

Quarterly Eos Contract Report - Report #33

Period: July 1 - September 30, 1994

Remote Sensing Group (RSG), Optical Sciences Center at the
University of Arizona Principal Investigator: P. N. Slater

Contract Number: NAS5-31717

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Summary:

Work by members of the RSG during the past quarter consisted of Science Team support activities including presentations of papers by members of the group at IGARSS'94 and the Rome SPIE meeting, attendance at meetings related to MODIS and CERES calibration, work on the atmospheric correction ASTER data, and participation in a calibration round-robin. We continued improvements to our calibration facilities including receiving a 40-inch spherical integrating source, testing a new laboratory reflectance standard, and characterization of our Optronics monochromator. Field work activities were continued with a trip to White Sands in August, plans for a trip in October, and work on developing new and improving existing equipment for future work.

Task Progress:

On July 1, S. Biggar and P. Slater met in Tucson with Ed Knight, representing MCST, who had visited SBRC earlier in the week with Harry Montgomery (MCST). The meeting was held to discuss the latest developments on the MODIS project at SBRC, in particular the problem of stray light introduced by the scanning mirror. During the Payload Panel meeting at Landover, Maryland, Slater met with Bruce Guenther, Peter Abel, and Harry Montgomery to discuss the next step in the response to criticisms made by the MODIS Calibration Peer Review Panel. It was decided to hold a meeting on September 22 and 23 at Goddard Space Flight Center to review the progress that MCST has made in the past five months in this regard.

At the end of July, Slater sent a message to eight of the key payload panel members emphasizing the loss to EOS that would occur if the US ASTER Science Team was disbanded. (This was proposed, in addition to approximately 18 other possibilities, to meet the \$750M cut in the EOS budget.) The following extract summarizes the message: "Is NASA prepared to sacrifice the US ASTER Science Team to save \$5M per annum, while paying for the space and cost of accommodating ASTER on the AM-1 platform, to get OPS-quality data and science results in return?"

Slater edited, revised and reformatted the Ono et al. paper titled "Preflight and in-flight calibration plan for ASTER" which is to be published in the Journal of Atmospheric and Oceanic Technology. There are five Japanese and four US ASTER team members who have

contributed to the paper. Slater, Biggar, Thome, Gellman and Spyak wrote a paper titled "In-flight radiometric calibration of ASTER by reference to well characterized scenes" for the EOS/SPIE meeting in Rome. On September 21- 23 Slater met with Bruce Guenther and other members of MCST to discuss stray light, the agenda for the MODIS Science Team Meeting in October, and replies to the RFAs generated during the MODIS Cal Peer Review chaired by Skip Reber. Slater attended the EOS/SPIE meeting in Rome, for which he was honorary chairman, and presented the paper on in-flight ASTER calibration mentioned above.

P. Spyak attended the International Symposium on Spectral Sensing Research in San Diego, July 8-15. Biggar and K. Thome attended IGARSS'94 August 8-12 in Pasadena, Calif. Biggar co-chaired a session on sensor calibration and performance verification and presented a paper entitled "Solar-radiation-based absolute calibration of optical sensors: SeaWiFS and Daedalus 1268." Thome co-chaired a session on atmospheric correction of satellite data over land and presented two papers entitled "Proposed atmospheric correction for the solar reflective bands of the ASTER" and "Absolute radiometric calibration of Landsat-5 TM and the proposed calibration of the ASTER." Also while in Pasadena, Biggar and ASTER team member F. Sakuma of NRLM performed cross-calibration measurements on the MISR and AVIRIS spherical integrating sources, the AVIRIS lamp and panel, and filters at JPL. Thome met with R. Alley, B. Eng, A. Murray, M. Pniel, and C. Voge to discuss issues related to the atmospheric correction of ASTER. On August 16 and 17, Thome attended a workshop on Techniques for Radiometric Cross-Calibration of Visible and IR Remote Sensing Instruments held at the Eros Data Center near Sioux Falls, South Dakota. Spyak sent optical components scatter data to Jerry Godden at Goddard and performed a first-cut MODIS diffraction analysis. Spyak also served as a panel member for the CERES calibration peer review September 27 - 28.

