

PROCEEDINGS OF SPIE

Earth Observing Systems XIII

James J. Butler

Jack Xiong

Editors

11–13 August 2008

San Diego, California, USA

Volume 7081

Proceedings of SPIE, 0277-786X, v. 7081

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:

Author(s), "Title of Paper," in *Earth Observing Systems XIII*, edited by James J. Butler, Jack Xiong, Proceedings of SPIE Vol. 7081 (SPIE, Bellingham, WA, 2008) Article CID Number.

ISSN 0277-786X

ISBN 9780819473011

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445

SPIE.org

Copyright © 2008, Society of Photo-Optical Instrumentation Engineers

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/08/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

The logo for SPIE Digital Library features the word "SPIE" in a bold, sans-serif font above the words "Digital Library" in a similar font. To the right of the text is a stylized graphic consisting of three vertical bars of increasing height, resembling a bar chart or a signal waveform.

SPIDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc.

The CID number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

ix *Conference Committee*

PLENARY SESSION

- 7081 02 **Measurement science for climate remote sensing** [7081-53]
G. T. Fraser, S. W. Brown, R. U. Datla, B. C. Johnson, K. R. Lykke, J. P. Rice, National Institute of Standards and Technology (United States)

PRELAUNCH CALIBRATION

- 7081 03 **Vacuum compatible large uniform-radiance source for ground calibration of satellite cameras inside a thermal vacuum environment** [7081-01]
A. V. Arecchi, SphereOptics LLC (United States); S. Pal, Indian Space Research Organization (India); J. W. Jablonski, M. Gervais, M. Gugliotta, SphereOptics LLC (United States); H. Seth, A. Bhardwaj, H. S. Sahoo, Indian Space Research Organization (India)
- 7081 04 **Design and validation of a transfer radiometer** [7081-02]
N. Anderson, K. Thome, S. Biggar, J. S. Czaplak-Myers, College of Optical Sciences, Univ. of Arizona (United States)
- 7081 06 **Pre-launch performance characterization of EOS-C camera** [7081-04]
Y.-W. Choi, S. Kang, J. Yun, J. Kim, M. Kang, S. Jeong, H. Kim, J. Song, E.-E. Kim, Satrec Initiative (South Korea)
- 7081 07 **BRDF study of gray-scale Spectralon** [7081-05]
G. T. Georgiev, Science Systems and Applications, Inc. (United States); J. J. Butler, NASA Goddard Space Flight Ctr. (United States)
- 7081 08 **Pre-launch optical tests of MODIS and MISR** [7081-06]
E. Waluschka, NASA Goddard Space Flight Ctr. (United States); C. J. Bruegge, Jet Propulsion Lab. (United States); X. Xiong, NASA Goddard Space Flight Ctr. (United States)

MODIS I

- 7081 09 **MODIS along-scan direction Line Spread Function (LSF) modeling and verification using the Integration and Alignment Collimator (IAC)** [7081-07]
N. Che, T. Choi, Science Systems and Applications, Inc. (United States); X. Xiong, NASA Goddard Space Flight Ctr. (United States); D. Moyer, Aerospace Corp. (United States)
- 7081 0A **On-orbit aqua MODIS modulation transfer function trending in along-scan from the Spectro-Radiometric Calibration Assembly** [7081-08]
T. Choi, N. Che, Science Systems and Applications, Inc. (United States); X. Xiong, NASA Goddard Space Flight Ctr. (United States)

- 7081 OB **Assessment of MODIS scan mirror reflectance changes on-orbit** [7081-09]
X. Xiong, NASA Goddard Space Flight Ctr. (United States); A. Wu, A. Angal, Science Systems and Applications, Inc. (United States)

MODIS II

- 7081 OC **Characterization of MODIS VIS/NIR spectral band detector-to-detector differences** [7081-10]
X. Xiong, NASA Goddard Space Flight Ctr. (United States); J. Sun, Science Systems and Applications, Inc. (United States); G. Meister, Futuretech Corp. (United States); E. Kwiatkowska, SAIC, NASA Goddard Space Flight Ctr. (United States); W. L. Barnes, Univ. of Maryland, Baltimore County (United States)
- 7081 OD **Sun beta angle residuals in solar diffuser measurements of the MODIS ocean bands** [7081-11]
G. Meister, Futuretech Corp., NASA Goddard Space Flight Ctr. (United States); J. Sun, Science Systems and Applications, Inc. (United States); R. E. Eplee, Jr., F. S. Patt, SAIC, NASA Goddard Space Flight Ctr. (United States); X. Xiong, C. R. McClain, NASA Goddard Space Flight Ctr. (United States)
- 7081 OE **Long term MODIS spatial characterization using ground target approach** [7081-12]
Y. Xie, George Mason Univ. (United States); X. Xiong, NASA Goddard Space Flight Ctr. (United States); J. J. Qu, George Mason Univ. (United States) and NASA Goddard Space Flight Ctr. (United States); N. Che, Science Systems and Applications, Inc. (United States)
- 7081 OF **Determination of the noise characterization of MODIS thermal emissive bands for cold scene observations** [7081-13]
A. Wu, Science Systems and Applications, Inc. (United States); X. Xiong, NASA Goddard Space Flight Ctr. (United States)

