinate a means for moving efficiently the large (84 Megabyte) digital files onto usual GIS platforms, even within the UNIX environment. A TAR tape with the 84Mb file is in hand, but none of the user platforms can deal efficiently with such a large data file.

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The following is an institution by institution description of progress on this project:

Progress made to date by Moss Landing Marine Labs personnel.

A MapGraphix GIS program was purchased and a data base has been constructed for the Elkhorn Slough study area. This GIS data base is running on a Quadra 950 donated by Apple Computer Corporation for the duration of the project, and includes the following elements that have been produced or acquired specifically for this project.

1) DXF digital base map of the Elkhorn Slough USGS 7.5' quadrangle provided by the California State Lands Commission.

2) Nine ground control points established using differential GPS corrections transmitted by MBARI and received on MLML's mobile survey unit. These points have an error of 2 m and were surveyed in specifically for this project.

3) Three high precision DGPS points surveyed in by researchers from Fresno State University for this project. These points have an error of 2 cm.

4) DGPS survey of all major roads within the project area was completed in April for this project.

5) Habitat and vegetation classification polygons for the entire project study area were obtained from the Elkhorn Slough Foundation. Seventeen vegetation and land use types were identified from a mosaic of low altitude aerial photographs

Very high resolution (1:1200 scale) habitat polygons were verified by ground surveys during the course of this project. These polygons were digitized and entered into the GIS as part of this project.

6) All major roads within the project area were digitized from the 24"x24" print of the February NASA photo to determine the level of distortion inherent in the photograph. This process was done within the GIS program by comparing the digitized tracings from the photo with the road positions determined using DGPS. We found that within the Elkhorn Slough study area, there was no detectable distortion given the 2 m survey data precision.

7) Vegetation patterns were digitized and classified within transects delineated on the NASA photo for comparison with patterns determined from ground surveys and the low altitude photos.

8) DIMPLE image processing software was purchased for image rectification and vegetation classification based on digital spectral images. We have not been able to meet this objective because we have not yet received the spectral images from NASA for the February flight.

California State University Fresno staff accomplished the following for the project:

1) Preparatory to obtaining the spectral digital imagery:

Obtained an HP 1 Gig SCSI 2 DAT Tape for the Sun used until this summer.
Obtained a 1.7 Gig SCSI 2 external hard disc for the Sun.
Obtained 1 year licenses for the Sun versions of: Terramodel, a very powerful digital terrain modeling and survey CAD software. CORE Image Processing Software, a one year license of all the modules including programming.

2) Built Bibliography for Reference and Training:

We built a set of 3-ring binders containing a bibliography of all the remote sensing and image processing articles from the Journal of Remote Sensing and Photogrammetry from about 1989 (first entry of serious articles into high precision surveying/mapping domain) to 1994. Needs and types of problems that we would encounter on the equipment characteristic of survey mapping are of somewhat different nature than other types of imaging.

3) Training of two student workers:

Use of environmental level Trimble and Motorola GIS data collection units, differential correction (from 25 m to 2-3 meter), transfer of data to GIS software (ESRI Arc/Info and Arcad).

Training at local aerial mapping facility for workflow process from machine setup, data collection from color diapositives, transfer to Sun CAD data cleanup software over network and transfer to GIS.

Small project in Terramodel (digitizing through terrain model creation) to familiarize student workers with workflow in preparation of receipt of NASA data.

4) California State Plane Coordinate Map Base:

An extensive effort that resulted in the entry into a GIS database of the recorded land base maps for the Elkhorn Slough Preserve. This base map can be transferred to other geodetic coordinate systems and is accurate to under 0.5 of a foot. It is currently in Autocad Data Exchange Format (DXF) and Arcad format and can readily be transferred to both CAD and GIS systems with full double-precision geodetic coordinates.

5) High Precision GPS Network:

Geodetic quality Trimble Dual Channel GPS receivers were used to establish high quality geodetic coordinates at the NOAA Elkhorn Slough National Environmental Research Reserve.

A 2" brass disc stamped "CSUF Surveying Engineering" has been set adjacent to the visitors center in the main overlook at the beginning of the nature trail. The coordinates have been given to NOAA and California Fish and Game management for use in orienting their hand held GPS receivers for use in research and resource monitoring.

The GPS coordinates are full 3-dimensional coordinates and were transferred from three California High Precision Geodetic Network points (Pt. Sur, Davenport and Morgan Hill). The elevation component was also tied to the local segment of the National Geodetic Survey Primary Geodetic Level line and to the California Highway 1, California Division of Highways survey control lines.