Using the Optronic monochromator, Biggar attempted several times to measure the filter transmittance of the interference filters in preparation for the MISR and AVIRIS cross calibration at JPL in early August. Spyak and Biggar obtained a new controller board for the monochromator chopper and installed it. They also continued their characterization of the monochromator and prepared and sent a letter to Optronic detailing the numerous difficulties we have had with the system. Spyak ordered a diffuse reflectance attachment and software for the monochromator, and upgraded the current software. The filter wheel for the system failed again in September while J. Lamarr was attempting to make measurements for characterizing the system. The unit was returned to the manufacturer for repair. Measurements made by Lamarr before the unit malfunctioned indicate significant differences in results from measurements made on different days.

Biggar modified the VNIR transfer radiometer code to control the 6" Spectralon sphere and to use the new HP3458A voltmeter for radiometer output. He measured the radiometer's FOV and out of

band response two different ways - using a collimator and the recently received 40-inch spherical integrating source. He found the size of source effect should be less than 1% and the response is down 4 orders of magnitude at about 4 degrees off axis. Biggar modified the radiometer's software to monitor temperature and shutdown the heater if the temperature exceeds a critical value. He developed software needed to use the new transfer voltmeter as the A/D. He spent the week of September 26-30 at SDSU for SIRREX 3 making measurements of several spherical integrating sources including the CHORS sphere overnight. Measurements were also made on two of our calibrated lamps the week before. The new HP3458A was used to check shunts and other voltmeters. Spyak continued his review of the SWIR radiometer design, and began design of the TIR field radiometer. Nelson is approximately 25% complete on drawings related to improving/redoing the electronics and mechanical pieces for the visible transfer radiometer.

Spyak ordered a laminar flow clean bench, an electrically calibrated pyroelectric radiometer, and a barometer to replace our field version which is to go into the calibration laboratory. Biggar ordered a kinematic FEL lamp socket and alignment jig and Spyak ordered equipment for cleaning optics in the calibration laboratory. Biggar modified our blacklab software to enable it to use active lamp control and to allow for more viewing geometries. Biggar and Spyak ordered a lock-in amplifier to upgrade the amplifier currently being used.

Spyak and C. Lansard compared Halon and Algoflon reflectance standards for our blacklab calibration work and found Algoflon to be a good replacement for Halon since it is slightly more lambertian, has no specular component, and its reflectance is spectrally flat over the 450- 1040-nm wavelength region. Hemispherical reflectance measurements still must be made and these measurements will most likely be done by NIST and RSG. Spyak is currently trying to get information from NIST so we can remake our holders to accommodate NIST's facility. Spyak ordered a calibrated weight set for calibrating the scale used in creating the Halon/Algoflon reflectance standards. Lansard investigated the repeatability of our measurements in the blacklab. Spyak ordered a shutter to automate our blacklab dark measurements, a chopper for use with the lock-in amplifier, and purchased additional accessories for Algoflon panel making. Biggar ordered a filter wheel motor/translator for the facility, V. Sinclair began looking for an optical breadboard with 1-inch hole grid to mount on the blacklab table to simplify mounting to the table, and E. Nelson and Sinclair began designing new baffle plates for the blacklab wall.