VICARIOUS CALIBRATION AND VALIDATION

- 7081 OG **Using raw star signals in the monitoring of GOES imager visible-channel responsivities** [7081-14]
I-L. Chang, American Univ. (United States) and Perot Systems Corp. (United States); C. Dean, Perot Systems Corp. (United States); M. Weinreb, Riverside Technology, Inc. (United States); X. Wu, NOAA/NESDIS/ORA (United States); D. Han, K. Mitchell, ASRC Aerospace Corp. (United States); Z. Li, SGT, Inc. (United States); G. Sindic-Rancic, IMMSG (United States); F. Yu, ERT, Inc. (United States)
- 7081 OH **Removal of contaminated pixels from the desert target for AVHRR vicarious calibration** [7081-15]
F. Yu, ERT, Inc. (United States); X. Wu, NOAA/NESDIS/STAR (United States)
- 7081 OI **Temporal, spectral, and spatial study of the automated vicarious calibration test site at Railroad Valley, Nevada** [7081-16]
J. S. Czapla-Myers, K. J. Thome, B. R. Cocilovo, J. T. McCorkel, J. H. Buchanan, College of Optical Sciences, Univ. of Arizona (United States)

- 7081 OJ **Validation of the IASI temperature and water vapor profile retrievals by correlative radiosondes** [7081-17]
N. Pougatchev, Utah State Univ. (United States); T. August, X. Calbet, T. Hultberg, O. Oduleye, P. Schlüssel, EUMETSAT (Germany); B. Stiller, MOL-RAO (Germany); K. St. Germain, E/IP Integrated Program Office (United States); G. Bingham, Utah State Univ. (United States)
- 7081 OK **New differential Fabry-Perot radiometer for remote sensing measurements of column CO₂, O₂, H₂O and other atmospheric trace gases** [7081-18]
W. S. Heaps, NASA Goddard Space Flight Ctr. (United States); E. Georgieva, Goddard Earth Sciences and Technology Ctr. (United States); E. Wilson, NASA Goddard Space Flight Ctr. (United States)
- 7081 OL **Level 1C spectra from the Atmospheric Infrared Sounder (AIRS)** [7081-19]
D. A. Elliott, H. H. Aumann, Y. Jiang, S. E. Broberg, Jet Propulsion Lab. (United States)

CLARREO

- 7081 ON **On-orbit accuracy of infrared spectra for climate model testing** [7081-26]
J. A. Dykema, P. J. Gero, S. S. Leroy, Harvard Univ. (United States); H. E. Revercomb, Univ. of Wisconsin, Madison (United States); D. Kirk-Davidoff, Univ. of Maryland, College Park (United States); J. G. Anderson, Harvard Univ. (United States)
- 7081 OO **On-orbit absolute calibration of temperature with application to the CLARREO mission** [7081-27]
F. A. Best, D. P. Adler, S. D. Ellington, D. J. Thielman, H. E. Revercomb, Univ. of Wisconsin, Madison (United States)
- 7081 OQ **On-orbit characterization of blackbody emissivity and spectrometer instrument line-shape using quantum cascade laser based reflectometry** [7081-29]
P. J. Gero, J. A. Dykema, J. G. Anderson, S. S. Leroy, Harvard Univ. (United States)

NEW MISSIONS AND TECHNOLOGIES

- 7081 OS **ESA future Earth observation Explorer missions** [7081-20]
J.-L. Bézy, P. Bensi, M. Berger, B. Carnicero, M. Davidson, M. Drinkwater, Y. Durand, F. Hélière, P. Ingmann, J. Langen, C. C. Lin, R. Meynard, H. Rebhan, P. Silvestrin, A. Thompson, ESA-ESTEC (Netherlands)
- 7081 OT **WindCam and MSPI: two cloud and aerosol instrument concepts derived from Terra/MISR heritage** [7081-21]
D. J. Diner, M. Mischna, Jet Propulsion Lab. (United States); R. A. Chipman, Univ. of Arizona College of Optical Sciences (United States); A. Davis, Jet Propulsion Lab. (United States); B. Cairns, NASA Goddard Institute for Space Studies (United States); R. Davies, The Univ. of Auckland (New Zealand); R. A. Kahn, NASA Goddard Space Flight Ctr. (United States); J.-P. Muller, Univ. College London (United Kingdom); O. Torres, Hampton Univ. (United States)

