

PHYSICAL GEOGRAPHY

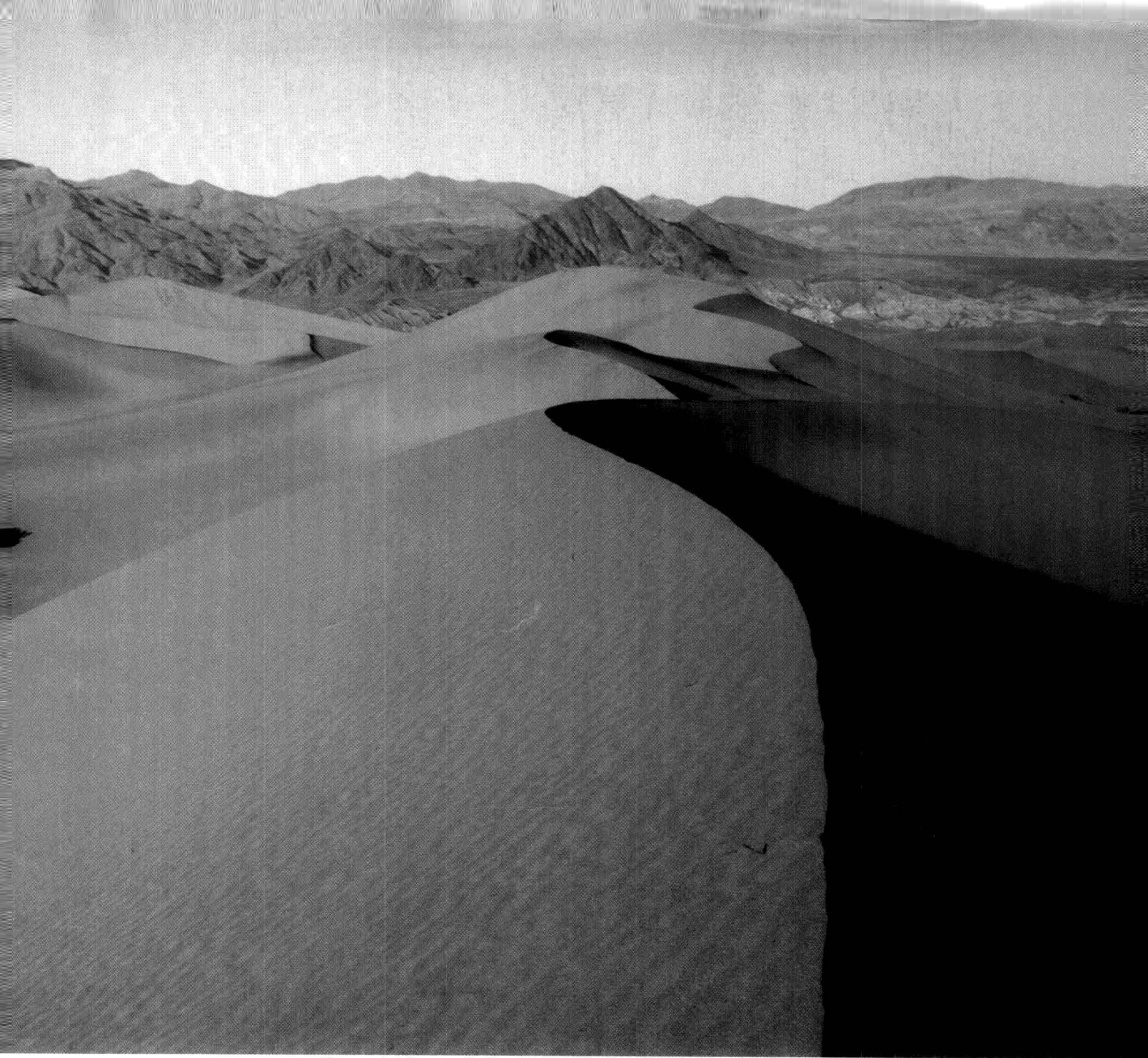
THE GLOBAL ENVIRONMENT

Third Edition

H. J. de Blij

Peter O. Muller

Richard S. Williams, Jr.



