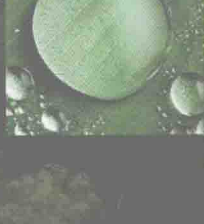
Jonathan Adams

VEGETATION–CLIMATE INTERACTION

How Plants Make the Global Environment

Second Edition



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Dr Jonathan Adams
Assistant Professor in Biological Sciences
Seoul National University
Gwanak-Ro
Seoul
Republic of Korea

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Preface to the Second Edition

In the two years since the First Edition of this book, the study of climate and vegetation has continued to advance rapidly, with many new and interesting things to write about. I have also been able to benefit from the comments and suggestions of colleagues who have read the book. And, furthermore, I have thought up some new—and hopefully better—ways to explain things, including various new diagrams and photographs. All these seem like good reasons to attempt a new edition, which I hope will continue to serve as an up-to-date review of the complex role of vegetation in our planet's environment. Once again, my wife Mei Ling and my daughters have been a great help in encouraging my efforts, trying to improve my limited photographic skills, and politely listening as I try to explain earth system science to them.

Jonathan Adams
Seoul, Republic of Korea, 2009

Preface to the First Edition

I had wanted to write something like this book for many years, but would probably never have dared to attempt it unless I had been asked to by Clive Horwood at Praxis Publishing. As it is, this has been a rewarding experience for me personally, something which has forced me to read literature that I would not otherwise have read, and to clarify things in my head that would have remained muddled.

What I have set out to do here is provide an accessible textbook for university students, and a generalized source of current scientific information and opinion for both academics and the interested lay reader. I have myself often found it frustrating that there have been no accessible textbooks on most of the subjects dealt with here, and I hope that this book will fill the gap.

My friends and colleagues have provided valuable comment, amongst them David Schwartzman, Axel Kleidon, Alex Guenther, Ellen Thomas, Tyler Volk, Ning Zeng, Hans Renssen, Mary Killilea, Charlie Zender, Rich Norby, Christian Koerner and Roger Pielke Sr. I could not stop myself from adding to the manuscript even after they had sent me their careful advice, and any embarrassing errors that have slipped through are of course a result of my doing this. I am also very grateful to everyone who has generously given me permission to use their own photographs as illustrations in this book, and I have named each one in the photo caption. Lastly but very importantly, Mei Ling Lee has provided the encouragement to show that what I have been writing is of interest to somebody, somewhere.

Thanks in particular to Neil Cobb for providing the photo of a mountain scene, used on the cover of this book.

Jonathan Adams
Newark, New Jersey, 2007

Foreword

This book has been written with the aim of providing an accessible introduction to the many ways in which plants respond to and form the environment of our planet. As an academic scientist, and yet as a teacher, I have tried to balance conflicting needs between something which can be trusted and useful to my colleagues, and something which can enthuse newcomers to the subject. For too long, I feel, earth system science has been a closed door to students because of its jargon, its mathematics and its emphasis on meticulous but rather tedious explanations of concepts. I hate to think how many good potential scientists we have lost because of all this, and how many students who could have understood how the living earth worked have gone away bored or baffled. At a time when we may be facing one of the greatest challenges to our well-being in recent history, from global warming, it is essential that we recruit all the good researchers that we can. If we want the public, business people and politicians to understand the problems they are facing, we need to disseminate knowledge of earth system processes as widely as possibly.

In line with the aims of Praxis—and with my own aims too—I have not attempted a complete referenced literature review in this book. Instead, selected papers of authors named in the text are listed in a bibliography, to provide the reader with some useful leads into the literature. Many important studies are not directly referenced even if their findings are mentioned in the text, and I hope that the authors of these studies will not feel snubbed (because my selection of papers to reference was often fairly arbitrary). The text is written in an informal way, reflecting my own dislike of pomposity in academia. Jargon in science gives precision, but it also takes away understanding if newcomers to the subject are driven away by it. As part of my balancing act, I have tried to keep jargon to a minimum. I have also used some homey and traditional categories such as "plants" to apply to all photosynthesizers, bacterial or eukaryotic (I regard being a plant as a lifestyle, not a birthright), and somehow I could not bear to keep throwing the word "archaea" around when I could just call them "bacteria".

Dedicated to the irreverent and brilliant
Hugues Faure (1928–2003)

Abbreviations and acronyms

CAM	Crassulacean Acid Metabolism
CDIAC	Carbon Dioxide Information and Analysis Center
CSIRO	Commonwealth Scientific and Industrial Research Organization
FACE	Free Air CO_2 Experiment
GCM	General Circulation Model
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-Tropical Convergence Zone
LAI	Leaf Area Index
LGM	Last Glacial Maximum
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NOAA	National Oceanic and Aerospace Administration
NPP	Net Primary Production
UV	UltraViolet
VOC	Volatile Organic Compound

About the author

Jonathan Adams was born in England and studied Botany at St Catherine's College of the University of Oxford. His PhD was in Geology from the University of Aix-Marseilles II, France, where his mentor was the distinguished Quaternary geologist Hugues Faure.

After postdoctoral studies at Cambridge University and at Oak Ridge National Laboratory (Tennessee), Jonathan Adams has taught at the University of Adelaide (Australia), Rutgers University (New Jersey), and latterly at Seoul National University (South Korea).

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