

REMOTE SENSING

FACULTY

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Keck Workshop on Remote Sensing

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Workshop Director: Raymond E. Arvidson, Washington University

Guest Lecturer: Gerald Webers, Macalester College

Introduction

The remote sensing workshop was limited to faculty participants because of the high level of interest and increased potential for application of these techniques on our campuses through faculty involvement. Resources permitted twelve participants, and all Keck schools were represented except for Amherst, Pomona and Wooster. Washington and Lee, Carleton, and Trinity each had two representatives. The course structure was developed by Ray Arvidson, with generous support from Guinness, Shephard, Sultan Izenberg, and Stein from Washington University. General logistics, including lodging, transportation, and meals were handled by Mary Dale-Bannister, and her efforts assured that the workshop ran smoothly. Laura Reiser (Keck participant from 1990) took time from her graduate studies at Washington University to join us for the banquet dinner Friday. To top of a very productive program, we enjoyed record-breaking warm temperatures for this time of year.

Program

Participants were housed at the Holiday Inn and shuttled to the remote sensing lab on the campus for a continental breakfast at 8:00 a.m. on Friday, Saturday, and Sunday morning. Ray began the workshop with an overview of remote sensing, including the concepts governing the measurement of radiance. He reviewed the role of wavelength and surface roughness, reflectance spectroscopy and directional emissivity. The workshop was then split into two groups for laboratory experiments, one using detectors set up to record intensity of signal at different wavelength bands using a Daedalus AA440 Spectrafax spectrometer and specimens from the Meatiq Dome in Egypt (Mohamed Sultan, Ed Guinness), and the other group to measure the influence of the angle of reflector to the detector (Mike Shephard). During the afternoon laboratory session, groups were reversed so everyone had the opportunity to work with both experimental setups. There was a break from laboratory measurements following lunch, during which time Ray Arvidson continued discussing aspects of the work we were doing on reflectance and emittance. Toward the end of this session there was a discussion summarizing material covered and providing direction for the lectures on Landsat and Magellan data. A banquet supper was held at the Whittemore House with the guest speaker Professor Larry Haskin providing a refreshing version of the need for space travel to "collect the moon's cheese" along with other possible benefits from lunar exploitation.

On Saturday, while coffee and donuts were in the process of being digested, Ray directed our attention to the setup of satellite antennas for radar transmission and factors governing the strength of the returning signal. This was then translated into possible roughness of surface based upon area of scatter. Comparison was made of the setup for Magellan and AIRSAR. The class again split into two work groups, one working with landsat data using computers to combine the spectral signals from different bandwidths in ratios that have petrological significance, and then displaying the lithologies using different colors on the screen. This brought relevance to the work done the day before on the reflectance of different minerals as a consequence of their composition and absorbance bands. Using as an example the Meatiq Dome of the Nubian desert region of Egypt, Mohamed Sultan and Ed Guinness had the group work with different combinations of spectral bands from Landsat to differentiate rock types and delineate structural features of the region. While one lab group was working with the Landsat images, the other under the direction of Noam Izenberg was using radar and emissivity data from Magellan to study Maat Mons and Sapas Mons volcanos on Venus. Discussion of significance of image brightness in terms of ages of volcanic flows and also possible compositional changes was followed by processing of elevation data into a three dimensional display using PV-Wave on a Sun workstation. Ray again turned to examples from the Red Sea and the Magellan mission to pull together the significance of earlier lectures on signal generation and detection, and how they can be applied to interpret ground conditions. Later in the afternoon Glenn Kroeger demonstrated how the Quadra 700 could be used to process Landsat images, and showed the potential of a prototype program he was developing to assign values to the spectral bands and combine them in different ratios. Glenn's program, "BandAid," makes it possible for those who do not have Sun workstations to develop remote sensing projects using the Macintosh computers.

Following supper Saturday night the free "night out on the town" was abandoned - there were too many questions left to be answered. We managed to commandeer a meeting area in the basement of the Holiday Inn, and discussed how we could implement remote sensing on our campuses. Glenn Kroeger again provided much of the insight, with numerous contributions from others. Discussion included some possible prototype setups, including hardware and software. Some of the more favored combinations were the Macintosh Quadra equipped with "lots of" memory, CD-ROM drive, 24 bit color, and software packages such as Adobe Photoshop, Spyglass Transforms, NIH Image, and Canvas or Adobe Illustrator. Sun workstations were also mentioned, with the Sun IPC being the entry level but offering only 8 bit color. To move to 24 bit color the cost becomes nearly that of the Sun IPX. As we moved toward 11:00 p.m. it was obvious that we were not going to resolve all of the issues, and discussion centered on closer cooperation through formation of a remote sensing group with possible funding to support compatible work environments on each of our campuses. Glenn volunteered to start a remote sensing newsletter to help us share results and ideas. The group did not break up until about 1:00 a.m., and if it weren't for an early session again on Sunday, it probably would have kept going much longer.

Sunday Ray covered trends in geological remote sensing, and spoke about changes in the space program. We discussed at greater length how we might continue with this working relationship that we have established. Mary Dale-Bannister provided us with the GRSFE set of CD-ROM discs covering experimental work done by Ray and his colleagues in the desert of California, and promised complete sets of Magellan for all those who wanted them. Jerry Webers then described how he set up a remote sensing capability at Macalester College, working closely with Ray Arvidson, and indicated how it was used in a student research project in Madagascar. This was followed by a presentation by Tom Stein on some image processing packages. The morning session ended with considerable enthusiasm, which extended into the lunch hour at the Holiday Inn restaurant. We all were very grateful for the hospitality of Washington University and the enormous effort put forth by Ray Arvidson, Mary Dale-Bannister, Ed Guinness, Noam Izenberg, and Mohamed Sultan in providing this opportunity. Our appreciation for the fine support provided by the staff and graduate students in the program was conveyed to Ray and the administration. We also appreciated Jerry Webers joining us from Macalester with his experience in setting up a work station and describing how it has been used in undergraduate research.