- 7081 0U **Space instrument performance traceability for high resolution satellite systems** [7081-22]
A. Eckardt, A. Börner, H. Jahn, DLR (Germany); R. Reulke, Humboldt-Univ. zu Berlin (Germany)
- 7081 0V **Observational considerations for moderate resolution nighttime lights** [7081-23]
C. Elvidge, NOAA National Geophysical Data Ctr. (United States); D. Pettit, NASA Johnson Space Ctr. (United States); M. Imhoff, NASA Goddard Space Flight Ctr. (United States); R. Nemani, NASA Ames Research Ctr. (United States); D. Pack, The Aerospace Corp. (United States); P. Cinzano, Light Pollution Science and Technology Institute (Italy)

CROSS CALIBRATION AND INTERCOMPARISONS

- 7081 0X **Radiometric calibration stability and inter-calibration of solar-band instruments in orbit using the moon** [7081-31]
T. C. Stone, U.S. Geological Survey (United States)
- 7081 0Y **MODIS and SeaWiFS on-orbit lunar calibration** [7081-32]
J. Sun, Science Systems and Applications, Inc. (United States); R. E. Eplee, Jr., Science Applications International Corp. (United States); X. Xiong, NASA Goddard Space Flight Ctr. (United States); T. Stone, U.S. Geological Survey (United States); G. Meister, Futuretech Corp. (United States); C. R. McClain, NASA Goddard Space Flight Ctr. (United States)
- 7081 10 **Radiometric cross-calibration of the Terra MODIS and Landsat 7 ETM+ using an invariant desert site** [7081-34]
T. Choi, A. Angal, Science Systems and Applications, Inc. (United States); G. Chander, SGT, Inc. (United States); X. Xiong, NASA Goddard Space Flight Ctr. (United States)

ON-ORBIT CALIBRATION

- 7081 12 **The on-orbit calibration of SeaWiFS: functional fits to the lunar time series** [7081-37]
R. E. Eplee, Jr., Science Applications International Corp. (United States); G. Meister, Futuretech Corp. (United States); F. S. Patt, Science Applications International Corp. (United States); C. R. McClain, NASA Goddard Space Flight Ctr. (United States)
- 7081 13 **Monitoring MODIS calibration stability of visible and near-IR bands from observed top-of-atmosphere BRDF-normalized reflectances over Libyan Desert and Antarctic surfaces** [7081-38]
A. Wu, Science Systems and Applications, Inc. (United States); X. Xiong, NASA Goddard Space Flight Ctr. (United States); C. Cao, NOAA/NESDIS (United States); A. Angal, Science Systems and Applications, Inc. (United States)
- 7081 14 **L5 TM radiometric recalibration procedure using the internal calibration trends from the NLAPS trending database** [7081-39]
G. Chander, M. O. Haque, SGT, Inc. (United States); E. Micijevic, NCDC Imaging (United States); J. A. Barsi, SSAI, NASA Goddard Space Flight Ctr. (United States)

- 7081 15 **Development of Landsat-5 thematic mapper internal calibrator gain and offset table** [7081-40]
J. A. Barsi, Science Systems and Applications, Inc., NASA Goddard Space Flight Ctr. (United States); G. Chander, SGT, Inc. (United States); E. Micijevic, NCDC Imaging (United States); B. L. Markham, NASA Goddard Space Flight Ctr. (United States); M. O. Haque, SGT, Inc. (United States)
- 7081 16 **WorldView-1 pre and post-launch radiometric calibration and early on-orbit characterization** [7081-41]
K. S. Krause, DigitalGlobe, Inc. (United States)
- 7081 17 **1999–2003 shortwave characterizations of Earth Radiation Budget Satellite (ERBS)/Earth Radiation Budget Experiment (ERBE) broadband active cavity radiometer sensors** [7081-42]
R. B. Lee III, Consultant, National Institute of Aerospace (United States); G. L. Smith, National Institute of Aerospace (United States); T. Wong, NASA Langley Research Ctr. (United States); K. A. Bush, Science Systems and Applications, Inc. (United States)

