

Quarterly EOS Contract Report - Report #63

Period: January 1 - March 31, 1997

Remote Sensing Group (RSG), Optical Sciences Center at the University of
Arizona

Principal Investigator: P. Slater

Contract Number: NAS5-31717

Report compiled by: K. Thome

Summary:

Two major tasks occupied the group's efforts during this quarter. The first was measuring the bidirectional reflectance properties of four samples provided by NIST. S. Biggar and P. Spyak made these measurements in both the VNIR and SWIR. The second major task was the group's move to a new facility in March. In addition, K. Scott continued work on the cross-calibration software package by developing a graphical interface to 6S, an uncertainty analysis code, and an image registration module. M. Sicard used a trip to Cimel in France to change the Cimel TIR radiometer's field of view and then characterized this new field of view. Z. Rouf and M. Zaheedul began processing radiance-based data from last summer's Lunar Lake campaign. The group also made several field campaigns for satellite calibration.

Task Progress:

E. Nelson and P. Spyak designed upgrades for the blacklab's shutter and chopper. S. Biggar, C. Burkhart, and Spyak made blacklab upgrades to measure four round-robin, reflectance samples from NIST. Biggar converted older blacklab programs to run with the lockin amplifier used with the SWIR CCR and to allow the same type of data collection with this radiometer as is used for the VNIR radiometers. Biggar also eliminated some stray light sources in the blacklab. Biggar, Burkhart, and Spyak designed a 2-inch-diameter mask (made of stainless steel and painted with Krylon Ultraflat Black) used to mask the 4 NIST samples and our reference standard to ensure we measure the same area of each sample. Burkhart machined this mask as well as new mounts for the NIST, round-robin samples. He also improved the mount for the VNIR radiometer used in the blacklab and began machining leveling pads for the blacklab table. Biggar tested the improvements by measuring an Alfoflon sample with and without the mask. Biggar and Spyak measured the NIST samples with the modified set up in both the VNIR and SWIR.

K. Scott continued development of the cross-calibration software that is

being written in IDL. She completed a module that provides a graphical user interface for the 6S radiative transfer program. Scott integrated site reflectance data of Lunar Lake, White Sands Missile Range, and Ivanpah Playa into this module. In addition, Scott began work on the error analysis part of the program. This included running many iterations of 6S to determine the sensitivity to the different inputs used in 6S. The cross-calibration software will contain a module where the most important inputs will be randomly perturbed using given uncertainties to determine the overall uncertainty of a calibration. Scott began work to develop software to register images from different sensors. The current approach uses a combination of an edge detection method and a standard correlation method. The edge detection step emphasizes edges in the two images and these are then correlated. The second step calculates a final correlation using the original images where the position of maximum correlation found in the first step defines a starting point. This reduces the time needed to correlate the two images. Both translation and rotation errors will be considered in the final program. Currently Scott is exploring the use of FFTs to speed up the correlations.

M. Sicard spent a week at Cimel in Paris. While there, he changed the fieldstop diaphragm of the Cimel TIR radiometer. A rough FOV measurement was done in the laboratory and showed a FOV of 6.8 degrees that is slightly off-center and asymmetric. Sicard tested the effect of ambient temperature changes on the Cimel radiometer by measuring the signal from water at 0, 26 and 54 degrees C with ambient temperatures of 10, 26 and 55 degrees C.

B. Crowther and Biggar reduced the diffuse-to-global data from the December White Sands trip for use in Crowther's dissertation. J. LaMarr received a new absolute shaft encoder for the RSG's autotracking solar radiometer, to replace the damaged one. Nelson and Spyak designed new panel stands and carrying cases for the two Spectralon panels that were recently received. Burkhart began machining the parts for these stands and he also completed the mechanical work on the diffuse-to-global meter. He also constructed counterweights for the panels to balance the load on the blacklab stages. Spyak calibrated the directional reflectance of our four field reflectance panels and evacuated the dewar of the Optronic monochromator, as well as the dewar of the SWIR CCR.