Thome and R. Parada travelled to Lake Tahoe, July 6-9 to look for possible locations for SeaWiFS field work. Biggar met with the Optical Sciences Center mechanical engineering personnel so they could begin the aircraft mount for the Lake Tahoe experiment. Thome completed the ASTER test site survey and returned it to A. Morrison of JPL and also completed revising the data dictionary

for the atmospheric correction of ASTER and sent it to B. Eng of JPL. Thome sent an email message to F. Palluconi of JPL regarding the DEM requirements for the atmospheric correction of ASTER in the solar reflective range. Thome also began making plans for a trip to White Sands to perform a calibration of Landsat-5 and a possible cross-calibration attempt with SPOT-3. The Cimel solar radiometer arrived from GSFC and Thome and C. Deschappelles began learning its operation. Thome continued work on the atmospheric correction of ASTER and began evaluating imagery data for use as test data to be sent with the prototype look-up table to JPL. He selected a Landsat scene from Maricopa Agricultural Center as the test data set which will accompany the prototype look-up table. Work on the prototype look-up table included specifying the parameters which will be used to generate it and preliminary work on the format of the table.

M. Brownlee ordered the interference filters for the BRDF meter and anticipates delivery by October 14. She specified the carrying cases for the BRDF meter equipment and is in the process of obtaining the cases. She is testing the gasket seal of the liquid chiller to see if it is possible to transport the chiller with liquid. Brownlee is designing a new mount for the camera to include a tip-tilt table and rotation stage. The tip-tilt table will be used to level the system and the rotation stage will offer azimuthal rotation.

K. Scott and Spyak prepared for the group's August trip to White Sands for SPOT-3 calibration. Biggar, C. Grotbeck, E. Nelson, Scott, Sinclair, Slater, and Spyak travelled to White Sands August 16-19 to test data retrieval methods in addition to performing SPOT-3 calibration work. The group was also accompanied by T. Mitchell from the USDA and several French visitors representing CNES. Because of range closures and weather, no useful data were collected, but the group was able to test the new video camera and yoke design. E. Nelson investigated SMPTE code generators, character generators, and frame grabbers for the video system. Nelson began breadboarding the sample and hold, Biggar ordered a Sun frame grabber, and Nelson completed designs for the new MMR yoke which should be ready for the October WSMR trip. Biggar met with the trailer vendor representative to ensure we get what we need from Wells Cargo. Nelson received the information necessary to get the hitch for the trailer on the truck installed. Biggar also found a problem with the Fluke Helios scanner board and ordered a replacement.

Three new students joined the, PhD candidates Christine Gustafson and John Lamarr, and Master's candidate Curt Laumann. All three spent considerable time familiarizing themselves with the computer system and the group's calibration facilities. Gustafson and Lamarr constructed apertures for the 40-inch SIS and assisted Biggar in his transfer radiometer measurements of the sphere. Lamarr instructed Gustafson on the operation of the Optronics monochromator and Lansard showed Gustafson and Lamar how to press reflectance samples. Laumann familiarized himself with the

operations of the recently completed aureole camera and will develop improvements to make it more user friendly. Thome was informed that he had been promoted to Assistant Professor and that he would teach a course entitled "Fundamentals of Remote Sensing."

Anticipated Actions:

Biggar and Slater will attend the MODIS Science team meeting October 12-14 and the MODIS Calibration Working Group meeting October 11. Slater will submit an expanded version of the Rome SPIE paper to the Journal of Atmospheric and Oceanic Technology and begin work on a position paper describing the role of vicarious calibration for present and future EOS optical sensors. Slater and Thome will attend the Joint ASTER Science Team Meeting in Kagoshima, Japan, November 14-17. Slater will also attend the ASTER Cal Plan Review the week prior to the Joint Science Team Meeting.

Biggar will complete processing of data collected during the SIRREX 3 experiment and will begin work on the design of the transfer radiometer for the NIR and SWIR. Spyak intends to continue developing the calibration laboratory, improving the field-work capabilities, and evaluating SWIR and TIR radiometer designs. Thome will develop a first attempt at the prototype lookup table for the ASTER atmospheric correction and deliver it to JPL. Brownlee plans to measure the spectral response of the filters and have the filters mounted in the fisheye lens and determine a flat-fielding calibration methodology using our 40-inch SIS. Also, as mentioned above, the group is planning a trip to White Sands October 8-9 to collect data for a Landsat-5 calibration and also for a possible cross-calibration between Landsat and SPOT.