

This volume describes modern procedures for calibrating digital optical scanner and radiometer data acquired for Earth observations. The contents address radiometric, geometric, and geositional calibration parameters, the definitions of these parameters, and current "best practices" for their measurement. Three stimuli guided the evolution of this work: the growing practice of fusing imagery from a variety of sensors having different data collection strategies and data formats, thereby demanding that image quality be assessable in traceable Standard International Units (SIU); the need to co-register raster and vector data sets in a variety of geospatial architectures requiring common mapping projections; and, the expanding number of data and image types derived from wide field-of-view, narrow swath, multi-angular stereoscopic, and both active and passive sensing strategies, the combination of which permits broader understanding of Earth as a tapestry of complex systems. The Joint ISPRS/CEOS WGCV Task Force on Radiometric and Geometric Calibration, which prepared this volume, recognizes the need for, and aims to develop, a set of calibration practices and consistent parameter definitions that will ensure the quality of future Earth observation imagery for everyone who uses these resources. International organizations, national governments, and regional and local authorities all require accurate, high-quality imagery for their increasingly complex decision-making endeavors. Anyone who supplies such imagery should redouble their efforts to provide products that meet the needs of their user constituencies, whether in the name of public health at the local level, tracking economic and social trends at a national level, or assessing Earth's changing environments on a global scale.

Stanley A. Morain is the Director of the Earth Data Analysis Center at the University of New Mexico in Albuquerque New Mexico, USA. As President of ISPRS Commission-I (2000-2004), he was responsible for organizing and coordinating the early activities of the Joint ISPRS/CEOS WGCV Task Force.

Amelia M. Budge is Deputy Director for Federal Programs at the Earth Data Analysis Center, University of New Mexico. She also served as Technical Secretary for ISPRS Commission-I (2000-2004).

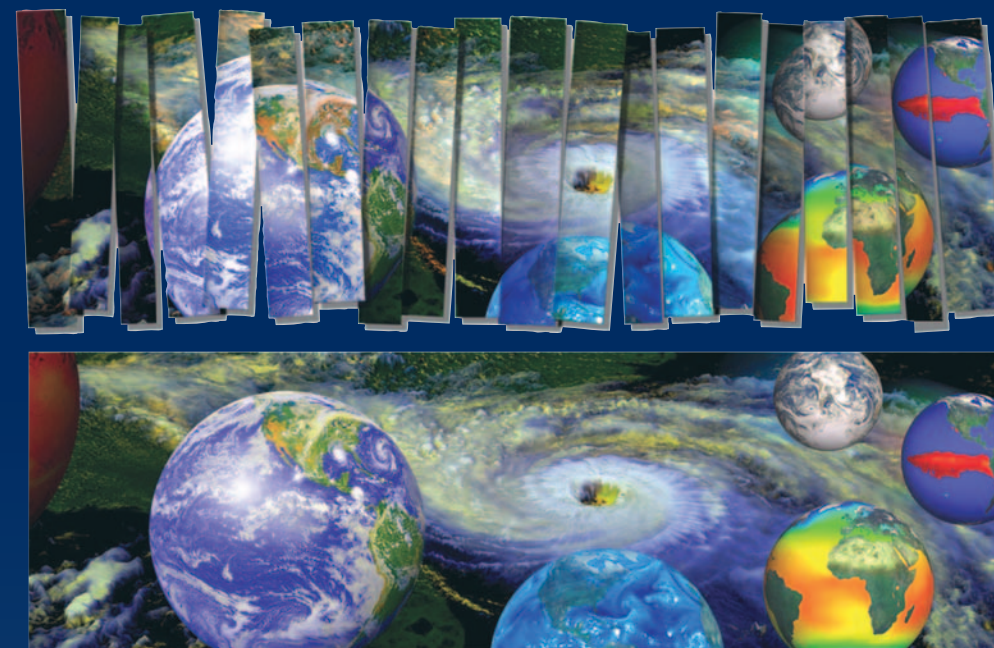
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POST-LAUNCH CALIBRATION OF SATELLITE SENSORS



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Balkema

Edited by Stanley A. Morain and Amelia M. Budge

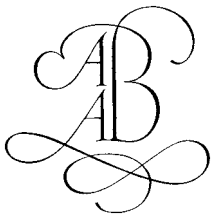
PROCEEDINGS OF THE INTERNATIONAL WORKSHOP ON RADIOMETRIC AND
GEOMETRIC CALIBRATION, 2–5 DECEMBER 2003, GULFPORT, MISSISSIPPI, USA

