

A Review of the Book

Observation of the Earth and its Environment: Survey of Missions and Sensors

(4th Edition, 2002, Springer–Verlag, Berlin, ISBN 3–540–42388–5)

by Herbert J. Kramer

Reviewed by David L. Glackin

David L. Glackin is a remote sensing scientist with The Aerospace Corporation in Los Angeles, California, where he is on senior staff. He has authored over 70 publications in remote sensing, solar physics, stellar atmospheres, geophysics and image processing. He has given many invited talks and chaired sessions at international conferences. He has worked on remote sensing physics, phenomenology, sensor concepts, sensor design, and data interpretation for Earth environment and solar applications across the spectrum from X-rays to microwaves. He is also the principal author of the book *Civil, Commercial and International Remote Sensing Systems and Geoprocessing*. The views expressed in this book review are solely his own, and not those of his employer.

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Of all of the books in my office, this is the one that I refer to most frequently. Anyone working in the field of remote sensing will eventually need the answers to questions such as, "What is the instrument complement of UARS," or "What is the spatial resolution of EROS–A1?" Even in this age of on–line resources, the best and fastest way to answer those questions is to consult this book. Herbert Kramer has provided a comprehensive and up–to–date compendium of spaceborne missions that are designed to perform not only Earth remote sensing, but also upper atmosphere and ionosphere sensing, near–Earth space environmental monitoring, and technology demonstrations. Thus, the word "Environment" in the book title should be interpreted in the broadest possible sense. Nearly all relevant spaceborne missions, past and present, and those that appear to be reasonably firmly planned, can be found. The encyclopaedic portion of the text on spaceborne missions totals over 1000 pages, and that alone would comprise a unique reference text. But there is much more to this book. The first chapter includes an exhaustive 157–page "short" history of Earth observation. The section entitled "Reference Data and Definitions" could itself be a useful 110–page guidebook on remote sensing technologies. And in keeping with the theme of choosing modest titles, the 84–page section of "Acronyms and Abbreviations" is far more than that. It includes excellent descriptions of the functions of many remote–sensing related organizations, useful tables, and concise histories of the organizational name changes and mergers that many companies around the world have undergone over the decades. I don't know anyone in this field who isn't confused by those changes, and this summary is very helpful.

The portion of the book in which the spaceborne missions and sensors are detailed is both broad and deep. In Parts A through N, the missions are organized into areas such as "Atmosphere/Radiation/Aeronomy Missions," "Commercial Imaging Satellites," "Data Collection Systems," "Earth Observation/Monitoring Missions," "Meteorology–GEO Missions," "Space Science/Solar–Terrestrial Missions," and so on. The mission descriptions include in–depth information about the sponsor, the spacecraft, the hardware providers, and each individual sensor (instrument). Much information that is difficult to find elsewhere is presented in an organized fashion. For instance, there is a full description of the extensive sensor complement on the Russian Priroda module that was part of the Mir space station. There is a complete description of the Indian IRS series of satellites and their sensors. There is a table of the complete history of NOAA's weather satellites and sensor complements. There is even an inclusion of the odd little fact that the Russian Okean–O satellite series is a follow–on to the Okean–O1 series.

The entire contents of the book are also provided on a CD-ROM. The CD also contains a 327-page survey of airborne sensors. The author states that most of his effort in updating this book, since the third edition was published in 1996, was spent on the spaceborne missions, since that is where more of the changes occurred. But the information on airborne missions is quite useful and detailed. Remarkably, there is also an 80-page summary of remote sensing field campaigns. To my knowledge, this information has been gathered in one place nowhere else.