The local elevation ties were done to provide a comparison between the local elevation (geoidal) and ellipsoidal information and the High Precison state wide network values. It allowed Rikk Kvitek, PI at MLML, to check tidal data between two tidal gauges (two miles apart). The geodetic coordinates placed on the NGS station near Kirby Park on the slough will be the basis for geodetic coordinates for current and future research work and monitoring along critical sections of the slough.

6) Data to the People:

A MOU has been arranged with the UCSC GIS lab as an Internet node to transfer data from NASA-AMES to a Sun workstation and then to PC workstation by network connections. This MOU provides a pathway from NASA Ames, through the GIS lab in the UC Santa Cruz Environmental Studies Board, to the california Coastal Commission, and the new California State University Monterey Bay, Information Resources and Technology Center, the proposed central location of the CSUNet nodes for Internet access and environmental data repository for the central coastal region.

DOS image processing software (MIRA) has been obtained and modifications made by the vendor that allow the translation of Band Sequential binary files to the NASA FITS standard, or to TIFF. The software also has user controlled sub-sampling to produce new images for use on machines of lesser capacity, or for use in building image browsing (metadata) libraries for researchers. MIRA also has the capability to provide sub-sampling viewing of very large data files for orientation and rapid preview of a data file and then switch to full resolution viewing and processing.

Image "chopping" tools have also been integrated within MIRA that allow cutting out subsections of interest from larger image files so that they will fit on common sizes of floppy discs for cross platform transfers and use by researchers. Output of the vector information in user defined local or geodetic coordinate systems is a simple two keystroke operation. This allows the seamless merger of spatially located imagery, vector output from the imagery and high-resolution land surveying information for research and legal environmental enforcement purposes.

The remaining challenge for this project is to develop a relatively rapid protocol for receiving digital spectral data sets, navigating them, and moving them from the digital "cutting board" to users. Once the files have been cut into useful, smaller sections, they become more amenable to Internet or modem-to-modem transfers. The NASA standard 84MB file is neither conveniently transferable via Internet, nor any other techniques within NASA somewhat aged technologies, into the contemporary desktop computing environment.

As most State Resource Management Agencies, and their regional offices remain underfunded, and inappropriately staffed to cope with mainframe or UNIX platforms, the utility of NASA data sets remains limited to only NASA contracted communities, or major University research centers, where UNIX platforms have been placed by vendors, for teaching purposes. Real World resource managers do not have these capabilities, and therefore are actually limited, therefore, by the internal services focus of NASA's data centers. This is not news.

During a visit to the Distributed Active Archive Center at the Jet Propulsion Laboratory (JPL) in Pasadena, in June, Dr. Sharp (CIRIOS) was informed (reminded) that the data sets available via the Center's technologies were not geolocated to adequate precision for use in more than representative display formats. The georectification problem plagues these data sets, and to date, NASA has deemed this a "User Problem Area".

This attitude is the basis of much of NASA's constituency issues. If better geolocated data sets were provided by NASA's Data Centers there would be far more user interest. The present state of the JPL imagery files is simply that they provide lots of "pretty pictures", with little direct application, other than as wall coverings, magazine covers, or gross maps for heuristic purposes.

Tools developed for use within NASA are becoming available, via the NASA software distribution center, but for all practical purposes, the necessary image subsampling software has been reinvented in every NASA lab, and no standard tools have yet evolved. The best software package that we were shown for subsampling and manipulating the NASA standard large spectral image files has yet to be moved into the software distribution pipeline, and, to date, remains sequestered within JPL.

Concluding Comments:

We are within a few weeks of finalizing our project, but remain puzzled in regard to the reluctance of NASA support staff and data distribution facilities to recognize that the NASA protocols need to include both careful navigation, and post digitization subsampling of these 84Mb files into 81 (9X9) images, so that they can be efficiently transfered to desktop computing technologies where most of the day-to-day resource management effort takes place.

A second, and at least as important consideration is that for most intents and purposes, an image that is more than five days from being collected to delivery in digital form to the users' desktops is nearly pointless as a management tool. The focus on retrospective data sets for research purposes needs to be re-examined at NASA, if it expects to develop constituents in the state or federal resource management agencies. Applied science is not exclusively real-time, but it is certainly not limited to a posteriori studies. However, without clear near-real time capabilities, and ready access, the funds expended to produce historical insights may not be justified by resource management agency requirements. Policy and management decisions are built around a short-term response requirement, and therefore ready access to status information is most important. Days to weeks after the fact until data access is not realistic.

Report Submitted by:

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