Z. Rouf and M. Zaheedul began processing the radiance-based data from Lunar Lake. They registered the video data to the radiometer data from the aircraft as well as determined the averaged radiometer readings for all flight lines from the June 2 and 3 dates. They determined the calibration coefficients for the radiometer used in the data collections by determining the band-averaged irradiance on a calibrated panel using

data for a NIST-traceable standard lamp. Then this irradiance was converted to radiance using panel BRDF measurements made in our blacklab. These radiances were compared to the voltage outputs of the Exotech radiometer while it looked at the panel to give the radiometer's calibration. Applying this calibration, the site, spectral radiance was determined.

Biggar and E. Zalewski traveled to central Nevada from March 8-14 to examine the Lunar Lake and Railroad Valley test sites. They were accompanied by G. Fedosejevs, R. Gauthier, and P. Teillet of the Canada Centre for Remote Sensing. Lamarr, P. McIntosh, P. Nandy, R. Parada, Spyak, Thome, and Zalewski traveled to White Sands for calibrations of SPOTs-1 and -2 HRV as well as for Landsat-5 TM. The group was also accompanied by C. Cattral and R. Stewart of K. Carder's group of the University of South Florida. Cattral, Parada, and Stewart also traveled to the Steward Observatory on Mt. Lemmon for comparisons of solar radiometer data.

The group moved to a new facility in March. Biggar and R. Kingston spent portions of January and February configuring our local computer network to reduce the time during which our network would be down during the move. All members of the group spent the latter portion of February and early part of March preparing for the move. The process of unpacking was begun the latter portion of March. Biggar, Burkhart, and Spyak made plans for further blacklab modifications to be done while the equipment was disassembled for the move and these modifications were begun.

K. Thome attended the JORNEX96 meeting in Las Cruces on January 13-15 where he described ASTER's plans for validation and how the Jornada Experimental Test Range could be used. While at the meeting, Thome also met with J. Privette, W. van Leeuwen, and F. Raman of MODIS and J. Conel of MISR to discuss the possibility of an EOS AM-1 validation campaign at Jornada in May. Thome and Zalewski met with B. Eng, A. Kahle, A. Murray, M. Pniel, and A. Schwarz at JPL on March 20 to discuss modifications to the ASTER atmospheric correction in the VNIR and SWIR.

Parada successfully defended his PhD dissertation titled "In-flight absolute calibration of radiometric sensors over dark targets using vicarious methods." Crowther also successfully defended his PhD dissertation titled "The design, construction, and calibration of a spectral diffuse/global irradiance meter." Spyak completed a draft of a paper on comparisons between MODTRAN and laboratory measurements of atmospheric absorption bands and sent the paper to G. Anderson of the Phillips Laboratory for review. Spyak had his paper on alignment of beam expanders, pinholes, and crosshairs to laser beams accepted for publication in Applied Optics. Sicard submitted a paper titled

"Shortwave infrared spectroradiometer for atmospheric transmittance measurements" to the Journal of Atmospheric and Oceanic Technology. Sicard and Spyak submitted an abstract for the SPIE '97 annual meeting in San Diego. Sicard and Spyak completed a draft of an article titled "Characterization of an internally calibrated thermal-infrared field radiometer and comparisons with other field instruments".

P. Slater worked on an invited paper titled "Review of methods for optical-sensor calibration" for the 7th International Symposium on Physical Measurements and Signatures in Remote Sensing in Courchevel, France. M. Dinguirard, the senior author, who works under contract for CNES in Toulouse, will present the paper. Later the paper will be presented to Remote Sensing of Environment for publication in a special issue on calibration edited by Slater. Sicard prepared a poster presentation on the characterization of the Cimel TIR radiometer that will also be presented for Courchevel meeting.

Future work:

Spyak will continue setting up our calibration laboratory after the move to our new facility. He and Sicard will complete the paper on the characterization of the Cimel TIR radiometer and Spyak will attend the CORM97 meeting where he will make a presentation on the SWIR CCR. Biggar and Spyak will submit a paper with B. Schmid titled "Evaluation of the applicability of solar and lamp radiometric calibrations of a precision Sun photometer operating between 300 and 1025 nm." Biggar and Spyak will test our blacklab setup in the group's new location by measuring the field reference-panels. The two will also calibrate the VNIR and SWIR CCRs and the CCRs will be used for the MODIS SIS calibration.