This is the fourth and unquestionably the best (and quite possibly the last) edition of this book. Some of the aspects of my professional life require that I maintain cognizance of past, present and planned Earth remote sensing missions worldwide. I can thus attest to the quality and thoroughness of this book. Given the freeze date of mid-2001 on the information, nearly every mission that should be included is included. I could only identify two that probably should have been that were not, namely ARIES and AVSat. I personally know Herbert Kramer to be a tireless and dedicated individual, and it takes someone with those attributes to see a task like this to completion. In the interest of full disclosure, it should be stated that I provided the author with certain historical and mission information, definitions, technical and organizational advice, and proofreading. My opinion of the past editions was such that I was happy to donate my personal time to help with this latest effort.

No book of this magnitude and scope can be perfect, however, and this one is no exception. It is sorely in need of an alphabetical index of missions. The index of sensors is a help, but if you were looking for the mission SUNSAT, you probably wouldn't know the names of the sensors onboard. The list of acronyms and abbreviations has selected page references, but not all mission names are acronyms and locating the others can be difficult. Additionally, the book often presupposes a detailed level of knowledge in the reader. For example, you will find the German BIRD fire-and-hot-spot monitoring mission under "Satellite Emergency Services and Environmental Monitoring" rather than "Earth Observation/Monitoring Missions." You will find the South African SUNSAT under "University/Student-Developed Satellites & Payloads." And, somewhat inappropriately, you will find the sea-surface-winds QuikSCAT mission under "Atmosphere/Radiation/Aeronomy Missions."

There are also various technical problems with the book. Pushbroom and whiskbroom scanning are discussed under "Observation Schemes" on pages 1210-1212 and in the glossary on page 1355. While the figures are clear, the discussion of whiskbroom scanning is inaccurate, confusing and poorly organized. The discussion of spatial resolution on pages 1235-1236 refers only to the geometrical projection of a detector onto the ground (IFOV). It does not discuss the role of integration time and the resultant smear of that projected footprint. Nor does it discuss the role of Ground Sample Distance, which can be found separately in the glossary on page 1339, nor the Modulation Transfer Function, which can be found on page 1351. The other quibbles I have with the book are relatively minor. Some have to do with an occasional incorrect usage of terms, such as the use of "timeliness" when "refresh" is intended in the definition of "In-situ soundings" on page 1342. Less obvious flaws relate to the book's omissions. A definition of "beamsplitter" is found on page 1324, as a device that splits a light beam, but no definition is found for "dichroic beamsplitter," which is a device that is frequently used for spectral separation in multispectral imagers.

But those criticisms pale beside the overall value of the book. This book is a tour de force. It is an indispensable reference book that belongs on the bookshelf of every serious practitioner of remote sensing science and technology, and I have already enthusiastically recommended it to colleagues around the world. In my estimation, it is a unique resource and has my very highest recommendation.

Observation of the Earth and its Environment – Survey of Missions and Sensors
by Herbert J. Kramer – Springer Verlag, 4th edition, 2002, ISBN 3–540–42388–5.

Reviewed by: Dr. Bizzarro Bizzarri, CNR/ISAC (Istituto Scienze dell’Atmosfera e del Clima) Rome, Italy

The 4th edition of this well-known book series of the past decade is fully re-structured and very much expanded. The hardcopy is 1510 pages long, and an attached CD–ROM stretches the total volume to 1934 pages. This ”little treasure” should be available in all offices where people are working in Earth observation for environmental sciences, applications and operations. The survey goes back far enough in time as to provide a sufficiently wide historical perspective, and is amazingly complete and detailed, on spaceborne missions currently operating, as well as on approved programs under development. The book also includes a number of important projects with emphasis on evolving remote sensing technologies. There is certainly no risk of premature book obsolescence with the excellent wide–range coverage of the subject matter.