Post-Workshop Activities:

Since the workshop, efforts have continued to build on this background and apply aspects of the material learned in Keck projects and at our home institutions. Examples follow.

During the summer of 1992 the sophomore project on the Saint Jean estuary in the Gaspé employed computer analysis of images and combined the results of field collection of data with plots on scanned map images superposed on aerial photo coverage. We did not have satellite images, or we would have tried to use them as well. The availability of four sets of aerial photos from 1948 to 1976 allowed interpretation of changes in the estuarine environment through time. We had a Macintosh IIsi for processing images, and Glenn Kroeger brought his Quadra 700 to the Gaspé on his visit to the project. Glenn's visit also gave us a chance to explore some of the Meatiq Dome images using Adobe Photoshop with Glenn's BandAid program.

Walt Coppinger at Trinity applied mapping and structural/tectonic interpretations to landsat images in two courses; Field Methods - which is a lower division course (soph-level) required of all potential majors, and the upper division Structural Geology. Glenn Kroeger and Walt had a senior student working during the spring of '92 on software packages for image manipulation, using the "BandAid" software program created by Glenn which allows assigning values to the spectral bands before they are combined using a Macintosh environment. Spectral analysis information provided by Ray Arvidson was very important to the success of her efforts. The Magellan imagery has been used in demonstrations, and a local high school physics teacher worked with that data this past fall. Glenn Kroeger will be on academic leave Fall '93 at Washington University, and part of his leave will involve a continuing direct interaction with the remote sensing research team. Upon his return, he plans to initiate a course on computer applications in geology. In the next 2 to 3 years remote sensing work and GIS work will be added to the curriculum at some level. This project - including Glenn's successful proposal for academic leave - is a direct spinoff of experiences in the workshop.

Bill Fox at Williams College taught a one-month remote sensing course based on the workshop given by Ray. He used 4 Mac IIsi computers with 5 megs of ram, and 2 Mac Iici computers with 16 inch monitors, CD-ROM readers and 20 megs of ram, along with NIH Image®, Photoshop® and Canvas® in the course. A brief summary of the structure of the course follows, for more details, contact Bill Fox directly.

Week 1 - Aerial Photographs (Gaspe and the Oregon coast, using Image and Canvas®).

Week 2 - Colored aerial photos and Landsat images from Washington Univ. (Photoshop® with Oregon coast, using red component to penetrate water to see sand bars. Six Landsat images were provided by Mary Dale-Bannister from Wash.U., also images from Meatiq Dome in Egypt using bandaid 1.5 from Glenn Kroeger). Bill used a series of rock samples to match the rock units in the GSA paper on the dome.

Week 3 - Magellan Images using the CD-ROMs and Photoshop®. TMS thermal emission data from the Geologic Remote Sensing Field Experiment in California using GRSFE CD-ROMs .

Week 4 - Student projects and reports.

Bob Carson at Whitman reports one student tried using the Magellan imagery. At present the images on the CD-ROMs tax the capacity of the computers available.

Sam Kozak at Washington & Lee University has used some of the materials from the workshop, but not in classes. Formatting has been a problem in the use of the discs, and Glenn Kroeger is providing guidance to correct the problem.

Bob Newton at Smith College is developing a geomorphology lab exercise using materials supplied at the Keck Remote Sensing Workshop.

Mary Savina taught a course in Planetary Geomorphology using material from the Remote Sensing workshop, which drew considerable interest among the students and filled the seminar class. Teams of 2 students wrote papers about a single "Browse" image and its sub-images using Magellan. One student worked on a simple procedure to enhance the Magellan images using Adobe Photoshop® and methods to allow students to make a geologic map on top of the images using layers in Photoshop® or Canvas®. Mary claims the workshop was the best experience like that that she can remember having! Dave Bice had students using the Magellan images in independent studies and he and Mary had lab demos in introductory geology and tectonics. Dave and Mary gave a well-attended and well-received lecture on remote sensing last spring, based in part on their background from the course. Glenn Kroeger is supplying the Meatiq Dome material and a copy of BandAid®. A proposal was submitted to NSF for Quadras that would be used for image processing as well as dynamic modeling (STELLA). Ray Arvidson promised his support for their work and the workshop was mentioned in the proposal.

Dick Stenstrom at Beloit managed to secure special funds after the workshop to get a Quadra 900 and optical disc reader. Adobe Photoshop software was added to process images. Some experimentation has been going on with the Magellan images, and Kathryn Desmarais spent the remainder of her summer after the Bahamas Keck project research working with Ray Arvidson at Washington University on images from Egypt. Carl Mendelson has submitted a proposal to NSF for funds that would provide for class and laboratory capabilities using remote sensing and image analysis, and background supplied by Stenstrom from the course was used for some of the justification. Additional proposals for remote sensing and GIS and in the works.

Dorothy Merritts at Franklin and Marshall will use remote sensing in her sabbatical research in the South Pacific. She plans to develop at least one lab for geomorphology based on skills and information presented at the workshop.

From all accounts received, the workshop that Ray Arvidson and his dedicated colleagues at Washington University put together for us was an unquestionable success. The instruction is already producing a dividend, and we have only seen the beginning.