THE GLOBAL ENVIRONMENT

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Preface

In the decade since the appearance of this book, environmental issues have become prominent among public concerns. Even the most cursory content analysis of the popular press proves the extent to which global climate change, El Niño effects, melting glaciers, and climatic extremes have become front-page news. Add to this the technologically enhanced reportage of earthquakes in remote locales, hurricanes on their computer-predicted tracks, “millennium” floods, sun-blocking volcanic eruptions, and other natural events that briefly but vividly make the headlines, and it is clear that our collective awareness of nature’s challenges have taken center stage.

But how well are the environmental systems that underlie all this often-sensational news understood? During the 1980s, when America’s geographic illiteracy became a matter of public embarrassment when polls revealed that many citizens could not identify prominent locations on outline maps, the cause was obvious—geographic education was in decline. When respondents could not find New York on a blank map of the United States or the Pacific Ocean on a world map, this could have been attributed to faulty curricula and misplaced priorities. Lost in the ensuing debate, however, was this dispiriting reality: For countless high-school students, some exposure to geography would have provided that crucial link between location and function, between place and system, and between human society and natural environment. It is one thing to know (as only 5 percent of one survey’s respondents did) approximately where the El Niño phenomenon occurs. It is quite another to have some basic understanding of how it works and what its regional and global implications are. When Mount Pinatubo erupted explosively in 1991, the consequences ranged from the climatic (a temporary but distinct cooling effect) to the strategic (the closure of United States military bases in the Philippines). One needed some background in physical as well as human geography to appreciate these linkages.

Meanwhile, slower and less dramatic changes in our Earthly environments have potentially far greater consequences. In the 1800s the planet emerged from what has been called a “Little Ice Age” and entered a phase of

warming that continues, despite a major reversal in the middle decades of the twentieth century, to this day. The degree to which human activities enhance this “greenhouse warming” is a matter for informed debate, but it is essential to understand the climatic history of the entire Holocene to see it in appropriate context. Even if emission-limiting agreements more stringent than the Kyoto Protocols could be approved and implemented (and we all wish it could be so), climatic fluctuations would not cease. We live in a world of wide and often rapid environmental swings, and we should understand their impacts on human societies much better than we do.

In this book we provide a background for an understanding of the Earth’s environmental systems and processes, carrying the story from the place of our planet in the solar system to the regional landscapes resulting from tectonic and erosional forces. Because this is a geography book, we tend to use spatial perspectives and approaches when we address environmental problems and issues—but our working definition of physical geography, where several sciences converge, is broad and encompassing.

The Third Edition

In this new edition of *Physical Geography: The Global Environment*, we have benefited from the comments of readers of earlier editions as well as the advice provided by Richard S. Williams, Jr., who is the author and editor of numerous scientific publications in a wide range of related fields. As those familiar with this book will note, we have made only one significant structural change, involving the combination and condensation of Units 52 and 53 of the Second Edition, thus sharpening the focus on the North American landscapes with which students tend to be most familiar. In the redesigned part openers, we have sketched the systemic frameworks that recur in the text. Dr. Williams alerted us to the growing research focus on the cryosphere, and following our reading of the relevant literature, notably in the journals

Science and *Nature*, we recast the key figure (Figure 2.1, page 19), recognizing *five* (not four) Earth-system spheres as the basis for this and future editions.