There is an initial chapter (Earth Observation Short–History) and a chapter referred to as Part O (Reference Data and Definitions), with 160 and 120 pages, respectively; this should be considered the basics of remote sensing information that every environmental scientist should be familiar with. The description of satellites and sensors is structured in a logical way to make searching of the required information easy: (A) Atmosphere / Radiation / Aeronomy Missions; (B) Commercial Imaging Satellites; (C) Data Collection (Messaging) Systems; (D) Earth Observation / Monitoring Missions; (E) Geodynamic / Earth–System Missions; (F) Meteorology – GEO (Geosynchronous Earth Orbit) Missions; (G) Meteorology – LEO (Low Earth Orbit) Missions; (H) Satellite Radionavigation Systems; (I) Satellite Emergency Services & Environmental Monitoring; (J) Shuttle–Selected Missions and Payloads; (K) Space Science / Solar–Terrestrial Missions; (L) Space Stations; (M) Technology Missions; and (N) University / Student–Developed Satellites & Payloads. In addition, the CD–ROM includes: (P) Survey of Airborne Sensors; and (Q) Survey of Campaigns.

Completeness is a main feature of the book. It is nearly impossible to find a mission or an instrument either current or firmly planned on which the reader cannot find information. The degree of detail presented is sufficient for nearly all purposes, on the science/application objectives as well as on the technical descriptions. In several cases the information provided is much more detailed than what is available from the pertinent literature or from websites; it shows that the Author, when needed, did receive first–hand information directly from the persons responsible of the projects. Most important, the information reported includes all elements of real interest, so that the reader can rely on the fact that he can any time find in the book the information elements that he actually needs. Accuracy also is an important attribute, making the reader fairly confident that he can use the information without longer verification checks. Clearness is ensured by a greatest number of tables and illustrations.

The book can be used as a handbook to be kept within reach of consultation. It is structured in such a way, that it can serve as a textbook for studies in the fields of Earth observation and space sciences; it may also be used for thesis/dissertation work in support of Bachelor, Master, or Ph.D. degrees. In any case, the book is an excellent reference for all definition work of new projects.

Review of "Observation of the Earth and Its Environment – Survey of Missions and Sensors", 4th Edition, by Herbert J. Kramer, Springer–Verlag, Berlin, 2002, ISBN 3–540–42388–5, \$199. 522 figures, 857 tables, 1510 pages (hard copy), 1923 pages (CD–ROM).

Reviewed by R. Keith Raney, Ph.D., Senior Scientist at Johns Hopkins University Applied Physics Laboratory, Laurel, MD, USA.

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Simply stated, this remarkable book is an essential resource for anyone concerned with any aspect of Earth–centered remote sensing. Now in its 4th Edition, and blessed for the first time with a complete CD–ROM (that includes more than 400 pages of resource material that is not in the hard copy), this encyclopedic monograph captures the entire field of space–based and airborne systems, instruments, campaigns, and much more. Although the price might dissuade purchase for personal use, at less than 1/10th the cost of a single frame of decent space–based imagery, it is a steal. No laboratory, agency, technical library, or serious practitioner concerned with remotely sensed data or systems should be without this work.

Dr. Kramer has chosen – wisely in my view – to make extensive use of tables. These invariably present a wealth of information in a relatively small amount of space. In each case, be it instrument, spacecraft, or mission, one has the impression that details of internal design reviews are being summarized. Given that such specifics are presented for more than 500 topical entries, the sheer quantity of information is awesome. These tables are backed up by 522 figures that include instrument and spacecraft layouts, and in some cases, diagrams that explain the inner workings of selected instruments.

The work includes more than 2000 references, most of which have appeared in the last five years. References are presented as footnotes on the page where they are cited, which is a thoughtful gesture for the reader, especially for a book more than 5 cm thick.

Unlike previous editions, this volume includes a brief history of Earth observation (Part A) that in 160 pages provides a detailed telescopic view of the field, a review of the basic physics that enable and constrain Earth observation, an introduction to spacecraft systems, overviews of operational meteorological missions, and navigation and orbital issues, among other topics. Initial progress towards international cooperation is outlined, backed up by specifics elsewhere in the book on World Data Centers (WDC), the Committee on Earth Observation Satellites (CEOS), and national agencies. As in previous editions, the section on reference data and definitions (Part O) offers concise descriptions of most classes of sensors. The excellent and timely review of orbit options for single– and multiple–satellite systems includes a description of the "cartwheel" constellation now in consideration for solid Earth applications by interferometric synthetic aperture radar. The description of over 200 airborne sensors appears in Part P (only in the CD–ROM). The three Appendices include an extensive glossary, a list of acronyms and abbreviations, and a 34–page list of individual sensors, each succinctly defined, and cross–referenced to supporting in–text articles.

