HANDBOOK OF GEOPHYSICS AND THE SPACE ENVIRONMENT

SCIENTIFIC EDITOR

Adolph S. Jursa

AIR FORCE GEOPHYSICS LABORATORY

AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
1985

Additional copies of this document can be obtained from
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Document Accession Number: ADA 167000

ASSISTANT EDITOR

Marylou Tschirch

CONTRIBUTING AUTHORS

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FOREWORD

The space, atmospheric, and terrestrial environments influence the functioning of all Air Force systems. As technology advances, the role of the enviroment becomes more important to system performance. In many cases, the environment determines the limit in technical capability. This Handbook reflects the world of geophysics as honed and shaped by the special needs of the Air Force.

Today's operational systems were designed with the environmental knowledge made available by the Air Force Geophysics Laboratory and its predecessor, the Air Force Cambridge Research Laboratories. Tomorrow's Air Force depends on the quality and breadth of today's research as reflected in this Handbook. Although written primarily by Air Force Geophysics Laboratory scientists, this work reflects the state-of-knowledge of thousands of collaborative investigators, both U.S. and foreign. It is a mixture of basic research and exploratory development, and as such, represents the entire range of our technology based efforts. The very breadth of Air Force operations from space, through the atmosphere, to the earth makes it challenging, exciting, and rewarding to do front line research across this broad spectrum and to present a useable summary of the results to a wide community via this publication. This Handbook is one of our deliverable end products.

The recognition by the Air Force of the value of geophysics research to its mission is clearly illustrated in this work. The advances made by in-house scientists, the unique world class facilities created to do this work, and the excellent support of space based experiments, all attest to the long term dedication required to advance our understanding of the environment. Many significant players, military and civilian, have come and gone since the last issue of this Handbook. It is in the context of pride in these people and pride in our accomplishments for our country that we take great pleasure in dedicating this book to the twenty-fifth anniversary of the International Geophysical Year.

J. R. JOHNSON, Colonel, USAF
Commander

A. T. STAIR, JR.
Chief Scientist

PREFACE

This fourth edition of the Air Force Handbook of Geophysics and the Space Environment has been completely revised. It was conceived as a commemorative issue in recognition of the twenty-fifth anniversary of the International Geophysical Year. This was particularly appropriate since the Air Force Geophysics Laboratory—at that time the Air Force Cambridge Research Center—had been an active participant in the IGY in 1957–58 and the first edition of the Handbook had been published in 1957. The complex task of preparing this edition involved several years of effort during which time the twenty-fifth anniversary of the IGY occurred.

The purpose of the Handbook remains the same, that is, to provide Air Force designers, engineers, and systems operators with facts and data about the environment in which the Air Force operates. Extraordinary progress has occurred in this scientific field since the first edition was published due both to rapid advances in computer capability and the development of large rockets and satellites which have made available to experimenters platforms for upper atmosphere and space research that did not exist twenty-seven years ago.

The first edition of the Handbook was published the same year the first artificial earth satellite was orbited. At the time of the third edition, there was considerable activity in space but man had not yet gone to the moon. Since the publication of the third edition, research in and use of space has grown at an astonishing pace and its importance in man's future is an accepted fact. The Air Force has been active in space since the development of intercontinental ballistic missiles and early reconnaissance satellites, and is preparing for an even more active role as the space shuttle becomes operational.

In keeping with the Air Force interest in space, the format of the Handbook has been arranged to give those chapters dealing with the space environment increased emphasis. The fourth edition begins with chapters on the sun and its emissions, then treats the earth's magnetic field and the radiation belts, and follows with chapters on the ionosphere and the aurora. The subject of electrical charging of space vehicles has been of special concern to the Air Force and has been included to aid designers interested in that problem. Of no less importance are Air Force operations in the atmosphere and on the earth itself. The next group of chapters deals with properties of the atmosphere, and the Handbook concludes with chapters on the earth sciences and infrared astronomy.

Readers familiar with earlier editions will note that some chapters of the older versions have been deleted, while new chapters have been added. The choice of subject matter has been determined primarily by changes in today's Air Force requirements and operational activities. The contents also are related to the technical programs at the Air Force Geophysics Laboratory and reflect the expertise of the scientific staff, but should not be considered a technical report on such programs. In fact, the Handbook is only an introduction to several areas of geophysics. Subjects such as galactic x ray astronomy, astrophysics, planetary physics, meteors, some aspects of atmospheric pollution, oceanography, and others not of current concern to the Air Force do not appear here. Such subjects are covered very adequately elsewhere.

Numerous references have been included in each chapter so that the reader may pursue a specific subject area to whatever depth desired. The authors were not constrained by chapter format or length but were allowed to express themselves freely. As a result the chapters range from brief statements on a subject to textbook treatment of others. The Handbook has been brought as up to date as possible. Other government organizations such as NASA and NOAA have also published surveys and technical memoranda that deal with aspects of the atmosphere and space environment. Together with this Handbook they can provide the reader with an up-to-date picture of our understanding of the atmosphere and the near-earth space environment.

A. S. J.

ACKNOWLEDGMENTS

Many people have contributed to make this edition of the Handbook of Geophysics and Space Environment possible. The decision to proceed with the fourth edition of the Handbook was made by Colonels James Baker and Gerald D'Arcy, Commander and Vice Commander, respectively, of the Air Force Geophysics Laboratory in 1981. We are indebted to the authors of the twenty-five chapters; without them there would be no Handbook. Recognition is due three co-editors who undertook the necessary preliminary planning steps to organize the Handbook before I assumed responsibility as scientific editor. They are Dr. John N. Howard, Dr. Morton Barad, and Dr. Jules Aarons, who also contributed as co-author and scientific editor of Chapter 10. I would like especially to acknowledge the very important contribution of my assistant editor, Marylou Tschirch, who has been primarily responsible for the detailed editing, coordination, and final preparation of the manuscript for publication. Her tireless effort has been a major factor in the success of the Handbook. Mr. John Dempsey assisted with the editing of several chapters as well as contributing his expertise to discussions of format, typesetting, and printing.

Thanks are due to many secretaries in the Laboratory who typed the draft manuscripts of the chapters for the authors and, in particular, to Mrs. Ann Turner for her competent and extensive typing, copying, and accomplishment of many other administrative tasks that were necessary in the preparation of this Handbook.

A.S.J.

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