The new edition also brings us up-to-date on the continuing debate over global climate change—but only after the fundamentals of climate have been discussed. The public is bombarded with reportage, opinion pieces, and exhortations regarding global warming, but surveys show environmental literacy scores even lower than scores for spatial literacy. An informed public is needed when it comes to forging effective public policy. In this book we attempt to provide information as well as guide opinion, and we hope that these pages will enhance the quality of discourse. Comprehending global climate change requires an understanding of the diverse topics that constitute physical geography, ranging from atmospheric and oceanic systems to ice ages and glaciations, from Earth-orbit variations to biogeographic responses. One notable geographic aspect of the accumulating global-warming evidence is its regional divergence: While some areas of the planet exhibit evidence of sustained warming, others experience simultaneous cooling (for example, the U.S. Northeast winter of 2002–2003, one of the most severe in recorded history). The reasons for such apparent contradictions can be understood through the study of global environmental systems in time *and* space.

There was a time when physical geography was studied with little or no reference to human-environmental interconnections, but humanity has itself become a factor in the environmental evolution of the planet. In the text we refer frequently to this relationship, and every unit includes a box under the heading *Perspectives on the Human Environment*, in which the topic is given emphasis. In previous editions of this book, the *Perspectives* boxes proved to be a productive element, and we have strengthened this feature in this edition, using the opportunity to reflect on the impacts of environmental extremes (such as Hurricane Mitch) and their aftermaths.

As readers familiar with this book will note, we have made numerous changes to keep pace with scientific discovery as well as ongoing research. The recognition of an additional soil order in the soil taxonomy required revisions in Unit 25; the potential impact of change in the North Atlantic Oscillation (not as well known as the El Niño/Southern Oscillation of the Pacific) is now chronicled in Unit 11. Growing understanding of the capacity of asteroids, comets, and meteor-like objects not only to kill dinosaurs but also to transform climate and land, led to substantial revision of Unit 4. The identification of a boundary separating the Indian from the Australian

tectonic plates (previously regarded as a single entity) changed the text and maps in Unit 32. Minor updates abound, and not a page of this book remained unaffected.

In response to sometimes-frustrated correspondents, we added small locator maps to photographs not otherwise identified by location. Many of the photographs were taken by the senior author in the course of his fieldwork (over more than 40 years of research), and extracts from the fieldnotes provide background to the images. We hope that you will find enjoyment as well as information and explanation in the pages that follow.

Supplementary Materials

As a user of this text, you will have access to the following supplementary material, produced by Oxford University Press:

For the Student

- *Study Guide*, by Peter O. Muller and Elizabeth Muller Hames

Packaged free with each new copy of the textbook, the *Study Guide* contains unit outlines, glossaries, and various self-testing exercises that reinforce material in the textbook. An excellent resource that helps students master the concepts of physical geography.

- *Natural Hazards Website*

Created by Stephen E. LaDochy, Hengchun Ye, and Pedro C. Ramirez of California State University, Los Angeles, this website provides supplemental information about earthquakes, hurricanes, floods, and other geological, meteorological, and biological hazards in an exciting, interactive format. Exercises and activities on the site allow students to further their knowledge of a variety of concepts related to the study of physical geography. Access the Natural Hazards website at <http://www.oup.com/us/highered/physicalgeography>.

For the Instructor

- *Instructor's Manual and Test Bank*, by Jeremy E. Diem of the University of Georgia

The *Instructor's Manual* contains a variety of resources to assist professors who are teaching the physical geography course. These resources include: chapter summaries, lecture guides, lists of additional references, and a test

bank with approximately 1500 multiple choice, short answer, and short essay questions.

- *Instructor's CD-Rom*

This CD-Rom contains the following two items:

Computerized Test Bank (for PC or Mac). A wonderful tool, containing all of the questions from the printed test bank in a digital format. Users can customize tests to fit their teaching style.

PowerPoint slide presentation. Ideal for professors who use PowerPoint to create lecture presentations, these digital art files contain all of the line art and some of the photography from the book. Use these slides to heighten the visual impact of lectures.

- *Overhead Transparencies*

Contains 200 color acetates of selected line art from the text. Available upon request.

Visit the **companion website** for *Physical Geography: The Global Environment, 3/e*, at <http://www.oup.com/us/highered/physicalgeography> to find more resources for students and instructors.