The organization of the book departs from that of its predecessors. Spaceborne missions are grouped according to themes (Parts B through N) selected by Dr. Kramer's own judgement. Whereas this scheme takes some getting used to, with a bit of practice it proves to be very helpful. For example, the TOPEX/Poseidon (T/P) mission, dedicated to investigating dynamic ocean topography with radar altimeters, is found in Part E – Geodynamic/Earth–System Missions – along with only about twenty others that also fit the theme, such as GRACE, GOCE, and CryoSat. That is a far more manageable set than an extensive chronological or alphabetical listing can offer, which these days would run to many hundreds of

items, most of which would be irrelevant to a given theme. The T/P discussion in four pages provides a detailed summary of the spacecraft and its systems, the primary and supporting payload instruments, the original science objectives, and 10 references sufficient to carry the interested reader to the next level. This example is illustrative of all cases that I pursued for which I know the territory. The data provided are accurate, extensive, and up-to-date. Mission themes include commercial satellites, meteorology, Earth monitoring and environment, solar-terrestrial science, and space station-based missions, among others.

The CD-ROM includes an Adobe Reader™ and search engine. Search capability is new with this Edition, and is invaluable. As a test case, I found several dozen hits throughout the book on "TOPEX." Items that surface include: KITSAT-1, which in 1992 shared the launch with T/P; DORIS and GPS navigation; major measurement missions such as WOCE (World Ocean Circulation Experiment); a description of the three-frequency microwave radiometer that is part of the T/P payload; and the Jason-1/TOPEX tandem mission, among others. Key word searches also find reference citations, which is a valuable tool in its own right.

Dr. Kramer graciously acknowledges the more than 500 individuals who provided project information for this edition. It is clear that the author has invested an incredible amount of work to compile so much rich detail in such an accessible format and pleasing style. There is no alternative reference to be found anywhere that approaches the scope and depth of this modern classic.

Review of "Observation of the Earth and Its Environment – Survey of Missions and Sensors," 4th Edition, by Herbert J. Kramer, Springer-Verlag, Berlin, 2002, ISBN 3-540-42388-5, 522 figures, 857 tables, 1510 pages (hard copy), plus 1923 pages on CD-ROM.

Reviewed by Prof. Arnold Schoonwinkel, Associate Dean: Engineering Faculty, Stellenbosch University, Stellenbosch, South Africa.

Observation of the Earth and Its Environment is the most comprehensive book in print on remote sensing systems to date. The author managed to capture valuable information through many years of dedicated research using journals, conference proceedings, visits to the remote sensing industry, personal networks, etc. It is compiled into a single "encyclopedia of remote sensing" that consistently provides information to a level that is rarely available from internet web sites. The descriptions of the individual remote sensing missions, satellites and sensors have sufficient technical detail to provide the reader with the essential characteristics of each system.

The book commences with a fascinating summary of the history of Earth observation. The rest of the manuscript is systematically organized in parts that classify remote sensing systems according application area (commercial imaging satellites, space science mission, technology missions, etc.). Many missions have specialized functions and payloads, and the reference data and definitions section in the book is therefore highly informative to readers. Airborne sensors and campaigns are also covered, and included in CD-ROM with the book. A comprehensive Index, Glossary of terms, Acronyms and Abbreviations lists add to the user friendliness of the book.

Observation of the Earth and Its Environment is strongly recommended for remote sensing practitioners and researchers in industry and academia.