GEOS AND EOS JOINT SESSION I

- 7081 18 **Accuracy assessment for the radiometric calibration of imaging sensors using preflight techniques relying on the sun as a source** [7081-43]
K. Thome, J. Czapla-Myers, Optical Sciences Ctr., The Univ. of Arizona (United States); M. Kuester, Ball Aerospace & Technologies Corp. (United States); N. Anderson, Optical Sciences Ctr., The Univ. of Arizona (United States)
- 7081 19 **Development of a heliostat facility for solar-radiation-based calibration of earth observing sensors** [7081-44]
M. A. Kuester, Ball Aerospace & Technologies Corp. (United States); J. Czapla-Myers, The Univ. of Arizona (United States); P. Kaptchen, W. Good, T. Lin, R. To, Ball Aerospace & Technologies Corp. (United States); S. Biggar, K. Thome, The Univ. of Arizona (United States)
- 7081 1A **Radiometric performance of the CERES broadband radiometers on the Terra and Aqua spacecraft** [7081-45]
K. J. Priestley, NASA Langley Research Ctr. (United States); G. L. Smith, National Institute of Aerospace (United States); S. Thomas, G. Matthews, Z. P. Szewczyk, Science Systems and Applications, Inc. (United States)
- 7081 1B **Absolute radiometric calibration accuracy of the Atmospheric Infrared Sounder (AIRS)** [7081-46]
T. S. Pagano, H. H. Aumann, R. Schindler, D. Elliott, S. Broberg, Jet Propulsion Lab. (United States); K. Overoye, M. H. Weiler, BAE Systems (United States)

POSTER SESSION

- 7081 1D **Multi-wavelength lidar for remote sensing applications** [7081-49]
S. Song, P. Li, W. Gong, L. Zhang, T. Chen, Wuhan Univ. (China)
- 7081 1E **The simulator of single photon counting planetary altimeter** [7081-50]
J. Blazej, I. Prochazka, Czech Technical Univ. in Prague (Czech Republic)

- 7081 1F **Derivation of the MODIS Aqua Point-Spread Function ocean color bands** [7081-51]
G. Meister, Futuretech Corp., NASA Goddard Space Flight Ctr. (United States); Y. Zong,
National Institute of Standards and Technology (United States); C. R. McClain, NASA
Goddard Space Flight Ctr. (United States)
- 7081 1G **Novel laser approach for remote sensing of atmospheric CO₂ column** [7081-54]
E. Georgieva, Goddard Earth Sciences and Technology Ctr. (United States); E. Wilson,
W. S. Heaps, NASA Goddard Space Flight Ctr. (United States)

Author Index

Conference Committee

Program Track Chair

Allen H. L. Huang, University of Wisconsin, Madison (United States)

Conference Chairs

James J. Butler, NASA Goddard Space Flight Center (United States)

Jack Xiong, NASA Goddard Space Flight Center (United States)

Program Committee

Philip E. Ardanuy, Raytheon Intelligence and Information Systems
(United States)

Robert A. Barnes, Science Applications International Corporation
(United States)

Jeffrey S. Czapla-Myers, College of Optical Sciences, The University of
Arizona (United States)

Armin W. Doerry, Sandia National Laboratories (United States)

Thomas S. Pagano, Jet Propulsion Laboratory (United States)

Carl F. Schueler, Orbital Sciences Corporation (United States)

Session Chairs

- 1 Prelaunch Calibration
Jeffrey S. Czapla-Myers, College of Optical Sciences, The University of
Arizona (United States)
- 2 MODIS I
James J. Butler, NASA Goddard Space Flight Center (United States)
- 3 MODIS II
James J. Butler, NASA Goddard Space Flight Center (United States)
- 4 Vicarious Calibration and Validation
Armin W. Doerry, Sandia National Laboratories (United States)
- 5 CLARREO
Thomas S. Pagano, Jet Propulsion Laboratory (United States)
- 6 New Missions and Technologies
Carl F. Schueler, Orbital Sciences Corporation (United States)

- 7 Cross Calibration and Intercomparisons
Philip E. Ardanuy, Raytheon Intelligence and Information Systems
(United States)
- 8 On-orbit Calibration
Jack Xiong, NASA Goddard Space Flight Center (United States)
- 9 GEOSS and EOS Joint Session I
James J. Butler, NASA Goddard Space Flight Center (United States)
- 10 GEOSS and EOS Joint Session II
Cheng-Zhi Zou, National Oceanic and Atmospheric Administration
(United States)