For additional information regarding these supplementary materials, please call your Oxford sales representative at 1-800-280-0280, or visit the Oxford Higher Education website at <http://www.oup-usa.org/highered>.

Acknowledgments

During the preparation of this new edition of *Physical Geography: The Global Environment*, we received advice and guidance from many quarters. First and foremost, we thank our reviewers, who supplied valuable feedback on the previous edition and thoughtful suggestions as to how we could improve a number of units. They were:

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We are indebted to our colleagues at Oxford University Press, who superbly managed the preparation of this third edition from our arrival at the company in 2001 to the publication of bound books barely two years later. Vice President and General Manager of the Higher Education Group, our longtime friend Dr. Christopher J. Rogers, brought us to Oxford, set the revision process into motion, and insisted on the highest standards as he oversaw the entire project. Ms. Eman Hudson admirably handled the developmental editing, constantly exuding high energy and infectious enthusiasm. Peter Gordon not only coordinated myriad details as he smoothed us into the production process, but also entertained us fabulously with his wit and wisdom on several occasions. Mary Hopkins deftly supervised the marketing responsibilities, and Linda Harris splendidly organized the suite of ancillary publications and computer activities that accompany this book.

A special note of appreciation is reserved for those individuals who contributed so effectively to the production process. Karen Shapiro, our Managing Editor, marvelously coordinated the entire operation and worked tirelessly to get the best possible results. Talia Krohn did a truly outstanding job in assembling our photography program and astonished us repeatedly with her resourcefulness in obtaining usable photos no matter how outlandish our requests. Our designer, Cathleen Bennett, was especially pleasant to work with, and she deserves much of the credit for the handsome appearance of the end product. We also thank Elyse Dubin,

Barbara Brown, and Erin Clancy for their invaluable assistance at crucial moments of personnel change and for their many additional efforts to keep things moving along. Special thanks, too, go to Janice G. Goodell, who worked tirelessly and effectively to correct the scanned text and to make revisions to the initial draft of the manuscript.

Last, but certainly not least, we thank our wives—Bonnie, Nancy, and Mary Ellen—for all their support

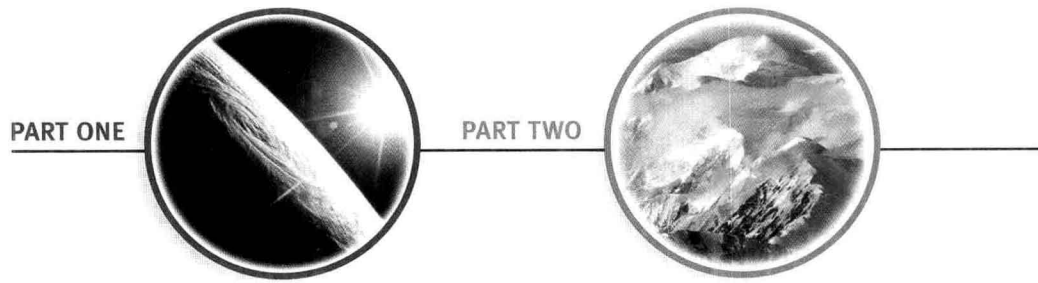
and encouragement, particularly in getting us across those inevitable bumps in the road as this enterprise successfully found its congenial new home.

H. J. de Blij

Peter O. Muller

Richard S. Williams, Jr.

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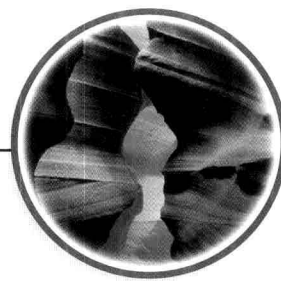
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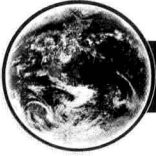


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**PHYSICAL GEOGRAPHY
THE GLOBAL ENVIRONMENT**

A high-contrast, black and white photograph of a tree trunk, showing the texture of the bark. A horizontal band across the middle of the image contains the text "PART ONE".

PART ONE