Post-Launch Calibration of Satellite Sensors

Edited by

Stanley A. Morain & Amelia M. Budge

Earth Data Analysis Center, University of New Mexico, Albuquerque, NM, USA



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Preface

The need for consistency in sensor calibration terminology, and the definitions for these terms, has been an issue in the Earth observing community for more than two decades. With this volume, it is gratifying to see progress in this direction; more so because ISPRS has taken a leadership role in its production. In 1998, the Committee on Earth Observing Satellites (CEOS) passed a Resolution requested by the terrain mapping subcommittee of the Working Group on Calibration and Validation (WGCV) to form a Joint WGCV/ISPRS Task Force on Radiometric and Geometric Calibration. For its part, Dr. George Joseph (then President of ISPRS Commission-I, 1996–2000) drafted a white paper outlining why confusion arises among various calibration terms used to measure spatial, radiometric, and temporal resolution of sensors. He also suggested definitions for several of these terms. His white paper is published here as the lead article.

After passing the presidency of Commission-I to Dr. Stan Morain for the 2000–2004 Congress quadrennium, a profile of perceived expertise was created by ISPRS prior to organizing the first meeting of the Joint Task Force. A founding group of some fifteen people convened at the Commission-I midterm symposium in 2002, one of the outcomes of which was to schedule an *International Workshop on Radiometric and Geometric Calibration*. Over 80 experts from seven countries met for four days in December 2003 to discuss issues and methods for post launch calibration of infrared and visible optical scanners (IVOS) onboard commercial and government satellites. Their discussions also touched upon digital aerial cameras, characterization of image quality, and design of field calibration sites and test ranges. This volume is a collection of presentations forming the technical program for that workshop.

The volume addresses only a fraction of the complexity of calibration terms and definitions. In the 2004–2008 Congress quadrennium, it is hoped that Commission-I will continue this important work through incremental improvements, and perhaps by expanding the Task Force's scope to include the full range of sensors.



John Trinder, President, ISPRS

Foreword

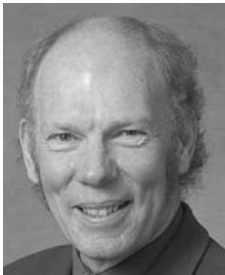
It is now generally recognised that calibration is an essential component of any sensing system; however, interest in the topic is limited to a few scientists who are directly involved. The December 2003 workshop, the CD of technical presentations, the workshop report, and this published volume are designed to review current activities in radiometric and geometric calibration, and to create discussion on this topic in context of image quality, mapping, and data analysis. The topic is a wide one involving many organizations and touching upon topics beyond just calibration. Standards are also involved, along with interoperability, traceability of units, and the presentation of data. I was pleased to see representatives from all of these communities at the workshop and I know that the discussions were constructive in preparing for the 20th ISPRS Congress in Istanbul.

Working groups coordinated by Technical Commissions carry out the technical work of ISPRS. In the 2000–2004 quadrennium there are seven technical commissions and a total of 47 working groups. Five of these working groups specifically mention *calibration* or *standards* in their terms of reference, and work with organizations such as ISO and OGC in developing standards or collaborating in developing new protocols and techniques. ISPRS also works with other international organizations, is an Associate member of CEOS, and also attends the United Nations Committee of Peaceful Uses of Outer Space. We also have memoranda of understanding with IEEE-IGARSS and SPIE.

Many different committees and groups are involved in sensor calibration and image and data quality assessment. The CEOS Working Group on Calibration and Validation (WGCV) is one. In this working group, several national space agencies and national standards laboratories are represented. ISO and OGC are also involved, as is the wider international community of photogrammetry and remote sensing, represented by ISPRS, and other organizations. It is essential that these bodies work together, not only to advance the science of calibration, but also to gain a better understanding of each others' perspectives on the topic and to avoid duplication of effort. With so many new sensors, calibration and inter-comparison is increasingly important. We should also note that new digital aerial sensors and LiDAR create new challenges.

One of the components of the December 2003 workshop leading to this volume was a set of in-depth discussions conducted by the Joint WGCV/ISPRS Task Force. This group arose from a conviction that commercial satellite data providers and space agencies should present data about sensors in a way that would ensure one's ability to intercompare sensors and products. This conviction was later formalized in a resolution of the CEOS Plenary, leading to the creation of the Task Force. The basic task could be constrained simply to listing parameters in a uniform way, but the implications are much wider.

Finally, I would like to thank Stan Morain and Amelia Budge for the effort they have invested in producing this volume. They brought together a formidable group of experts covering a wide range of topics for the workshop, then coordinated and edited the manuscripts published here. I would also like to thank Karsten Jacobsen, University of Hannover, and Manfred Schroeder, DLR, for their valuable services as consulting editors; and both NASA and USGS for their financial and scientific support for the meeting and the book.



Ian Dowman, Secretary General, ISPRS